Sunday, December 01, 2013
10:45-12:15 PM • SPOI11 • Room: E353C • Oncodiagnosis Panel: Pediatric Sarcoma (An Interactive Session)
10:45-12:15 PM • SSA07 • Room: E450A • Gastrointestinal (Rectal Carcinoma Imaging)
10:45-12:15 PM • SSA08 • Room: E450B • Gastrointestinal (Hepatic Fibrosis Imaging)
10:45-12:15 PM • SSA12 • Room: S504CD • ISP: Molecular Imaging (Oncology I)
10:45-12:15 PM • SSA14 • Room: E451B • Musculoskeletal (Tumor I)
10:45-12:15 PM • SSA18 • Room: S505AB • Nuclear Medicine (PET/CT in Oncology)
01:30-06:00 PM • VSIO11 • Room: S405AB • Interventional Oncology Series: Controversies and Emerging Questions in the Management of Renal Tumors
02:00-03:30 PM • RC101 • Room: E451B • Lung Cancer Screening: How I Do It
02:00-03:30 PM • RC117 • Room: S504CD • Combining In Vitro Diagnostics and Imaging for Integrated Decision Making
02:00-03:30 PM • RC118 • Room: E353A • Interactive Game: Interactive Quiz Cases in Neuro-oncologic Imaging
02:00-03:30 PM • RC120 • Room: E352 • Radiographic Evaluation of the Post-Radiotherapy Brain
02:00-03:30 PM • RC124 • Room: S403B • Extranodal Lymphoma from Head to Toe (In Conjunction with the American Institute for Radiologic Pathology)
02:00-03:30 PM • RC129 • Room: S404AB • Interactive Game: MR Imaging Innovations for the Oncological Practice: Case-based Instruction

Monday, December 02, 2013
07:15-08:15 AM • SPSH21 • Room: E353A • Hot Topic Session: Therapies for Early Stage I Lung Cancer: Options and Controversies
08:30-10:00 AM • MSMI21 • Room: S406B • Molecular Imaging Symposium: Preparing for Tomorrow: The Application of Novel and Advanced Imaging in Clinical...
08:30-10:00 AM • MSRO21 • Room: S103AB • BOOST: Head and Neck-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM • MSRO24 • Room: S103CD • BOOST: Gynecology-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM • RC201 • Room: E353C • Practical Issues in Chest Imaging: Case-based Approach (An Interactive Session)
08:30-10:00 AM • RC218 • Room: E451A • Pitfalls In Oncologic Imaging
08:30-10:00 AM • RC220 • Room: S104A • Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology
08:30-12:00 PM • VSNM21 • Room: S505AB • Nuclear Medicine Series: Assessment of Cancer Treatment Response: Updates
10:30-12:00 PM • MSMI22 • Room: S406B • Molecular Imaging Symposium: Radiogenomics - The Next Logical Step in 'Rad-Path' Correlation for Clinical Imag...
10:30-12:00 PM • MSRO25 • Room: S103CD • BOOST: Gynecology-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • SSC04 • Room: S404AB • ISP: Chest (Lung Nodule/Screening)
10:30-12:00 PM • SSC05 • Room: E353A • Gastrointestinal (Hepatocellular Carcinoma Imaging)
10:30-12:00 PM • SSC06 • Room: E451A • Gastrointestinal (Oncology: Surveillance and Tumor Response)
10:30-12:00 PM • SSC07 • Room: N228 • ISP: Genitourinary (New Methods for Characterization of Renal Masses)
10:30-12:00 PM • SSC11 • Room: N226 • Neuroradiology (Imaging Genomics and New Techniques in Brain Tumors)
10:30-12:00 PM • SSC17 • Room: E353C • France Presents 2013
01:30-03:00 PM • MSMI23 • Room: S406B • Molecular Imaging Symposium: Imaging Cellular Subpopulations - Current Progress and Future Directions
01:30-02:45 PM • PS20 • Arie Crown Theater • Monday Plenary Session
01:30-06:00 PM • VSIO21 • Room: S405AB • Interventional Oncology Series: Hepatocellular Carcinoma
03:00-04:15 PM • MSRO23 • Room: S103AB • BOOST: Head and Neck-Case-based Review (An Interactive Session)
03:00-04:15 PM • MSRO26 • Room: S103CD • BOOST: Gynecology-Case-based Review (An Interactive Session)
03:00-04:00 PM • SSE08 • Room: E353C • ISP: Gastrointestinal (Oncology: Staging and Distant Metastases)
03:00-04:00 PM • SSE11 • Room: E353B • ISP: Genitourinary (Intervention in the GU Tract)
04:45-06:00 PM • MSRO29 • Room: S104B • BOOST: Head and Neck Hands-on Contouring (In Cooperation with ASTRO)

Tuesday, December 03, 2013
07:15-08:15 AM • SPSH30 • Room: E351 • Hot Topic Session: Lung Adenocarcinoma - Evolving Concepts
08:30-10:00 AM • MSRO31 • Room: S103AB • BOOST: Gastrointestinal-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM • MSRO34 • Room: S103CD • BOOST: Breast-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM • RC318 • Room: S104A • Imaging of Irradiated and Ablated Tumors
08:30-10:00 AM • RC320 • Room: S504AB • Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometas...
08:30-12:00 PM • VSBR31 • Arie Crown Theater • Breast Series: Emerging Technologies in Breast Imaging
08:30-12:00 PM • VSGU31 • Room: N228 • Genitourinary Series: Prostate Cancer 2013-Review of the Disease and the Role of MR in Staging and Surveillance
08:30-12:00 PM • VSNM31 • Room: S505AB • Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology
08:30-12:00 PM • VSNR31 • Room: N227 • Neuroradiology Series: Brain Tumors
10:30-12:00 PM • MSCC32 • Room: S406A • Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Abdomen and Pelvis (In Conjunction with ...
10:30-12:00 PM • MSRO32 • Room: S103AB • BOOST: Gastrointestinal-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • MSRO35 • Room: S103CD • BOOST: Breast-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • SSG17 • Room: E353A • Vascular/Interventional (Ablative Therapies)
01:30-03:00 PM • MSCC33 • Room: S406A • Case-based Review of Nuclear Medicine: PET/CT Workshop-Lymphoma/Melanoma/Sarcoma (In Conjunction with SNMMI) (...
01:30-06:00 PM • VSIO31 • Room: S405AB • Interventional Oncology Series: Lung
03:00-04:15 PM • MSRO33 • Room: S103AB • BOOST: Gastrointestinal-Case-based Review (An Interactive Session)
03:00-04:15 PM • MSRO36 • Room: S103CD • BOOST: Breast-Case-based Review (An Interactive Session)
03:30-05:00 PM • MSCC34 • Room: S406A • Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Thorax (In Conjunction with SNMMI) (An I...

04:30-06:00 PM • RC409 • Room: E350 • Gastrointestinal: Tumor Response Assessment
04:30-06:00 PM • RC411 • Room: S505AB • Improving PET Interpretation: Present Updates in GI and GYN Cancers with Case Examples (An Interactive Session)
04:30-06:00 PM • RC417 • Room: S504CD • Quantitative CT and MR Perfusion Imaging
04:30-06:00 PM • RC418 • Room: N230 • Imaging Mimics of Common Malignancies

Wednesday, December 04, 2013
08:30-10:00 AM • MSRO41 • Room: S103CD • BOOST: Genitourinary-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM • RC506 • Room: E353C • Oral Cavity, Pharynx, Larynx
08:30-10:00 AM • RC518 • Room: E350 • Imaging of Tumor Syndromes
08:30-10:00 AM • RC520 • Room: S504AB • New Paradigms for the Treatment of Hodgkins and non-Hodgkins Lymphomas: The Crucial Role of Imaging
10:30-12:00 PM • MSRO42 • Room: S103CD • BOOST: Genitourinary-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • SSK08 • Room: E353C • Genitourinary (Prostate Cancer: Multimodality Diagnosis and Staging of Disease)
10:30-12:00 PM • SSK09 • Room: N228 • Genitourinary (Functional and Anatomic Imaging in Staging and Follow-up of Gynecologic Cancers)
10:30-12:00 PM • SSK12 • Room: S504CD • ISP: Molecular Imaging (Oncology II)
10:30-12:00 PM • SSK17 • Room: S505AB • Nuclear Medicine (PET/MRI for Oncology)
01:30-02:45 PM • PS40 • Arie Crown Theater • Wednesday Plenary Session
01:30-06:00 PM • VSIO41 • Room: S405AB • Interventional Oncology Series: Progress, Challenges and Opportunities
03:00-04:15 PM • MSRO43 • Room: S103CD • BOOST: Genitourinary-Case-based Review (An Interactive Session)
03:00-04:00 PM • SSM05 • Room: S404CD • Chest (Thoracic Malignancy)
03:00-04:00 PM • SSM07 • Room: E353B • Gastrointestinal (Esophagus)
03:00-04:00 PM • SSM08 • Room: E353C • Gastrointestinal (Liver Imaging)
03:00-04:00 PM • SSM15 • Room: N227 • Neuroradiology (Neuro-Oncology)
04:30-06:00 PM • SPSC41 • Room: E450A • Controversy Session: Lung Cancer Screening: Conflict of 'Dollars and Sense?'
04:45-06:00 PM • MSRO49 • Room: S104B • BOOST: Genitourinary Hands-on Contouring (In Cooperation with ASTRO)

Thursday, December 05, 2013
08:30-10:00 AM • RC618 • Room: E353A • Interactive Game: Interactive Quiz Cases in Body Oncologic Imaging
10:30-12:00 PM • SSQ01 • Arie Crown Theater • Breast Imaging (Ultrasound Screening)
01:30-02:45 PM • PS50 • Arie Crown Theater • Thursday Plenary Session
01:30-06:00 PM • VSIO51 • Room: S405AB • Interventional Oncology Series: Liver Metastases and Bone
04:30-06:00 PM • RC717 • Room: S504CD • Ultrasound/Opto-Acoustic Molecular Imaging
04:30-06:00 PM • RC718 • Room: S402AB • Advances in Cross-sectional Oncologic Imaging

Friday, December 06, 2013
08:30-10:00 AM • RC807 • Room: N226 • Imaging and Treating Gynecologic Cancer 2013: What Really Works and What Is Most Cost Effective
08:30-10:00 AM • RC810 • Room: E351 • Right Upper Quadrant Ultrasound

08:30-10:00 AM • RC817 • Room: S505AB • Essentials of Molecular Imaging
08:30-10:00 AM • RC818 • Room: S404CD • Techniques for Quantitative Cancer Imaging: Current Status
08:30-10:00 AM • RC831 • Room: E450B • US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment (How-to Workshop)
08:30-10:00 AM • RC850 • Room: E260 • Targeted Treatment and Imaging of Liver Cancers: Basic to Advanced Techniques in Minimally-Invasive Therapies ...

Oncodiagnosis Panel: Pediatric Sarcoma (An Interactive Session)

Sunday, 10:45 AM - 12:15 PM • E353C

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PD RO OI MK

SPOI11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Nina A Mayr , MD
Moderator
John Breneman , MD
Gregory S Stacy , MD *
Lynn Million , MD
Raffi S Avedian , MD

LEARNING OBJECTIVES
1) Understand the principles of musculo-skeletal imaging as it relates to soft tissue tumors arising in the extremity and trunk. Specifically, the learner will understand the importance of how appropriate imaging modalities are critical to correct diagnosis, staging and treatment of soft tissue tumors in children. 2) Apply basic physics principles to the imaging and therapeutic modalities involved in diagnosis, staging and management of soft tissue sarcomas in children. Specifically, the learner will be able to apply specific imaging modalities and techniques in order to improve the detection, accuracy of staging and management of soft tissue sarcomas, while minimizing the risk of ionizing radiation exposure in children. 3) Analyze the value of different imaging modalities and therapeutic techniques for children with soft tissue sarcomas. Specifically, the learner will be able to analyze the importance of specific imaging studies required for patient enrollment in clinical trials and ensure safe administration of cancer therapy with respect to cost. 4) Demonstrate how cultural and economic differences may influence practices of care for radiologic imaging in children with soft tissue sarcomas today and the future. 5) Compare relative value of image guided techniques in management of pediatric soft tissue sarcomas. Specifically, the learner will be able to compare the pros and cons of current imaged guided techniques for the diagnosis and management of soft tissue sarcomas in children to optimize outcome and minimize complications.

Gastrointestinal (Rectal Carcinoma Imaging)

Sunday, 10:45 AM - 12:15 PM • E450A

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OI MR GI

SSA07 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Michael E Zalis , MD *
Moderator
Marc J Gollub , MD
Moderator
Byung Ihn Choi , MD, PhD *

SSA07-01 • Texture Analysis of MR Dixon Images in Primary Colorectal Cancer: Initial Experience Using PET-MRI

Balaji Ganeshan PhD (Presenter) * ; **Asim Afaq** FRCR ; **Shonit Punwani** MBBS ; **Alec Engledow** ; **Daren Francis** ; **Nicholas Rhys-Jones** ; **Tan Arulampalam** ; **Sanjay Dindyal** ; **Omer Jalil** ; **Anna Barnes** ; **Celia O'Meara** ; **Manuel Rodriguez-Justo** ; **Peter J Ell** MD * ; **Kenneth Miles** * ; **Ashley M Groves** MBBS *

PURPOSE
To describe the technique and initial results obtained from texture analysis of MR Dixon images derived from PET-MRI in primary colorectal cancer.

METHOD AND MATERIALS
10 consecutive prospectively recruited primary colorectal cancer patients (6 male and 4 female; Mean age 61.3±10.02) underwent PET-MRI including acquisition of Dixon images for attenuation correction, measurement of tumor fluorodeoxyglucose uptake (SUVmean) and MRI apparent diffusion coefficient (ADCmean). A parametric image of fractional water content was produced from the Dixon images from the ratio of the water-weighted image and the summed water- and fat-weighted images. Fractional water images underwent texture analysis using a filtration-histogram method. Filtration highlighted image features ranging between approximately 2mm and 7mm diameter. Histograms of filtered images quantified as standard-deviation (SD) and proportion of positive pixels (PPP) were correlated against SUVmean and ADCmean using Spearman Rank Correlation.

RESULTS
The mean tumor fractional water content was 0.88 (range: 0.74 – 0.95). Fractional water content did not correlate significantly with ADCmean (rs = 0.358, p=0.310) and SUVmean (rs = -0.030, p=0.934). Fractional water texture expressed as SD correlated negatively with ADCmean (rs = -0.75, p=0.013) with PPP values correlated positively with SUVmean (rs = 0.75, p=0.013).

CONCLUSION
Texture analysis of Dixon images can potentially assess tumor water distribution. Tumor ADCmean and SUVmean measurements may be related to tumor water distribution in colorectal cancer.

CLINICAL RELEVANCE/APPLICATION
Texture analysis of Dixon images in colorectal cancer can potentially provide information about tumor biology with possible applications in personalized medicine.

SSA07-02 • CT Manifestations of the Mesorectal Fascia Invasion of Rectal Carcinoma

Chen Nan MD (Presenter) ; **Kuncheng Li** MD

PURPOSE
The total mesorectal excision (TME), which the surgical removal of rectal tumor and the surrounding mesorectum along the mesorectal fascia (that is circumferential resection margin, CRM), has become the standard surgical method of rectal cancer which originated from the section below the pelvic peritoneum reflection. Therefore, to preoperatively comprehensive evaluate the state of mesorectal fascia is very important an impact on the decision of potential for TME surgical removal as well as whether neoadjuvant therapy should be administered. So, our Purpose is to evaluate the CT manifestations of the mesorectal fascia invasion of rectal carcinoma.

METHOD AND MATERIALS
Seventy-eight patients with rectal carcinoma which originated from the section below the pelvic peritoneum reflection underwent preoperative CT examinations and the operations were performed with TME method in 72 resectable tumor. Compared the CT characteristics of mesorectal fascia invasion of rectal carcinoma with the pathologic findings.

RESULTS
In 78 cases, 51 cases rectal carcinoma had penetrated through the rectal wall present patching-like, lining or mass shadows distributed within the perirectal fat tissue on CT. Among them, none of rectal fascia was thicken on CT in 27 cases. In these cases, no tumor cells infiltrating was found in the CRM proved by pathology. The thickenings of the rectal fascia present even or irregularly thickened was found in 24 cases on CT. In these cases, the invasion outside of rectal fascia into the pararectal space on CT and the CRM involvement proved by pathology was 11 cases and 13 cases, respectively. The e values was 0.818 and the p
CONCLUSION
CT is valuable in identifying tumor invasion mesorectal fascia. The state of mesorectal fascia on CT is excellent agreement with the pathologic findings of CRM.

CLINICAL RELEVANCE/APPLICATION
it's very import for preoperative determination of resectability, surgical approach and prognosis of rectal carcinoma.

SSA07-03 • The Correlation of Radiologic Serosal Involvement in Rectal Cancer to Pathologic Assessment, and Comparison of Impact on Survival, Local Recurrence and Metachronous Peritoneal Carcinomatosis

Michael R Torkzad MD, PhD (Presenter) * ; **Faoz Dranichnikov** ; **Hakan Ahlstrom** ; **Peter Nygren** ; **Lars Pahlman** ; **Haile Mahteme** MD, PhD

PURPOSE

To investigate the correlation between radiologic and pathologic assessment of serosa involvement in patient with rectal cancer, and also compare the impact of serosa involvement on survival, local recurrence and metachronous peritoneal carcinomatosis (MPC).

METHOD AND MATERIALS
100 consecutive patients diagnosed with T3 and T4 primarily rectal cancer between 2007 and 2008 made the basis of this study. Detailed radiologic analysis of magnetic resonance imaging (MRI) of rectum at the time of diagnosis of rectal cancer was performed by an experienced radiologist blinded to the clinical data. T4s was defined as tumor growing locally into the serosal layer; rT4s was when the radiologist made such an assessment and pT4s when the pathologist made such assessment. The clinical data at the time of diagnosis and surgery, and 4-5 years postoperative follow-up regarding survival and adverse outcomes (cancer-related mortality and recurrence) and development of MPC were recorded.

RESULTS
94 patients had complete clinical data of which 63 had MRI prior to treatment. 11 patients showed radiologic signs of local peritoneal involvement (rT4s), while 6 patients showed this at pathology (pT4s). Only two of these were assessed as T4s by both the radiologist and the pathologist. Cancer-related mortality and local recurrence rate were higher among rT4s patients than pT4s (55% vs. 33% and 58% vs. 17%, respectively with odds ratio of 1.67 and 3.49). The only two cases of MPC were seen among rT4s patients. Step-wise multivariate regression showed higher impact by rT4s than pT4s classification on survival, recurrence rate and MPC with adjusted correlation coefficients (R2) of 0.04, 0.15 and 0.14. rT4s staging was the only factor with adjusted R2 > 0.03 for development of MPC.

CONCLUSION
There seems to be a large discrepancy between rT4s and pT4s though the latter was usually after neoadjuvant therapy. rT4s showed higher impact on development of MPC, local recurrence and even cancer-related survival.

CLINICAL RELEVANCE/APPLICATION
Involvement of serosal layer in rectal cancer denotes a higher risk for metachronus development of peritoneal carcinomatosis, local recurrence and cancer-related mortality than pathologic assessment.

SSA07-04 • Diffusion Weighted Imaging for Evaluating Lymph Node Eradication after Neoadjuvant Chemoradiation Therapy in Locally Advanced Rectal Cancer

Kyeong Hwa Ryu MD (Presenter) ; **Seung Ho Kim** MD ; **Jung Hee Yoon** MD ; **Yedaun Lee** MD ; **Yun-Jung Lim** ; **Choong K Eun** MD

PURPOSE
To evaluate the added value of the diffusion-weighted imaging (DWI) for evaluating lymph node (LN) eradication after neoadjuvant chemoradiation therapy (CRT) in patients with locally advanced rectal cancer (LARC).

METHOD AND MATERIALS
Institutional review board approved this retrospective study and waived informed consent. Ninety-five consecutive patients (64 men, 31 women; mean age: 59 years, range: 32-82 years) with LARC (=T3 or LN metastasis) who underwent CRT and subsequent surgery, were enrolled in this study. All patients underwent pre-and post-CRT 1.5-T rectal MRI with DWI (b=0, 1000). To evaluate the added value of the DWI for evaluating LN eradication after CRT, two blinded radiologists independently read the pre-and post-CRT T2-weighted images (T2WI) first and then the combined image set of the T2WIs and pre-and post-CRT DWI with a four-week interval and recorded their confidence score for LN eradication with a 5-point scale on a per-patient basis. The diagnostic performances were compared between the two reading sessions for each reader by using pair-wise comparison of receiver operating characteristic curves. Histopathology reports served as the reference standard for LN eradication.

RESULTS
Study population consisted of LN-eradicated group (n=65) and non-eradicated group (n=30). The diagnostic performances did not significantly differ between the two reading sessions for both readers (AUC, for reader 1, 0.770, 0.774, p=0.8155; for reader 2, 0.794, 0.798, p=0.8588). The sensitivity, specificity and accuracy for LN eradication were stationary after adding DWI for both readers (for reader 1, from 88%, 63% and 80% to 88%, 73% and 83%, respectively; for reader 2, from 77%, 77% and 77% to 77%, 80% and 78%, respectively).

CONCLUSION
Adding DWI to T2WI provides no additional diagnostic benefit for evaluating LN eradication after CRT in patients with LARC.

CLINICAL RELEVANCE/APPLICATION
Adding DWI to T2WI provides no additional diagnostic benefit for evaluating LN eradication after CRT in patients with LARC.

SSA07-05 • Magnetic Resonance Imaging of Tumor Initiation and Progression, and Response to Vitamin D in a Mouse Model of Colitis and Colitis-associated Colon Cancer

Devkumar Mustafi PhD (Presenter) ; **Urszula Dougherty** MS ; **Erica Markiewicz** BA ; **Xiaobing Fan** PhD ; **Marc Bissonnette** MD ; **Gregory S Karczmar** PhD *

PURPOSE
Colon cancer is a leading cause of cancer-deaths in the US. Ulcerative colitis is causally linked to colitis-associated neoplastic progression but is difficult to detect and monitor non-invasively. Goals of this study were to determine MRI characteristics of early colitis-associated colon cancer and to assess vitamin D chemopreventive efficacy.

METHOD AND MATERIALS
This study included CF1 female control mice (n=12), and mice treated with azoxymethane i.p. and dextran sulfate sodium in the drinking water (n=25) to induce colitis and colon cancer. Mice were fed a Western diet or Western diet supplemented with vitamin D (500 μg/kg chow). Western diets are relatively deficient in vitamin D and calcium. Mice were studied serially using anatomic and dynamic contrast enhanced MRI (DCEMRI) with a Gd-based contrast agent. *In vivo* MR and *ex vivo* histological images were co-registered using an agar based color-coded phantom in a flexible tube (2 mm o. d.) that was inserted via the rectum to the cecum. The phantom provided visual and MRI-detectable reference markers to co-register *in vivo* and *ex vivo* images.

RESULTS
We demonstrated that: 1) a visible reference marker could be used to successfully co-register MRI abnormalities with histological features identified in HandE stained sections; 2) T_2 values distinguished normal colon from colitis, and from focal neoplastic lesions (ptrans values assessed by DCEMRI (a measure of perfusion/capillary permeability) reliably distinguished normal colon from tumor (0.12 ± 0.01 min^{-1} vs. 0.61 ± 0.05 min^{-1}, respectively, p3-fold larger adjacent to early colonic tumors compared to vessels in control mice, suggesting that MRI might be used to detect dilated blood vessels as biomarkers of early colorectal cancer; 5) Vitamin D reduced the number of colonic tumors and degree of inflammation detected by MRI (p
CONCLUSION
A novel technique was successfully developed to co-register MR and histological images. Several reliable image-based markers for colitis and colon cancer were identified. These MRI methods could monitor the chemopreventive efficacy of vitamin D in this model in real time and without sacrifice.

CLINICAL RELEVANCE/APPLICATION
Non-invasive MRI/DCEMRI studies of colitis and colon cancer in mice will improve understanding of these diseases, produce new MRI markers to improve diagnosis, and guide development of new therapies.

SSA07-06 • Neoadjuvant Radiochemotherapy Response Evaluation with Magnetic Resonance and FDG-PET/CT in Rectal Cancer Patients: Predictive Value of Combined Quantitative Parameters of ADC and SUV Compared with TRG at Histology

Davide Ippolito MD (Presenter) ; **Pietro A Bonaffini** MD ; **Davide Fior** MD ; **Cristina Capraro** MD ; **Chiara Trattenero** MD ; **Sandro Sironi** MD

PURPOSE
To determine the clinical value of functional imaging by analyzing quantitative parameters of ADC and SUV max values before and after chemo-radiation therapy in prediction of tumor response of patients with rectal cancer, correlated with the histologic examination expressed as tumor regression grade.

METHOD AND MATERIALS
A total of 45 patients with biopsy proven diagnosis of rectal carcinoma were enrolled in our study.All patients underwent a whole body 18 FDG PET/CT scan and a pelvic MR examination before(PET 1,MR 1) and after the neoadjuvant chemoradiation therapy(PET 2,MR 2).Subsequently all patients underwent total mesorectal excision and the histological results were compared with imaging findings.MR scanning,performed on 1,5 T magnet(Philips,Achieva),comprised T2-weighted multiplanar imaging and in addition DW images with b-value of 0 and 1000 mm^2/sec. On PET/CT the SUVmax of the rectal lesion were calculated in PET1 and PET2. The percentage decrease of SUVmax(?SUV) and ADC(?ADC) values from baseline to presurgical scan were assessed and correlated with pathologic response classified as tumor regression grade (Mandard's criteria;TRG 1= complete regression,TRG5= no regression).

RESULTS
At histological examination,according to Mandard's criteria, 29 tumors(68%) showed complete or subtotal regression(TRG1-2) and were classified as responders;16 tumors(32%) were classified as non-responders(TRG3-5).Considering all patients the mean values of SUVmax in PET 1 was higher than mean value of SUVmax in PET 2 (p-3mm^2/s) with high sensitivity and specificity.Combining in a single analysis median quantitative value, the PPV in predicting the different group category response, related to TRG system,presented an AUC of 96%, higher than DWI (88.2%) or SUVmax (93.3%).

CONCLUSION
Combination of PET-CT and MR imaging, evaluating changes in glucose metabolism and ADC, allows the identification of spatially distinct regional responses to therapy within tumor tissues, with higher sensitivity than either method alone.

CLINICAL RELEVANCE/APPLICATION
In era of PET/MRI scanner, the combination of DWI and PET/CT represents the most feasible method to evaluate LARC patients,with accuracy values higher than those reported for other imaging technique.

SSA07-07 ● Most Accurate Selection of Complete Responders After Chemoradiation for Rectal Cancer with a Combination of T2-weighted MRI, Diffusion-weighted MRI and Endoscopy

Monique Maas MD (Presenter) ; **Doenja M Lambregts** MD, PhD ; **Luc Heijnen** ; **Milou Martens** ; **Jeroen Leijtens** ; **Meindert Sosef** ; **Karel Hulsewe** ; **Geerard L Beets** MD, PhD ; **Regina G Beets-Tan** MD, PhD

PURPOSE
Chemoradiation (CRT) for rectal cancer leads to complete tumour response (CR) in 15-25% of the cases. Accurate identification of a CR is necessary to allow for less invasive treatments (e.g. local excision or waitandsee). Standard imaging cannot accurately identify a CR due to incorrect overestimation of fibrosis as residual tumour. Aim was to evaluate what is the best strategy to identify patients with a CR by use of T2W MRI, DWI and endoscopy.

METHOD AND MATERIALS
49 patients underwent CRT and restaging consisting of T2W-MRI, DWI and endoscopy 8 weeks after completion of CRT. One reader scored the T2W images followed by immediate evaluation of the DWI images with the T2W images at his disposal. A second reader scored the endoscopy images. Readers were blinded for histology and each others' results. Scoring was performed with a confidence level score (0=definitely residual tumour, 4=definitely CR).

RESULTS
Of the 49 patients, 18 had residual tumour and 31 had a CR. The AUCs for T2W-MRI, T2+DWI and endoscopy were 0.71, 0.78 and 0.88, respectively. Corresponding sensitivities and specificities were 39%and87% for T2W, 39%and93% for T2+DWI and 67%and97% for endoscopy. When a combination of MRI (T2W and DWI) with endoscopy was used the highest accuracy was reached: 0.91.

CONCLUSION
The combination of endoscopy, T2W-MRI and DWI leads to a very high accuracy for the identification of patients with a CR after CRT for rectal cancer. Endoscopy corrects for overestimation of fibrosis as residual tumour with MRI. MRI provides a low risk for missing residual tumour and thus guarantees a safe selection process. It is therefore highly recommendable to use this combination of endoscopy and T2W-MRI with DWI to select patients with a CR after CRT, particularly now less invasive treatment is increasingly being considered as an alternative for standard TME.

CLINICAL RELEVANCE/APPLICATION
Use of endoscopy with T2WMRI+DWI for the selection of a CR after CRT for rectal cancer leads to a high accuracy and is recommended for restaging when considering less invasive treatment instead of TME.

SSA07-08 ● Diffusion-weighted MR Imaging for the Follow-up of Patients after Primary Surgical and Non-surgical Treatment for Rectal Cancer

Doenja M Lambregts MD, PhD (Presenter) ; **Max Lahaye** MD, PhD ; **Luc Heijnen** ; **Monique Maas** MD ; **Milou Martens** ; **Regina G Beets-Tan** MD, PhD ; **Geerard L Beets** MD, PhD

PURPOSE
Detection of local recurrences after primary treatment of rectal cancer is crucial in order to allow for timely surgical intervention. Standard imaging is known to experience difficulties in differentiating between post-treatment effects (inflammation/fibrosis) and recurrent tumor. Diffusion-weighted MRI (DWI) has in various studies shown to be a powerful technique for the detection of tumors. Hence, DWI may also be a promising tool for follow-up (FU) after treatment. Aim of this study was to evaluate the diagnostic value of DWI for the FU of patients after primary surgical or non-surgical treatment for rectal cancer.

METHOD AND MATERIALS
The study group consisted of 117 patients who had previously undergone rectal cancer treatment, consisting of either standard surgical resection +/- neoadjuvant (chemo-)radiotherapy (n=36), a local transanal excision (n=40, of which 15 after chemoradiotherapy), or a non-operative 'wait-and-see'-policy (n=41). During clinical FU all patients underwent one or more FU-MRIs (1.5T) including DWI (highest b-value b1000), as part of routine FU or because of a suspected local recurrence (e.g. clinical complaints or rising CEA levels) after surgery. Two readers in consensus evaluated each MRI and scored the b1000 DWI-images as 'no high signal', 'high signal suspected of recurrence' or 'not adequately assessable due to artefacts'.

RESULTS
Patients underwent a mean number of 3 FU-scans (range 1-11) with a mean FU-time of 44 months (4-144). 27/117 patients developed a local recurrence, of which 23 (85%) were accurately detected on DWI. The other 90 patients (without recurrence) together underwent a total of 261 FU scans, of which 194 (74%) consistently remained true negative on DWI. 57 DWI-scans (19%) could not adequately be assessed due to artefacts. 14 DWI scans were false positive (mainly at the first FU-scan after surgery), of which 50%, however, again normalised during further FU.

CONCLUSION

1. DWI can be a useful tool for the FU of patients after primary rectal cancer treatment.
2. False positive DWI findings may occur shortly after surgery, but the DWI signal generally normalises during further follow-up. This should be taken into acount when using DWI for the clinical FU of rectal cancer patients.

CLINICAL RELEVANCE/APPLICATION
Diffusion-weighted MRI can be a useful tool for the follow-up of rectal cancer patients after primary surgical or non-surgical treatment and can help detect locally recurrent disease.

SSA07-09 ● MRI with DWI Compared with FDG-PET/CT in the Evaluation of Suspected Local Recurrence in Rectal Cancer

Matteo Cappucci MD (Presenter) ; **Marco Di Girolamo** MD ; **Vincenzo David** MD ; **Daniela Prosperi** ; **Stefania Durante** ; **Elsa Iannicelli** MD

PURPOSE
In case of suspicion of locally recurrent rectal cancer, the use of MRI with diffusion-weighted MRI or [18F]-fluorodeoxyglucose (FDG) PET/CT still remains debated. Our purpose was to compare the two imaging modalities in the discrimination between local recurrence and post-treatment scar tissue.

METHOD AND MATERIALS
Since september 2010, all patients treated with neo-adiuvant chemio-radiation therapy and surgical resection for rectal cancer were referred, in case of high suspicion of local recurrence during follow-up, for MRI and PET/CT.25 patients were enrolled (17M, 8F; mean age: 64) and the mean time of the diagnostic evaluation after surgical resection was 14 months. MRI was performed with 1,5T superconductice magnet with TSE T2-w. scan on sagittal, axial and coronal planes, DWI axial scans (b values:50,400,800) and post-contrast fat saturated Flash 2D T1-w. axial scans. All exams were reported by two radiologists in consensus. Total-body PET/CT images were aquired 60 minutes after i.v. injection of 185 MBq FDG and reported by two physicians who were unaware of MRI findings. In case of concordantly negative findings, the patients followed a routinary follow-up. Patients with concordantly positive findings or discordance were subjected to a CT-guided biopsy or surgical excision for histological evaluation.

RESULTS
MRI+DWI and PET/CT were concordantly negative in 15pts and concordantly suggestive of recurrence in 7pts. The patients with concordantly findings of fibrosis remained disease-free after 10 months follow-up. In 6pts the concordantly imaging suggestion of recurrence was confirmed by biopsy while in one patient hystology disconfirmed the suspected diagnosis. A discordance with negative MRI+DWI and positive PET-CT was found in 3 cases: in 2pts the histological speciment was negative (2 PET/CT false positive) while in 1 patient a recurrence was found at biopsy (MRI+DWI false negative). The sensitivity, specificity and diagnostic accuracy of MRI+DWI was respectively 86%, 94% and 92% while for PET/CT was 100%, 83% and 88%

CONCLUSION
MRI+DWI shows higher specificity than PET/CT, especially in case of active inflamatory tissue while PET/CT has a higher sensitivity than MRI+DWI and can detect distant metastasis. MRI is also essential in the local recurrence surgical planning.

CLINICAL RELEVANCE/APPLICATION
MRI with DWI shows higher specificity than PET/TC in the evaluation of suspected local recurrence rectal cancer and it is recommended.

Gastrointestinal (Hepatic Fibrosis Imaging)

Sunday, 10:45 AM - 12:15 PM ● E450B

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SSA08 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Nirvikar Dahiya , MD
Moderator
Hero K Hussain , MD *
Moderator
Wui K Chong , MD *

SSA08-01 ● The Effect of Echo Times on the Accuracy of Susceptibility Weighted Magnetic Resonance Imaging in Staging Liver Fibrosis

Csilla Balassy MD (Presenter) ; **Diana S Feier** MD ; **Friedrich Wrba** ; **Stephan Witoszynskyj** ; **Gert Reiter** * ; **Ahmed Ba-Ssalamah** MD

PURPOSE
To assess the effect of echo-sampling on the accuracy of magnetic resonance (MR) susceptibility-weighted imaging (SWI) to detect and stage liver fibrosis in patients with chronic liver diseases (CLD), using histology as reference standard.

METHOD AND MATERIALS
This prospective study was approved by the local ethics committee. All subjects gave written informed consent. Sixty-eight consecutive patients (mean age 55.86 years; 60% males) with CLD and histologically proven liver fibrosis were included. Liver fibrosis was evaluated according to the Metavir scoring system. SWI MRI sequences were performed on a 3 Tesla unit and data were collected at two different echo times (TE), 2.5 ms and 10ms. Signal intensity (SI) of the liver and spinal muscle was defined using region-of-interest measurements and liver-to-muscle signal intensity ratios (2.5TE LMR and 10TE LMR) were calculated. The diagnostic performance of both LMR in staging liver fibrosis was assessed using sensitivity (Se%), specificity (Sp%) and area under receiver operating characteristics (AUROC) analysis.

RESULTS
Histology resulted F0 (n=13, 19.4%), F1 (n=6, 9%), F2 (n=8, 11.9%), F3 (n=12, 17.9%), F4 (n=28, 41.8%). Both 2.5TE LMR and 10TE LMR correlated strongly with liver fibrosis (r=-0.74, p
CONCLUSION
SWI is a promising non-invasive tool to detect and stage liver fibrosis in CLD patients, having increased accuracy with higher TE values.

CLINICAL RELEVANCE/APPLICATION
Implementation of imaging parameters as assessed in our study will enable improved and accurate assessment of liver fibrosis in patients with CLD using SWI.

SSA08-02 ● Intravoxel Incoherent Motion Magnetic Resonance Imaging of the Liver: Diagnostic Accuracy in Classifying the Severity of Liver Fibrosis

Sae Rom Chung MD (Presenter) ; **Seung Soo Lee** MD ; **Namkug Kim** PhD ; **Eunki Kim** ; **Seong Ho Park** MD * ; **So Yeon Kim** MD ; **Jae Ho Byun** MD ; **Moon-Gyu Lee** MD

PURPOSE
To investigate the relationship of liver ADC and intravoxel incoherent motion (IVIM) parameters with liver fibrosis and to evaluate the diagnostic performance of these parameters in classifying the severity of liver fibrosis.

METHOD AND MATERIALS

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
IVIM magnetic resonance imaging of the liver can be used as a diagnostic test to assess the severity of liver fibrosis.

SSA08-03 ● Correlation of Magnetic Resonance Elastography (MRE) with Hepatic Fractional Extracellular Space (fECS) - Preliminary Findings

Sudhakar K Venkatesh MD, FRCR (Presenter) ; **Bogdan Dzyubak** BS ; **Benjamin M Yeh** MD * ; **Joel G Fletcher** MD * ; **Jeff L Fidler** MD * ; **Naoki Takahashi** MD * ; **David M Hough** MD ; **Jayant A Talwalkar** MD * ; **Richard L Ehman** MD * ; **Adam J Weisbrod** MD

PURPOSE
The purpose of the study was to evaluate the correlation of two promising MRI techniques of measuring diffuse liver disease: magnetic resonance elastography (MRE) and hepatic fractional extracellular space (fECS) measured with gadolinium (Gd-DTPA) enhanced MRI.

METHOD AND MATERIALS
Thirty-two consecutive clinical patients underwent routine liver MRI examinations. The MRI protocol included MRE as well as Gd-DTPA enhanced equilibrium phase (10-15 minute delay) sequences. MRE was performed with a standard GRE-based sequence to calculate liver stiffness. Hepatic fECS (%) was calculated from equilibrium phase liver and aortic enhancement normalized to the pre-enhancement signal and hematocrit. Pearson's correlation coefficient between MRE and fECS was calculated. Comparison of mean fECS values of normal and elevated liver stiffness group was also performed using the current clinical cut-off value of 2.93kPa for detection of liver fibrosis.

RESULTS
The liver stiffness and fECS of the study population ranged from 1.68kPa to 8.6kPa and 17.5% to 40.1% respectively. There was good correlation between MRE measures of liver stiffness and equilibrium phase measures of fECS (Pearson's correlation coefficient r=0.86, 95% CI, 0.73-0.93, p
CONCLUSION
Liver stiffness with MRE correlates strongly with fECS. Future study of these methods is warranted improve the multiparametric evaluation of diffuse liver disease.

CLINICAL RELEVANCE/APPLICATION
MRE correlates strongly with hepatic fECS suggesting a complementary role in the evaluation of diffuse liver disease.

SSA08-04 ● Liver Fibrosis Staging: Magnetic Resonance Elastography Is Better than Liver Biopsy

Hiroyuki Morisaka MD (Presenter) ; **Utaroh Motosugi** MD ; **Shintaro Ichikawa** MD ; **Katsuhiro Sano** MD ; **Satoshi Ikenaga** ; **Tadao Nakazawa** MD, PhD ; **Tetsuo Kondo** MD, PhD ; **Tomoaki Ichikawa** MD, PhD * ; **Ryouhei Katoh** MD, PhD

PURPOSE
Liver biopsy for the staging of liver fibrosis has some clinical concerns; sampling errors, variability and reproducibility. In this study, we aimed to compare magnetic resonance elastography (MRE) of the liver with liver biopsy specimens for liver fibrosis staging by using surgically resected samples as a reference.

METHOD AND MATERIALS
In this retrospective study, we included 55 patients with chronic liver disease who underwent preoperative MRE on a 1.5 or 3-Tesla clinical MRI scanner and subsequent surgical liver resection. Liver biopsy specimens were obtained from 55 surgically resected liver tissues by using an 18-gauge biopsy needle; the sample size was more than 15 mm, and the specimens were stained with Masson trichrome. Whole sections were used as a reference for liver fibrosis. Liver stiffness (kPa) was measured using MRE, and the results were divided into 5 stages corresponding to the METAVIR scoring system F 0 4. Liver fibrosis was graded on biopsy specimens and whole sections by using the METAVIR system. The concordance rate (kappa value) with reference fibrosis grades in the two methods was calculated. The proportion of correct diagnosis was compared between the two methods.

RESULTS
The kappa coefficient value between MRE staging and the reference fibrosis staging was 0.49 (moderate agreement) and that between the biopsy staging and the reference fibrosis staging was 0.18 (slight agreement). The proportion of correct diagnosis of MRE was significantly higher than that of biopsy specimens (33/55 vs. 18/55, respectively; p = 0.004).

CONCLUSION
A substantial sampling error of biopsy specimens was observed. MRE is an accurate and promising method of noninvasive liver fibrosis staging as compared with biopsy specimens.

CLINICAL RELEVANCE/APPLICATION
Liver MR elastography is more accuarate than liver biopsy specimens in liver fibrosis staging and can be serve as biopsy in clinical practice.

SSA08-05 ● Automated Technique for Hepatic MR Elastography Analysis: Comparison to Skilled Human Interpretation

Bogdan Dzyubak BS (Presenter) ; **Armando Manduca** PhD * ; **Joel P Felmlee** PhD ; **Kevin J Glaser** * ; **Sudhakar K Venkatesh** MD, FRCR ; **Richard L Ehman** MD *

PURPOSE
To test the performance of an automated technique for the analysis of clinical MR Elastography (MRE) images.

METHOD AND MATERIALS
In a retrospective analysis of 64 MRE cases performed for fibrosis screening, the performance of an automated algorithm (A) was compared to that of clinical readers (R), with gold standard (G) measurements provided by a radiologist highly experienced with MRE.
The algorithm presented here has been developed to fully automate MRE ROI selection and yield a standardized stiffness measurement. First, a crude outline of the liver was found by using the known relative positions and intensities of the dominant tissue types in the abdominal images (abdominal fat, lung, liver, and "other"). A Random Walker segmentation was subsequently run on the MRI magnitude images to capture liver tissue and exclude vessels, and then again on the reconstructed stiffness images to remove partial-volume effects. The average stiffness from the ROIs was then calculated.
To test the ability of the algorithm to reproduce manual measurements, a conventional diagnostic threshold of 2.93 kPa was used to separate patients into normal (below) and fibrotic (above) based on the results of the three analysis methods, and the diagnostic accuracy of A with respect to G was compared to that of R. Additionally, the absolute percent differences in the measured stiffness between R and G were compared to the differences between A and G using a Wilcoxon Signed-Rank test.

RESULTS
Of the 64 cases, 28 were classified by G as having fibrosis. The accuracy of A for diagnosing fibrosis was 92% and was superior to R's 84%. It was shown to be statistically non-inferior within 10% accuracy with a p
CONCLUSION
The fully automated algorithm presented here has been shown to yield results as accurate as the manual methods currently used in the clinic. If implemented as a standard, it can remove biases due to inter-reader variability as well as facilitate future MRE developments by creating a consistent framework for ROI selection and artifact exclusion.

CLINICAL RELEVANCE/APPLICATION
The automated algorithm presented here can provide a standard for the practice of clinical hepatic MRE that reduces the measurement variability and improves diagnostic accuracy.

SSA08-06 ● Ultrasound Elastography with Concomitant Liver Biopsy: Comparison of Acoustic Radiation Force Impulse (ARFI) Measurement with Histolopathological Grading

Minal C Jagtiani MBBS, MD (Presenter) ; **Philip J Shorvon** FRCR, FRCPC ; **Paul Bassett** ; **Kesavan Kandiah** ; **Paul Tadrous** ; **David I Sherman**

PURPOSE
To correlate ultrasound elastography stiffness measurements in chronic liver disease patients with concomitant liver biopsy histopathological scores of fibrosis.

METHOD AND MATERIALS
Patients from January 2010 through January 2013 (n= 161; 84 males) who underwent ultrasound guided liver biopsy for chronic liver disease, performed by an Attending Radiologist with a specialist interest in liver imaging, were assessed prospectively. All patients also underwent ultrasound elastography for liver stiffness immediately prior to the biopsy by the same Attending Radiologist. Elastography measurements (ARFI method shear velocity m/ sec; mean of 10 measurements) were obtained in the same anatomical region of the liver as the biopsy. All histopathology reports were scored by a specialist Attending Pathologist. ISHAK and Metavir fibrosis scores were then correlated with the ARFI measurements using Spearman's rank correlation. A sub-group analysis was also performed to compare these variables in patients with viral hepatitis.

RESULTS
Data for 159 patients (mean age 49 ± 14 years) were available. The mean elastography measurement was 1.7 ± 0.7 m/sec.
The results demonstrated statistically significant associations between higher histological grading and increasing ARFI measurements in all analyses. Significant correlation was obtained between the ARFI measurement and both the ISHAK (r value= 0.58; p value < 0.001) and Metavir scores (r value= 0.58; p value < 0.001) in all comers. For the subgroup of patients with viral hepatitis (n= 85), the correlation coefficient for ISHAK and METAVIR scores were 0.51 and 0.53 respectively with p values < 0.001 in both groups.

CONCLUSION
To the best of our knowledge, this is the first study with a large cohort to assess ARFI elastography measurements and liver biopsy taken concomitantly and validating its accuracy in 'all- comers'. It has demonstrated a highly significant statistical correlation between elastography measurements by the ARFI method and the histological grading of fibrosis.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates that ARFI elastography can be performed as part of a routine ultrasound study of the liver to aid in the assessment of liver fibrosis thus optimising patient pathway.

SSA08-07 ● Accuracy of Shear-wave Elastography to Determine the Degree of Liver Fibrosis in Patients with Hepatitis C Virus Infection

Anand Rattansingh (Presenter) ; **Hosein Amooshahi** MSc ; **Sandra Fischer** MD ; **Morris Sherman** * ; **Richard Kirsch** MD, PhD ; **Mostafa Atri** MD

PURPOSE
The purpose of this study was to determine the accuracy of shear-wave elastography in grading fibrosis in patients with Hepatitis C virus (HCV) infection.

METHOD AND MATERIALS
105 patients (85 Men and 20 women), mean age 56 (range23-74) with HCV infection underwent US guided random core biopsy and shear-wave elastography on the same day. Elastography was performed on a Supersonics machine using a 3.5 MHz probe. Five samples were obtained from the right lobe of liver of each patient and averaged to determine stiffness measured as kilo-Pascal (kPa). The same pathologist reported all pathology specimens using METAVIR fibrosis scoring 0 to 4. Student's t-test was used for comparison of continuous variable, and ROC curve to calculate Area Under Curve (AUC).

RESULTS
There were 82 patients with no to moderate fibrosis (METAVIR 0 to 2) and 23 with severe fibrosis or cirrhosis (METAVIR 3and4) with the prevalence of severe fibrosis or cirrhosis being 22% (23/105). Stiffness ranged from 3.2 to 26.4 (mean 9.6) kPa. Stiffness of livers with no or moderate fibrosis on pathology ranged from 3.2 to 26.4 (mean 9.1) kPa and for severe fibrosis and cirrhosis 6.2 to 24.3 (mean 12.2) kPa (p=0.01). ROC curve showed an AUC of 0.78 (CI: 0.68-0.89) (p < 0.0001).

CONCLUSION
Shear-wave elastography has the potential to discriminate between = moderate liver fibrosis and severe liver fibrosis or cirrhosis in patients with HCV infection.

CLINICAL RELEVANCE/APPLICATION
Ultrasound shear-wave elastography has the potential to assess parenchymal stiffness of the liver with good correlation to degree of fibrosis

SSA08-08 ● Comparison of Liver Stiffness Measurement by Acoustic Radiation Force Imaging (ARFI) and Fibroscan for the Non-invasive Diagnosis of Liver Fibrosis

Victoire Cartier MD (Presenter) ; **Derek Bardou** ; **Jerome Boursier** ; **Jerome Lebigot** MD ; **Sophie Michalak** ; **Isabelle Fouchard-Hubert** ; **Christophe Aube** MD, PhD *

PURPOSE
To compare ARFI and Fibroscan in an intention-to-diagnose (ITD) basis for the non-invasive diagnosis of liver fibrosis in chronic liver disease.

METHOD AND MATERIALS
219 patients with chronic liver disease and liver biopsy were prospectively included. Liver stiffness measurements (m/s) were performed by ARFI (right lobe: ARFI-D, left lobe: ARFI-G) and Fibroscan (right lobe). ARFI-DG corresponded to the median value of all valid measurements obtained in both lobes. Reference for fibrosis was Metavir F staging. Diagnostic accuracy was evaluated using AUROC and Obuchowski index ("adjusted AUROC). For ITD analysis, failures of elastographic measurement were replaced by the median value measured in the opposite group of the biopsy diagnosis.

RESULTS
Fibrosis stage prevalence was F=2: 50%, F=3: 26% and F4: 9%. Rate of measurement failure was ARFI-D or ARFI-G: 0.5% versus Fibroscan: 5.9% (p=0.002). In per-protocol analysis, AUROCs of Fibroscan were significantly higher than those of ARFI-D for each diagnostic target (p
CONCLUSION
ARFI and Fibroscan have close and high accuracy for liver fibrosis diagnosis. Due to a higher failure rate, accuracy of Fibroscan decreases in the ITD analysis but remains not significantly different from ARFI accuracy.

CLINICAL RELEVANCE/APPLICATION
The high feasibility and reliability of ARFI could be useful to detect undiagnosed significant fibrosis during any abdominal ultrasound examination, with a high

diagnostic accuracy.

SSA08-09 • Simply Combine the Results of Multiple Elastographies and Serum Fibrosis Markers Using Bayesian Prediction for Noninvasive Liver Fibrosis Staging

Utaroh Motosugi MD (Presenter) ; **Katsuhiro Sano** MD ; **Hiroyuki Morisaka** MD ; **Shintaro Ichikawa** MD ; **Tomoaki Ichikawa** MD, PhD *

PURPOSE
Elastography, using ultrasound or MRI, has been applied to liver fibrosis staging, while serum fibrosis marker has commonly been used to predict the fibrosis stage. The combined use of elastographies and fibrosis marker may be a superior method to their individual use. This study was aimed to evaluate the usefulness of *Bayesian* prediction method to combine the results of elastographies and serum fibrosis marker for noninvasive liver fibrosis staging.

METHOD AND MATERIALS
This study included 20 cases of chronic liver disease. The pathological fibrosis staging were performed with the specimen of partial hepatectomy by using METAVIR staging system in all cases. The use of *Bayesian* prediction to stage liver fibrosis can provide the possibility of the fibrosis stages on the basis of the results of elastographies or serum fibrosis markers. We used aspartate transferase-to-platelet ratio index (APRI) as a serum fibrosis marker and ultrasound transient elastography (UTE) and MR elastography (MRE) as imaging-based elastographies for liver fibrosis stage estimation. We compared the accuracy of fibrosis staging and the confidence of the *Bayesian* prediction among the 3 groups; i) APRI only, ii) APRI + UTE, iii) APRI + UTE + MRE.

RESULTS
The most probable stage by *Bayesian* prediction were accurate in 6 (30%), 8 (40%), and 15 (75%) of 20 cases for APRI only, APRI+UTE, and APRI+UTE+MRE, respectively. The confidence of *Bayesian* prediction significantly increased by adding UTE and MRE to APRI (mean [SD] confidence of prediction [SD]; APRI only, 42.6 [6.7]%; APRI+UTE, 67.1 [23.0]%; APRI+UTE+MRE, 77.7 [18.0]%).

CONCLUSION
Bayesian prediction is simple and useful method to combine variable methods for noninvasive liver fibrosis staging.

CLINICAL RELEVANCE/APPLICATION
Probability of each liver fibrosis stage for the patient can be estimated with *Bayesian* prediction which can simply combine the results of multiple elastographies and serum fibrosis markers.

ISP: Molecular Imaging (Oncology I)

Sunday, 10:45 AM - 12:15 PM • S504CD

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SSA12 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Daniel C Sullivan , MD
Moderator
Heike E Daldrup-Link , MD

SSA12-01 • Molecular Imaging Keynote Speaker: Multi-modal Molecular Imaging of Cancer
Heike E Daldrup-Link MD (Presenter)

SSA12-02 • Utilization of Ultrasound Molecular Imaging Targeted to Thy1(CD90) for the Detection of Pancreatic Ductal Adenocarcinoma in an Orthotopic Murine Xenograft Model

Steven B Machtaler PhD (Presenter) ; **Kira Foygel** PhD ; **Huaijun Wang** MD, PhD ; **Ru Chen** ; **Teresa A Brentnall** MD ; **Juergen K Willmann** MD *

PURPOSE
To describe the identification of Thy1/CD90 as vascular tumor marker for human pancreatic ductal adenocarcinoma (PDAC) and assess the feasibility of using ultrasound (US) molecular imaging directed against human Thy1 (hThy1) to detect pancreatic tumors in an orthotopic murine xenograft model.

METHOD AND MATERIALS
Proteomic analysis of whole tissues from patients with PDAC (n=5), chronic pancreatitis (n=5), and normal pancreas (n=10) using a LTQ-Orbitrap hybrid mass spectrometer identified Thy1 as a pancreatic tumor marker. Expression of Thy1 in human PDAC vasculature was verified by IHC of pancreatic tissue obtained from normal, primary chronic pancreatitis, and PDAC patient samples. An orthotopic murine xenograft tumor model was created to assess human (h) CD90-specific *in vivo* microbubble (MB) binding. Murine vascular endothelial (MS1) cells stably expressing hCD90 and human AsPC1 PDAC cells were co-injected into the tail of the pancreas of nude mice. In all PDAC xenografts, intra-animal comparisons of ultrasound imaging signals were performed following injection of both MB_{Thy1} and $MB_{Control}$ in a randomized order during the same imaging session using a VEVO2100 US system.

RESULTS
IHC analysis validated the proteomic data showing that hThy1 was expressed on the vasculature and significantly increased in PDAC tumors (score: 2.1±0.1, 81% of tumors were Thy1-positive) in contrast to normal pancreata (score: 0.5±0.1; P<0.001). In vivo binding of MB_{Thy1} to PDAC xenografts was assessed using US molecular imaging. A targeted signal using MB_{Thy1} of 7.7±2.3 au was observed in hThy1 expressing PDAC xenografts compared to 1.9±1.8 in control tumors and 1.4±2.2 using non-targeted MBs.

CONCLUSION
These results illustrate the development of a translational US-MB directed against a vascular tumor marker and the development of a novel, orthotopic human PDAC model expressing hThy1 within the tumor vasculature, which may eventually aid in earlier detection of PDAC.

CLINICAL RELEVANCE/APPLICATION
This work provides the first steps towards the development of an US molecular imaging contrast agent targeted to a vascular tumor marker for the detection of pancreatic tumors in humans.

SSA12-03 • Characterization of Perfusion and Therapeutic Resistance in a Renal Cell Carcinoma Mouse Model with Hyperpolarized 13-C-tert-butanol

Leo L Tsai MD, PhD (Presenter) * ; **Xiaoen Wang** MD ; **Gopal Varma** PhD ; **David C Alsop** PhD * ; **Rupal Bhatt** ; **Aaron K Grant** PhD

PURPOSE

METHOD AND MATERIALS
12 mice were implanted with A498 RCC tumors. 5 were treated with sunitinib, 5 controls were administered phosphate-buffered saline (PBS), and 2 were untreated. Sunitinib-treated mice were imaged pretreatment, 5-7 days after treatment initiation, and at resistance. Control mice were imaged pre-PBS, 5-7 days with PBS treatment, and at a tumor limit of 20 mm. Tumors were harvested after final images for immunohistological analysis. MRI was performed at 4.7 T using: (1) 1H-T2-weighed rapid acquisition with refocused echoes for anatomical localization, TR/TE=3000/80ms, 128x128 matrix, 2mm slice, 3.5cm FOV, (2) h13C-tert-butanol imaging with 2D balanced steady state free precession (bSSFP), 128x128 matrix, 8.5cm FOV, 3.3 mm slice, 512ms/frame for 100 frames, (3) arterial-spin-label (ASL) perfusion mapping with flow-sensitive inversion-recovery.

RESULTS
Fig (a) and (b) show interval growth of a control tumor (outlined in red, over an axial T2-weighted 1H image) and increased perfusion (green overlay). Sunitinib-treated tumors are vascular at pretreatment (c) but demonstrate unperceivable perfusion and growth at postreatment day 7 (d). Reperfusion is seen at resistance (e). The peak intratumoral h13C-tert-butanol SNR of 7.9 exceeds ASL by ~2-fold. Moreover, multiple h13C-tert-butanol frames can be averaged to obtain perfusion-weighted images with greater SNR. Peripheral tumor enhancement was consistent with central necrosis as seen on 1H imaging and histopathology. Increased perfusion during resistance was detected in all mice using h13C-tert-butanol.

CONCLUSION
h13C-tert-butanol MRI provides high-SNR in vivo perfusion mapping of RCC and detects reperfusion with sunitinib resistance in a xenograft mouse model.

CLINICAL RELEVANCE/APPLICATION
h13C-tert-butanol provides quantitative perfusion mapping with improved detection of vascular tumor progression and therapeutic resistance, with high potential for translation into clinical use.

SSA12-04 • Next-generation Nanoparticle Allows Accurate Prediction of Nodal Status in Pre-operative Patients with Pancreatic Adenocarcinoma

Shaunagh McDermott FFRRCSI (Presenter) ; **Sarah Thayer** ; **Carlos Fernandez-Del Castillo** MD ; **Mari Mino Kenudson** MD ; **Ralph Weissleder** MD, PhD ; **Mukesh G Harisinghani** MD

PURPOSE
The purpose of this study was to assess the ability of a lymphotrophic nanoparticle-enhanced MRI to preoperatively detect lymph node metastases in patients with pancreatic cancer.

METHOD AND MATERIALS
This exploratory study was performed as a prospective, pilot study and was approved by the Institutional Review Board. All patients with known or high index of suspicion of pancreatic cancer and who were scheduled for surgical resection were eligible for enrollment in this study. The study group consisted of thirteen patients (6 males, 7 females) with a mean age of 64 years; range 40 -91 years. Eleven patients underwent surgery with an average of 23 lymph nodes resected; range 7 - 42. In total 264, lymph nodes were resected and available for analysis. In two patients liver metastases were identified on the pre-operative MRI and therefore they did not undergo resection. Patients underwent MRI before, and immediately and 48 hours after the intravenous administration of ferumoxytol. Signal-to-noise ratios and subjective nodal characterization were determined based on the T2*-weighted sequences. Following resection, the pathologic and imaging findings were compared on a regional basis.

RESULTS

CONCLUSION
Lymphotropic nanoparticle-enhanced MRI is an accurate and safe method for detecting nodal metastases in patients with pancreatic cancer.

CLINICAL RELEVANCE/APPLICATION
The ability to preoperatively identify metastatic lymph nodes in patients with pancreatic cancer could alter management, possibly making an extended lymphadenectomy or systemic therapy a better option

SSA12-05 ● Targeted Biodegradable Nanoparticles MRI Contrast Agent for Enhanced Tumor Imaging and Non-viral Gene Delivery

Xiaolong Gao PhD (Presenter) ; **Peijun Wang** MD, PhD ; **Chao Lin** ; **Guoliang Wang**

PURPOSE
To prepare targeted biodegradable nanoparticles to connect folic acid MRI contrast agent with appropriate size. To explore the feasibility of the macromolecular contrast agent for tumor targeting and the characteristics of imaging in vivo and in vitro with folic receptor-positive tumor cells in nude mice models.

METHOD AND MATERIALS

RESULTS

CONCLUSION
In summary, SSPUA-DTPA-FA-PEG-Gd was successfully developed as a target specific, biodegradable and non-toxic delivery system of siRNA therapeutics. Treatment with SSPUA-DTPA-FA-PEG-Gd/siVEGF complex reduced VEGF mRNA and protein expression in vitro and in vivo, and it also retarded tumor growth in vivo. The SSPUA-DTPA-FA-PEG-Gd helps to intensify the effect in MR enhancement in nude mice models. Therefore, SSPUA-DTPA-FA-PEG-Gd might be effective non-viral gene vector for gene therapy.

CLINICAL RELEVANCE/APPLICATION
no

SSA12-06 ● In Vivo Reporter Imaging in a Large Animal Pre-clinical Model Demonstrates that Angiotensin II Improves Gene Expression Upon Intra-arterial Adenovirus Delivery

Vikas Kundra MD, PhD (Presenter) * ; **Murali Ravoori** ; **Lin Han** ; **Sheela Singh** ; **Katherine Dixon** RT ; **Rajesh Uthamanthil** DVM, PhD ; **Sanjay Gupta** MD ; **Kenneth C Wright** PhD *

PURPOSE
Gene therapy has been hampered by low levels of gene expression upon in vivo delivery. Using a somatostatin receptor type 2 (SSTR2)-based reporter, we assessed whether angiotensin II can improve gene expression by adenovirus upon intra-arterial delivery.

METHOD AND MATERIALS
A SSTR2-based reporter that can be imaged with the FDA approved radiopharmaceutical111-In-octreotide was used to assess gene expression in vivo. 8 rabbits bearing VX2 tumors in each thigh were randomly injected intra-arterially with adenovirus containing a human somatostatin receptor type 2A (Ad-CMV-HA-SSTR2A) gene chimera + angiotensin II or control adenovirus containing green fluorescent protein (Ad-CMV-GFP). 3 days later, 111-In-octreotide was given IV after CT imaging using a clinical CT scanner and intravenous contrast. Tumor uptake of 111-In-octreotide was evaluated the next day using a clinical gamma camera. Gene expression was normalized to tumor weight and morphology from CT to obtain in vivo biodistribution.

RESULTS
SSTR2-based expression was readily visualized. VX2 tumors infected with Ad-CMV-HA-SSTR2 upon intra-arterial delivery with angiotensin II had greater in vivo biodistribution, thus greater gene expression, than without angiotensin II (P
CONCLUSION
Angiotensin II can improve in vivo gene expression by adenovirus upon intra-arterial delivery. In vivo SSTR2-based reporter imaging can be used to compare methodologies for improving gene expression.

CLINICAL RELEVANCE/APPLICATION
SSTR2-based reporter imaging may be useful in comparing methods for improving gene expression. Intra-arterial co-delivery of angiotensin II with adenovirus may improve gene therapy efficacy.

SSA12-07 ● PSMA Imaging with 18F-DCFBC PET for Detection of Primary Prostate Cancer: Initial Evaluation Using MRI and Pathologic Analysis

Kenneth L Gage MD, PhD (Presenter) ; **Sheila Friedrich Faraj** MD ; **George Netto** MD ; **Katarzyna J Macura** MD, PhD * ; **Martin G Pomper** MD, PhD * ; **Steve Cho** MD * ; **Ronnie Mease** PhD ; **Enrico Munari** MD ; **Akimosa Jeffrey-Kwanisai** MBA

PURPOSE
^{18}F-DCFBC (DCFBC) is a novel low-molecular weight PET agent targeted to prostate specific membrane antigen (PSMA) that has previously demonstrated uptake at sites of metastatic prostate cancer (PC). We present our preliminary findings evaluating quantitation of DCFBC for the detection of primary PC.

METHOD AND MATERIALS
Eight patients with biopsy-proven PC with Gleason score (GS) >= 6 were imaged with both DCFBC PET and pelvic MRI (T2 and DWI) prior to prostatectomy. PET imaging with 35 min pelvic imaging (30 min 2D and 5 minute 3D) and whole body imaging was started 2 hrs after injection of 370 MBq (10 mCi) of DCFBC. Post-surgical prostatectomy specimens were sectioned in 4mm planar increments from apex to base, divided into quadrants and analyzed by both HandE and PSMA immunohistochemistry (IHC). PET and MRI were visually correlated and co-registered for analysis, and compared with the anatomically reassembled pathology results. The area of highest GS (postsurgical) determined the location for analysis. The PET ROI (SUVmax) was correlated using Spearman's rank correlation with Gleason score, MRI ADC values, H-score for PSMA IHC staining, degree of staining (strong, moderate, weak), and lesion size.

RESULTS
Three pts showed strongly positive (pos) intraprostatic DCFBC PET signal which correlated with signal on MRI and prostatectomy pathology with dominant GS of 4+5=9 tumor. Three pts were negative (neg) by DCFBC PET with low-grade disease (GS 6, 4+3=7, 3+4=7). Two additional patients had discernible but subtle uptake which also correlated with signal on MRI and pathology with dominant GS 4+3=7 and GS 3+4=7 PC. DCFBC PET SUVmax on WB and 2D pelvic imaging was positively correlated with GS (? coeff=0.85, p=0.0079; ? coeff=0.72, p=0.045, respectively), and trended toward significance when compared to PSMA IHC H-score results in this small dataset. MRI DWI imaging was able to localize sites of prostate cancer but ADC values did not correlate significantly with PC GS or PSMA IHC.

CONCLUSION
DCFBC PET imaging of primary PC demonstrates tumor PET SUVmax is positively correlated with GS and trended toward significance with tumor PSMA expression by IHC. These findings will need further confirmation in our ongoing clinical trial.

CLINICAL RELEVANCE/APPLICATION
PSMA imaging with DCFBC PET may provide a novel biomarker for noninvasive detection of high-grade primary prostate cancer and tumor PSMA expression.

SSA12-08 ● MR Colonography with Intestine-absorbable Nanoparticle Contrast Agents in Evaluation of Colorectal Tumors

Yin Jin (Presenter) ; **Jihong Sun** MD, PhD ; **Xia Wu** ; **Xiaozhe Shi** ; **Peng Hu** ; **Xiaoming Yang** MD, PhD

PURPOSE
To develop a novel nanoparticle-based magnetic resonance (MR) colonography technique, which enabled us to evaluate colorectal tumors via transrectal administration of intestine-absorbable nanoparticle contrast agents.

METHOD AND MATERIALS
Solid lipid nanoparticles (SLNs) were synthesized with loading of gadolinium (Gd) diethylenetriaminepenta acetic acid (Gd-DTPA) and otcadecylamine fluorescein isothiocyanate (FITC) to construct Gd-FITC-SLNs for histologic confirmation of MR findings. Twelve APCMin/+ female mice were treated with 1-2 administration cycles of 2% dextran sulfate sodium in the drinking water for 5-7 days to create the colorectal tumors. The neoplastic mice were administered by a transrectal enema with Gd-FITC-SLNs (40mg/ml). T1-weighted MR colonographies using spin echo sequence (TR/TE, 840/15 msec) were then performed to detect various Gd-carrying SLNs within the colonic walls. MRI findings were correlated with subsequent histological confirmation.

RESULTS
MR colonographies displayed mild enhancement of the tumor masses and significant enhancement of normal colorectal walls. Confocal fluorescence microscopy demonstrated the delivered Gd-FITC-SLNs as highly-concentrated green fluorescent spots into the surface of the tumor mass with less spots within the tumor of APCMin/+ mice (Figure).

CONCLUSION
This study establishes the proofs-of-principle of a new MR colonography technique, which enables the differentiation of colorectal tumors from the normal colorectal walls based on various absorption capability of nanoparticle contrast agents. Solid lipid nanoparticle-based MR colonography may open new avenues for efficient management of colorectal tumors.

CLINICAL RELEVANCE/APPLICATION
Solid lipid nanoparticle-based MR colonography may open new avenues for efficient management of colorectal tumors.

SSA12-09 • Interventional Optical Molecular Imaging: Intra-procedural Imaging Guidance via a Translatable Handheld Device for Percutaneous Sampling of Focal Hepatic Lesions

Rahul A Sheth MD (Presenter) ; **Shadi A Esfahani** MD, MPH ; **Pedram Heidari** MD ; **Umar Mahmood** MD, PhD

PURPOSE
As a real-time, high resolution imaging modality, optical molecular imaging has the potential to significantly advance image guidance during interventional radiology (IR) procedures. The clinically approved optical molecular imaging agent indocyanine green (ICG) has recently been shown to localize to both primary and metastatic malignant hepatic lesions. We assessed the ability of ICG to serve as a molecular beacon for hepatic malignancy by highlighting lesions with high target-to-background ratios (TBRs). We also evaluated the ability of custom-designed, translatable, catheter-based handheld imaging system to perform intra-procedural measurements of ICG fluorescence intensity during the percutaneous sampling of focal hepatic lesions.

METHOD AND MATERIALS
A handheld optical molecular imaging device was constructed to pass through the introducer needle of a standard 18 gauge percutaneous biopsy kit. Intrahepatic colorectal cancer metastases (human colorectal cancer cell line HT-29) were generated in nude mice (n = 25). Epifluorescence imaging of the tumors was performed 4 weeks post-implantation at multiple time points following the intravenous administration of 0.5mg/kg ICG. The mice were then imaged using the custom designed handheld imaging device, and measurements of fluorescence intensity within normal liver versus tumor were acquired.

RESULTS
There was avid localization of ICG to the focal hepatic lesions at all time points by epifluorescence imaging. Similarly, fluorescence intensity within the tumors was significantly greater than within normal liver as detected by the handheld imaging system, with a TBR of 3.9 ± 0.2 at 24 hours. A core biopsy of tumor and normal adjacent liver using a standard 18 gauge biopsy needle demonstrates a sharp margin of fluorescence intensity at the tumor-liver interface, with a 10%-90% rise distance of 4mm.

CONCLUSION
The custom-designed molecular imaging device, in combination with ICG, was able to readily differentiate between normal versus malignant tissue, an ability that is of tremendous potential utility in IR. Both the device and imaging agent are ready for immediate clinical translation.

CLINICAL RELEVANCE/APPLICATION
Optical molecular imaging may improve the accuracy and obviate the need for cytologic wet reads or frozen section analysis during percutaneous biopsy procedures.

Musculoskeletal (Tumor I)

Sunday, 10:45 AM - 12:15 PM • E451B

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OI MR MK

SSA14 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Mark D Murphey , MD
Moderator
Jim S Wu , MD *

SSA14-01 • Diagnostic Performance of Ultrasound Elastography in the Evaluation of Benign and Malignant Soft Tissue Tumors

Se Kyoung Park (Presenter) ; **In Sook Lee** ; **You Seon Song** ; **Jeung Il Kim** MD, PhD ; **Hoon Soo Kim**

PURPOSE
To evaluate the diagnostic performance of ultrasound elastography for differentiating malignant from benign soft tissue tumors.

METHOD AND MATERIALS
From December 2012 to March 2013, 52 consecutive patients with soft tissue mass lesions underwent ultrasound including elastography by two musculoskeletal radiologists. One radiologist measured quantitatively the size, elasticity ratio between lesion and normal subcutaneous fat layer, region-of-interest (ROI) values and semiquantitatively elasticity score (1-10) by color pattern on obtained cine elastographic images by using Q-Lab software consulting other radiologist. Also two radiologists analyzed the location (5 types according to depth), echogenecity (6 types), margin, the presence or absence of posterior enhancement and vascularity by consensus.

RESULTS
36 patients had benign lesions and 16 had malignant soft tissue tumors. In the cases of benign tumors, mean ROI value, elasticity ratio, and elasticity score were 73.4, 1.53, and 5.25, respectively. In the malignant tumors, those are 52.3, 1.88, and 2.93, respectively. By two sample t-test, the ROI values, the size, the elasticity score and the location were significant factors ($p < 0.05$). The elasticity ratio, echogenecity, the presence or absence of posterior enhancement and vascularity and margin not affected to differentiate between benign and malignant lesions ($p > 0.05$). In the measurement of elasticity ratio, intra-class correlation coefficient was 0.896 ($p < 0.05$) and the difference of measured values was insignificant. Also, the locations of tumors did not affect to the elasticity ratio. By ROC analysis, only the size (AUC, 0.825; SE, 0.0611; 95% confidence interval, 0.694-0.916; $p < 0.0001$, criterion > 28 mm) was statistically significant.

CONCLUSION
Although the elasticity ratio of the soft tissue mass was not significant, the elasticity score by color pattern was helpful for differentiating between benign and malignant lesions on ultrasound elastography.

CLINICAL RELEVANCE/APPLICATION
The quantitative measurement such as elasticity ratio was not yet useful for differentiating between benign and malignant soft tissue tumors. However the elasticity score by color pattern was helpful.

SSA14-02 • Cost-effectiveness of Advanced Cross-sectional Imaging in the Work-up of Newly Discovered Soft Tissue Masses

Sahar J Farahani MBBS (Presenter) ; **John Eng** MD ; **Christian Meyer** ; **John A Carrino** MD, MPH * ; **Laura M Fayad** MD

PURPOSE
To determine the required accuracy of an advanced imaging modality to be cost-effective over biopsy in the work-up of new soft tissue masses (STMs) that have already undergone a conventional work-up.

METHOD AND MATERIALS
A decision analytic model was developed to estimate quality-adjusted-life (QALY) and costs associated with biopsy and advanced imaging (such as MR spectroscopy) in differentiating between malignant and benign STMs for the first five years after diagnosis. The model incorporated prevalence of malignant and benign STMs at the community level, the performance characteristics of the imaging modality of choice, 1-5 year overall survival rate for the different stages at the time of diagnosis, and costs and effectiveness associated with each strategy. A discount rate of 3% was considered. An incremental cost per QALY gained was compared between two strategies. One-way sensitivity analysis was performed to evaluate the stability of the model to change in the

clinically-plausible range for all the variables. Threshold analysis was used to determine the performance characteristic of the imaging tool, which could justify its utilization regarding costs and effectiveness instead of biopsy.

RESULTS
Considering a malignancy prevalence of 0.01 and sensitivity and specificity of 95% and 82% for the imaging modality, we ran a Monte Carlo micro-stimulation model 10000 times. The results demonstrated that the incremental cost for one QALY gained by advanced imaging was $776, whereas by biopsy, was $1472. Threshold analysis revealed a required sensitivity of 83% and specificity of 75% for justifying advanced imaging over biopsy. One-way sensitivity analysis showed the model is stable to change in a clinically plausible range for the other variables.
Conclusion: For the work-up of new STMs, advanced imaging is a cost-effective non-invasive alternative to biopsy.

CONCLUSION
For the work-up of new STMs, advanced imaging is a cost-effective non-invasive alternative to biopsy.

CLINICAL RELEVANCE/APPLICATION
Benign STMs present to Orthopaedic clinics 100 times more commonly than malignant STMs and are often unnecessarily referred for biopsy. Decision analysis proves the value of advanced imaging as the in

SSA14-03 ● Detection of Soft Tissue Sarcoma Recurrence: Added Value of Functional MR Imaging Techniques at 3T

Filippo Del Grande MD, MBA (Presenter) ; **Ty K Subhawong** MD ; **Kristin L Weber** MD ; **Michael R Aro** MBBS * ; **Charles M Mugera** MBBCh, MRCP ; **Laura M Fayad** MD

PURPOSE
To define the added value of dynamic contrast-enhanced (DCE-MR) and quantitative diffusion weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping to detect recurrence of soft tissue sarcomas (STS) after surgical resection.

METHOD AND MATERIALS
The study is HIPPA compliant and approved by our institutional review board. 58 MR patients referred for post-operative surveillance following STS resection were studied with 3 T MR. The MR protocol included: T1-weighted, fluid-sensitive, contrast-enhanced T1-weighted, DCE-MR, and DWI with ADC map. Two readers independently reviewed for signal and morphologic characteristics on conventional sequence, the presence or absence of arterial enhancement by DCE-MR and ADC measurements of the surgical bed. Mass-like signal abnormality on conventional sequences, arterial enhancement by DCE-MR or a low signal mass on ADC maps were defined as recurrence. The readers reviewed first the conventional sequences, second the addition of DCE-MR, and third the DWI/ADC maps. The diagnostic performance of conventional MR for detecting recurrence was compared to that with the addition of functional sequences.

RESULTS
There were eight histologically-proven recurrences out of 58 studies. The sensitivity and specificity of MR for detecting tumor recurrence were 100% and 48.0%, 60.0% and 93.2%, and 100% and 90.7% for conventional sequences, for addition of DCE-MR, and for addition of DWI/ADC mapping, respectively.

CONCLUSION
The addition of functional MR sequences to a routine MR protocol increase specificity over 90%. In particular DCE-MR alone has a discrimination ability of 95% for distinguishing recurrent sarcoma from post-surgical scarring

CLINICAL RELEVANCE/APPLICATION
For detecting recurrence, the improved specificity offered by functional sequences has the potential to reduce unnecessary biopsies and patient anxiety

SSA14-04 ● Mural Nodule in a Postoperative Fluid Collection after Soft Tissue Sarcoma Resection at MRI: Not a Sign of Recurrent Tumor

Joshua Lantos MD (Presenter) ; **Sinchun Hwang** MD ; **David M Panicek** MD

PURPOSE
To determine the prevalence and clinical significance of nodules within fluid collections at MRI after surgical resection of primary soft tissue tumors.

METHOD AND MATERIALS
This retrospective study includes 175 consecutive patients who underwent resection of primary soft tissue sarcoma at a tertiary cancer center and showed fluid collections at least 1 cm in largest diameter in the surgical bed at postoperative MRI. Images were reviewed to determine the presence of nodules within the collections, defined as a well-defined focus measuring at least 0.7 cm on T1-weighted and fluid-sensitive images. Collections were classified based on signal intensity (homogeneous, heterogeneous), and the presence of septa, blood products (hyperintense T1 signal), and rim (thin, thick, enhancing). The size, signal intensity, and contrast enhancement of nodules were reviewed. Nodules were classified as benign or malignant based on histologic results, or clinical or MRI follow-up.

RESULTS
Collections were present in 75 patients (43%). 43 collections showed homogeneous fluid intensity (57.3%) and 32 were heterogeneous (42.6%). Internal septa were present in 49 (65.3%) and blood products in 16 (21.3%). The majority of collections showed a thin rim (66.6%) and rim enhancement (90.6%). Nodules were present inside six (8%) collections. All collections that contained nodules were heterogeneous, and half showed an enhancing rim. Three (50%) nodules enhanced and two (33%) were T1-hyperintense. At follow-up MRI, three nodules resolved, two were stable in size, and one decreased in size. Nodules in two patients were biopsied, and surgically resected in another; all three nodules were benign. Two other patients had no recurrence at clinical or imaging follow-up, and another died within three months from metastases.

CONCLUSION
Nodules infrequently develop within a fluid collection at MRI after surgical resection of a primary soft tissue sarcoma, and are unlikely to represent local tumor recurrence.

CLINICAL RELEVANCE/APPLICATION
A nodule within a postoperative fluid collection at MRI after soft tissue sarcoma resection generally does not represent tumor recurrence; follow-up MRI is recommended rather than immediate biopsy.

SSA14-05 ● Magnetic Resonance Imaging of Incompletely Excised Soft Tissue Sarcomas

Anna McNaught MBBS (Presenter) ; **Ali M Naraghi** ; **Ravi Menezes** PhD ; **Bader Alhariqi** ; **Peter C Ferguson** MD ; **Jay Wunder** MD ; **Lawrence M White** MD *

PURPOSE
The aim of this study was to assess the utility of MRI in identifying the presence of residual disease in incompletely excised soft tissue sarcomas.

METHOD AND MATERIALS
Following IRB approval, 315 consecutive cases of incomplete excision of soft tissue sarcoma were identified from a surgical database. 237 patients with a positive margin at initial surgery who underwent MRI prior to re-excision were included. Two MSK radiologists, blinded to the final pathological finding at re-operation reviewed all MRIs in consensus. Pulse sequences varied but included axial and longitudinal T1 and fat suppressed fluid sensitive images in all cases. Post-gadolinium T1 fat-suppressed images were available in some. Imaging features evaluated included lesion morphology, location, fascial penetration, signal characteristics and enhancement. An overall consensus prediction was made regarding the presence of residual disease. The individual findings and the overall prediction were compared to the final pathology.

RESULTS
There were 98 females and 139 males with an average age of 55 years (range 17-89). The pathological diagnosis was malignant fibrous histocytoma (n=67), leiomyosarcoma (n=47) and liposarcoma (28). The remaining 96 patients had undifferentiated sarcomas or rare subtypes.
120 patients had residual disease, 48 with microscopic foci and 72 with macroscopic foci greater than 10 mm in diameter. 117 patients had no residual disease on pathology. MRI had a sensitivity of 60%, specificity of 91%, PPV of 87% and NPV of 69%. When a mass was present on pathology, MRI had a high sensitivity (88%) and specificity (88%) and a high NPV (94%). There was a poor sensitivity (19%) in detection of microscopic residual disease.
82 lesions had nodular, 40 plaque and 115 reticular morphology. The presence of a nodule had a high specificity (89%) and PPV (84%) but a low sensitivity (58%). Plaque and reticular morphology had low sensitivities and predictive values.

CONCLUSION
MRI performs poorly in identifying those with microscopic disease but has a better performance in the presence of macroscopic disease. The presence of a nodule is the most specific morphologic predictor of residual disease.

CLINICAL RELEVANCE/APPLICATION
Many soft tissue sarcomas have positive margins at initial surgery. MRI is the modality of choice for re-evaluation. Further investigation of its utility in predicting disease is of value.

SSA14-06 ● Comparison of 3T Diffusion-weighted MR Imaging and PET/CT in Bone and Soft Tissue Tumors: Quantitative Analysis of ADC and SUV

So-Yeon Lee MD (Presenter) ; **Won-Hee Jee** MD ; **Ie Ryung Yoo** ; **Joon-Yong Jung** MD ; **Yang-Guk Chung** MD

PURPOSE
To retrospective determine whether the apparent diffusion coefficients (ADC) on 3T diffusion-weighted magnetic resonance imaging (DWI) correlate with the standardized uptake values (SUV) on positron emission tomography (PET)/computed tomography (CT) in bone and soft tissue tumors.

METHOD AND MATERIALS
The institutional review board approved this HIPAA-compliant study, and informed consent was waived. This study included 45 patients (30 men, 15 women, mean age 57 years, range 17-90) with pathologically confirmed soft tissue (n = 34) and bone (n = 15) tumors who underwent 3T MR imaging including DWI and whole-body fluorine 18 fluorodeoxyglucose PET/CT before treatment. Maximum (SUVmax) and average (SUVav) SUVs of the tumors were obtained by one nuclear medicine physician. Two musculoskeletal radiologists independently measured minimum (ADCmin) and average (ADCav) ADCs of tumors on the corresponding regions of the tumors where SUVs were obtained. ADC (ADCmus) of normal skeletal muscle was measured on the same axial plane. The ratios ADCmin/ADCmus and ADCav/ADCmus were calculated by ADCmin and ADCav of tumors divided by ADCmus, respectively. The Spearman rank correlation was obtained for statistical analysis. The differences in areas under the receiver operating characteristic curves (AUCs) were assessed.

RESULTS
There was significant, inverse correlation between SUVmax and the ratio ADCmin/ADCmus (r = -0.435 for reviewer 1 and r = -0.449 for reviewer 2, respectively, P < .005). SUVav and ADCav/ADCmus showed significant, inverse correlations (r = -0.444 for reader 1 and r = -0.440 for reviewer 2, respectively, P < .005). The AUCs of ADCmin/ADCmus and ADCav/ADCmus (0.955 for reviewer 1, 0.959 for reviewer 2, respectively) were significantly higher than those of SUVmax and SUVav (0.820 and 0.777, respectively) (P < .05).

CONCLUSION
There was significant correlation between ADC at 3T DWI and SUV at PET/CT in bone and soft tissue tumors and DWI showed better diagnostic performance than PET/CT for diagnosing malignancy.

CLINICAL RELEVANCE/APPLICATION
Quantitative DWI at 3T is comparable to PET/CT for evaluating bone and soft tissue tumors.

SSA14-07 ● Dynamic Contrast Enhanced (DCE) Targeted MR-guided Biopsy of Soft Tissue Tumors at 3Tesla: Feasibility, Preliminary Results on Accuracy, and Correlation with Diffusion Weighted Imaging (DWI), and Multivoxel 1H-MR Spectroscopy (1H-MRS)

Iris-Melanie Noebauer-Huhmann MD (Presenter) ; **Gabriele Amann** MD ; **Martin Krssak** PhD ; **Joannis Panotopoulos** MD ; **Christian Czerny** MD ; **Siegfried Trattnig** MD

PURPOSE
To test the dynamic contrast enhanced (DCE) sequence of soft tissue tumor staging MR for intralesional targeting with subsequent minimally MR-guided biopsy at 3T, and to compare DCE "hotspots" with diffusion-weighted imaging (DWI) and multivoxel 1H-MR spectroscopy (1H-MRS).

METHOD AND MATERIALS
Fifty-six patients with suspected soft tissue tumors prospectively underwent preoperative staging MR with subsequent MR-guided core needle biopsy at 3T after written informed consent, according to Institutional review board approval. Surgical histology available in 54 patients revealed 53 soft tissue tumors (29m, 24f, mean age 54 years, range 19-90). DCE was conducted in 50/53 patients (contrast agents: Gd-BOPTA, Gd-DOTA, and Gd-DO3A-butrol), DWI-MSh FH in 51/53 patients, and 1H-MRS in 37/53 patients. Matching of the most suspicious regions in DWI and 1H-MRS with DCE results was assessed.

RESULTS
DCE was heterogeneous in 42 cases, including all malignant tumors. In 2 cases, DWI was additionally used for targeting. In 6 cases appearing homogeneous on all sequences, biopsy was taken arbitrarily. 3 small lesions required no region selection. Diagnostic yield was 98.1% (52/53). The accuracy rates of biopsy were 100% (52/52) in predicting the dignity, 96.2% for definitive tissue diagnosis, and 92.3% for tumor grade. DCE matched with preselected DWI regions in 87.5%, and with 1H-MRS in all assessable regions. The diffusion weighted sequence was of limited value for the selection of the biopsy area. Spectroscopy could be compared with the DCE target region in 23/37 patients only. Area match of 1H-MRS with the hotspots revealed by DCE was observed in all assessable cases, but, due to technical restraints, tumor coverage was not possible by 1H-MRS in feasible examination time.

CONCLUSION
Our preliminary study indicates, that biopsy of soft tissue tumors can be performed accurately and safely by DCE targeted MR-guidance at 3T, using the DCE staging sequence in combined staging/biopsy MRI in outpatients. DWI was of limited value. 1H-MRS results were promising, but the method cannot be recommended for biopsy targeting in its present form.

CLINICAL RELEVANCE/APPLICATION
In soft tissue tumors, the DCE-sequence of staging MR can be used accurately and safely for targeting of minimally-invasive MR-guided biopsy, which might be useful especially in heterogeneous tumors.

SSA14-08 ● Preoperative Tractography Assessment of the Anatomic Relationship between Peripheral Nerve Sheath Tumors and Fibers within the Nerve of Origin Correlate with Intraoperative Findings

Stephanie W Hou MD (Presenter) ; **Esther L Yuh** MD, PhD ; **Jared A Narvid** MD ; **Gregory E Punch** MD ; **Jason F Talbott** MD, PhD ; **Suchandrima Banerjee** * ; **Michel Kliot** ; **Cynthia T Chin** MD

PURPOSE
Magnetic resonance neurography (MRN) is an emerging tool for anatomic depiction of nerves and their pathology. To investigate the preoperative utility of MRN, including diffusion tensor tractography, we compared MRN findings to intraoperative findings and histopathology in 7 patients.

METHOD AND MATERIALS
Seven patients (ages 24-69 years) with a clinical/imaging diagnosis of peripheral nerve sheath tumor were referred by neurosurgeons for MRN at our institution in 2011-2013 and subsequently underwent surgical resection. Preoperative DTI was performed with 28 directions, and tractography was performed by placing seed points along the peripheral nerve proximal and distal to the mass, using FA minimum threshold of 0.18 and maximum turning angle threshold of 45 º. The neuroradiologist and surgeon used the following categorical rating system to describe the spatial relationship of the dominant location of most of the peripheral nerve fibers relative to the mass: fibers predominantly anterior-1, medial-2, posterior-3, lateral-4, anterior and medial-5, posterior and medial-6, posterior and lateral-7, anterior and lateral-8. We calculated Cohen's kappa for agreement between neuroradiologist assessment of MRN tractograms and operative findings.

RESULTS
Seven resected masses consisted of 6 schwannomas (including 2 cellular schwannomas) and one neurofibroma. ADC within the solid portion of the masses was 1.9+/-0.8 x 10^{-3} mm^2/sec (mean+/-SD), consistent with prior reports of relatively higher ADC within benign tumors. Six of seven cases were concordant for nerve fibers predominantly along the posterior and medial margins (n =4), posterior margin (n = 1), or anterior and medial (n =1) margins of the tumor. The "discrepant" case was interpreted as predominantly dorsal fibers on the MRN, with operative findings indicating both dorsal and medial fibers. Cohen's kappa for agreement between neuroradiologist and intraoperative findings was 0.73 (p = 0.006).

CONCLUSION
In the setting of nerve sheath tumors planned for resection, DTI tractography may be useful preoperatively to assess the spatial relationships of tumor to fibers within the nerve of origin and thereby reduce the risk of causing a functional deficit during surgery.

CLINICAL RELEVANCE/APPLICATION
This study is the first to demonstrate the application of DTI tractography in preoperative characterization of the relationship of peripheral nerve sheath tumors to fibers within the nerves of origin.

SSA14-09 ● Differential MRI Diagnosis between Benign and Malignant Bone or Soft Tissue Tumors Using Dynamic Contrast-enhanced and Diffusion-weighted Images

In Sook Lee (Presenter) ; **You Seon Song** ; **Se Kyoung Park** ; **Jeung Il Kim** MD, PhD ; **Hak Jin Kim** MD ; **Jong Woon Song**

PURPOSE
to evaluate the diagnostic performance of dynamic contrast-enhanced (DCE) and diffusion-weighted (DW) MR images for differentiation between benign and malignant bone or soft tissue tumors

METHOD AND MATERIALS
Forty-two patients with bone or soft tissue masses prospectively performed DCE and DW MR examinations addition to routine protocols. On DCE images using tissue 4D perfusion software, K(trans) (transfer constant), Kep (rate constant), Ve (volume fraction), and iAUC (initial area under curve) were calculated from quantitative analysis. Also, the graphs of VOI (volume of interest) about whole mass and region-of-interest (ROI) within the mass were automatically obtained. The types of graphs were classified into five. On DW and apparent diffusion coefficient (ADC) images, ROIs of masses were measured.

RESULTS

Twenty-three patients had benign tumors and nineteen had malignant tumors. The mean values of Ktrans, Kep, Ve, iAUC, and ROI in benign tumors were 0.0596, 0.308, 0.251, 3.761, and 1.801 respectively. Those in malignant tumors were 0.157, 0.476, 0.298, 10.471, and 0.72 respectively. Ktrans, iAUC and ROI values were statistically significant ($p < 0.05$) for differentiating benign and malignant tumors. By ROC curve analyses, Ktrans (AUC, 0.8; standard error (SE), 0.0696; 95% confidence interval (CI), 0.648-0.907; $p < 0.0001$, criterion > 0.117), ROI value on ADC (AUC, 1; SE, 0; 95% CI, 0.694-0.916; $p = 0$, criterion = 0.97), Kep (AUC, 0.745; SE, 0.0779; 95% CI, 0.588-0.867; p=0.0016; criterion > 0.287) and iAUC (AUC, 0.832; SE, 0.0632; 95% CI, 0.685-0.929; $p < 0.0001$; criterion > 4.908) were significant.

CONCLUSION
Ktrans, representing permeability into the extracellular space from blood plasma and contrast delivery (perfusion) on DCE images and ADC values were helpful for differentiating between benign and malignant bone or soft tissue tumors.

CLINICAL RELEVANCE/APPLICATION
The perfusion study from DCE and ADC values from DW MR examination may helpful for differentiating between benign and malignant bone or soft tissue tumors, quantitatively and semi-quantitatively.

Nuclear Medicine (PET/CT in Oncology)

Sunday, 10:45 AM - 12:15 PM • S505AB

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OI NM CT

SSA18 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Andrew Quon , MD

SSA18-01 • Anti-3-[18F] FACBC PET Is Useful to Improve Salvage Radiotherapy Failure Rates in Recurrent Prostate Cancer

Oluwaseun Odewole MBBS, MPH (Presenter) ; **Ashesh B Jani** MD ; **Pooneh Taleghani** MD ; **Bital Savir-Baruch** MD ; **Leah M Bellamy** ; **Weiping Yu** PhD ; **Peter Nieh** MD ; **Viraj Master** MD ; **Mark M Goodman** PhD * ; **David M Schuster** MD ; **Raghuveer K Halkar** MD *

PURPOSE
Salvage radiotherapy after prostate cancer recurrence is associated with failure rates of up to 50% (Radiation Medicine Rounds 2:1 (2011) 59–80), probably from failure to detect extra-regional disease. Therefore, detection of such disease on imaging has substantial value. anti-3-[18F] FACBC is a synthetic amino acid PET radiotracer with utility in detection of prostate cancer (Radiology 2011; 259:852). Our aim was to determine if FACBC PET could be used to improve salvage radiotherapy failure rates

METHOD AND MATERIALS
Retrospective analysis of 11 patients who had salvage radiotherapy for prostate cancer recurrence (9 post-prostatectomy; 2 non-prostatectomy) selected by findings from FACBC PET-CT. PSA failure was defined as nadir PSA + 0.2 ng/mL for prostatectomy and nadir PSA + 2.0 ng/mL for non-prostatectomy.

RESULTS
11 patients without FACBC PET extra-pelvic disease were qualified for salvage radiotherapy. Mean original Gleason score (±SD, range) was 7 (±0.74, 6 - 8). 9/11 patients had radiotherapy to the prostate bed and 2/11 also to the pelvis. Average time (±SD, range) from FACBC to radiotherapy was 7.9 (±5.9, 4-22) months; average pre-radiotherapy PSA (±SD, range) was 4.4 (± 5.2, 0.2-15.3) ng/ml. Average PSA follow-up from time of scan (±SD, range) was 29.9 (±9.5, 15-54) months and 20.9 (±7.2, 8-35) months from time of radiotherapy. 18.2% (2/11) of our patients had PSA failure at time of analysis. Of these, one did not receive radiotherapy until 16 months after FACBC scan. Salvage radiotherapy was successful in 3/5 patients with PSA > 2.0 ng/ml at time of radiotherapy.

CONCLUSION
Guidance with advanced molecular imaging using anti-3-[18F] FACBC PET-CT may be valuable in selecting recurrent prostate carcinoma patients for salvage radiotherapy. Impact on salvage radiotherapy outcomes is currently being studied at our institution in a prospective randomized controlled trial.

CLINICAL RELEVANCE/APPLICATION
Patient selection for salvage radiotherapy guided by molecular imaging with anti-3-[18F] FACBC PET-CT may enable better response rate at higher PSA's as compared with conventional imaging guidance.

SSA18-02 • Pre-treatment Whole-body Total Lesion Glycolysis and Metabolic Tumor Volume at FDG PET-CT as Prognostic Indicators in Advanced Cervical Cancer

Mohammad A Husainy MD (Presenter) ; **Farhina Sayyed** MRCS ; **Helene Thygesen** PhD ; **Chirag Patel** FRCR ; **Mark Barnfield** ; **Andrew F Scarsbrook** FRCR

PURPOSE
To study the prognostic value of whole body total lesion glycolysis (TLG) and total metabolic tumor volume (MTV) derived from pre-treatment fluorine 18 fluorodeoxyglucose (FDG) positron emission tomography - computed tomography (PET-CT) in locally advanced cervical cancer.

METHOD AND MATERIALS
Patients with locally advanced cervical cancer who underwent pre-treatment FDG PET-CT from the year 2010-12 were identified from an institutional cancer database. Mean and maximum standardized uptake value and MTV of each primary tumor and any nodal or distant disease were determined. Whole body MTV was calculated by summation of the primary tumor and any other disease site volumes. TLG was calculated by summation of individual tumor volume multiplied by mean SUV. Univariate analysis was performed to assess the prognostic significance of clinical stage, SUVmax, whole-body MTV and TLG on subsequent patient outcome.

RESULTS
34 patients were included in data analysis. Median follow up time was 2.2 years. The estimated median overall survival (OS) for the cohort was 2.1 years. The 1-year OS was 64.7% for patients with high whole-body TLG (> 385.29) and 88.2% for those with low whole-body TLG (67) and 88.2% for those with low whole-body MTV (14.7). Univariate Cox analysis showed that whole-body TLG, whole-body MTV and clinical stage were significant prognostic factors for OS. For statistical test, we used the confidence level 95%. Cox proportional hazard modeling showed a significant prognostic value of whole body-TLG (hazard ratio= 3.63; 95% confidence interval: 1.15, 11.43; p
CONCLUSION
Whole-body TLG and MTV may be better prognostic indicators than primary tumor SUVmax for predicting outcome in advanced cervical cancer.

CLINICAL RELEVANCE/APPLICATION
Whole-body TLG and MTV may be better prognostic indicators in the advanced cervical cancer and could have a role for treatment stratification in the future.

SSA18-03 • Is MDP Bone Scan Necessary for Initial Staging of Ewing Sarcoma If FDG PET/CT Is Performed?

Gary A Ulaner MD, PhD (Presenter) ; **Heather Magnan** MD ; **John Healey** MD ; **Wolfgang A Weber** MD * ; **Paul Meyers** MD

PURPOSE
To determine whether MDP bone scans are necessary during initial staging of Ewing sarcoma (ES) patients, if FDG PET/CT is performed.

METHOD AND MATERIALS
An IRB approved retrospective review was performed of patients who underwent FDG PET/CT and MDP bone scan prior to treatment of newly diagnosed ES from 1/04 to 11/12. Studies were reviewed to document suspected primary and metastatic malignancy. Pathology and imaging follow-up were used to determine the presence or absence of disease at suspected sites.

RESULTS
60 patients were identified with FDG PET/CT and MDP bone scans performed prior to treatment of newly diagnosed ES. 44 primary malignancies demonstrated a lytic CT appearance, 3 were sclerotic, and 13 involved only soft tissue. 11/12 patients with osseous metastases were detected on PET/CT, with the 1 false negative occurring in a sclerotic primary tumor. 9/12 patients with osseous metastases were detected on MDP bone scan, with the 3 false negatives occurring in patients with lytic primary tumors. Only 1 of 13 patients with a soft tissue primary malignancy demonstrated bone metastases, evident on both bone scan and PET/CT. PET/CT also demonstrated 8 patients with lung metastases and 3 patients with lymph node metastases, which were not evident on MDP bone scan.

CONCLUSION
When ES is lytic, MDP bone scan does not add to staging performed by FDG PET/CT, thus MDP bone scanning may be omitted. However, when ES is sclerotic, MDP bone scan may detect patients with osseous metastases which are not detected by FDG PET/CT.

CLINICAL RELEVANCE/APPLICATION

Bone scan may be omitted from the staging of newly diagnosed ES when the primary tumor is lytic. When the primary tumor is sclerotic, MDP bone scan may detect osseous metastases missed on FDG PET/CT.

SSA18-04 • Prognostic Value of Concurrent Staging 18F-FDG PET/CT and Staging Endoscopic Ultrasound in Esophageal Cancer

Vinod Malik MBBCh, MA (Presenter) ; **Ciaran J Johnston** MD ; **Julie A Lucey** PhD ; **Zieta Claxton** BSc ; **Dermot O'Toole** MD ; **John V Reynolds** MD

PURPOSE
Staging of esophageal cancer is improved by the concurrent use of 18F-fluorodeoxyglucose positron emission tomography/computed tomography (18F-FDG PET/CT) and endoscopic ultrasound (EUS). This study ascertained if these complementary adjuncts can enhance staging by proposing correlating independent prognostic factors in esophageal cancer.

METHOD AND MATERIALS
From December 2008 to May 2011, 150 patients with biopsy-proven cancer of the esophagus or esophagogastric junction underwent concurrent staging 18F-FDG PET/CT and staging EUS. 18F-FDG PET/CT obtained maximum standardized uptake value (SUVmax) and metabolic tumor volume (MTV) of the primary tumor was recorded. EUS evaluated the tumor for T stage (T1-T4), regional lymph node metastases (N0 or N+) and the presence or absence of celiac axis nodes and hepatic metastasis. Relationships between parameters were investigated using the spearman rho correlation coefficient, survival analysis performed using Kaplan-Meier and independent prognostic factors determined using Cox regression multivariate analysis.

RESULTS
A strong positive correlation between 18F-FDG PET/CT MTV and EUS ‘T’ stage was demonstrated (r=0.566, p18F-FDG PET/CT MTV was noted between early EUS tumors (T1/T2) and late EUS tumors (T3/T4) (p18F-FDG PET/CT MTV < 7.5cm3 (p=0.0013), 18F-FDG PET/CT SUVmax < 4.1 (p=0.0014), EUS ‘T’ stage (p18F-FDG PET/CT MTV < 7.5 cm3 (p=0.0006), EUS ‘T’ stage (p=0.01) and EUS ‘N’ stage (p=0.01).

CONCLUSION
MTV, a volumetric parameter of 18F-FDG PET/CT is a valuable independent prognostic factor in esophageal cancer, more so than SUVmax and enhances staging when used in conjunction with EUS ‘T’ stage and EUS ‘N’ stage by predicting survival.

CLINICAL RELEVANCE/APPLICATION
Independent prognostic factors identified by staging 18F-FDG PET/CT and EUS in esophageal cancer may facilitate selection of patients to treatment regimens with the benefit of enhanced outcomes.

SSA18-05 • Intratumoral Heterogenity of Tracer Uptake on 18F-FDG PET/CT for Characterization of Peripheral Nerve Sheath Tumors in Patients Suffering from Neurofibromatosis Type 1

Johannes M Salamon MD (Presenter) ; **Peter Bannas** MD ; **Jasmin D Busch** MD ; **Jochen Herrmann** MD ; **Gerhard B Adam** MD ; **Victor F Mautner** MD ; **Thorsten Derlin**

PURPOSE
Peripheral nerve sheath tumors (PNSTs) in patients with neurofibromatosis type 1 (NF1) may undergo focal malignant transformation, and heterogeneity of tumor composition is therefore a histopathological hallmark of malignant PNSTs (MPNSTs). MPNSTs usually demonstrate strongly increased and inhomogenous tracer uptake. The aim of this study was to evaluate the potential usefulness of intratumoral tracer uptake heterogeneity on 18F-fluorodeoxyglucose (FDG) PET/CT as compared to a cut-off SUVmax for characterization of PNSTs in NF1.

METHOD AND MATERIALS
50 patients suffering from NF1 underwent 18F-FDG PET/CT. Intralesional18F-FDG uptake was analyzed qualitatively and semiquantitatively by measuring the mean and maximum standardized uptake value (SUV). Heterogeneity of tracer uptake was evaluated by computing a SUV-based heterogeneity index (HISUV) and qualitatively graded using a three-point scale. Inter- and intrarater agreement was determined using Cohen`s ?. Histopathologic evaluation as well as clinical and radiological follow-up served as reference standard.

RESULTS
Using either intralesional heterogeneity or SUVmax malignant tumors could be identified with a sensitivity of 100%. Qualitative intratumoral uptake heterogeneity and malignant transformation in peripheral nerve sheath tumors showed a significant association (p
CONCLUSION
18F-FDG PET/CT reveals strong intratumoral heterogeneity of tracer uptake in MPNSTs in patients with NF1. Either a SUVmax cut-off value or a heterogeneity index can be used to identify malignant PNSTs with a sensitivity of 100%, however the approach using a cut-off value leads to a higher specificity. There is no significant improvement in diagnostic performance using both methods in combination.

CLINICAL RELEVANCE/APPLICATION
New imaging parameters for the characterization of peripheral nerve sheath tumors in NF1 patients may help reducing unnecessary morbidity due to biopsies or surgery.

SSA18-06 • Can I-124 PET/CT Predict the Uptake of Therapeutic Dosages of Radioiodine (I-131) in Differentiated Thyroid Carcinoma?

Gauke K Lammers MD (Presenter) ; **P.C.M. Pasker** ; **M. E. Sanson-Van Praag** ; **John M De Klerk** MD, PhD

PURPOSE
Follow up of differentiated thyroid carcinoma (DTC) is currently mainly based on monitoring of serum thyroglobulin (Tg) levels. In the case of an elevated serum Tg level and suspected recurrent DTC, but negative diagnostic imaging, a so called ‘blind’ I-131 therapy is recommended, followed by whole body scintigraphy to assess the extent of disease. Regrettably, in a significant number of patients this ‘blind’ I-131 therapy results in no visible abnormal I-131 uptake and hence in probably no beneficial therapeutic effect. Iodine-124 PET/CT is a promising tool for identifying patients who will benefit from I-131 therapy, by predicting iodine uptake. I-124 PET/CT could therefore be important in personalizing treatment for patients with DTC.

METHOD AND MATERIALS
The results of 34 I-124 PET/CT scans performed in our hospital between 2007 and 2012 were retrospectively evaluated. All scans were made in patients under follow up, replacing the diagnostic I-131 scintigraphy. In all cases Tg was stimulated (by recombinant TSH or thyroid hormone withdrawal). A dosage of 40MBq I-124 was used, with scans at 24 hours and 96 hours after administration. Results were compared to subsequent I-131 post-treatment scans (6 cases) and a combination of follow up, stimulated Tg and other imaging tools results available to assess presence of recurrence.

RESULTS
Recurrence of DTC was found in 14/34 cases. I-124 PET/CT correctly detected recurrence in 2 cases, with false negative results in 12 cases. In 1 case a false positive I-124 PET/CT result was recorded. 19 true negative results were found. For I-124 PET/CT this meant a sensitivity of 14% and a specificity of 95%. PPV was 67%, NPV 61%. Post-treatment I-131 uptake (6 cases) was correctly predicted in 1 case, with false negative results in 4 cases and 1 true negative result.

CONCLUSION
In this study I-124 PET/CT did not reliably detect recurrent differentiated thyroid carcinoma. More importantly it failed to predict I-131 uptake on post-treatment scintigraphy in a significant number of cases, which would lead to under-treatment.

CLINICAL RELEVANCE/APPLICATION
I-124 PET/CT in follow up of differentiated thyroid cancer cannot reliably identify the patients who would benefit from I-131 treatment.

SSA18-07 • Whole-body MRI vs. Co-registered Whole-body FDG-PET/MRI vs. Integrated Whole-body FDG-PET/CT: Capability for TNM and Stage Assessment in Non-small Cell Lung Cancer Patients

Yoshiharu Ohno MD, PhD (Presenter) * ; **Shinichiro Seki** ; **Mizuho Nishio** MD * ; **Hisanobu Koyama** MD ; **Maho Tsubakimoto** MD ; **Hitoshi Yamagata** PhD * ; **Kota Aoyagi** * ; **Yumiko Onishi** MD ; **Takeshi Yoshikawa** MD * ; **Sumiaki Matsumoto** MD, PhD * ; **Nobukazu Aoyama** RT ; **Katsusuke Kyotani** RT ; **Akiko Kusaka** RT ; **Kazuro Sugimura** MD, PhD *

PURPOSE
To directly and prospectively compare the capability for TNM and clinical stage assessments among whole-body MR imaging (MRI), co-registered FDG-PET/MRI and integrated FDG-PET/CT in non-small cell lung cancer (NSCLC) patients.

METHOD AND MATERIALS
70 consecutive pathologically diagnosed NSCLC patients (37 men, 33 women; mean age 73 years) prospectively underwent whole-body MRIs at 3T system, integrated FDG-PET/CTs, conventional radiological examinations, surgical biopsies and/ or treatments, pathological examinations and follow-up examinations. Final diagnosis of TNM factors and clinical stage in each patient was determined according to all examination results. All co-registered FDG-PET/MRIs were generated by means of our proprietary software. Then, TNM factor and clinical stage on all methods were visually assessed by radiologists and nuclear medicine physicians. Then, final diagnosis in each patient was made by consensus of two readers on each method. To determine the agreements of TNM factor and clinical stage between each method and final diagnosis, kappa statistics were performed. To compare the diagnostic capability for operability assessment (T factor: T1 or T2 vs. T3 or T4, N factor: N0 or N1 vs. N2 or N3, M factor: M0 vs. M1, clinical stage: stage I or II vs. stage III or IV) among all methods,

sensitivities, specificities and accuracies were statistically compared each other by using McNemar's test.

RESULTS
Each agreement with final diagnosis was as follows: T factor, 0.90=?=0.93; N factor, 0.60=?=0.88; M factor, 0.78=?=0.93; clinical stage, 0.55=?=0.87, respectively. When compared each operability assessment capability according to TNM factor, accuracies (97.1 [68/70] %) of N factor on MRI and FDG-PET/MRI were significantly higher than that on FDG-PET/CT (88.6 [62/70] %, p
CONCLUSION
Whole-body MRI and co-registered FDG-PET/MRI are more useful than integrated FDG-PET/CT for TNM and clinical stage assessments in non-small cell lung cancer patients.

CLINICAL RELEVANCE/APPLICATION
Whole-body MRI and co-registered FDG-PET/MRI are more accurate than integrated FDG-PET/CT for TNM and clinical stage assessments in non-small cell lung cancer patients.

SSA18-08 ● Correlations between FDG Uptake Indices and the Expression of Various Type Oncogenes (KRAS, BRAF, HIF-1, EGFR, CDH13, p53, Ki67, Glut 1 and Glut 3) in Biliary Cancer: A Comparison Study to MRI Diffusion Weighted Image Parameters

Shigeki Nagamachi MD, PhD (Presenter) ; **Ryuichi Nishii** MD, PhD ; **Youichi Mizutani** ; **Syogo Kiyohara** ; **Nobuhiro Shibata** ; **Kazuhiro Kondo** ; **Masahiro Kai** ; **Shozo Tamura** MD, PhD ; **Kazuo Chijiiwa** ; **Keiichi Kawai** ; **Seigo Fujita** MD ; **Hideyuki Wakamatsu** MD ; **Shigemi Futami**

PURPOSE
We investigated the correlations between FDG uptake and the expression of various type oncogenes in biliary cancer. In addition, we also analyzed the correlation between parameters of diffusion weighted MRI image (DWI) and oncogenes expression. Then, we compared both correlation coefficients to find which imaging parameters were more associated with the expression of which oncogenes in biliary cancer.

METHOD AND MATERIALS
We investigated forty-three patients of biliary cancer who underwent both MRI and FDG-PET/CT before operation. Using Reverse Transcription-Polymerase Chain Reaction (RT-PCR) analysis, we measured the various DNA content (EGFR, CDH13, p53, Ki67, KRAS, BRAF, HIF-1, Ki-67, p53, Glut 1 and Glut 3) in surgically resected cancer tissues. We investigated the correlation coefficients between the expression of oncogenes DNA and FDG uptake parameters (SUV max early and SUV max delayed), or between the expression of oncogenes DNA and apparent diffusion coefficient (ADC mean and ADC min).

RESULTS
FDG uptake parameters (SUV max early and SUV max delay) were positively correlated with B-RAF (0.34 and 0.43), HIF-1(0.41 and 0.48), Glut1 (0.45 and 0.52) or Glut 3(0.35 and 0.48). In contrast, DWI parameters (ADC mean or ADC min) showed positive correlation only with HIF-1 (0.48 and 0.16). However, there was not any significant correlation in other parameters.

CONCLUSION
In biliary cancer, both SUV max and DWI parameters showed the close association with the expression of oncogenes related with hypoxia. In addition, SUV max was more associated with the expression of oncogenes associated with RAF/MEK/ERK signaling pathway.

CLINICAL RELEVANCE/APPLICATION
By the correlation analysis, we may estimate the expression of oncogenes such as B-RAF or HIF-1 by the values of SUVmax. We may estimate the expression of HIF-1 by ADC also.

SSA18-09 ● Incremental Value Of FDG PET CT in Differentiating Benign and Malignant Cardiac Masses

Kavitha Yaddanapudi DMRD, MBBS (Presenter) ; **Michael A Bolen** MD ; **Ahmed El-Sherief** MD ; **Carmela Tan** MD ; **Richard Brunken** MD *

PURPOSE
To evaluate the incremental value of FDG-PET CT over contrast enhanced magnetic resonance imaging (CE MRI) and computed tomography (CT) in differentiating benign cardiac masses from malignant lesions.

METHOD AND MATERIALS
Retrospective evaluation of eleven patients with cardiac masses who underwent CE MRI (n=9), CT (n=2) and FDG-PET (n=11) was performed. The gold standard was histopathology after surgical excision (n=8) and long term follow up of more than 2 years (n=3). Patients were divided into two groups benign (n=7) and malignant (n=4) cardiac masses. On FDG PET CT the maximum standardized uptake values (SUV max) of the lesions was determined. A SUV max cutoff of 3.5 was used to differentiate benign from malignant lesions. MRI and CT characteristics as size, invasiveness and tissue characterization were evaluated. The ability of SUV max on FDG PET to differentiate benign and malignant lesions was then compared to morphological imaging diagnosis and correlated with pathology and follow up.

RESULTS
The mean SUV max for malignant lesions was 5± 2.5. The mean SUV for benign lesions was 0.85. No FDG uptake was seen in 5 of the 7 benign lesions (71%). The sensitivity and specificity for determining malignancy by FDG PET CT was 75% and 100% respectively. FDG PET CT has a 100% positive predictive value for diagnosing malignancy with a SUV max cut off of 3.5. Morphological imaging could not differentiate between benign and malignant lesions in 36% (n=4) cases. In 3 of these 4 cases FDG PET CT was able to differentiate between benign and malignant lesions. In one case of osteosarcoma of left atrium that was densely calcified both FDG PET CT and morphological imaging could not point towards the malignant nature preoperatively.

CONCLUSION
FDG PET CT is a useful adjunct to morphological imaging in differentiating benign from malignant cardiac masses. FDG uptake by the mass with a high SUV (>3.5) has a good positive predictive value for malignancy.

CLINICAL RELEVANCE/APPLICATION
FDG PET CT with a high positive predictive value can noninvasively differentiate benign from malignant lesions in most situations and is a powerful tool in the evaluation of cardiac masses.

Interventional Oncology Series: Controversies and Emerging Questions in the Management of Renal Tumors

Sunday, 01:30 PM - 06:00 PM ● S405AB

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VSIO11 • *AMA PRA Category 1 Credit* ™:4.25 • ARRT Category A+ Credit:5
Moderator
Debra A Gervais , MD *

LEARNING OBJECTIVES
1) To review management options for small renal masses as well as indications for each. 2) To review the data supporting the energy based thermal ablation modalities for ablation of renal masses. 3) To describe the role and limitations of biopsy of renal masses. 4) To review the management of benign solid renal masses. 5) To describe the evidence for ablation of T1b renal masses.

VSIO11-01 ● Controversy 1-T1a Renal Tumor: Resect, Ablate, or Follow

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-02 ● Small Renal Mass (T1a): The Case for Resection

Adam S Feldman MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-03 ● Long-term Results of Renal RFA Based on a Single-center 203 Cases Experience: Better than Surgery for Early RCC?

Irene Garetto MD ; **Carlo Gazzera** ; **Marco Busso** MD ; **Gianluca Amadore** ; **Federica Solitro** MD ; **Andrea Veltri** MD (Presenter) *

PURPOSE
To evaluate the long-term effects of RFA of renal masses (RM), assessing safety, technique effectiveness and survival, in order to compare the best results with surgical series.

METHOD AND MATERIALS
203 RM (12-75 mm, m 30; 193 malignant; 123 exophytic, 67 parenchymal, 13 central) in 137 patients (95 males; 20-88 y, m 64; 13 with hereditary tumors, 31 with solitary kidney) underwent RFA in our center in the last decade (196 US-guided, 7 CT-guided). The treatment sessions have been 220 (17 retreatments for partial ablation or early recurrence). More recently, complications were prevented with additional techniques (namely, 10 hydrodissection and 3 pyeloperfusion). Adverse Events (including major complications) and technique effectiveness (Complete Ablation) were evaluated, as well as predictors for adverse AE and CA. Overall (OS), Disease-Free (DFS) and Cancer-Specific Survival (CSS) were calculated (follow-up 1-109 months, m 39). Predictors for survival (solitary kidney, previous cancer disease, tumor type, site and size, etc.) were specifically investigated.

RESULTS
17 (8.4%) AE were recorded, including 4 (2%) major complications (all before using preventing techniques). Exophytic extension and smaller diameter were protective against AE at the uni/multivariate analysis. CA was obtained in 85% RM overall and in 115/124 with a diameter
CONCLUSION
RFA of not central small RM is safe and effective and provide high long-term survival rates. Early stage RCC should be considered for RCT comparing RFA with surgical resection.

CLINICAL RELEVANCE/APPLICATION
RFA of not central T1a RCC is safe and successful. Thus, RFA offers an optional choice as a first-line therapy. RCTs are still necessary to assess if RFA is better than surgery for early RCC.

VSIO11-04 ● Small Renal Mass (T1a): The Case for Ablation

Jeremy C Durack MD (Presenter)

LEARNING OBJECTIVES
1) Understand and compare treatment alternatives for small renal masses. 2) Recognize imaging features of small renal masses that impact treatment alternatives. 3) Understand the risks and benefits of image guided renal mass ablation.

VSIO11-05 ● Small Renal Mass (T1a): Both Cases for Intervention are Weak. Active Surveillance Will Do Just as Well

Stuart G Silverman MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-06 ● Controversy 2-Small Renal Mass (T1a) Ablation is Chosen. Heat or Cold?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-07 ● Small Renal Mass (T1a): The Case for Heat Based Ablation

Debra A Gervais MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-08 ● 5-year Outcomes of Percutaneous Radiofrequency Ablation of 100 Renal Cell Carcinomas

Timothy D McClure MD (Presenter) ; **Nelly Tan** MD ; **Daniel S Chow** MD ; **Allan Pantuck** MD ; **James Sayre** PhD ; **Steven S Raman** MD

PURPOSE
Determine intermediate term oncological outcomes and determine predictors of primary efficacy in the percutaneous radiofrequency ablation (RFA) of pathologically proven renal cell carcinomas (RCC).

METHOD AND MATERIALS
After IRB approval we performed a HIPAA compliant study of all patients who underwent RFA for pathologically proven RCC. Technical success, local tumor progression, primary and secondary technique effectiveness were defined per the Working Group of Image Guided Tumor Ablation. Univariante and multivariate logistic regression analysis was performed to determine predictors of primary technique effectiveness and complications. Kaplan-Meier local tumor progression-free, metastasis-free, and overall survival were calculated. All analyses were done using the statistical software STATA/SE® 11.2. Alpha of 0.05 was considered significant.

RESULTS
115 RFA sessions for 100 RCC lesions in 84 patients were identified. Mean age was 70.3 years (range 35-93). 51/84 (61%) patients were men and 33/84 patients (39%) were women. The median ASA score was 3 (range 2-3). The median(mean) lesion size was 2.3(2.6) cm (range 0.7-6cm). The median(mean) follow up was 24(27) months (range 1-106 months). Total technique effectiveness was 95%. Primary technique effectiveness was 86% (86/100 lesions). Secondary technique effectiveness was 9% (9/100 lesions). Treatment failure was 5%(5/100). Technical success was 99.1%. Using logistic regression statistical analysis, predictors of primary efficacy were: location, size, proximity to collecting system, R.E.N.A.L nephrometry sum, and number of ablation zones. Complications occurred in 15 of 115 RFA sessions (13%) with no deaths. The median 2.1year local progression free, metastasis free, disease specific survival, and overall survival was 86%, 98.7%, 100%, and 97.6% respectively.

CONCLUSION
Percutaneous RFA for RCC is safe and effective with excellent intermediate oncologic control. Location, size, lesion nearness to the collecting system, R.E.N.A.L Nephrometry sum, and number of ablation zones predicts primary efficacy.

CLINICAL RELEVANCE/APPLICATION
Percutaneous RFA for RCC has excellent intermediate oncologic outcomes. Predictors of primary efficacy include: location, size, R.E.N.A.L Nephrometry sum, and number of ablations.

VSIO11-09 ● Percutaneous Microwave Ablation of Renal Tumors: Multicenter Evaluation of Safety and Efficacy

Anna Moreland (Presenter) ; **Timothy J Ziemlewicz** MD ; **Aaron M Fischman** MD * ; **J. Louis Hinshaw** MD * ; **Jason Abel** ; **Meghan G Lubner** MD ; **Sarah Best** ; **Marci Center** ; **Christopher L Brace** PhD * ; **Fred T Lee** MD *

PURPOSE
To evaluate the feasibility, safety, and efficacy of a high-powered, gas-cooled microwave ablation system for treatment of renal tumors.

METHOD AND MATERIALS
Between 1/2011 and 4/2013, 45 renal tumors were treated at 2 medical centers using ultrasound and CT-guided microwave ablation with a high-powered, gas-cooled microwave ablation system (NeuWave Medical, Madison, WI). Tumors included biopsy-proven renal cell carcinoma (n=36), angiomyolipoma (n=4), oncocytoma (n=2), and other (n=3). Mean patient age was 64 years. Post-procedure imaging was performed by CECT or MRI to evaluate for enhancement in the ablation zone.

RESULTS
Mean pre-treatment tumor diameter was 2.7 cm (range: 1.0-5.4). Tumor diameter decreased by a mean of 11% on immediate post-ablation CT. Mean duration of power application was 6.5 minutes, and mean generator power was 73.7 W. Technical effectiveness was 100%. There was one major complication: a retroperitoneal hematoma on post ablation day 11. This coincided with restarting anticoagulation for suspected pulmonary embolus in a patient with a thrombotic history, and required readmission and transfusion of PRBCs. Median hospital stay was 1 day, and median length of clinical follow-up was 11 months. All patients are alive and without evidence of metastatic disease, with the exception of 1 death occurring 6 months post ablation and unrelated to either the procedure or the malignancy. 28 patients have had follow-up imaging at a mean of 6.3 months status post ablation, with local tumor progression noted at the ablation zone in 1 case. Overall, the procedure demonstrated 95% primary treatment effectiveness and a 98% secondary treatment effectiveness, with 1 tumor yet to be retreated.

CONCLUSION
Use of a high-powered, gas-cooled percutaneous microwave ablation system for the treatment of small renal masses demonstrates safety and technical success in the short term.

CLINICAL RELEVANCE/APPLICATION
Preliminary experience treating renal tumors with a high-powered, gas-cooled microwave system suggests that the procedure is technically feasible, safe, and efficacious at early time points.

VSIO11-10 ● Small Renal Mass (T1a): The Case for Cold Ablation

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques of thorough renal mass cryoablation that produces very low recurrence rates, even for larger central tumors. 2) Understand the appropriate settings to utilize protective techniques (i.e., hydrodissection, balloon interposition, ureteral stent, etc..) for adjacent calyces, bowel and ureter to avoid complications. 3) Identify major imaging follow-up criteria for ablation success and any early failures. 4) Describe the overall cost-efficacy trade-offs for cryo vs. heat-based renal ablations vs. partial nephrectomy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of smaller renal cancers (i.e., T1a, or For safety, cases will be considered for avoidance of direct calyceal puncture, selection of hydrodissection or balloon interposition for bowel protection, and protection of the uretero-pelvic junction by stent placement. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the "1-2 Rule" of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of

VSIO11-11 ● Percutaneous Renal Cryoablation in Obese and Morbidly Obese Patients

Grant D Schmit MD (Presenter) ; **Anil N Kurup** MD ; **Adam J Weisbrod** MD ; **Robert J McDonald** MD, PhD ; **Matthew R Callstrom** MD, PhD * ; **Thomas D Atwell** MD ; **Robert Thompson** MD ; **Stephen Boorjian**

PURPOSE
To compare percutaneous renal cryoablation complications and outcomes in obese and morbidly obese versus nonobese patients.

METHOD AND MATERIALS
389 percutaneous cryoablation procedures were performed in 367 patients for treatment of 421 renal masses at our institution between 2003 and 2012. Patients were categorized into three groups based on body mass index (BMI): nonobese (BMI < 30.0kg/m2), obese (BMI 30.0"39.9kg/m2) and morbidly obese (BMI > 40.0kg/m2). Each group was retrospectively analyzed for major complications (Clavien > Grade 2) and oncologic outcomes.

RESULTS
189 (48.6%) renal cryoablation procedures were performed on nonobese patients, 161 (41.4%) on obese patients and 39 (10.0%) on morbidly obese patients. Eleven (5.8%) major complications occurred in nonobese patients, 15 (9.3%) in obese patients and 3 (7.7%) in morbidly obese patients. As such, there was no significant difference in the rate of major complications in obese (p=0.23) or morbidly obese (p=0.67) compared to nonobese patients. There was one ablation-related death from complications of urosepsis. A total of 13 local treatment failures were identified, including 5 technical failures and 8 local tumor recurrences during median imaging follow-up of 18 months (interquartile range: 8"36). Six (3.2%) local treatment failures occurred in nonobese patients, 5 (2.9%) in obese patients and 2 (4.8%) in morbidly obese patients. Again, no significant difference was noted in local treatment failure rate between obese (p=0.96) or morbidly obese (p=0.57) compared to nonobese patients.

CONCLUSION
Percutaneous renal cryoablation complication rates and outcomes in obese and morbidly obese patients are similar to those in nonobese patients.

CLINICAL RELEVANCE/APPLICATION
To our knowledge, this is the first paper to evaluate percutaneous renal cryoablation complications and outcomes based on patient body mass index (BMI).

VSIO11-12 ● Controversy 3-Biopsy or No Biopsy Before Ablation

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-13 ● Renal Cell Cancer Subtype as a Predictor of Efficacy in Radiofrequency Ablation

Timothy D McClure MD (Presenter) ; **Allan Pantuck** MD ; **James Sayre** PhD ; **Steven S Raman** MD

PURPOSE
To determine if renal cell cancer (RCC) subtype predicts efficacy in the percutaneous radiofrequency ablation (RFA) of RCC.

METHOD AND MATERIALS
With IRB approval we performed a HIPAA compliant retrospective study of patients who underwent RFA for RCC and determined subtype pathology that included clear cell, chromophobe, papillary, oncocytic neoplasm, and RCC not otherwise specified. Pathology was determined by biopsy or post resection surgical pathology. Group comparisons were done using univariate and multivariate logistic regression analysis to determine factors impacting primary efficacy, secondary efficacy, and technique effectiveness. All analyses were done using the statistical software STATA/SE" 11.2. Alpha of 0.05 was considered significant. Technical success, local tumor progression, primary and secondary technique effectiveness were defined per the Working Group of Image Guided Tumor Ablation.

RESULTS
100 pathologically proven RCC masses were identified in 84 patients with the following subtypes: clear cell: 55/100 (55%), oncocytic neoplasms: 19/100 (19%), papillary: 13/100 (13%), RCC not otherwise specified 10/100 (10%), and chromophobe: 3/100 (3%). Median post ablation follow up was up to 106 months (mean 24 months). Non clear cell RCC subtypes had more favorable outcome compared to clear cell RCC for primary, secondary and total technique 44/45(97.8%), 1/45 (2.2%), 45/45 (100%) versus 42/55 (76.4%), 8/55 (14.5%), 50/55 (90.9%) respectively(p=0.002). Overall primary, secondary and total technique effectiveness was 86%, 9%, and 95% respectively.

CONCLUSION
Non-clear cell RCC subtypes have more favorable ablation outcomes compared to clear cell RCC after percutaneous RFA.

CLINICAL RELEVANCE/APPLICATION
Pathology predicts efficacy in the percutaneous RFA of renal masses. Pre-procedure biopsy should be done prior to percutaneous RFA of renal masses to better predict outcomes.

VSIO11-14 ● Biopsy or No Biopsy Before Ablation? Don't Trouble Yourself or the Patient with the Renal Mass Biopsy - Go Ahead and Ablate

Steven S Raman MD (Presenter)

LEARNING OBJECTIVES
1) Understand how to image renal masses prior to ablation. 2) Understand how to use appropriate CT and MR protocols to enable renal mass characterization. 3) Describe the most common CT and MRI enhancement signatures of common RCC subtypes, oncocytoma and lipid poor AML.

ABSTRACT
Characterization of small renal masses has proven challenging. However, with appropriate CT and MR protocols, the majority of these lesions can now be characterized pre procedurally, enabling a confident diagnosis. In this lecture, we will describe renal mass characterization protocols and describe the common imaging signatures of RCC subtypes and their common mimics including lipid poor AML and oncocytoma. This may eliminate need for preprocedural biopsy.

VSIO11-15 ● Biopsy or No Biopsy Before Ablation? Biopsy Every Renal Tumor before Percutaneous Ablation

William W Mayo-Smith MD (Presenter) *

LEARNING OBJECTIVES
1) Explain the expanding role of renal mass biopsy. 2) Explain why biopsy is necessary before all renal tumor ablations. 3) Demonstrate biopsy techniques.

VSIO11-16 ● Emerging Questions in Renal Tumor IR Management

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-17 ● Benign Disease: Leave Alone, Ablate or Suggest Something Else?

S. William Stavropoulos MD (Presenter) *

LEARNING OBJECTIVES

1) Understand and compare treatment alternatives for benign renal masses. 2) Recognize imaging features of benign renal masses that impact treatment alternatives. 3) Understand the risks and benefits of image guided treatment of benign renal masses.

VSIO11-18 • Large Renal Masses (T1b): Does Ablation Have a Seat at the Table?

Thomas D Atwell MD (Presenter)

LEARNING OBJECTIVES
1) Appreciate the strengths and limitations of percutaneous ablation in treating renal tumors measuring larger than 4cm.

ABSTRACT

VSIO11-19 • Outcomes Following Percutaneous Cryoablation of Renal Masses 4.1-7.0cm

Jay J Vlaminck MD (Presenter) ; **Grant D Schmit** MD ; **Anil N Kurup** MD ; **Adam J Weisbrod** MD ; **Matthew R Callstrom** MD, PhD * ; **Thomas D Atwell** MD ; **Stephen Boorjian** ; **Robert Thompson** MD

PURPOSE
To describe safety and oncologic outcomes following percutaneous cryoablation of renal masses measuring 4.1-7.0cm.

METHOD AND MATERIALS
Retrospective review of 71 renal tumors measuring 4.1-7.0cm in 70 consecutive patients treated with percutaneous cryoablation between 2003 and 2011. Local recurrence, cancer-specific survival and overall survival rates were recorded. Complication rates (Clavien Dindo) were also documented.

RESULTS
Mean tumor size was 4.8 cm. A single (1.4%) technical failure was observed at the time of ablation. Of the 58 (82%) tumors that were followed for at least three months, there was a single (1.7%) recurrence. The mean duration of follow-up for the 57 tumors that did not recur was 2.2 years (range 0.3 – 7.1). Estimated recurrence-free survival rates at 1, 3, and 5 years following cryoablation were 97.9%, 97.9%, and 97.9%, respectively.
Among the 58 tumors that were followed for at least three months, 36 (62%) were RCC at biopsy, including the single recurrence. Mean duration of follow-up for the 35 RCC tumors that did not recur was 2.0 years (range 0.3 – 6.1). Estimated recurrence-free survival rates at 1, 3, and 5 years for these biopsy-confirmed RCC tumors were 96.4%, 96.4%, and 96.4%, respectively. Of the 36 (51%) patients with sporadic RCC, estimated cancer-specific survival rates at 1, 3, and 5 years were 100%, 94%, and 94%, respectively. Of the 71 cryoablation procedures, there were 5 (7.0%) complications of grade 3 or greater.

CONCLUSION
Cryoablation represents a safe treatment alternative for patients with renal masses, with intermediate-term oncologic efficacy for T1b tumors.

CLINICAL RELEVANCE/APPLICATION
Outcomes in this study suggest that cryoablation of T1b renal cell carcinoma may be more efficacious than previously considered, particularly when considering the AUA guidelines.

Lung Cancer Screening: How I Do It

Sunday, 02:00 PM - 03:30 PM • E451B

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OI CH

RC101 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC101A • Current Data Summary and Recommendations

Ella A Kazerooni MD (Presenter)

LEARNING OBJECTIVES
1) To understand the current guidelines for lung cancer screening with CT from major professional societies. 2) To learn what the current position is of the U.S. Preventative Services Task Force on screening for lung cancer. 3) To understand options for reimbursement, from self pay to third party payors.

ABSTRACT
Since the results of the NLST were published in 2011, demostrating a 20% reduction in lung cancer specific mortality in high risk current and former smokers, many professional organizations have developed guidelines that recommend screening CT in that same population: 55-74 year olds with a 30 or more pack year history of smoking who ar current smokers or who quit in the last 15 years. Some professional organizations have somewhat controversially extended favorable recommendations to younger and older individuals, and those at moderate risk of developing lung cancer basedon other risk factors. The last words from the US Preventative Task Force on this issue were a non favorable receomnendation in 2004, 'The U.S. Preventive Services Task Force (USPSTF) concludes that the evidence is insufficient to recommend for or against screening asymptomatic persons for lung cancer with either low dose computerized tomography (LDCT), chest x-ray (CXR), sputum cytology, or a combination of these tests' followed by similar lack of endorsement in a 2009 USPSTF publication of making decisions in the setting of 'insufficient evidence.' The latter addressed the question in 4 domains: potential preventable burden, potential harm of the intervention, costs (both monetary and opportunity), and current practice. While an increasing but small number of third party payors cover screening CT today, and nost self pay programs are seeing little uptake of individuals, Medicare has not issued a statement. Like some other organizations, the cost effectiveness analysis may be very important in their decision. Circustances that coudl lead Medicare to cover screening CT for lung cancer if there is a favorable USPSTF recommendation or if federal legislation is passed, similar to what was done with MQSA and breast cancer screening with mammography.

RC101B • Starting a Screening Program

Reginald F Munden MD, DMD (Presenter) *

LEARNING OBJECTIVES
1) Understand important issues to be addressed in planning a lung cancer screening program. 2) Appreciate the need to have a multidisciplinary approach to lung cancer screening. 3) Determine the resources to undertake lung cancer screening program.

ABSTRACT
Launching a lung cancer screening program is not simply a matter of opening the doors and offering low-dose CT to anyone who wishes to be screened. There are many decisions that need to be resolved prior to launching a screening program such as the criteria for screening – NLST, NCCN or one based on previous screening trials. A system of registration, recording and follow-up of patients will need to be established. Other considerations include whether the radiologist is responsible for follow up of patients or whether a physician of record is required. Is self-referral allowed? What about structured reporting? It is extremely important to develop a protocol to manage positive findings for patients that the physicians who will ultimately treat the patient agree upon. This session will discuss many of the fundamental issues related to establishing a lung cancer screening program.

RC101C • Management Strategies for Screen-Detected Nodules

Thomas E Hartman MD (Presenter) *

LEARNING OBJECTIVES
1) Identify imaging findings and tools that can aid in the management of screen detected pulmonary nodules.

ABSTRACT
In order to optimize CT screening for lung cancer, appropriate management of screen detected pulmonary nodules is essential. Various criteria from initial size, attenuation and margin to growth rate on subsequent exams can be used to help stratify risk and determine appropriate management. Evolving computer aided diagnostic applications may improve our ability to manage screen detected nodules.

RC101D • Biopsy of Screen-Detected Nodules

David F Yankelevitz MD (Presenter) *

LEARNING OBJECTIVES
1) To understand indications for biopsy of screen-detected nodules. 2) To develop an approach to optimize small specimen evaluation. 3) To improve communication between the radiologist and the cytologist to optimize diagnosis.

RC101E • Other Findings: What Do I Do?

Caroline Chiles MD (Presenter)

LEARNING OBJECTIVES
1) Suggest management guidelines for incidental findings discovered at the time of lung cancer screening, with special emphasis on COPD, coronary artery disease, and other cancers.

ABSTRACT

Combining In Vitro Diagnostics and Imaging for Integrated Decision Making

Sunday, 02:00 PM - 03:30 PM • S504CD

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OI BQ

RC117 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Sanjiv S Gambhir , MD, PhD *

RC117A • Combining In Vitro and In Vivo Diagnostics for Monitoring Response to Anti-cancer Therapies

Sanjiv S Gambhir MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand biomaker discovery for response to therapy applications. 2) Understand how animal models are used for validating biomarkers. 3) Learn relative advantages of In Vitro vs. In Vivo diagnostics. 4) Understand a specific application in EGFR targeted Lung Cancer Therapy.

RC117B • In-Vivo, Near-Vivo, and On-Vitro Diagnostics: The Overlap

Richard Levenson MD (Presenter) *

LEARNING OBJECTIVES
1) Appreciate the challenges confronting rigorous correlation between pathology and radiology findings and the potential benefit to both disciplines if better, high-resolution correspondences are established, perhaps via machine-learning-based image segmentation tools. 2) Understand the potential that in-vivo microscopy holds for integrating pathology and radiology diagnostic procedures. 3) Learn about virtual autopsy procedures (combined post-mortem CT and tissue sampling) and their role in improving quality control. 4) And possibly hear about new technology that should allow comparison of PET tracer gross anatomic location with cellular-scale imaging (work in progress).

RC117C • Combining In Vivo and In Vitro Diagnostics for Lung Cancer Detection

Viswam S Nair MD (Presenter)

LEARNING OBJECTIVES
1) To understand how blood biomarker integration may improve clinical diagnosis for solitary pulmonary nodules. 2) To understand how circulating tumor cells may be helpful in diagnosing malignant nodules of the lung.

ABSTRACT
Current data from CT screening studies suggest that they improve survival for high risk patients with a lung nodule. Yet, this comes at considerable cost, both to the patient as a result of unnecessary procedures and for the medical system delivering care. Non-invasive circulating biomarkers that augment current clinical diagnostic algorithms provide one solution to these issues. The specific case of circulating tumor cells will be discussed.

Interactive Game: Interactive Quiz Cases in Neuro-oncologic Imaging

Sunday, 02:00 PM - 03:30 PM • E353A

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OI NR

RC118 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
This interactive session will use RSNA Diagnosis Live. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

RC118A • Spine

James C Anderson MD (Presenter)

LEARNING OBJECTIVES
1) Review imaging of tumors of the spine. 2) Identify aspects of spinal tumors that affect staging, treatment and management 3)Highlight roles of various imaging modalities.

ABSTRACT
Review imaging of tumors of the spine Review aspects of spinal tumors that affect staging, treatment and management Review roles of various imaging modalities

RC118B • Head and Neck/ENT

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Review common head and neck tumors. 2) Identify pertinent imaging findings that show how imaging affects staging. 3) Highlight specific imaging findings that will affect staging, treatment and management.

ABSTRACT
Review common tumors of the head and neck Review imaging findings in head and neck malignancies that specifically change staging Review the value of imaging in directly affecting managemement and treatment

RC118C • Brain

Megan K Strother MD (Presenter)

LEARNING OBJECTIVES
1) Identify basic anatomic, pathologic, and physiologic principles as they apply to neuro-oncologic imaging of the brain.

ABSTRACT
Five interactive neuro-oncologic cases will be presented in an interactive format. Participants will review basic knowledge and skills that are relevant to the clinical practice of neuroradiology, while evaluating the results of the latest research in neuro-oncologic imaging.

Radiographic Evaluation of the Post-Radiotherapy Brain

Sunday, 02:00 PM - 03:30 PM • E352

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RO OI NR

RC120 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
John Breneman , MD
Luke E Pater , MD
Mary F Gaskill-Shipley , MD

LEARNING OBJECTIVES

1) Discuss the expected radiographic findings following radiation therapy including radiosurgery. 2) Discuss the occurence of radiation necrosis following radiosurgery including risk factors and imaging findings. 3) Discuss the role of Avastin in the management of gliomas and radiation necrosis. 4) Discuss the phenomena of pseudoprogression including imaging analysis and clinical management.

Extranodal Lymphoma from Head to Toe (In Conjunction with the American Institute for Radiologic Pathology)

Sunday, 02:00 PM - 03:30 PM • S403B

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GN OI

RC124 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Mark D Murphey , MD
Jeffrey R Galvin , MD
Rachel B Lewis , MD
Aletta Ann Frazier , MD
Ellen M Chung , MD
Leonard M Glassman , MD
Kelly K Koeller , MD

LEARNING OBJECTIVES
1) Describe the typical clinical and pathologic features of extranodal lymphoma. 2) Define the characteristic imaging patterns of extranodal lymphoma. 3) Identify the pathologic and imaging manifestations of lymphoma in immunocompromised patients and their variation from lymphoma occurring in immunocompetent individuals. 4) Understand the pathologic basis for the imaging patterns of extranodal lymphoma.
ABSTRACT

Interactive Game: MR Imaging Innovations for the Oncological Practice: Case-based Instruction

Sunday, 02:00 PM - 03:30 PM • S404AB

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OI MR

RC129 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
This interactive session will use RSNA Diagnosis Live. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

RC129A • Whole Body Diffusion-weighted Imaging - Tips, Tricks, and Pitfalls

Dow-Mu Koh MD, FRCR (Presenter)

LEARNING OBJECTIVES
1. Understand the development of whole body diffusion-weighted MRI and its relevance for disease detection, especially in the oncologic practice. 2. Learn how to perform and optimize whole body diffusion-weighted MRI for disease assessment. 3. Recognize common artifacts in whole body diffusion-weighted MRI and how to address these. 4. Review interpretative pitfalls in using whole body diffusion-weighted MRI for disease evaluation.

ABSTRACT
Whole body Diffusion-weighted MRI (WB-DWI) can be applied for disease detection, tumor staging and the assessment of treatment response. With recent MR hardware and technological innovations, the technique can be performed on most current MR system within 30-40 minutes, without the need for intravenous contrast administration. The technique is most robust when performed at 1.5T, as the technique is more sensitive to artefacts that may arise from magnetic field inhomogeneity at 3.0T. Whole body diffusion-weighted MRI is usually acquired with T1-weighted morphological images for disease evaluation. The high contrast of disease against the signal suppressed background produces "at-a-glance" high-b-value images, which aid disease detection and assessment. However, meticulous technique is required to maximize image signal-to-noise and to minimise artifacts. The WB-DWI high b-value images should be interpreted together with the morphological images and apparent diffusion coefficient (ADC) maps. Knowledge of potential interpretive pitfalls is important to avoid mistakes and establish this relatively new modality within the radiologic practice.

RC129B • Whole Body Diffusion MRI - Making Sense of the Bone Marrow

Anwar R Padhani MD (Presenter) *

LEARNING OBJECTIVES
1) To illustrate how whole body; MRI with diffusion can address the limitation of conventional imaging of the bone marrow for bone lesion detection, staging and disease follow-up. 2) To show that appearances of the bone marrow diffusion imaging is related to the cellular content of the bone marrow in health and disease. 3) To demonstrate that lesion conspicuity varies by histological type, tumor grade and that lytic bone deposits are better seen than sclerotic lesions. 4) To discuss false psoitive and negative cases and how to avoid missinterpretations. 5) To inform on the number of patterns that can be seen in progression and with success which are dependent on degree of marrow infiltration, mechanism of action of treatments and underlying response of bone tissue.

ABSTRACT
Accurate assessments of skeletal disease burden and response evaluations of patients with bone metastases are notoriously difficult. Current methods of assessing tumor response at skeletal sites do not always enable the positive assessment of therapeutic benefit to be made but instead provide an evaluation of progression, which then guides therapy decisions in the clinic. Whole body DW imaging (WB-DWI) has emerged as a promising bone marrow assessment tool for detection and therapy monitoring of bone metastases. On WB-DWI, lytic skeletal metastases appear as focal or diffuse areas of high-signal intensity on high b-values on a background of lower signal intensity of the normal bone marrow. Metastasis detection with DWI should be done with anatomical MRI; a recent meta-analysis demonstrated high sensitivity of WB-DWI to detect metastases at the expense of specificity. Causes for false-positive findings on WB-DWI include bone marrow edema caused by fractures, osteoarthritis, infection, bone infarcts, vertebral hemangiomas, isolated bone marrow islands and bone marrow hyperplasia. False-negative findings occur when there are low levels of bone marrow infiltration or when background bone marrow hyperplasia obscures metastases. Detection of skeletal metastases may be impaired in areas of body movement and the visibility of skull vault and base infiltrations are impaired because of the adjacent high signal of the brain. False-negative findings also include treated malignant disease and sclerotic deposits. Both high b-value image signal intensity and ADC value changes are needed for therapeutic assessments. A range of imaging findings can be seen depending on the type of therapy and duration of treatment. Diffusion MRI therapy response criteria need to be developed and tested in prospective studies in order to address current, unmet clinical and pharmaceutical needs for reliable measures of tumor response in metastatic bone disease.

RC129C • MR/PET - Is It Ultimate Cancer Imaging Technique?

Pablo R Ros MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To discuss technical and work flow challenges of MR/PET in Oncologic applications. 2) To demonstarte MR/PET key clinical performance results in Oncologic imaging. 3) To explore the potential of MR/PET for treatment monitoring and predictions of response to therapy.

ABSTRACT
N/A

Hot Topic Session: Therapies for Early Stage I Lung Cancer: Options and Controversies

Monday, 07:15 AM - 08:15 AM • E353A

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RO OI CH

SPSH21 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1

Moderator
Zhongxing Liao , MD
Joseph K Salama , MD
Damian E Dupuy , MD *
Jessica S Donington , MD *

LEARNING OBJECTIVES
1) To understand the role, benefits and risks of stereotactic radiation in the treatment of early-stage lung cancer. 2) To understand interventional oncology and

surgical options in the treatment of early-stage lung cancer. 3) To gain a critical appraisal of all three options and risks and benefits of each for personalized care in challenging patients population with common multi-morbidity.
ABSTRACT
URL

Molecular Imaging Symposium: Preparing for Tomorrow: The Application of Novel and Advanced Imaging in Clinical Oncology

Monday, 08:30 AM - 10:00 AM • S406B

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OI MI BQ

MSMI21 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Ronald L Korn , MD, PhD

MSMI21A • Fluorescence and Optoacoustic Imaging Heads to the Clinics

Vasilis Ntziachristos PhD (Presenter) *

LEARNING OBJECTIVES
1) Learn the technology basics and assess the current state of the art in fluorescence and optoacoustic imaging. 2) Understand the imaging performance achieved and major improvements over past approaches. 3) Learn on how this new-generation imaging performance offers a paradigm shift in optical and clinical imaging. 4) Link the developments described to unique contrast generation in clinical and pre-clinical applications. 5) Gain insights into current clinical pilot studies using these approaches.

MSMI21B • CT Biomarkers and How to Use Them

Kenneth Miles (Presenter) *

LEARNING OBJECTIVES
1) Describe the oncological imaging biomarkers available from CT. 2) Demonstrate knowledge of the processes required for qualification of CT biomarkers in oncological drug development and clinical practice. 3) Compare the applications of CT biomarkers for prognosis, response prediction and response assessment.

ABSTRACT
By measuring size and attenuation with or without contrast material, CT can provide a range of oncological biomarkers including T-stage, RECIST, enhancement, CT perfusion and CT texture analysis. Implementation of these biomarkers requires prior assessments of technical/biological performance and establishment of biomarker performance characteristics. For clinical applications, assessments of therapeutic and health impact are also required. Technical/biological validation includes assessments of test-retest performance and identification of relevant biological correlates. Evaluations of biomarker performance should report cross-validated diagnostic/prognostic thresholds, hazard ratio and biomarker prevalence. Based on these parameters, modelling studies can evaluate the potential therapeutic and health impacts that would result from clinical deployment. Current evidence supporting the use of CT biomarkers in drug development and clinical practice are summarised.

MSMI21C • The Use of Novel PET Tracers. What is in the Pipeline for Approval

Jonathan E McConathy MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the PET tracers in late phase clinical trials for oncologic imaging in terms of their molecular targets and potential clinical indications. 2) Identify the major regulatory and financial challenges encountered during the translation of PET tracers into widespread clinical use. 3) Compare the properties, strengths, and weaknesses of PET tracers for prostate cancer imaging as case studies.

ABSTRACT
Positron emission tomography (PET) with the glucose analogue 2-deoxy-2-[F-18]fluoro-D-glucose (FDG) combined with computed tomography (CT) is currently the workhorse for clinical molecular imaging in oncology. While very successful, FDG-PET/CT has limitations in certain cancers and provides a readout of only one aspect of cancer biology. Novel PET tracers have great promise to improve diagnostic imaging, and a wide range of small molecule, peptide, antibody, and nanoparticle-based PET tracers are in development for oncologic imaging. This presentation will provide an overview of PET tracers in late phase clinical development with an emphasis on mechanism of action and potential clinical indications. Additionally, some of the key challenges to the widespread clinical use of PET tracers including regulatory and financial issues will be reviewed. Finally, several classes of PET tracers for prostate cancer imaging will be discussed in greater depth to illustrate key points.

MSMI21D • Systems Diagnostics - The Future of Diagnostic Medicine?

Michael D Kuo MD (Presenter) *

LEARNING OBJECTIVES
1) To understand systems diagnostics as a new diagnostics paradigm. 2) To explore clinical applications and future directions of systems diagnostics.

BOOST: Head and Neck-Anatomy and Contouring (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • S103AB

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RO OI NR HN

MSRO21 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD

MSRO21A • Anatomy of the Lymph Nodes

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Review the normal anatomy of the lymph ndoes of the neck. 2) Review the radiological anatomy and ladmarks for identifying lymph node groups. 3) Review the primary eschelon draimage patterns of various head and neck subsites.

ABSTRACT
1. Review the normal anatomy of the lymph ndoes of the neck
2. Review the radiological anatomy and ladmarks for identifying lymph node groups
3. Review the primary eschelon draimage patterns of various head and neck subsites

MSRO21B • Current Concepts and Controversies in Contouring and Treatment of Lymph Nodes

Sung Kim MD (Presenter)

LEARNING OBJECTIVES
1) Learn and discuss what lymph node levels are appropriate to target depending on primary site. 2) Discuss the appropriate dose and margins for lymph node coverage.

MSRO21C • Anatomy and Staging of the Brachial Plexus

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Review the normal anatomy of the brachial plexus. 2) Review the pertinent radiologic landmarks that permits accurate contouring of the brachial plexus. 3) Review the common ineoplastic processes of the brachial plexus.

ABSTRACT

This session will be a detailed review normal anatomy of the brachial plexus and focus on the landmarks that help permit accurate contouring of the plexus

MSRO21D ● Current Concepts and Controversies in Contouring the Brachial Plexus

Sung Kim MD (Presenter)

LEARNING OBJECTIVES
1) Discuss a reproducible method for contouring brachial plexus.

BOOST: Gynecology-Anatomy and Contouring (An Interactive Session)

Monday, 08:30 AM - 10:00 AM ● S103CD

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RO OI OB GU

MSRO24 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Beth A Erickson , MD
Paul M Knechtges , MD *
Mark D Hohenwalter , MD

LEARNING OBJECTIVES
1) Review the radiologic features of female gynecologic cancers for both intact and post-operative presentations. 2) Review the radiologic features of female gynecologic cancers before, during and after external beam irradiation and brachytherapy. 3) Review the recommended external beam and brachythreapy contouring guidelines for intact and post operative gynecologic cancer presentations.
ABSTRACT
The treatment of gynecologic cancers with radiation as a component of treatment requires a clear understanding of the imaging characteristics of disease before and after radiation. Knowledge of the patterns of cancer spread , both locally and regionally, is important in designing radiation treatment plans which may include external beam and/or brachytherapy. Proper contouring of radiation targets and organs at risk is essential in developing treatment plans which maximize the benefits and minimize the risks of radiation, both for external beam and brachytherapy. The subsequent follow up of patients with imaging after radiation is also important in helping to identify recurrent disease and complications.Radiation oncologists and radiologists working in collaboration can enhance the care of these patients before, during and after treatment.

Practical Issues in Chest Imaging: Case-based Approach (An Interactive Session)

Monday, 08:30 AM - 10:00 AM ● E353C

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OI CT CH

RC201 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC201A ● Pulmonary Infection

Lacey Washington MD (Presenter)

LEARNING OBJECTIVES
1) Recognize a broad range of potential radiographic findings of acute infection. 2) Recognize clinically relevant features in infection imaging. 3) Recognize findings that are not characteristic of community-acquired pneumonia and that suggest an alternate diagnosis.

RC201B ● Lung Cancer: Hiding in Plain Sight

Eric J Stern MD (Presenter)

LEARNING OBJECTIVES
1) Understand characteristics of missed lung cancers on CXR. 2) Understand how we visually search. 3) Be aware of common observer errors. 4) Know CXR hiding spots. 5) Be aware of some ancillary diagnostic tools.

ABSTRACT
Have you ever missed a lung cancer on CXR? Missed lung cancer is one of most frequent causes for malpractice lawsuits in radiology in USA This lecture:
Focus on detecting smaller cancers -Opportunities for earlier detection
-Potentially better survival?
-Characteristics of missed lung cancers
-Visual searching pitfalls Common Observer errors: -Scanning error
(failing to look at the abnormality)
-Recognition error
(looking at the abnormality but not identifying it)
-Attention error
(distractions)
-Decision making:
identifying abnormality but deciding to ignore it -Satisfaction of search Contributing factors: -Lesion Characteristics
-Density, margins, etc
-Other distractors Eg. Superimposed diseases, artifacts, etc.
-History
-Technical considerations
Recognize common hiding spots Other Diagnostic Tools

RC201C ● Management of Sub-Solid Lung Nodules: How I Do It...

Myrna C Godoy MD, PhD (Presenter)

LEARNING OBJECTIVES
1) To comprehend the new IASLC/ATS/ERS classification of lung adenocarcinomas and its correlation with subsolid nodules. 2) To review the current approach to diagnosis and management of subsolid pulmonary nodules.

ABSTRACT
The term subsolid nodule includes pure ground-glass nodules (GGNs) and part-solid nodules (PSNs), which are mixed ground-glass/solid lesions. Strong correlation has been demonstrated between the histologic findings of lung adenocarcinoma with lepidic growth pattern and the CT appearance of persistent subsolid nodules. Radiologists should be familiar with the new classification of lung adenocarcinoma that has been recently proposed by the International Association for the Study of Lung Cancer, American Thoracic Society and European Respiratory Society. Serial CT imaging has demonstrated stepwise progression of these nodules in a subset of patients, characterized by increase in size and density of GGNs and development of a solid component. Given the slow growth rate of GGNs, standardized guidelines with long-term (= 3 years) CT follow-up have been proposed using low-dose CT technique.

RC201D ● Post-Operative Chest Imaging

Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) To demonstrate the radiologic appearance of expected and unexpected complications of thoracic surgical appearances through a case-based approach. 2) An understanding of the surgical procedures and expected findings will facilitate the recognition of complications. 3) Prompt identification of post-operative complications in a timely and accurate way will improve post-operative morbidity.

Pitfalls In Oncologic Imaging

Monday, 08:30 AM - 10:00 AM • E451A

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OI

RC218 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Describe some common and important missed and mistaken diagnoses in body oncologic imaging with updated information on common problematic boby oncologic imaging findings.
ABSTRACT
Research consistently indicates that there are serious errors in 1.0 to 2.6% of radiology reports, and there is no reason to believe the error rate in body oncologic imaging is substantially different. Accordingly, the recognition of potential pitfalls that may lead to mistakes in diagnosis, especially those that lead to inappropriate management, is of major importance. This course will highlight some of the common and important sources of error, especially those that are not widely appreciated or are newly described.

RC218A ● Neuroradiology

Andrei I Holodny MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

RC218B ● Body Imaging

Fergus V Coakley MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

RC218C ● Musculoskeletal Radiology

David M Panicek MD (Presenter)

LEARNING OBJECTIVES
1) Describe various imaging pitfalls in characterizing soft tissue and bone lesions. 2) Review several post-treatment pitfalls in bones and bone marrow.

ABSTRACT

Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology

Monday, 08:30 AM - 10:00 AM • S104A

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RO OI MI

RC220 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Nina A Mayr , MD
Carryn Anderson , MD
Jinxing Yu , MD
William T Yuh , MD

LEARNING OBJECTIVES
1) To understand challenges in the optimal and timely assessment of tumor response in clinical cancer therapy and in clinical trial testing new therapy regimens. 2) To understand the role and the potential of functional and molecular imaging modalities and techniques used prior, during or after cytotoxic therapy in headandneck, brain, lung, prostate and gynecologic malignancies. 3) To apply and integrate imaging modalities into the therapeutic management of cancer. 4) To review the role of imaging as predictors of tumor control and survival and their emerging role as short-term surrogate markers for long-term therapeutic outcome of cancer treatment regimens and its potential for adaptive therapy.
ABSTRACT

Nuclear Medicine Series: Assessment of Cancer Treatment Response: Updates

Monday, 08:30 AM - 12:00 PM • S505AB

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OI NM

VSNM21 • *AMA PRA Category 1 Credit* ™:3.25 • ARRT Category A+ Credit:3.75
Moderator
Lale Kostakoglu , MD,MPH
Moderator
Terence Z Wong , MD, PhD *

LEARNING OBJECTIVES
1) Important methods used for evaluation of treatment response. 2) Examine important findings on PET CT using FDG PET and other novel tracers to understand how to avoid potential pitfalls. 3) Interpret relevant finding with FDG PET and other PET tracer to evaluate response in tumors. 4) Compare available novel tracers for evaluation of treatment response.
ABSTRACT
The course is designed for nuclear medicine physicians and radiologists involved in the use of PET CT. The audience will gain knowledge on various clinical applications of FDG PET for evaluation of the therapy response in tumors. The audience will become familiar with novel PET tracers and their application for evaluation of the therapy response in tumors. At the end of the course the audience should be able to apply suitable techniques of FDG PET or other novel tracers for evaluation of the therapy response in tumors.

VSNM21-01 ● Response Assessment Recommendations in Hematologic Malignancies

Lale Kostakoglu MD,MPH (Presenter)

LEARNING OBJECTIVES
1) Recognize the strengths of FDG PET Imaging in evaluation of therapy response in lymphoma. 2) Understand the importance of interim evaluation of therapy response. 3) Recognize the weaknesses of FDG PET Imaging in evaluation of therapy response in lymphoma.

ABSTRACT
There remains a need for a valid means to predict the completeness of therapy response and patient outcome, ideally at baseline, or at least early during treatment, to identify a patient subset with a poor-prognosis in whom continuation of ABVD treatment would be ineffective at achieving remission. [18F]-Fluoro-2-Deoxy-D-Glucose positron emission tomography, particularly integrated with computed tomography (PET/CT) imaging yielded promising results as a surrogate for tumour chemosensitivity and response even proving to be a more accurate predictor of prognosis compared with conventional prognostic factors for lymphoma. One of the most relevant hurdles for a full integration of interim PET scan in the overall therapeutic strategy of HL treatment to harness its prognostic value in the daily clinical practice, is the lack of simple, reproducible interpretation rules shared by the medical community. This depends not only on the uncertainty of boundary definition between "weekly" and "frankly" positive scan, but also from the clinical context in which interim PET is planned: for treatment intensification or de-intensification in case of interim positive or negative scan, respectively. It is evident, in fact, that in the first case a very high PPV and specificity are needed, while in the second a very high sensitivity and NPV are essential to avoid under treatment. Various reading schemes have been used however recently more standardized approaches have been adopted. In this session interpretation criteria developed to be used for interim PET studies and also after completion of therapy will be reviewed to emphasize the strengths and weaknesses of PET as a response surrogate.

VSNM21-02 ● Comparative Diagnostic Performance of ¹?F-FDG PET/CT versus Whole-body MRI for Determination of Remission Status in Multiple Myeloma after Stem Cell Transplantation

Christoph Weber MD (Presenter) ; **Silvia Muenster** ; **Kersten Peldschus** MD ; **Peter Bannas** MD ; **Christian R Habermann** MD ; **Nikolaus Kroger** MD, PhD ; **Gerhard B Adam** MD ; **Thorsten Derlin**

PURPOSE
To compare the diagnostic performance of whole-body magnetic resonance imaging (WBMRI) versus (18)F-fluorodeoxyglucose ((18)F-FDG) positron emission

tomography/computed tomography (PET/CT) for determination of remission status in patients with multiple myeloma (MM) after stem cell transplantation (SCT).

METHOD AND MATERIALS
Thirty-one patients were examined by both WBMRI and PET/CT after SCT. Imaging results and clinical remission status as determined by the clinical gold standard (Uniform Response Criteria) were compared.

RESULTS
One hundred four lesions were detected in 21 patients. PET/CT had a sensitivity of 50.0 %, a specificity of 85.7 %, a positive predictive value of 62.5 %, a negative predictive value of 78.3 %, and an overall accuracy of 74.2 % for determination of remission status. MRI had a sensitivity of 80.0 %, a specificity of 38.1 %, a positive predictive value of 38.1 %, a negative predictive value of 80 %, and an overall accuracy of 51.6 %. Concordant results were observed in only 12 (11.5 %) of the 104 lesions.

CONCLUSION
In the post-treatment setting, both FDG PET/CT and WBMRI provide information about the extent of disease, allowing for a more comprehensive evaluation of persisting or recurrent myeloma. MRI may often be false positive because of persistent non-viable lesions. Therefore, PET/CT might be more suitable than MRI for determination of remission status.

CLINICAL RELEVANCE/APPLICATION
PET/CT is the method of choice for an imaging based determination of the remission status in multiple myeloma after stem cell transplantation.

VSNM21-03 ● The PERCIST Assessment of Response to Radioimmunotherapy in Patients with Lymphoma by Measuring a Single, 5 and all Tumor Lesions

Joo Hyun O MD (Presenter) ; **Heather Jacene** MD ; **Jeffrey P Leal** BA ; **Richard L Wahl** MD *

PURPOSE
To determine how well the different PET metrics in PET response criteria in solid tumor (PERCIST) correlate to each other for measuring fractional change before and after radioimmunotherapy.

METHOD AND MATERIALS
Patients with refractory or relapsed non-Hodgkin's lymphoma received Bexxar (n=35) or Zevalin (n=14) therapy. FDG PET/CT studies were obtained before the radioimmunotherapy and 12 weeks after single dose of radioimmunotherapy. Three different PERCIST metrics were measured from the baseline and the post therapy FDG PET studies: 1.) the peak standard uptake value corrected for lean body mass (SULpeak) of the single hottest tumor, 2.) the sum of up to the 5 hottest SULpeaks, and 3.) the total lesion glycolysis (TLG) of the entire tumor burden. The three PET metrics represent measurement of a single, up to the 5 hottest lesions, or the entire tumor burden. The fractional change for each PET metric was computed. (Percent change=[baseline measurement - follow-up measurement] ÷ baseline measurement.)

RESULTS
For patients treated with Bexxar, the percent change in a single SULpeak correlated with the change of up to 5 SULpeaks (r=0.932, p
CONCLUSION
Tracking the single hottest SULpeak before and after radioimmunotherapy shows high correlation with both the analysis of up to the 5 hottest lesions and the entire tumor TLG, both for Bexxar and Zevalin.

CLINICAL RELEVANCE/APPLICATION
Measuring just the one hottest SULpeak may adequately represent the entire tumor burden, saving the time and effort that goes into measuring multiple lesions.

VSNM21-04 ● Role of 18F NaF PET-CT in Tumor Response Assessment of Skeletal Metastasis from Prostate Cancer: A Preliminary Analysis

Bhushan Desai MD (Presenter) ; **Evan Allgood** ; **Steven Cen** PhD ; **Hossein Jadvar** MD, PhD

PURPOSE
Conventional morphologic (CT) and functional (99m Tc-MDP bone scintigraphy) imaging methods for qualitative treatment response assessment of bone metastases have been inaccurate and poses a challenge in routine oncological practice and clinical trials. We hypothesize that bone-specific imaging with 18F NaF PET-CT might address an urgent need to develop an objective method for assessing tumor response in bone lesions which can clinically help physicians determine the effectiveness of systemic therapy.

METHOD AND MATERIALS
Our preliminary analysis included 21 prostate cancer patients who underwent a baseline and a follow-up 18F NaF PET-CT scan. Clinical (treatment), biochemical (PSA) and quantitative imaging (SUVmax) parameters were collected on these patients. Response was assessed using operational Imaging and PSA based treatment response criteria. Percentage change in AVG of SUVmax of all lesions for each patient was compared to changes in PSA and treatment, to assess if these changes correlated and accurately predicted treatment response. Patients were categorized as Progressors (P) vs. Non-Progressors (NP); Responders (R) vs. Non-Responders (NP) and cross-tabulation was done comparing Imaging and PSA-based response criteria.

RESULTS
R vs. NR: 14 of the 21 patients showed concordant response (66.67%). Of the 7 cases which were discordant: 3 were NR by Imaging but R by PSA with a change in treatment after the scan and 4 were R by Imaging but NR by PSA with only 1 patient undergoing change in treatment after the scan. P vs. NP: 7 of the 21 patients showed concordant response (33.34%). Of the 13 cases which were discordant: 5 showed P by Imaging but NP by PSA with a change in treatment after the scan and 8 were NP by Imaging but P by PSA with a change in treatment for only 2 patients.

CONCLUSION
Imaging based criteria captured progressors earlier than PSA and this was well correlated with the corresponding change in therapy post scan. Results of our preliminary analysis demonstrate that semi-quantitative analysis of 18F NaF PET/CT might serve as an important imaging tool for monitoring tumor response in bone lesions. These preliminary findings need to be validated on a larger cohort of subjects and assessed in a variety of tumor types as it might have a major implication in patient management.

CLINICAL RELEVANCE/APPLICATION
18F NaF PET/CT might serve as an important imaging tool for monitoring tumor response in bone lesions.

VSNM21-05 ● Response Assessment Recommendations in Solid Tumors: RECIST vs PERCIST

Heather Jacene MD (Presenter)

LEARNING OBJECTIVES
1) To compare anatomic and metabolic imaging for response assessment in solid tumors. 2) To discuss limitations of current, widely used criteria for assessing response in solid tumors. 3) To discuss the benefits and limitations of metabolic imaging for response assessment in solid tumors.

VSNM21-06 ● RECIST 1.0, PERCIST 1.0 and PSA Treatment Response Criteria in Metastatic Castrate-resistant Prostate Cancer

Hossein Jadvar MD, PhD (Presenter) ; **Bhushan Desai** MD ; **Lingyun Ji** MS ; **Susan Groshen** PhD ; **Chung Y Yu** BS ; **Tanya Dorff** MD ; **Jacek Pinski** MD, PhD ; **Peter S Conti** MD, PhD ; **David I Quinn** MD, PhD

PURPOSE
Many novel therapies are under active evaluation for the treatment of men with metastatic castrate-resistant prostate cancer (CRPC). Anatomic (RECIST1.0), metabolic (PERCIST1.0) and PSA-based (PCWG2) criteria have been proposed for assessing treatment response in this clinical setting. We compared these guidelines in assessment of response to treatment and in relationship to overall survival in men with CRPC.

METHOD AND MATERIALS
47 men with metastatic CRPC underwent FDG PET-CT before and 4-mo after start of new systemic therapy. Baseline and 4-mo data were compared using published operational RECIST 1.0, PERCIST 1.0 and PCWG2 definitions with some modifications. Patients were categorized as Responders (R) vs. Non-Responders (NR) and cross-tabulation was done comparing any 2 response criteria eliminating patients who were not evaluable based on either of 2 criteria in each combination. Association between overall survival and a specific response criteria status was calculated using the Kaplan-Meier method.

RESULTS
Not all 47 patients were evaluable by all 3 criteria. RECIST 1.0 vs. PERCIST 1.0: 28 of 37 evaluable by both with 75.7% concordance and 9 cases discordant; 6 were NR by RECIST 1.0 but R by PERCIST 1.0 with 3 alive and 3 dead after 22 mo; 3 cases were R by RECIST 1.0 but NR by PERCIST 1.0, 2 died within 1.9 mo post 4-mo scan and 1 was alive at 18.1 mo. PCWG2 vs. RECIST1.0: 23 of 39 evaluable by both with 58.9% concordance and 16 cases discordant; 14 were R by PCWG2 but NR by RECIST 1.0 with 9 dead and 5 alive; 2 were NR by PCWG2 but R by RECIST 1.0 and both died within 1.9 m after 4-mo scan. PCWG2 vs. PERCIST 1.0: 31 of 43 evaluable by both PCWG2 and PERCIST 1.0 with 72.1% concordance and 12 cases discordant; 10 were R by PCWG2 but NR by PERCIST 1.0, 6 died and 4 were lost to follow-up, 2 were NR by PCWG2 but R by PERCIST 1.0, 1 died and 1 was alive at last follow-up.

CONCLUSION
PERCIST 1.0 was more concordant than RECIST 1.0 with the PCWG2 response criteria and tended to be better associated with overall survival. PERCIST 1.0 may have a competitive advantage over RECIST 1.0 in the assessment of treatment response in metastatic CRPC (Supported by NIH grants R01-111613 and P30-CA014089; Clinical Trial Registration number NCT00282906)

CLINICAL RELEVANCE/APPLICATION
Use of an appropriate treatment response criteria is pivotal for comparative effectiveness of various current and novel therapies in metastatic prostate cancer.

VSNM21-07 ● FDG PET/CT for Early Response Assessment in Patients (pts) with Advanced Melanoma (MEL) Receiving Immune Checkpoint Blockade

Steve Cho MD (Presenter) * ; **Evan J Lipson** MD ; **Alin Chirindel** MD ; **Suzanne Topalian** MD * ; **Drew M Pardoll** MD, PhD ; **Richard L Wahl** MD *

PURPOSE
Immune checkpoint blockade with anti-CTLA-4 (ipilimumab) prolongs survival in ~20% of pts with advanced MEL, and blockade of the PD-1/PD-L1 pathway induces objective responses in some pts with MEL and other cancers. Traditional CT-based response criteria can be insufficient to measure the activity of these therapies, which can produce delayed or "mixed" tumor regressions preceded by apparent progressive disease (PD). In MEL pts receiving immune checkpoint inhibitors, we compared the ability of FDG PET and CT at 4 and 12 weeks of therapy to predict and evaluate clinical response.

METHOD AND MATERIALS
Ten pts with MEL scheduled for treatment with ipilimumab (8 pts) or anti-PD-L1 (2 pts; BMS-936559) were enrolled. FDG PET/CT was performed at baseline (day -28 to 0) (PET1), and 4 wks (PET2) and 12 wks (PET3) after treatment initiation. The CT portion of the PET/CT was used for conventional restaging with RECIST 1.1 (REC) and WHO criteria. FDG PET was used for quantitative assessment with PERCIST 1.0 (PER). One pt was not able to receive PET3 due to rapid PD.

RESULTS
At PET3, 9/10 pts demonstrated PD by all criteria; one pt with lymph node < 1.5 cm in short axis was not evaluable by REC, but had stable disease (SD) by WHO and complete response (CR) by PER. However, when evaluating only index lesions and excluding new lesions as PD, the response for these cohort of patients showed varying clinical benefit by REC (4 SD), WHO (3 SD, 1 partial response (PR)), or PER (1 CR, 1 PR, 2 SD). 8/9 pts had increased tumor FDG uptake at PET2 (7.8% to 211% increase from baseline) of whom 2 had CR or PR on PET3 (100% and 49% decrease from baseline). 1/9 pts had decreased tumor FDG uptake at PET2 (28% decrease from baseline). We observed a pattern of increased tumor FDG uptake and dimensions at PET2 with subsequent improvement by PET3, suggesting the presence of tumor inflammation (anti-tumor immune response) on PET2.

CONCLUSION
Increased tumor FDG uptake at 4 weeks (PET2) may indicate inflammation preceding lesional response, or actual tumor progression. These preliminary data suggest that early increased FDG uptake may be necessary but not sufficient for tumor regression in pts receiving immune checkpoint blockade, requiring validation in larger trials.

CLINICAL RELEVANCE/APPLICATION
Combined FDG PET/CT using an early 4 week and standard 16 week time-point may be used predict melanoma response assessment to immune checkpoint blockade therapy.

VSNM21-08 ● The Clinical Value of FDG PET/CT in Assessing Therapeutic Efficacy of Non-surgical Ablation Therapy for Radioiodine-negative Recurrent or Metastatic Thyroid Cancer

Kunihiro Nakada (Presenter) ; **Hiroki Sugie** MD ; **Keiichi Kamijo** MD, PhD ; **Masayuki Sakurai**

PURPOSE
Percutaneous ethanol injection (PEI) and radiofrequency ablation (RFA) serve as feasible options for local control of radioiodine-ineffective thyroid cancer after surgery. The purpose of the study was to determine clinical value of PET/ CT using F-18 fluorodeoxyglucose (FDG) in assessing therapeutic efficacy of PEI or RFA for radioiodine" negative metastatic thyroid cancer.

METHOD AND MATERIALS
The study consists of 108 metastatic tumors from thyroid cancer (100 metastatic nodes in the neck or mediastinum and 8 metastatic bone tumors) in 76 patients (PCA/FCA 68/8) who had underwent total thyroidectomy and radioiodine ablation. All patients received high dose I-131 therapy. However, I-131 uptake in the metastatic tumor on the post-therapy scan was no or equivocal. Additionally, patients had reluctance to further surgery or were at high risk for surgery due to other complications. Patients underwent FDG PET/CT within 2mos. prior to and between 1 and 2 mos. post completion of ablation therapy. FDG uptake in the tumor was visually assessed as positive or negative. Patients were followed up for 14-66mos. (median 31) to investigate clinical course of the treated tumors. Efficacy of PEI or RFA was determined based upon RECIST 1.1. Achievement of CR or PR was considered as successful.

RESULTS
On the pre-treatment PET/CT, all 109 tumors were FDG positive. Then 99 were treated by PEI while 9 were treated by RFA. On the post-treatment PET/CT, FDG uptake was negative in 76 (70%) and was persistently positive in the remaining 33 (30%). In the FDG negative tumors, CR and PR were observed in 55 and 20, respectively. Regrowth of the tumor was seen in 8 (11%). In the FDG positive tumors, PR were seen in 13 while remaining 20 showed SD. Regrowth of the tumor was seen in 15 (45%). The PPV, NPV and accuracy of FDG PET/CT for successful outcome of ablative therapy were 99%,61% and 88%.

CONCLUSION
Almost all tumors with negative FDG uptake after treatment showed good response. In contrast, tumors with persistent FDG uptake were associated with poorer response and the risk of tumor regrowth was 4 times higher than that in FDG negative tumors. FDG PET seems valuable in assessing efficacy of non-surgical ablation therapy for metastatic thyroid cancer.

CLINICAL RELEVANCE/APPLICATION
Application of FDG PET/CT may enhance clinical value of non-surgical ablation therapy and may improve management of radioiodine-negative metastatic thyroid cancer.

VSNM21-09 ● Response Assessment Recommendations after Radiation Therapy

Terence Z Wong MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the physiology of normal tissue response to radiation therapy. 2) Understand potential limitations of PET/CT imaging following radiation therapy. 3) Suggest potential strategies for evaluating patients following radiation therapy.

ABSTRACT
FDG-PET/CT imaging following radiation therapy can be complicated, due to the resulting inflammatory response. These post-radiation effects can mimic residual or recurrent tumor, and may preclude accurate determination of response to therapy. The extent to which radiation therapy effects influences interpretation of PET/CT scans is highly dependent on the organ site and time-dependent normal tissue response. Armed with this knowledge, it is often possible to distinguish radiation changes from tumor. Several strategies are available to improve accuracy of post-treatment PET/CT. Waiting for several months following radiation therapy allows the inflammatory response to subside. Alternatively, imaging early in the course of radiation therapy may allow response to be evaluated before the inflammatory response occurs. Alternative PET tracers, such as F-18 fluorothymidine as a marker of cell proliferation, may be less affected by the inflammatory reaction. Therapeutic strategies can be designed to minimize the impact of radiation effects; for example chemotherapy can be initiated prior to combined chemoradiation, allowing PET/CT to measure the response to the chemotherapy prior to starting radiation therapy.

VSNM21-10 ● Early Assessment of Therapeutic Response of Radioimmunotherapy (RIT) in Non-Hodgkin Lymphoma: Comparing Tumor Volume Reduction and Metabolic PET Measurements in Prediction of Progression Free Survival (PFS)

Ehab H Youssef MD, FRCR (Presenter) ; **Yuni K Dewaraja** PhD ; **Hatice Savas** MD ; **Matthew Schipper** ; **Shen Jincheng** ; **Mark S Kaminski** * ; **Anca Avram** MD

PURPOSE
To evaluate if initial tumor volume reduction and metabolic response predicts progression free survival (PFS) in patients with advanced follicular non-Hodgkin lymphoma (NHL) receiving 131-I Tositumomab therapeutic regimen.
Tumor volumes were measured on CT component of SPECT/CT (at 6 days and 2 weeks), and of PET/CT at 2 months post-RIT; qualitative metabolic response (defined as positive or negative "complete metabolic response" for disease) was assessed on PET/CT at 2 months post-RIT. Clinical and imaging follow-up was continued for all patients until they progress 1-51.5 months (average 9.3).

METHOD AND MATERIALS
A group of 53 patients (37 males, 16 females), with advanced (stage III or stage IV) chemotherapy-refractory follicular B-cell lymphoma, aged 33-81 years (median age 54) received 131-I Tositumomab therapy based on whole body dosimetry calculations with the goal of delivering 75 cGy whole body radiation absorbed dose for patients with platelets > 150.000/mL, or 65Gy for patients with platelets
RESULTS

51 patients (96%) had tumor shrinkage, 26 of them (49%) had =30% shrinkage in 2 weeks, and 25 (47%) had = 73% shrinkage at 2 months. Statistically significant correlation between progression free survival (PFS) and tumor volume reduction of =30% on CT portion of SPECT-CT (at 2 weeks) and = 73% on PET-CT (at 2 months) was observed (p= 0.0013), and (p< 0.0001) respectively.
Statistically significant correlation between PFS and complete metabolic tumor response on post-therapy PET-CT (2 months) (p< 0.0001) was observed.

CONCLUSION
Initial tumor volume reduction and complete metabolic response (in PET) can be used to predict PFS, hence can potentially be used to customize future treatment protocols for NHL patients.

CLINICAL RELEVANCE/APPLICATION
Initial tumor volume reduction and complete metabolic response (in PET) can be used to predict PFS, hence can potentially be used to customize future treatment protocols for NHL patients.

VSNM21-11 ● 18F-fluorodeoxyglucose Positron Emission Tomography (PET) Response to Stereotactic Body Radiotherapy (SBRT) in Metastatic Melanoma

Miran J Blanchard MD (Presenter) ; **Zachary C Wilson** MD ; **Brandon M Barney** MD ; **Gregory Wiseman** ; **Kenneth R Olivier** MD ; **Sean S Park** MD, PhD ; **Svetomir Markovic** MD, PhD

PURPOSE
We report our SBRT experience for extracranial melanoma metastases to objectively characterize the PET metabolic response.

METHOD AND MATERIALS
32 metastatic melanoma patients (pts) treated with SBRT with baseline and post-SBRT PETs were identified in our prospectively maintained database from 2008 to August 2011. PET metabolic response was evaluated per PERCIST 1.0 criteria: Complete response (CR) was a decrease in the maximum standard uptake value corrected for lean body mass (SUL) to 1.5 times the liver mean + 2 standard deviations, partial response (PR) was a 30% decrease in SUL, progressive disease (PD) was> 30% increase in SUL and stable disease (SD) was any lesion not fitting these criteria. Local control (LC) included CR, PR, and SD.

RESULTS
57 lesions treated with SBRT and 174 pre- and post-SBRT PET scans were analyzed. Median follow-up (f/u) was 1.6 years. Sites of treated lesions were: 15 musculoskeletal, 14 liver, 14 lung, 12 abdominal, 2 extra abdominal lymph nodes. Median single-fraction equivalent dose (SFED) was 43 Gy (range 18-56 Gy). A median of 5 PET scans (range 2-6) were evaluated for each lesion. LC was 92% and 87% and overall survival was 59% and 29% at 1.5 and 3 years, respectively. Median time to CR was 2.8 months (0.7-15 months). CR was achieved in 49 lesions (86%), and 44 lesions maintained CR at last f/u. Median f/u for lesions in continuous CR was 18 months (0.9-36.5). PR, SD, and PD were 9%, 4%, and 10%, respectively. SFED = 24 Gy correlated with PD (HR 17, p=0.01). At initial f/u (median 2 months), CR was 60%, and 9 lesions (16%) had increased SUL. These 9 lesions resolved to 6 CR, 1 SD, and 2 PD with subsequent f/u. One patient is alive with no evidence of disease (NED) and one patient with NED died of other causes. Three patients had NED on PET and died suddenly of CNS metastasis. 28% developed CNS metastases at a median of 5 months (0.2-32 months) after SBRT.

CONCLUSION
SBRT is highly effective in inducing a complete metabolic response in melanoma. A SFED of > 24 Gy has been validated as a predictor of lesion control. 16% of lesions had a SUL rise at initial f/u with the majority subsequently achieving CR with no additional local therapy. Three pts with NED on PET died suddenly of brain metastases. Screening brain MRI prior to SBRT for oligometastatic melanoma should be considered.

CLINICAL RELEVANCE/APPLICATION
SBRT leads to a high rate of complete metabolic response in metastatic melanoma.

VSNM21-12 ● Cu-ATSM Uptake May Predict Prognosis after Treatment in Advanced Head-and-Neck Cancers: Evaluation of Resistant Hypoxic Tissue with Tumor-to-Muscle Ratio

Yoshitaka Sato MD ; **Myungmi Oh** MD, PhD ; **Tetsuya Mori** PhD ; **Yasushi Kiyono** PhD ; **Shigeharu Fujieda** MD, PhD ; **Hidehiko Okazawa** MD, PhD (Presenter)

PURPOSE
To delineate hypoxic tissue in head-neck cancers, [^{62}Cu]diacetyl-bis(N^4-methlythiosemicarbazone) (Cu-ATSM) PET was employed and tracer distribution was compared with [^{18}F]fluorodeoxyglucose (FDG). Predictability of effectiveness of tumor treatment was compared between the 2 tracers.

METHOD AND MATERIALS
Thirty patients with head-and-neck cancer (mean age: 67 ± 13 y.o.) underwent Cu-ATSM-PET and FDG-PET/CT within a week interval. For Cu-ATSM PET images, 20-min dynamic data acquisition was performed after 600-800 MBq tracer injection, and 10 to 20 min data were used for analysis. After co-registration of Cu-ATSM-PET and FDG-PET/CT images, region of interest (ROI) was placed on the tumour mass using the threshold of 40% of maximum value for each PET image to obtain standardized uptake values (SUV) and maximum SUV (SUV_{max}) of each tumour. SUV values of the muscles in the head-and-neck region were also obtained and tumour-to-muscle (T/M) ratio for each tracer was calculated. Patients were followed up at least 6 months after the treatment by using CT, MRI or FDG-PET/CT, and progression-free survival (PFS) period was compared using Kaplan-Meier Logrank analysis. The end-point of the follow-up for PFS was set at the time of recurrence or metastasis of the cancer. Relationships between PET parameters and PFS period were analyzed to assess which was the most appropriate parameter to predict prognosis of head-and-neck cancers.

RESULTS
Twenty-eight of the patients received chemoradiation therapy and 2 underwent surgical treatment only. The mean PFS period was 12.6 ± 9.5 months, and 14 patients showed recurrence or metastasis. Patients were divided into 2 groups of higher and lower uptake of tracers using SUV_{max} and T/M ratio. Threshold was determined by ROC analysis for each PET parameter, and PFS was compared between the 2 groups. The patient groups determined by the T/M ratio of Cu-ATSM showed significantly different PFS; i.e. higher T/M ratio showed poor PFS compared with the lower T/M ratio group. Other PET parameters did not show significant difference in PFS.

CONCLUSION
The high Cu-ATSM T/M ratios predicted the poor prognosis after treatment in patients with head-and-neck cancer. SUV_{max} and FDG-T/M ratio were not good indicators of prognosis after the cancer treatment.

CLINICAL RELEVANCE/APPLICATION
Cu-ATSM PET is expected to be useful for detection of resistant malignant tumours.

Molecular Imaging Symposium: Radiogenomics - The Next Logical Step in 'Rad-Path' Correlation for Clinical Imaging?

Monday, 10:30 AM - 12:00 PM ● S406B

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OI MI

MSMI22 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
King C Li , MD

MSMI22A ● Radiogenomics: Merging Molecular Diagnostics and Clinical Imaging in Cancer

Michael D Kuo MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the fundamental concepts behind radiogenomics. 2) To explore the current and evolving landscape of radiogenomics. 3) To understand how radiogenomics can be implemented in current clinical practice.

MSMI22B ● Linking Molecular and Imaging Data in Lung Cancer

Olivier Gevaert PhD (Presenter)

LEARNING OBJECTIVES
1) Learn how image features are defined and extracted from non small cell lung cancer CT and PET images. 2) Learn the complexity and dimensionality reduction of gene expression data. 3) Learn how to correlate image features with gene expression data and establishing a radiogenomics map.

ABSTRACT
Radiogenomics is an emerging field that attempts to correlate and integrate radiological information from medical images and molecular data from tissue. Typically medical image features are extracted from a wide range of imaging modalities such as MRI, CT or PET images. Similarly, recent developments in

molecular technologies have unleashed a myriad of technologies to produce diverse biological data types such as gene expression, microRNA expression, DNA methylation, and DNA mutation data. Radiogenomics is defined as the integration of these two developments. We demonstrate our approach on non-small cell lung carcinoma patients for whom CT, PET/CT and gene expression data were obtained. We extracted 149 computational features, 30 semantic features and PET-SUV from the imaging data. The microarray data was processed using an advanced clustering algorithm and 56 high quality clusters were represented using metagenes. We found several though provoking associations between imaging features and metagenes. 115 of 180 image features were predicted by a sparse regression on 56 metagenes with an accuracy of 65-86%. After mapping the predicted image features to a public gene expression dataset, we found 26 image features were significantly associated with recurrence-free survival and 22 with overall survival. A multivariate survival analysis identified prognostic image features independent of clinical covariates. Our results show that we have developed a method that can be used as a non-invasive way for rapid prognostic assessment of imaging. This motivates investing in larger studies that collect and store medical images and tissue of the same patients in NSCLC and other diseases such that our method can be used to assess immediately the prognostic relationship of new imaging biomarkers or technologies without the need for follow-up data. Our bioinformatics strategy for identifying imaging biomarkers may be most relevant to the clinical evaluation of emerging and evolving

MSMI22C ● A Radiogenomic Analysis of the TCGA Glioma Data Set

David Gutman MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand how to access large public data sets with imaging, genomics, and clinical data available. 2) Learn the steps involved in generating a controlled vocabulary to describe and annotate imaging data sets. 3) Review of current findings in associating MRI features with patient outcome and genomic profile. 4) Become familiar with 2-D and 3-D volumetric methods to extract quantitative features to describe tumors.

BOOST: Gynecology-Integrated Science and Practice (ISP) Session

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MSRO25 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Nina A Mayr , MD
Moderator
Manjeet Chadha , MD

MSRO25-01 ● Invited Speaker:
Susan A Higgins MD (Presenter)

MSRO25-02 ● A First Report on GYN Permanent Seed Implant with CS-131
Wei Luo (Presenter) ; **Janelle A Molloy** PhD ; **Prakash Aryal** ; **Marcus E Randall** MD

MSRO25-03 ● Serum MicroRNA Expression as Predictive Biomarker of Outcome in Patients with Locally Advanced Cervical Cancer after Chemoradiotherapy

Yoko Harima MD, PhD (Presenter) ; **Koshi Ikeda** MD, PhD ; **Keita Utsunomiya** MD, PhD ; **Atsushi Komemushi** MD, PhD ; **Shohei Kanno** MD ; **Toshiko Shiga** ; **Noboru Tanigawa** MD

PURPOSE
To identify microRNAs (miRNAs) that correlate with clinical outcome in patients with locally advanced cervical cancer after chemoradiotherapy.

METHOD AND MATERIALS
This study included a total of 81 patients with locally advanced squamous cell cervical cancer who underwent definitive chemoradiotherapy between February 2006 and September 2011. We compared the expression level of miRNAs in 45 no evidence of disease [NED] and 36 cancer-caused death [CD] patients serum before treatment using miRCURY LNA ™ Universal RT microRNA PCR. The amplification was performed in a LightCycler 480 Real-Time PCR System (Roche) in 384 well plates. The raw data was extracted from the Lightcycler 480 software. Data was internally calibrated by UniSp3 IPC using GenEx software (ver.5). The significance of the expression differences between the NED group and the CD group was evaluated using t-test. The endpoint was correlation between patient characteristics and disease-free and overall survival rates determined by multivariate Cox proportional-hazard model analysis.

RESULTS
Among 384 miRNAs analyzed, miR-214* was most significantly overexpressed in the NED group than in the CD group (p=0.03), whereas miR-493* was most significantly overexpressed in the CD group than in the NED group (p=0.03). The results of multivariate analysis showed that miR-214* is a significant predictor of disease-free survival [RR=2.01, p=0.03], while miR-493* is a significant predictor of poor overall survival [RR=1.32, p=0.02].

CONCLUSION
Two miRNAs identified in this study, miR-214* and miR-439* can be used as prognostic biomarker to improve clinical strategies for treatment of locally advanced cervical cancer after chemoradiotherapy.

CLINICAL RELEVANCE/APPLICATION
Two miRNAs identified in this study, miR-214* and miR-439* can be used as prognostic biomarker to improve clinical strategies for treatment of advanced cervical cancer after chemoradiotherapy.

MSRO25-04 ● Stepwise Implementation of Imaging Changes for Cervical Cancer Brachytherapy Planning Using Existing Infrastructure: A Multidisciplinary Approach to Advancing Patient Care

Theodora A Koulis MD (Presenter) ; **Derek W Brown** ; **Deepak Bhayana** MD ; **Laurel Traptow** ; **Karen Long** ; **Maree Patrick** ; **Gregg Nelson** ; **Peter Craighead** ; **Corinne Doll** ; **Tien Phan** MD

ABSTRACT
Purpose/Objective(s): In 2005 the GEC-ESTRO group published recommendations on 3D planning for cervical cancer brachytherapy (BT) using MR image guidance as the new standard of care. There are many resource and infrastructure constraints that can hinder the mainstream implementation of new technologies. The objectives of this report are to describe the process of transition from 2D to 3D-based planning for cervical cancer BT at our centre, to highlight some of the challenges we encountered, and to describe the solutions and process maps that we developed.
Materials/Methods: A step-wise method was devised to transition from orthogonal x-ray (2D) planning to 3D-based planning of cervical cancer BT using existing infrastructure. First we identified the departments and personnel that would be affected by this change in practice and formed a working group consisting of radiation oncologists, gynaecologic oncologists, medical physicists, RT treatment planners, nursing staff, a radiologist, RT manager, and simulator staff. Possible challenges and strategies were mapped out in a CT-HDR Prospective Risk Analysis. After review and approval from all members of the group, an in-house, ethics-approved protocol was developed: both 2D images and CT images were acquired with the BT apparatus in situ. Feedback was monitored and updates were made to the process map to improve safety and efficiency. An MR-HDR Prospective Risk Analysis was then developed focusing on the logistics of patient transfer from the OR to MR department and subsequent BT treatment. Phantom studies were performed to ensure equipment safety and appropriateness of scanning protocols.
Results: Starting in April 2009, 5 patients were treated on the study protocol. Subsequent patients were planned with CT, but concurrent x-ray images provided verification for dose calculations. Since November 2010, CT-based planning has been used exclusively. Transition to MR-based planning began in February 2012. In August 2012, a "dry-run" of the MRI process map was undertaken before proceeding with our first MRI-guided BT patient in September 2012. Currently a combination of MRI and CT images are used for planning.
Conclusions: Using a stepwise approach it is possible to implement a 3D-based cervical cancer BT planning program utilizing resources of existing infrastructure. Achieving the recommended guidelines requires a multidisciplinary approach, and appropriate prospective risk analysis. Our program is still under development, but our experiences thus far may serve as a reference tool for other centres that are considering a switch to 3D-based planning of cervical cancer BT.

MSRO25-05 ● Does “A? of Point A Mean to Be Avoided in Image Guided Brachytherapy?
Zhanrong Gao ; **Yana Goldberg** (Presenter) ; **James R Wong** MD ; **Mei Li** MS ; **J. Emmolo** ; **Paul Heller** ; **D. Tobias** ; **N. Tchabo** ; **B. Slomovitz**

MSRO25-06 ● A Preliminary Data on Image Based Intracavitary Brachytherapy for Cervical Cancer: Point A Plan and CTV Based Plan

Joanna Athel Embestro-Rodriguez MD (Presenter) ; **Jake John Galingana** MSc ; **Anthony Albert Abad** MD ; **Lilian B Rodriguez** MSc ; **Miriam Joy Calaguas** ; **Teodoro Ramos** RT

ABSTRACT
Purpose/Objective(s):
The main objectives of this study are to determine the three dimensional dose volume parameters for a Point A plan and a CTV-based plan and to compare these values using statistical tools.
Materials/Methods:
A total of 22 cases of cervical cancer who were subjected to CT-based Intracavitary Brachytherapy were enrolled in this retrospective study. After the DICOM files were loaded, the critical organs (i.e. bladder and rectum) and target volume were delineated. Treatment planning was undertaken using 2 methods: (1) Manchester of Patterson and Parker and (2) optimization of radiation dose to assigned calculation points which highly depends on the target volume. A prescribed dose of 7 Gy was used for the two methods. 44 plans were generated using the Oncentra version 4 treatment planning system. Patients were divided according to the total volume of the CTV. Patients with CTV less than or equal to 100 cm3 were assigned as Group 1, those with more than 100 cm3 were assigned as Group 2. The following 3D dose volume parameters were determined using relative and absolute values from graph of the plotted DVH: Coverage Index, V100 of the CTV, D90 of the CTV and D2cc of the bladder and rectum.
Results:
With regards to the dose volume parameters evaluated in this study, all mean values generated from all cases were higher when CTV based planning was done rather than Point A based planning. But the results generated were only significant for those that belong in Group 2 or those having a large CTV (> 100cm3). This shows a better coverage of the target volume in terms of the D90, V100 and Coverage Index which can be correlated with an increase in terms of the success of treatment outcome for the CTV based planning. But for the organs at risk, namely the bladder and rectum, having higher radiation doses can result to increase risk of early and late complications
Conclusions: The evidence of this study showed that CTV based treatment planning has more advantage compared to Point A planning if implemented in a CT-based brachytherapy because the method depends highly on the anatomy of the patient (i.e. patient specific). But the organs at risk must be considered in the evaluation of the plan because of the tendency of over dosing the bladder and rectum specially when dealing with a large cervix (> 100cm3). Thus, the dose to the target volume and organs at risk must be noted and be optimized to be able to meet the goals of brachytherapy treatment.

MSRO25-07 ● Treatment Outcome and Prognostic Factors of Concurrent Chemoradiotherapy with Nedaplatin for FIGO Stage IB-IVA Carcinoma of the Cervix Uteri

Fujiwara Masateru MD (Presenter) ; **Isohashi Fumiaki** ; **Yoshioka Yasuo** ; **Mabuchi Seiji** ; **Kimura Tadashi** ; **Ogawa Kazuhiko**

PURPOSE
Concurrent chemoradiotherapy (CCRT) with cisplatin is, at present, a common method of treatments for carcinoma of the cervix uteri, but CCRT with nedaplatin is uncommon. The purpose of this retrospective study was to evaluate the efficacy and safety of CCRT with nedaplatin and analyze prognostic factors for survival among patients with FIGO stage IB-IVA carcinoma of the cervix uteri.

METHOD AND MATERIALS
We retrospectively reviewed the medical records of 55 patients with FIGO stage IB-IVA carcinoma of the cervix uteri treated with CCRT using nedaplatin 35 mg / m 2 weekly from 2000 and 2009. The treatment consisted of external beam radiotherapy 46.5-66 Gy (in 24-33 fractions) followed by 13.6-28.8 Gy (in 2-4 fractions) of high-dose-rate intracavitary brachytherapy (ICBT) or 34-35 Gy (in 4 fractions) of medium-dose-rate ICBT. Overall survival (OS) and progression-free survival (PFS) were estimated by the Kaplan-Meier method. The Cox proportional hazard model was used for multivariate analysis. Acute and late toxicities were evaluated by CTCAE ver.4.

RESULTS
The median follow-up was 48 months (range 3-121 months). The median age was 62 years old (range 25-73 years old). The 5-year OS and PFS were 78.9 and 55.6 %, respectively. The 5-year local control was 71.6 %. Multivariate analysis showed that histologic type (adenoma / squamous cell carcinoma), regional lymph node metastases, maximum diameter of the tumor and pretreatment hemoglobin level were independent risk factors for PFS, (hazard ratio (HR) 3.40, 95% confidence interval (95%CI)1.03-9.81), (HR 2.89, 95%CI 1.12-7.72), (HR 1.42, 95%CI 1.11-1.79) and (HR 0.63, 95%CI 0.46-0.85), respectively. In terms of adverse effects, 27 patients (49.1 %) had acute grade 3-4 leukopenia. Seven patients (12.7 %) had late grade 3 intestinal complications. There was no renal toxicity during CCRT.

CONCLUSION
Our data showed that the CCRT with nedaplatin for FIGO stage IB-IVA carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity. Histologic type, lymph node metastases, maximum diameter of tumor and pretreatment hemoglobin level were statistically significant prognostic factors.

CLINICAL RELEVANCE/APPLICATION
Chemoradiotherapy with nedaplatin for carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity.

MSRO25-08 ● Single vs. Individual Vaginal Cuff Brachytherapy Planning. Rectal Dose Results from a Rigid/Deformable Registration

Sebastia Sabater (Presenter) ; **Ignacio Andres** ; **Sevillano M Mar** ; **Roberto Berenguer** ; **Santiago Machin-Hamalainen** ; **Meritxell Arenas**

ABSTRACT
Purpose: Debate exists about the need of a CT plan for every fraction vs. the use only the first fraction plan for the overall treatment. Our aim was to investigate the relevance of individual CT-based planning for high-dose rate vaginal cylinder brachytherapy vs. a single fraction CT-based planning using rigid/deformable registration and dose warping.
Materials and methods: Ten patients underwent 5 CT-studies, before each vaginal cylinder brachytherapy fraction. All images were re-segmented and re-planed under the same parameters. Rigid and bspline registration were carried out using the first CT-study as the fixed set, and doses were warped. Three dose accumulation scenarios were studied: (1) multiplying the treatment plan metrics and the number of fractions; (2) summing the first dose fraction with the rigid warped doses; (3) summing the first dose fraction with the deformed doses. Each scenario was evaluated for 3 and 5 fractions. Dose volume histogram (DVH) metrics (mean dose, D0.1cc, D1cc, D2cc and D5cc) of rectum were collected and compared according to the dose accumulation scenario. To study if the number of fractions could have an impact the DVH metrics were re-escaled to maximum dose and normalized to the overall treatment dose. Paired non-parametrical tests were performed (Friedman and Wilcoxon signed-rank test).
Results: Median values and the variation percentage related to the multiplying scenario are shown in table 1a. Dose metric values and median percentage variation were small (table 1a).Non significant differences were seen according to the number of fractions and type of registration, after normalization to the overall dose (table 1b).

A							**B**	**Normalized doses (%)**	
		Median			**%**				
		Multiply	**Rigid**	**Deformable**	**Rigid**	**Deformable**		**Rigid**	**Deformable**
3fx	**DMean**	0,81	0,85	0,77	6,51	7,70		5,64	5,12
	D0.1	5,12	5,50	5,16	-4,48	0,35		36,63	34,37
	D1	4,13	4,17	4,16	-2,05	0,68		27,77	27,70
	D2	3,74	3,69	3,71	-1,80	0,80		24,57	24,70
	D5	3,02	2,96	3,025	-0,66	2,00		19,70	20,17
5fx	**DMean**	1,34	1,42	1,43	2,35	7,05		5,66	5,70
	D0.1	8,53	9,45	8,94	13,26	-0,11		37,78	35,74
	D1	6,88	7,11	7,29	-6,69	2,45		28,42	29,14
	D2	6,23	6,45	6,48	-4,26	2,64		25,80	25,90

	D5	5,03	4,82	5,08	-1,77	1,41	19,26	20,30

Conclusions: Data show small and non significant differences on rectal DVH metrics using rigid/deformable registration and dose warp compared to the simple dose multiplication; nevertheless they could be irrelevant from a clinical point of view.

ISP: Chest (Lung Nodule/Screening)

Monday, 10:30 AM - 12:00 PM • S404AB

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SSC04 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
James G Ravenel , MD
Moderator
Alexander A Bankier , MD, PhD *

SSC04-01 • Chest Keynote Speaker
James G Ravenel MD (Presenter)

SSC04-02 • Lung Cancer Probability in Subjects with CT-detected Pulmonary Nodules

Nanda Horeweg MD (Presenter) ; **Joost Van Rosmalen** PhD ; **Marjolein A Heuvelmans** BSc ; **Carlijn Van Der Aalst** PhD ; **Harry De Koning** * ; **Matthys Oudkerk** MD, PhD ; **Rozemarijn Vliegenthart** MD, PhD ; **Ernst T Scholten** MD ; **Kristiaan Nackaerts** MD, PhD * ; **Jan-Willem J Lammers** MD, PhD ; **Harry Groen** ; **Carla Weenink** MD, PhD ; **Erik Thunnissen** MD, PhD ; **Peter M Van Ooijen** ; **Willem P Mali** MD, PhD

PURPOSE
The main challenge in computed tomography (CT) screening for lung cancer is the high prevalence of pulmonary nodules and the relatively low incidence of lung cancer. Thresholds for nodule size and growth rate, which determine which nodules require additional diagnostic measures, should be based on the lung cancer probability of the individual.

METHOD AND MATERIALS
The diameter, volume and volume-doubling time (VDT) of 9,681 non-calcified nodules detected in 7,135 participants in the Dutch-Belgian lung cancer screening trial were used to quantify their lung cancer probability. Complete coverage on all lung cancer diagnoses was obtained by linkages with the national cancer registry, for a follow-up of eight years. The probabilities were used to propose and evaluate optimized thresholds for CT-detected nodules.

RESULTS
Lung cancer probability was low in subjects with a nodule volume 600days, 4.0% for VDTs 400-600days and 6.7-25.0% for VDTs
CONCLUSION
Subjects with nodules
CLINICAL RELEVANCE/APPLICATION
This study provides detailed and reliable data on the lung cancer probability of subjects with CT-detected nodules stratified by nodule diameter, volume and growth rate. This information can be valuab

SSC04-03 • Lung Nodule Detectability on Computed Tomography at Ultra-low Dose Scanning with Adaptive Iterative Dose Reduction Using Three Dimensional Processing (AIDR3D): Comparison with Low-dose Scanning by Receiver-operating Characteristic Analysis

Yukihiro Nagatani MD (Presenter) ; **Masashi Takahashi** MD ; **Kiyoshi Murata** MD ; **Mitsuru Ikeda** MD ; **Tsuneo Yamashiro** MD ; **Tetsuhiro Miyara** ; **Hisanobu Koyama** MD ; **Mitsuhiro Koyama** MD ; **Yukihisa Satoh**

PURPOSE
To compare lung nodule detectability (LND) on computed tomography (CT) with adaptive iterative dose reduction using three dimensional processing (AIDR3D) between ultra-low dose CT scanning (ULDS) and low dose CT scanning (LDS)

METHOD AND MATERIALS
This was part of the Area-detector Computed Tomography for the Investigation of Thoracic Diseases (ACTIve) Study, a multicenter research project being conducted in Japan. The Institutional Review Board of each institution approved this study and written informed consent was obtained. In a single visit each, 83 subjects underwent chest CT (64-row helical mode) using identical multi-detector CT scanners at a gantry rotation speed of 0.35 second with three different tube currents: 240,120 and 20 mA (2.51, 1.26 and 0.21mSv, respectively). Axial CT images with 2-mm thickness and increment were reconstructed using AIDR3D. Standard of reference (SOR) was determined on the basis of CT images at 240mA by consensus reading of two board-certificated radiologists with regard to the presence of nodule with the longest diameter of more than 3mm. Five radiologists independently assessed and recorded presence/absence of lung nodules and their locations by continuously-distributed rating in CT images at 20mA (ULDS) and 120mA (LDS). Receiver-operating characteristic (ROC) analysis by jackknife method was used to evaluate LND of both methods in total and also in subgroups classified by nodular longest diameter (>4, 6 and 8mm) and characteristics (solid and non-solid).

RESULTS
For SOR, 160 solid and 61 non-solid lung nodules were totally identified. No significant difference in LND for nodules with the longest diameter of more than 6mm was shown between both methods, as area under ROC curve was 0.932±0.020 in ULDS and 0.948±0.020 in LDS. Similarly, for the entire solid nodules, LND was quite similar between both methods, as area under ROC curve was 0.844±0.017 in ULDS and 0.876±0.026 in LDS.

CONCLUSION
It was demonstrated that ULDS with AIDR3D could have comparable LND to LDS with AIDR3D except for smaller non-solid nodules.

CLINICAL RELEVANCE/APPLICATION
ULDS with AIDR3D has a sufficient potential to be used for lung cancer screening.

SSC04-04 • Coronary Artery Calcification as a Predictor of Mortality in the National Lung Screening Trial - American College of Radiology Imaging Network

Caroline Chiles MD (Presenter) ; **Fenghai Duan** PhD * ; **Gregory W Gladish** MD ; **James G Ravenel** MD ; **Scott Baginski** MD ; **Bradley J Snyder** MD ; **Sarah Baum** MS ; **Stephanie M Smith** BA ; **Reginald F Munden** MD, DMD *

PURPOSE
Low dose CT (LDCT) screening for lung cancer offers an opportunity to evaluate coronary artery calcification (CAC), a predictor of cardiovascular events strongly associated with age and smoking history. This study examines mortality in NLST participants with quantitative and qualitative CAC scores.

METHOD AND MATERIALS
We conducted a retrospective, randomly selected, case-control study to analyze the relationship between baseline LDCT CAC, coronary heart disease (CHD) and all-cause (AC) mortality . Five cardiothoracic radiologists evaluated a total of 1,570 LDCTs from 3 groups: group 1 included 210 CHD deaths; group 2 included 314 AC deaths (excluding CHD); a control group included 1046 participants alive at conclusion of the trial. Of these, 133 were excluded for clinical/technical reasons. Readers performed quantitative analysis of CAC (Agatston scoring), as well as qualitative analysis, based on both an overall and a per-vessel visual assessment (none/0, mild/1, moderate/2, heavy/3), using a set of standard reference CT images.

RESULTS
A CAC Agatston score of 0 was present in 34% of controls, 12% of patients with CHD death and 18% of patients with ACM (p1,000 (reference 0) were associated with hazard ratios (HRs) of 1.3 (p=.40), 3.5 (p
CONCLUSION
A visual assessment of CAC can be used for risk prediction of CHD death and ACM using non-gated LDCT for lung cancer screening, and is comparable to Agatston scoring. ACRIN receives funding from the National Cancer Institute through the grants U01 CA079778 and U01CA 080098.

CLINICAL RELEVANCE/APPLICATION
CAC, a significant cause of mortality in the lung cancer screening population, can be evaluated by a simple visual assessment.

SSC04-05 • Diagnostic Accuracy of Digital Tomosynthesis of the Chest for Nodules Detection in Lung Cancer Screening Program

Maurizo Grosso MD (Presenter) ; **Liliana Comello** ; **Roberto Priotto** MD ; **Emanuele Roberto** ; **Luca Bertolaccini** ; **Alberto Terzi** ; **Stephane Chauvie** PhD *

PURPOSE

METHOD AND MATERIALS
Accrual of study participants started in December 2010 and ended in December 2011. Smokers or former smokers aged from 45 to 75 years, with a smoking history of at least 20 pack-years, without malignancy in the 5 years before the start of the study were eligible for the study. DTS were performed at baseline and at 1 year follow up. Subjects with lung nodules were addressed to other radiological examination (CT, contrast enhanced CT or PET/CT).

RESULTS
Of the 1919 candidates assessed, 1843 (96%) were enrolled into the study. The mean age was 61 years (ranging 48-73). A total of 1843 DTS studies were performed. Pulmonary abnormalities were detected in 268 (14.5%) subjects. First-line basal computed tomography (CT) was subsequently carried out in 132 (7.2%) subjects, 68 (4.9%) of which were referred for follow-up CT; PET/CT was performed in 27 (1.46%), and lung cancer was detected in 18 (0.98%) individuals.

CONCLUSION
The detection rate of non-calcified lung nodules for DTS was comparable to rates reported for CT. A small subgroup underwent low-dose CT and entered a follow-up program. Overall, lung cancer was detected in about 1% of cases. Chest DTS holds promise as a first-line lung cancer screening tool. With a low-dose protocol effective dose could be kept as low 0.1 mSv/exam.

CLINICAL RELEVANCE/APPLICATION
Tomosynthesi could find a role in lung caner screening screening program

SSC04-06 ● CT Screening for Lung Cancer: Current Practice Patterns at Leading Academic Medical Centers

Phillip M Boiselle MD (Presenter) ; **Charles S White** MD ; **James G Ravenel** MD

PURPOSE
Evidence-based guidelines recommend that lung cancer screening be conducted at academic medical centers similar to the NLST sites, but several aspects of CT screening are not addressed by clinical guidelines. Thus, our purpose was to determine current practice patterns for CT screening at leading academic medical centers.

METHOD AND MATERIALS
An electronic survey was emailed in March 2013 to thoracic radiologists at 21 leading academic medical centers, which were identified from the 2012-2013 US News and World Report listings of top hospitals, cancer centers, and pulmonary medicine centers. Participants who reported that they currently offer lung cancer screening were asked additional questions about patient selection, referral requirements, self-pay charges, dose, number of patients screened, nodule management guidelines, use of CAD and volumetric analysis software, and inclusion of a smoking cessation program.

RESULTS
Of the 18 survey respondents (86% response rate), 15 (83%) currently have a CT screening program and 3 (17%) are planning one. Among the 15 respondents with an active screening program, almost all included a smoking cessation program (n=14, 93%) and did not employ CAD (n=13, 87%) or nodule volumetry software (n=14, 93%). Less uniformity was reported for: patient selection criteria (NLST criteria most common, n=11, 73%); required referral from a patient's clinician (n=11, 73%); rate of self-pay charges ($300-$400 most common, n=10, 67%); choice of guidelines for nodule management (Fleischner Society guidelines most common, n=10, 67%); and estimated scan dose (1-2 mSv most common, n=7, 47%). One to 5 patients are scanned per week at 13 of the 15 sites, which is the same or fewer than 6 months ago.

CONCLUSION
Screening programs at leading academic medical centers routinely include a smoking cessation program and only infrequently employ CAD or volumetric analysis software. However, there is less uniformity in patient selection criteria, referral requirements, self-pay charges, scan dose, and choice of nodule management guidelines.

CLINICAL RELEVANCE/APPLICATION
The variability in screening practices at leading academic medical centers suggests the need for formalized radiology guidelines for CT screening for lung cancer.

SSC04-07 ● Solitary Pulmonary Nodule: Which Parameters Would Be Better to Assess for Quantitative Diagnosis on Diffusion-weighted MR Imaging with Multiple b-Values?

Hisanobu Koyama MD (Presenter) ; **Yoshiharu Ohno** MD, PhD * ; **Shinichiro Seki** ; **Mizuho Nishio** MD * ; **Sumiaki Matsumoto** MD, PhD * ; **Takeshi Yoshikawa** MD * ; **Nobukazu Aoyama** RT ; **Kazuro Sugimura** MD, PhD * ; **Masakazu Kanzawa** RT

PURPOSE
To determine the appropriate parameter for quantitative differentiation of solitary pulmonary nodules (SPNs) by means of diffusion weighted MR imaging (DWI) with multiple b values.

METHOD AND MATERIALS
Thirty-two subjects (24 men and 12 women, mean age 68.2 years) with 36 SPNs (range; 5-30mm) underwent DWI with multiple b values (b=0, 50, 100, 150, 300, 500, and 1000 s/mm2). According to the results from pathological and/ or more than 2 year's follow-up examinations, all SPNs were divided into two groups: malignant SPNs (n=27) and benign SPNs (n=9). Then, five quantitative parameters were determined from region of interest (ROI) drawn over each SPN as follows: apparent diffusion coefficient (ADC), true diffusion coefficient (D) and perfusion fraction (PF) from all b-value data, and the signal intensity ratio between SPN and spinal cord on DWI with b-value at 1000 s/mm2 (LSR1000) and 500 s/mm2 (LSR500). To compare the quantitative parameter difference between malignant SPNs and benign SPNs, all parameters were compared by using Mann-Whitney's U-test. To determine the each feasible threshold value, ROC-based positive test was performed. Finally, sensitivity, specificity and accuracy were compared each other by means of McNemar's test.

RESULTS
On comparison of each parameter between malignant and benign SPNs, both LSRs had significant difference between two groups (p
CONCLUSION
For quantitative differentiation of SPNs on chest DWI, LSR evaluation is more useful and practical method than ADC, D, and PF assessment in routine clinical practice. In addition, b-value at 500 s/mm2 would be better to choose than b values at 1,000 s/mm2 in this setting.

CLINICAL RELEVANCE/APPLICATION
For quantitative differentiation of SPNs on chest DWI, LSR evaluation is more useful and practical method than ADC, D, and PF assessment in routine clinical practice.

SSC04-08 ● A Multicenter, Community Based Chart Review of the Management of Small (8-15 mm) Nodules by Pulmonologists

James G Ravenel MD (Presenter) ; **Nichole Tanner** * ; **Anil Vachani** * ; **Gregory B Diette** * ; **Jyoti Aggarwal** ; **Charles Mathews** ; **Paul Kearney** ; **Kenneth Fang** ; **Gerard Silvestri** MD

PURPOSE
Increased utilization of CT along with a growth in lung cancer screening will result in the detection of many new small nodules. While there are defined algorithms for the management of small nodules in screening trials, little is known as to how small nodules are managed in the private practice setting. The purpose of this chart abstraction is to understand what diagnostic pathways are utilized to diagnose small pulmonary nodules in community practice.

METHOD AND MATERIALS
A chart review was conducted of ten community practice pulmonology clinics across the United States. This study was approved with a waiver of consent from the IRB and charts were reviewed and findings documented in a HIPAA compliant manner. Consecutive charts from patients with newly detected pulmonary nodules between 8 and 20 mm with either a confirmed diagnosis or two-years follow-up were included. Nodules >8 and
RESULTS
One hundred ninety-five charts from 10 practices were abstracted. The average age was 64.7 years. 46% were male and 87% were white. Never smokers, former smokers, and current smokers accounted for 28%, 41%, 31%, respectively. A total of 159 nodules 8-15 mm in size were reviewed. A final diagnosis of malignancy was made in 30 (18.8%) by 24 major and 6 minor procedures. There were 129 (82.1%) benign nodules. This was confirmed by histopathology in 48 cases (30.3%) (14 major and 34 minor procedures). The remaining 81 (50.9%) were followed radiographically and considered indeterminate or benign at the end of two years. Of those monitored, 4 underwent non diagnostic minor procedures, 74 had a least one CT follow-up (range 0-7) and 20 had a FDG PET scan.

CONCLUSION
Over one third of benign nodules between 8 and 15 mm in our chart review underwent an invasive procedure for diagnosis. Education and improved pathways are needed in the community to limit costs and potential morbidity related to small nodule management.

CLINICAL RELEVANCE/APPLICATION
Over 1/3 of benign nodules referred to community pulmonologists undergo an invasive procedure for diagnosis. Better pathways are needed to avoid invasive

diagnosis of benign lesions.

SSC04-09 ● Discrimination of Pulmonary Benign from Malignant Nodules Using a Computerized Three-dimensional Shape Analysis

Won Chang MD (Presenter) ; **Chang Min Park** MD, PhD ; **Sang Joon Park** ; **Sang Min Lee** MD ; **Jin Mo Goo** MD, PhD *

PURPOSE
To retrospectively investigate the differentiating value of computerized three-dimensional (3D) shape analysis between pulmonary benign and malignant nodules

METHOD AND MATERIALS
Between January 2010 and June 2012, we identified 113 patients (59 men and 54 women; mean age, 58.7 ± 13.0 years) with 113 pathologically-confirmed pulmonary nodules = 2cm in size (mean size, 1.45 ± 0.40 cm; 62 malignant and 51 benign nodules) on thin-section chest CT. Each lung nodule was manually-segmented from the surrounding lung parenchyma on axial CT images and 3D shape features of each nodule were calculated using an in-house software program. To evaluate the differentiating value of these 3D shape features between benign and malignant nodules, comparison statistics and receiver-operating characteristics curve (ROC) analysis was performed.

RESULTS
Between benign and malignant nodules, there were significant differences in nodule's sphericity, discrete compactness and 3D roundness. Compared with malignant nodules, benign nodules showed significantly higher sphericity (0.767 vs. 0.653, p
CONCLUSION
Computerized 3D shape analysis such as nodule's sphericity has a potential as a differentiating tool between pulmonary benign from malignant ones.

CLINICAL RELEVANCE/APPLICATION
(dealing with thin section chest CT); Computerized 3D shape analysis of lung nodules can differentiate benign from malignant ones ;and is recommended as part of initial evaluation prior to the biopsy.

Gastrointestinal (Hepatocellular Carcinoma Imaging)

Monday, 10:30 AM - 12:00 PM ● E353A

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OI MR GI

SSC05 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Keyanoosh Hosseinzadeh , MD *
Moderator
Steven S Raman , MD
Moderator
Elmar M Merkle , MD *

SSC05-01 ● 'Delayed Washout' on the Hepatospecific Phase of Gd-BOPTA MRI in the Characterisation of Arterial-enhancing HCCs Lacking Washout on the Portal Venous and Equilibrium Phases

Kelvin Cortis MD, MRCS, FRCR (Presenter) ; **Rosa Liotta** ; **Roberto Miraglia** MD ; **Settimo Caruso** ; **Vincenzo Carollo** MD ; **Angelo Luca** MD

PURPOSE
The current cornerstone of HCC diagnosis is the wash-in(WI)/wash-out(WO) enhancment pattern. However, there remain a significant proportion of hypervascular HCCs lacking WO on the portal venous and/or equilibrium phases. We investigated the possible role of the hepatospecific phase on gadobenate dimeglumine-enhanced MR imaging (Gd-BOPTA-MRI) in further characterising HCCs lacking the typical WI/WO pattern.

METHOD AND MATERIALS
Ninety-seven consecutive patients who underwent liver transplantation between 2004 and 2012 and Gd-BOPTA-MRI within three months of surgery were enrolled. Two experienced radiologists performed a nodule by nodule analysis, which was followed by liver explant correlation. "Delayed WO" was defined as hypointensity on the hepatospecific phase in arterial-enhancing nodules lacking WO on the portal venous and/or equilibrium phases.

RESULTS
Imaging was performed 41.7±25.4 days prior to transplantation. 295 lesions were identified on histopathology, of which 240 were HCCs. 47 HCCs with massive necrosis after percutaneous treatment were eliminated. Of the remaining 193 HCCs, 48 were not detectable on imaging (24.9%). The 145 HCCs seen on imaging showed WI/WO (n=68;46.9%), arterial enhancement without WO (n=55;37.9%), and hypovascularity on arterial and venous sequences (n=22;15.2%) The WI/WO pattern was observed only in HCC. 23 of the 55 arterially-enhancing HCCs lacking WO (41.8%) showed "delayed WO". This pattern was only observed in 3 other nodules (2 cholangiocarcinomas, 1 regenerative nodule). Hypointensity on the hepatospecific phase was not sensitive in detecting hypovascular HCCs. Combining "delayed WO" with WI/WO raises the sensitivity of HCC characterisation from 46.9% to 62.8%, with a minor decrease in the positive predictive value (PPV) (from 100% to 96.8%).

CONCLUSION
A significant proportion of arterial-enhancing nodules lacking WO demonstrate "delayed WO" on the hepatospecific phase of Gd-BOPTA-MRI. When coupled with WI/WO, "delayed WO" augments sensitivity of HCC characterisation with no significant compromise on the PPV.

CLINICAL RELEVANCE/APPLICATION
This "delayed washout" phenomenon increases the sensitivity of HCC characterisation when used alongside the cornerstone wash-in/wash-out pattern, with no significant compromise on the PPV.

SSC05-02 ● Differentiation of Small (≤2 cm) Hepatocellular Carcinoma from Small (≤2 cm) Benign Nodule in Cirrhotic Liver on Gadoxetic Acid-enhanced and Diffusion-weighted MR Images

Gil-Sun Hong MD (Presenter) ; **Jae Ho Byun** MD ; **Heon-Ju Kwon** MD ; **So Yeon Kim** ; **Kyoung Won Kim** MD ; **Hyung Jin Won** MD ; **Yong Moon Shin** ; **Pyo Nyun Kim** MD

PURPOSE
To identify characteristic imaging features that differentiate small (=2 cm) hepatocellular carcinoma (HCC) from small (=2 cm) benign nodule in the cirrhotic liver on gadoxetic acid -enhanced and diffusion-weighted (DW) magnetic resonance (MR) images.

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board, and informed consent was waived. We included 230 cirrhotic patients with 222 pathology-confirmed small HCCs and 61 benign nodules including 28 pathology-confirmed dysplastic nodules (diameter, 0.5"2 cm), who underwent gadoxetic acid-enhanced and DW MR imaging. In consensus, two radiologists analyzed signal intensity of the HCCs and benign nodules at each MR sequence and rim enhancement during the portal or equilibrium phases. The findings relevant as predictors of small HCCs were identified using univariate and multivariate logistic regression analyses. The combinations of significant MR findings in multivariate analysis were compared with American Association for the Study of Liver Disease (AASLD) practice guideline (a combination of arterial enhancement and portal or delayed washout) using McNemar test.

RESULTS
On multivariate analysis, arterial enhancement (adjusted odds ratio [OR], 8.7), T2 hyperintensity (adjusted OR, 6.2), and hyperintensity on DW images (adjusted OR, 2.6) were significant for differentiating small HCCs from benign nodules (P=0.04). When two or all three findings of them were applied as diagnostic criteria for differentiating small HCCs from benign nodules, sensitivity and accuracy were significantly higher than those of AASLD practice guideline (91% vs. 81% and 89% vs. 83%, respectively; each P=0.006).

CONCLUSION
On gadoxetic acid-enhanced and DW MR images, arterial enhancement and hyperintensity on T2-weighted image and on DW images are helpful for differentiating small HCCs from benign nodules in patients with liver cirrhosis.

CLINICAL RELEVANCE/APPLICATION
Our proposed criteria of MR images can be a potential alternative to the AASLD practice guideline in diagnosing small HCCs in patients with liver cirrhosis on gadoxetic acid-enhanced and DW MR images.

SSC05-03 ● Clinical Features of Hepatocellular Carcinoma Showing Isointense or Hyperintense on Hepatocyte-phase of Gadoxetic Acid-enhanced Magnetic Resonance Imaging; Radiologic-pathologic Correlation in Surgically Resected Cases

Katsuhiro Sano MD (Presenter) ; **Utaroh Motosugi** MD ; **Hiroyuki Morisaka** MD ; **Shintaro Ichikawa** MD ; **Tomoaki Ichikawa** MD, PhD *

PURPOSE
Hepatocellular carcinoma (HCC) commonly demonstrates hypointense on hepatocyte-phase of gadoxetic acid-enhanced magnetic resonance (EOB-MR) imaging. However, some cases of hepatocellular carcinoma show isointense or hyperintense on hepatocyte-phase of EOB-MR images, which is a pitfall for diagnosing HCC. The purpose of this study was to elucidate the radiological and histopathological features of HCC that appear isointense or hyperintense on hepatocyte-phase of EOB-MR images.

METHOD AND MATERIALS
In this study, 24 HCCs in 23 patients (mean age; 71.1, 18 males and 5 females, mean tumor size; 32.4mm) who were surgically resected from January 2008 to March 2012 were included. Inclusion criteria of HCC were more than 0.9 of EOB enhancement ratio (tumor to liver contrast on hepatocyte-phase / tumor to liver contrast on precontrast image). All tumors were retrospectively reviewed of enhancement of arterial-phase, bile juice production, histopathological grading, 1 and 3 year survival rate, and 1 and 3 year recurrence-free survival rate.

RESULTS
Twenty-one nodules (88%) showed hypervascular on arterial-phase of EOB-MR images. In gross pathologically, 13 (54%) cases showed green hepatoma producing bile juice. In histopathological findings, all cases were diagnosed as well to moderately-differentiated HCC with no case of poorly-differentiated HCC. The survival rate of 1 and 3 years are 100%. Recurrence-free survival rate of 1 and 3 years are 67% and 56%, respectively.

CONCLUSION
This study demonstrated that poorly-differentiated HCC was not included in the HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images. HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images tend to show good survival rate.

CLINICAL RELEVANCE/APPLICATION
In our study, clinical features of HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images tend to show good survival rate.

SSC05-04 • Diagnostic Performance of Delayed Hepatobiliary Imaging Post Gadoxetic Acid Combined with DWI vs. Dynamic Contrast-enhanced Imaging for HCC Detection

Cecilia Besa MD (Presenter) ; **Nancy A Cooper** MD ; **Sara Lewis** MD ; **Amita Kamath** MD ; **Sasan Roayaie** ; **Bachir Taouli** MD *

PURPOSE
To compare the diagnostic performance of hepatobiliary phase imaging (HBP) post gadoxetic acid combined with diffusion-weighted imaging (DWI) vs. dynamic contrast-enhanced (CE) T1-weighted imaging (T1WI) for hepatocellular carcinoma (HCC) detection.

METHOD AND MATERIALS
203 consecutive patients at risk of HCC who underwent gadoxetic acid-enhanced MRI from 01/2011 to 12/2011 were included in this IRB approved retrospective single center study. Two sets of images were analyzed independently by 2 readers: HBP/DW-set (HBP + DWI using b 0-50-500-1000) and dynamic CE-set (pre-contrast, arterial, portal venous and late venous 3D T1WI after administration of 10 mL of gadoxetic acid). Reference standard was represented by consensus interpretation of 2 separate readers using combination of imaging, clinical and pathologic data. HCCs were defined as lesions > 1 cm with hypointensity on HBP and/or restricted diffusion (hyperintensity on b500/1000 and low ADC) on HBP/DW-set and typical wash-in/wash-out on the CE-set (AASLD criteria). Per lesion and per patient sensitivity, specificity, PPV and NPV were calculated for each image

RESULTS

CONCLUSION
Initial data demonstrate similar sensitivity, slightly lower specificity and equivalent NPV when using a combination of HBP imaging post gadoxetic acid and DWI compared to ASSLD criteria for detection of HCC > 1 cm. This combination has potential for HCC screening.

CLINICAL RELEVANCE/APPLICATION
A fast post-contrast liver MRI protocol consisting of gadoxetic acid injection outside the MR room with DWI can be used for HCC screening, which could provide shorter and possibly less expensive exams

SSC05-05 • Pilot Study to Evaluate the Diagnostic Per-patient Accuracy of a Limited Hepatobiliary Phase-gadoxetate Enhanced MRI for Hepatocellular Carcinoma Surveillance

Robert M Marks MD (Presenter) ; **Andrew Ryan** MD ; **Elhamy R Heba** BMBCh ; **An Tang** MD ; **Claude B Sirlin** MD * ; **Mustafa R Bashir** MD *

PURPOSE
To evaluate the diagnostic performance of an abbreviated gadoxetate-enhanced MRI protocol as a potentially low-cost alternative to conventional MRI for hepatocellular carcinoma surveillance in the setting of chronic liver disease.

METHOD AND MATERIALS
This pilot dual center retrospective cross-sectional study was IRB approved at both institutions where informed consent was waived. 299 consecutive patients at risk for HCC that were in an MRI-based HCC surveillance program between October 28, 2008 and January 31, 2010 were included in the study. For each patient, their first gadoxetate-enhanced MRI was evaluated as the index study. Two readers, blinded to the history and clinical interpretation of the study, independently read two image sets per patient: set 1 included T1w 20-minute hepatobiliary phase images and a T2w SSFSE sequence; set 2 included diffusion-weighted imaging and set 1. For each image set per patient, each nodule larger than 10mm was scored using a 5 point predetermined scoring grid and the highest scoring nodule was then used to give the image set a final score. Image sets with a score of 1-3 were classified as negative, and 4 and 5 were classified as positive. The composite reference standard included pathologic proof after transplantation, hepatectomy, biopsy, empirical treatment based on the index MRI, and follow-up imaging within 12 months of the index MRI.

RESULTS
There were a total of 49 lesions considered positive for HCC. Inter-reader agreement was substantial for both image sets (?=0.72 for both). Intra-reader agreement was excellent (?=0.97 and 0.99). Reader performance for image set 1 (given as reader A/reader B) was: sensitivity 85.7%/79.6%; specificity 91.2%/95.2%; positive predictive value 65.6%/76.5%; negative predictive value 97.0%/96.0%; accuracy 90.3%/92.6%. Only one examination (out of 299) was scored differently on image set 2 compared with set 1, leading to nearly identical performance.

CONCLUSION
Due to its high negative predictive value, an abbreviated MRI protocol with T2-weighted SSFSE and hepatobiliary phase sequences may be an acceptable, low cost alternative to a complete MRI in the setting of chronic liver disease at centers that rely on MRI for HCC surveillance.

CLINICAL RELEVANCE/APPLICATION
This limited MRI may be an acceptable alternative to dynamic conventional MRI's and could potentially reduce costs and improve throughput for patients in an MRI surveillance program for HCC.

SSC05-06 • Radiopathological Correlation of Hepatocellular Carcinoma in Transplant Patients. MR Evaluation with Gadoxetic Acid

Nehal Shah MBBS, FRCR (Presenter) ; **Raneem Albazaz** MBBCh ; **Andrew F Scarsbrook** FRCR ; **Maria B Sheridan** MD ; **James A Guthrie** MBBCh *

PURPOSE
To evaluate the clinical performance of MRI using Gadoxetic acid in the detection of patients with hepatocellular carcinoma (HCC) and the disease burden within a transplant population.

METHOD AND MATERIALS
A retrospective analysis was performed of the MRI and explant histology reports of patients receiving liver transplants between January 2011 and April 2013. MRI and histologically detected HCC were recorded and correlated as were the indications for transplantation. Comparison was made with an initial cohort of patients and the total study population.

RESULTS
166 adult patients received a liver transplant over the study period. The indications included acute liver failure (6), alcoholic liver disease (45), Primary biliary cirrhosis (16), primary sclerosing cholangitis (20), viral hepatitis (34), alcoholic liver disease and hepatitis (7) and miscellaneous (38). 131 patients had an MRI scan preoperatively for evaluation of HCC and 40 patients had image positive hepatocellular carcinoma. With histological correlation on a per patient basis, MRI was 100% sensitive and 98.9% specific in detecting HCC. One patient was diagnsed with multifocal HCC on MRI but only had multiple dysplastic nodules. A total of 83 histological HCCs were detected with 76 true positives, 7 false negatives and 9 false positives on imaging. This equates to a sensitivity of 91.6% on a per lesion basis. All patients transplanted had tumour burdens within Milan criteria on explant histology. There was no difference in the diagnostic performance between the early and total population.

CONCLUSION
Concerns in changing practice from a dual contrast technique using superparamagnetic iron oxide and gadolinium to a gadoxetic acid technique were unfounded. Performance in identifying patients with HCC within transplant criteria was high as was the per lesion corelation.

CLINICAL RELEVANCE/APPLICATION

Pre liver transplantation MRI with gadoxetic acid has a high sensitivity for detecting HCC on a per patient and per lesion basis.

SSC05-07 ● Detection of Hepatocellular Carcinoma (HCC) in Liver Transplant Candidates: Intraindividual Comparison of Gadobenate Dimeglumine (Gd-BOPTA) Enhanced MR Imaging and Multiphasic 64-slice CT

Michele Di Martino (Presenter) ; **Rossella Di Miscio** ; **Concetta V Lombardo** ; **Bruna Cerbelli** ; **Sandro Bosco** ; **Maddalena D'Addario** ; **Carlo Catalano** MD

PURPOSE
To intraindividually compare gadobenate dimeglumine (Gd-BOPTA) enhanced MRI and 64-slice CT for detection of HCC in patients with cirrhosis.

METHOD AND MATERIALS
Informed consent and ethical approval were obtained. Eighty-five consecutive patients with 104 HCC nodules underwent MRI at 1.5T (Avanto, Siemens) and 64-slice CT (Sensation 64, Siemens) at a mean interval of 14 days (range, 10–20 days). All patients underwent transplantation within 60 days. MR acquisitions comprised unenhanced breath-hold T2W images and volumetric 3D Gd-BOPTA-enhanced (0.1 mL/kg; MultiHance®, Bracco) T1W GRE images acquired at 25s, 60s, 180s (dynamic phase) and 90 min (hepatobiliary phase). 64-slice CT was performed with 0.6 x 64 mm collimation, 3-mm section thickness, 250 mAs, 120 kVp. A triple-phase protocol was started 18s, 60s and 180s after reaching a trigger threshold of 150 HU above baseline CT number in the aorta. Image analysis was independently performed by three observers in two sessions separated by 4 weeks. Findings were compared directly with explanted liver pathology results. Diagnostic accuracy was evaluated using the receiver operating characteristic (ROC) method. Sensitivity, specificity, PPV and NPV with corresponding 95% confidence intervals were determined.

RESULTS
The mean area under the ROC curve for Gd-BOPTA MRI (0.78) was higher than that of CT (0.76). On a lesion-by-lesion basis, the mean sensitivity (73%) of Gd-BOPTA MRI was significantly higher than that of CT (63.4%) (P
CONCLUSION
Gd-BOPTA-enhanced MRI is significantly more accurate and sensitive than 64-slice CT for the diagnosis of HCC in patients with cirrhosis prior to liver transplantation.

CLINICAL RELEVANCE/APPLICATION
MR imaging with hepatobiliary contrast agent may improve the diagnostic accuracy of MR in the detection of focal liver lesions in cirrhotic patients.

SSC05-08 ● Retrospective Comparison of MRI Sequences for Prediction of Size of Hepatocellular Carcinoma Based on Explant Evaluation

Claudia R Seuss MD (Presenter) ; **Min Ju Kim** ; **Michael J Triolo** MD ; **Cristina H Hajdu** MD ; **Andrew B Rosenkrantz** MD

PURPOSE
Size of hepatocellular carcinoma (HCC) is a critical feature in determining liver transplant allocation. The purpose of this study was to compare measurements of size of HCC on different MRI sequences with pathologic size of HCC determined from evaluation of liver explantation specimens.

METHOD AND MATERIALS
92 patients with HCC who underwent contrast-enhanced liver MRI between July 2005 and June 2012 within 90 days before liver transplantation were included in this retrospective study. One radiologist reviewed the imaging in conjunction with pathologic findings and created a map depicting the location of the dominant lesion in each case. Then, two separate abdominal radiologists (R1 and R2) used these maps to independently measure the size of the dominant HCC on the following sequences in different sessions: T2-weighted imaging (T2WI); b-500 diffusion weighted imaging (DWI); and arterial (AR), portal venous (PV) and equilibrium (EQ) post-contrast phases. Size measurements on the various MRI sequences were compared with explant measurements using Pearson's correlation coefficients, paired T-tests, and Bland-Altman plots.

RESULTS
For R1, correlation with pathology was highest for PV (r = 0.89) and EQ (r = 0.83); for R2, correlation was highest for AR, PV, and EQ (r = 0.85-0.86). Absolute error was lowest for R1 on PV (4.3 mm, p
CONCLUSION
When considering absolute and systematic error, we suggest use of portal venous phase images to obtain the most reliable measurements of size of HCC on MRI. Measurements on arterial phase images systematically over-estimated lesion size for both readers in our study.

CLINICAL RELEVANCE/APPLICATION
HCC size is critical for determining transplant eligibility and allocation. Our findings regarding the utility of size measurements in the portal venous phase may help standardize such measurements.

SSC05-09 ● Clinical Utility of Weighted Liver Spleen Contrast Using Gadoxetate Disodium-enhanced Hepatic MRI: Pre-evaluation of Stereotactic Body Radiotherapy for Hepatocellular Carcinoma

Yuko Nakamura MD (Presenter) ; **Tomoki Kimura** ; **Toru Higaki** PhD ; **Fuminari Tatsugami** ; **Yasushi Nagata** MD ; **Kazuo Awai** MD *

PURPOSE
Stereotactic body radiotherapy (SBRT) is a loco-regional therapy for hepatocellular carcinoma (HCC). Radiotherapy to the liver must be planned carefully because of poor hepatic radiation tolerance especially in HCC patients with liver dysfunction and their eligibility for SBRT for HCC must be assessed carefully because radiation-induced liver disease can be fatal. At SBRT for HCC, V20, defined as the percentage of the liver volume exposed to >20 Gy, is usually planned to be
METHOD AND MATERIALS
We retrospectively studied 18 HCC patients who underwent SBRT; the dose was 48 Gy delivered in 4 fractions. We measured the signal intensity of the liver parenchyma during the hepatobiliary phase in a circular region of interest by referring to a dose distribution map and calculated the liver-spleen contrast (LSC) ratio for each radiation dose area. Then we calculated the weighted LSC (W-LSC) as W-LSC = (mean $LSC_{0\text{-}30Gy}$ x liver $volume_{0\text{-}30Gy}$ + mean $LSC_{30Gy\text{-}}$ x liver $volume_{30Gy\text{-}}$) / total liver volume. We divided the patients into groups A (no change in the Child Pugh score 6 months post-SBRT) and B (increased Child Pugh score 6 months post-SBRT) and compared the W-LSC and V20 in the groups. We also calculated the optimal W-LSC cut-off value for predicting liver function transit using receiver operating characteristic analysis.

RESULTS
Of the 18 patients 13 were in group A and 5 in group B. There was no significant difference in V20 between the groups (10.36% vs 16.45%, p=0.15); in one patient it was below 10%. There was also no significant difference in W-LSC (1.81 vs 1.47, p=0.22), however, in all 5 group B patients it was below 2.0. At the optimal cutoff value for W-LSC (1.98), sensitivity and specificity for predicting liver function transit were 100% and 61.5%.

CONCLUSION
W-LSC may be a more useful quantitative parameter than V20 for predicting liver function transit.

CLINICAL RELEVANCE/APPLICATION
The value of W-LSC should be evaluated before SBRT to avoid radiation-induced liver disease.

Gastrointestinal (Oncology: Surveillance and Tumor Response)

Monday, 10:30 AM - 12:00 PM ● E451A

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RO OI BQ GI

SSC06 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Bonnie N Joe , MD, PhD
Moderator
Seong Ho Park , MD *
Moderator
Erik K Paulson , MD

SSC06-01 ● Multimodality Multiparametric Imaging for Prediction of Response and Survival after Radioembolization of Liver Metastases

Fabian Morsbach (Presenter) ; **Bert-Ram Sah** ; **Niklaus G Schaefer** MD ; **Thomas Pfammatter** MD ; **Caecilia S Reiner** MD ; **Hatem Alkadhi** MD

PURPOSE
To determine prospectively, in patients with liver metastases, the best predictor for response and survival to transarterial radioembolization (TARE) comparing multi-phase CT, perfusion CT, and 99mTc-MAA SPECT.

METHOD AND MATERIALS

Forty consecutive patients (mean age 61 years) with liver metastases undergoing multi-phase CT, CT perfusion and 99mTc-MAA SPECT were included, who all underwent TARE with 90Yttrium microspheres. Arterial perfusion (AP) acquired from perfusion CT, HU values from arterial phase (aHU) and portalvenous phase from multi-phase CT, and 99mTc-MAA uptake ratio from SPECT were calculated. Morphologic response was evaluated 4 months after TARE based on RECIST 1.1 criteria. One-year survival was calculated with Kaplan-Meier survival curves, Cox proportional hazard model was used to determine predictors of survival.

RESULTS
We found significant differences between responders and non-responders for AP from perfusion CT (38 ± 15 ml/100ml/min vs 12 ± 6 ml/100ml/min, P 20ml/100ml/min showed a significantly (P=0.010) higher one-year survival (mean survival 345 days vs 205 days), whereas an aHU value >55HU did not result in a statistically significant difference in survival (P=0.123). Cox proportional hazard model revealed AP as the only significant (P=0.004), independent predictor of survival.

CONCLUSION
Compared to arterial and portal-venous enhancement as well as to the 99mTc-MAA uptake-ratio of liver metastases, the AP from CT perfusion is the best predictor for morphologic response and one-year survival to TARE.

CLINICAL RELEVANCE/APPLICATION
Perfusion CT can be used to differentiate between patients most likely to respond to transarterial radioembolization.

SSC06-02 ● Validation of Best Surrogate Markers of DCE-US to Predict PFS for Different Anti-angiogenic Treatments

Nathalie B Lassau MD, PhD (Presenter) * ; **Michele Kind** MD ; **Valerie Vilgrain** MD ; **Joelle Lacroix** MD ; **Sophie Taieb** MD ; **Serge Koscielny**

PURPOSE
The dynamic contrast enhanced ultrasonography (DCE-US) has been used in several monocentric studies to evaluate tumor response to anti-angiogenic treatments. The prospective multicentre French National Program for the Evaluation of DCE-US has studied the technique in different tumor types and anti-angiogenic treatments.
The aim was identify perfusion parameters to predict tumor response to different anti-angiogenic treatments

METHOD AND MATERIALS
DCE-US were performed at baseline and at 4 time-points (Day 7, 15, 30, 60). At each examination, we quantified 7 DCE-US parameters. We also estimated the variation between baseline and each post-baseline time-point. The main endpoint was freedom from progression assessed according to RECIST. We first selected the best parameters: for each parameter and each time point, we studied the trend between the parameter value and freedom from progression. After, the best cut-points were searched through a grid search. The best single cut-point was that with the lowest P-value for progression free survival. We performed analyses according to the treatment and type of tumor, looking for the groups of patients that contribute the most to the heterogeneity.

RESULTS
A total of 1968 DCE-US were performed in 539 patients. The median follow-up was 1.65 year. The mean transit time (MTT) was the only significant parameter at day 7 (P=0.002). The best cut-point to predict tumor progression was 12 seconds (P=0.02), a MTT >12s being of good prognosis. Variations from baseline were significant at day 30 for several parameters. The area under the curve (AUC) was the parameter with the lowest P-value (P=0.00004); Patient with a decrease of more than 40 % had a better prognosis. The groups defined accordingly were different for both FFP (P=0.009) and OS (0.03). The analyses according to treatment suggested heterogeneity which could be attributed to 81 RCC patients treated by Sunitinib. We performed a separate analysis of this group: the best cutoff for AUC at 30 days was 0.1, corresponding to a decrease of 90%.

CONCLUSION
DCE-US is the first functional imaging technique that validated predictors of tumor progression in a large multicentric cohort.

CLINICAL RELEVANCE/APPLICATION
A large multicentric study confirms the potential of DCE-US to monitor different anti-angiogenic treatments in different type of tumors.

SSC06-03 ● Acoustic Radiation Force Impulse Elastography for the Prediction of Chemotherapeutic Response in the Patients with Liver Metastases from Colon Cancer

Jae Young Lee MD (Presenter) ; **Soo Yeon Kang** ; **Se Hyung Kim** ; **Joon Koo Han** MD ; **Byung Ihn Choi** MD, PhD *

PURPOSE
To investigate if and when acoustic radiation force impulse (ARFI) elastography can predict chemotherapeutic response in patients with liver metastasis from colon cancer.

METHOD AND MATERIALS
The institutional review board approved this prospective study and informed consents were observed in all patients. 45 untreated metastatic liver tumors from colon cancer (mean, 3.6 ± 1.9 cm; =3 nodules per patient) of 26 patients (M:F=16:10; mean age, 58.6 ± 9.6 years) were included in this study. ARFI elastography was performed before chemotherapy and 48 hours, 1 week, 2 weeks and 4 weeks after chemotherapy for the same liver tumors along with measurement of tumor diameter. Shear wave velocities were obtained from the center, 12 o□clock, 3 o□clock, 6 o□clock and 9 o□clock direction within a tumor, two times per measurement point (total, 10). Responders and nonresponders were determined by RECIST 1.1 criteria on CT taken 2 month after the start of chemotherapy. Paired t-test was used for statistical analysis.

RESULTS
Responders (n=10) showed significant interval drop in elasticity of metastatic liver tumors between pre-chemotherapy and post-48hr (mean difference, -0.23 m/s: 95% CI, -0.42 to-0.04 m/s) (P=0.016). There was no significant interval change between pre-chemotherapy and other time points in responders. No significant interval change between pre and any time points in nonresponders (n= 16) was noted. Rather, elasticity in liver tumors in nonresponders increased 48 hours after chemotherapy (mean difference, 0.08m/s; 95% CI, -0.21 to 0.39 m/s) (P=0.54). Significant size change of liver tumors in diameter was detected since 1 week after chemotherapy only in responders.

CONCLUSION
ARFI elastography might be used as a biomarker to predict chemotherapeutic response as early as 48 hours after initiation of chemotherapy in patients with colon cancer liver metastasis

CLINICAL RELEVANCE/APPLICATION
ARFI elastography might be used as a biomarker to predict chemotherapeutic response as early as 48 hours after initiation of chemotherapy in patients with colon cancer liver metastasis.

SSC06-04 ● Diagnosis of Complete Response in the Colorectal Cancer Liver Metastasis (CRCLM) after Chemotherapy: Which Imaging Modality Should Be Used?

Min Jung Park (Presenter) ; **Mi-Suk Park** MD ; **Seong Ho Park** MD * ; **Won Jae Lee** MD ; **Min Ju Kim** ; **Sung Eun Rha** MD ; **Chang Hee Lee** MD ; **Yoon Jin Lee** MD ; **Sumi Park** ; **Yang Shin Park** MD ; **Nurhee Hong** MD

PURPOSE
To compare the accuracy of CT and MRI with liver-specific contrast agent for the evaluation of complete response in CRCLM after chemotherapy in a retrospective multicenter setting and to find out alternative role of non-contrast enhanced MRI (NE-MR) with Diffusion-weighted imaging (DWI) for the evaluation of complete response in CRCLM after chemotherapy

METHOD AND MATERIALS
Among patients treated for CRCLM between 2008 and 2011 at eight hospitals in Korea, 90 patients (63men, 27women; mean age, 57 years; age range, 36□77 years) with the following criteria were retrospectively included: fewer than 10 liver metastases (LM) before chemotherapy; neoadjuvant chemotherapy followed by liver resection; disappearance of at least one LM on post-chemotherapy multidetector CT portal venous phase images with slice thickness=5mm; post-chemotherapy gadoxetic acid-enhanced MRI including DWI of b-value=500sec/mm2; time interval=4weeks between post-chemotherapy CT and MRI; follow-up at least 1 year after surgery. We retrospectively evaluated 445 LM in these patients on CT and MRI. Pathologic report of surgical specimen, sonographic finding on radiofrequency ablation and follow-up CT or MRI were served as reference standard. The diagnostic accuracies of MRI and CT were determined and compared using the McNemar test.

RESULTS
In diagnosing complete response after chemotherapy, gadoxetic acid-enhanced MRI showed significantly higher accuracy (89%), sensitivity (75%), and specificity (94%) compared to CT (59%; 91%; 49%), respectively (P
CONCLUSION
MRI with liver-specific contrast agent is more accurate than CT for the evaluation of complete response in CRCLM after chemotherapy. And NE-MR with DWI could be an alternative tool as it is more accurate than CT.

CLINICAL RELEVANCE/APPLICATION
MRI with liver-specific contrast agent and diffusion weighted imaging is more accurate than CT for the evaluation of complete response in colorectal cancer liver metastasis after chemotherapy.

SSC06-05 ● Formula-based Lesion Volume Estimation: Evaluation of the Agreement with Software-based Volumetry

Melvin D'Anastasi MD (Presenter) * ; **Ruediger P Laubender** MA, MPH * ; **Julia Lynghjem** * ; **Volker Heinemann** MD * ; **Maximilian F Reiser** MD ; **Anno Graser** MD *

PURPOSE
To evaluate the agreement between true tumor volume and tumor volume derived from (i) a new formula based on longest lesion (RECIST) diameter, (ii) a new formula based on longest diameter and longest orthogonal (WHO) diameter.

METHOD AND MATERIALS
89 baseline and follow-up CTs were available in 20 patients with metastastic colorectal cancer from the randomized phase II multicenter CIOX trial. Target lesions were defined at baseline and followed over time. Lesions were evaluated by (i) semi-automated volumetry using Siemens Syngo.via and (ii) volumetric assessment using a newly developed formula based on manual measurement of the longest diameter and the longest orthogonal diameter. True, WHO- and RECIST-based volumes were calculated. We compared the agreement of the true volume to the WHO-based volume and RECIST-based volume. We also compared the agreement between "true" and WHO-based volume relative changes by means of the intraclass correlation.

RESULTS
A total of 151 lesions were evaluated. Using a variance components model it was shown that the difference between true and RECIST-based volume is statistically significant ($p < 0.001$) indicating a substantial constant bias. The same model showed a difference between true and WHO-based volume, which was not statistically significant ($p = 0.50$), indicating no substantial constant bias. Scatter-plots show that the RECIST-based volume overestimates lesion volume. The intraclass correlation between "true" and WHO-based volume relative changes was 0.95, showing nearly perfect agreement between methods.

CONCLUSION
Our proposed formula, if based on WHO-measurements, allows for a very good estimate of relative volume changes (the RECIST-based formula overestimates the true volume).

CLINICAL RELEVANCE/APPLICATION
Volumetric tumor information, in particular relative changes in volume during therapy, can be approximated using the proposed WHO-based formula if no volumetric software is available.

SSC06-06 ● Novel Diffusion Kurtosis Imaging for Improved Evaluation of Treatment Response of Hypervascular Hepatocellular Carcinoma

Satoshi Goshima MD, PhD (Presenter) ; **Yoshifumi Noda** MD ; **Hiroshi Kondo** MD ; **Hiroshi Kawada** MD ; **Haruo Watanabe** MD ; **Masayuki Kanematsu** MD ; **Yukichi Tanahashi** MD ; **Nobuyuki Kawai** MD ; **Kyongtae T Bae** MD, PhD *

PURPOSE
To determine the value of diffusion kurtosis imaging (DKI) of the liver for improved evaluation of treatment response of hypervascular hepatocellular carcinoma (HCC).

METHOD AND MATERIALS
During a five-month period, we prospectively recruited 62 patients with treated or untreated hypervascular HCC (48 men and 14 women; mean age, 73.4 years; range, 49-86 years) and evaluated their MR images. DKI was performed with a respiratory-triggered single shot echo-planar sequence at multiple *b* values (0, 100, 500, 1000, 1500, and 2000 sec/mm^2). The duration of this imaging acquisition was five minutes. We computed the mean kurtosis (MK) and apparent diffusion coefficient (ADC) (10^{-3} mm^2/s) over regions of interest encompassing the entire tumor using MATLAB software (Mathworks, Natick, Mass). The diagnostic performance of MK and ADC values for the evaluation of HCC viability were compared.

RESULTS
MR image acquisition and analysis were successful in all our study patients. Forty-nine HCCs were completely necrotic: 10 after transcatheter arterial chemoembolization (TACE) and 39 after radiofrequency ablation (RFA), whereas 22 HCCs revealed local recurrences: 18 after TACE and 4 after RFA. On the other hand, 41 HCCs remained untreated. MK was significantly higher in the untreated and local recurrent HCCs (0.81+/- 0.11) than the necrotic HCCs (0.57 +/- 0.11) ($P < 0.001$). Mean ADC value was significantly lower in the untreated and local recurrent HCCs (1.44 +/- 0.42) than the necrotic HCCs (1.94 +/- 0.52) ($P < 0.001$). For the evaluation of HCC viability comparing between the MK and ADC, the sensitivity, specificity, and area under the ROC curve for the MK (85.7%, 98.0%, and 0.95; cutoff value of 0.710) were greater than those of the ADC (79.6%, 68.3%, and 0.77; cutoff value of 1.535).

CONCLUSION
Our study findings suggest DKI is superior to conventional diffusion MRI analysis for the evaluation of posttherapeutic response of HCC.

CLINICAL RELEVANCE/APPLICATION
When MRI is performed to evaluate the posttherapeutic response of HCC, diffusion kurtosis imaging may improve the diagnostic confidence of lesion characterization over conventional diffusion imaging.

SSC06-07 ● Heterogeneity Analysis of Tumor Perfusion for Monitoring Antiangiogenic Therapy in Hepatocellular Carcinoma Using Fractal Analysis

Koichi Hayano MD (Presenter) ; **Sang Ho Lee** PhD ; **Hiroyuki Yoshida** PhD * ; **Dushyant V Sahani** MD

PURPOSE
Noninvasive imaging biomarkers that can quantitatively monitor physiologic changes in tumor microenvironment in response to antiangiogenic therapies will be of significant value. No in vivo study showed whether angiogenic agents can change the heterogeneity of tumor blood physiology. The purpose of this study is to evaluate the change of heterogeneity in tumor perfusion during antiangiogenic therapy using fractal dimension analysis in hepatocellular carcinoma patients treated with bevacizumab.

METHOD AND MATERIALS
Twenty-three patients (15 men, 8 women; mean age: 61.0 years) with advanced HCC underwent CT perfusion (CTP) at baseline and 2 weeks after administration of bevacizumab. Perfusion color maps of blood flow (BF) generated by the perfusion software (CT Perfusion 3; GE) were saved in a grayscale format, and were loaded onto ImageJ (NIH), and fractal analyses were applied to perfusion maps using a plugin ImageJ software (FracLac, version 2.5). Differential box count method was applied, and fractal dimension and lacunarity were calculated as heterogeneity parameters. The baseline and percent change of heterogeneity parameters were compared with clinical response and PFS at 6 months.

RESULTS
This study included 12 clinical responders and 11 non-responders. 11 patients were PFS > 6 months, whereas 12 were PFS
CONCLUSION
Fractal analysis demonstrated that a patient whose BF heterogeneity in tumor was improved during antiangiogenic therapy could show a longer PFS. Homogenization of blood physiology may reflect an important process in normalization of tumor vasculature during antiangiogenic treatment.

CLINICAL RELEVANCE/APPLICATION
Fractal analysis of CT perfusion can be a new noninvasive biomarker for antiangiogenic therapy.

SSC06-08 ● Significance of Pelvic Imaging in Computed Tomographic Surveillance of Hepatocellular Carcinoma

Kazim Narsinh MD (Presenter) ; **Iris M Otani** MD ; **Cynthia S Santillan** MD ; **Claude B Sirlin** MD *

PURPOSE
To retrospectively determine the frequency and clinical significance of the findings and recommendations derived from pelvic CT performed as part of multiphasic CT surveillance imaging for hepatocellular carcinoma (HCC) in patients at risk for the development of HCC.

METHOD AND MATERIALS
The study was HIPAA-compliant and approved by the institutional review board with waiver of informed consent. The cohort was comprised of 602 patients with either cirrhosis and/or hepatitis B who were referred for routine HCC surveillance by hepatologists from an academic medical center in southern California. Multiphasic acquisitions were performed using a multidetector 16-slice or 64-slice helical CT scanner (GE Lightspeed) to obtain non-contrast, arterial, portal venous, and delayed phase images. Reports from the initial abdominopelvic CT scan for each patient obtained between 2002-2007 were retrospectively reviewed for extrahepatic findings in the pelvis.

RESULTS
Screening was performed in 602 patients (mean age 54 years). Of these patients, 389 (65%) were male and 213 (35%) were female. Logistic regression indicated a lower likelihood of pelvic findings in patients that were young (
CONCLUSION
Pelvic CT included at the time of HCC surveillance does not uncover a statistically significant number of incidental pelvic findings that impact patient care. In light of the increased ionizing radiation dose to patients and unnecessary healthcare costs associated with pelvic CT imaging in this context, routine surveillance of patients with known risk factors for HCC should be performed with multiphasic abdominal CT only.

CLINICAL RELEVANCE/APPLICATION
Pelvic CT does not detect clinically meaningful pelvic pathology with sufficient frequency to warrant its routine inclusion in HCC surveillance protocols.

SSC06-09 • Accuracy of mRECIST versus RECIST 1.1 in Predicting Outcome in Hepatocellular Carcinoma Treated with Sorafenib

Giulia Gallusi ; **Rossella Di Miscio** ; **Michele Di Martino** (Presenter) ; **Concetta V Lombardo** ; **Adolfo Attili** ; **Carlo Catalano** MD

PURPOSE
To compare RECIST1.1 and mRECIST ability in the estimation of the response to therapy in patients with advanced HCC treated with Sorafenib.

METHOD AND MATERIALS
From August 2008 to July 2012, 58 cirrhotic patients with advanced HCC received Sorafenib at starting dose of 400 mg bid and were followed until death occurred. Using RECIST1.1 and mRECIST, 27 patients who had undergone a 4-phase CT scan/dynamic MR before and after (30-100 days) the start of treatment were retrospectively analysed. RRR was evaluated according to RECIST1.1 and mRECIST, to determine the ability of each method in predicting the response of HCC to Sorafenib, taking OS as end-point.

RESULTS
The objective response [OR= complete response (CR) + partial response (PR)], stable disease (SD) and progressive disease (PD) rates according to RECIST1.1 and mRECIST were 14%, 25%, 59% and 25%,18%, 55%, respectively. In CR+PR versus SD+PD patients, median OS was 24.3 months (both with RECIST1.1 and mRECIST) versus 10.9 (with RECIST1.1) and 10.1 months (with mRECIST). OR was significantly associated with OS only according to mRECIST (p=0.007).

CONCLUSION
RRR according to mRECIST, but not to RECIST1.1, sensibly correlates to outcome in cirrhotic patients with HCC treated with Sorafenib.

CLINICAL RELEVANCE/APPLICATION
mRecist evaluation may help to select patient who try benefit from Sorafenib treatment

ISP: Genitourinary (New Methods for Characterization of Renal Masses)

Monday, 10:30 AM - 12:00 PM • N228

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OI CT GU

SSC07 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Richard G Abramson , MD *
Moderator
Cary L Siegel , MD

SSC07-01 • Genitourinary Keynote Speaker: Targeted Therapies for Renal Cell Carcinoma-Imaging of Treatment Response and Complications

Richard G Abramson MD (Presenter) *

PURPOSE
The ascendancy of targeted anticancer agents has broad implications for clinical imaging. This short presentation discusses targeted therapies for renal cell carcinoma, highlighting important challenges for assessing response and identifying treatment-related complications. An understanding of targeted agents and their mechanisms of action can enhance the radiological interpretation and improve patient care.

SSC07-02 • Radiogenomics of Clear-cell Renal Cell Carcinoma: Associations between CT Imaging Features and Mutations

Christoph A Karlo MD (Presenter) ; **Pier Luigi Di Paolo** MD ; **Joshua L Chaim** DO ; **A Ari Hakimi** MD ; **James J Hsieh** MD, PhD ; **Oguz Akin** MD ; **Hedvig Hricak** MD, PhD

PURPOSE
To investigate associations between computed tomography (CT) features of clear-cell renal cell carcinoma (ccRCC) and mutations in VHL, PBRM1, SETD2, KDM5C or BAP1 genes.

METHOD AND MATERIALS
The institutional review board approved this retrospective, hypotheses-generating study of 233 patients with ccRCC and waived the informed consent requirement. The study was HIPAA compliant. Three radiologists independently reviewed pre-treatment CT images of all ccRCC without knowledge of their genomic profile. One radiologists measured largest diameter and enhancement parameters of each ccRCC. Associations between CT features and mutations in VHL, PBRM1, SETD2, KDM5C and BAP1 genes were tested using Fisher's exact tests. Associations between mutations and size/enhancement were assessed using independent t-tests. Interreader agreements were calculated using Fleiss' Kappa.

RESULTS
Mutation frequencies among ccRCC were: VHL, 53.2% (124/233); PBRM1, 28.8% (67/233); SETD2, 7.3% (17/233); KDM5C, 6.9% (16/233); BAP1, 6% (14/233). Well-defined tumor margins (p=0.013), nodular enhancement (p=0.021) and evidence of intratumoral vascularity (p=0.018) were associated with VHL mutations. Mutations of KDM5C (p=0.022) and BAP1 (p=0.046) were associated with evidence of renal vein invasion. 3. While mutations of VHL (p=0.016) and PBRM1 (p=0.017) were significantly less common among multicystic ccRCC, mutations of SETD2 (p=0.373), KDM5C (0.375) and BAP1 (0.612) were absent when compared to solid ccRCC. Interreader agreements for CT feature assessments ranged from substantial to excellent (?=0.791-0.912).

CONCLUSION
This preliminary Radiogenomics analysis of ccRCC revealed associations between CT features and underlying mutations and therefore warrants further investigation and validation.

CLINICAL RELEVANCE/APPLICATION
The results of this study, which demonstrated clinical implications, allow for the generation of hypotheses regarding further Radiogenomics research in ccRCC.

SSC07-03 • Biopsy Proven Oncocytoma and Oncocytic Neoplasms: In Situ Natural History and Clinical Outcomes of 139 lesions

Manish Dhyani MBBS (Presenter) ; **Sameer M Deshmukh** MD ; **Adam S Feldman** MD ; **Rosemary Tambouret** MD ; **Debra A Gervais** MD * ; **Ronald S Arellano** MD ; **Anthony E Samir** MD

PURPOSE
Renal oncocytomas (oncocytic adenoma/oxyphilic adenoma/proximal tubular adenoma) account for 3-7% of all renal neoplasms and are the most common benign, solid renal neoplasms. Oncocytomas (OC) have a distinctive pathological appearance but other neoplasms such as chromophobe RCC and oncocytic papillary RCC can mimic this pattern, precluding tumor classification as "Oncocytoma" and instead classifying it as an "Oncocytic Neoplasm (ON)". OC are thought likely benign, but their long-term outcome has not been established with certainty. The purpose of this study was to review the in-situ natural history and clinical outcomes of biopsy proven OC and ON at our institution.

METHOD AND MATERIALS
We performed a retrospective review of patients who underwent percutaneous biopsy of a suspicious renal mass at our institution between 1998- 2011. Lesions with a pathological diagnosis of (1) OC, (2) "ON favoring a diagnosis of OC" and (3) ON on percutaneous biopsy were identified. Surveillance follow-up and treatment outcomes were assessed.

RESULTS
A total of 1254 image-guided percutaneous renal biopsies were performed between 1998-2011. A total of 139 lesions (11%) in 135 patients (M:F = 86:49) with a mean age of 70 years (range: 24-91 years) were identified to have a pathological diagnosis of OC (n=90, 7%), ON favoring OC (n= 20, 1.6%) and ON (n=29, 2.4%) on image-guided (US:CT =8:131) percutaneous biopsy. The majority of lesions were solid (n=135, 97%) with a mean size of 2.7 cm (range: 0.8"10cm).
110 lesions were followed with a minimum of one imaging study. 57 lesions were either stable or decreased in size during a mean 1.5±1.2 years of follow-up and have been summarized in Table 2. Of the 53 lesions that grew in size the mean rate of growth was 0.39±0.38 cm/year (follow-up interval = 2.7±2.3 years).
Overall repeat pathology was available for 11/110 (10%) lesions that were followed. One pathological diagnosis of RCC " chromophobe on re-biopsy prompted resection in a lesion that was stable while all others were categorized as OC.

CONCLUSION
Renal lesions diagnosed as ON, ON favoring OC and OC usually remain stable or are slow growing. Our data suggests that lesions of this type can be safely followed with periodic imaging.

CLINICAL RELEVANCE/APPLICATION
Extremely little is known about Oncocytoma's with the largest series in the literature describing 33 lesions. This larger series provides a better understanding of their *in situ* natural history.

SSC07-04 • Characterization of Focal Renal Masses Using Post-contrast-Enhanced Images Alone from a Dual Energy CT Data Set Acquired with Fast Kilovoltage-switching

Drew E Davis MD (Presenter) ; **Daniele Marin** MD ; **Achille Mileto** MD ; **Kingshuk Roychoudhury** ; **Rendon C Nelson** MD *

PURPOSE
To evaluate the diagnostic performance of quantitative methods for characterization of focal renal masses using post-contrast enhanced images alone from a fast kilovoltage-switching single source dual energy CT (ssDECT) dataset.

METHOD AND MATERIALS
IRB approved study comprised of 58 patients (43 men, 15 women; age range, 43-82 years) with 63 focal renal masses measuring = 1.5-cm (mean diameter, 3.5 cm; range, 1.5-8.0 cm), who underwent noncontrast (NCCT) and contrast-enhanced fast kilovolt switching ssDECT from 11/2011-2/2013. Lesions were classified as: (a) simple cysts (=20 HU on NCCT and =15 HU enhancement)(n=42), (b) complex cysts (>20 HU on NCCT and =15 HU enhancement)(n=9) and (c) enhancing masses (>15 HU enhancement)(n=12). Synthesized monochromatic datasets were reconstructed at selected x-ray energies of 40 keV, 50 keV, 59 keV (mean energy for 120-kVp beam) and 140 keV. Material density reconstructions were also generated for iodine, calcium and water. All reconstructed datasets were analyzed using a region-of-interest drawn in the center of each renal lesion. Linear discriminant analysis was used for lesion classification using profiles of values obtained at different keV (spectral analysis) and material density reconstructions from post-contrast DECT images.

RESULTS
Material density analysis demonstrated characteristic features: (a) simple cysts: low iodine, low water; (b) complex cysts: low iodine, high water; and (c) enhancing masses: high iodine, high water. High diagnostic accuracy was achieved in differentiating enhancing renal masses from simple and complex renal cysts using: (i) spectral analysis at 40 and 140 keV (sensitivity/specificity 92%/100%) and (ii) iodine and water material density reconstructions (sensitivity/specificity 92%/98%). One enhancing renal lesion was misclassified as a complex cyst using both methods. Additionally, one complex renal cyst was misclassified as an enhancing lesion using the material density reconstruction only.

CONCLUSION
Focal enhancing renal masses may be accurately differentiated from simple and complex renal cysts using single-phase contrast-enhanced DECT alone. However, our data suggest a slight but important risk of misclassifying small enhancing renal masses.

CLINICAL RELEVANCE/APPLICATION
It is possible to accurately characterize focal renal masses using only post-contrast images from a fast kilovoltage-switching single source dual energy CT dataset.

SSC07-05 • Dual-energy CT in Renal Lesions. Which Are the Best Approaches and Thresholds to Evaluate the Iodine-uptake?

Achille Mileto MD (Presenter) ; **Daniele Marin** MD ; **Bernhard Krauss** PhD * ; **Alfredo Blandino** ; **Emanuele Scribano** ; **Silvio Mazziotti** ; **Giorgio Ascenti** MD

PURPOSE
To compare the accuracy of different dual-energy CT approaches in evaluating the iodine-uptake in renal lesions using a single-phase nephrographic acquisition.

METHOD AND MATERIALS
IRB approval and waiver of informed consent were obtained for this HIPAA-compliant study. Fifty-nine patients (41 men, 18 women; mean age, 57.7 years) with 80 renal lesions underwent contrast-enhanced dual-energy CT during the nephrographic phase of enhancement. Renal lesions were characterized as enhancing or nonenhancing, using contrast-enhancement with thresholds of 15-HU and 20-HU and iodine quantification with threshold of 0.5 mg/mL. Accuracy of contrast-enhancement and iodine quantification was calculated, using histopathology or CT follow-up as reference standard. Differences in sensitivity and specificity were assessed by means of McNemar test and ROC analysis.

RESULTS
A significant difference was found between contrast-enhancement with thresholds of 15-HU (sensitivity, 91.4%; specificity, 93.3%; PPV, 91.4%; NPV, 93.3%) and 20-HU (sensitivity, 77.1%; specificity, 100%; PPV, 100%; NPV, 84.9%) (P = .008). Iodine quantification (sensitivity, 100%; specificity, 97.7%; PPV, 97.2%; NPV,100%) was significantly more accurate (P = .004) than contrast-enhancement with threshold of 20-HU. No significant difference in accuracy was found between iodine quantification and contrast-enhancement with threshold of 15-HU. Contrast-enhancement and iodine quantification showed an area under the ROC curve of 0.98 (95% CI: 0.92, 0.99) and of 1.00 (95% CI: 0.95, 1.00), respectively (P = 0.31).

CONCLUSION
Contrast-enhancement with threshold of 15-HU and iodine quantification are the most accurate dual-energy CT approaches to assess the iodine-uptake in renal lesions, using a single-phase nephrographic acquisition.

CLINICAL RELEVANCE/APPLICATION
Dual-energy CT may reduce radiation exposure, increases cost and patient's anxiety from further tests, most frequently CT, that are usually needed when an unenhanced acquisition is not available.

SSC07-06 • Intimate Contact: CT Evaluation of Tumor Contact Surface Area and Its Role in Peri Operative Outcome Prediction

Scott Leslie MBBS ; **Inderbir S Gill** MBBCh * ; **Andre L Abreu** MD ; **Mihir Desai** ; **Vinay A Duddalwar** MD, FRCR (Presenter) ; **Darryl Hwang** PhD

PURPOSE
The surface area of contact that a tumor has with the adjacent renal parenchyma considerably determines the extent of resection of kidney tissue during partial nephrectomy (PN), and thus may impact on peri-operative outcomes. We present a novel method of calculating renal tumor contact surface area (CSA) using image-processing technology and correlate it with peri-operative variables in patients undergoing PN.

METHOD AND MATERIALS
From 01/2010-08/2011, 162 patients underwent minimally invasive PN for tumor, and had CSA data available using image rendering software (3D Synapse © Fuji film©). CSA was correlated with baseline demographics and peri-operative outcomes.

RESULTS
Mean tumor size was 3.1 cm and mean CSA was 18.3 cm2. Univariate analysis demonstrated that CSA significantly correlated with blood loss (p=0.0001), operative time (p=0.003), length of hospital stay (p=0.0028), and post-operative eGFR (0.0124). On multivariable logistic regression CSA was an independent predictor of the above outcomes as well as overall complications

CONCLUSION
In patients undergoing partial nephrectomy, tumors with greater contact surface area with surrounding renal parenchyma require a more extensive resection, thus impacting on peri-operative outcomes including blood loss, operative duration, complications and renal function. If these findings are validated in larger cohorts, future nephrometry systems could incorporate CSA measurements to objectively quantify renal tumor complexity and predict peri-operative outcomes of partial nephrectomy surgery.

CLINICAL RELEVANCE/APPLICATION
The contact surface area of a renal mass is a predictor of the amount of dissection needed during surgery and may predict operative outcomes In patients undergoing partial nephrectomy,

SSC07-07 • Renal Lesions Causing Restricted Diffusion: Breaking the Myths!

Ankur Goyal MBBS, MD (Presenter) ; **Raju Sharma** MD ; **Ashu Seth Bhalla** MBBS, MD ; **Shivanand R Gamanagatti** MBBS, MD ; **Amlesh Seth** MBBS, MCHIR ; **Ajay K Yadav** MBBS ; **Prasenjit Das** ; **Arun K Gupta** MBBS, MD

PURPOSE
• To investigate the diffusion characteristics of focal renal lesions
• To assess which renal lesions demonstrate diffusion restriction and evaluate the utility of Diffusion-weighted MRI (DW-MRI) in their differentiation.

METHOD AND MATERIALS
The institutional ethics committee waived the requirement of informed consent for this retrospective study. 120 adult patients with 225 focal renal lesions underwent MRI with DW Imaging (at b-values of 0 and 500 s/mm^2) from September 2008 – December 2012. In all, there were 65 malignant neoplasms (44 renal cell carcinomas RCCs, 10 transitional cell carcinomas TCCs, 11 miscellaneous) and 25 benign neoplasms (20 angiomyolipomas AMLs, 4 oncocytomas). In addition, there were 25 inflammatory lesions (including 19 abscesses), 45 pseudotumors (40 in diseased and 5 in normal kidneys), 15 hemorrhagic cysts and

50 benign cysts (Bosniak category I, II and IIF). Lesion ADC values were determined, compared and receiver operating characteristic (ROC) curves were drawn to establish cut-off values.

RESULTS
Both benign and malignant renal neoplasms showed restricted diffusion with mean ADC values: RCC [1.56 ± 0.40 (x 10^{-3} mm^2/s)], TCC [1.26 ± 0.12 (x 10^{-3} mm^2/s)] and AML [1.32 ± 0.19 (x 10^{-3} mm^2/s)]. Inflammatory renal lesions demonstrated lowest ADCs [1.1 ± 0.21(x 10^{-3} mm^2/s)] while hemorrhagic cysts showed wide range of ADC values [1.47 ± 0.81 (x 10^{-3} mm^2/s)]. Pseudotumors and benign cysts showed unrestricted diffusion. Individually, AMLs and TCCs showed significantly lower ADC values compared to RCCs (p=0.0133 and 0.0236 respectively). ROC analysis revealed an area under curve of 0.730 in differentiating RCC from AML and 0.809 in differentiating RCC from TCC.

CONCLUSION
The difference between the ADC values of different focal renal lesions was statistically significant and ROC analysis yielded cut-off values with high accuracy in making clinically relevant distinctions. Restricted diffusion in a renal mass does not always imply malignancy; rather benign neoplasms cause greater diffusion restriction. Renal abscesses depict lowest ADC values. Despite overlapping ranges, ADC values provide an additional paradigm for distinguishing AMLs and TCCs from RCCs.

CLINICAL RELEVANCE/APPLICATION
Diffusion restriction is not specific for malignancy; rather inflammatory renal lesions cause most marked diffusion restriction, followed by benign neoplasms and RCCs in ascending order of ADC values.

SSC07-08 ● Dual Energy CT (DECT) for Assessment of Response to Antiangiogenic Treatment in Patients with Metastatic Renal Cell Cancer (mRCC)

Katharina Hellbach MD (Presenter) ; **Alexander Sterzik** ; **Wieland H Sommer** MD ; **Martina Karpitschka** MD ; **Jozefina Casuscelli** ; **Michael Ingrisch** ; **Michael Staehler** MD ; **Anno Graser** MD *

PURPOSE
To evaluate whether dual energy CT (DECT) allows for better assessment of response to antiangiogenic treatment with multi-kinase inhibitors (MKI) than standard contrast-enhanced CT.

METHOD AND MATERIALS
17 patients with mRCC (14 males, 62.1±10.9 years; 3 females, 64.3±5.1 years) underwent baseline and follow-up single-phase abdominal contrast enhanced DECT (100 kVp/Sn140 kVp) on a dual source scanner (Somatom Definition Flash, Siemens). DECT scans were performed immediately before and 10 weeks after start of treatment with MKI. Virtual non-enhanced and color coded iodine images were generated. 31 metastases were measured at the two timepoints. We determined Hounsfield unit (HU) values for VNE and iodine density (ID) as well as iodine content (IC) in mg/ml of tissue. These values were compared to the standard venous phase CT number of the lesions.
Values before and after treatment were compared using t test.

RESULTS
Between baseline and follow up, standard CT density and ID showed a significant reduction (CT: 76.3±20.7 HU vs 52.4±19.1 HU; p=0.0001; ID: 40.4±19.0 HU vs 19.5±16.0 HU; p
CONCLUSION
Dual energy CT-based quantification of iodine content of mRCC metastases allows for significantly more sensitive detection of antiangiogenic treatment effects. Further research is warranted to correlate these findings to outcome measures of patients.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT improves detection of antiangiogenic effectsof MKI in patients with mRCC.

SSC07-09 ● Dual-energy CT: Evaluation of Hyperdense Renal Masses Incidentally Detected on Single-phase Postcontrast CT

Ji Ye Son (Presenter) ; **Chan Kyo Kim** MD, PhD ; **Dong Ik Cha** MD ; **Sung Yoon Park** ; **Byung Kwan Park** MD

PURPOSE
To determine whether dual-energy CT (DECT) can help characterize hyperdense (> 30 HU) renal masses incidentally detected on single-phase postcontrast CT.

METHOD AND MATERIALS
In 80 patients, 90 hyperdense renal masses (median size, 1.3 cm) that were incidentally detected on single-phase postcontrast CT were further evaluated with DECT. DECT protocols included true noncontrast (TNC), DE corticomedullary and DE late nephrographic phase imaging. Virtual noncontrast (VNC) and iodine overlay (IO) images were derived from DE corticomedullary and DE late nephrographic phases, respectively. The CT numbers of hyperdense renal masses were calculated on linearly blended and IO images from DE corticomedullary and DE late nephrographic phases and the results were compared. A minimum size of hyperdense renal masses was also investigated to accurately differentiate solid masses from benign cystic lesions.

RESULTS
47 benign cystic lesions (25 hemorrhagic cysts and 22 simple cysts) and 43 solid masses (24 renal cell carcinomas and 19 angiomyolipomas) were analyzed. The mean CT numbers of the renal masses calculated on IO images from DE corticomedullary and DE late nephrographic phases were statistically not different from those on the corresponding linearly blended images (P> 0.05). For differentiating solid masses from benign cystic lesions, the sensitivities of IO images from DE corticomedullary and DE late nephrographic phases were 77.6 % and 55.5%, compared with on the corresponding linearly blended images (95.7% and 80.1%), respectively (P= 0.004 and P< 0.001, respectively); the specificities of IO images from the two phases were 97.7% and 100%, compared with on the corresponding linearly blended images (97.7% and 100%), respectively (P> 0.05). The minimum size of the renal masses to accurately differentiate solid masses from benign cystic lesions without false-positive or false-negative enhancement on IO images was 1.5 cm. For the renal masses with 1.5 cm or greater, the mean CT numbers between TNC and VNC images were not significant different (P> 0.05).

CONCLUSION
DECT may be used to characterize hyperdense renal masses incidentally detected on single-phase postcontrast CT, particularly in cases with the size of 1.5 cm or greater.

CLINICAL RELEVANCE/APPLICATION
DECT can offer useful information in characterizing hyperdense renal masses on single-phase postcontrast CT, without the use of TNC images.

Neuroradiology (Imaging Genomics and New Techniques in Brain Tumors)

Monday, 10:30 AM - 12:00 PM ●N226

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OI MR NR

SSC11 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Moderator
Eu-Meng Law , MBBS *

SSC11-01 ● A Novel 3D MR Sequence Capable of Simultaneous Image Acquisitions with and without Blood Vessel Suppression: Observe Test for Efficacy in Detecting Brain Metastases

Kazufumi Kikuchi MD (Presenter) ; **Takashi Yoshiura** MD, PhD ; **Akio Hiwatashi** MD ; **Osamu Togao** MD, PhD ; **Koji Yamashita** MD ; **Hiroshi Honda** MD ; **Masami Yoneyama** ; **Makoto Obara**

PURPOSE
Post-contrast 3D gradient-echo is the standard for brain metastases, but enhancing blood vessel can be a disturbing factor. Recent studies have shown that blood vessel suppression techniques help detect metastases more efficiently. However, incompletely suppressed vessels may closely mimic metastases, hence can result in false positive results. To solve this issue, we developed a novel 3D sequence named volume isotropic simultaneous interleaved bright- and black-blood examination (VISIBLE), which allows for simultaneous acquisitions of images with blood vessel suppression (Black images) and those without (Bright images) in 5 minutes. Our purpose was to evaluate usefulness of VISIBE through an observer study.

METHOD AND MATERIALS
In VISIBLE, two sequential phases of TFE acquisition are implemented following a motion-sensitized driven-equilibrium preparation for black-blood imaging. Patients with suspected brain metastasis were prospectively imaged using both VISIBLE and conventional MPRAGE. 34 patients including consecutive 17 patients with 1 to 6 metastases and 17 with no metastasis were selected and used for the observer study. 3 radiologists read VISBLE and MPRAGE of the 34 patients in the first and second reading session. In reading VISIBLE, each observer was instructed to use Black images to pick up high signal intensity areas as candidates for metastases and Bright images as a second opinion to reject false positives such as incompletely suppressed enhancing vessels. The observers diagnostic performance was evaluated by means of the figure-of-merit (FOM) as an index of diagnostic performance derived from the JAFROC analysis, sensitivity, false-positive per case (FP/case), and reading time.

RESULTS
Compared to MPRAGE, VISIBLE was associated with significantly higher sensitivity (91.7±4.2% for VISBLE vs. 70.8±11.1% for MPRAGE, P
CONCLUSION
VISIBLE can improve radiologists' diagnostic performance in detecting brain metastases.

CLINICAL RELEVANCE/APPLICATION
VISIBLE is capable of simultaneous acquisitions with and without blood vessel suppression and can improve radiologists' diagnostic performance in detecting brain metastases.

SSC11-02 • Histogram Analysis of Intravoxel Incoherent Motion in Patients with Recurrent Glioblastoma: Initial Experience

Ho Sung Kim (Presenter) ; **Namkug Kim** PhD ; **Choong Gon Choi** MD ; **Sang Joon Kim** MD

PURPOSE
To determine whether the perfusion (f) and true diffusion (D) parameters derived from intravoxel incoherent motion (IVIM) MR imaging can be an imaging biomarker for distinguishing recurrent glioblastoma (RGM) from radiation necrosis (RN) and to compare its diagnostic accuracy with normalized cerebral blood volume (nCBV) derived from dynamic susceptibility contrast MR perfusion imaging.

METHOD AND MATERIALS
Our institutional review board approved this retrospective study. Forty-seven consecutive patients with pathologically confirmed RGM (n=27, 57.4%) or RN (n=20, 42.6%) were assessed using IVIM MR imaging. The 90th and 10th percentile cumulative histogram cutoffs for the f, D, and apparent diffusion coefficient (ADC) (f90, D10, and ADC10) were calculated respectively and then correlated with the final pathology. The best predictor for differentiating RGM from RN was determined by receiver operating characteristic (ROC) curve analyses. The f90 was correlated with nCBV90 using Pearson's correlation analysis.

RESULTS
The mean f90 was significantly higher in the RGM group (0.091 ± 0.014) than in the RN group (0.047 ± 0.019) ($p < 0.0001$). The mean D10 was significantly lower in the RGM group than in the RN group ($P = 0.021$). ROC curve analyses showed f90 to be an excellent predictor for differentiating RGM from RN, with a sensitivity of 93.6% and a specificity of 87.9%. There was a significant positive correlation between f90 and nCBV90 for all cases ($r = 0.729$; $P < 0.0001$).

CONCLUSION
A histogram analysis of IVIM perfusion and diffusion parameters can be a potential, noninvasive imaging biomarker for differentiating RGM form RN.

CLINICAL RELEVANCE/APPLICATION
Intravoxel incoherent motion (IVIM) MR imaging can simulatenously measure the diffusion and perfusion characteristics of posttreatment glioblastomas without administration of contrast material.

SSC11-03 • MRI Grading versus Histology: Predicting Survival of WHO Grade II-IV Astrocytomas

Arian Lasocki MBBS, FRANZCR (Presenter) ; **Alpha Tsui** ; **Mark Tacey** ; **Kate Drummond** ; **Kathryn Field** ; **Frank Gaillard** MBBS *

PURPOSE
Grading of intracranial astrocytomas using histopathology alone is affected by sampling error and inter- and intra-observer variability. Under-grading can result in less aggressive therapy and potentially a worse prognosis. We propose that incorporating MRI into grading will predict patient survival better than the current gold standard of histopathology alone.

METHOD AND MATERIALS
Patients with a new diagnosis of a WHO grade II-IV fibrillary astrocytoma or oligoastrocytoma were identified through the ACCORD neuro-oncology database of The Royal Melbourne Hospital. Pre-operative MRIs performed between September 2007 and December 2010 were independently reviewed on PACS by two readers, blinded to the histological grade, and an MRI grade was given. The grade was assigned primarily on the basis of the post-contrast appearances, with supplementary information from both standard and advanced sequences. The MRI and histopathological grades were compared against patient survival, adjusted for patient age.

RESULTS
A total of 245 patients met the inclusion criteria. Correlation between the two MRI readers was high, at 95% (kappa 0.87). Correlation between the MRI consensus grade and the histological grade was moderate, at 82% (kappa 0.58). Patients with MRI appearances consistent with a grade IV tumour but lower grade (II or III) histology had significantly worse survival than patients with the same histology but lower grade MRI appearances ($p = 0.001$ for grade II histology and $p = 0.013$ for grade III). Taken as a group, the survival of all these patients up-graded from lower grade histology to grade IV based on MRI was equivalent to those patients with grade IV tumours on both histology and MRI (no significant difference, $p = 0.896$). Therefore, the tumours up-graded to grade IV based on MRI behave as grade IV tumours, and at least some may truly be grade IV tumours under-graded by histology.

CONCLUSION
MRI is a better predictor of survival than histopathology for high grade gliomas, with high inter-observer agreement. Incorporating MRI into grading can therefore decrease the risk of under-grading. This has the potential to guide optimal therapy and thus substantially improve patient survival.

CLINICAL RELEVANCE/APPLICATION
MRI is currently under-utilised in the management of intracranial astrocytomas. Adding MRI information to the current histopathological grading system allows more accurate grading of astrocytomas.

SSC11-04 • 2-hydroxyglutarate (2HG) Level Is Associated to Tumor Progression in Gliomas Carrying IDH Mutations

Liya Wang MD (Presenter) ; **Juliya Kalinina** ; **Shaoxiong Wu** PhD ; **Chad A Holder** MD ; **Erwin G Van Meir** ; **Hui Mao** PhD

PURPOSE
Mutation in the isocitrate dehydrogenase (IDH) is a common feature of a major subset of primary low grade gliomas. The IDH mutation specific metabolite 2-hydroxyglutarate (2HG) can be detected and quantified by magnetic resonance spectroscopy (MRS). This study investigates whether the 2HG concentration, a possible marker for IDH mutant activity, is related to tumor progressions.

METHOD AND MATERIALS
2HG in 28 gliomas carrying IDH1/2 mutations were detected and quantified using 2D correlation MRS. Tumor volumes were determined from routine clinical MRI exams performed on each patient based on the enhancing portion of mass in post-contrast T1weighted imaging. Tumor grade and Ki-67 proliferation index (MIB) data were obtained from histopathology analysis. Two-tailed Spearman (P
RESULTS
Higher 2HG concentrations were found in tumors with higher grades. Higher 2HG level appears associated with the increased tumor volume and MIB index. However, 2HG levels in Grade IV tumor, which is considered as the secondary glioblastom multifprme (GBM) and different from low grade gliomas, is lower than those of Grade III gliomas. In all four cases with follow-up MRI and repeated biopsy, 2HG concentrations were increased when tumor progression took place from grade II to grade III two years later. In all four cases, routine MRI exams showed increased tumor volume and more pronounced contrast enhancing effect in tumors after two years. In comparison, 2HG levels obtained from MRS showed more than 2-fold of increase. These results provided patient specific examples demonstrating that the 2HG level is increasing with the elevated tumor grade in low grade gliomas carrying IDH mutations.

CONCLUSION
Findings of this study provide the evidence that IDH mutation specific 2HG level has a strong correlation with several clinically important prognostic measurements, such as tumor size and MIB index value. Excess 2HG accumulated in tumors may contribute to formation and malignant progression of glioma.

CLINICAL RELEVANCE/APPLICATION
Association of increased 2HG level and tumor progression features suggests 2HG as a MRS detectable marker for predicting glioma prognosis.

SSC11-05 • Development of an Unbiased, Semi-automated Method of Tumor Volume Segmentation Using Image Processing Software in Glioblastoma before and after Resection

Chad A Holder MD (Presenter) ; **James S Cordova** BS ; **Eduard Schreibmann** PhD * ; **Constantinos G Hadjipanayis** MD, PhD ; **Ying Guo** PhD ; **Hyunsuk Shim** PhD

PURPOSE
This work aims to standardize and evaluate an MR signal-based approach for tumor segmentation using an FDA 510k-approved software package (Velocity AI) that allows the rendering, fusion, and analysis of multi-modality 3D medical images.

METHOD AND MATERIALS
Currently, glioblastoma (GBM) volume measurements rely on the product of orthogonal tumor diameters on post-contrast T1w MRI; however, it is difficult to measure post-resection tumor in this manner, especially when hyperintense, nonneoplastic lesions are present. Though the need for objective volumetric analysis was highlighted by the NeuroOncology Working Group (Wen, PY et al. JCO 2010; 28,11 1963-1972), a standardized image display, processing, and analysis protocol has not been developed for a clinically-utilized volume rendering software. We applied our volume determination method to compare the

extent of resection (EOR) using 5-ALA-guided resection to EOR of standard resections. Datasets consisted of high-resolution pre- and post-op MR images (T1w images pre- and post-contrast) from 13 randomized patients in an Emory ALA study and 13 controls matched for tumor location. To tabulate preop tumor volume, a coarse ROI was drawn around the tumor and the software was used to segment volumes of hyper- and hypointensity on T1w MRI in the ROI in a semi-automated fashion. To estimate residual post-op tumor, image difference maps were produced by subtracting co-registered, pre- and postcontrast T1w MRI to correct for postop blood.

RESULTS
The average EOR without ALA-guidance expressed as percent residual tumor was 10.69 ± 7.45%, while that of ALA-guidance was 4.85 ± 3.98%. These values were found to be significantly different at p
CONCLUSION
These results support the use of this semi-automated method for the unbiased and reproducible generation of contrast-enhancing tumor volumes in GBM pre- and post-resection. In addition, this technology allows the selection of voxels in discrete tumor regions on T1w MRI for the quantitative analysis of treatment-induced metabolic changes in spatially-coregistered, high-resolution MR spectroscopic images.

CLINICAL RELEVANCE/APPLICATION
This method allows quantitative analysis of brain tumor response to chemo-, radiation, and surgical therapies, offering a precise tool for the longitudinal monitoring of patients in clinical trials.

SSC11-06 • Imaging Genomic Mapping Using Perfusion Uncovers Potential Genomic Targets Involved in Angiogenesis and Invasion

Rivka R Colen MD (Presenter) ; **Tapan Abrol** MD ; **Omar Ashour** MD ; **Pascal O Zinn** MD

PURPOSE
To create an imaging genomic map, linking MR imaging traits with gene- and miRNA expression profiles, in patients with GBM to determine genomic correlates of a MR perfusion radiophenotype to possibly find new genomic targets for GBM treatment. Increases in angiogenesis demonstrate increases on MRI perfusion relative cerebral blood volume (rCBV) maps. Increases in angiogenesis are seen in patients with highly aggressive and hypervascular tumors. Here, we present the first study examining in a quantitative way the perfusion imaging genomics in GBM to determine novel and targetable angiogenic biomarkers in GBM.

METHOD AND MATERIALS
We identified 30 GBM patients from The Cancer Genome Atlas (TCGA) who had both genetic- expression profiles and neuroimaging. All morphological image analyses were done using slicer 3.6 (slicer.org) and functional analysis using NordicICE, and reviewed in consensus by 2 neuroradiologists. Quantitative perfusion parameters where obtained using the region of interest (ROI) method. ROIs were placed in the previously segmented regions of contrast enhancement, necrosis, and non-enhancing perilesional FLAIR hyperintensity- the latter reflecting a mixture of edema/tumor infiltration. Biostatistics analysis was performed for gene and miRNA sets whereas the median CBV values of each of the segmented regions were taken as the cutoff to define high and low groups. These groups were then analyzed by Comparative Marker Selection (Broad Inst.). Among the whole gene set the most upregulated mRNAs/miRNAs, were analyzed with ingenuity pathway analysis (IPA).

RESULTS
IPA identified molecular networks, as well as canonical and functional pathways highly associated with cancer, angiogenesis, and invasion in those patients with high tumor rCBV.

CONCLUSION
The perfusion radiophenotype identified genes and miRNAs and corresponding molecular networks that were highly associated with angiogenesis and invasion. By these means we were able to identify possible key genes and miRNAs involved in the latter regulation. The uncovered genes and miRNAs represent new insight into tumors with high perfusion seen on MRI and the underlying molecular mechanisms in GBM for growth and treatment response.

CLINICAL RELEVANCE/APPLICATION
The discovery of imaging biomarkers reflecting specific genomic tumor compositions in necrosis is clinically relevant as they can determine aggressivity and tumor growth.

SSC11-07 • Validating MRI as a Screening Tool for Genomic Target Discovery for Therapeutic Drug Development

Rivka R Colen MD (Presenter) ; **Prateesh Sathyan** ; **Ashok J Kumar** MD ; **Pascal O Zinn** MD

PURPOSE
The search for an effective therapy of Glioblastoma Multiforme (GBM) continues. Imaging Genomics, a newly emerged field, links gene expression profiles with MRI phenotypes (Zinn et al, 2011). MRI-FLAIR was found to correlate with cellular invasion in GBM; thus, whole genome quantitative imaging analysis can reveal functional microRNA-gene regulatory networks as novel targets for cellular invasion in GBM. We sought to validate MRI as a screening tool for genomic target discovery.

METHOD AND MATERIALS
We performed radiogenomic mapping of MRI- and corresponding genomic data in 78 TCGA patients. The top microRNA-gene regulatory network was biologically validated by functional and mechanistic in-invitro and invivo orthotopic xenograft model studies using gain and loss of function. Small animal 7T MRI-T2/FLAIR was used for imaging-genomic validations.

RESULTS
The top up-regulated gene in high invasion MRI phenotypes was PERIOSTIN (POSTN). The top down-regulated microRNA (miR-219) was validated to bind to POSTN. MRI-T2/FLAIR signal highly correlated with POSTN levels and the degree of cellular invasion in orthotopic xenograft models. Furthermore, high POSTN and a high POSTN/miR-219 signature resulted in decreased survival and shorter time to progression (P
CONCLUSION
In this study, we validated a novel noninvasive diagnostic method to screen for functional networks of cellular invasion. POSTN inhibition can be a novel therapeutic approach to target invasion in GBM. Furthermore, targeted individualized molecular therapies can be based on diagnostic imaging-genomics and can be monitored through-out the treatment period.

CLINICAL RELEVANCE/APPLICATION
Imaging, specifically MRI, can be used as a screening method in order to identify genomic targets that are clinically meaningful and can potentially go on to develop genomic based therapeutics.

SSC11-08 • MRI and PET Measurements of Oxygen Extraction Fraction in Patients with Brain Tumors

Parinaz Massoumzadeh PhD (Presenter) ; **Dhanashree Rajderkar** MD ; **Hongyu An** DSc ; **Jonathan E McConathy** MD, PhD * ; **Joshua S Shimony** MD, PhD ; **Abraham Z Snyder** PhD ; **Yi Su** PhD ; **Andrei Vlassenko** MD, PhD ; **Xiaodong Zhang** PhD ; **Jon J Christensen** ; **Sarah C Jost** MD ; **Daniel S Marcus** PhD * ; **Keith M Rich** MD ; **Tammie S Benzinger** MD, PhD *

PURPOSE
To quantify and compare the cerebral oxygen extraction fraction (OEF) measurement in the normal brain and brain tumors using ^{15}O positron emission tomography (PET) and oxygen sensitive magnetic resonance (MR)[1,2] imaging.

METHOD AND MATERIALS
30 participants (20 with brain tumors) were recruited. MRI included standard clinical sequences plus OEF-MR1; a two-dimensional multi-echo gradient spin echo sequence. Concurrent with the MR acquisition, subjects with brain tumors underwent PET scanning, which included 2 sets of 3 scans with serial inhalation of air with 40-75 mCi radiolabeled carbon monoxide (C ^{15}O), 40-75 mCi radiolabeled oxygen ($^{15}O_2$), and injection of 25-50 mCi radiolabeled water ($H_2{}^{15}O$). MR and PET data were post-processed off line and registered to the anatomic T1 pre-and post-contrast images. Regions of interest were drawn based upon contrast-enhancing tumor areas, contra-lateral normal white matter (NWM), and normal gray matter (NGM) Ratios of OEF (rOEF) were obtained for lesions compared to normal tissue.

RESULTS
There is very good correlation between two OEF-PET measurements for tumor (R^2=0.90 with slope of 0.82), and for rOEF (R^2=0.93 and slope of 1.14). The OEF values of NWM are not significantly different between the OEF-PETmeasurements. OEF-MR and OEF-PET correlates well when subjects with SWI abnormalities (blood cloth, hemorrhage, calcification) are excluded (R=0.73).

CONCLUSION
Both MR and [^{15}O] PET can measure OEF in brain tumors and in peritumoral edema. Variable OEF measurements for tumor and edema may be implication for tumor grade and prognosis. BOLD MR fails in regions with signal loss on SWI or T2*. Both techniques have tremendous potential and may offer new insight into the underlying physiology of brain tumors and their response to therapy without requiring radiation or injected contrast. **References:**
[1] An and Lin (2000), 'Quantitative measurements of cerebral blood oxygen saturation using magnetic resonance imaging.' J. Cereb. Blood, Flow Metab [2] He and Yablonskiy (2007), 'Quantitative BOLD: mapping of human cerebral deoxygenated blood volume and oxygen extraction fraction: default state.' Magn Reson Med.

CLINICAL RELEVANCE/APPLICATION
Both MR and [15O] PET can measure OEF in brain tumors and in peritumoral edema and have potential to predict treatment response. BOLD MR fails in regions with signal loss on SWI or T2*.

SSC11-09 • Creating a Radiogenomics Map of Multi-omics and Quantitative Image Features in Glioblastoma Multiforme

Olivier Gevaert PhD (Presenter) ; **Lex A Mitchell** MD ; **Achal Achrol** ; **Jiajing Xu** MS ; **Gary K Steinberg** MD, PhD ; **Samuel H Cheshier** ; **Sandy Napel** PhD * ; **Greg Zaharchuk** MD, PhD * ; **Sylvia K Plevritis** PhD

PURPOSE
To create mappings between quantitative image and genomic features for glioblastoma multiforme (GBM) and to assess the prognostic association of significant correlations.

METHOD AND MATERIALS
We obtained multi-omics data from 251 patients and MR image data from a subset of 55 patients in the Cancer Genome Atlas (TCGA) and The Cancer Imaging Archive (TCIA) GBM databases. A board certified neuroradiologist traced 2D regions of interest (ROI) around necrotic and enhanced parts of the largest lesion in a selected slice from a T1 post-contrast MR, and around the region of hyperintensity obtained from the enhancement on the matched T2 FLAIR slice. These ROIs were used to compute quantitative image features from their shapes and pixel values. We used a module network algorithm that integrates copy number, DNA methylation and gene expression data into 100 co-expressed gene modules, modeled by sparse linear regression of driver genes, which were selected based on a significant correlation of copy number or DNA methylation with their respective gene expression. We established a radiogenomics map by correlating the modules with the quantitative image features, and correlated the image features from this map with significant correlations with survival using Cox proportional hazards modeling.

RESULTS
A total of 28 quantitative image features were extracted for each of the necrosis, enhancement and edema ROIs in each patient. The radiogenomics map between modules and quantitative image features revealed 14, 10 and 16 significant gene-module associations with necrosis, enhancement and edema ROIs respectively. For example we found a significant correlation between Module 64, enriched with genes in neuronal differentiation, and the compactness of the necrosis (p=0.0145). Also, we found that the amount of necrosis vs. enhancement or edema is correlated with Module 74, enriched in metabolism related genes (p
CONCLUSION
Creating radiogenomics maps provides multi-scale insight by associating image features with molecular function. Moreover, these maps may provide additional insight for image features with prognostic correlations.

CLINICAL RELEVANCE/APPLICATION
Associating activation of molecular pathways with image features has the potential of allowing non-invasive assessment of the molecular properties of a tumor at the time of diagnosis.

France Presents 2013

Monday, 10:30 AM - 12:00 PM • E353C

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SSC17 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Nicolas Grenier , MD

SSC17-01 • Opening Remarks
Sarah S Donaldson MD (Presenter) ; **Jean-Pierre Pruvo** MD, PhD (Presenter)

SSC17-02 • Whole Body Diffusion in Hematology Malignancies

Alain Luciani MD, PhD (Presenter) * ; **Emmanuel Itti** MD ; **Alain Rahmouni** MD

Whole body Diffusion Weighted Imaging in Hematologic Malignancies
Alain LUCIANI1,2, Emmanuel ITTI3,2, Alain RAHMOUNI1,2
1 AP-HP, CHU Henri Mondor Albert Chenevier, Imagerie Medicale, Creteil, F-94010, France
2 Universite Paris Est Creteil, Creteil, F-94010, France
3 AP-HP, CHU Henri Mondor Albert Chenevier, Nuclear Medicine, Creteil, F-94010, France Imaging biomarkers are important tools for the detection and characterization of cancers as well as for monitoring the response to therapy. Whole-body molecular imaging, in particular using 18F-fluorodeoxyglucose (FDG) positron emission tomography (PET), has been proven useful in the evaluation and management of lymphoma patients. FDG-PET has evolved as a valuable biomarker in aggressive lymphomas, which is the current state-of-the-art imaging technique for response assessment at the end of treatment. Whole-body magnetic resonance imaging (MRI) providing high-resolution anatomical information with multichannel surface coils mounted on a movable table and parallel imaging technique has been feasible in clinical routine in the recent five years. Functional MRI probing tumor neoangiogenesis and cell density diffusion-weighted MR imaging (DWI) have been recently used on a whole body scale. Parameters derived from DWI namely the apparent diffusion coefficient (ADC) are appealing as imaging biomarkers because the acquisition is non-invasive, does not require any exogenous contrast agents, does not use ionizing radiation yet is quantitative and can be obtained relatively rapidly, and is easily incorporated into routine patient evaluations. Hence, like PET, DWI provides both qualitative and quantitative information. For lymphomas, where disseminated disease with both nodal and/or extranodal involvement is common, technical development and optimization of whole-body DWI could potentially add complementary information to current state-of-the-art imaging techniques and prove to be helpful in patient management
The aim of this lecture will be to review technical requirements of whole body MR imaging, as well as on-going and future hematologic malignancies applications.
Discussion and conclusion :
WB-MRI can allow combination of morphologic and functional data on a whole body scale.
Further optimization of MR instrumentation, standardization of MR protocols are mandatory.
Large-scaled prospective studies are needed before this new potential imaging-based biomarker can be validated. References :
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SSC17-03 • Beyond Morphology: Molecular Imaging for Biopsy Guidance in Oncology

Eric De Kerviler MD (Presenter) ; **Alexandre Coffin** ; **Stephanie Cohen-Zarade** ; **Cedric M De Bazelaire** MD

Purpose/Aim:
To learn about applications of biomarkers and functional imaging to optimize image-guided biopsy Content:
Molecular and functional imaging has become an integral step in the evaluation of cancer patients. Most primary tumors are now biopsied under image-guidance to determine the best therapeutic strategy. However, the standard image-guided biopsy entails sampling a small portion of a tumor. Tumors are notoriously heterogeneous so that a small amount of tissue may not adequately represent the most aggressive component. Serial biopsies to account for variable expression of molecular targets throughout the tumor (tumor heterogeneity) are typically not practical. In order to optimize tissue sampling, molecular imaging can provide a more complete insight into living tumors. The ability of PET/CT to demonstrate malignancies, which are not visible on anatomic images, increases the number of biopsy requests based on foci of tracer uptake. Also, some neoplasms may demonstrate nonuniform tracer uptake and can be mostly necrotic or contain metabolically active tumor cells in only a small portion of the total mass. Image fusion with MR can also be used to target biopsies toward areas with restricted diffusion. Dynamic contrast enhancement studies using MRI, CT or ultrasound nicely demonstrate foci of microvascular anomalies suitable for biopsy. Lastly, elastography depicts the stiffness of tissues, identifying desmoplasia in malignant tumors. Summary: Molecular and functional imaging has become essential in the planning of image-guided biopsies.

SSC17-04 • Intra-arterial Therapy of Liver Malignancies: Where Do We Stand-Future Trends

Thierry J De Baere MD (Presenter) * ; **Frederic Deschamps** ; **Geoffroy Farouil** ; **Julien Joskin** ; **Lambros C Tselikas** MD

Abstract France Presents
Intra-arterial hepatic therapy for liver tumors
Intra-arterial therapies directed to the liver take advantage that the liver tumors are exclusively fed by the hepatic artery while the liver vascularization is 30% arterial and 70% portal. Today, most common techniques of intra-arterial therapies for colorectal cancer liver metastases (CRLM) and hepatocellular carcinoma (HCC) include hepatic arterial hepatic infusion chemotherapy (HAIC), trans arterial chemoembolization (TACE), rand radioemlbolization. The high concentration of the active compounds delivered via hepatic artery is able to increase response rates when compared with the same therapy used intravenously.
For CRLM, HAIC is used as an induction therapy in patients with unresectable liver metastases. with the goal of high morphologic response in order to render patient surgical candidate. interventional radiology can place percutaneously the indwelling catheters/ports requires for HIAC with a technical success rate close to 100%, and equivalent or superior patency when compared to surgically implanted catheters [1]. 49 patients with unresectable CRLM (>5 CRLM in 73% of patients, bilobar disease in 98%, =6 segments involved in 86%) received IAHC with FUDR and dexamethasone, plus systemic chemotherapy with oxaliplatin and irinotecan allows a 92% response rate with 47% of the patients able to undergo resection with a median survival of 50.8 and 35 months for na□ve and previously treated patients, respectively [2]. HAIC with oxaliplatinum combined with cetuximab in first-line results in overall response rate was 90% (95%CI, 70-99) and disease control rate was 100% (95%CI, 84-100) with 48% of patients were downstaged enough to undergo R0 resection and/or radiofrequency ablation. [3].
TACE is the standard of care for intermediate stage HCC and is used in neuroendocrine liver metastases (NELM). Recent technical improvement in TACE includes recent advances in delivery plateform an imaging guidance. Drug eluting beads have been demonstrated in a experimental models to increase concentration of drug in tumor [4], and have a potential benefit over drug alone. The ideal size of beads and the ideal agent to load on beads are still under investigation. It is noteworthy that the survival reported for HCC and NELM patient treated with TACE is improved in recent publication, probably as a consequences of this technical improvement and better patient selection.
Further randomised trials are needed to evaluate the real benefit of intra-arterial therapies to patient survival and to define what is the best technique of HAIC or TACE. REFERENCES
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2.Kemeny NE, et al. (2009) J Clin Oncol 27:3465-71
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SSC17-05 ● Colorectal Liver Metastases: Role of the Radiologist in the Multidisciplinary Team

Valerie Vilgrain MD (Presenter) ; **Mohamed Abdel-Rehim** MD ; **Maxime Ronot** MD ; **Magaly Zappa** MD ; **Annie Sibert** MD

Abstract France Presents
There are various treatments for liver metastases from primary colorectal cancer including surgical resection, non surgical ablative treatments, and chemotherapy. Yet, surgical resection with perioperative chemotherapy has been shown to be the best treatment option for cure in these patients. Therefore the role of the Radiologist in the Multidisciplinary Team is key and can be splitted in four topics: 1) diagnosis of liver lesions as liver metastases, 2) extrahepatic staging including nodal metastases, peritoneal implants, regional or local recurrent or residual disease, and pulmonary metastases, 3) intrahepatic staging which aims to define number and extent of liver metastases in the segmental and lobar distribution in order to evaluate surgical resectability or feasibility of non surgical ablative treatments, 4) and eventually response to chemotherapy with or without targeted therapy.
Multimodal imaging is needed to answer all these questions. The most important imaging modalities are CT, MR imaging and PET. Multidetector CT is particularly helpful for whole body investigation and anatomic information for surgical planning. MR imaging is better than CT for lesion detection and lesion characterization in the liver in particular with diffusion-weighted images and sequences using liver-specific agents. Pretherapeutic and intraoperative contrast-enhanced ultrasound may complete the work-up.

SSC17-06 ● Closing Remarks
Richard L Baron MD (Presenter) ; **Jean-Pierre Pruvo** MD, PhD (Presenter) ; **Nicolas Grenier** MD (Presenter)

Molecular Imaging Symposium: Imaging Cellular Subpopulations - Current Progress and Future Directions

Monday, 01:30 PM - 03:00 PM ● S406B

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Moderator
Michael D Kuo , MD *

MSMI23A ● Using Imaging to Track the In Vivo Contribution of Lgr5 Stem Cells in GI Cancer

Nick Barker PhD (Presenter)

LEARNING OBJECTIVES
1) To learn about in vivo lineage tracing as a technique to document endogenous stem cell activity.

ABSTRACT
Lgr5 Stem Cells in Epithelial Self-Renewal and Cancer Nick Barker: Institute of Medical Biology, 8A Biomedical Grove, 06-06 Immunos, Singapore 138648 The intestinal epithelium is subjected to a constant barrage of mechanical and chemical assault, imposing a requirement for regular self-renewal. This renewal is driven by a small population of adult stem cells residing in epithelial pockets known as crypts of Leiberkuhn. Lgr5 is a Tcf/?-catenin (Wnt) target gene specifically expressed on crypt-base columnar cells located at the base of the intestinal crypts. Employing in vivo lineage tracing we have proven these cells to be the stem cells of the small intestine and colon. The same rapid turnover of the intestinal epithelium also makes it particularly susceptible to cancer-forming mutation. Using Lgr5-CreERT2 mice to selectively induce deletion of the APC tumor suppressor gene in the intestinal stem cells, we recently proved that these Lgr5+ve stem cells are the cell-of-origin of colon cancer. This work also revealed the presence of a minor population of Lgr5+ve cells within intestinal tumors. Multicolor lineage tracing from these tumor-resident Lgr5+ve cells has demonstrated these to be cancer stem cells contributing to tumor growth in vivo.

MSMI23B ● CLARITY and Beyond: Towards Complete Structural and Molecular Investigation of Large-Scale Intact Biological Systems

Kwanghun Chung PhD (Presenter)

LEARNING OBJECTIVES
1) To understand the limitations of current imaging-based approaches in understanding disease processes. 2) To understand how CLARITY overcomes these limitations and allows cellular and subcellular imaging/molecular phenotyping while maintaining a whole system-wide perspective. 3) To explore potential clinical applications and future directions of CLARITY.

MSMI23C ● Imaging Immune Cell Subsets Using ImmunoPET

Anna M Wu PhD (Presenter) *

LEARNING OBJECTIVES
1) To delineate the advantages and disadvantages of using an antibody-based imaging approach for cell tracking. 3) To identify appropriate combinations of antibody formats and radionuclides for specific immunoPET applications.

ABSTRACT
Antibodies are attractive candidates as imaging agents due to their exquisite specificity. Recent advances in protein engineering have enabled optimization of antibodies for noninvasive imaging applications such as immunoPET, through reduction of immunogenicity, acceleration of clearance to enable rapid, same-day imaging, and provision of site-specific radioconjugation. Broader availability of non-standard PET radionuclides, including Cu-64, Zr-89, and I-124 and others, has expanded the range of biological targets and processes that can be imaged. The cell-surface CD markers provide a well-characterized set of targets that can be used to distinguish lineage, differentiation, and activation state of hematopoietic and immune cells. Corresponding antibodies can readily be converted into engineered fragments for PET imaging, and can be used to profile immune responses such as expansion, trafficking, homing, and activtion of immune cell subsets. Examples of profiling immune cells and responses in mouse models will be presented, as well as the potential for clinical translation.

MSMI23D ● New Strategies for Using Smart MRI Contrast Agents for Monitoring Cell Therapy

Michael T McMahon PhD (Presenter)

LEARNING OBJECTIVES
1) Describe the Chemical Exchange Saturation Transfer (CEST) MRI contrast mechanism and how to modify an imaging sequence to obtain this contrast. 2) List the properties that make a compound a successful CEST MRI contrast agent. 3) Describe the various methods to employ CEST MRI contrast for monitoring cell therapy.

ABSTRACT
Hydrogels have facilitated cell therapies by protecting therapeutic cells from immune responses and providing a physical cue to support the grafts. A non-invasive imaging technique that allows the monitoring of engrafted cell viability is needed as these therapies move into the clinic. Chemical Exchange Saturation Transfer (CEST) imaging is sensitive to changes in pH and ion concentrations, and as a result is well suited as a tool to obtain information on the status of these cells. We have incorporated organic CEST contrast agents into alginate hydrogels for this purpose and have developed a magnetization transfer image collection scheme suitable for obtaining high quality CEST contrast maps in the abdomen. The in vivo results upon transplanting these hydrogels into mice will be discussed.

Monday Plenary Session

Monday, 01:30 PM • Arie Crown Theater

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OI BQ

PS20 • *AMA PRA Category 1 Credit* ™: 1.25 • ARRT Category A+ Credit: 1
To receive credit, relinquish attendance voucher at end of session.
Presiding
Sarah S Donaldson , MD , *Palo Alto, CA*
President, Radiological Society of North America

Presentation of the Alexander R. Margulis Award for Scientific Excellence

Presentation of Honorary Memberships

Gabriel P Krestin , MD, PhD * , *Rotterdam, , NETHERLANDS*
Anne W Lee , MD , *Shenzhen, Guangdong, CHINA*
Malgorzata Szczerbo-Trojanowska , MD , *Lublin, , POLAND*
Introduction by
Sarah S Donaldson , MD , *Palo Alto, CA*

Eugene P. Pendergrass New Horizons Lecture: Normal and Neoplastic Stem Cells: Implications for the Radiological Sciences

Irving L Weissman , MD * , *Stanford, CA*
Introduction by
Sarah S Donaldson , MD , *Palo Alto, CA*

LEARNING OBJECTIVES
Research that bears on the earliest stages of cancer development as well as the sequelae of cancer treatment is of import not only to radiation oncologists but to diagnostic radiologists as well. Our investigation into blood-forming stem cells (HSC) and their non-self-renewing progeny hold promise for (1) regenerating the hematopoietic system after chemotherapy and radiation for cancer, (2) replacing genetically defective or otherwise damaged blood-forming systems, and (3) understanding the stages of hematopoiesis that harbor the earliest stages of pre-leukemia.
Following embryonic development, most of our tissues and organs are continuously regenerated from tissue/organ specific stem cells. The principal property that distinguishes such stem cells from their daughter cells is self-renewal; when stem cells divide they give rise to stem cells (by self-renewal) and progenitors (by differentiation). In most tissues only the primitive stem cells self-renew.
Stem cell isolation and transplantation is the basis for regenerative medicine. For example, prospectively isolated blood forming [hematopoietic] stem cells [HSC] are cancer-free even when isolated from marrow or mobilized blood containing cancer cells; autologous pure HSC transplants into women with metastatic breast cancer to rescue them from high dose chemotherapy in a phase 1/2 trial resulted in 33% overall survival, compared to 6% for unpurified mobilized peripheral blood. This is contrary to "conventional wisdom" only because the titles of most mobilized blood transplants are still called HSC transplants, even in major journals that should know better. Still, the therapy began in the 1996-8 trial has not been extended to extended phase 3 trials, largely because most oncologists counsel against it, and the company with the rights to use it does not offer it.
Pure HSC in allogeneic transplants can give graft vs host free hematopoietic regeneration, and because the host has a donor immune system, it cannot reject any organ, tissue, or tissue stem cell transplant from the HSC donor. The failure of extension of HSC transplantation clinically has blocked the testing of such protocols in humans. Nevertheless, if it is extended to it's logical conclusion, in the next decades the organ and tissue donors will not be living people, but pluripotent stem cell lines that can generate HSC and organ-specific stem cells. Because total body irradiation (TBI) is the preferred method to condition for HSC transplants, it could become a major clinical entity for the radiation therapy community.
Self-renewal is dangerous, and therefore strictly regulated. Poorly regulated self-renewal can lead to the genesis of cancer stem cells, the only self-renewing cells in the cancer. In myelogenous leukemia the developing cancer clones progress at the stage of HSC, until they become fully malignant. At this point, the "leukemia" stem cell moves to a stage of a downstream progenitor that has evaded programmed cell death and programmed cell removal, while acquiring self-renewal. While there are many ways to defeat programmed cell death and senescence, there appears to be one dominant method to avoid programmed cell removal"the expression of the cell surface "don't eat me" protein CD47, the ligand for macrophage SIRP-alpha. All cancers tested express CD47 to overcome expression of "eat me" signals such as calreticulin. Antibodies that block the CD47"SIRP-alpha interaction enable phagocytosis and killing of the tumor cells in vitro and in vivo. In primary human cancers of all types transplanted from patients to immune deficient mice orthotopically, anti-CD47 eliminates all metastases, but often requires local resection or radiotherapy to remove bulky tumors that grow faster than the macrophages can eat them. The anti-CD47 therapies are expected to be in phase 1 trials in early 2014.

Interventional Oncology Series: Hepatocellular Carcinoma

Monday, 01:30 PM - 06:00 PM • S405AB

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RO OI IR GI

VSIO21 • *AMA PRA Category 1 Credit* ™:4.25 • ARRT Category A+ Credit:5
Moderator
Jean-Francois H Geschwind , MD *

LEARNING OBJECTIVES
1) To learn the indications for transcatheter-based therapies for patients with HCC. 2) To understand the potential limitations, pitfalls, side effects and toxicities associated with transcatheter therapies for patients with HCC. 3) To know the results, imaging responses and survival benefit of various transcatheter therapies. 4) To know the future transcatheter therapies and understand their potential. 5) To learn the various combination therapies available and undergoing clinical evaluation for HCC.
ABSTRACT
01) Staging Systems, Epidemiology, and Medical -1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with HCC. 2) Identify the most appropriate treatment for early and advanced stage of HCC. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of HCC. **02) HCC mgmt in Europe** -1) To understand how HCC patients are being managed in Europe.2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the European point of view. **03) HCC mgmt in Korea** -1) To understand how HCC patients are being managed in Korea.2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Korean point of view. **04) HCC mgmt in HK/China**- 1) To understand how HCC patients are being managed in China. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Chinese point of view. **05) HCC mgmt in Japan**- 1) To understand how HCC patients are being managed in Japan. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Japanese point of view. **06) Panel Discussion:** HCC in the world **07) Intraarterial Therapies in the US: Where are we?** - 1)Understand patient selection process 2) Understand the patient indications and complications 3) Understand the rationale for combining anti-angiogenic agenst with loco-regional therapies 4)Understand the results of various catheter based intra-arterial therapies for Liver Cancer 08**) Assessment of Tumor Response** - 1)review methods of response assessment 2) discuss limitations of current methods 3) describe future imaging concepts in development **09) Tumor Board** - The algorithm by which patients with HCC are worked up and their appropriateness for transplant or resection will be discussed.

VSIO21-01 • Staging Systems, Epidemiology, and Medical Therapy

Alan P Venook MD (Presenter) *

LEARNING OBJECTIVES
1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with Hepatocellular Carcinoma. 2) Identify the most appropriate treatment for early and advanced stage of Hepatocellular Carcinoma. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of Hepatocellular Carcinoma.

VSIO21-02 • HCC Management in Europe

Riccardo A Lencioni MD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO21-03 ● Hepatocellular Carcinoma (HCC) Treated with Transarterial Chembolization and Radiofrequency Ablation: Diagnostic Efficacy of Combined Dynamic Perfusion MRI with ADC Mapping in the Assessment of Therapeutic Effects

Davide Ippolito MD (Presenter) ; **Pietro A Bonaffini** MD ; **Davide Fior** MD ; **Cristina Capraro** MD ; **Orazio Minutolo** MD ; **Sandro Sironi** MD

PURPOSE
To determine the additional predictive value obtained by the correlation of kinetic parameters derived from dynamic contrast-enhanced MR perfusion imaging with apparent diffusion coefficient (ADC) value obtained by diffusion weighted MR imaging in the assessment of therapeutic effects of interventional treatment of HCC lesions.

METHOD AND MATERIALS
A total of 54 patients with biopsy proven diagnosis of HCC lesion,that underwent to TACE or RFA treatment,were prospectively enrolled in our study.MR study was performed,using a 1.5T MRI system(Achieva, Philips),for each patient 4 weeks after the treatment and consist of multiplanar standard protocol with T2 and T1 sequences, dynamic contrast enhanced THRIVE,including also diffusion weighted imaging (DWI) with different b-value.Philips's workstation was used to generate color permeability maps showing perfusion of enhancing tumors and quantitative ADC maps.After the placing of regions of interests(ROIs)on site of the maps which best corresponded to the enhanced regions of the lesion,the following parameters were calculated:Relative Enhancement,Maximum Enhancement,Maximum Relative Enhancement,Time to Peak and ADC values, and statistical analysis was performed.

RESULTS
Perfusion parameters and ADC values of treated lesions could be quantitative assessed using parametric imaging analysis.Sixteen out of 54 patients had a residual disease and values of obtained parameters measured within residual tumor tissue were: REA 44.66, RVE 60.50, RLE 52.72, ME 553.21(%), MRE 65.95(%),TTP(s) 140.61, and 982.21 ± 103.93 $x10^{-3}mm^2/sec$.The corresponding values obtained in remaining cases in whom a complete necrosis was achieved were: REA -1.24, RVE 5.93, RLE 16.9, ME 203.24, RE 25.78, TTP 165.87 and 1682.7 ± 149.7$x10^{-3}mm^2/sec$.A significant difference(p
CONCLUSION
The quantitative multiparametric MR images analysis could offer functional quantitative information about cellular density and tumor blood supply of HCC lesions, useful in predicting and assessing treatment response.

CLINICAL RELEVANCE/APPLICATION
Combined parametric analysis of functional MRI represents an vivo marker of biological characteristic of HCC lesion, providing quantitative information useful for assessment of therapeutic response.

VSIO21-04 ● HCC Management in Korea

Jin Wook Chung MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-05 ● HCC Management in Hong Kong, China

Ronnie T Poon (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-06 ● Radiofrequency Ablation of 318 Cases of Hepatocellular Carcinoma as First Line Treatment: 10 Years Survival Result and Prognostic Factors

Wei Yang (Presenter) ; **Wei Wu** PhD ; **Jung Chieh Lee** ; **Zhong-Yi Zhang** PhD ; **Min Hua Chen** MD ; **Kun Yan** MA

PURPOSE
To our knowledge, the long-term (>5 years) survival results for radiofrequency ablation (RFA) in HCC is few. Our study aimed to investigate the efficacy of RFA for 318 patients with hepatocellular carcinoma (HCC) as first line treatment, and the prognostic factors for post-RFA survival rate.

METHOD AND MATERIALS
From 2000 to 2012, 730 patients with HCCs underwent ultrasound guided percutaneous RFA treatment in our department. Among them, 318 consecutive patients received RFA as first treatment and enrolled in this study. They were 251 males and 67 females, average age 60.3±11.3 years (24-87 years). The HCC were 1.0-6.7 cm in diameters (average 3.3±1.2 cm). Univariate and multivariate analysis with 15 potential variables were examined to identify prognostic factors for post-RFA survival rate.

RESULTS
The overall post-RFA survival rates at 1, 3, 5, 7, 10 year were 90.2%, 67.3%, 53.6%, 41.2% and 29.1%, respectively. In the 209 patients with stage I of HCC (AJCC staging), the 1, 3, 5, 7, 10 year survival rates were 94.2%, 72.9%, 63.6%, 57.6%, 41.5% , respectively. In the 239 patients with liver function class A (Child-Pugh classification), the 1, 3, 5, 7, 10 year survival rates were 94.4%, 75.8%, 64.3%, 52.3%, 32.4%, respectively. Ten potential factors were found with significant effects on survival rate, and they were AJCC staging, tumor pathological grading, number of tumors, pre-RFA liver function enzymes, pre-RFA AFP level, Child-Pugh classification, portal vein hypertension, using contrast ultrasound in RFA procedure, RFA electrode type and tumor necrosis one month after RFA. After multivariate analysis, 4 factors were identified as independent prognostic factors for survival rate, and they were Child-Pugh classification, number of tumors, pre-RFA AFP level, and portal vein hypertension. Totally, 548 RFA sessions were performed and major complications occurred in 12 sessions (2.1%).

CONCLUSION
This long-term follow-up study on a large group of HCC patients confirmed that RFA could achieve favorable outcome on HCC patients as first line treatment, especially for patients with child-Pugh class A, single tumor, low AFP level pre-RFA and without portal vein hypertension.

CLINICAL RELEVANCE/APPLICATION
This study provided evidence that RFA for early HCC was effective and safe as a first-line treatment even for patients usually considered good candidates for surgery.

VSIO21-07 ● HCC Management in Japan

Yasuaki Arai MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-08 ● A Minimal Ablative Margin Is Acceptable for Radiofrequency Ablation of Small Hepatocellular Carcinoma: A Long-term, Follow-up Study Using Magnetic Resonance Imaging with Impaired Ferucarbotran Clearance

Kensaku Mori MD (Presenter) ; **Kuniaki Fukuda** MD ; **Katsuhiro Nasu** MD, PhD ; **Michiko Nagai** MD ; **Tsukasa Saida** MD ; **Manabu Minami** MD, PhD

PURPOSE
We aimed to prospectively compare the local recurrence rates after radiofrequency ablation (RFA) for small (=3 cm) hepatocellular carcinomas (HCCs) among different ablative margin (AM) statuses on magnetic resonance imaging (MRI) with impaired ferucarbotran clearance.

METHOD AND MATERIALS
Fifty-five patients with 57 HCCs (diameter; 0.8-2.7 cm; mean ± SD, 1.6 ± 0.5 cm) underwent RFA 2-7 h after ferucarbotran-enhanced MRI. On unenhanced T2*-weighted images acquired after 3-5 days, AMs appeared as hypointense rims owing to impaired ferucarbotran clearance. AM status was classified as "AM-plus," AM completely surrounding the tumor; "AM-zero," partly discontinuous AM without tumor protrusion; or "AM-minus," discontinuous AM with tumor protrusion. The minimal AM thicknesses were measured in the AM-plus group. The range of follow-up periods in the patients with and without local recurrence was 0-45 months (10 ± 15 months) and 7-58 months (28 ± 14 months), respectively. Local recurrence rates of different AM statuses were compared using the Kaplan"Meier method and log rank test.

RESULTS
Of the 57 HCCs, 34 (60%), 16 (28%), and 7 (12%) were classified as AM-plus, AM-zero, and AM-minus groups, respectively. The respective 1-, 2-, 3-, and 4-year local recurrence rates were 3%, 8%, 8%, and 31% for the AM-plus group; 12%, 12%, 20%, and 20% for the AM-zero group; and 71%, 71%, not applicable (NA), and NA for AM-minus group. The local recurrence rates were significantly lower for the AM-plus and AM-zero groups than for the AM-minus group ($P < 0.001$ and $P = 0.003$, respectively). However, the difference of local recurrence rates between AM-plus and AM-zero groups was not significant ($P = 0.454$). In the AM-plus, the local recurrence rates were 22% (2/9), 10% (1/10), 0% (0/5), 0% (0/4), and 0% (0/6) for AMs of 1 mm, 2 mm, 3 mm, 4 mm, and =5 mm, respectively.

CONCLUSION
When AMs are assessed after RFA for small HCCs by using MRI with impaired ferucarbotran clearance, the minimal AMs are acceptable to avoid local recurrence in a long-term period, although AMs of =3 mm seems preferable.

CLINICAL RELEVANCE/APPLICATION
MRI with impaired ferucarbotran clearance enables precise assessment of AMs after RFA and will contribute to avoid not only insufficient but also overzealous treatment for small HCCs.

VSIO21-09 ● Panel Discussion: HCC in the World: How Do We Put All this Information Together? New International Staging System? Are Guidelines Really Useful?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-10 ● Intraarterial Therapies in the US: Where Are We?

Jean-Francois H Geschwind MD (Presenter) *

LEARNING OBJECTIVES
1) Understand patient selection process. 2) Understand the patient indications and complications. 3) Understand the rationale for combining anti-angiogenic agenst with loco-regional therapies. 4) Understand the results of various catheter based intra-arterial therapies for Liver Cancer.

VSIO21-11 ● Final Analysis of GIDEON (Global Investigation of therapeutic DEcisions in hepatocellular carcinoma and Of its treatment with sorafeNib): Regional Trends, Safety, and Outcomes in Patients Receiving Concomitant Transarterial Chemoembolization

Jean-Francois H Geschwind MD (Presenter) * ; **Masatoshi Kudo** ; **Jorge Marrero** * ; **Alan P Venook** MD * ; **Sheng-Long Ye** ; **Jean-Pierre Bronowicki** * ; **Xiao-Ping Chen** ; **Lucy Dagher** ; **Junji Furuse** ; **Laura Ladron De Guevara** * ; **Christos Papandreou** * ; **Arun J Sanyal** ; **Tadatoshi Takayama** ; **Seung Kew Yoon** MD, PhD ; **Keiko Nakajima** * ; **Riccardo A Lencioni** MD

PURPOSE
Transarterial chemoembolization (TACE) and sorafenib represent distinct treatment modalities for hepatocellular carcinoma (HCC), and there is a strong rationale and growing evidence supporting the use of TACE and sorafenib combined in unresectable HCC (uHCC) patients. GIDEON is a large, non-interventional study conducted in uHCC patients treated with sorafenib. The study allows for analysis of global treatment patterns in real-life practice, including concomitant TACE use.

METHOD AND MATERIALS
Data were collected from >3000 patients in whom the decision to treat with sorafenib had been made in clinical practice. Treatment history and disease characteristics were recorded at study entry; safety and outcomes data were collected during follow-up.

RESULTS
3202 patients comprised the final safety population. Of these, 47.2% received prior TACE, 10.1% received concomitant TACE, and 7.3% received TACE both prior to and concomitantly with sorafenib. Regionally, concomitant TACE use was highest in Latin America (14.4%), Asia-Pacific (13.5%), and the US (13.0%), with the lowest use in the EU (4.7%). Overall, of the patients who received concomitant TACE, the greatest number were from the US, China, and Japan (22.5%, 24.6%, and 19.1%, respectively). Patients who received concomitant TACE had a similar incidence of drug-related adverse events (88.6%) to those who did not (84.9%), as well as a similar incidence of serious drug-related adverse events (6.2% and 9.6%, respectively). In the intent-to-treat population (n=3213), median overall survival (months [95% CI]) was longer in patients who received concomitant TACE (21.6 [17.9-upper limit not estimable]) than in those who did not (9.7 [9.2-10.4]). Time to progression was also slightly higher in patients who received concomitant TACE (6.6 [5.8-7.6]) compared with those who did not (4.5 [4.1-4.8]).

CONCLUSION
The GIDEON study provides insight into treatment patterns in clinical practice. Data from the GIDEON study suggest that, globally, TACE is used concomitantly with sorafenib and appears to be a valid therapeutic option in patients with uHCC.

CLINICAL RELEVANCE/APPLICATION
The optimal role of TACE and sorafenib combined in the HCC treatment pathway is of increasing clinical interest. Data from GIDEON add to the evidence to further evaluate this approach.

VSIO21-12 ● Assessment of Tumor Response

Riad Salem MD, MBA (Presenter) *

LEARNING OBJECTIVES
1) Review methods of response assessment. 2) Discuss limitations of current methods. 3) Describe future imaging concepts in development.

VSIO21-13 ● Evaluation of Tumor Necrosis in Liver Explants after Chemoembolization or Radiofrequency Ablation as Bridge Therapies for Hepatocellular Carcinoma

Carmen Garcia Alba MD (Presenter) ; **Julien Cazejust** MD ; **Fabiano Perdigao** ; **Bertrand Bessoud** MD ; **Dominique Wendum** MD, PhD ; **Yves M Menu** MD ; **Olivier Soubrane** ; **Olivier Rosmorduc**

PURPOSE
To compare, in liver explants, the tumor necrosis rate of hepatocellular carcinoma (HCC) treated by chemoembolization (TACE) or radiofrequency ablation (RFA) as bridge therapies for patients on the waiting list for liver transplantation.

METHOD AND MATERIALS
This monocentric retrospective study included 38 liver transplanted patients between November 2009 and December 2012 with history of HCC treated with bridge therapies while on the waiting list for liver transplantation. All treatments were approved by the Multidisciplinary Tumor Board of our institution following BCLC and EASL guidelines. Treatments were performed by experienced interventional radiologists. Anatomopathologic study of the liver explants was performed by an experienced anatomopathologist.
In patients with consecutive treatments, only the last one was taken into consideration in this study.

RESULTS
Twelve patients underwent RFA for 14 lesions (mean 1.17 lesions per patient). The mean tumor size was 24mm (SD 7), with a mean necrosis rate of 93% (SD 13). No lesion treated by RFA had a necrosis rate
CONCLUSION
Tumor necrosis rate for both treatments was =80% on liver explants. RFA showed a trend toward higher tumor necrosis rate than TACE. TACE allowed treating twice as many lesions per patient as RFA (p

CLINICAL RELEVANCE/APPLICATION
The use of bridge therapies for HCC prevents from progression related dropout, with a high necrosis rate for both treatments studied (>80%) demonstrated on liver explants.

VSIO21-14 ● Tumor Board

LEARNING OBJECTIVES
1) The algorithm by which patients with HCC are worked up and their appropriateness for transplant or resection will be discussed.

VSIO21-15 ● Percutaneous Microwave Ablation of Hepatocellular Carcinoma: Early Clinical Results with 106 Tumors

Timothy J Ziemlewicz MD (Presenter) ; **J. Louis Hinshaw** MD * ; **Meghan G Lubner** MD ; **Christopher L Brace** PhD * ; **Marci Center** ; **Fred T Lee** MD *

PURPOSE
Microwave (MW) ablation is a promising technology that offers several advantages over radiofrequency (RF) ablation. The purpose of this study was to retrospectively review the results in the first 75 patients with hepatocellular carcinoma (HCC) treated with a high-power, gas-cooled MW device at a single center.

METHOD AND MATERIALS

Between December 2010 and March 2013 we treated 106 hepatocellular carcinomas in 75 patients via a percutaneous approach utilizing US and/or CT guidance. There were 65 male and 10 female patients with mean age of 61 years (range 44-82). All procedures were performed with a high-powered, gas-cooled microwave system (Certus 140, Neuwave Medical, Madison, WI). Mean power was 77 Watts (range 30-140 Watts) and mean ablation time 5.3 minutes (range 1-11.5 minutes).

RESULTS
Tumors ranged in size from 0.5 to 7.0 cm (mean 2.5 cm) and median imaging follow-up was 7 months. All treatments were considered technically successful with no evidence of residual tumor at immediate post-procedure CECT. Primary treatment effectiveness by imaging was 88.7% (94/106), 92.5% (87/94) for tumors < 4 cm and 61.5% (8/13) for tumors > 4 cm. Of the tumor progression in lesions
CONCLUSION
Treating hepatocellular carcinoma using microwave ablation is safe with treatment effectiveness equivalent or improved from other percutaneous ablation modalities.

CLINICAL RELEVANCE/APPLICATION
Microwave tumor ablation can be safe and effective when compared with more established modalities such as radiofrequency ablation, however more research of effectiveness is needed.

BOOST: Head and Neck-Case-based Review (An Interactive Session)

Monday, 03:00 PM - 04:15 PM • S103AB

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MSRO23 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Suresh K Mukherji , MD
Sung Kim , MD
Carol R Bradford , MD
Ezra Cohen , MD *

LEARNING OBJECTIVES
1) Review common tumors of the head and neck. 2) Review imaging findings in head and neck malignancies that specifically change staging. 3) Review the value of imaging in directly affecting managemement and treatment.
ABSTRACT
This session will be tumor board that includes a head and neck radiologist, head and neck surgeon, medical oncologist and radiation oncolgist. We will discuss a variety of head and neck camcer cases and illustrate the value-added benefits and highlight of imaging affects staging, treatment and management.

BOOST: Gynecology-Case-based Review (An Interactive Session)

Monday, 03:00 PM - 04:15 PM • S103CD

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RO OI OB GU

MSRO26 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Beth A Erickson , MD
William Small , MD
Julian C Schink , MD
Susan A Higgins , MD
Daniel Cornfeld , MD
Joseph H Yacoub , MD *

LEARNING OBJECTIVES
1) Present the multidisciplinary management of gyneocolgic cancers including surgery, radiation and chemotherapy. 2) Highlight the importance of diagnostic imaging before, during and after treatment. 3) Highlight the importance of imaging in the planning and delivery of radiation.
ABSTRACT
The care of patients with gyneocologic cancers requires the collaboration of imaging specialists as well as gynecologic and radiation oncologists. Patterns of disease spread and recurrence have tremendous impact on the managment of these patients, and diagnostic imaging is key in defining disease at diagnosis and following patients for detection of recurrence after treatment. Image-guided radiation is considered the standard of care for both the planning of external beam and brachytherapy and is key in maximizing the benefits of radiation while minimizing the risks. Case examples of the pivotal imapct of imaging and its importance in multidisiplinary care will be highlighted in this session.

ISP: Gastrointestinal (Oncology: Staging and Distant Metastases)

Monday, 03:00 PM - 04:00 PM • E353C

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OI NM MR CT GI

SSE08 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1

Moderator
Tracy A Jaffe , MD
Moderator
Brian C Lucey , MBBCh

SSE08-01 • Gastrointestinal Keynote Speaker: Imaging and Cancer Staging-Present and Future
Tracy A Jaffe MD (Presenter)

SSE08-03 • Integrated Whole Body PET/MR for Evaluation of Abdominal Malignancies: Does It Really Add Clinical Value Compared with Contrast-enhanced Body CT Scans?

Beomsik Kang (Presenter) ; **Jeong-Min Lee** MD * ; **Yong Sub Song** MD ; **Joon Koo Han** MD ; **Byung Ihn Choi** MD, PhD *

PURPOSE
To evaluate the added value of combined positron emission tomography (PET) and magnetic resonance (MR) imaging (PET/MR) in diagnostic performance in patients with abdominal malignancy compared to that of conventional contrast-enhanced body CT examinations.

METHOD AND MATERIALS
Between October 2012 and March 2013, 77 patients who had history of abdominal malignancy underwent 18-FDG PET/MR and conventional body CT in our institution. Imaging analysis was performed to verify added values of PET/MR compared to conventional body CT for detection and characterization of abdominal tumors as well as staging. Added value of PET/MR was defined as follows: 1. Further characterization of the lesion which had been found on CT image; 2. Added detection of distant metastasis or lymph node metastasis which had not been detected on CT image; 3. Change of preoperative staging of disease. In addition, quality of image registration was subjectively assessed in a three point scale: 1: poor; 2: average; and 3: excellent. In 10 patients, patients already had their PET/CT scan performed immediately before undergoing the PET/MR examination.

RESULTS
In all patients, PET/MR examinations from head to proximal thigh were obtained within 25-35 minutes and additional dedicated MR examinations including dynamic MR imaging and diffusion weighted imaging took additional 20 minutes. In all patients except 1 patient (98.7%), quality of image registration was excellent or at least average. Overall added values of PET/MR were observed in 24 patients (31.2%). In detail, added values of MRI were observed at 13 patients (16.9%) and added values of PET were observed at 21 patients (27.3%). Further characterization of CT-detected lesions were made in 15 patients (19.5%), detection of new lesions in 5 patients (6.5%) and change of stage in 4 patients (5.2%). SUV values of the malignant tumors and the major organs on PET/MR were slightly lower than those on PET/CT.

CONCLUSION
Compared to conventional body CT, PET/MR imaging provides added value in further characterization of the lesions, detection of distant metastasis or lymph node metastasis and staging of malignancy at abdominal malignancy patients.

CLINICAL RELEVANCE/APPLICATION
PET/MR could be obtained within 1 hour, maximize diagnostic information and provide additional value for characterization and detection of abdominal malignancies, and staging compared to body CT scan.

SSE08-04 • Colorectal Cancer Staging: Comparison of Whole-body Hybrid MR/PET and PET/CT Imaging

Onofrio A Catalano MD (Presenter) ; **Dushyant V Sahani** MD ; **Francesco Crafa** MD ; **Carlo Iannace** MD ; **Peter F Hahn** MD, PhD * ; **Alexander R Guimaraes** MD, PhD * ; **Bruce R Rosen** MD, PhD * ; **Mark Vangel** PhD ; **Marco Catalano** ; **Elisa Varriale** ; **Ignazio Maria Francesco Sordelli** ; **Anna Ferrante** ; **Emanuele Nicolai** ; **Andrea Soricelli** MD ; **Marco Salvatore** MD

PURPOSE
To compare the lesion detection performance and SUV measurement accuracy of whole-body hybrid MR/ PET with PET/CT in patients with colorectal cancer (CRC).

METHOD AND MATERIALS
In this prospective IRB approved study, 15 consecutive patients with CRC underwent whole-body hybrid FDG PET/CT (Gemini TF, Philips) and same day MR/PET (Biograph mMR, Siemens). PET/CT and MR/PET studies were independently evaluated by two readers. Attenuation correction of MR/PET images was performed with Dixon sequences. The tumor with the highest FDG uptake (primary cancer or metastases) -to-liver SUV ratios were calculated and compared between PET/CT and MR/PET.

RESULTS

CONCLUSION
Hybrid MR/PET imaging provides all the diagnostic benefits in the assessment of the CRC patients with the benefits of superior local staging, nodal staging and accuracy in comparison to PET/CT.

CLINICAL RELEVANCE/APPLICATION
MR/PET might represent a very promising and innovative technique for accurate staging of CRC patients.

SSE08-05 • Comparison between MRI, CT and PET-CT for Lymph Node Staging in Patients with Squamous Cell Carcinoma of Anorectum and Anal Verge

Michael R Torkzad MD, PhD (Presenter) * ; **Hakan Ahlstrom** ; **Jens Sorensen** ; **Peter Nygren**

PURPOSE
To compare T2 weighted imaging on MRI with contrast-enhanced CT with PET-CT and biopsy for lymph node staging in squamous cell carcinoma of anorectum and anal verge

METHOD AND MATERIALS
35 patients with histologically confirmed squamous cell carcinoma of anorectum and anal verge with available MRI and contras-enhanced CT prior to PET-CT and biopsy were identified from the database.
10 lymph node stations were identified: inguinal (x2), internal iliac (x2), external iliac (x2), common iliac (x2), perirectal (x1) and paraaortic (x1). Based on signal characteristics on T2 weighted images of lymph node stations and the primary tumor and lymph node size node were classified into malignant and benign with different sets of criteria. Similarly, nodal stations were staged on contrast-enhanced pelvic CT based on size and different density criteria. Reference test comprised of histopathology whenever available, otherwise FDG-PET/CT with Max SUV = 2.5.

RESULTS
The best set of criteria for assessment of lymph node staging was obtained by CT based on any of the following criteria:
1. Lymph short axis diameter = 2 times the largest reported normal size
2. Clear sign of necrosis
3. Density of the node = the primary tumor.
With these criteria a sensitivity and specificity of 100% was achieved on CT. Non-enhanced MRI achieved significantly less promising results than CT ($p < 0.01$).

CONCLUSION
Contrast-enhanced CT can identify all pelvic nodes that are deemed malignant on FDG-PET/CT in patients with squamous cell carcinoma of anorectum and anal verge. This might reflect increased flow seen in metablically active tumors as seen on PET/CT. Non-enhanced MRI cannot achieve the same good results.

CLINICAL RELEVANCE/APPLICATION
Contrast-enhanced CT is sufficient for lymph node staging in squamous cell carcinoma of anorectum and anal verge, decreasing the need for biopsy and PET/CT while MRI without contrast is insufficient.

SSE08-06 • Does PET/CT Derived Tumor Heterogeneity and Glucose Uptake Predict Survival in Primary Colorectal Cancer Patients?

Ming Young S Wan MBBChir ; **Balaji Ganeshan** PhD (Presenter) * ; **Alec Engledow** ; **Daren Francis** ; **Nick Reay-Jones** ; **Manuel Rodriguez-Justo** ; **Vicky J Goh** MBBCh * ; **Marie Meagher** ; **Jacquie Peck** ; **Kim Jaggs** ; **Jackie Hayward** ; **Helen Whiteway** ; **Zia Saad** ; **Faira Rizal** ; **Jakub Nalepa** * ; **Michael Hayball** * ; **Robert Kozarski** ; **Peter J Ell** MD * ; **Stuart A Taylor** MBBS ; **Steve Halligan** MD ; **Kenneth Miles** * ; **Ashley M Groves** MBBS *

PURPOSE
To investigate the prognostic value of FDG PET and CT textural analysis (CTTA) in determining overall survival in primary colorectal cancer.

METHOD AND MATERIALS

RESULTS
3 patients were lost to follow up leaving 126 for analysis (79-males; 47-females;
mean-age 62.6±10·6y). 39 (31.0%) patients died during follow-up. Univariate analysis
revealed that textural heterogeneity (p=0.012) and tumor clinical stage (p=0.003)
predicted survival but SUVmax or size did not. Using multivariable analysis, tumor
computed tomography textural heterogeneity (p=0.026) and stage (p independent survival predictors.

CONCLUSION
Using a cross validation model, tumor heterogeneity as measured on CT is
shown to be a survival factor for patients with primary colorectal cancer, independent of
clinical stage.

CLINICAL RELEVANCE/APPLICATION
Given that performing textural analysis is simple and could be easily adopted into clinical workflow, it
would have potential management implications for primary colorectal cancer patients.

ISP: Genitourinary (Intervention in the GU Tract)

Monday, 03:00 PM - 04:00 PM • E353B

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OI MR GU

SSE11 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Parvati Ramchandani , MD *
Moderator
Thomas D Atwell , MD

SSE11-01 • Genitourinary Keynote Speaker
Thomas D Atwell MD (Presenter)

SSE11-02 ● MR-guided Focal Cryoablation of Prostate Cancer Recurrence following Radiotherapy: Short Term Follow-up

Joyce G Bomers MSc (Presenter) ; **Sjoerd Jenniskens** MD ; **Derya Yakar** MD ; **Christiaan G Overduin** MSc ; **Henk Vergunst** ; **Emile Van Lin** MD ; **Frank De Lange** PhD ; **Erik Cornel** MD, PhD ; **Jelle O Barentsz** MD, PhD ; **Michiel Sedelaar** MD, PhD ; **Jurgen J Futterer** MD, PhD

PURPOSE
To assess short-term clinical outcome of MR-guided focal cryoablation in patients with prostate cancer (PCa) recurrence after previous radiotherapy.

METHOD AND MATERIALS
Between May 2011 and April 2013, 31 MR-guided focal cryoablation procedures were performed in 28 patients with histopathologically proven local PCa recurrence after radiotherapy without evidence for local or distant metastases.
Follow-up after MR-guided cryoablation consisted of a visit to the urologist, PSA-level measurement and a multi-parametric MRI after 3, 6 and 12 months.

RESULTS
In one patient the procedure was cancelled because the urethral-warmer could not be inserted. Two months later he was treated successfully. All other procedures were technically feasible. Follow-up ranged from 0 – 22 months with a median of 10 months. One patient died 4 months after treatment for reasons unrelated to PCa.
In 4/28 of the patients mild incontinence, defined as urge-incontinence, was seen. Temporary urinary retention was experienced by 2/28 of the patients, 2/28 suffered from continuing urinary retention, needing clean-intermittent catheterization. One of them needed surgery to remove an urethral stricture. Fistulas were not recorded. Four patients underwent an MR-guided biopsy after six months and one patient after 12 months, because of a tumor suspicious region on the multi-parametric MR images. In two patients the biopsies were negative for tumor recurrence. In the other 3 patients recurrent or remnant PCa was histopathologically proven and they were successfully re-treated with MR-guided cryotherapy after respectively 8, 8 and 14 months.
Node metastases were found in 2 patients after respectively 3 and 22 months. In another patient, bone metastases were seen 3 months after MR-guided cryoablation.

CONCLUSION
Initial results of MR-guided focal cryoablation of recurrent PCa after radiotherapy are promising, however longer follow-up is needed and more patients have to be studied.

CLINICAL RELEVANCE/APPLICATION
Initial results of MR-guided focal cryoablation of recurrent PCa after radiotherapy are promising, however longer follow-up is needed and more patients have to be studied.

SSE11-03 ● Long-term Results after Magnetic Resonance-guided Focused Ultrasound Surgery (MRgFUS) Treatment of Patients with Symptomatic Uterine Fibroids

Julia Kamp MD (Presenter) ; **Vera Froeling** MD ; **Patrick Freyhardt** ; **Matthias David** PhD ; **Alexander N Beck** MD

PURPOSE
Long-term results after magnetic resonance-guided focused ultrasound surgery (MRgFUS) treatment of premenopausal women with symptomatic uterine fibroids. Outcome was measured by the Uterine fibroid Symptom and Quality of Life Questionnaire (UFS-QOL).

METHOD AND MATERIALS
Retrospective evaluation of 54 patients, who were initially included into a prospective short-time study. MRgFUS treatment had been performed between 2003 and 2008. Patients were readdressed to receive long-term results of this collective. Clinical outcome was assessed by the fibroid specific questionnaire UFS-QOL. Results at baseline, after 3, 12 and a mean time of 59 months are presented.

RESULTS
After MRgFUS-treatment of symptomatic uterine fibroids quality of life improved significantly. Symptom relief was seen after 3 and 12 months and especially at long-term follow-up after a median time of 59 months. The score of overall quality of life increased significantly from a median of 64.7 (QR: 28.1-56.3) to 77.6 (QR: 61.4-87.1) after 3 months (p
CONCLUSION
MRgFUS therapy of symptomatic uterine fibroids leads to long-term symptom relief (mean 59 months). The rate of reinterventions might be reduced by improved patient-screening. As in current studies suggested there seem to exist possible predictors of long-term success.

CLINICAL RELEVANCE/APPLICATION
Long-term results after MRgFUS treatment of uterine fibroids are still rare, they are essential to prove effectivity and to allow comparison with other methods (surgical and minimal invasive).

SSE11-04 ● Assessment of Therapeutic Response to Radiofrequency Ablation for Renal Cell Carcinomas Using Dual-energy CT

So Yoon Park (Presenter) ; **Chan Kyo Kim** MD, PhD ; **Sung Yoon Park** ; **Byung Kwan Park** MD

PURPOSE
To retrospectively investigate the utility of dual-energy (DE) CT using virtual noncontrast (VNC) and iodine overlay (IO) images in assessing therapeutic response to radiofrequency ablation (RFA) for renal cell carcinomas (RCCs).

METHOD AND MATERIALS
47 consecutive patients with RCCs that underwent DECT after RFA were enrolled in this study. Our DECT protocols included true noncontrast (TNC), DE corticomedullary and DE late nephrographic phase imaging. VNC and IO images were derived from the DE corticomedullary and DE late nephrographic phases, respectively. For predicting local tumor progression at RFA site, linearly blended and IO images from DE corticomedullary and DE late nephrographic phases were analyzed qualitatively and quantitatively. Contrast-to-noise ratios (CNR) of renal cortex-to-RFA zone were calculated. The overall imaging quality of VNC images were compared with TNC images. The effective radiation doses for DECT and for TNC images were calculated.

RESULTS
For predicting local tumor progression, IO images from DE corticomedullary and DE late nephrographic phases showed excellent diagnostic performance (each sensitivity 100% and each specificity 91.5%). The enhancement degree of local tumor progression at linear blended versus IO images was not significantly different (P> 0.05). The mean CT numbers between TNC and VNC were not significantly different (P> 0.05). In the renal cortex-to-RFA site, the CNR between linearly blended and IO images was not significantly different (P> 0.05). The imaging quality of the VNC from the two phases was rated as good. The mean effective doses for the three-phase protocol and for TNC images were 11.2 and 2.1 mSv, respectively

CONCLUSION
DECT can be a useful tool to evaluate the therapeutic response to RFA in patients with RCCs. Moreover, VNC images can be an alternative to TNC images for evaluating the ablation zone after RFA.

CLINICAL RELEVANCE/APPLICATION
As a follow-up tool after RFA, DECT has the potential to be a preferred CT imaging modality in RCC patients, with reducing radiation exposure.

SSE11-05 ● MRgFUS as an Alternative Method to Hysterectomy in Uterine Adenomyosis: Clinical Results and Technical Approach

Fabiana Ferrari MD (Presenter) ; **Anna Miccoli** MD ; **Francesco Arrigoni** ; **Eva Fascetti** MD ; **Giulio Mascaretti** MD ; **Antonio Barile** ; **Carlo Masciocchi**

PURPOSE
To evaluate the efficacy of uterine adenomyosis treatment using magnetic resonance guided focused ultrasound surgery (MRgFUS) as a mininvasive therapy, alternative to hysterectomy.

METHOD AND MATERIALS
From October 2011 to March 2013, 54 patients aged between 24 and 51 (mean age 37.5), with symptomatic adenomyosis and uterine fibroids were treated with MRgFUS, in our department . This study includes 18 patients affected only by adenomyosis. Symptomatology was assessed through the symptoms severity score questionnaire. The technical plan was characterized by the use of a high-energy-grid-sonication. The mean energy delivered for each patient was of 3450 J (minimum value of 1300 J and maximum value of 5600 J). This allowed us to reach the therapeutic temperature also in more vascularized parts of the lesion. In order to treat the peripherical parts of the lesion, we used a shorter spot length (from 4 to 6 mm) and a shorter cooling time between the sonication. All patients were treated once and the longest treatment lasted about 120 minutes.

RESULTS
We evaluated "pre-treatment volume" measured in the T2-weighted sequences using an informatic method on single slice; "treated volume" obtained from the Exablate measurement system 2100 ; "Non Perfused Volume"(NPV), evaluated on the c.e. T1-weighted sequences made immediately after treatment. Results showed a "treated volume" mean value of 72.5% of the volume drawn by the operator. The NPV was meanly 14% greater than the"treated volume". Comparing the three different parameters we can demostrate that we treated a mean of 86.5% of the lesion. After 12 weeks, the symptomatic score showed a reduction of about 90% if compared to the pre-treatment one.

CONCLUSION
MRgFUS is a mini-invasive treatment for adenomyosis. It permits to maintain the integrity of the uterus, a good extension of NPV, a shorter hospitalization with significant reduction of the symptoms. In conclusion, it is a valid and conservative treatment in a pathology which so far had limited therapeutic perspectives.

CLINICAL RELEVANCE/APPLICATION
The study demonstrates the effectiveness of the technique in the uterine adenomyosis treatment, allowing complete resolution of symptomatology and mostly uterine saving, thus avoiding hysterectomy.

SSE11-06 ● Entirely Endophytic Small Renal Masses: Outcomes of Percutaneous Biopsy with US or CT Guidance

Mi-Hyun Kim MD (Presenter) ; **Jeong Kon Kim** MD ; **Hyuck Jae Choi** MD ; **Kyoung-Sik Cho** MD

PURPOSE
Endophytic renal tumors have been related to higher surgical complexity and higher postoperative complication rate than exophytic lesions. To avoid unnecessary surgery, the number of biopsies in these endophytic lesions is increasing in our institution. The purpose of our study was to evaluate the diagnostic rate and safety of the percutaneous core needle biopsy in patients with entirely endophytic small renal masses (SRM).

METHOD AND MATERIALS
A total of 57 biopsies of the entirely endophytic SRM (= 4 cm) were performed with 18-gauge needle from July 2004 to January 2013. The diagnostic rate, histologic finding, complication rate, the type of image guidance (US or CT), and tumor location were assessed from the retrospective chart and image reviews. Tumor location was divided into two subgroups (central- vs. peripheral tumor). Central lesions were defined as tumors protruding to the renal sinus fat and in actual contract with the pelvicalyceal system and/or main renal vessels.

RESULTS
Biopsy was diagnostic in 53 (93.0%) renal masses and nondiagnostic in 4 (7%). Among the diagnostic biopsies, 60% (32 of 53) were malignant and 40% (21 of 53) were benign. No serious complication such as active bleeding was occurred. Of the 57 biopsies, 39 were done with CT guidance and 18 with US guidance. Of the entirely endophytic SRMs, 35% (20 of 57) were central tumors and 65% (37 of 57) were peripheral tumors. Central tumors had a higher rate of malignant pathology (90% in central tumors, 44% in peripheral tumors, P < .05). The diagnostic rate was not different between central tumors (95%) and peripheral tumors (92%) (P > .05).

CONCLUSION
Percutaneous biopsy of the entirely endophytic SRMs is safe and diagnostic in most cases. Image-guided core needle biopsy can aid the clinician in the management and decision-making of the entirely endophytic SRMs.

CLINICAL RELEVANCE/APPLICATION
Image-guided biopsy can be helpful for the the management of the entirely endophytic small renal mass, and can decrease unnecessary surgery of benign tumors.

BOOST: Head and Neck Hands-on Contouring (In Cooperation with ASTRO)

Monday, 04:45 PM - 06:00 PM ●S104B

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RO OI NR HN

MSRO29 •*AMA PRA Category 1 Credit* ™:1.25 •ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Suresh K Mukherji , MD
Sung Kim , MD

LEARNING OBJECTIVES
The intent of this course is to provide direct hands-on education regarding contouring of head and neck cancer. Participants will be given the opportunity to contour head and tumor of the nasopharynx and larynx. Their contours will be compared to contours drawn by experts in head and radiation oncology and radiology. The session will emphasize various techniques approaches that enhance the participants ability to accurately contour tumor and prevent geographic misses. The session will also discuss important anatomic landmarks and patterns of spread for cancers at these sites.
ABSTRACT
The inten of this course is to provide a hands-on contouring session for head adn neck cancer. This session will be presented by a radiolgist and radiation oncologist.

Hot Topic Session: Lung Adenocarcinoma - Evolving Concepts

Tuesday, 07:15 AM - 08:15 AM ●E351

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OI CH

SPSH30 •*AMA PRA Category 1 Credit* ™:1 •ARRT Category A+ Credit:1
Moderator
Ella A Kazerooni , MD

LEARNING OBJECTIVES
1) To become familiar with the revised lung adenocarcinoma classification scheme. 2) To learn the appropriate imaging technique for detection and characterization of lung adenocarcinomas, particularly part solid and ground glass nodules. 3) To learn appropriate strategies for managing nodules with a ground glass component, including the recommendations from the Fleischner Society.
ABSTRACT
With advances in CT technnology, thinner slices of the whole lungs in a single breath hold has become routine. With the improved resolution, more small nodules, and increasingly more nodules that are partly or entirely ground glass in opacity are detected that ever before. This has become particularly evidennt through the many single are lung cancer screening with low dose CT cohort studies, and the NLST. As nodules have been resected internationally, the need to redefine these largely adenocarcinomas are was needed, resulting in a multisociety effort published in 2011; the details of this revised pathologic classification with imaging correlation be discussed and illustrated. In addition, it has been recognized that part solid nodules (mixed ground glass and solid components) carry a higher risk than pure ground glass nodules, and the latter higher risk than the more ubiquitious solid nodules. Managing these part solid and non solid nodules, together referred to as 'subsolid nodules' should therefore be different. In early 2013 the Fleischner Socity published new recommendations for how to manage solitary and multiple subsolid nodules detected on CT as a complement to their earlier recommendations for managing indeterminate lung nodules which dealt with solid nodules, The details of the subsolid nodule management recommendations will also be discussed. Recommended reading: 1) Recommendations for the Management of Subsolid Pulmonary Nodules Detected at CT: A Statement from the Fleischner Society. Radiology. 2013 Jan;266(1):304-17 http://radiology.rsna.org/content/early/2012/10/10/radiol.12120628.full 2) International Association for the Study of Lung Cancer/American Thoracic Society/European Respiratory Society International Multidisciplinary Classification of Lung Adenocarcinoma. J Thorac Oncol. 2011 Feb;6(2):244-85 http://www.ncbi.nlm.nih.gov/pubmed/21252716
URL
http://radiology.rsna.org/content/early/2012/10/10/radiol.12120628.full http://www.ncbi.nlm.nih.gov/pubmed/21252716

SPSH30A ● The Revised Lung Adenocarcinoma Classification: Justification and Radiologic-Pathologic Correlation

William D Travis (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH30B ● The Radiologist Approach to Lung Adenocarcinomas: Imaging Technique, Reporting, and Management Recommendations

David P Naidich MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

BOOST: Gastrointestinal-Anatomy and Contouring (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • S103AB

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RO OI GI

MSRO31 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Theodore S Hong , MD
Mukesh G Harisinghani , MD

LEARNING OBJECTIVES
1) Achieve a basic understanding of the anatomy pertinent to the anorectal region and imaging appearance of ano-rectal tumors. 2) Understand strengths and limitations of imaging techniques, including MRI, PET-CT and CT, as they are used in delineating primary tumor and staging involved regional nodes. 3) Identify common sites of recurrence for anorectal tumors and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for anorectal tumors, both in the locally advanced and postoperative setting.
ABSTRACT
ABSTRACT: In this course MRI will be used to contour normal anorectal anatomy as well as tumors involving this anatomical region. Also patterns of spread of pathological lymph nodes will be shown, and MRI will be used to contour the regional nodal lesions. Cases will be presented and the participants will be stimulated to do the contouring themselves, and will have feed-back on their results

BOOST: Breast-Anatomy and Contouring (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • S103CD

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RO OI BR

MSRO34 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Reni S Butler , MD
Nina A Mayr , MD

LEARNING OBJECTIVES
1) Gain an understanding of the staging of breast cancer and appropriate imaging and diagnostic studies used in the staging of breast cancer focusing on nodal evaluation. 2) Gain an understanding of the various breast imaging techniques, controversies, emerging technologies and future directions in the imaging of breast cancer, focusing on nodal evaluation. 3) Gain an understanding and appreciation of identifying and contouring nodal target volumes and radiation management of regional nodes. 4) Gain an understanding of the controversies regarding nodal evaluation and managment in the current era of neoadjuvant systemic therapy and sentinel nodal evaluation.
ABSTRACT
The managment of breast cancer has undergone rapid evolution with the increased utilization of neoadjuvant systemic chemotherapy and hormonal therapy, and increased utilization of sentinel nodal evaluation. These issues have impacted on both the imaging and radiotherapeutic managment of breast cancer, particularly with respect to the evaluation and managment of the regional lymphatics. During this 90-minute session a diagnostic radiologist and radiation oncologist will provide an overview of the principles of staging, radiographic imaging and radotherapeutic contouring and considerations in the management of breast cancer,focusing on nodal evaluation and management. The speakers will review AJCC staging, controversies regarding imaging and staging studies in the evaluation of patients with breast cancer, and provide an overview of contouring of target and normal tissue structures and radiation field considerations in the management of breast cancer with special attention to imaging, contouring and management of the regional lymphatics in the setting of primary managment, evaluation after neoadjuvant therapy, and in the setting of local-regional relapse. In this session, special attention will be given to current and evolving approaches to regional nodal evaluation and management.

Imaging of Irradiated and Ablated Tumors

Tuesday, 08:30 AM - 10:00 AM • S104A

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OI

RC318 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC318A • Imaging of Recurrent Disease in the Irradiated Head and Neck

Christopher P Hess MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Illustrate the limitations of CT, MRI and PET in the evaluation for residual and recurrent malignancy in the head and neck. 2) Review typical imaging changes that result from radiation and common pitfalls. 3) Develop a structured approach for interpreting studies in the post-radiation neck.

URL's
http://www.radiology.ucsf.edu/research/meetings/rsna

RC318B • Imaging after Ablation of Hepatic and Renal Tumors

Steven S Raman MD (Presenter)

LEARNING OBJECTIVES
1) Background on ablation and histopathological changes. 2) Understanding hepatic ablation related changes chronologically: Differences between heat, cold and electroporation on CT, MRI and US. 3) Understanding renal thermal ablation changes chronologically: Differences among heat, cold and electroporation on CT, MRI and US.

RC318C • Imaging after Irradiation of Pelvic Malignancy

Antonio C Westphalen MD (Presenter)

LEARNING OBJECTIVES
1) Recognize recurrent rectal, cervical, and prostate cancer. 2) Identify benign findings that can mimic recurrent disease. 3) Describe common complications associated with radiation treatment.

ABSTRACT

Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases

Tuesday, 08:30 AM - 10:00 AM • S504AB

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RO OI IR

RC320 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Simon S Lo , MD

LEARNING OBJECTIVES
1) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of stereotactic ablative radiotherapy (SABR) for lung, liver and other

visceral metastases. 2) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of SABR for spinal metastases in primary, postoperative and recurrent setting. 3) Understand the role of interventional radiology in the managment of lung and liver metastases. 4) Understand the controversies regarding the use of local aggressive therapy for oligometastases based on evidence from the literature.
ABSTRACT
It has been a notion that once distant metastases occur, cancer is typically widely disseminated. Hellman and Weichselbaum from University of Chicago have proposed the state of oligometastasis where the metastatic disease is limited in number and site. There is clinical evidence to suggest that local aggressive therapy such as surgical resection may prolong survival and may even achieve a cure. Most recently, non-surgical therapies such as stereotactic ablative radiotherapy and image-guided ablative therapies for oligometastases have emerged, appearing to yield promising results based on multiple retrospective studies and single arm clinical trials. There are certainly controversies with regard to the use of local aggressive therapies for oligometastases. To establish this strategy as the standard of care for oligometastasis, a randomized controlled trial comparing conventional care and local aggressive therapy would be ideal. The potential toxicities associated with these therapies have to be seriously considered before offering them to patients. Currently, there is an ongoing international randomized trial comparing SABR and conventional treatment enrolling patients in Canada and Europe and the results of this trial are eagerly awaited.

RC320A ● SABR for Visceral Oligometastases

Simon S Lo MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

RC320B ● SABR for Spinal Oligometastases

Arjun Sahgal (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

RC320C ● Interventional Radiology in the Management of Oligometastases

Sandeep Vaidya MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

RC320D ● Controversies in the Management of Oligometastases

David Palma MD, FRCPC (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

Breast Series: Emerging Technologies in Breast Imaging

Tuesday, 08:30 AM - 12:00 PM ● Arie Crown Theater

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OI DM BR

VSBR31 • *AMA PRA Category 1 Credit* ™:3.25 • ARRT Category A+ Credit:4
Moderator
Michael A Cohen , MD
Moderator
John M Lewin , MD *

LEARNING OBJECTIVES
ABSTRACT

VSBR31-01 ● Contrast Mammography

John M Lewin MD (Presenter) *

LEARNING OBJECTIVES
1) This course will review the use of contrast enhancement in mammography- prior results with temporal evaluation and current results using dual energy technology. 2) Results of trials comparing contrast enhancement with standard breast imaging such as routine mammography, ultrasound and MRI will be discussed.

ABSTRACT
Contrast-enhanced digital mammography, now a clinically available product, continues to be a fruitful area of both basic and clinical research. This session will provide an overview of the physics of CEDM, its history, recent research results, current status and potential clinical applications.

VSBR31-02 ● Contrast-enhanced Spectral Mammography vs. Mammography and MRI - Clinical Performance in a Multi-reader Evaluation

Eva M Fallenberg MD (Presenter) * ; **Felix Diekmann** MD * ; **Corinne Balleyguier** MD ; **Diane M Renz** MD ; **Ritse M Mann** MD, PhD * ; **Florian Engelken** MD, MBBCh ; **Alexander Poellinger** MD ; **Heba A Amer** ; **Clarisse Dromain** MD

PURPOSE
To compare contrast-enhanced digital mammography (CESM) to mammography (MG) and MRI on diagnostic accuracy of histologically proven breast lesions.

METHOD AND MATERIALS
The study was approved by Health Authorities and Ethics Committee. 90 consenting patients diagnosed with breast cancer were imaged with MG, CESM and MRI and underwent surgery. CESM was performed as a bi-lateral mammography starting 2 minutes after injection of 1.5ml/kg of an iodinated contrast agent (300 mg/ml) with a flow of 3ml/s. CESM images alone and MG images were interpreted by two blinded independent radiologists with an interval of minimum 4 weeks for memory wash-out. MRI was analyzed by another set of two independent readers. Per lesion sensitivity and specificity were evaluated across readers. BI-RADS 4 was defined as threshold for true positives. Gold standard was post-surgical histology.

RESULTS
105 malignant and 10 benign histologically proven lesions were assessed in this dataset.
Average sensitivity were 84.1% (reader1) and 67% (reader 2) for MG, 90.2% and 88.8% for CESM and 91.1% and 90% for MRI, respectively.
Specificity was 100% (reader 1) and 80% (reader 2) for MG, 81.8% and 90% for CESM and 71.4% and 50% for MRI.

CONCLUSION
CESM and MRI showed similar sensitivity for index cancer and multiple foci, both superior to MG. MG and CESM outperformed MRI in specificity.

CLINICAL RELEVANCE/APPLICATION
CESM is a reliable imaging technique, which may replace MRI in cases with contraindications and may replace MG due to superior diagnostic accuracy in symptomatic patients.

VSBR31-03 ● Contrast-enhanced Spectral Digital Mammogram versus Contrast-enhanced MR Mammography in the Assessment of Breast Carcinoma: Initial Clinical Experience

Maha Helal MD (Presenter) ; **Rasha M Kamal** MD ; **Radwa Essam** MBBS ; **Iman Godda** MD ; **Sahar Mansour** MD ; **Nelly Alieldin** MD ; **El-Shaimaa M Sharaf** MBBCh

PURPOSE
evaluate the diagnostic performance of contrast-enhanced spectral digital mammography versus dynamic contrast-enhanced magnetic resonance imaging in the detection and staging of breast cancer.

METHOD AND MATERIALS
In this institutional ethics approved prospective study, we compared the performance of contrast based digital mammography with magnetic resonance imaging on 70 female patients. Standard digital mammogram was done in the mediolateral oblique and craniocaudal projections followed by low (22–33 kVp) and high (44–49 kVp) energy exposures in the same projections. Sequentional post contrast magnetic resonance imaging was set in the axial orientation and

post processed using maximum intensity projection and multiplanar reconstruction images. Both examinations performed by IV injection of non- ionic contrast agent. Outcomes of the surgical specimen or ultrasound guided core biopsy were the gold standard of reference in all cases.

RESULTS
The study included 33 pathologically proved benign (47 %) and 37 (53%) malignant breast lesions. The areas of contrast uptake had been correlated with abnormalities seen on the conventional mammography. Both contrast enhanced digital mammography and magnetic resonance imaging were individually assessed in the same group of cases. Multicentric and multifocal carcinomas were detected by contrast mammograms in 29.7% (n=11) of diagnosed malignant cases, when only unifocal carcinoma was reported on conventional mammograms. In the contest of malignancy both modalities stood on the same land. Enhancement detection of some benign lesions (n=5) was limited in digital mammography. Statistical analysis yielded a sensitivity, specificity and accuracy of 93.7%, 66.6% and 80.6% compared to 93.7 %, 86.6% and 90.3% for contrast enhanced mammograms and magnetic resonance imaging respectively

CONCLUSION
Contrast-enhanced digital mammogram is non-inferior to breast MRI in the contest of detection and characterization of breast malignancy.

CLINICAL RELEVANCE/APPLICATION
Contrast-enhanced mammography is an advanced application of digital mammography that had to be compared with breast MRI as it is more applicable and cost effective.

VSBR31-04 ● Contrast-enhanced Breast Tomosynthesis versus Dynamic Contrast-enhanced Breast MRI in the Diagnosis of Suspicious Breast Lesions on Mammogram

Chen-Pin Chou MD (Presenter) * ; **Chia-Ling Chiang** ; **Tsung-Lung Yang** MD

PURPOSE
To compare the diagnostic performance of contrast-enhanced breast tomosynthesis (CEBT) and dynamic contrast-enhanced breast MRI (DCE-MRI) for breast lesions detected on digital mammogram.

METHOD AND MATERIALS
The study was approved by institutional review board. Written informed consent was obtained from all patients. A total of 102 consecutive women suspected of having breast lesions on digital mammogram between March 2012 and December 2012 underwent both CEBT and DCE-MRI. For the dual-energy CEBT, a modified Selenia Dimensions (Hologic, Inc.) machine was used. Simultaneously 2D mammogram and 3D tomosynthesis were taken after injection with 1.5 mL iodine contrast agent per kilogram of body weight of and imaged between 2 and 6 minutes after injection. Contrast-enhanced images were taken in the suspicious breast (pre-contrast MLO view, post-contrast CC and MLO view) and contralateral breast (post-contrast MLO view). The lesion classifications on CEBT were finally determined based on findings on 2D mammogram, 3D tomosynthesis and post-contrast subtraction 2D and 3D images. Women were also evaluated at 1.5T (GE) or 3T MRI (Siemens) with dedicated breast coil. CEBT and DCE-MRI were interpreted by different radiologists.

RESULTS
Total 90 histological findings were available in 76 women (mean age 50.7 years, range 35-66 years). About 89% women did not have clinical symptoms. Ten women had two breast lesions in unilateral breasts. Four women had bilateral breast lesions. Of the 90 lesions, 67% had microcalcification on mammogram. The pathology revealed 46 benign lesions and 44 breast malignancies (21 carcinoma in situ, and 23 invasive breast cancers). The sensitivity/ specificity for CEBT and DCE-MRI were 97%/63% and 91%/63%, respectively.

CONCLUSION
Both CEBT and DCE-MRI showed similar diagnostic efficacy for women with suspicious breast lesions on mammogram, but CEBT was faster and easily accomplished diagnostic tool than breast DCE-MRI.

CLINICAL RELEVANCE/APPLICATION
CEBT may be an alternative tool for women who have suspicious breast lesions and cannot tolerate breast DCE-MRI.

VSBR31-05 ● Benign Enhancement on Contrast Enhanced Dual Energy Digital Mammography

Maxine S Jochelson MD (Presenter) ; **D. David Dershaw** MD ; **Janice S Sung** MD ; **Mary Hughes** MD ; **Elizabeth A Morris** MD

PURPOSE
To describe the incidence, appearance and etiologies of non-malignant enhancing lesions depicted on contrast enhanced dual energy digital mammography (CEDM).

METHOD AND MATERIALS
In a retrospective HIPAA compliant IRB approved study, images and clinical histories of 100 consecutive women who underwent CEDM for either breast cancer staging or high risk screening were reviewed. The incidence of benign, focally enhancing lesions or diffuse parenchymal enhancement on CEDM, diagnosed by either biopsy, correlation with the clinical history or recent MRI findings, was determined.

RESULTS
CEDM was performed for staging of known cancer in 67/100 (67%) and for high risk screening in 33/100 (33%). 95/100 (95%) of patients had a breast MRI within 30 days of CEDM. Focal enhancement, subsequently determined to be the result of a benign process , was detected in 11/100 (11%) of women: 8/67 (12%) of women with cancer and 3/33 (9%) of screening patients. 5 patients demonstrated rim enhancing lesions: 3 corresponded to cysts on MRI (2 simple and 1 inflammed) and 2 to seromas at the site of recent intervention. 1 corresponded to a skin lesion on MRI. 5 other areas of focal enhancement underwent biopsy yielding radial scar, fibroadenoma, adenosis, PASH, and periductal inflammation. Diffuse background parenchymal enhancement was present in 26/100 (26%), all of whom had a similar pattern on MRI.

CONCLUSION
Focal non-malignant enhancement occurred in 11% of studies. Etiologies included cysts, seromas, a radial scar and a fibroadenoma among others. Half of them required tissue sampling to exclude malignancy. Appreciating the imaging appearance of these benign lesions may potentially prevent unnecessary biopsies in the future.

CLINICAL RELEVANCE/APPLICATION
Both focal and diffuse non malignant enhancement can be seen on CEDM. Recognition of the appearance of these findings may improve the specificity of this exam and limit unnecessary biopsies.

VSBR31-06 ● Tomosynthesis

Mark A Helvie MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the basic principles used in obtaining digital breast tomosynthesis (DBT) images. 2) To understand experimental and clinical trial data which form the basis for DBT clinical application. 3) To understand the potential benefits and areas of weakness of DBT compared to conventional mammography. 4) To understand the potential clinical applications of DBT and current regulatory status of DBT. 5) To understand future issues related to DBT.

ABSTRACT
DBT clinical trial data is emerging which will form the basis of clinical use. Because DBT has the potential to significantly change the practice of breast imaging, careful review of the results of these trials and implications for clinical practice is essential for informed decision regarding DBT.

VSBR31-07 ● Implementation of Synthesized 2D Plus Tomosynthesis Images in Breast Cancer Screening: Comparison of Performance Levels with Full Field Digital Mammography Plus Tomosynthesis in a Population-based Screening Program

Per Skaane MD, PhD (Presenter) * ; **Randi Gullien** RT * ; **Ellen B Eben** MD * ; **Ingvild N Jebsen** * ; **Unni Haakenaasen** MD * ; **Ulrika Ekseth** MD * ; **Mona Krager** MD *

PURPOSE
To compare diagnostic performance of combined FFDM plus digital breast tomosynthesis (DBT) with synthesized 2D (C-view) plus DBT in breast cancer screening.

METHOD AND MATERIALS
Eight radiologists prospectively interpreted independently 12,271 screening examinations including FFDM plus DBT and C-View plus DBT. Both reading modes included standard CC and MLO views of each breast. A 5-point rating scale for probability of cancer was used in the image interpretation. All cases with a positive score (defined as 2 or higher) were discussed at an arbitration meeting before decision for final recall. The reconstructed images (C-Views) do not require additional radiation exposure. Using analyses for binary data accounting for correlated interpretations and adjusted for reader-specific volume and performance levels and two-sided significance levels of 0.05, we compared performance levels when using C-view plus DBT with respect to positive scores, recall rates, and cancer detection rates with the corresponding FFDM plus DBT interpretations.

RESULTS

Interpretation of 12,271 independently interpreted examinations under the two modes resulted in 656 (656/12,271=5.3%) and 651 (651/12,271=5.3%) positive scores for the FFDM plus DBT and the C-view plus DBT, respectively. Following arbitration meeting, the recall rates were 297/12,271= 2.4% and 270/12,271=2.2%, respectively. The cancer detection rate was 100/12,271=0.81% and 100/12,271=0.81%, for FFDM plus DBT and C-view plus DBT, respectively. There was no significant difference in the cancer detection between the two modes (McNemar test, p=0.85).

CONCLUSION
Synthetically reconstructed 2D images applied in combination with DBT showed comparable results regarding positive predictive values and cancer detection rates with FFDM plus DBT.

CLINICAL RELEVANCE/APPLICATION
The use of synthetically reconstructed 2D images (C-View) in combination with tomosynthesis resulted in comparable performance to actual exposure generated 2D plus tomosynthesis.

VSBR31-08 ● Diagnostic Accuracy of Combination Synthetic Mammograms with Tomosynthesis vs. Combination FFDM with Tomosynthesis

Margarita L Zuley MD (Presenter) ; **Andriy I Bandos** PhD ; **Jules H Sumkin** DO * ; **Victor J Catullo** MD ; **Amy H Lu** MD ; **Denise Chough** MD ; **Marie A Ganott** MD ; **Grace Y Rathfon** MD ; **Luisa P Wallace** MD

PURPOSE
To assess the diagnostic performance of combination synthetic mammograms and tomosynthesis (synthetic 2D+Tomo) to combination FFDM and tomosynthesis (FFDM+Tomo)

METHOD AND MATERIALS
IRB approval was obtained. 123 cases deemed challenging by 2 non-participating independent reviewers were chosen from our research database to create a stress test, including 36 biopsy verified cancers, 35 biopsy proven benign lesions and 52 recalled screening exams proven to be normal on recall and 1 year follow up. 5 academic womens imagers performed a retrospective fully crossed and balanced multi case multi reader study where each study was reviewed twice, once with the synthetic mammogram and then tomosynthesis and once with the standard mammogram and then tomosynthesis. Probability of malignancy (POM) on a 100 point scale and BI-RADS scores were recorded for the 2D study and then again with tomosynthesis for each mode. Data analysis was performed using random-reader analysis (DBM MRMC, v.2.33) based on the nonparametric area under the ROC curve (AUC).

RESULTS
The reader-averaged AUC for the FFDM+Tomo and synthetic 2D+Tomo modalities were 0.898 and 0.871 correspondingly (p=0.15). Four readers performed somewhat poorer albeit not significantly (p>0.05) with synthetic 2D+Tomo. The average difference of 0.027 was not statistically significant with 95% confidence interval from -0.013 to 0.067.

CONCLUSION
Synthetic 2D mammograms with tomosynthesis allowed similar interpretive performance to standard FFDM in combination with tomosynthesis and, therefore, may be an acceptable alternative for screening.

CLINICAL RELEVANCE/APPLICATION
Lowering radiation dose during tomosynthesis based screening is possible with synthesized 2D images.

VSBR31-09 ● Features of Additional Breast Cancers Detected by Digital Breast Tomosynthesis after Normal Digital Mammography

Paula Martinez Miravete ; **Jon Etxano** MD (Presenter) ; **Pedro Slon** MD ; **Paula B Garcia** MD ; **Maite Millor** MEd ; **Luis Pina** MD, PhD

PURPOSE
To evaluate the radiological presentation and histology of breast cancers detected by digital mammography (DM) and additional cancers detected by complemmentary Digital Breast Tomosynthesis (DBT).

METHOD AND MATERIALS
From December 2010 to Septembre 2012, we prospectively recruited 9300 consecutive patients with ACR density patterns II, III and IV in a enriched population that underwent both DM and DBT (COMBO mode).165 patients with cancer were detected using the COMBO mode. Out of these 165 breast tumors, 105 were detected by DM and 71 by additional DBT. We retrospectively evaluated the features of the radiological presentation and histology of breast cancers detected by DM and breast cancers detected by DBT. For the statistical analysis we performed a Pearson's Chi Square test with the SPSS 15.0 software.

RESULTS
Significant differences were found regarding the radiological presentation of both groups (p0.05) were found in the rate of Invasive Ductal Cancers (DM= 35/105; 33%, DBT=25/61; 41%) and Invasive Lobular Carcinoma (DM= 14/105; 13.3%, DBT=13/61; 21.3%).

CONCLUSION
The additional breast cancers detected by DBT show different radiological presentation and histology than breast cancers detected with DM, being more common architectural distortions and tubular breast cancers.

CLINICAL RELEVANCE/APPLICATION
DBT is an emerging imaging technique capable to detect additional cancers not seen in conventional DM. The radiological presentation and histology of these additional cancers are different.

VSBR31-10 ● Addition of Tomosynthesis to Conventional Digital Mammograms: Effect on Image Interpretation Time of Screening Examinations

Pragya A Dang MD (Presenter) ; **Phoebe E Freer** MD ; **Kathryn L Humphrey** MD ; **Elkan F Halpern** PhD * ; **Elizabeth A Rafferty** MD *

PURPOSE
To determine the impact of the implementation of a screening tomosynthesis program on real-world clinical performance by quantifying the differences in interpretation times of conventional screening mammography to combined tomosynthesis-mammography screening for multiple participating radiologists with a wide range of experience in a large academic center.

METHOD AND MATERIALS
Ten board certified radiologists read digital mammography alone or combined tomosynthesis-mammography screening examinations in batch mode for one hour-long uninterrupted sessions, as a part of routine screening practice. Number of examinations read during each session was recorded for each reader. The experience level for each radiologist was also correlated to the average number of cases read during the hour. The BI-RADS density and BI-RADS assessment category for each examination were collected. Analysis of Variance (ANOVA) test (SAS) was used to determine differences in the number of studies interpreted per hour for different radiologists, different techniques, and different experience levels of radiologists.

RESULTS
A total of 3,665 examinations (1,502 combined tomosynthesis-mammography and 2,163 digital mammography) were interpreted by 10 radiologists, with at least 5 sessions per radiologist per modality. An average of 23.8±0.55 (14.4-40.4) and 34.0±0.55, (20.4-54.3) examinations per hour, were interpreted by combined tomosynthesis-mammography and digital mammography, respectively. The average interpretation time for a combined tomosynthesis-mammography examination was 2.8 (1.5-4.2) minutes and digital mammography was 1.9 (1.1-3.0) minutes. The time taken to read a combined tomosynthesis-mammography examination was on average 0.9 minutes longer (47% longer) compared to the digital mammography alone examination. With the increase in years of breast imaging experience, there was a decrease in the overall additional time required to read combined tomosynthesis-mammography examinations (p= 0.03, R2= 0.52).

CONCLUSION
Addition of tomosynthesis to mammography results in increased time to interpret screening examinations when compared to conventional digital mammography alone.

CLINICAL RELEVANCE/APPLICATION
Reliable estimation of differential interpretation time with tomosynthesis should prove useful in preparing for its impact on radiologists' workload and resource allocation.

VSBR31-11 ● Diagnostic Performance of Digital Breast Tomosynthesis: Comparison with Breast Magnetic Resonance Imaging and Conventional Digital Mammography in Women with Known Breast Cancers

Won Hwa Kim MD, MS ; **Jung Min Chang** MD (Presenter) ; **Ann Yi** MD ; **Woo Kyung Moon** ; **Su Hyun Lee** MD ; **Nariya Cho** MD ; **Hye Ryoung Koo** MD ; **Min Sun Bae** MD, PhD ; **Seung Ja Kim**

PURPOSE
To evaluate the diagnostic performance of digital breast tomosynthesis (DBT) compared with breast magnetic resonance (MR) imaging and conventional digital mammography (DM) in women with known breast cancers.

METHOD AND MATERIALS
This study was approved by the institutional review board and informed consent was obtained. Between March and October 2012, 176 consecutive patients with known breast cancer (mean age, 51.3 years; range, 22-78 years) underwent DM, DBT and MR imaging. All 176 index cancers and 12 additional cancer (6 ipsilateral and 6 contralateral) cancers were identified. Two radiologists independently interpreted the images from each examination without clinical information and evaluated probability of cancer (5-point scale) for all findings. Sensitivity, false-positive rates, and area under the alternative free-response receiver operating characteristic curve (AUC) were estimated with histopathology and follow-up data as a reference standard.

RESULTS
The mean invasive tumor size was 2.2cm. Sensitivity for index cancers was the highest in MR imaging followed by DBT and DM (all $P < .05$; reader 1, 98%, 93%, and 85%; reader 2, 98%, 92%, and 85%). Sensitivity for additional cancer was the highest in MR imaging followed by DBT and DM (all $P < .05$; reader 1, ipsilateral, 67%, 33%, and 0%; reader 2, ipsilateral, 83%, 50%, and 17%; reader 1, contralateral, 100%, 67%, and 50%, reader 2, contralateral, 100%, 83%, and 67%). False-positive rate was the highest in MR imaging followed by DBT and DM (reader 1, 18%, 9%, and 7%; reader 2, 13%, 8%, and 7%), and was significantly frequent in MR imaging than DBT in one reader ($P = .033$). The AUC for MR imaging, DBT, and DM were 0.946, 0.920, and 0.832 for reader 1; and 0.945, 0.912, and 0.828 for reader 2. The AUCs for DBT and MR imaging were significantly higher than DM ($P < .05$); AUCs were not significantly different between DBT and MR imaging (Reader 1, $P = .18$; Reader 2, $P = .12$).

CONCLUSION
DBT showed lower sensitivity than MR imaging in detection of index and additional breast cancers, but false positives were less frequent with DBT than MR imaging.

CLINICAL RELEVANCE/APPLICATION
With DBT, comparable diagnostic performance to MR imaging and higher performance than DM was achieved. For additional cancer detection, DBT had limited diagnostic performance compared to MR imaging.

VSBR31-12 ● Comparison of Visibility and Diagnostic Accuracy of Cone Beam Computed Tomography, Tomosynthesis, MRI and Digital Mammography for Breast Masses

Margarita L Zuley MD (Presenter) ; **Ben Guo** PhD ; **Marie A Ganott** MD ; **Andriy I Bandos** PhD ; **Victor J Catullo** MD ; **Amy H Lu** MD ; **Amy E Kelly** MD ; **Maria L Anello** DO ; **Gordon S Abrams** MD ; **Denise Chough** MD

PURPOSE
To compare lesion visibility and diagnostic accuracy of cone beam computed tomography (CBCT) and tomosynthesis (DBT) to MRI and digital mammography (FFDM)

METHOD AND MATERIALS
IRB approval was obtained. From 04/16/2009 to 06/21/2011,, 178 mass lesions in 151 consecutively consenting women underwent FFDM, DBT, CBCT and contrast enhanced MRI prior to percutaneous biopsy. 97 CBCTs were unenhanced (NC-CBCT) and 81 had contrast (CE-CBCT). DBTstudies were unenhanced. Histopathology established truth. A nonparticipating radiologist marked each lesion location. A retrospective fully crossed, balanced reader study was performed with 7 MQSA qualified academic breast radiologists who recorded lesion visibility in each mode and if visible provided a probability of malignancy (POM) score on a 100 point scale. For each mode, ROC curves were obtained by a vertical average of the reader specific curves. Statistical analyses accounting for correlation and random reader effects were performed using the MRMC analysis (DBM MRMC, v.3.0) for area under the ROC curve (AUC) and using the generalized linear mixed model (proc glimmix, SAS, v.9.3) for visibility.

RESULTS
100 benign and 78 malignant masses were included. Average size was 19.7 mm (median 14mm, range 4-100mm). Percentage of visible lesions differed (88% FFDM, 91% DBT, 82% CBCT [81% NC-CBCT sub-set, 84% CE-CBCT sub-set] and 93% MRI). For visualization, MRI was significantly better than CBCT (p
CONCLUSION
For masses MRI has the highest accuracy and visibility and was significantly better than CBCT but not DBT. CBCT accuracy and visibility improve with use of contrast but further improvements are necessary for use as an alternative to MRI, FFDM or DBT.

CLINICAL RELEVANCE/APPLICATION
Tomosynthesis may possibly be a viable alternative to MRI for breast mass evaluation.

VSBR31-13 ● Elastography

A. Thomas Stavros MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the elastic properties of normal and pathologic breast tissues. 2) To get an overview of the different ultrasound methods and technologies. 3) To learn about the clinical results obtained with the different methods. 4) To understand the role of elastography within the imaging protocol.

ABSTRACT
Real-time elastography (RTE) of the breast may easily and quickly integrate conventional breast imaging. Excitation is applied to the tissue and sophisticated algorithms are used to estimate their elasticity. Different technologies use direct mechanical or radiation force excitation. Qualitative scores and/or quantitative values are usually derived from the estimate of the effect on the tissue and help to differentiate soft benign lesions from malignancies. These are usually stiffer due to the secretion of collagen and fibronectin, and the surrounding edema. Fluid lesions almost always show a typical three-layered pattern on strain elastography. They have typical patterns even with radiation force technologies (ARFI and shear wave). These last allow a true quantitative evaluation of the acoustic modulus and promise to be the gold standard for the future applications. Clinical reports show a high diagnostic accuracy: increased specificity for atypical carcinomas and a very high specificity in benign lesions, including BI-RADS category 3 lesions. With the best cutoff point between elasticity scores 3 and 4, the true negative predictive value is over 90%. Most mistakes are linked to the histopathology of the lesions. In invasive carcinomas RTE clearly shows the peripheral infiltration improving the volume measurement; 3D elastography and tomographic imaging may help in this respect. RTE scores and values are well reproducible. Indexes of intra-observer and inter-observer agreement are very good. Elastography scores have been introduced into the new BI-RADS edition. They upgrade BI-RADS 3 lesions and downgrade 4a lesions. In daily practice this results into earlier biopsies for cancers and reduced biopsies and longer follow-up intervals for benign lesions. Elastography is easy and quick; it must become part of the evaluation of all focal lesions. Still RTE score is only a complementary descriptor to BI-RADS and its interpretation requires some training.

VSBR31-14 ● BIRADS Classification for Real Time Ultrasound Elastography: More Comprehensive, Accurate and Action Oriented Results

Mukta D Mahajan MBBS (Presenter) ; **Sonal Garg** MBBS ; **Mukund S Joshi** MD ; **Chander Lulla** MBBS

PURPOSE
1. To devise a BIRADS category of standardized breast reporting for Elastography of focal breat lesions based on the elastography score and distance ratio method of evaluating them. 2. To qualitatively assess the sensitivity, specificity, positive and negative predictive value of preset cutoffs of elastography score and distance ratio in assigning a BIRADS rating to them when compared with BIRADS grey scale ultrasound and histopathology. 3. To evaluate the efficacy of implementing this Elastography BIRADS scheme in the diagnostic pathway of evaluating breast lesions at our institution and thereby generate a protocol based guide to management. 4. To reduce the incidence of biopsies and diagnostic conundrums in assessing indeterminate focal breast lesions.

RESULTS
The data was analyzed using 2 cut offs for ES and 4 cut offs for DR to compute the most accurate scheme for BIRADS-EL categorisation.The sensitivity, specificity,PPV and NPV for BIRADS-EL was found to be 71.7%, 90.1%, 68%, 91.5%. This was found to be superior the existing methods of analysis. The area under the receiver operating characteristic (ROC) curve for BIRADS-US, ES, DR and BIRADS-EL was 0.888, 0.928, 0.938 and 0.956 respectively. After implementing BIRADS-EL as a part of diagnostic workflow and protocol, assessment of the number of biopsies that were successfully averted was analyzed. The data collected after its implementation was evaluated after 3 months, 6 months and 1 year and has shown consistent result as the study group.

CONCLUSION
The present study suggests that Elastographic BIRADS classification of focal breast lesions is mopre accurate than BIRADS grey scale ultrasound in differentiating benign and malignant lesions when both methods i.e. ES and DR are combined. This method of reporting can standardize elastography results and make them readily comparable with other modalities. Results obtained are action oriented and leave no ambiguity in inconclusive or indeterminate lesions thereby improving the quality of non-invasive diagnosis and reducing the incidence of ultrasound guided biopsies.

METHODS
We studied a total of 215 breast lesions in 112 women by B-mode ultrasonography and real time breast elastography. All the lesions were assigned an ultrasound BIRADS category based on their imaging appearance. An Elastography score (ES) of 1 to 5 and distance ratio (DR) of 1 was assigned to each lesion based on elastographic assessment. BIRADS US category 4 and 5 lesions, ES 4,5 and DR = 1 or >1 lesion were biopsied. BIRADS US 3, ES 3 and DR 0.8 to 1 lesions were either followed up every 6 months for a period of 2 years or biopsied. BIRADS US 2, ES 1,2 and DR

VSBR31-15 ● Added Value of Shear-Wave Elastography in Evaluation of Breast Masses Detected on Screening Ultrasound

Su Hyun Lee MD ; **Jung Min Chang** MD (Presenter) ; **Nariya Cho** MD ; **Hye Ryoung Koo** MD ; **Min Sun Bae** MD, PhD ; **Won Hwa Kim** MD, MS ; **Mirinae Seo** MD ; **Woo Kyung Moon**

PURPOSE
To prospectively validate the added value of shear-wave elastography (SWE) in evaluation of breast masses detected on screening ultrasound (US).

METHOD AND MATERIALS
This study was conducted with institutional review board approval, and written informed consent was obtained. From April to October 2012, B-mode US and SWE were performed for 207 breast masses detected on screening US (mean size, 1.0 cm) in 207 consecutive women (mean age, 45 years) prior to US-guided core biopsy. Ten radiologists performed the examinations and assessed the likelihood of malignancy and Breast Imaging Reporting and Data System (BI-RADS) category for breast masses using B-mode US alone and a combination of B-mode US and SWE, respectively. Radiologists were allowed to upgrade BI-RADS category 3 masses to 4a when the maximum elasticity color (Ecol) was red and to downgrade category 4a to 3 when Ecol was dark blue or light blue with a maximum elasticity value (Emax) = 65 kPa, a cutoff value determined in a prior study, to achieve the best diagnostic accuracy in differentiating benign lesions from malignant ones. The areas under the receiver operating characteristics curve (AUC), sensitivities, and specificities of the two datasets were compared.

RESULTS
Twelve of the 207 breast masses (5.8%) were malignant and consisted of nine invasive ductal carcinomas, two ductal carcinomas in situ, and one tubular carcinoma. The AUC of B-mode US increased from 0.700 to 0.879 when SWE was added (P =.002). Considering category 4a or higher as a positive result for malignancy, the sensitivities were not different between B-mode alone and combined B-mode and SWE (91.7% [11 of 12], both). However, the specificity increased from 17.4% (34 of 195) to 73.8% (144 of 195) when SWE was added (P
CONCLUSION
Combined use of SWE and B-mode US can increase both the accuracy and specificity in differentiating benign from malignant breast masses detected on screening US.

CLINICAL RELEVANCE/APPLICATION
SWE can be valuable in reducing the considerable false-positive rate of screening breast US examinations.

VSBR31-16 • Volume of Peri-tumoural Stromal Stiffness (VPSS) Surrounding Invasive Breast Cancer as Measured by 3D Shearwave Elastography (SWE): An Imaging Biomarker for Risk of Systemic Spread?

Andrew Evans MRCP, FRCR (Presenter) ; **Patsy Whelehan** MSc * ; **Sarah J Vinnicombe** MRCP, FRCR ; **Kim Thomson** ; **Lee Jordan** ; **Caroline Mitchie** ; **Colin Puride** ; **Alistair M Thompson**

PURPOSE
3D SWE allows the VPSS around breast cancers to be measured. Vascular invasion (VI) is most commonly detected at the tumour/stromal interface and is strongly associated with nodal involvement. We hypothesised that the likelihood of VI and nodal involvement may vary with the VPSS and that these relationships may be stronger than those seen between these risk factors for systemic spread and other ultrasound (US) parameters such as mean stiffness on 2D SWE, grey scale diameter and grey scale volume.

METHOD AND MATERIALS
2 and 3D grey scale US and SWE were carried out on a series of 62 consecutive breast cancers treated by immediate surgery. The VPSS and other US features were measured prior to surgery and then correlated with the presence of vascular invasion and nodal status at histologic examination. Statistical significance was ascertained using chi square and chi square test for trend.

RESULTS
VPSS has a strong relationship to VI status (p=0.003) with none of the 17 patients with 3 of VPSS having VI, 13 of 36(36%) with a VPSS between 0.5 and 3cm 3 having VI and 5 of 9(56%) with a VPSS >3cm3 having VI. Grey scale diameter and grey scale volume had significant but weaker relationships with VI (p=0.02 and 0.03 respectively). A significant relationship was also found between VPSS and nodal status (p=0.04). Nodal positivity rates using the above VPSS cut offs were 12%, 33% and 44% respectively. None of the other US parameters had statistically significant associations with nodal status

CONCLUSION
VPSS has stronger associations with markers of systemic spread than other US parameters and may be helpful in patient selection for neoadjuvant chemotherapy.

CLINICAL RELEVANCE/APPLICATION
In women with breast cancer the volume of peritumoral stiffness seen on 3D shearwave elastography may help patient selelection for neoadjuvant chemotherapy

VSBR31-17 • Shear-wave Elastography in Detection of Residual Breast Cancer after Neoadjuvant Chemotherapy

Su Hyun Lee MD ; **Jung Min Chang** MD (Presenter) ; **Nariya Cho** MD ; **Hye Ryoung Koo** MD ; **Min Sun Bae** MD, PhD ; **Won Hwa Kim** MD, MS ; **Mirinae Seo** MD ; **Woo Kyung Moon**

PURPOSE
To evaluate the accuracy of shear-wave elastography (SWE) in detecting residual cancer after neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board and the requirement for written informed consent was waived. From January 2012 to February 2013, 71 women with stage II-III invasive breast cancers who received NAC and were imaged with B-mode ultrasonography (US), SWE, and magnetic resonance imaging (MRI) before surgery were included. Clinical tumor response was assessed using image findings from B-mode US and MRI and classified into two groups (0: no residual tumor, 1: residual tumor). Quantitative elasticity values (maximum kPa) were acquired for primary lesions depicted on US. Pathological complete response (pCR) was defined as no residual invasive cancer cells. The quantitative SWE values were compared between the pCR and non-pCR group using independent samples t-test. The areas under the receiver operating characteristics curve (AUC), sensitivities, and specificities of B-mode US, MRI, and SWE for detecting residual tumor were compared, with histopathologic examination as the reference standard.

RESULTS
Of the 71 women, 15 (21.1%) achieved pCR. The mean size of residual invasive cancers was 2.1 cm (range 0.1-6.4 cm). The maximum SWE value was significantly higher in the non-pCR group (mean, 122.9 kPa) than in the pCR group (30.6 kPa) (P
CONCLUSION
SWE was accurate in the detection of residual cancer after NAC. When combined with B-mode US, the accuracy improved to a level similar to breast MRI.

CLINICAL RELEVANCE/APPLICATION
In predicting pCR after NAC, SWE can offer valuable information. Addition of SWE to conventional imaging can be useful for surgical planning in breast cancer patients.

Genitourinary Series: Prostate Cancer 2013-Review of the Disease and the Role of MR in Staging and Surveillance

Tuesday, 08:30 AM - 12:00 PM • N228

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OI MR GU

VSGU31 • *AMA PRA Category 1 Credit* ™:3.25 • ARRT Category A+ Credit:3.5
Co-Moderator
Peter L Choyke , MD *
Co-Moderator
Anwar R Padhani , MD *

VSGU31-01 • Introduction: Prostate Cancer: Why We Need Imaging

Peter L Choyke MD (Presenter) *

ABSTRACT
There have been exciting recent developments in new PET/SPECT tracers for oncology. It is now possible to examine all of the major hallmarks of cancer using PET tracers including proliferation (18F-FLT), angiogenesis (18F-Fluciclitide), apoptosis (18F-CP18) and hypoxia (18F-VM4). These agents, among others, will be introduced in the context of targeted molecular therapy of cancer.

VSGU31-02 • Basics of Prostate MRI: Detection

Masoom A Haider MD (Presenter) *

LEARNING OBJECTIVES
1) Have a systematic approach to the interpretation of multiparametric MRI for prostate cancer localization prostate. 2) Appreciate the strengths and

limitations of multiparametric MRI in cancer localization. 3) Understand the requirements for performing a state of the art prostate MRI protocol for cancer localization.

VSGU31-03 ● Role of Repeat 3T Multiparametric MR Imaging and MR-guided Biopsy versus Repeat TRUS-guided Biopsies after 1 Year Follow-up in Low-risk Prostate Cancer Patients in an Active Surveillance Protocol

E. H. J. Hamoen MD (Presenter) ; **Caroline M Hoeks** MD ; **Rik Somford** MD ; **Henk Vergunst** ; **J. Oddens** ; **Christina A Hulsbergen-Van De Kaa** MD, PhD ; **Inge Van Oort** MD, PhD ; **Fred Witjes** MD, PhD ; **Chris Bangma** ; **Jelle O Barentsz** MD, PhD

PURPOSE
To evaluate reclassification rates after 1 year follow-up of repeat 3T multiparametric MR imaging (mp-MRI) and MR guided biopsy (MRGB) versus repeat TRUS-guided biopsy (TRUSGB) for men with prostate cancer within the Prostate Cancer Research International Active Surveillance (PRIAS) study.

METHOD AND MATERIALS
From September 2009 to February 2013, 93 prostate cancer patients from 4 referral centers were included in the MR-PRIAS protocol. Inclusion criteria were: PSA =10 ng/ml, PSA density < 0,2 ng/ml/ml, clinical stage = cT2, Gleason score = 6, and = 2 positive biopsy cores. Patients underwent mp-MRI and MRGB within 3 months after diagnosis, and mp-MRI, MRGB and TRUSGB after 1 year follow-up. Reclassification was defined as more than two positive cores at repeat TRUSGB, Gleason > 6 at repeat TRUSGB or MRGB, presence of prostate cancer in = 3 separate cancer foci upon both MRGB and TRUSGB, or suspicion on T3 tumor on mp-MRI. Results of combined repeat mp-MRI and MRGB were compared with standard repeat TRUSGB at 1 year follow-up.

RESULTS
With mp-MRI + MRGB, 24/93 (26%) patients were initially reclassified. In the first year, 9/93 (10%) patients were excluded on patient request or because of other reasons.Repeat examinations at 1 year follow-up were thus far performed in 41 patients, of whom 17/41 (41%) showed reclassification and were advised to undergo radical treatment. The other 24/41 (59%) patients remained on active surveillance. Reclassification at 1 year was due to both TRUSGB and MRGB results in 6/17 patients (35%), due to TRUSGB results only in 7/17 patients (41%), and due to mp-MRI or MRGB results only in 4/17 patients (24%). Combined with standard repeat TRUSGB, performing repeat mp-MRI and MRGB after 1 year led to an additional reclassification of 10% (4/41) of the patients.

CONCLUSION
Repeat mp-MRI and MRGB after 1 year follow-up are of additional value in prostate cancer patients in an active surveillance protocol, as combining mp-MRI and MRGB with repeat TRUSGB leads to an additional reclassification of 10% of the patients.

CLINICAL RELEVANCE/APPLICATION
mp-MRI and MRGB are of added value in low-risk prostate cancer patients on active surveillance, especially shortly after the initial diagnosis. However, TRUSGB cannot be omitted at 1 year follow-up.

VSGU31-04 ● Multi-parametric MR Imaging Characteristics of Missed Prostate Cancer: Correlation with Histopathology

Nelly Tan MD (Presenter) ; **Daniel J Margolis** MD * ; **David Y Lu** MD ; **Kevin G King** MD ; **Steven S Raman** MD ; **Robert E Reiter** MD ; **Jiaoti Huang**

PURPOSE
To determine the characteristics of prostate cancer foci missed by mulit-parametric MRI.

METHOD AND MATERIALS
A HIPPA-compliant, IRB-approved retrospective study of 122 patients with multi-parametric prostate MRI were compared to whole mount prostate obtained after a radical prostatectomy was performed between October 2010 and January 2013 was performed. Clinical (age, PSA, biopsy), MR imaging (T2, DWI, DCE and MRSI), and pathologic features (Gleason Score, size of tumor, pathological stage, extracapsular extension) were obtained. A GU radiologist and pathologist collectively reviewed each case and matched the MR lesion to whole-mount pathology lesion. A standardized classification system (Pi-RADS) was used to characterize the multi-parametric MR features based on Linkert scale (1-5). Chi-square analysis was performed for categorical variable and t-test for continuous variable. A p-value of 0.05 was considered significant.

RESULTS
122 patients had 284 unique prostate tumor foci. 149 (52.5%) prostate cancer foci in 74 patients were missed by MRI. 111 (74.5%) were GS6 followed by 23 (15.4%) GS 3+4, 9 (6.0%) GS4+3, 6 (4.0%)GS 8-10. Missed CaP foci were smaller in size (0.8 vs 1.8 cm, p=0.001), had higher proportion of GS6 (74 vs 28%) and lower proportion of GS3+4 (15 vs 40%), GS4+3 (6 vs 21%), GS8-10 (4 vs 10%), compared to CaP that were detected by MR. Missed CaP had higher proportion localized to one segment of the prostate-- apex (30 v 10%), mid (37 v 18%), base(9 v 5%)-- and lower proportion of foci crossing multiple segments--apex to base (3 v 20%), apex to mid (11 vs 26%), mid to base (10 v 22%)-- compared to detected CaP lesions (p=0.0001). There was no difference in use of endorectal coil (87 vs 86%, p=0.86), PSA (7.7 v 7.1, p=0.44) or prostate volume (41 vs 45, p=0.12) between detected and missed CaP.

CONCLUSION
Prostate CaP foci missed on MRI were smaller in maximal diameter, higher in proportion of low-grade tumors (GS6), were localized to one segment of the prostate instead of crossing multiple segments compared to prostate foci detected by MR.

CLINICAL RELEVANCE/APPLICATION
Our findings has implications for the use of standard systematic prostate biopsies in addition to MR-based targeted biopsy for full characterization of tumor burden.

VSGU31-05 ● Staging Prostate Cancer with MRI
Neil M Rofsky MD (Presenter)

VSGU31-06 ● Identification of Apparent-diffusion-coefficient (ADC) Cut-off Values for the Detection of Lymph Node Metastasis During DWI-MRI in High-risk Prostate Cancer Patients: Implication for Daily Clinical Practice

Marc Regier (Presenter) ; **Christian Seiwerts** ; **Frank Oliver G Henes** MD ; **Hendrik Kooijman** * ; **Hendrik Isbarn** ; **Markus Graefen** ; **Guido Sauter** ; **Gerhard B Adam** MD ; **Lars Budaus**

PURPOSE
Recent investigations have outlined a remarkable potential of diffusion-weighted MRI (DWI) to detect lymph node metastases in various tumour entities. Therefore, the purpose of this study was to determine apparent-diffusion-coefficient (ADC) cut-off values for the differentiation of benign and malignant lymph nodes in patients suffering from prostate cancer in a high-risk constellation.

METHOD AND MATERIALS
In 59 consecutive patients classified as high-risk following the D'Amico criteria, pelvic MRI was performed one day prior to radical prostatectomy. A standardized T2-STIR and DWI sequence were applied to all patients (b-values: 0, 25, 75, 100, 200, 500 and 900). Monoexponential ADC calculation and mapping was performed for all lymph nodes within the small pelvis which had been identified reading the T2-STIR and DWI data. Overall, 1393 lymph nodes were removed during radical prostatectomy and level based drawings were used to record their location. Histopathologic analysis was performed for all dissected nodes using standard techniques. Finally, lymph nodes were dichotomized into benign and malignant and ADC cut-off values were determined using ROC, Wilcoxon and chi-square test.

RESULTS
Histopathologic analysis revealed nodal metastases in 35.6% (21/59) of all patients. The mean number of lymph nodes removed was 26 in node negative and 24 in node positive patients (p=0.35). In all patients, lymph nodes >4mm were successfully identified at MRI. In malignant lymph nodes the mean ADC was 0.76 x 10-3mm2/s, whereas in benign nodes the mean ADC was 1.43 x 10-3mm2/s (p0.99 for the differentiation of benign and malignant lymph nodes.

CONCLUSION
In a high-risk collective, DWI with ADC mapping can be used to assess lymph node metastases prior to prostatectomy. Mean and minimum ADC cut-off values of 0.98 x 10-3mm2/s and 0.74 x 10-3mm2/s allow for the discrimination of benign and malignant lymph nodes with high accuracy.

CLINICAL RELEVANCE/APPLICATION
The application of DWI with ADC cut-off values determined can help to assess nodal meastases in prostate cancer prior to surgery and should therefore be implemented into preoperative routine imaging.

VSGU31-07 ● The Role of PI-RADS Scoring System in Increasing Radiologist's Performance in Detecting Prostate Cancer with a Multiparametric-MRI Examination

Flavio Barchetti ; **Valeria Panebianco** MD ; **Valerio Forte** ; **Damiano Caruso** MD ; **Maria Giulia Bernieri** ; **Chiara Zini** MD (Presenter) ; **Carlo Catalano** MD

PURPOSE
To evaluate the gain of radiologist's performance in assessing suspected areas of prostate cancer (PC) by assessing the increase of sensitivity and specificity employing PI-RADS scoring system in a Multiparametric-MRI (Mp-MRI).

METHOD AND MATERIALS
400 patients who underwent from June 2010 to january 2013 a Mp-MRI examination of the prostate gland for raising PSA serum levels and who were positive for PC at histology, were independently retrospectively evaluated by the same 2 readers who together previously observed the exams. Reader A (R.A) was an experienced radiologyst in uro-genital field with 10 years of experience, and reader B (R.B) was a radiology resident with 3 years of experience. In the previous reading session the suspected lesions were assessed without using PI-RADS scoring system, while in the second reading session PI-RADS was employed.

RESULTS
58 patients out of 400 were originally assessed negative for the presence of morpho-functional changings both in peripheral zone (PZ) and central zone (CZ). In the second reading session R.A identified 25 PI-RADS 1, 21 PI-RADS 2 and 12 PI-RADS 3, while R.B 34 PI-RADS 1, 14 PI-RADS 2 and 10 PI-RADS 3 (K = 0.765, P = 0.134).
145 patients out of 400 were originally assessed doubtful for the presence of PC. R.A in 94 out of 145 patients subsequently considered the lesions PI-RADS 4, in 8 men PI-RADS 5 and in 43 PI-RADS 3, while R.B in 84 patients assumed the altered areas PI-RADS 4, in 5 men PI-RADS 5 and in 56 PI-RADS 3 (K = 0.754, P = 0.254).
In the remaining 197 patients the lesions were esteemed simply as suspicious PC in the previous reading session. In the second reading session R.A deemed 156 altered zones as PI-RADS 5 and the other 41 as PI-RADs 4, on the other hand R.B accounted 141 lesions as PI-RADS 5 and 56 as PI-RADS 4 (K = 0.862, P = 0.383).
All in all the sensitivity and specificity of R.A in evaluating the foci of morpho-functional changings increased respectively from 59% to 94% and from 52% to 94% (P = 0.025) and for R.B respectively from 47% to 86% and from 41% to 92% (P = 0.038).

CONCLUSION
the sensitivity and specificity of radiologist's performance in assessing suspected areas of PC by employing PI-RADS scoring system in a Mp-MRI examination seems to increase substantially reaching statistically significative results (P < 0.05).

CLINICAL RELEVANCE/APPLICATION
We highlight the importance of PI-RADS in evaluation of prostate cancer

VSGU31-08 ● The Role of Imaging in Active Surveillance

Anwar R Padhani MD (Presenter) *

LEARNING OBJECTIVES
1) To provide an overview of the concepts underpinning active surveillance (AS) strategies for low risk prostate cancer patients. 2) To illustrate the ability of multiparametric (mp) MRI (diffusion weighted, dynamic contrast enhanced and spectroscopy) to assess tumor location, volume and grade. 3) To discuss the role of mpMRI for confirming clinical patient selection criteria for AS. 4) Highlight the benefits of mpMRI for detecting cases at higher risk and thus unsuited for AS. 5) Demonstrate changing imaging phenotype during AS period.

ABSTRACT
Active surveillance is a widely accepted treatment strategy for men diagnosed with low-risk prostate cancer. However, follow up studies show that up to one third of suitable patients eventually undergo radical therapy. Early conversion to radical therapy is likely to be due to imperfect initial selection methods resulting in inclusion of higher-risk cases. Large anterior-apical lesions of higher grades constitute these cases. This MRI overview will provide radiologists with the necessary knowledge on how to best inform clinicians of the suitability of cases for AS and to identify those at higher risk requiring earlier intervention. Multiparametric MRI assessments enable the location, grading and volumetry of index prostatic lesions to be undertaken. Reviews of mpMRI of index lesions suspicious of high grade and high-risk, unsuitable for AS and requiring earlier intervention will be shown. Challenges facing mpMRI in this area of clinical application will be discussed

VSGU31-09 ● Prospective Comparative Study of Targeted Prostate Biopsy Directed to MRI-suspicious Regions vs. Artemis™ Computerized 12 Core Template Biopsy

James Wysock (Presenter) ; **Andrew B Rosenkrantz** MD ; **Fang-Ming Deng** MD, PhD ; **Samir S Taneja** MD *

PURPOSE
Artemis® computerized 12 core template biopsy (ARTEMIS 12 core) standardizes prostate sampling through template construction from 3D ultrasound (US) modeling of 2D transrectal ultrasound. MRI-targeted biopsy aims to optimize diagnostic yield via targeted sampling of MRI-suspicious regions (mSR). This study describes results of an IRB-approved prospective study of men undergoing MRI-targeted biopsy of mSR followed by ARTEMIS 12 core in order to prospectively compare mSR targeted biopsy to 12 core biopsy.

METHOD AND MATERIALS
125 men enrolled in a prospective clinical trial underwent biopsy that included 4 cores to each mSR (2 cores via MRI-US fusion guidance and 2 cores via visual guidance) followed by ARTEMIS 12 Core. All mSR were localized by a single radiologist and reviewed by two urologists prior to biopsy. Biopsy yield was compared between the two techniques.

RESULTS
Mean age of the study cohort was 64.0 ± 8.15 yrs with a mean PSA 5.91 ± 4.37 ng/mL. The cohort was composed of 67 (53.6%) men undergoing initial biopsy and 34 (27.2%) undergoing repeat biopsy without a prior diagnosis of cancer and 24 (19.2%) men on active surveillance. Overall, cancer was detected in 71 (56.8%) men on targeted biopsy and 61 (48.8%) by ARTEMIS 12 core biopsy (p 0.254). MRI-targeted biopsy detected Gleason 7 or higher in 34 (27.2%) men, equal to the detection rate with ARTEMIS 12 core 34 (27.2%), (p 0.789). MRI-targeted biopsy detected Gleason 6 cancer in 37 (29.6%) as compared to 47 (37.6%) detected on ARTEMIS 12 core (p 0.185). Mean cancer core length per positive core and percent positive cores were significantly greater in MRI-targeted than ARTEMIS 12 core among all cancers detected, (p 0.014, p 0.0001, respectively).

CONCLUSION
MRI-targeted biopsy with 4 cores per mSR provided equivalent detection of Gleason 7 or greater cancer as ARTEMIS 12 core biopsy while significantly reducing the number of cores to obtain this information and providing significantly greater cancer core length per core.

CLINICAL RELEVANCE/APPLICATION
Targeted biopsy of mSR improves diagnostic efficency over 12 core biopsy. Future work may prove targeted biopsy alone sufficient for prostate cancer evaluation.

VSGU31-10 ● Initial Prospective Evaluation of the Prostate Imaging Reporting and Data Standard (PI-RADS)

Geert Litjens MSc (Presenter) ; **Nico Karssemeijer** PhD * ; **Jelle O Barentsz** MD, PhD ; **Henkjan Huisman** PhD *

PURPOSE
To evaluate the performance of the prostate imaging reporting and data standard (PI-RADS) proposed by the European Society of Urogenital Radiology and the effect of reader experience on this performance.

METHOD AND MATERIALS
A consecutive cohort of 254 patients who underwent a detection MRI in 2012 and a subsequent MR guided biopsy were included. All patients were prospectively reported by 1 out of the 10 reporting radiologists according to the PI-RADS guidelines.
Two radiologists are experts (20 and 15 years of experience) and 8 are inexperienced (3 years of experience or less). The inexperienced and experienced readers reported 146 and 108 cases respectively.
The radiologists reported 436 lesions in these patients of which 339 were biopsied. 190 of these 339 were prostate cancer. 127 tumors had a Gleason 4 or higher component and were considered high-grade cancer, all others were considered low grade.
Each lesion received an overall PI-RADS score between 1 and 5. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated by thresholding at each of the PI-RADS scores with the biopsy results as ground truth. High-grade cancers with a PI-RADS score above or equal to the threshold are true positives. Non-cancers below the threshold were considered true negatives.

RESULTS
In total 19, 67, 112 and 141 lesions were biopsied for PI-RADS 2, 3, 4 and 5. The inexperienced reader sensitivities for PIRADS 2, 3, 4 and 5 are: 1, 1, 0.96 and 0.69 respectively. The experienced readers obtained 1, 1, 0.98 and 0.71. The specificities were 0, 0.16, 0.48 and 0.76 for the inexperienced and 0, 0.07, 0.36 and 0.89 for the experienced readers. The PPV and NPV were 0.46, 0.50, 0.61, 0.71 and 1, 1, 0.93, 0.74 for the inexperienced readers. For the experienced readers we obtained 0.46, 0.48, 0.57, 0.84 and 1, 1, 0.96, 0.78 respectively.

CONCLUSION
Only PI-RADS 4 and 5 lesions require biopsy; inexperienced and experienced readers have sensitivities of 0.96 and 0.98 at this threshold. Experience matters: the number of unnecessary biopsies in PI-RADS 5 lesions is reduced by almost half, according to the PPV change from 0.71 to 0.84 between inexperienced and experienced readers.

CLINICAL RELEVANCE/APPLICATION
PI-RADS reported lesions may help reduce the number of unnecessary biopsies. The strong effect of experience emphasizes the need for adequately trained radiologists for reporting prostate MR.

VSGU31-11 ● Negative Predictive Value of Multiparametric MRI for Prostate Cancer Detection: Outcomes of 5-year Follow Up for Men with Negative Findings on Initial MRI

Ryo Itatani (Presenter) ; **Tomohiro Namimoto** MD ; **Shutaro Atsuji** ; **Kazuhiro Katahira** ; **Shoji Morishita** MD ; **Kousuke Kitani** ; **Yasuyuki Hamada** ; **Mitsuhiko Kitaoka** ; **Takeshi Nakaura** MD ; **Yasuyuki Yamashita** MD *

PURPOSE
Prostate cancer is currently screened by PSA and digital rectal examinations (DRE), and diagnosed by random biopsy resulting in the discovery of multiple insignificant cancers that often lead to overtreatment. MRI may be used to triage patients who require invasive treatment, if its negative predictive value (NPV) is sufficiently high. The purpose of our study was to assess NPV of multiparametric MRI and evaluate its clinical utility as an optimal tool to rule out significant prostate cancer to investigate outcomes of 5-year follow up for men with negative findings on initial MRI.

METHOD AND MATERIALS
Between November 2004 and August 2007, there were 622 men who were suspected of harboring prostate cancer and underwent MRI followed by transrectal ultrasound (TRUS)-guided biopsy in our institution. Among them, 255 men with negative findings on MRI were included in our study and their 5-year outcomes were retrospectively assessed. A positive finding by TRUS-guided biopsy was considered as false negative. Patients with neither increase in PSA value nor positive finding on DRE, MRI and TRUS-guided biopsy for 5-year follow up were considered to be true negative. NPV of multiparametric MRI were calculated. For patients undergone radical prostatectomy who had positive finding in biopsy, mean signal intensity (SI) on T2 weighted imaging and mean apparent diffusion coefficient (ADC) value on ADC map of initial MRI were compared between peripheral-zone cancer and normal peripheral zone based on pathologic maps.

RESULTS
For 5-year follow up, 49/255 patients had positive findings of TRUS-guided biopsy. Among them, 27/49 cases proved to be clinical insignificant cancer. The other 206/255 patients had no clinical evidence of prostate cancer. NPV was 80.8% for total prostate cancer detection and was 91.4% for significant prostate cancer detection. With respect to SI and ADC value, there was no significant difference between peripheral-zone cancer and normal peripheral zone.

CONCLUSION
Our study showed that negative findings on multiparametric MRI were associated with either negative TRUS-guided biopsy or insignificant prostate cancer. The risk of harboring significant prostate cancer is considered to be relative low in such patients.

CLINICAL RELEVANCE/APPLICATION
Multiparametric MRI shows great NPV for prostate cancer detection and is a useful tool to rule out clinical significant prostate cancer before biopsy.

VSGU31-12 ● A Global Standard for Prostate MRI Reporting

Jelle O Barentsz MD, PhD (Presenter)

LEARNING OBJECTIVES
1) After this course the participants will have guidelines for magnetic resonance imaging (MRI) in prostate cancer. 2) They will know clinical indications, and minimal and optimal imaging acquisition protocols. 3) The participants will have an introduction in a structured reporting system (PI-RADS).

ABSTRACT
The aim is to show clinical guidelines, developed for multi-parametric MRI of the prostate by a group of prostate MRI experts from the European Society of Urogenital Radiology (ESUR), based on literature evidence and consensus expert opinion. True evidence-based guidelines cannot not be formulated, but a compromise, reflected by "minimal" and "optimal" requirements will be made. The scope of these ESUR guidelines is to promulgate high quality MRI in acquisition and evaluation with the correct indications for prostate cancer across the whole of Europe and eventually outside Europe. The guidelines for the optimal technique and three protocols for "detection", "staging" and "node and bone" will be presented. The use of endorectal coil vs. pelvic phased array coil and 1.5 vs. 3 T discussed. Clinical indications and a PI-RADS classification for structured reporting are shown. This presentation provides guidelines for magnetic resonance imaging (MRI) in prostate cancer. Clinical indications, and minimal and optimal imaging acquisition protocols shown. A structured reporting system (PI-RADS) will be introduced and described.

VSGU31-13 ● Discussion and Concluding Comments

Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology

Tuesday, 08:30 AM - 12:00 PM ● S505AB

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OI NM

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Moderator
Jonathan E McConathy , MD, PhD *
Moderator
Hossein Jadvar , MD, PhD

VSNM31-01 ● Proliferation Imaging: FLT/PET in Oncology

David A Mankoff MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Describe the kinetics of thymidine relevant to FLT PET imaging. 2) Discuss approaches to FLT image interpretation. 3) Describe studies that have tested FLT PET as a marker cancer response to treatment.

VSNM31-02 ● Quantitative Study of 18F-fluorodeoxyglucose and 18F-fluorothymidine PET Characteristics in Esophageal Squamous Cell Carcinoma Staging

Changsheng Ma MS (Presenter) ; **Yong Yin**

PURPOSE
To quantitatively evaluate the value of diagnostic information provided by both 18F-FDG and 18F-FLT PET and quantitatively investigated whether 18F-FLT PET had a better performance compared with 18F-FDG PET in esophageal squamous cell carcinoma (ESCC) staging and delineation.

METHOD AND MATERIALS
26 patients with newly diagnosed ESCC and underwent pretreatment 18F-FDG and 18F-FLT PET were included in this study. The indices such as the standardized uptake value (SUV), gross tumor length and extracted texture parameters between 18F-FDG and 18F-FLT PET were compared, respectively. Moreover, the indices' relationship between 18F-FDG and 18F-FLT PET mentioned above, were analyzed using Spearman's correlation coefficient and Paired T-test. Subsequently all patients received esophagectomy and the extracted PET indices' capability in ESCC pathological staging were assessed by Kruskal-Wallis test and Mann-Whitney test. In addition, tumor delineation length on 18F-FDG (SUV threshold 2.5) and 18F-FLT (SUV threshold 1.4) PET were validated by pathologic gross tumor length.

RESULTS

CONCLUSION
The 18F-FDG and 18F-FLT PET scans have their own advantages in ESCC staging and tumors were well identified as the nonphysiologic distribution of radiotracers intensity typically higher than normal tissues on either PET scans. Delineation on the two types of PET with proper threshold can both provide accuracy estimation of pathologic tumor length. Those different indices extracted from PET scans can be potentially employed to differentiate AJCC and TNM in ESCC stage.

CLINICAL RELEVANCE/APPLICATION
No

VSNM31-03 ● Diagnostic and Prognostic Value of Nodal Staging by 4'-[Methyl-11C]-Thiothymidine (4DST) PET/CT in Non Small Cell Lung Cancer

Ryogo Minamimoto MD, PhD (Presenter) ; **Jun Toyohara** ; **Miyako Morooka** MD ; **Yoko Miyata** ; **Momoko Okazaki** ; **Kazuhiko Nakajima** ; **Kiichi Ishiwata** ; **Kazuo Kubota** MD

PURPOSE
4'-[methyl-11C]-thiothymidine (4DST) is a novel PET tracer available for evaluating proliferation of malignancy. We prospectively compared the diagnostic ability of 4DST PET/CT and FDG PET/CT for detection of regional lymph node metastasis of non-small cell lung cancer (NSCLC). In addition, we surveyed the relation between these PET results and prognosis of NSCLC patients.

METHOD AND MATERIALS
A total of 31 patients with NSCLC underwent 4DST PET/CT and FDG-PET/CT. PET imaging was obtained from 40 min for 4DST and 60 min for FDG after injection. The PET/CT images were evaluated qualitatively and quantatively for focal uptake of each PET tracers, according to American Joint Committee on Cancer staging system. Surgical and histologic results were regarded as reference standards. Patients were followed up 2 years after surgery for survey of recurrence. A multivariate analysis was performed to assess the prognostic significance of T stage, N stage and maximum SUV of 4DST and FDG for primary lung tumor.

RESULTS
Four patients were inoperable by being proved dissemination during surgery. In 27 patients with 156 resected lymph nodes, metastasis was pathologically proved in 9 patients with 17 lesions. On a per-lesion basis, sensitivity, specificity, positive predictive value, negative predictive value and accuracy for lymph node staging were 82, 73, 33, 96 and 74 % respectively for 4DST, 29, 86, 25, 88 and 78% respectively for FDG. Statistical significant difference was confirmed in the sensitivity between 4DST and FDG. The cases with positive nodal findings by 4DST showed higher rate (91%) of lesion extent or recurrence within 2 years, compared to FDG (45%). Multivariate analysis showed that N stage by 4DST was most influential prognostic factor for recurrence or lesion extent.

CONCLUSION
4DST PET/CT showed high sensitivity for the detection of lymph node metastasis, and it was independent prognostic value for recurrence or lesion extent in NSCLC.

CLINICAL RELEVANCE/APPLICATION
4DST PET/CT can contribute to detect lymph node metastasis, and 4DST PET/CT can predict prognosis for recurrence or lesion extent in NSCLC.

VSNM31-04 • Bone PET Imaging: NaF PET in Oncology

Baris Turkbey MD (Presenter)

LEARNING OBJECTIVES
1) To identify the advantages of F-18 NaF PET/CT imaging in oncology. 2) To understand the importance of a standardized imaging protocol. 3) To become comfortable differentiating benign from malignant lesions on F-18 NaF PET/CT.

ABSTRACT
F-18 NaF PET/CT has been shown to have higher sensitivity and specificity than planar 99m-Tc MDP bone scanning in several small studies. The concomitant acquisition of anatomic images permits immediate correlation of any abnormal findings. Additionally, F-18 NaF PET/CT bone imaging can be quantitated, allowing bone disease to be measureable, increasing its utility therapy monitoring. When a consistent F-18 NaF uptake period is used, the SUV values are highly reproducible, and due to the high extraction fraction, high quality images can be obtained with a radiation dose exposure similar to that of Tc-99m MDP (including the low dose CT scan). This presentation will discuss the benefits and challenges of F-18 NaF PET/CT in oncology.

VSNM31-05 • Prospective Evaluation of Planar Bone Scintigraphy, SPECT/CT, 18F NaF PET/CT and Whole Body 1.5T MRI for Detection of Bone Metastases in High Risk Breast and Prostate Cancer Patients

Ivan Jambor MD (Presenter) ; **Anna Kuisma** ; **Riikka Huovinen** ; **Minna Sandell** ; **Joakim Auren** ; **Sami A Kajander** MD ; **Jukka Kemppainen** ; **Jani Saunavaara** ; **Tommi Noponen** ; **Heikki R Minn** MD, PhD * ; **Hannu J Aronen** MD, PhD ; **Marko Seppanen**

PURPOSE
The aim of the study was to compare the diagnostic accuracy of ^{99m}Tc methylene-diphosphonate planar bone scintigraphy (^{99m}Tc-MDP BS), ^{99m}Tc methylene-diphosphonate single photon emission tomography/computed tomography (^{99m}Tc-MDP SPECT/CT), ^{18}F NaF PET/CT and whole body 1.5 Tesla MRI (wbMRI) for the detection of bone metastases in high risk breast cancer and prostate cancer patients.

METHOD AND MATERIALS
Twenty-five breast cancer and twenty-six prostate cancer patients at high risk of bone metastases prospectively underwent ^{99m}Tc-MDP BS, ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI. Coronal T1-weighted, T2-weighted STIR, axial diffusion weighted images (b-values: 0, 150, 1000 s/mm^2) covering whole body were acquired. Four independent reviewers interpreted each individual modality, grading lesions as suspicious, equivocal and benign, without the knowledge of other imaging findings. The final metastatic status was based on the consensus reading of all imaging modalities. The bone findings were compared on patient and region basis. In the region based analysis, the skeleton was divided into five regions.

RESULTS
Based on the consensus reading, 18 (35%) patients and 54 (21%) regions had presence of bone metastases while 33 patients and 201 regions were free of bone metastases. 99mTc-MDP BS was false negative in 4 patients. In the region based analysis, the sensitivity for ^{99m}Tc-MDP BS, ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI was 70%, 87%, 98% and 90%, respectively. The number of equivocal findings for 99mTc-MDP BS, 99mTc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI was 30, 6, 8, 2, respectively. wbMRI provided clinically useful information concerning soft tissues in 6 patients while CT in 4 patients.

CONCLUSION
Whole body 1.5T MRI, including diffusion weighted imaging, had similar diagnostic accuracy for detecting bone metastases in high risk breast and prostate cancer patients as ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT. These modalities were significantly more sensitive in region based analysis than ^{99m}Tc-MDP BS and provided increased diagnostic confidence. Additional soft tissues information provided by whole body 1.5T MRI has potential to affect the patient management.

CLINICAL RELEVANCE/APPLICATION
Whole body MRI showed similar sensitivity for detecting bone metastases in high risk breast and prostate cancer patients as ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and was superior to bone scintigraphy.

VSNM31-06 • Quantitative Imaging Biomarkers in Whole Body 18F-Sodium Fluoride (18F-NaF) PET-MRI to Evaluate Prostate Cancer Bone Metastases

Luis S Beltran MD (Presenter) ; **Christopher Glielmi** PhD * ; **Fabio Ponzo** MD ; **Andrew B Rosenkrantz** MD ; **Rajan Rakheja** ; **Anna Ferrari** MD ; **Marc H Schiffman** MD ; **Scott Tagawa** MD ; **David Nanus** MD ; **Himisha Beltran** MD ; **Michael P Recht** MD

PURPOSE
To correlate quantitative PET and MR diffusion weighted imaging parameters in prostate cancer (PC) bone metastases utilizing whole body 18F-Sodium Fluoride (18F-NaF) PET-MRI

METHOD AND MATERIALS
6 men (median age 73, range 63-83) with advanced PC and known bone metastases underwent whole body PET-MRI (Siemens Biograph mMR) 45 minutes after the intravenous administration of 9 mCi of 18F-Sodium Fluoride (18F-NaF). The maximum Standardized Uptake Value (SUVmax), mean Apparent Diffusion Coefficient (ADCmean), and Intravoxel Incoherent Motion (IVIM) parameters including fast component of diffusion (Dfast), slow component of diffusion (Dslow), and Perfusion Fraction (PF) from multi-b value diffusion weighted imaging were calculated in dominant bone lesions (diameter > 1.5 cm). Correlation between SUVmax and ADCmean, Dfast, Dslow, and PF were evaluated using Spearman rank correlation (r). Two patients underwent biopsy of metastatic lesions.

RESULTS
15 metastatic bone lesions were evaluated. The average value for SUVmax was 28.6 (5.9-61.7, SD 27). The average value (10^-3 mm^2/sec) for ADCmean was 0.93 (0.47-1.8, SD 0.38), for Dfast was 18.2 (11-28, SD 4.5), and for Dslow was 0.98 (0.4-1.7, SD 0.39). The average PF (%) was 10.3 (3.2-18.5, SD 5.1). There was a significant negative correlation between SUVmax and ADCmean (r=-0.75; p=0.001). There were weak to moderate negative correlations between SUVmax and IVIM parameters (p>0.14): Dfast: r=-0.11; Dslow: r=-0.38; PF: r=-0.17. In both patients who had biopsies of metastatic lesions, the biopsy site was determined after reviewing the PET-MRI images. One patient had a biopsy of a bone lesion with a high SUVmax of 48.9 in the L5 vertebral body. Another patient had a biopsy of a metastatic supraclavicular lymph node rather than a bone lesion due to a low SUVmax value of 5.9 of the dominant bone lesion. Both patients with biopsies of metastatic lesions, were positive for metastatic PC.

CONCLUSION
ADCmean and SUVmax show a significant negative correlation in 18F-NaF PET-MRI. IVIM parameters showed weak to moderate negative correlations with SUVmax and may provide complementary information to ADC and SUV, thus warranting further attention in future larger studies.

CLINICAL RELEVANCE/APPLICATION
Our pilot data shows feasibility of 18F-NaF PET-MRI in providing quantitative metrics (SUV,ADC,IVIM) of PC bone metastases, which warrant study as biomarkers for biopsy planning and treatment response

VSNM31-07 • Prostate Cancer Choline PET Imaging and Other PET Tracers

Hossein Jadvar MD, PhD (Presenter)

LEARNING OBJECTIVES

1) Review the major biological targets that may be useful for imaging in prostate cancer. 2) Understand the need for tailoring the imaging technique to the particular clinical phase of disease. 3) Analyze the current evidence with the potential utility of PET with various radiotracers in the imaging evaluation of prostate cancer.

ABSTRACT
Recent advances in the fundamental understanding of the complex biology of prostate cancer have provided increasing number of potential targets for imaging and treatment. In this presentation, I review the experience with a number of major PET radiotracers for potential use in the imaging evaluation of men with prostate cancer.

VSNM31-08 ● [Cu-62]-ATSM PET-CT Study as Hypoxic Imaging in Patients with Gliomas: Comparison with Multitracer Approach Using [F-18]-FDG and [C-11]-Methionine

Ukihide Tateishi MD, PhD (Presenter) ; **Kensuke Tateishi** ; **Ayako Shishikura** ; **Tomohiro Yoneyama** ; **Ikuo Torii** ; **Tomio Inoue** MD, PhD ; **Nobutaka Kawahara**

PURPOSE
The purpose of study was to investigate multitracer approach by [Cu-62]-diacetylbis (N4-methylthiosemicarbazone) ([Cu-62]-ATSM) PET-CT as hypoxic imaging comparing with [F-18]-FDG PET-CT and [C-11]-Methionine PET-CT for differentiation of tumor grade in patients with glioma.

METHOD AND MATERIALS
Multitracer PET-CT studies using [Cu-62]-ATSM, [F-18]-FDG and [C-11]-Methionine were performed in 32 patients with glioma prior to surgery. The maximum standardized uptake value (SUV max), tumor/ background ratio (TBR), and volumetric analysis were quantitatively assessed. Distribution of trace uptake was qualitatively evaluated in comparison with MR images. To confirm tissue hypoxia, the transcription factor hypoxia inducible factor-1alpha (HIF-1alpha) utilized as a hypoxic marker was also assessed.

RESULTS
There were 17 glioblastoma multiformes (GBM) and 15 grade II or grade III gliomas. Of these, 19 (59.4%) patients were newly diagnosed. The SUVmax and TBR of [Cu-62]-ATSM were significantly higher in GBM than in non-GBM gliomas (p = 0.003 and 0.0001, respectively); however, there were no significant differences when assessed by [F-18]-FDG and [C-11]-Methionine. At a TBR cutoff threshold of 1.9, [Cu-62]-ATSM was the most predictive of GBM, with 94.1% sensitivity and 80.0% specificity. The mean TBR was significantly higher in HIF-1alpha positive tumors than those with HIF-1? negative tumors (p
CONCLUSION
Our results demonstrated that [Cu-62]-ATSM PET-CT provides the valuable information to discriminate GBM. [Cu-62]-ATSM appears to be a suitable tracer establishing attractive therapeutic strategies for hypoxic imaging in GBM.

CLINICAL RELEVANCE/APPLICATION
[Cu-62]-ATSM is a suitable biomarker establishing attractive therapeutic strategies for hypoxic imaging in GBM.

VSNM31-09 ● Diagnostic Performance of Synthetic Amino Acid Anti-3-[18F] FACBC PET in Recurrent Prostate Carcinoma Detection

Oluwaseun Odewole MBBS, MPH (Presenter) ; **Pooneh Taleghani** MD ; **Ashesh B Jani** MD ; **Bital Savir-Baruch** MD ; **Leah M Bellamy** ; **Adeboye Osunkoya** MD ; **Weiping Yu** PhD ; **Raghuveer K Halkar** MD * ; **Peter Nieh** MD ; **Viraj Master** MD ; **Mark M Goodman** PhD * ; **David M Schuster** MD

PURPOSE
anti-3-[18F] FACBC is a synthetic amino acid PET radiotracer with utility in detection of prostate cancer (Radiology 2011; 259:852). Following full accrual in a clinical trial, we investigate the diagnostic performance of anti-3-[18F] FACBC PET/CT in the detection of both prostatic and extraprostatic recurrence of prostate cancer.

METHOD AND MATERIALS
115 patients with suspected recurrent prostate carcinoma after definitive therapy for localized disease and negative bone scan underwent anti-3-[18F] FACBC. Studies were interpreted blindly to other imaging using established dual time point criteria. Correlation was made to histology and clinical followup by a multidisciplinary board.

RESULTS
109 out of 115 patients and 86 out of 115 patients had a reference standard sufficient to determine the presence of prostatic or extraprostatic disease respectively. Mean PSA (±SD) was 7.1(±7.7) ng/ml. Average follow-up after imaging was 41.5(±13.4) months. 94 of 115 (81.7%) examinations were positive. In the prostate bed, anti-3-[18F] FACBC had a sensitivity of 89.0%, specificity of 35.1%, accuracy of 70.6%, positive predictive value of 72.7% and a negative predictive value of 61.9% while for extra-prostate disease detection, anti-3-[18F] FACBC had a sensitivity of 58.3%, specificity of 94.7%, accuracy of 74.4%positive predictive value of 93.3%, and a negative predictive value of 64.3%. All prostatic true positive lesions (100%) on FACBC and 89.3% of extra-prostatic lesions had histological confirmation of disease. On a whole body basis, true positive lesion detection rate was 16.7, 72.7, 85.2 and 84.3 at PSA (ng/ml) of 0-1, 1.1-2, 2.1-5 and >5.1 respectively.

CONCLUSION
anti-3-[18F] FACBC has favorable diagnostic performance in the detection of recurrent prostate cancer and can delineate prostatic from extra-prostatic recurrence.

CLINICAL RELEVANCE/APPLICATION
anti-3-[18F] FACBC is useful for restaging of patients with suspected prostate cancer recurrence.

VSNM31-10 ● Hypoxia Imaging: FMISO PET Imaging in Oncology

Joseph G Rajendran MBBS (Presenter)

LEARNING OBJECTIVES
1) Understand the evolution of tumor hypoxia and its biological implications. 2) Identify the mechanistic changes in tumor biology that will result in tumor resistance and poor patient outcome. 3) Learn novel ways to image tumor hypoxia with focus on FMISO PET imaging. 4) Understand the potential approaches to overcoming the negative impact of hypoxia.

ABSTRACT
The physiological microenvironment for a tumor is largely dictated by abnormal vasculature and metabolism. Many solid tumors develop areas of hypoxia during their evolution caused by unregulated cellular growth, resulting in greater demand on oxygen for energy metabolism. Hypoxia induces a cascade of changes that reflects the homeostatic attempts (highly conserved evolutionally) to maintain adequate oxygenation that may result in tumor cells to adapt by developing more aggressive survival traits; mediated by Hypoxia Inducible Factor (HIF1a) part of the cellular oxygen sensing mechanism. Hypoxic tumors are not effectively eradicated with conventional doses of radiation and show resistance to several chemotherapy drugs. Hypoxia may also result in angiogenesis (itself a marker of tumor aggressiveness) mediated by Vascular endothelial growth factor (VEGF). While angiogenesis is a frequent consequence of hypoxia, some tumors develop extensive angiogenesis without the presence of hypoxia and vice versa. Advances in PET imaging instrumentation, coupled with the development of an increasing array of novel molecular probes, provide opportunities for imaging and selection of appropriate therapies to overcome the cure limiting effects of these two fundamental aspects of tumor microenvironment. The biology of tumor microenvironment related to hypoxia and its effect on patient outcome and developments in imaging technology and novel radiotracers for hypoxia imaging with a focus on F-18 FMISO would be reviewed.Challernges and novel treatments to overcome the cure limiting ability of hypoxia will be discussed.

VSNM31-11 ● Correlation of F-18 Fluoromisonidazole PET Findings with HIF-1A and p53 Expressions in Head and Neck Cancer: Comparison with F-18 FDG PET

Takashi Norikane (Presenter) ; **Yuka Yamamoto** MD, PhD ; **Yukito Maeda** ; **Nobuyuki Kudomi** ; **Yoshihiro Nishiyama** MD

PURPOSE
We evaluated tumor hypoxia using F-18 fluoromisonidazole (FMISO) positron emission tomography (PET) in relation to the expression of hypoxia-inducible factor-1? (HIF-1?) and p53 in patients with head and neck cancer and compared with 2-deoxy-2-F-18-fluoro-D-glucose (FDG) PET.

METHOD AND MATERIALS
A total of 28 tumors (23 primary tumors and 5 metastatic lymph nodes) from 24 patients with newly diagnosed head and neck cancer were examined with FMISO PET and FDG PET. The FMISO PET images were scaled to the venous blood concentration of FMISO activity to produce tumor-to-blood (T/B) values. Hypoxia was defined as a region with a T/B ratio of =1.2. The maximum T/B (T/B_{max}) and hypoxic volume were calculated by region-of-interest (ROI) analysis. For FDG PET, the maximum standardized uptake value (SUV_{max}) and hypermetabolic volume were calculated by ROI analysis. The expressions of HIF-1? and p53 using immunohistochemistry were estimated in tumor tissue samples.

RESULTS
There was a significant correlation between hypoxic volume and T/B_{max} (r=0.53, P=0.003) using FMISO PET and between hypermetabolic volume and SUV_{max} (r=0.38, P=0.046) using FDG PET. The hypoxic volume using FMISO PET and hypermetabolic volume using FDG PET also showed a significant correlation (r=0.44, P=0.020). The values of FMISO hypoxic volume was significantly correlated with HIF-1? (r=0.40, P=0.037) and p53 (r=0.47, P=0.012)

obtained on immunohistochemical examination.

CONCLUSION
These preliminary results suggest that hypoxic volume measured by FMISO PET may be a potential noninvasive biomarker for predicting tissue hypoxia in patients with head and neck cancer.

CLINICAL RELEVANCE/APPLICATION
Hypoxic volume measured by FMISO PET may be a potential noninvasive biomarker for predicting tissue hypoxia in patients with head and neck cancer.

VSNM31-12 ● 18F-fluoroethylcholine (18F-Cho) PET/MRI Functional Parameters in Paediatric Brain Tumors

Francesco Fraioli MD (Presenter) ; **Ashley M Groves** MBBS * ; **Jamshed Bomanji** ; **Rizwan Syed** MBBS, FRCR ; **Asim Afaq** FRCR

PURPOSE
This study tested the principle that simultaneous 18F-fluoroethylcholine PET/MRI along with functional parameters (SUVmax/mean and ADCmean) is a valuable option for diagnosis, and response assessment, in children and adolescents with histological confirmed gliomas and intra-cranial germ cell tumors.

METHOD AND MATERIALS
18F-Cho PET MRI scans were performed in 10 children with biopsy proven intra-cranial tumours detected on MRI imaging.
Five patients also underwent a second PET MR scan after chemotherapy. PET data were acquired simultaneously with the MR sequences. The standardized uptake values (SUVs) ratios between the lesion and normal brain tissue greater than background was indicative of a positive scan. Maximal Standardized Uptake Value (SUVmax) and mean SUV (SUVmean) and apparent diffusion coefficient (ADC) Mean of the whole tumor ROI were recorded.
For all tumors the association between the ADC mean and to SUV mean and max was assessed using the non-parametric Spearman correlation coefficient

RESULTS
In all the patients the ratio between 18F-cho lesion and normal brain tissue were significantly elevated and were shown to be independent predictors of the presence of gliomas. The areas of 18F-Cho uptake matched to areas of contrast enhancement and of restricted diffusion.
There was a negative correlation between SUV max and ADC mean.
Five patients had response assessment scans 6 weeks after chemo-radiotherapy; in four patients there was an agreement between volume changes, 18F-Cho and ADC values. In one patient there was a minimal reduction of SUV max and mean and ADC mean. In this patient the tumor volumetric dimensions were stable.

CONCLUSION
PET MR allows simultaneous acquisition of morphological and molecular images. ADC maps may provide additional information in staging and follow up brain tumors.

CLINICAL RELEVANCE/APPLICATION
PET MR allows simultaneous acquisition of morphological and molecular images. ADC maps may provide additional information in staging and follow up brain tumors.

Neuroradiology Series: Brain Tumors

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Moderator
Soonmee Cha , MD
Moderator
Edmond A Knopp , MD

VSNR31-01 ● Pre-op fMRI: Protocols and Pearls
Andrei I Holodny MD (Presenter) *

VSNR31-02 ● Language Mapping with 3T Functional MRI: Application to Preoperative Planning of Patients with Diffuse Gliomas

Gregory Kuchcinski (Presenter) ; **Charles Mellerio** ; **Johan Pallud** ; **Edouard Dezamis** ; **Guillaume Turc** ; **Raphaelle Souillard-Scemama** ; **Caroline Malherbe** DSc ; **Jean-Francois Meder** MD, PhD ; **Catherine Oppenheim** MD, PhD

PURPOSE
To evaluate the accuracy of 3Tesla functional MRI (fMRI) for preoperative language mapping, compared to direct electric cortical stimulations (DCS) during awake surgery in adult patients with diffuse gliomas. To identify clinical and tumor factors associated with fMRI accuracy.

METHOD AND MATERIALS
Language mapping with fMRI and DCS of 31 consecutive patients with diffuse gliomas (low-grade n=19, high-grade n=12) since January 2010 was analyzed. Three block-design paradigms were performed during fMRI (letter fluency, category fluency, semantic association). During awake surgery, the entire exposed cortex was stimulated to identify essential language areas. A site-by-site comparison between fMRI and intraoperative DCS mapping was performed, using a cortical grid (1 cm3 voxels), with calculation of sensitivity and specificity. Influence of gender, age, previous oncological treatment and tumor features (volume, malignancy grade, contrast enhancement, perfusion) on fMRI accuracy (match vs. mismatch sites) was tested in uni- and multivariate analyses.

RESULTS
Among 1637 tested cortical sites, 90 (5%) were positive for language during DCS. Sensitivity and specificity of the 3 language paradigms ranged from 29 to 41% and 89 to 90%, respectively. Higher sensitivity was achieved by combining the 3 tasks (60% [95%CI=49-70]; p
CONCLUSION
Preoperative language mapping with fMRI, even at 3T, cannot replace intraoperative DCS in patients with diffuse gliomas. Combinating the language tasks may improve its reliability. Tumor grade is associated with fMRI/DCS discrepancy.

CLINICAL RELEVANCE/APPLICATION
fMRI is recommended as part of the presurgical planning of gliomas to assess language hemispheric dominance, though its reliability in localizing essential language cortical areas is insufficient.

VSNR31-03 ● Usage of fMRI for Pre-surgical Planning in Tumor and Vascular Lesion Patients: Task and Statistical Threshold Effects on Language Lateralization

Matthew Andreoli (Presenter) ; **Tanvi Nadkarni** ; **Veena A Nair** PhD ; **Bornali Kundu** ; **Peng Yin** ; **Brittany Young** ; **Chad H Moritz** RT ; **M. Elizabeth Meyerand** PhD ; **Vivek Prabhakaran** MD, PhD

PURPOSE
Functional magnetic resonance imaging (fMRI) is a non-invasive pre-surgical tool that may be used to measure lateralization of language function in brain tumor and vascular lesion patients, and guide neurosurgeons to devise a surgical approach to treat lesions. We investigated the effect of varying the statistical thresholds as well as the type of language task on functional activation patterns and language lateralization. We hypothesized that language lateralization indices (LIs) would be threshold- and task-dependent.

METHOD AND MATERIALS
Imaging data were collected from brain tumor patients (n=67, average age 48 years) and vascular lesion patients (n=25, average age 43 years) who received pre-operative fMRI scanning. Both patient groups performed expressive (antonym and letter word generation) and receptive (text-reading, text-listening) language tasks. A control group (n=25, average age 45 years) performed the letter-word generation task.

RESULTS
Brain tumor patients showed left-lateralization during antonym-word generation and text-reading tasks at high threshold values and bilateral activation during letter-word generation task, irrespective of varying the threshold values. Vascular lesion patients showed left-lateralization during the antonym and letter-word generation, and text-listening task at high threshold values.

CONCLUSION
Our results suggest that the type of task and the applied statistical threshold influence LI and that the threshold effects on LI may be task-specific. Thus identifying critical functional regions and computing LIs should be done on an individual subject basis, using a continuum of threshold values with different tasks to provide the most accurate information for pre-surgical planning of lesion resections.

CLINICAL RELEVANCE/APPLICATION

Examining lateralization index (LI) using a variable statistical threshold and different tasks may maximize retention of language activity in tumor and vascular lesion patients, post-surgically.

VSNR31-04 ● Diffusion Applications in Brain Tumors

Aaron S Field MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Review the fundamental mechanisms by which diffusion imaging can address problems of tissue characterization in brain tumor patients. 2) Examine the role of diffusion imaging in differential diagnosis of the most common brain tumors including meningioma, glioma, lymphoma, and pediatric tumors of the posterior fossa. 3) Understand the potential but also the limitations of diffusion tensor imaging in defining tumor margins and planning tumor resections. 4) Understand the role of diffusion imaging in evaluating brain tumor treatment-related effects, including cytoreductive therapeutic response, radiation necrosis, and treatment-related white matter injury.

VSNR31-05 ● Diffusion Repeatability Evaluation And Measurement (DREAM)-MRI: A New Technique for Quantifying the Voxel-wise ADC Probability Density Function for Brain Tumor Characterization and Response Measurement

Benjamin M Ellingson MS, PhD (Presenter) * ; **Timothy F Cloughesy** MD * ; **Whitney B Pope** MD, PhD *

PURPOSE
Diffusion MRI has been shown to be valuable for characterizing brain tumor cellularity and response to therapy; however, measurements of ADC can often be prone to noise contamination and other artifacts that lead to inaccurate measurement. We have developed a new method termed "diffusion repeatability evaluation and measurement" (DREAM)-MRI for repeatedly acquiring ADC measurements in a short period of time in order to construct the voxel-wise ADC probability density function (ADC PDF) and provide a measure of uncertainty in ADC estimation. In the current study we have examined this technique in phantoms, normal volunteers, and patients with glioblastoma.

METHOD AND MATERIALS
All scans were performed on a 3T MR system (Siemens Trio; Erlangen, Germany). The ACR and ADNI phantoms were used to test ADC PDF dependence on pulse sequence parameters. A total of 10 healthy volunteers and 5 patients with glioblastoma were enrolled in the current study. DREAM-MRI consisted of a total of 100 diffusion measurements in the x, y, and z direction were obtained within 8 minutes for 10 slices using optimized partial Fourier encoding, parallel imaging, and echoplanar acquisition. ADC PDFs were constructed from the different samples and compared across sequence parameters and tissue types.

RESULTS
ADC PDF variability was lowest using a b-value of 500s/mm2, but did not change appreciably across TR, TE, number of acquisitions, shimming technique, or T1 characteristics of the material (from ADNI phantom). Mean ADC and variability in ADC appeared correlated. As expected, normal white matter had a lower mean ADC and lower ADC variability compared with gray matter. Serial ADC PDFs showed no appreciable difference when volunteers were rescanned at a later time point. Glioblastoma patients showed low ADC PDF characteristics in tumor regions, which changed serially as a result of radiation therapy.

CONCLUSION
DREAM-MRI is a novel technique for quantifying the voxel-wise ADC PDF and may be useful for evaluation of brain tumor response to therapy.

CLINICAL RELEVANCE/APPLICATION
Diffusion MRI is useful for brain tumor treatment evaluation, but ADC measurement uncertainty is a concern. The DREAM-MRI sequence overcomes this limitation.

VSNR31-06 ● Potential Use of Mean Apparent Diffusion Coefficient Values in Defining the Portal for Radiotherapy

Daniel Jeong MD (Presenter) ; **Sharon E Byrd** MD ; **Shalini Garg** MD ; **Mehmet Kocak** MD

PURPOSE
A major challenge in treating Glioblastoma Multiforme (GBM) is distinguishing the extent of tumor from surrounding inflammation and edema on conventional MRI sequences. The T1 post contrast and T2/FLAIR sequences are widely utilized to assess tumor extent and define the radiation portal for radiotherapy, but Apparent Diffusion Coefficient (ADC) maps are not as widely used. Multiple authors have shown a significant difference in ADC values for tumor, edema, and normal white matter. However, few studies have evaluated ADC values at sites of future tumor recurrence using pre and post treatment MRI exams. The aim of this study is to evaluate pre treatment mean ADC values at sites that gave rise to future tumor recurrence compared to similar background tissue that did not progress to tumor.

METHOD AND MATERIALS
Out of 110 consecutive patients with pathology proven GBM at our institution from 1/1/2009 to 5/31/2012, 20 had definitive post radiotherapy recurrence after 3 months and had received treatment and follow-up imaging at our institution. These 20 patients were included in this single-center retrospective cohort study. Pre and post radiotherapy MRI exams were evaluated, and the sites of tumor recurrence on post treatment exams were correlated with corresponding tissue on pretreatment exams and the type of background surrounding tissue was noted (edema, normal white or gray matter). Mean ADC values were compared for sites of future tumor recurrence and background tissue that did not progress to tumor recurrence.

RESULTS
The mean ADC value of brain tissue on pre-radiotherapy MRI exams in regions of future tumor recurrence was significantly lower than the mean ADC values in regions of surrounding tissue not progressing to tumor ($p = 0.002$), without noticeable abnormalities seen on conventional T1 post contrast and T2/FLAIR MR sequences.

CONCLUSION
Mean ADC values may help predict sites of future tumor recurrence in GBM, and could be helpful in pre-radiation planning and identifying microscopic tumor prior to gross tumor recurrence on conventional MR imaging.

CLINICAL RELEVANCE/APPLICATION
Mean ADC values may help identify microscopic tumor prior to gross recurrence and should be considered during radiation planning.

VSNR31-07 ● Perfusion Methods in CNS Tumors

Daniel P Barboriak MD (Presenter) *

LEARNING OBJECTIVES
1) To gain familiarity with the basic principles used to derive imaging measurements of blood volume, blood flow and capillary permeability in brain tumors. 2) To learn the potential utility of perfusion imaging for providing insight into the processes of neoangiogenesis and into the methods of action of brain tumor therapies. 3) To understand how the challenges of lack of standardization in both image acquisition and analysis are being addressed by national research and cooperative groups.

ABSTRACT
In the context of brain tumors, perfusion imaging is a broad term referring to a variety of techniques measuring delivery of blood to tumors, the intrinsic vascularity of tumors, and the permeability of the blood brain barrier. The most commonly used techniques are dynamic susceptibility contrast-enhanced MRI (DSC-MRI), dynamic contrast-enhanced MRI (DCE-MRI) and arterial spin labeling (ASL). The most commonly used figures of merit corresponding to these techniques are relative cerebral blood volume and blood flow (rCBV, rCBF) for DSC-MRI, volume transfer coefficient and initial area under the gadolinium concentration curve (K^{trans}, IAUGC) for DCE-MRI and cerebral blood flow (CBF) for ASL. There is considerable interest in using these techniques to grade tumors by predicting either tumor pathology or patient survival, to distinguish between true progression and pseudoprogression / radiation necrosis in patients with recurrent enhancement after treatment, and to provide an earlier or more reliable indicator of patient response to treatment. Without question, perfusion imaging has provided insight into the brain tumor vascular microenvironment, which could be considered a phenotypic characteristic of tumors with important implications for tumor genomics, tumor pathophysiology and drug development. Although these techniques have been shown to influence therapy decisions for individual patients, multicenter clinical trials demonstrating the added value of perfusion imaging have yet to be successfully concluded. In this talk, four questions will be addressed. First, how are figures of merit derived from perfusion imaging related to underlying tumor pathophysiology? Second, how can these figures of merit be derived? Third, why have these techniques not yet been being integrated into routine clinical practice? Finally, what is the future outlook for these techniques?

VSNR31-08 ● Baseline Spin-Echo Echo-Planar Perfusion nCBV > 2.0 prior to Chemoradiation Is a Strong Independent Predictor of Poor Progression-free and Overall Survival in Patients with Newly Diagnosed Glioblastoma

Ayca Akgoz MD (Presenter) ; **Rifaquat Rahman** ; **Hui You** ; **Alhafidz Hamdan** ; **Ravi T Seethamraju** PhD * ; **Patrick Y Wen** MD * ; **Geoffrey S Young** MD *

PURPOSE
Prior studies have indicated that gradient-echo echo-planar (GE-EPI) perfusion weighted imaging (PWI) may be helpful in prognosis and treatment assessment in newly diagnosed glioblastoma (GBM) patients. While both animal and limited human data suggest that SE-EPI PWI data is more closely correlated with the presence of neovascularity and survival in GBM than GE-EPI PWI, no large series has assessed this. We assessed whether SE-PWI before and after initiating

chemoradiation can stratify patients with respect to progression free survival (PFS) and overall survival (OS).

METHOD AND MATERIALS
Sixty-eight glioblastoma patients with interpretable pre and post-treatment SE-PWI were identified. In each study, normalized cerebral blood volume (SE-nCBV) was calculated by hot-spot method from 3 regions of interest (ROI) selected within the areas of maximal cerebral blood volume (CBV) in enhancing and/or non-enhancing tumor and 1 ROI selected within the contralateral normal appearing white matter. Univariate and multivariate Cox proportional hazards model was utilized to identify perfusion parameters predictive for PFS and OS. Receiver operator curve characteristic analysis was used to identify thresholds optimized for 15-month survival, and Kaplan-Meier estimates of PFS and OS were calculated.

RESULTS
In multivariate analysis, baseline mean SE-nCBV was predictive of PFS (p=0.038) and OS (p=0.004). Patients with a baseline mean SE-nCBV < 2.0 had a PFS (median 47.0 weeks, p 2.0 (median PFS 25.3, median OS 56.0 weeks). Exploratory multi-group stratification demonstrated that survival was inversely proportional to baseline mean SE-nCBV over a range from 2.0 - 4.0 (p=0.025) suggesting a 'dose dependency' for SE-nCBV as a survival marker.

CONCLUSION
Baseline mean SE-nCBV prior to chemoradiation promises to be strongly predictive of poor chemoradiation response and poor survival in the subgroup of GBM patients with SE-nCBV >2.0. Prospective evaluation of SE-nCBV as a marker to select patients for more frequent monitoring and possibly early initiation of adjunctive therapy is indicated.

CLINICAL RELEVANCE/APPLICATION
Glioblastoma patients with high SE nCBV prior to adjuvant radiochemotherapy should be monitored particularly carefully and strongly considered for adjuvant therapy when indicated.

VSNR31-09 ● Intravoxel Incoherent Motion of Malignant Brain Tumors: A Validation Study with Pathologic Correlation and Normalized Cerebral Blood Volume

Chong Hyun Suh MD (Presenter) ; **Ho Sung Kim** ; **Ji-Won Kang** MD ; **Seung Soo Lee** MD ; **Namkug Kim** PhD ; **Choong Gon Choi** MD ; **Sang Joon Kim** MD

PURPOSE
To validate the perfusion (f) and true diffusion (D) parameters derived from intravoxel incoherent motion (IVIM) MR imaging with pathologic correlation of hypervascular tumor (glioblastoma) and hypovascular tumor (primary CNS lymphoma, PCNSL) and normalized cerebral blood volume (nCBV) derived from dynamic susceptibility contrast MR perfusion imaging.

METHOD AND MATERIALS
Our institutional review board approved this study. Fifty-nine consecutive patients (33 men, 26 women, mean age 54.5 years) who had pathologically confirmed glioblastoma (n=38) or PCNSL (n=21) prior to any treatment were assessed using maximum f (f_{max}) and minimum D (D_{min}) derived from IVIM MR imaging. We acquired 16, different b-values. The best predictor for differentiating glioblastoma from PCNSL was determined by receiver operating characteristic (ROC) curve analyses. A corresponding nCBV was used for validation of the f_{max} using partial correlation analysis.

RESULTS
The mean f_{max} was significantly higher in the glioblastoma group (0.101 ± 0.016) than in the PCNSL group (0.021 ± 0.010) ($p < 0.0001$). The mean D_{min} did not significantly differ between the two groups ($P = 0.190$). f_{max} was an excellent predictor for differentiating glioblastoma from PCNSL (area under the curve, 0.987; 95% confidence interval (CI): 0.916, 0.996; cut-off value, 0.025), with a sensitivity of 97.4% and a specificity of 90.5%. There was a significant positive correlation between f_{max} and corresponding nCBV for all cases ($r =0.651$; $P < 0.0001$).

CONCLUSION
IVIM MR imaging can be used as a non-contrast, noninvasive imaging method to assess the diffusion and perfusion characteristics of malignant brain tumors.

CLINICAL RELEVANCE/APPLICATION
Intravoxel incoherent motion (IVIM) MR imaging allows noninvasive, reliable distinction as part of the diagnostic workup for patients who are suspected of having malignant brain tumors.

VSNR31-10 ● Imaging the Post Therapy Brain

Eu-Meng Law MBBS (Presenter) *

LEARNING OBJECTIVES
1) To understand the challenges with current and novel therapeutics for brain tumors, particularly with regard to conventional imaging of the post therapeutic brain. 2) To understand the challenges with defining and characterizing pseudoprogression and the application of advanced MRI methods. 3) To understand pseudo response with anti-angiogenic agents therapy and the application of advanced MRI methods in characterizing pseudo respoinse.

ABSTRACT

REFERENCES:
1. L.C. Hygino da Cruz Jr, Gasparetto E et al AJNR April 2011 2. Sanghera et al., Clin Oncol (R Coll Radiol). 2011 24:216-27 3. Shiroishi M, Law M et al MRI Clinics 2013

VSNR31-11 ● Proliferation Rate Estimates Derived from Serial Diffusion MR Scans Correlate with [18F]-FLT PET SUV Values in Recurrent Glioblastoma Treated with Bevacizumab

Benjamin M Ellingson MS, PhD (Presenter) * ; **Timothy F Cloughesy** MD * ; **Johannes Czernin** MD * ; **Whitney B Pope** MD, PhD *

PURPOSE
Proliferation rate estimates from cell invasion, motility, and proliferation level estimate (CIMPLE) maps derived from fitting a novel spatiotemporal mathematical model to serial diffusion MR data have been shown to correlate with choline-to-NAA ratio using NMR spectroscopy, glioma grade, and PFS/OS during bevacizumab. These maps predict future contrast enhancement in approximately 30% of patients on bevacizumab, as suggested in a recent pilot study. Proliferation rates based on the time-rate-of-change in ADC values within a voxel may reflect proliferative potential. The current study examined the relationship between CIMPLE map estimates of proliferation rate and 18F-FLT PET SUV, a molecular marker of DNA synthesis, in order to test whether CIMPLE maps could spatially localize regions of proliferative tumor.

METHOD AND MATERIALS
Fourteen patients were enrolled in the current pilot study. All patients had at least three MRI scans and one 18F-FLT PET scan during bevacizumab therapy. MR scans consisted of at least a T2w, post-contrast T1w, and diffusion MR scan with b=0 and 1000s/mm2. Diffusion MR scans were distortion corrected, then all follow-up MR scans were registered to the first post-treatment MR scans. CIMPLE maps were generated by fitting a voxel-wise spatiotemporal model of cell invasion and proliferation, assuming ADC a surrogate for cell density. A new matrix solution to the CIMPLE map algorithm was implemented for patients with >3 scans. 18F-FLT PET scans were acquired during the period of MR evaluation. PET SUV scans were co-registered to MR space for subsequent analyses.

RESULTS
Regions with high proliferation rate on CIMPLE maps appeared generally colocalized to regions of 18F-FLT PET. Average proliferation rate within contrast-enhancing regions was highly correlated with average 18F-FLT PET SUV (Pearson's correlation coefficient, R2 = 0.79, P
CONCLUSION
Regions with elevated proliferation rate on CIMPLE maps derived from serial diffusion MR data appear to reflect regions undergoing rapid DNA synthesis as suggested by 18F-FLT PET.

CLINICAL RELEVANCE/APPLICATION
CIMPLE maps provide a non-invasive method for estimating tumor growth dynamics, which may be useful for treatment monitoring and predicting tumor progression.

VSNR31-12 ● Change in ADC of High Grade Glioma Infiltrative Component during Radiotherapy Predicts Treatment Response and Time-to-Progression

Jin Rong Qu MD, PhD ; **Jian-Ping Dai** MD ; **Tao Jiang** ; **Ayca Akgoz** MD (Presenter) ; **Ravi T Seethamraju** PhD * ; **Qifeng Wang** ; **Shao-Wu Li** ; **Lin Ai** ; **Tianzi Jiang** PhD ; **Geoffrey S Young** MD *

PURPOSE
Apparent diffusion coefficient (ADC) derived from diffusion-weighted imaging (DWI) is a promising marker for cellularity in a wide range of tumors. While change in ADC during chemoradiation is a rational marker for prediction of high grade glioma (HGG) patient response and prognosis, mixed success has been reported to date. This may be because temozolamide chemotherapy and angiogenesis inhibition induce changes in vascular permeability and edema that confound the correlation of ADC with cellularity. As such, we hypothesize that ADC should perform well as a marker of survival in a cohort of patients treated with radiotherapy (RT) alone.

METHOD AND MATERIALS
In 25 patients who had undergone resection of HGG, ADC was measured in ROI placed in residual solid and infiltrative tumor before and after 30Gy RT. RT response during radiation was classified as complete resolution (CR), partial response (PR), stable disease (SD), or progressive disease (PD) based on conventional anatomic MRI images. Change in ADC during RT was correlated with treatment response, TTP and OS.

RESULTS
As predicted, RT response correlated significantly with TTP (0.59; p=0.002). Median TTP was 49.9 days for patients with PD compared with 202.7 days for SD, 208.0 days for PR, 234.5 days for CR. The ADC of the residual solid tumor increased during RT in the CR group but did not significantly change in the PD group. ADC of infiltrative tumor increased during RT in PD. Increase in infiltrative tumor ADC correlated significantly with shorter TTP (0.545; p=0.005). Correlation between increase in solid tumor ADC and longer TTP (0.286; p=0.249) did not reach statistical significance but showed a trend consistent with the prior literature.

CONCLUSION
Decrease in non-enhancing infiltrative tumor ADC correlates with better RT response and longer progression free survival of HGG patients treated with radiation alone. This supports our hypothesis that temozolamide chemotherapy and angiogenesis inhibition effects on vascular permeability may significantly confound the use of ADC for detection of HGG response.

CLINICAL RELEVANCE/APPLICATION
Increase in ADC of infiltrative tumor during RT of HGG correlates with worse treatment response, shorter time to progression and decreased overall survival.

Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Abdomen and Pelvis (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, 10:30 AM - 12:00 PM • S406A

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OI NM CT GU GI

MSCC32 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Director
John A Parker , MD, PhD
Jacqueline C Brunetti , MD

LEARNING OBJECTIVES
1) Demonstrate an understanding of normal distribution of FDG PET in the abdomen and pelvis and possible pitfalls in interpretation of PET/CT scans of the abdomen and pelvis. 2) Understand the variability of FDG PET metabolic activity in specific abdominal and pelvic malignancies and apply this knowledge to optimally utilize this modality for the most efficient and accurate patient care. 3) Understand the current accepted indications of FDG PET/CT in diagnosis, staging and restaging in neoplasms of the abdomen and pelvis.
ABSTRACT
FDG PET/CT has evolved into a routine tool in the diagnosis, staging and restaging of cancer patients. The accuracy and clinical benefit of the technique, however, are dependent on the glycolytic activity of the specific neopalsm, the background activity and the pattern of spread of metastatic disease. As the healthcare system is increasingly stressed by decreasing reimbursements and increasing regulations, it is critical for the Radiologist to have a clear concept of the value of FDG PET/CT for each tumor type. Acting in the role as consultant, the Radiologist can steer the referring physician to the most cost efficient approach that will yield the most beneficial and appropriate treatment choice. Thsi course will presnt a case-based review of abdominal and pelvic malignancies, highlighting the benefits, pitfalls and best indications for FDG PET/CT in tumors of the hepatic, gastrointestinal, gynecologic and urologic neoplasms.

BOOST: Gastrointestinal-Integrated Science and Practice (ISP) Session

Tuesday, 10:30 AM - 12:00 PM • S103AB

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RO OI GI

MSRO32 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Albert C Koong , MD, PhD
Moderator
Thomas Brunner , PhD

MSRO32-01 • Invited Speaker:
Edward Y Kim MD (Presenter)

MSRO32-02 • Does Neoadjuvant Therapy Increase the Risk of Post-operative Complications after Definitive Rectal Cancer Surgery?
Sarah A Milgrom MD (Presenter)

MSRO32-03 • Intensity Modulated Radiation Therapy Is a Reasonable Technique for Cervical or Upper Thoracic Esophageal Carcinoma
Tingting Zhuang (Presenter)

MSRO32-04 • Esophageal Stenosis Following Radiotherapy for Superficial Carcinoma of Esophagus

Gentaro Togasaki (Presenter)

ABSTRACT
Purpose/Objective(s):
To evaluate the frequency of esophageal stenosis after radiotherapy for superficial esophageal carcinoma and its association with patient or treatment related factors.
Materials/Methods:
We retrospectively reviewed 25 patients with superficial esophageal carcinoma treated by radiotherapy with curative intent at Chiba University Hospital between January 2002 and December 2012. The age of the patients ranged from 55 to 85 years old (median age 72 years). There were 23 men and 2 women. All tumors were classified according to the UICC 7 th TNM staging system: 5 patients had T1a tumor and 20 patients had T1b tumor. All tumors had squamous cell carcinoma histology. Location of the lesion were as follows: cervical esophagus in 2 patients, upper thracic in 3, mid thoracic in 7, lower thoracic in 11, abdominal esophagus in 2. Total dose of radiotherapy ranged from 60 to 66 Gy at daily 2 Gy per fraction. Prior to radiotherapy, 8 patients had received endoscopic submucosal dissection or endoscopic mucosal resection. Six patients were treated with radiotherapy alone, while other 19 patients were treated with concurrent chemotherapy. Upper gastrointestinal endoscopy or esophagography was performed for all patients before treatment and within 3 months after completion of the radiotherapy. Post-treatment esophagographs were reviewed to calculate the stenotic ratio. The calculated stenotic ratio was then classified into the four levels: stenosis level 1, stenotic ratio of 0-25%; 2, 25-50%; 3, 50-75%; 4, 75-100%. Patients with stenosis level 2 and higher or the presence of passage disturbance were deemed to have esophageal stenosis.
Results:
The median follow-up period for surviving patients was 12.3 months (range: 1.7-76.4 months). Twenty patients obtained complete response, while 4 had stable disease and another resulted in disease progression.
Esophageal stenosis occurred in 8 patients (32%), causing passage disturbance in 3 patients. The number and percentage of patients at each stenosis level were as follows: level 1: n = 17 (68%); level 2: n = 5 (20%); level 3: n = 3 (12%); level 4: n = 0 (0%). The occurrence of grade 3-4 acute esophagitis during treatment were significantly associated with the frequency of esophageal stenosis (p=0.024). Tumor location, stage, preceding endoscopic surgery, use of chemotherapy, radiotherapy dose, and treatment response were not associated with the frequency of stenosis.
Conclusions:
Significant proportion of patients experience esophageal stenosis after radiotherapy for superficial esophageal carcinoma. The occurrence of grade 3-4 acute esophagitis during treatment may predict post-treatment
esophageal stenosis.

MSRO32-05 • Impact of Medications to Control Inflammation, Cholesterol and Blood Sugar on Survival in Esophageal Cancer Patients
Nicholas Figura BS (Presenter)

MSRO32-06 • The Role of Proton Therapy in Postoperative Radiotherapy for Gastric Cancer: A Dosimetric Analysis
Nicholas Lukens (Presenter)

MSRO32-07 • Assessing Effectiveness of Proton Stereotactic Radiotherapy (PSRT) for Liver Metastasis with MRI

Surabhi Bajpai MBBS, DMRD (Presenter) ; **Sheela Agarwal** MD, MS ; **Theodore S Hong** MD ; **Andrew X Zhu** MD, PhD ; **Dushyant V Sahani** MD

PURPOSE
We investigated the imaging manifestations and treatment effect in liver metastasis following Proton Stereotactic Radiotherapy (PSRT).

METHOD AND MATERIALS
In this ongoing study, 17 patients (10M: 7F, mean-66 yrs) with liver limited metastasis (CRC-9, gastric-1, pancreatic-4, neuroendocrine-2) treated with PSRT were included. The patients underwent CE-MRI (Magnevist, n=12; Eovist, n=22) at baseline and 4-8 weeks after treatment. MR images (n=34) at baseline and after PSRT were evaluated for size on post contrast T1 images, signal on T1, T2 and DWI and enhancement characteristics on post contrast images. Treatment response was classified as local response according to RECIST criteria and long term outcome based on development of new hepatic metastases and extrahepatic disease.

RESULTS
Seventeen patients with 31 metastatic lesions (solitary, n=12, multiple, n=5 and size-2.6±1.8cm) were included in the final analysis. Out of 17 patients, 12 (70.5%) demonstrated local treatment response (Pre- 2.83 ±2.1cm, post: 1.8±1.7cm, p
CONCLUSION
MR is an accurate method for monitoring treatment response to proton beam radiation in patients with metastatic liver disease.

CLINICAL RELEVANCE/APPLICATION
CE-MRI is often a preferred modality for pre and post treatment evaluation and therefore it is essential to familiarize with the expected and unexpected MR features following PSRT.

MSRO32-08 ● Retreatment of Hepatic Malignancies with Yttrium-90 Resin Microspheres

Jim Zhong (Presenter) ; **Tony J Wang** MD ; **David Horowitz** MD

ABSTRACT
Purpose/Objectives: The use of yttrium-90 resin microspheres in hepatic radioembolization (RE) is well established in the management of primary and metastatic malignancies of the liver. However, few data have been reported on the safety and efficacy of retreatment with yttrium-90 RE. We present data on patients treated with multiple courses of RE.
Materials/Methods: Using an institutional review board approved protocol, all patients treated with multiple courses of yttrium-90 RE from 2009-2012 for primary or metastatic malignancies of the liver were reviewed retrospectively. Baseline demographic, laboratory and pathologic information were recorded, as well as dosimetric factors related to all courses of RE. Acute treatment toxicity was recorded using common terminology criteria for adverse events (CTCAE), version 4.0. Response to treatment was measured using RECIST criteria. Overall and progression-free survival were calculated using the method of Kaplan and Meier. Statistical analyses were conducted with SPSS, version 20.
Results: 70 patients were treated with RE and were evaluated for inclusion. With a median follow up of 17 months (range 3-22 months), 8 patients, all male, were treated with multiple courses of yttrium-90 RE. 6 patients (75%) were treated with 2 courses of RE, and 2 patients (25%) were treated with 3 courses of RE, a total of 18 courses of RE and 10 retreatments. Median patient age was 62 years (range 33-78). 4 patients (50%) had hepatocellular carcinoma, and 4 patients (50%) had metastatic liver tumors. 7 patients (87.5%) were Child-Pugh class A and 1 was class B. 7 patients (87.5%) had disease that was limited to the liver. 6 patients (75%) had tumors associated with portal vein thrombosis. Mean time between first and second RE was 3.5 months (range 1-17 months). Cumulative median total liver dose was 58.37 Gy (range 28.93-80.71 Gy), and cumulative median total lung dose was 5.22 Gy (range 1.82-17.2 Gy). One patient had grade 3 gastrointestinal toxicity after a second course of RE; no grade 4 or greater toxicity was seen. For all repeat treatments with RE, analysis with RECIST criteria showed partial responses in seven retreatments (70%). For patients receiving first retreatment, analysis with RECIST criteria showed five patients (62.5%) with partial responses, one patient (12.5%) with stable disease and two patients (25%) with progressive disease. Two patients had a third RE course and both showed partial responses (100%). Median overall survival from date of first RE was 17 months (95% CI = 11.87-22.13). From time of second RE, median progression free survival was 10.5 months (95% CI = 0.96-19.97) and median overall survival was 10.7 months (95% CI not calculable).
Conclusion: For selected patients, retreatment with yttrium-90 RE for primary and metastatic liver malignancies can be performed with acceptable acute toxicity, with high rates of radiographic response.

MSRO32-09 ● CT Guided Fiducial Placement for Targeted Image Guided Radiation Therapy in Hepatic Malignancies

Avinash R Kambadakone MD, FRCR (Presenter) ; **Selim R Butros** MD ; **Theodore S Hong** MD ; **Debra A Gervais** MD * ; **Ronald S Arellano** MD

PURPOSE
The purpose of our study was to evaluate the safety and efficacy of CT guided fiducial placement for targeted image guided stereotactic radiation therapy in hepatic malignancies.

METHOD AND MATERIALS
In this retrospective study, we included 108 patients (73M: 35 F, mean age 70 yrs, age range-30-94 yrs) who underwent image guided fiducial placement prior to image guided stereotactic radiation therapy. The fiducial placement was performed under CT guidance with the 'push' technique and with conscious sedation. The fiducial location was determined based on anatomic location of the tumor. The electronic medical records and the imaging studies in these patients were retrospectively evaluated to record the indications for fiducial placement, CT technique, procedure details and complications. The technical success rate and impact of the fiducial placement on treatment planning was evaluated.

RESULTS
A total of 215 fiducials were placed around 124 hepatic tumors in 108 patients under CT guidance. The technical success rate was 98% for placement of liver fiducials. The co-axial push CT technique performed with 19 gauge Chiba needle provided optimal results. The procedure related complications were seen in 6/108 patients (5.5%) which included hematoma, pseudoaneurysm and fiducial migration. The fiducial location around the tumor combined with surrounding anatomic landmarks in the liver were successfully used for stereotactic radiation treatment planning.

CONCLUSION
CT guided fiducial placement is a safe and effective technique with low complication rate for tumor bracketing of hepatic malignancies for performance of image guided stereotactic radiation therapy.

CLINICAL RELEVANCE/APPLICATION
With the increasing use of targeted radiation therapies for treatment of hepatic malignancies, CT guided fiducial placement is a safe and effective for treatment localization.

BOOST: Breast-Integrated Science and Practice (ISP) Session

Tuesday, 10:30 AM - 12:00 PM ●S103CD

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MSRO35 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Katherine L Griem , MD *
Moderator
Anna Shapiro , MD

MSRO35-01 ● Invited Speaker:
Steven J Chmura MD, PhD (Presenter)

MSRO35-02 ● Volume-based Parameters of 18F-fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Improve Disease Recurrence Prediction in Postmastectomy Breast Cancer Patients with 1 to 3 Positive Axillary Lymph Nodes without Adjuvant Radiotherapy

Naomi Nakajima (Presenter) ; **Masaaki Kataoka** MD ; **Takashi Ochi** MD ; **Yoshifumi Sugawara** MD ; **Masao Miyagawa** MD, PhD ; **Teruhito Mochizuki** MD

PURPOSE
The indication for postmastectomy radiotherapy (PMRT) in patients with 1 to 3 positive axillary nodes have been controversial. In the current study, we focused our study on volume-based parameters of pretreatment 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT), with the aim of investigating a measurement that could help identify high-risk populations for recurrence in breast cancer patients treated with mastectomy without adjuvant radiotherapy.

METHOD AND MATERIALS
We retrospectively analyzed 88 patients with 1-3 positive axillary nodes after modified mastectomy, who were studied with FDG-PET/CT within 30 days before surgery. We evaluated the relationship between PET parameters including the maximum standardized uptake value (SUVmax), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) and clinical outcomes.

RESULTS

CONCLUSION
Volume-based parameters on pretreatment FDG-PET/CT improve recurrence prediction in postmastectomy breast cancer patients with 1-3 positive nodes. The addition of MTV to ER status or TN could identify a subgroup of patients at higher risk for recurrence.

CLINICAL RELEVANCE/APPLICATION
Patients with high pretreatment MTV or TLG values should be monitored closely or considered for more aggressive treatments including adjuvant radiotherapy or systemic therapy.

MSRO35-03 ● Axillary Lymph Node Dose with Whole Breast Radiation Using 3D Conformal and Intensity-modulated Radiation Therapy

Matthew Janko BS (Presenter) ; **Shirin Sioshansi** MD ; **Patrick J Bonavitacola** ; **Paul S Rava** MD, PhD ; **Thomas J Fitzgerald** MD

PURPOSE
Intensity-modulated radiotherapy (IMRT) for whole breast irradiation has been shown to decrease acute radiodermatitis in the axilla. Although beneficial from a toxicity perspective this raises the concern of less incidental radiation to the axilla. As the extent of axillary surgery decreases, the radiation dose and distribution within the axilla become increasingly important. Here, we report a dosimetric comparison of incidental dose delivered to axillary level I-III lymph node volumes using CT-based three-dimensional conformal radiation therapy (3DCRT) and hybrid intensity-modulated radiation therapy (IMRT) techniques.

METHOD AND MATERIALS
58 women treated with whole breast irradiation (WBI) at our institution in 2011-2012 were identified. Patients with bilateral disease, regional nodal disease, or deliberate targeting of the axilla were excluded. All patients underwent CT-based planning. Breast tissue and tumor bed contouring was performed on all patients at the discretion of the treating radiation oncologist and treatment planning was performed to encompass the entire breast parenchyma. Axillary lymph node (ALN) level I, II and III volumes were retrospectively contoured according to the RTOG contouring atlas. The mean dose as well as the volume of each level receiving 50% (V50%), 90% (V90%) and 95% (V95%) of the prescription dose were calculated from treatment plans. Independent samples t-tests and univariate analyses were used to compare baseline characteristics and observed incidental doses.

RESULTS
Mean volumes of breasts, tumor beds and axillary levels did not differ significantly between WBI techniques. Mean doses to the ipsilateral breast, tumor beds and ALN levels I, II and III were similar between WBI techniques. No significant difference was seen in V50%, V90% and V95% for the same levels.

CONCLUSION
We report essentially identical incidental dose to axillary levels I, II and III using IMRT and 3DCRT for standard tangential whole breast irradiation.

CLINICAL RELEVANCE/APPLICATION
WBI with IMRT results in less acute desquamation and better quality of life. In the era of less axillary surgery, our results are reassuring that IMRT does not give less incidental dose than 3DCRT.

MSRO35-04 ● Patterns of Care in Ductal Carcinoma in Situ of the Breast: An Institutional Practice Quality Improvement Initiative

Parima Daroui MD, PhD (Presenter) ; **Jeffrey V Kuo** MD ; **Nilam S Ramsinghani** MD

ABSTRACT
Purpose/Objective(s):
Mastectomy has historically been the standard treatment for Ductal carcinoma in situ (DCIS) of the breast with excellent local control. However to spare patients from possible overtreatment and the morbidity of radical surgery, the treatment paradigm has shifted to an increased use of breast conserving surgery (BCS). In addition, several large randomized trials have demonstrated that the addition of adjuvant radiation treatment (RT) after BCS reduces breast recurrences by 50% to 60%, comparable to results with mastectomy. Although the role of RT in DCIS is strongly supported by randomized data, there are also data that support the possible omission of adjuvant RT in certain low risk subgroups, in attempts to further optimize the risk-benefit ratio in patients with DCIS. The purpose of our study is to determine the pattern of care and utilization of BCS+RT in patients with DCIS treated at our institution, as a quality of care improvement initiative.
Materials/Methods:
A retrospective analysis of data from patients with a first diagnosis of DCIS of the breast from 2008-2010 was performed. Predictors for the use of RT, in addition to the relative frequencies of mastectomy, BCS, and BCS+RT were evaluated to determine the pattern of care for DCIS at our institution in the specified interval.
Results:
A total of 37 patients with DCIS were treated for their disease. Of these patients 78% (n=29) received BCS, and 22% (n=8) received mastectomy as initial treatment. Of the 29 patients receiving BCS, 8 patients received mastectomy after BCS for persistent positive margins. Of the remaining 21 patients receiving BCS, nearly all patients (n=20) were given adjuvant RT after BCS, with the exception of one patient who refused RT. Among the patients who received mastectomy as an initial treatment (n=8), the choice of mastectomy as primary surgery was based on the presence of extensive or multifocal disease in 50% (n=4), patient choice in 25% (n=2) and was unknown in 25% (n=2). In addition, of the 8 patients undergoing mastectomy, 2 patients had residual close margins and one of the two was offered RT after mastectomy.
Conclusions:
In contrast to published data that report an under-utilization of RT after BCS in patients with DCIS, utilization of BCS+RT in patients treated at our institution was within the expectation of current standard of care. The majority of patients with DCIS had BCS as their initial surgical treatment (75%, n=29), and mastectomy was only used as a primary modality in patients with extensive disease, or based on patient preference. Of patients eligible for RT after BCS (n=21), nearly all (n=20) completed RT as per current standard of care guidelines. The implementation of practice quality improvement initiatives such as this can be helpful to gauge practice patterns and identify areas of variance from evidence-based guidelines.

MSRO35-05 ● Assessment of Lung Dose during Breast-respiratory-Gated Irradiation Using a 4-dimensional Breast Phantom Moving to Simulate Respiratory Motion

Shimizu Arisa (Presenter) ; **Toshie Horibe** ; **Yukihiko Oshima** ; **Toshiki Kawamura** ; **Masaru Nakamura** ; **Tsuneo Ishiguchi** MD

ABSTRACT
Purpose/Objective(s):
In standard radiotherapy after breast-conserving
therapy, a portion of the lung is included in the irradiation field due to
shifting of the thorax from respiratory motion, and may be a cause of radiation
pneumonitis post-therapy. To reduce the lung dose, using a 4-dimensional breast
phantom simulating respiratory motion the lung dose was compared between the
presence and absence of irradiation during respiratory gating.
Materials/Methods:
Phantoms resembling breast and lung tissues were
prepared, and a 4-dimensional breast phantom was prepared by placing the breast
phantom on the lung phantom and moving it up and down to simulate respiratory motion.
The breast and lung phantoms were divided into two from top to bottom, and a film
to assess the radiation dose was interposed between them. Then, the irradiation
field margin was set on the lung portion 5mm from the breast lower margin, and irradiation
administered with 4MV LINAC (Mitsubishi EXL-15DP). Irradiation was administered
while the respiratory motion of the phantom was stopped during the expiratory phase(irradiation during expiratory phase breath-holding), while the
respiratory motion of the phantom was continuous
(irradiation during spontaneous respiration), or only in the expiratory phase while
the respiratory motion of the phantom was continuous(irradiation during respiratory gating).
After irradiation, the films were scanned, and using analytical
software the respective lung doses were determined.
Results:
Lung dose increased in the order of expiratory phase breath-holding
irradiation, irradiation during respiratory gating, and irradiation during
spontaneous respiration. In the comparison of expiratory phase breath-holding
and spontaneous respiration, lung dose was lower during the former (p=0.001), while
in that of irradiation during respiratory gating and spontaneous respiration,
it was lower with respiratory-gating (p=0.024). No significant difference was
noted in lung dose between expiratory phase breath-holding and
respiratory-gating (p=0.38).

Conclusions:
In standard radiotherapy of breast-conserving therapy, irradiation during respiratory gating as compared to irradiation during spontaneous respiration significantly reduced the lung dose, and so may help to prevent the occurrence of radiation pneumonitis when clinically applied.

MSRO35-06 • Comparison of the Volume and Localization of Lumpectomy Cavity Delineated by Clips and Seroma Based on 4DCT Scan for External-beam Partial Breast Irradiation after Breast Conserving Surgery
Yun Ding (Presenter)

MSRO35-07 • Breast Conserving Treatment: External Beam or Intraoperative Boost? A Matched Pair Analysis

Elena Sperk (Presenter) ; **Daniela Astor** ; **Grit Welzel** ; **Axel Gerhardt** MD ; **Marc Sutterlin** MD ; **Frederik Wenz** *

ABSTRACT
Purpose/Objective(s): In the context of breast conserving treatment, radiotherapy leads to a better overall survival and in addition to whole breast radiotherapy (WBRT) a boost to the tumor bed leads to a better local control. The tumor bed boost is usually added after WBRT or can be done intraoperatively (IORT). Positive effects, an antitumoral effect and modulation of microenvironment after IORT with 50kV x-rays were already described by Belletti et al. (Clin Cancer Res., 2008). During the San Antonio Breast Cancer Symposium data from the randomized TARGIT A trial were presented (n = >3400 patients) showing a trend towards a better overall survival in patients treated with IORT immediately after tumor removal. For this report a matched pair analysis was performed to investigate the impact of IORT boost on overall survival compared to standard external beam boost.
Materials/Methods: In general 370 patients were treated for breast cancer with WBRT + boost (external beam (EBRT) boost n = 146, IORT boost n =224) between the year 2002 to 2009. A matched pair analysis (1:1 propensity score matching for age, TNM, grading, hormonal treatment and chemotherapy) for overall survival and local recurrence free survival could be done for 53 pairs. All patients underwent breast conserving surgery and WBRT with 46-50Gy. 53 patients received an EBRT boost with 16Gy (2Gy/fraction, dedicated linear accelerator) and 53 patients received an IORT boost with 20Gy (INTRABEAM system, 50kV x-rays). Median follow-up was 6 months (range, 1-77 months) for the EBRT boost patients and 56 months (range, 2-97 months) for IORT boost patients. Kaplan Meier estimates were performed for overall survival and local recurrence free survival.
Results: Due to a special follow-up program for IORT boost patients, the IORT group had a longer follow-up than the EBRT boost patients. Despite the difference in follow-up times, there was a strong trend towards better overall survival after IORT boost (90.2% vs. 62.3%, p = 0.375) in our cohort. One local recurrence was present in each group (EBRT boost after 15 months, local recurrence free survival 95%; IORT boost after 12 months, local recurrence free survival 98.1%).
Conclusion: IORT given as a boost seems to have a positive impact on overall survival in breast cancer patients after breast conserving surgery. To identify such an effect a prospective randomized trial should be conducted. Secondly, a good local control can be achieved by applying a boost after breast conserving surgery.

MSRO35-08 • Clinical Research of 3D-CRT Accelerated Partial-breast Irradiation (APBI) for the Selected Chinese Patients with Early-stage Breast Cancer after Breast-conserving Surgery

Min Xu (Presenter)

ABSTRACT
Purpose/Objective(s): To explore the feasibility, efficacy and cosmetic effect of three-dimensional conformal external(3D-CRT) beam partial breast irradiation after breast-conserving surgery for the selected Chinese patients with early-stage breast cancer.
Materials/Methods: From June 2003 to December 2010, Forty four Chinese patients with early-stage breast cancer undertaken three-dimensional conformal external beam partial breast irradiation (EB-PBI) after breast-conserving surgery in Shandong Cancer Hospital. Twenty patients undertaken computed tomography (CT) simulation scan in the state of moderate deep inspiration breathing hold (mDIBH) assisted by active breathing control (ABC) system, and twenty-four patients received CT simulation scan during free breathing (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm for the patients treated in the state of FB. EB-PBI was planned and carried out by 3D-CRT) with four non-coplanar fields powered by 6 MV X-ray, the total prescribed dosage was 34 Gy delivered in 3.4 Gy per fractions in thirty nine patients and 38.5Gy delivered in 3.85 Gy per fractions in five patients, twice per day at intervals of at least six hours, in five consecutive days.
Results: All patients was followed up for nine to ninety four months with a median follow-up of fifty four months. Grade 1 of acute radiation-induced dermatitis was observed in 38.6% (17/44) of all the patients. No equal or more than grade 2 of radiation-induced dermatitis was observed, and no any grade of acute radiation-induced pneumonitis was observed. Cosmesis scored basing on Harris critieria was good or excellent in all cases at the time of six months after radiotherapy and in 94.9% cases at the time of two years after radiotherapy. The 2-, 3- and 5-year local control rates were 100% (39/39), 98.8% (30/31) and 93.8% (15/16), respectively. The 2-, 3-, and 5-year survival rates were all 100% and no metastases occurred.
Conclusions:EB-PBI delivered by 3DCRT is feasible for the selected Chinese patients with early stage breast cancer after breast-conserving surgery, satisfactory cosmetic effect, local control rate and long-term survival rate are obtained, meanwhile, acute radiation response rate is lower

MSRO35-09 • Variability in Delineation of the Whole Breast Target Volume by Different Methods after Breast-conserving Surgery
Min Xu (Presenter)

Vascular/Interventional (Ablative Therapies)

Tuesday, 10:30 AM - 12:00 PM • E353A

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OI IR

SSG17 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Govindarajan Narayanan , MD *
Moderator
Kent T Sato , MD

SSG17-01 • Hepatic Radiofrequency (RF) Ablation-induced Stimulation of Distant Subcutaneous Tumor Growth: Suppression with a c-MET Kinase Inhibitor

Muneeb Ahmed MD (Presenter) ; **Gaurav Kumar** PhD ; **Marwan Moussa** MD ; **Nir Rozenblum** MA ; **S. Nahum Goldberg** MD *

PURPOSE
To determine if hepatic radiofrequency ablation (RFA)-induced stimulation of distant subcutaneous tumor growth can be suppressed with an adjuvant c-MET kinase inhibitor in a small animal tumor model.

METHOD AND MATERIALS
Single R3230 adenocarcinoma subcutaneous tumors were implanted in Fisher 344 rats (total n=38). At diameters of 10-11mm, tumors were randomized to receive standardized RFA (21g electrode, 1 cm active tip, tip temperature 70ºCx5min) or sham procedure (electrode placement without RFA) to normal liver (2 groups, n=13 each) and then with adjuvant intraperitoneal PHA-665752 (c-MET inhibitor) administered 3d after RFA (2 groups, n=6 each). Animals were sacrificed and tumors harvested 7d post-treatment. Tumor growth analysis (absolute diameter, change in diameter, and growth curve slope) and evaluation of proliferative indices (Ki-67 % positivity) was performed.

RESULTS
With RFA of normal liver, distant subcutaneous tumors were substantially larger at 7d compared to sham (17.1±2.2mm vs. 13.7±0.9mm, p
CONCLUSION
RF ablation of normal liver can stimulate distant subcutaneous tumor growth in this animal model. This effect can be successfully suppressed with an adjuvant c-MET kinase inhibitor.

CLINICAL RELEVANCE/APPLICATION
Achieving an ablative margin during hepatic RFA may stimulate distant tumor growth. The c-met pathway is one potential mechanism that can be targeted to suppress these deleterious effects.

SSG17-02 • Inhibition of PI3K-AKT-mTOR Signaling Enhances Heat Stress Induced HCC Cell Killing

Scott M Thompson BA (Presenter) ; **Matthew R Callstrom** MD, PhD * ; **Joseph P Grande** MD, PhD ; **Lewis R Roberts** MBChB, PhD * ; **David A Woodrum** MD, PhD

PURPOSE
AKT and ERK signaling pathways are frequently dysregulated in hepatocellular carcinoma (HCC) and promote HCC cell survival. The aim of the present study was to test the hypothesis that inhibition of PI3K-AKT-mTOR and/or MEK-ERK signaling enhances heat stress induced HCC cell killing.

METHOD AND MATERIALS

Intentional partial laser or sham ablation was performed on orthotopic N1S1 HCC tumors under US-guidance and liver/tumor tissue assessed for phospho-AKT and ERK immunostaining at 6 or 24 hours post-ablation (N=8). The HCC cell lines N1S1 and AS30D were pre-treated for 1-hour with small molecule inhibitors against PI3K-mTOR, MEK, both or vehicle control followed by sublethal heat stress (45.0°C) or control (37°C) for 10 minutes and recovered up to 48 hours in complete media at 37°C (N=3). Samples were assessed for heat stress induced AKT and ERK signaling immediately post-heat stress by western immunoblotting and cell viability at 48 hours post heat stress by WST-1 assay.

RESULTS
Immunohistochemical analysis of the ablation zone demonstrated markedly increased AKT and ERK phosphorylation at the tumor ablation margin but not at the liver ablation margin. There was no evidence of increased AKT or ERK phosphorylation in the tumor or at the margin between liver and tumor in the sham ablation group. Western immunoblotting demonstrated that inhibition of PI3K-mTOR and MEK blocked constitutive and heat stress induced AKT and ERK phosphorylation, respectively, in both the N1S1 and AS30D HCC cell lines. Viability assessment demonstrated that inhibition of PI3K-mTOR enhanced heat stress induced HCC cell killing over heat stress or drug alone in both cell lines (p
CONCLUSION
These data demonstrate that thermal ablation induces AKT and ERK phosphorylation at the tumor ablation margin *in vivo* and that inhibition of PI3K-mTOR prevents heat stress AKT signaling and enhances heat stress induced HCC cell killing.

CLINICAL RELEVANCE/APPLICATION
Inhibition of PI3K-AKT-mTOR signaling may be a promising therapeutic target in combination with thermal ablation as a method to enhance ablation induced HCC cell killing.

SSG17-03 ● Optimizing Pulsed Irreversible Electroporation Deposition

Ayelet Wandel MD (Presenter) ; **Muchamad Faruja** MD ; **Isaac Nissenbaum** BSc ; **Eliel Ben-David** MD ; **Liat Appelbaum** MD ; **S. Nahum Goldberg** MD *

PURPOSE
To determine optimal settings for creating large zones of IRE-induced ablation.

METHOD AND MATERIALS
IRE ablation (n = 33) was performed in vivo in pig liver (n= 7, Yorkshire swine 92 ± 105 kg) under ultrasound guidance using two IRE electrodes, 18 gauge, tip exposure of 2cm, 1.5-2cm inter-electrode spacing and Nanonknife generator (Angiodynamics, Fremont, CA). Energy deposition was applied at 2,250 to 3,000V for 10 ± 100 pulses per application cycle. In addition, to varying the number of pulses, the number cycles of IRE application (1-12) and the time interval between IRE applications (10-900 sec) were systematically varied. Electrical parameters including applied current and tissue resistance were measured throughout the ablation. Cross-sectional zones of ablation were measured by gross and histopathology. These data were compared and correlated with IRE pulse parameters to determine optimal settings.

RESULTS
For a 15 min application time, optimal ablation of 6.7 ± 0.2 x 3.3 ± 0.1 cm was produced at 100 pulses of 100 ±sec and 3000V with 100 sec time intervals. This was substantially larger than the 5.5 ± 0.2 x 2.0 ± 0.3 cm produced by continuous application at otherwise controlled parameters ($p < 0.01$). Varying the time interval between cycles of IRE application from 100 to 900 seconds altered both the maximum resistance and the diameter of treatment in a dose-dependent. For examples, for 4 cycles of 50 pulses, 100 - 300 sec interval delay between cycles decreased the active resistance by 30 ± 9.6 ohms and produced a diameter of 3.6 ± 0.2 with 600 - 900 sec delay showing virtually no change in resistance and producing a diameter of 3.0 ± 0.3 ($p < 0.01$). Altering the number of pulses or voltage for a constant 100 sec interval delay also produced dose dependant changes in max resistance (210-320 ohms range) and short-axis coagulation diameter (from 2.4 ± 0.3 ± 3.1 ± 0.4 cm).

CONCLUSION
These results establish that IRE not only induces tissue ablation, but also dynamically alters tissue characteristics in ways that can be used to further improve the treatment effect. Introduction of relatively short refractory period can indeed create larger, more clinically useful zones of ablation than continuous application.

CLINICAL RELEVANCE/APPLICATION
Optimization of IRE ablation parameters will enable the creation of larger volumes of treatment effect in the most efficient manner.

SSG17-04 ● Early Residual Tumor Differentiation from Benign Periablational Thermal Injury after Radiofrequency Ablation by Dual-energy Computed Tomography: A Phantom and Animal Study

Yuekao Li (Presenter) ; **Gaofeng Shi** MD ; **Runze Wu**

PURPOSE
The inflammatory reaction to the thermal injury after the radiofrequency ablation (RFA) makes it difficult to timely determine the treatment response using conventional computed tomography (CT). In this study, we applied iodine quantification with Dual-Energy CT (DECT) in rabbits with VX2 carcinoma after incomplete RFA to distinguish benign periablational reactive tissue from residual tumor and evaluated the therapeutic response of RFA.

METHOD AND MATERIALS
A phantom with ten tubes which contain solutions of varying iodine concentration was scanned with DECT to evaluate the feasibility of iodine quantification. Iodine concentration was calculated and compared with the true iodine concentration. In animal study, triple-phase contrast-enhanced DECT data on 24 rabbits with VX2 carcinoma were assessed by 2 reviewers independently after 3-day (n=6), 1-week (n=6), 2-week (n=6) and 3-week (n=6) of incomplete RFA. The iodine map images were obtained based on three materials decomposition theory after post-processing to CT images. Regions of interest (ROI) were positioned on the iodine image over the lesion and aorta as a reference, for the recording of iodine concentration in the lesion and in the aorta respectively. The pathologic specimens were sectioned in the same plane as CT imaging. The differences of lesion iodine concentration and lesion-to-aorta iodine ratio between residual tumor and benign periablational reactive tissue were statistically analyzed.

RESULTS
The calculated iodine showed excellent correlation with the true iodine concentration ($R2 = 0.999$, $P < 0.0001$) in the phantom study. The lesion iodine concentration and lesion-to-aorta iodine ratio in residual tumor were significantly higher than that in benign periablational reactive tissue in 2-week group during the arterial phase (AP) ($P < 0.01$), and in 3-week group during both AP ($P < 0.05$) and portal venous phase (PVP) ($P < 0.05$). There was no significant difference of lesion iodine concentration or lesion-to-aorta iodine ratio between them in 3-day and 1-week groups.

CONCLUSION
The results of this study indicated that iodine quantification with DECT is accurate in the phantom study and could be used to differentiate benign periablational reactive tissue from residual tumor in VX2 carcinoma 2 weeks after RFA.

CLINICAL RELEVANCE/APPLICATION
The iodine quantification with DECT could be performed 2 to 3 weeks after RFA clinically to early evaluate therapeutic response.

SSG17-05 ● Clinical Utility of Automatic Real-time Fusion System for Radiofrequency Ablation in Target Localization, Electrode Placement and Monitoring of Ablation Procedure

Jeong-Min Lee MD (Presenter) * ; **Jeong Hee Yoon** MD ; **Dong Hyeon Kim** MD ; **Joon Koo Han** MD ; **Byung Ihn Choi** MD, PhD *

PURPOSE
To prospectively evaluate clinical utility of automatic multimodality image fusion for radiofrequency ablation(RFA) procedures, and to determine clinical outcomes of fusion-guided RFA procedures.

METHOD AND MATERIALS
80 patients (M:F=66:14) with 89 liver malignancies (80 HCCs and 9 metastases) were treated with switching monopolar RFA using multiple electrodes under the guidance of image fusion system (PercuNav system, Philips Healthcare). Image fusion system was used in undergoing RFA to assist in target localization, electrode placement, and procedure monitoring. A preprocedural CT scan was obtained at slight inspiration phase with six sterile passive fiducial markers on the skin. Visibility of target tumor, planning of safe access route, operator's confidence for technical feasibility were graded by an operator using conventional B-mode ultrasound and using the image fusion system. In addition, registration time was recorded. Technique effectiveness, local recurrence rate and remote recurrence rate at 1, 6, 12, and 18 months were evaluated using the Kaplan-Meier method.

RESULTS
Real-time fusion of US with CT/MR provided information crucial for successful execution of the RFA procedure in 43.8% (35/80) patients, and may enable procedures that are not feasible with US guidance in 23.8 % of cases. Total additional setup time for the navigation system was 3.7 min ± 1.9. Tumor visibility was significantly improved on fusion system compared with on B mode US and ($p< 0.0001$). In addition, image fusion system provided better planning of safe access route without a risk for major vascular injury, and increased operator's confidence for technical feasibility compared with B-mode ultrasound ($p < 0.0001$). Technique effectiveness rate, determined 1 month after RFA was 100%. Local tumor progression rates at 6, 12 and 18 months were 2.5%, 6%, and 6%. In addition, intrahepatic remote recurrence rates at 6, 12 and 18 months after RFA were 12%, 16.5%, 22.4%.

CONCLUSION

Real-time multimodality fusion system provided information crucial for successful execution of the RFA procedure in 43.8% (35/80),and automatic real time fusion guided RFA safely provided successful local tumor control, and therefore, improved survival may be achieved with this technique.

CLINICAL RELEVANCE/APPLICATION
Real time image fusion system provided better visibility of target tumor, and increased operator's confidence for RFA, which allowed a high local tumor control rate.

SSG17-06 ● Radiofrequency Ablation Using a Multiple-electrode Switching System for Lung Tumors Measuring 2cm or Larger: Phase-II Clinical Study

Hiroshi Kodama (Presenter) ; **Koichiro Yamakado** MD, PhD ; **Takaaki Hasegawa** ; **Masashi Fujimori** MD ; **Takashi Yamanaka** MD ; **Haruyuki Takaki** MD ; **Junji Uraki** MD ; **Atsuhiro Nakatsuka** MD ; **Hajime Sakuma** MD *

PURPOSE
To prospectively evaluate the safety and effectiveness of radiofrequency (RF) ablation using a multiple-electrode switching system for the treatment of lung tumors measuring 2cm or larger.

METHOD AND MATERIALS
Our institutional review board approved this phase-II study and written informed consent was obtained from all patients. Inclusion criteria were not surgical candidates who had 3 or less malignant lung tumor with maximum tumor diameter of 2–5cm. The primary endpoint was safety and evaluated using the Common Terminology Criteria for Adverse Events (CTCAE). Patients were observed at least one year, and local tumor progression and overall survival were analyzed using Kaplan-Meier method.

RESULTS
Thirty-three consecutive patients (26 male and 7 female; mean age, 70.5 years; 46–87 years) were included. A total of 35 tumors with mean maximum tumor diameter of 3.0±0.7 cm (range, 2.0–4.4 cm) were ablated using a multiple-electrode switching system in 35 sessions. There was no procedure-related death and Grade-4 adverse event. Grade-3 adverse event occurred in 4 sessions (11.4%, 4/35): pleural effusion requiring chest tube placement (n=2), pneumothorax requiring pleural adhesion (n=1), and pulmonary hemorrhage treated by coil embolization of pulmonary artery (n=1). Grade-1 or -2 adverse events were detected in 37.1% (13/35) of RF sessions. The 1-year local tumor progression rates were 12.7% (95% confidence interval (CI), 1.0–25.5%). All of the tumors with local tumor progression (n=4) was adjacent to bronchi or vessels greater than 2mm. The 1-year overall survival rates were 81.2% (95% CI, 67.6–94.8%).

CONCLUSION
RF ablation using a multiple-electrode switching system is safe and effective for treatment of lung tumors measuring 2cm or larger.

CLINICAL RELEVANCE/APPLICATION
RF ablation using a multiple-electrode switching system can be useful when the lung tumor is 2cm or larger.

SSG17-07 ● Nanoparticle Distribution after Treatment of Rabbit VX2 Hepatic Tumor with Nanoparticle Embolization and Irreversible Electroporation (IRE) or Radiofrequency Ablation (RFA)

Alda L Tam MD (Presenter) * ; **Marites P Melancon** PhD ; **Joe Ensor** * ; **Laura Pageon** DVM ; **Mohamed E Abdelsalam** MD ; **Tomas Appleton Figueira** MD ; **Katherine Dixon** RT ; **Jennifer J Miller** ; **Amanda McWatters** ; **Chun Li** PhD ; **Sanjay Gupta** MD

PURPOSE
To investigate the intratumoral uptake of radiolabeled, hollow gold nanoparticles loaded with doxorubicin (64Cu-labeled PEG-HAuNS-DOX) after IRE or RFA in rabbit VX2 hepatic tumors.

METHOD AND MATERIALS
Twelve VX2 tumor-bearing rabbits were randomized to three treatment arms: (i) nanoembolization with 64Cu-labeled PEG- HAuNS-DOX (NE) alone; (ii) NE followed by IRE (NE+IRE); (iii) NE followed by RFA (NE+RFA). PET/CT imaging was obtained at 18-hours after intervention, after which animals were euthanized and tissue samples were collected for autoradiograph and TEM analysis. Dunnett's multiple comparison procedure was performed to evaluate differences in the mean uptake of nanoparticles in the tumor.

RESULTS
Based on PET/CT evaluation, the uptake and retention of the nanoparticles in the tumor following NE+RFA was significantly greater than following NE ($p=0.02$) but there was no difference in the uptake and retention of the nanoparticles following NE+IRE when compared to NE ($p=0.75$). The autoradiograph analysis demonstrates that following NE+IRE, there is nanoparticle deposition in the tumor, in the ablated tissues adjacent to the tumor and in normal liver; whereas, following NE or NE+RFA, there is nanoparticle deposition around the tumor but not in it. The TEM results indicate that following NE+IRE, intracellular uptake of nanoparticles was noted in tumor, ablated and normal liver cells. There was no intracellular uptake of nanoparticles following NE or NE+RFA.

CONCLUSION
Combining NE with IRE or RFA results in the retention of the nanoparticles in or around the tumor for up to 18-hours post-intervention; however, nanoparticles are found inside cells only after IRE.

CLINICAL RELEVANCE/APPLICATION
A combined nanoembolization and ablation treatment technique for liver tumors is feasible.

SSG17-08 ● Renal Cryoablation: A New Paradigm for Nearly Any Tumor Location

Hussein D Aoun MD (Presenter) ; **Peter J Littrup** MD * ; **Barbara A Adam** MSN ; **Evan N Fletcher** MS, BA ; **Mark J Krycia** BS

PURPOSE
To assess technical feasibility, efficacy and complication rates of CT guided percutaneous renal mass cryoablation in a large series on long term follow up.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 247 procedures on 262 tumors (210 RCC, 45 metastasis, 6 oncocytomas and 1 angiomylolipma) in 214 patients noting tumor size and location. Thirty-seven patients had multiple renal tumors ablated. Follow-up CT or MRI was utilized to assess efficacy and evaluate for local recurrences or new multicentric tumors. Hydrodissection with normal saline/ contrast (60:1) solution was performed to protect adjacent vital structures such as bowel, ureter or pancreas. Complications followed the grading system of the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE 4.0).

RESULTS
All the procedures were performed under conscious sedation and were virtually painless during and after the procedure. Average tumor and ablation size was 3cm and 5cm, respectively, with the largest 10.4cm. Hydrodissection was performed in 73 procedures. Major complication (only grade 3) rate attributable to the procedure was 2.4% (6/247). Of the major complications, 3 (3/5) were related to hemorrhage requiring transfusion (Grade 3). A ureteral stricture prior to ureteral stent placement for central tumors and bowel injury prior to protective hydrodissection techniques were observed early on in our experience. Median follow-up was 1.8 years with 72 patients having > 3 year follow-up and 36 patients having > 5 year follow-up. Local recurrence rate was 2% (6/262), with 4 technical failures and 2 tract recurrences. Of the local recurrences, 4 were re-ablated (2 tract and 2 technical) without residual disease on follow-up for a secondary efficacy of 99%.

CONCLUSION
Renal cryoablation has established low complication and local recurrence rates which do not appear to be significantly affected by tumor size or central location. CT guided percutaneous cryotherapy is a low cost and low morbidity alternative for patients with complex renal tumors.

CLINICAL RELEVANCE/APPLICATION
The rising cost of health care mandates consideration of renal cryoablation as a cost effective treatment option, justified by comparable low recurrence and complication rates for any renal location.

SSG17-09 ● RCC Perfusion before and after Radiofrequency Ablation Measured with DCE-MRI: A Pilot Study

Tze M Wah MBChB, FRCR (Presenter) ; **Steven Sourbron** PhD ; **Daniel Wilson** MS ; **Derek Magee** PhD ; **Walter Gregory** PhD ; **Peter J Selby** MD, DSc ; **David L Buckley** PhD

PURPOSE
The treatment efficacy of radiofrequency ablation (RFA) of renal cell carcinoma (RCC) is usually assessed with contrast enhanced CT or MRI. The lack of contrast enhancement in the zone of ablation is usually interpreted as successful ablation. However, the zone of ablation typically exhibits some enhancement rather than no enhancement at all, and it is this variability that can pose a clinical dilemma when deciding whether there is complete tumor cell death. Dynamic contrast enhanced (DCE) -MRI is routinely performed in our institution to assess the treatment effect for patients undergoing RFA. This pilot study aims to investigate if early treatment effects of RFA in RCC can be detected with DCE-MRI perfusion measurements.

METHOD AND MATERIALS
Twenty patients undergoing percutaneous RFA of their twenty one RCCs were evaluated with DCE-MRI immediately before and at one- month after RFA treatment. DCE-MRI was performed with volume acquisition under free breathing. The tumor perfusion was estimated using the maximum slope technique in two independent sittings. Blood flow to the renal tumors was correlated with total RF treatment time. This study was granted approval by our institution IRB.

RESULTS
DCE-MRI examinations were successfully evaluated for 21 renal tumors (size from 1.3 to 4 cm) with RFA time (7.4 to 63.4 minutes). The perfusion measurement of the RCCs decreased significantly (p
CONCLUSION
It is feasible to measure RCC perfusion before and after RFA using DCE-MRI. Pre-RFA tumor blood flow may be used to predict RFA time which may help planning treatment. Perfusion values significantly decrease in the zone of ablation, suggesting they may be useful for the assessment of treatment.

CLINICAL RELEVANCE/APPLICATION
It is feasible to measure RCC perfusion with DCE-MRI before and after RFA to assess treatment effect; blood flow to the RCC before RFA may be used to predict required ablation time.

Case-based Review of Nuclear Medicine: PET/CT Workshop-Lymphoma/Melanoma/Sarcoma (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, 01:30 PM - 03:00 PM • S406A

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OI NM CT

MSCC33 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Director
John A Parker , MD, PhD
Heather Jacene , MD

LEARNING OBJECTIVES
1) To understand the role of PET/CT in the management of patients with lymphoma, melanoma and sarcoma.

Interventional Oncology Series: Lung

Tuesday, 01:30 PM - 06:00 PM • S405AB

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RO OI IR CH

VSIO31 • *AMA PRA Category 1 Credit* ™:4.25 • ARRT Category A+ Credit:5

Moderator
Alison R Gillams , MBChB *

LEARNING OBJECTIVES
1) To learn the latest results of ablation in primary and secondary lung tumours. 2) To understand how to use the different ablation technologies (RF, MW and cryotherapy). 3) To learn optimal patient selection for lung ablation. 4) To understand the imaging appearances following ablation. 5) To know how to diagnose and manage possible complications following ablation.

VSIO31-01 • Primary Lung Cancer

Robert D Suh MD (Presenter)

LEARNING OBJECTIVES
1) Discuss long term outcomes of image-guided ablation for early stage lung cancer. 2) Discuss local control rates of image-guided ablation for early stage lung cancer. 3) Understand the factors in image-guided ablation influencing survival and local control. 4) Understand treatment options and relative outcomes of image-guided ablation compared to alternative therapies for early stage lung cancer.

ABSTRACT
Thermal ablation is a safe therapeutic and effective option to provide local control for 1 lung malignancies. Thermal ablation confers survival benefits in carefully selected patients: RF ablation with encouraging mid- and long-term results. Microwave and cryoablation remain promising techniques, requiring future studies for validation.

VSIO31-02 • Colorectal Lung Metastases

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO31-03 • Sarcoma and Other Non-CR Lung Metastases

Jean Palussiere MD (Presenter)

LEARNING OBJECTIVES
View learning objective under main course title.

VSIO31-04 • Irreversible Electroporation of Lung Metastases: Initial Experience

Thierry J De Baere MD (Presenter) * ; **Julien Joskin** ; **Antoine Hakime** MD ; **Geoffroy Farouil** ; **Lambros C Tselikas** MD ; **Frederic Deschamps**

PURPOSE
Because recurrence rate of lung RFA has been reported higher when tumor are in contact with large vessels we used Irreversible Eletroporation (IRE) used to treat such located lung metastases and reported herein our initial experience

METHOD AND MATERIALS

RESULTS

CONCLUSION
IRE is well tolerated, induces a rapid decrease in size of the treated tumor but tumor regrowth is frequent within the first year of follow-up.

CLINICAL RELEVANCE/APPLICATION
IRE of lung metastases, although inducing rapid decrease of the tumor size does not prevent later growth of the tumor. Consequently, the technique must be improved before routine clinical use.

VSIO31-05 • What Does SBRT Contribute to the Management of Primary or Metastatic Lung Cancer?

Brian T Collins MD (Presenter) *

LEARNING OBJECTIVES
1) Review SBRT technology. 2) Review SBRT patient selection. 3) Discuss mature locoregional outcomes of SBRT for stage I NSCLC and pulmonary metastases. 4) Discuss mature survival outcomes of SBRT for stage I NSCLC and pulmonary metastases. 5) Review expected chronic toxcities of thoracic SBRT.

VSIO31-06 • Clinical Tumour Board

Robert D Suh MD (Presenter) ; **Stephen B Solomon** MD (Presenter) * ; **Brian T Collins** MD (Presenter) * ; **Jean Palussiere** MD (Presenter)

LEARNING OBJECTIVES
1) Understand case-based information. 2) Identify treatment strategies. 3) Evaluate thoracic interventional procedures.

VSIO31-07 • Interpretation of Follow-up Imaging

William H Moore MD (Presenter) *

LEARNING OBJECTIVES
1) Identify the findings on follow up imaging that are characteristic of post-ablation zones. 2) Identify the findings on follow up imaging that are characteristic of recurrence. 3) Compare the post ablation imaging findings between RFA, Microwave, Cryoablation and Nanoknife.

ABSTRACT

VSIO31-08 ● Why, When and How I Perform RF Ablation of Lung Tumours

Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) Understand multidisciplinary patient selection and describe the indications and contraindicatons to RFA of the lung. 2) Outline the RFA procedure including sedation, appropriate approach and positioning, equipment setup and treatment and followup protocols.

VSIO31-09 ● Why, When and How I Perform MW Ablation of Lung Tumours

Thomas J Vogl MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Identify indications for MWA of lung tumors. 2) Identify procedure-related risk factors. 3) Learn about tips and tricks.

ABSTRACT
Thermal ablation techniques have increasingly expanded their role in minimal invasive destruction of tumor tissue beyond the liver, especially in the lung. Both primary and secondary lung cancers are currently of interest among thermal ablation techniques such as laser therapy, radiofrequency ablation, and others. With its introduction microwave ablation (MWA) has rapidly gained its role as a precise, excellently controllable ablation technique.
In the following course different techniques of MWA of lung cancers will be presented. This includes techniques on the access, protocols for the ablation and preventive management of complications. Special focus is directed towards the daily management of risk factors at our institute in Frankfurt based on the up-do-date experience.
In the second part the indications for thermal ablation among other technologies such as radiooncology, surgery and systemic chemo-immunotherapy will be presented.
In summary, MWA of neoplastic diseases of the lung rapidly gains acceptance and provides excellent treatment results with a low rate of complications and side effects. Its current role among an armamentarium of other treatment techniques has to be searched for, documented, consolidated and expanded.

VSIO31-10 ● Evaluation of a Combined Protocol of Microwave Ablation (MWA) and Transpulmonary Chemoembolization (TPCE) versus MWA Only Protocol: Treatment of Primary and Secondary Nonresectable Lung Tumors

Thomas J Vogl MD, PhD (Presenter) ; **Thomas Dauda** BS ; **Stefan Zangos** MD ; **Emmanuel C Mbalisike** MD ; **Nour-Eldin A Nour-Eldin** MD, MSc

PURPOSE
To evaluate tumor response with volumetric assessment of tumor sizes after treating nonresectable primary and secondary lung tumors with transpulmonary chemoembolization (TPCE) combined with microwave ablation (MWA) versus MWA only protocol in palliative intention.

METHOD AND MATERIALS
Between 2007 and 2012, 23 patients (10 males, 13 females; average, 61.2 years; range, 29-83) suffering from unresectable primary (n=3) and secondary lung tumors (n=20) were treated with TPCE (average, 4.3 sessions) followed by MWA. Another 13 patients (8 males, 5 females; average, 60.2 years; range, 28-83) suffering from unresectable primary (n=2) and secondary lung tumors (n=11) were only treated with MWA. Patients treated with a combined therapy suffered from primary lung tumors (n=3) and metastases of different origins such as colorectal carcinomas (n=6), breast cancer (n=5), urothel carcinoma (n=3), and others (n=6). Patients treated only with MWA suffered from primary lung tumors (n=2) and metastases of different origins such as colorectal carcinomas (n=6), and others (n=5). Follow-up was between 4 months and 3.7 years for primary and secondary lung tumors.

RESULTS
All patients tolerated the combined treatment and the MWA only well and without adverse effects. The rate of spontaneously resolving pneumothoraces was 5.3% in the combined protocol and 4.1% in the MWA only protocol. According to the retrospective study data, in the combined treatment protocol complete response was documented in 30.4% (n=7) of lesions, while in 21.7% (n=5) stable disease was documented and in another 47.8% (n=11) a progressive disease situation. In the group of patients treated only with MWA (n=13), complete response was documented in 38.5% (n=5), stable disease in 7.7% (n=1) and progress in 53.8% (n=7).

CONCLUSION
According to the first evaluated data the additional use of TPCE results in a slight improvement of the local response rate and a reduction of the rate of progression. Further prospective studies are, however, necessary.

CLINICAL RELEVANCE/APPLICATION
Transpulmonary chemoembolization (TPCE) and microwave ablation (MWA) are relevant palliative treatment options in patients with primary and secondary nonresectable lung tumors

VSIO31-11 ● Why, When and How I Perform Cryoablation of Lung Tumours

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the ‘1-2 Rule’), emphasizing unique benefits for chest wall, pleural-based, central and para-esophageal locations. 2) Understand techniques to minimize morbidity, assessing tumor location and approach. 3) Identify major imaging follow-up criteria for ablation success and any early failures. 4) Describe the overall cost-efficacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of lung tumors offers a lower pain alternative than heat-based modalities, especially for pleural and/or chest wall locations. Central locations near major bronchi locations also have low rates of pneumothorax or broncho-pleural fistulas, while paraesophageal locations are readily protected by esophageal warming balloons. Major cryoablation benefits include its excellent visualization of ablation zone extent, low procedure pain and flexible hydrodissection of chest wall ablation sites near skin. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. MR-guidance has little clinical benefit or cost-efficacy.
For safety, cases will be considered for choosing the most avascular approach, extent of peri-bronchial contact and chest wall involvement. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the ‘1-2 Rule’ of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of

VSIO31-12 ● Thoracic Cryoablation: A Major Benefit for More Central and Chest Wall Locations?

Peter J Littrup MD (Presenter) * ; **Hussein D Aoun** MD ; **Barbara A Adam** MSN ; **Evan N Fletcher** MS, BA ; **Mark J Krycia** BS

PURPOSE
To assess recurrence factors for percutaneous thoracic cryoablation. Tumor and ablation size, complications, location and vessel proximity were assessed for patients with primary thoracic and metastatic tumors.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablation was used in 222 procedures on 283 tumors (75 primary, 208 metastatic tumors) in 133 patients, noting tumor and ablation volumes, location, abutting vessels >3mm, recurrences, complications, and tumor type. Primary thoracic included all lung cancer types (n=70) and pleural tumors (n=5). Complications were graded by the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE). Hydrodissection and esophageal warming balloon were used for tissue separation as needed (20 and 9 respectively). A minimum of 2 cryoprobes were used on all patients and for larger tumors, tumor diameter plus one was used for probe number.

RESULTS
All patients required only conscious sedation. Overall tumor and ablation median size was 2.2cm and 4.2cm, respectively. Major complication rates were significantly lower in tumors =3 cm as opposed to =3cm, 1.5% (2/134) vs. 11.8% (9/76) (p
CONCLUSION
CT guided percutaneous cryoablation in the lung provides a low morbidity alternative for complex patients, particularly for pleural/chest wall and more central tumors. Complication rates are significantly lower for tumors
CLINICAL RELEVANCE/APPLICATION
Thoracic cryoablation is not affected by vessel proximity and produces low recurrence and complication rates. Cryoablation appears superior for central and chest wall locations.

VSIO31-13 ● Complications of Lung Ablation, Preventing Them and When They Occur - Their Management

Kamran Ahrar MD (Presenter)

LEARNING OBJECTIVES
1) List potential complications of lung tumor ablation. 2) Outline steps to avoid potential complications. 3) Outline steps to manage complications.

VSIO31-14 ● Evaluating Cryoablation of Metastatic Lung/Pleura Tumors in Patients - Safety and Efficacy (ECLIPSE)

David A Woodrum MD, PhD (Presenter) ; **Thierry Debaere** ; **Fereidoun G Abtin** MD ; **Peter J Littrup** MD * ; **Frederic Deschamps** ; **Robert D Suh** MD ; **Hussein D Aoun** MD ; **Matthew R Callstrom** MD, PhD *

PURPOSE
To evaluate safety and preliminary efficacy of CT guided lung cryoablation for lung metastases =3.5cm in patients with pulmonary metastatic disease.

METHOD AND MATERIALS
Forty patients (24 males,16 females; mean age 63 years) were enrolled in a prospective single arm study to evaluate CT guided lung cryoablation(Galil Medical,Arden Hills, MN) for patients with lung metastases. Inclusion criteria were up to 3 unilaterally or a maximum of 5 metastases bilaterally. Patients were followed with serial CT imaging at 1 week, 3, 6, and 12 months. The primary endpoint for the study is local tumor control assessed by a modified RECIST. Complications were assessed using the CTCAE 4.0

RESULTS
A total of 62 tumors (40 patients) underwent 48 cryoablation procedures. The mean tumor size was 1.4 cm (range 0.3 to 3.2 cm), and 80% (n=32) of patients had unilateral disease. Sedation was general (67%;n=32), conscious/sedation in 31%(n=15), and 2% regional sedation(n=1). Treatment time ranged from 32-272 minutes (mean=101). Nine chest tubes (18%) were placed for pneumothorax but removed in 1 day or less. With the exception of three grade 3 events (non-cardiac chest pain, pneumothorax requiring VATS, and dialysis fistula thrombosis), all other reported adverse events (95.2%) were classified as CTCAE grade 1 or 2. The most common events (48 procedures) occurring within 30 days of the procedure were pneumothorax 50% (n=24), hemorrhage 8% (n=4). All resolved with minimal to no intervention. We did not encountered major hemorrhage to the lung or the pleura. At 3 months, 28 patients (75%) followed up with 100% response rate defined as either stable disease, partial response, or complete response. At 6 months, 15 patients (38%) followed up with a 95% response rate due to one patient having a local failure.

CONCLUSION
Cryoablation of metastatic lung tumors =3.5 cm appears to be a safe. Our preliminary results demonstrate promising local tumor control within the lung.

CLINICAL RELEVANCE/APPLICATION
CT guided lung cryoablation demonstrates safety and preliminary efficacy in treating metastatic lung disease.

VSIO31-15 ● Percutaneous Cryoablation in Management of Recurrent Mesothelioma after Surgical Pleurectomy and Decortication: Efficacy and Predictors of Local Recurrence

Fereidoun G Abtin MD (Presenter) ; **Jesse K Sandberg** MD ; **Robert D Suh** MD ; **William Hsu** PhD ; **James Sayre** PhD ; **Robert Cameron** MD

PURPOSE
Percutaneous cryoablation (PCT) is an ablative technique, used to manage recurrent mesothelioma in patients following surgical lung sparing decortication and pleurectomy. The purpose of this study was to evaluate the efficacy and clinical and ablation variables that are predictive of tumor recurrence following PCT.

METHOD AND MATERIALS
IRB obtained. From a database containing surgical and radiological information, patients with recurrent mesothelioma following lung sparing pleurectomy and decortication with at least one PCT were identified. Patients were followed after PCT using CT and PET/CT scans for at least 6 months. Clinical variables included: stage at diagnosis, chemotherapy, radiation, recurrence time lag following surgery, and number of lesions at time of recurrence presentation. PCT variables included: size of the lesion, edge of ice ball beyond the tumor, number of probes, size of probes, number of cryo cycles, maximum and total freeze and thaw time. A stepwise multiple logistic regression model was used to assess predictors of local recurrence after ablation; local recurrence determined by increased regional metabolic activity or increased size of post ablation zone.

RESULTS
17 patients were identified who underwent a total of 75 outpatient cryoablations (range of 1-25). Lesions measured a mean of 37 mm (range 14-113) by 22.0 mm (range 12-55) in diameter. At 6 months 68/75 (90.7%) ablations showed no recurrence. No major, but minor complications including hematoma, small pneumothorax and hemoptysis in one patient each and erythema in 3 chest wall subcutaneous lesions (5/75 =6.6%). Late complications in 4/75 (5.3%) ablations. Considering the clinical and ablation variables, iceball beyond tumor edge less than 6.52 mm detected on CT scan during ablation was the only statistically significant predictor of recurrence (p
CONCLUSION
PCT can be used for management of recurrent mesothelioma following surgery with low recurrence rate of 9.3%, and limited early complications of 6.6%. When performing PCT, at least 6.52 mm of the edge of iceball is needed to extend beyond the edge of tumor to limit local recurrence.

CLINICAL RELEVANCE/APPLICATION
Percutaneous Cryoablation can be used in local control of recurrent mesothelioma after surgery with low recurrence rate and limited early complications.

VSIO31-16 ● Can a Biopsy Performed after Lung Radiofrequency Ablation Be Contributive?

Lambros C Tselikas MD (Presenter) ; **Julien Adam** ; **Frederic Deschamps** ; **Geoffroy Farouil** ; **Julien Joskin** ; **Christophe Teriitehau** ; **Antoine Hakime** MD ; **Thierry J De Baere** MD *

PURPOSE
To evaluate the effectiveness of a biopsy performed after lung radiofrequency ablation (RFA).

METHOD AND MATERIALS
Institutional review board approval was obtained. Eighteen patients with lung tumors, including 72% of metastases (14/18) (8 colorectal, 1 renal, 1 parathyroid, 1 melanoma, 1 osteosarcoma, 1 cholangiocarcinoma and 1 breast cancer) and 23 % of primary lung cancers (1 epidermoid and 3 adenocarcinomas) were treated with lung RFA. A biopsy was performed immediately after RFA. The biopsy was obtained through the canula used to insert the RFA probe without need for additional puncture. Pathological results including diagnostic of malignancy and morphological characteristics of tumor have been analyzed. Effectiveness was defined by ability to obtain a diagnosis of malignancy. The ability to diagnose tumor subtype, and primitive tumor location (if applicable) was determined. Procedures characteristics, recurrences and complications were also registered.

RESULTS
Mean tumor size was 17.9mm (SD: 1.5mm) at CT immediately before RFA. 89% (16/18) of biopsies were able to diagnose malignancy. Cancer subtype and origin for malignant tumors was determine in 72% (13/18) of tumors. During one-year follow-up, 1 tumor demonstrate local progression (5.5%), 5 patients presented distant lung disease progression (33%) and 11 were lung disease free (61%). Thirteen complications occurred (72%), including 5 pneumothoraxes requiring chest tube placement (27%), and 7 minor pneumothoraxes without treatment (34%), and 1 intrapulmonary hemorrhage (5%) not requiring any specific treatment. No fatal complication occurred.

CONCLUSION
A biopsy performed after RFA of lung tumor can confirm malignancy in close to 90% of cases. This diagnosis is obtained without the need for additional puncture. Such post RFA biopsy avoids the need for immediately pre-RFA biopsy, which are at risk of alveolar hemorrhage, then blurring the tumor for subsequent targeting with RFA.

CLINICAL RELEVANCE/APPLICATION
Biopsy performed after RFA through the guiding canula has a high success rate, limits the number of transthoracic punctures, and preserves the best puncture path for RFA probe placement in lung tumor.

VSIO31-17 ● IR Tumour Board

William H Moore MD (Presenter) * ; **Jo-Anne O Shepard** MD (Presenter) * ; **Thomas J Vogl** MD, PhD (Presenter) ; **Peter J Littrup** MD (Presenter) * ; **Kamran Ahrar** MD (Presenter)

LEARNING OBJECTIVES
1) Understand case-based information. 2) Identify treatment strategies. 3) Evaluate interventional procedures.

BOOST: Gastrointestinal-Case-based Review (An Interactive Session)

Tuesday, 03:00 PM - 04:15 PM • S103AB

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RO OI GI

MSRO33 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Theodore S Hong , MD
Lawrence Blaszkowsky , MD

LEARNING OBJECTIVES
1) Understand critical clinical issues that govern therapy of tumors in the anorectal region. 2) Understand how imaging techniques, including MRI, PET-CT and CT, provide useful information for deciding therapy of anorectal tumors. 3) Identify common sites of recurrence for anorectal tumors and recognize the imaging appearances of these recurrences.

BOOST: Breast-Case-based Review (An Interactive Session)

Tuesday, 03:00 PM - 04:15 PM • S103CD

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RO OI BR

MSRO36 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Bruce G Haffty , MD
Sharad Goyal , MD
Liane E Philpotts , MD *
Brigid Killelea , MD

LEARNING OBJECTIVES
1) To present diagnostic imaging, radiation oncology and surgical issues in the workup and selection of breast cancer patients being considered for breast cancer treatment, focusing on nodal managment issues. 2) To understand the surgical approach in the primary and neoadjuvant setting in patients being considered for sentinel node biopsy or axillary dissection, and how this effects the radiotherapy approach. 3) To improve knowledge and understanding of appropriate imaging evaluation of the regional lymphatics in these various clinical scenerios. 4) To apply these principles in the surgical, imaging, and radiotherapeutic management of several practical cases of patients being considered for breast cancer treatment, focusing on the regional nodal evaluation and management.
ABSTRACT
Regional nodal evaluation and management is undergoing rapid change due to implementation of neoadjuvant systemic therapy and sentinel node sampling, and evolving evidence regarding the benefit of regional nodal irradiation. There remain controversies regarding the appropriate managment of patients, imaging issues, surgical issues and radiotherapeutic approach in the evaluation and managment of the regional lymphatics, both in the primary treatment of breast cancer, in the neoadjuvant therapy setting, and in the setting of local-regional recurrence. In this panel a surgeon, diagnostic radiologist and radiation oncologist will discuss several cases being considered for regional nodal evaluation and managment. Appropriate workup, surgical approach and radiation approach for each case will be discussed. The panelists will present the most recent information on controversies in the surgery, diagnostic imaging and radiation therapy in managing the regional lymphatics in patients with breast cancer.

Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Thorax (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, 03:30 PM - 05:00 PM • S406A

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OI NM CT CH

MSCC34 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Director
John A Parker , MD, PhD
Terence Z Wong , MD, PhD *

LEARNING OBJECTIVES
1) Understand the role that PET/CT can play in managing thoracic malignancies. 2) Describe the major pitfalls in interpreting thoracic PET/CT. 3) Discuss strategies for maximizing diagnostic accuracy in evaluating thoracic malignancy.
ABSTRACT
FDG-PET/CT has proven diagnostic value for evaluating primary malignancy and metastatic disease within the thorax, and can have a significant impact on patient management. Malignancies that are frequently evaluated in the thorax include primary lung cancer, esophageal cancer, lymphoma, and pleural disease. Interpretation of thoracic FDG-PET/CT scans may be complicated by the presence of benign conditions that can have high metabolic activity simulating malignancy; examples include "brown fat", sarcoidosis, granulomatous disease, post-therapeutic changes, infection, and reactive inflammation. On the other hand, some malignant disease may exhibit only modest FDG accumulation; factors include tumor histology, partial volume averaging effects, and respiratory motion. Hence, factors other than intensity of FDG uptake are often essential to distinguish benign from malignant disease. Patient history and details of prior therapy are important. Additional helpful information includes patient history, lesion distribution and symmetry, and CT imaging characteristics of the lesions. Using a case-based approach, examples of FDG-PET/CT imaging will be presented for evaluating a variety of thoracic malignancies. The approach to interpretation and strategies for distinguishing malignant from benign processes will be highlighted.

Gastrointestinal: Tumor Response Assessment

Tuesday, 04:30 PM - 06:00 PM • E350

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OI MR BQ GI

RC409 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC409A • RECIST and Other Criteria

Vahid Yaghmai MD (Presenter)

LEARNING OBJECTIVES
1) To review the concepts behind development of anatomic imaging biomarkers. 2) To learn the strengths and weaknesses of RECIST and other anatomic imaging biomarkers. 3) New criteria for evaluation of gastrointestinal tumor response assessment.

ABSTRACT
Improvements in imaging technology and therapeutic options for the management of gastrointestinal tumors have revolutionized the way tumor response to therapy is assessed. Cytotoxic therapies result in tumor shrinkage and their efficacy is commonly assessed by evaluating tumor size based on strict guidelines such as the Response Evaluation Criteria in Solid Tumors (RECIST). This review will familiarize radiologists with the steps that have led to the development and modifications of the RECIST. New cytostatic and locoregional therapies may not change tumor size and have exposed many weaknesses of the RECIST. As a result, tumor and therapy specific response assessment criteria have been developed. These new criteria, including Choi, EASL, mRECIST and irRC will also be discussed.

RC409B • CT and MR Perfusion Imaging

Dushyant V Sahani MD (Presenter)

LEARNING OBJECTIVES
1) Understand newer concepts in oncology including tumor angiogenesis and the evolving role of imaging biomarkers in drug trials. 2) Discuss the basic principles of CT-MR perfusion and limitations of each method. 3) Develop basic knowledge and skills for acquisition and interpretation of perfusion imaging in the abdomen and pelvis. 4) Assess the potential of perfusion imaging in the oncology trials and in non-oncologic clinical settings.

RC409C • Diffusion-Weighted Imaging

Ihab R Kamel MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the basic concepts for DWI in body applications. 2) Describe the emerging role of DWI in assessing response in cancer. 3) Discuss the application of DWI in whole body imaging.

ABSTRACT
Diffusion-weighted magnetic resonance imaging (DWI) can provide functional information at a cellular level by measuring water diffusion values. DWI is sensitive to changes in the micro diffusion of water and the apparent diffusion coefficient (ADC) is an indicator of the movement of water within the tissue. In abdominal oncology, DWI has been successfully used in assessing treatment response of liver tumors. In addition, ADC values have been shown to predict tumor response to treatment. In some instances low tumor ADC before treatment can be predictive of better outcome. Assessing response of in the entire tumor volume may be more valuable than a single ROI measurement. Moreover, multiparametric response maps that include changes in both ADC and enhancement after therapy are more predictive of response and patient survival compared to ADC or enhancement alone. We will review the different response criteria for various liver tumors treated with intra arterial therapy. New application of DWI including whole body applications will also be discussed.

RC409D • PET-MR-What Do We Know in 2013

Raj M Paspulati MD (Presenter)

LEARNING OBJECTIVES
1) To understand the PET-MR technology, types of current PET-MR scanners and challenges. 2) To understand the clinical application, comparison with PET-CT, protocols and optimizing work flow. 3) To understand the pitfalls, artifacts and future of PET-MR.

ABSTRACT
Introduction of PET-CT had substantial influence on cancer staging and has become a standard practice of care in certain types of cancer staging, restaging and document tumor response to treatment. The low soft tissue contrast of the CT, especially the low dose non contrast CT is the main limitation of hybrid PET-CT imaging. MR imaging proved to be superior to even contrast enhanced CT certain anatomical regions such as pelvis, head and neck due to its excellent soft tissue contrast resolution. There has been a quest for combined PET ;MRI system to provide anatomical, physiological and molecular information with single integrated imaging. The main hurdle has been the sensitivity of PET photomultiplier tubes to magnetic field. This is overcome and integrated PET-MR systems are now available for clinical practice. There are currently two types of integrated PET-MR systems available from two different vendors. In the sequential type the photomultiplier tubes of PET are shielded from magnetic field by separating the PET and MR gantries. In the simultaneous type Photomultiplier tubes and MR coils are integrated in one system by using magnetically insensitive avalanche photo diodes. Both these systems have some advantages and disadvantages, but have common challenges. MR attenuation correction is the major challenge faced by both type of systems. World wide, there is limited literature available on the utility and clinical application of the PET-MR system. There has been lot of enthusiasm as well as anxiety in incorporating this integrated system into clinical practice by radiologists as well as physicians involved in managing cancer patients. This refresher course addresses these issues of clinical PET ;MR system, key areas where they have impact on patient care and management.At the end of the course the attendees of the course will be familiar with current types of PET-MR systems, clinical applications in oncology, advantages, limitations, pit falls andchallenges.

Improving PET Interpretation: Present Updates in GI and GYN Cancers with Case Examples (An Interactive Session)

Tuesday, 04:30 PM - 06:00 PM • S505AB

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OI NM CT GU GI

RC411 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC411A • Updates in PET Imaging of GYN Malignancies

Drew A Torigian MD, MA (Presenter)

LEARNING OBJECTIVES
1) To learn about the diagnostic performance of PET/CT for evaluation of various gynecologic malignancies. 2) To better understand the practical utility of PET/CT for evaluation of gynecologic malignancies through case example. 3) To learn about new horizons in PET for evaluation of gynecologic malignancies.

ABSTRACT

RC411B • Updates in PET Imaging of Colorectal Malignancies

Harry Agress MD (Presenter)

LEARNING OBJECTIVES
1) Understand the increasingly important role of PET/CT imaging in the evaluation of staging and restaging of colorectal cancer with the use of case studies and literature review. 2) Demonstrate how PET/CT helps guide surgical, endoscopic and CT-guided approaches for evaluating the presence of colonic malignancy in such cases as unexpected pre-clinical colonic lesions and metastatic disease. 3) Learn how to deal with subtle findings and understand the important correlation of the PET and CT components of the examination to optimize interpretation.

ABSTRACT

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RC411C • Updates in PET Imaging of Other GI Malignancies

Paul D Shreve MD (Presenter)

LEARNING OBJECTIVES
1) List the gastrointestinal malignancies that tend not to be FDG avid. 2) Describe the role of FDG PET-CT in initial staging of pancreatic cancer. 3) Compare the GIST tumor response criteria of FDG PET vs CT. 4) Compare FDG PET-CT with MRI in evaluation of primary hepatic and billary tract malignancies.

Quantitative CT and MR Perfusion Imaging

Tuesday, 04:30 PM - 06:00 PM • S504CD

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OI MR CT BQ GI

RC417 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Sandip Biswal , MD *

LEARNING OBJECTIVES
1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 4) To describe the potential clinical applications, with a focus on hepatic and extrahepatic applications and clinical trials. 5) To discuss several recent challenging issues regarding CT perfusion. 6) To discuss areas for further development including assessment of tumor heterogeneity.
ABSTRACT
With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to perfoming studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on hepatic and extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC417A ● CT Perfusion in Oncology: Hepatic Imaging

Se Hyung Kim (Presenter)

LEARNING OBJECTIVES
1) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 2) To describe the potential clinical applications, with a focus on hepatic applications. 3) To discuss several recent challenging issues regarding CT perfusion.

RC417B ● CT Perfusion in Oncology: Extrahepatic Imaging

Vicky J Goh MBBCh (Presenter) *

LEARNING OBJECTIVES
1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To describe the potential clinical applications, with a focus on extrahepatic applications and clinical trials. 4) To discuss areas for further development including assessment of tumor heterogeneity.

ABSTRACT

With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to perfoming studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology.
This presentation will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC417C ● Technical Considerations for Perfusion Imaging: CTP, DSC, and ASL

Roland Bammer PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the key technical principles of Dynamic Susceptibility Contrast, Arterial Spin Label, and CT Perfusion Imaging. 2) Know the basic MR pulse sequences and CT acquisition schemes for perfusion imaging. 3) Appreciate the strengths and weaknesses between CT and MR Perfusion imaging methods. 4) Understand the Central Volume Principle, Diffusible Tracer, and Deconvolution Methods.

RC417D ● Quantitative MR Perfusion Imaging of the Brain

Greg Zaharchuk MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the difference between quantitative and qualitative perfusion measurements. 2) Distinguish several approaches for obtaining quantitative perfusion maps in the brain. 3) Appreciate the strengths and weaknesses between the two major techniques, arterial spin labeling and bolus contrast dynamic susceptibility imaging.

Imaging Mimics of Common Malignancies

Tuesday, 04:30 PM - 06:00 PM ● N230

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OI

RC418 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC418A ● Brain Tumor Mimics

Soonmee Cha MD (Presenter)

LEARNING OBJECTIVES
1) Present an overview of various brain tumor mimicking lesions on imaging that can pose diagnostic dilemma and challenges in clinical management and assessment of prognosis. 2) Illustrate the three different disease processes--infectious, ischemic, and inflammatory--in the brain that most often mimic brain tumor on imaging. 3) Discuss imaging strategies to avoid making erroneous diagnosis and present specific imaging features that can help to differentiate brain tumor and brain tumor mimics.

RC418B ● Mimics of Thoracic Cancers

Steven L Primack MD (Presenter)

LEARNING OBJECTIVES
1) To present a category based differential approach to mimics of thoracic malignancy. 2) To demonstrate imaging features of a variety of entities that can mimic thoracic malignancy. 3) To present an approach to help distinguish mimics from malignancy.

ABSTRACT

RC418C ● Mimics of Abdominal Malignancy

Cynthia S Santillan MD (Presenter)

LEARNING OBJECTIVES
1) To familiarize radiologists with congenital, infectious, and inflammatory entities that may mimic abdominal malignancies. 2) To demonstrate some artifacts that can be misinterpreted as abdominal malignancies. 3) To demonstrate imaging features that can distinguish between these entities and neoplasms.

ABSTRACT

RC418D ● Mimics of Gynecologic Cancers

Liina Poder MD (Presenter)

LEARNING OBJECTIVES
1) Present an overview of various mimics of cancers of GYN origin, a case-based approach. 2) Discuss multi-modality approach to imaging and imaging strategies to avoid pitfalls in diagnosis.

ABSTRACT
Review of more common as well as rare benign conditions that can mimic malignancy of gynecologic origin.

BOOST: Genitourinary-Anatomy and Contouring (An Interactive Session)

Wednesday, 08:30 AM - 10:00 AM ● S103CD

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RO OI GU

MSRO41 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD

Co-Director
Bruce G Haffty , MD
Jelle O Barentsz , MD, PhD
Mark K Buyyounouski , MD *

LEARNING OBJECTIVES
1) Introduce imaging anatomy relevant to prostate cancer and review imaging issues for contouring primary tumors, nodal regions, and adjacent critical structures. 2) Review how the integration of different imaging modalities can affect tumor delineation. 3) How to choose appropriate imaging methods for specific purposes and to discuss the significance of certain imaging findings.

Oral Cavity, Pharynx, Larynx

Wednesday, 08:30 AM - 10:00 AM • E353C

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OI NR HN

RC506 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC506A • Nasopharynx

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Understand the normal anatomical landmarks and relations of the nasopharynx and in particular the relationship of the nasopharynx to the central skull base. 2) Recognize normal physiological variations and inflammatory processes of the nasopharynx that might be mistaken for more sinister pathology. 3) Understand the pathological behavior and important staging features of nasopharyngeal carcinoma and lymphoma, the two most common nasopharyngeal malignant processes.

ABSTRACT
The nasopharynx is the most superior portion of the pharynx, extending anteriorly to the posterior choanae and inferiorly to the level of the soft palate. The nasopharynx ;attaches; to the undersurface of the clivus via the pharyngobasilar fascia of the superior constrictor muscle. This fascia is in continuity with the buccopharyngeal fascia surrounding the pharynx. The foramen of Morgagni is a hiatus between the base of skull and constrictor muscle, through which the Eustachian tube, tensor veli palatini and levator veli pass. It is thus a potential ;weak spot; in the head and neck, through which pathological processes may reach the skull base and spread intracranially. Other important imaging landmarks include the lateral nasopharyngeal recess or fossa of Rosenm;ller and the midline nasopharyngeal tonsil, or adenoids. Nasopharyngeal carcinoma (NPC) is a distinct entity from pharyngeal squamous cell carcinoma (SCCa). NPC has a unique histological appearance, has different inciting factors to SCCa, and has unique familial, genetic, and geographic predispositions. Nasopharyngeal carcinoma also has a different pathological behavior to pharyngeal SCCa, with a tendency for clival invasion, intracranial spread, and early systemic metastasis. In keeping with this distinct pathological behavior, NPC has particular imaging manifestations and staging criteria that differ significantly from pharyngeal SCCa. In this session we will review the key anatomic landmarks and the key imaging features of the nasopharynx and of nasopharyngeal carcinoma, reviewing the 2010 TNM staging updates and changes to the WHO pathological classification. We will also review important differentials for masses in this region.

RC506B • Oral Cavity and Oropharynx

Kristine M Mosier DMD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Review the anatomy of the oral cavity and oropharynx. 2) Review common neoplasms that may involve this region. 3) Review common infectious and inflammatory processes that may involve the oral cavity and oropharynx.

ABSTRACT
The intent of this presentation is to review the normal anatomy of the oral cavity and oropharynx. In addition, this presentation will review the common pathology including neoplasms, infections and developmental processes that you will encounter in your practice.

RC506C • Larynx-Hypopharynx

Hilda E Stambuk MD (Presenter)

LEARNING OBJECTIVES
1) Review the imaging anatomy of the larynx. 2) Understand the key landmarks for describing a tumor of the larynx. 3) Understand imaging strategies for following patients after treatment for larynx carcinoma.

Imaging of Tumor Syndromes

Wednesday, 08:30 AM - 10:00 AM • E350

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OI

RC518 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC518A • Von Hippel Lindau and Other Hereditary Renal Cancer Syndromes

Peter L Choyke MD (Presenter) *

LEARNING OBJECTIVES
1) To identify the key genetic aspects of von Hippel Lindau (VHL) disease and their relevance to treatment. 2) To distinguish radiologic features of VHL from other hereditary renal cancers. 3) To explain the implications of hereditary renal cancers for sporadic renal cancers.

ABSTRACT
Hereditary renal cancers include clear cell carcinomas associated with von Hippel Lindau Disease (VHL), chromophobe carcinomas associated with Birt Hogg Dube, papillary carcinomas associated with hereditary papillary cancer syndrome and type II papillary carcinomas associated with Hereditary Leiomyoma-Renal Carcinoma (HLRC) syndrome. Additional rare syndromes exist. This talk will focus on the distinguishing features of each entity from a radiologic perspective but also will describe the lexicon underlying the description of the genetics of these entities. This should enable the participant to understand the 'language' of genetics when describing hereditary entities in general, including terms such as tumor suppressor gene, oncogene, hypoxia inducible factor and metabolomics. The participant should come away with a fuller understanding of these hereditary entities and their implications for more common, sporadically occurring renal cancers.

RC518B • Neurocutaneous Syndromes

Petra Vajtai MD (Presenter)

LEARNING OBJECTIVES
1) To identify the key distinguishing radiologic and clinical features of each of the most common phakomatoses: neurofibromatosis types I and II, tuberous sclerosis, and Sturge-Weber syndrome. 2) To provide guidance on the appropriate use of surveillance imaging in affected individuals.

ABSTRACT
The phakomatoses are a group of hereditary neuroectodermal diseases, each characterized by its unique cutaneous manifestations. The most common phakomatoses are neurofibromatosis (types I and II,) tuberous sclerosis, and Sturge-Weber syndrome, whose respective characteristic neuroradiological finding is the neurogenic tumor, the tuber and angiomatosis. The talk should enable the participant to distinguish the addressed phakomatoses based on radiologic and clinical characteristics, to describe the presentation, diagnosis and prognosis of each, and to provide guidance on the appropriate use of surveillance imaging in affected individuals.

RC518C • Multiple Endocrine Neoplasia

James G Smirniotopoulos MD (Presenter)

LEARNING OBJECTIVES
1) Distinguish between MEN 1 (Wermer) and MEN 2a (Sipple) syndromes. 2) Describe which syndromes have significant gastrointestinal features. 3) Identify syndromes associated with pheochromocytoma.

RC518D • Lynch and Other Hereditary Colonic Cancer Syndromes

Richard Kinh Gian Do MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Describe the advances in genetics for Lynch and other hereditary colonic cancer syndromes. 2) Identify the gastrointestinal and non-GI malignancies of Lynch and other polyposis syndromes. 3) Examine the role of imaging for monitoring hereditary colonic cancer syndromes.

New Paradigms for the Treatment of Hodgkins and non-Hodgkins Lymphomas: The Crucial Role of Imaging

Wednesday, 08:30 AM - 10:00 AM • S504AB

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RO OI

RC520 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
David C Hodgson , MD, MPH
Steve Cho , MD *

LEARNING OBJECTIVES
1) To understand the role of computed tomography and positron emission tomography-CT in the management of patients with Hodgkin and non-Hodgkin lymphoma. 2) To become familiar with the International Working Group Criteria, which integrate PET findings into lymphoma response assessment. 3) To become familiar with limitations of PET-CT in assessing lymphoma response by PET-CT. 4) To become aware of pitfalls (false positives) of PET-CT in the response assessment of patients with lymphoma.
ABSTRACT
Although computed tomography remains the gold standard for assessment of lymphoma response to therapy, PET-CT plays an important role for both staging and response evaluation. In this session we will review the role of imaging in lymphoma and demonstrate how it guides therapy in this patient population. The limitations of PET imaging as well as pitfalls and false positives of PET imaging will be addressed.

BOOST: Genitourinary-Integrated Science and Practice (ISP) Session

Wednesday, 10:30 AM - 12:00 PM • S103CD

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RO OI GU

MSRO42 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Moderator
Phuoc T Tran , MD, PhD *
Moderator
Martin Colman , MD

MSRO42-01 • Invited Speaker:
Ashesh B Jani MD (Presenter)

MSRO42-02 • Improved Dosimetry in Prostate Brachytherapy Using High Resolution Contrast Enhanced Magnetic Resonance Imaging

Karen Buch MD (Presenter) ; **Tye Morancy** ; **Irving Kaplan** MD ; **Mustafa Qureshi** ; **Ariel E Hirsch** MD ; **Neil M Rofsky** MD ; **Edward J Holupka** PhD ; **Renee Oismueller** ; **Robert Hawliczek** ; **Thomas H Helbich** MD * ; **Boris N Bloch** MD

PURPOSE
Postbrachytherapy prostate dosimetry data is generally derived from computed tomography (CT), however, studies have demonstrated superior delineation of prostatic and periprostatic structures on magnetic resonance imaging (MRI). The purpose of this study was to evaluate dosimetry data from postbrachytherapy CT versus high resolution, contrast-enhanced MRI (HR-HR-CEMRI).

METHOD AND MATERIALS
Following institutional review board approval, 11 postbrachytherapy prostate cancer patients underwent HR-CEMRI and CT imaging. CT and HR-CEMRI images were randomized and 2 independent, expert readers created contours of prostate, intra- and peri-prostatic structures. Dosimetry data including V100, D90 and D100 was calculated based on these contours. Mixed-effect models were used to test for differences between the two modalities.

RESULTS
Mean (± standard deviation, SD) V100 values from CT and HR-CEMRI contours were as follows: prostate (98.5% ± 1.5 and 96.2% ± 3.6, P=0.003), urethra (81.0% ± 6.6 and 88.7% ± 7.8, P=0.027), anterior rectal wall (ARW) (8.9% ± 5.8 and 2.8% ± 1.7, P
CONCLUSION
Statistically significant differences in prostate, intra- and peri-prostatic dosimetry were seen between CT and HR-CEMRI. These differences suggest volume overestimation of CT derived contours compared to HR-CEMRI. Superior MRI soft tissue contrast enables improved delineation of prostatic and peri-prostatic structures and seems to be superior for dosimetry analysis.

CLINICAL RELEVANCE/APPLICATION
HR-CEMRI likely is superior to CT for prostate postbrachytherapy dosimetry with a more accurate assessment of clinically and functionally relevant prostatic structures for improved clinical outcomes.

MSRO42-03 • Toward Contouring Guidelines for Prostate Cancer Focal Therapy Planning on MRI: Characterization of Tumor Boundary Contrast via Accurate Pathology Fusion

Eli Gibson MSc (Presenter) ; **Mena Gaed** MD ; **Jose A Gomez** ; **Madeleine Moussa** ; **Cesare Romagnoli** MD ; **Suha Ghoul** MBBS, MSc ; **Derek W Cool** MD, PhD * ; **Matthew Bastian-Jordan** MBBS, BSc ; **Jonathan Mandel** MD, FRCPC ; **Stephen E Pautler** MD ; **Joseph Chin** MD ; **Cathie Crukley** ; **Glenn S Bauman** MD * ; **Aaron Fenster** PhD * ; **Aaron D Ward** PhD

PURPOSE
Multi-parametric magnetic resonance imaging (MPMRI) is useful for detection and staging of prostate cancer (PCa); however, intra-prostatic lesion (GTV) focused therapy (e.g. radiation boost or ablative focal therapy) requires precise tumor delineation on T2-weighted (T2W) MRI. Our purpose was to measure the detectability (measured as intensity contrast with non-cancerous contralateral/non-neighboring tissue) and boundary localizability (intensity contrast with non-cancerous neighboring tissue) of Gleason score (GS) 7 tumors in the peripheral zone (PZ), contoured by a pathologist on prostatectomy specimens and deformably registered to T2W MRI with high accuracy.

METHOD AND MATERIALS
We acquired endorectal T2W MRI (3T GE Discovery MR750, FSE, TR=5434, TE=159) and histology from 6 subjects. Histology grading and contouring were approved by a genitourinary pathologist, identifying 7 PZ PCa foci with GS 7. To mitigate the bias toward high-contrast tumor boundaries inherent in qualitative consensus mapping of histology contours onto MRI, we used a histology–MRI deformable registration, blinded to the tumor locations, comprising a fiducial-based 3D histology reconstruction to *ex vivo* MRI followed by a deformable registration to *in vivo* MRI. For each focus mapped from histology to T2W MRI, we took 3 mean intensity measurements: T (tumor tissue), N (non-cancerous PZ tissue < 5 mm from the tumor), and C (non-cancerous contralateral PZ tissue). We characterized detectability as D = (T–C)/C and localizability as L = (T–N)/N; values < 0 denote tumor hypointensity and 0 indicates no contrast.

RESULTS
Detectability: All foci were hypointense relative to contralateral tissue (-0.53 < D < -0.15). Localizability: 3 of 7 foci had clear boundaries (L < -0.19); 4 had more poorly defined margins (-0.12 < L < 0.08). The mean target registration error was 2 mm.

CONCLUSION
Accurate deformable registration of pathology-defined GS 7 PZ tumors to T2W MRI shows tumor hypointensity but low boundary contrast, challenging accurate tumor boundary delineation for PCa treatment planning. Our preliminary results motivate further study to measure the performance of T2W MRI for tumor boundary delineation or augment it with MPMRI.

CLINICAL RELEVANCE/APPLICATION
Low tumor boundary contrast on T2W MRI for Gleason 7 peripheral zone prostate cancers suggests further assessment of T2W MRI is needed for contouring guidelines for focal/boosted therapy planning.

MSRO42-04 • MR Imaging of Ex Vivo Prostate Specimens for Predicting Resection Margins in Prostate Cancer: A Pilot Study

Martijn Hoogenboom MSc (Presenter) ; **Iringo Kovacs** ; **Isabell Steinseifer** ; **Andor Veltien** ; **Iris Nagtegaal** PhD ; **Michiel Sedelaar** MD, PhD ; **Fred Witjes** MD, PhD ; **Jurgen J Futterer** MD, PhD ; **Jelle O Barentsz** MD, PhD ; **Arend Heerschap** PhD ; **Christina A Hulsbergen-Van De Kaa** MD, PhD

PURPOSE
This study has been designed to explore if ex-vivo 7T MR imaging can be used for identification of potential positive resection margins in radical prostatectomy specimens.

METHOD AND MATERIALS
Fresh radical prostatectomy specimens (n=6) underwent MR imaging immediately after surgery. Tubes filled with saline both in the urethra and next to the prostate were used as markers. The prostate was doped in gadolinium to highlight the surgical margins. All specimens were emerged in oil (fomblin) to eliminate susceptibility artifacts. High resolution T2-weighted (T2W) and diffusion weighted images (DWI) were acquired. After evaluation of the in vivo MRI, the tumor and position of possible positive resection margins were determined at the ex vivo images (T2, DWI). Histopathology slices, every 4mm, were made according to the ex vivo images in transversal direction. The ex-vivo images were correlated with the histopathology.

RESULTS
In T2W MR images of ex-vivo prostate zonal distinction (peripheral vs. transition) is less clear than in MRI of the prostate in vivo. In all patients the tumor was visible on the DWI images, however also benign lesions showed reduced ADC and high signal intensity on the b1200 images. The resection margin was free of tumor in all patients with a high intense border at T2W images and a border of high ADC values between tumor and the outside of the prostate. Two patients showed a positive resection margin at the MR images, which correlated with the histopathology. However, in two patients a positive resection margin seemed to be visible based on the MR images, while the histopathology showed a negative resection margin. Therefore in these cases a histopathology confirmation is needed (frozen section).

CONCLUSION
Ex-vivo MRI has the potential to identify benign and malignant structures and to predict resection margins. However, further optimization of the MR imaging protocol is required guided by information from fast frozen histopathology sections to confirm the presence or absence of positive regions.

CLINICAL RELEVANCE/APPLICATION
A fast method is necessary to determine the resection margins after radical prostatectomy for direct extended resection or brachytherapy, ex-vivo MR might be a solution.

MSRO42-05 • Evaluation of Artifacts Reduction Using Spectral CT Imaging after CT Guided Radioactive Seed 125I Implantation

Rui Gang Huang (Presenter) ; **Alai Zhan** ; **Qinglong Shen**

PURPOSE
To explore the clinical value of puncture needle artifacts reduction using Spectral CT Imaging after CT guided radioactive seed ^{125}I implantation in treatment of liver cancer

METHOD AND MATERIALS
6 patients referred to CT guided radioactive seed 125I implantation in liver underwent GSI examinations using Discovery CT750 HD scanner. During the process of implantation,traditional CT scans were performed for comparision.All data were transferred to Workstation (AW4.5, GE Healthcare) to obtain one set of 140 kVp images (QC) and 11 sets of monochromatic images (40-140keV, interval of 10keV). Artifact was significant around particles and puncture needle. The CT value and variations were measured in the area with and without the most significant artifact while the background noise was measured in abdominal subcutaneous adipose tissue. The artifact index (AI) of the regions of interest is defined as the square root of the squared noise difference between the region with and without artifact of the same tissue. All the measurements were recorded and statistically compared.

RESULTS

CONCLUSION
Monochromatic images obtained from spectral CT imaging can substantially reduce metal artifacts caused by radioactive seed 125I and provide more accurate CT images for estimating the efficacy of the treatment.

CLINICAL RELEVANCE/APPLICATION
Spectral CT showed its potential applications in monitoring disease progressions after125I radioactive particles implantation.

MSRO42-06 • Evaluation of Two Automatic Deformable Contouring Methods for Prostate Image-guided Adaptive Radiation Therapy (IGART) in Terms of Delivered Dose Values

Zhilei Shen ; **Sara Pirozzi** BS (Presenter) * ; **Jon W Piper** BEng * ; **Aaron S Nelson** MD *

PURPOSE
Two deformable contouring methods for prostate CBCT, Adaptive and Multi-Adaptive, previously demonstrated good accuracy in terms of Dice coefficients. Now these methods are evaluated by comparing their delivered dose values with those from manual contouring.

METHOD AND MATERIALS
Twenty CBCTs were selected from 4 patients with prostate cancer. Prostate, bladder, rectum, left and right hip contours were manually defined on all the CBCTs. Adaptive contours were created by deforming manually defined Day 1 CBCT contours to subsequent CBCTs, for a total of 16 contour sets. Multi-Adaptive contours were generated by deforming the other 4 CBCTs to the remaining CBCT and combining contours using Majority Vote for a total of 20 contour sets. The daily dose values were measured from the deformed and manual contours. Bland-Altman analysis was used to analyze the 95% confidence limits of agreement (LOA) between manual and deformable contouring.

RESULTS
The mean±SD percentage differences and 95% LOA for Manual vs. Multi-Adaptive were: CTV Mean (-0.6±2.8%) [-0.12,0.09], D25 Bladder (-1.8±25.3%) [-0.54,0.46], D50 Bladder (-4.1±22.8%) [-0.39,0.31], D20 Rectum (0.3±8.3%) [-0.24,0.24], D40 Rectum (0.9±10.3%) [-0.21,0.22], D20 Left Hip (-0.1±0.7%) [-0.01,0.01], and D20 Right Hip (0.1±1.0%) [-0.02,0.02]. For Manual vs. Adaptive the results were: CTV Mean (-0.6±-3.9%) [-0.16,0.13], D25 Bladder (-1.2±-28%) [-0.71,0.45], D50 Bladder (-15.5±-25.2%) [-0.75,0.36], D20 Rectum (1.0±-9%) [-0.25,0.28], D40 Rectum (4.8±-10.9%) [-0.18,0.29], D20 Left Hip (-0.1±-0.6%) [-0.01,0.01], and D20 Right Hip (0.2±-1.1%) [-0.02,0.02].

CONCLUSION
Multi-Adaptive showed increased agreement and decreased bias compared to Adaptive. The 95% LOA showed that there were no clinically significant differences for CTV Mean, Left Hip, and Right Hip indicating the deformable methods were as good as manual in delineating these structures. Although the 95% LOA were larger for the other structures, the rectum may fall within clinical tolerances.

CLINICAL RELEVANCE/APPLICATION
Tracking dose using deformable contouring of CBCTs has the potential to identify deviations from the planned treatment. Deformable methods have the potential to reduce the burden for contouring.

MSRO42-07 • Neurovascular Bundle Sparing Technique in Prostate Brachytherapy, and the Utility of Intraoperative Ultrasound Fusion with Day 30 CT

Daniel A Jones MD (Presenter)

ABSTRACT
Purpose/Objective(s): Reducing dose to the cavernous neurovascular bundles may be important in maintaining sexual potency after prostate brachytherapy. Last year, we reported the feasibility of the nerve sparing technique, and a significant 28% reduction of mean dose to the NVB associated with the non-cancerous lobe. Dose calculations in the initial study were based on intraoperative assessments. The purpose of this study was to report longer follow up of the cohort, and to integrate a novel fusion technique of the intraoperative ultrasound images, with that of the day 30 CT scan.
Materials/Methods: Of the previously reported cohort of fourteen patients in which intraoperative contouring of NVB was performed, six had bilateral NVB contoured, and were thus available for comparison. All were categorized as having unilateral prostate cancer. The non-cancerous lobe was implanted with the NVB sparing technique, placing no radioactive seeds within a 5 mm radius of the NVB. Implant standards for V100 and D90 were maintained. Sexual function was measured with the IIEF questionnaire. Intraoperative assessment and contouring of the cavernous NVB location was based on anatomical correlation with ultrasound and doppler flow. Patients were brought back for day 30 CT scan to assess the implant and to confirm good dosimetry. The intraoperative ultrasound was fused to the day 30 CT scan by matching the prostate posterior border and the urethra contours. The intraoperative NVB contours were imported into the day 30 CT scan for dose assessment.
Results: Median follow up for the cohort approaches 24 months. All patients are in PSA remission. Four of the six are sexually potent, both with and without the aid of a phosphodiesterase (PDE) inhibitor. The mean dose to the spared NVB was 114 Gy, while mean dose to the non-spared NVB was 145 Gy. The mean per-patient dose reduction to the NVB was 16.7% (p=.27) and therefore was no longer significant.

Conclusions: The NVB sparing brachytherapy technique remains feasible, and does not appear to compromise oncologic outcomes. The dose reduction to the spared NVB was no longer significant with the adjusted fusion technique of day 30 imaging, while previously dose reduction of 27.9% was significant with regards to real time intraoperative ultrasound calculations. The size and shape of the prostate gland may change immensely compared to the fused day 30 CT images, limiting the ability to accurately determine the location of the cavernous NVB. Fusion may be aided with deformable imaging software or reimaging with ultrasound and/or MRI at day 30 to confirm NVB location. Intraoperative assessment of dose to the NVB is probably more accurate compared to the new fusion technique and remains our preferred method at this time. Limitations include small number of patients and short follow up.

MSRO42-08 • DVH-based Comparison Analyses of PTV-coverage and Doses to Organs at Risk (OARs) between Localized Cancers of Large and Regular Volume Prostate Treated with High Dose Rate Brachytherapy (HDR-BT)
Kaidu Motoki (Presenter) ; **Ayukawa Fumio** ; **Kensuke Tanaka** ; **Mika Obinata** ; **Hiraku Sato** MD ; **Nobuko Yamana** ; **Gen Kawaguchi** ; **Atushi Oota** ; **Eisuke Abe** ; **Ryuta Sasamoto** ; **Hidefumi Aoyama** MD, PhD

MSRO42-09 • Practice Patterns in the Prescription of Elective Nodal Irradiation in Prostate Cancer
David Greene MD (Presenter)

Genitourinary (Prostate Cancer: Multimodality Diagnosis and Staging of Disease)

Wednesday, 10:30 AM - 12:00 PM • E353C

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OI MR GU

SSK08 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Steven C Eberhardt , MD
Moderator
Antonio C Westphalen , MD

SSK08-01 • Comparison of Re-biopsy with Preceded MRI and Re-biopsy without Preceded MRI in Patients with Previous Negative Biopsy and Persistently High PSA

So Yoon Park (Presenter) ; **Byung Kwan Park** MD ; **Sung Yoon Park** ; **Chan Kyo Kim** MD, PhD ; **Moon Young Kim** MD

PURPOSE
Still, it is unclear whether MRI performed prior to a repeated biopsy helps to detect more cancer in patients with preceded MRI than in patients without preceded MRI because there is rare comparative two-arm study. The purpose of our study was to retrospectively evaluate the value of a pre-biopsy MRI using a large population of patient and control groups.

METHOD AND MATERIALS
Between January 2007 and May 2011, a total of 709 patients underwent a transrectal ultrasound (TRUS)-guided biopsy. Of these patients, 179 (age range, 40 – 91; mean, 63.3) underwent MRI examination (MRI group) before repeat biopsy and 530 (age range, 38 – 85; mean, 64.5) did not (Non-MRI group). Cancer detection rate and positive core rate was performed between these groups. The odds ratios were also obtained.

RESULTS
Of 709 patients, 129 were histologically confirmed as adenocarcinoma. These cancer-proven patients consisted of 57 in the MRI group and 72 in the non-MRI group. Cancer detection rates of MRI and non-MRI groups were 31.8% (57/179) and 13.6% (72/530), respectively (p=0.000). Positive core rates of MRI and non-MRI groups were 8.9% (167/1877) and 3.0% (179/5903), respectively. The odds ratios of cancer detection rate and positive core rate were 3.0 and 3.1, respectively.

CONCLUSION
Pre-biopsy MRI contributes to cancer detection in patients with previous negative biopsy results and persistently high PSA.

CLINICAL RELEVANCE/APPLICATION
Pre-biopsy MRI should be considered prior to rebiopsy in patients with a history of negative biopsy results and persistently high PSA.

SSK08-02 • Quantitative Shear Wave Ultrasound Elastography for Prostate Cancer Imaging: Correlation to Pathology

Jean-Michel Correas MD * ; **Ahmed Khairoune** * ; **Anne-Marie Tissier** MD ; **Olivier Helenon** ; **Richard G Barr** MD, PhD (Presenter) *

PURPOSE
To prospectively evaluate in two independent centers the diagnostic performance of real-time quantitative Shear Wave Elastography (SWE) in detecting and characterizing prostate lesions in patients with increased PSA and/or abnormal digital rectal examination, by using histologic biopsy results scoring system as the reference method. Correlation between elasticity and Gleason Score (GS) was also performed to analyse the relation between tumor stiffness and pathology.

METHOD AND MATERIALS
The IRB approved this prospective, HIPAA-compliant study in both institutions. Written informed consent was obtained from 184 men undergoing ultrasound guided systematic and targeted biopsies. Two blinded radiologists independently measured stiffness of prostate sextants and lesions depicted in ultrasound imaging. Biopsy core pathology analysis (GS) of corresponding sextants and lesions constituted the reference standard. The diagnostic performance at the sextant level and lesion detection sensitivity for lesions was calculated. The correlation between GS and tissue stiffness was investigated using Student T-test and Pearson's correlation coefficient.

RESULTS
A total of 184 patients were enrolled in the study, providing a total of 1176 peripheral zone regions including 1039 sextants and 137-targeted lesions. A total of 188 foci of cancer (size>2mm and GS=6) were detected in 65 patients. On the basis of the ROC curve analysis and to maximize the negative predictive value, a cutoff value of 35 kPa for the elasticity or 3.42 m/s for the shear wave velocity was chosen to differentiate benign and malignant regions (p
CONCLUSION
SWE might provide additional information for the biopsy guidance and differentiation of aggressive prostate cancers.

CLINICAL RELEVANCE/APPLICATION
Prostate tissue stiffness using Shear Wave Elastography could be used to guide prostate biopsy and significantly improve prostate positive biopsy rate.

SSK08-03 • Comparison of 1.5T vs. 3.0T Multiparametric MR Imaging in the Detection of High Grade Prostate Cancer

Daniel A Moses MBBS, FRANZCR (Presenter) ; **Ronald C Shnier** MBBS ; **James Thompson** MBBS ; **Lee E Ponsky** MD ; **Phillip Brenner** MBBS ; **Warick Del Prado** ; **Andrew Hayen** PhD ; **Phillip Stricker** MBBS

PURPOSE
Compare the efficacy of 1.5T and 3.0T mp-MRI in the detection/exclusion of high grade prostate cancer.

METHOD AND MATERIALS
A prospective study (for 300 men) was approved by the ethics board. 122 men had been randomised for mp-MRI at either 1.5T or 3T before a planned transperineal biopsy. The MR protocol included high resolution T2-weighted, diffusion and perfusion sequences without the use of an endorectal coil. Two uroradiologists used the PI-RADS reporting system independently for each scan. A combined score was attained by taking the average.

RESULTS
A total of 91/122 men received a average PI-RADS score of 2.5 or greater (intermediate to high risk of significant PCa), with 47/54 of men on the 1.5T MRI, and 44/68 of men on the 3T MRI being classified in the same way. On biopsy 48/122 [28/54 on 1.5T and 20/68 on 3T] had Gleason 7 or greater prostate cancer. 11/122 [6/54 on 1.5T and 5/68 on 3T] had greater than Gleason 8 prostate cancer. The following results were achieved using a threshold of Gleason 7 disease and above as positive for significant disease an average PI-RADS score of 2.5 and above for suspected clinically significant disease: 1.5T: TPR 100%, FPR 73%, NPV 100%, PPV 60% 3.0T: TPR 100%, FPR 50%, NPV 100%, PPV 45% Combined: TPR 100%, FPR 58%, NPV 100%, PPV 53% Using a threshold of Gleason 8 disease and above as positive for significant disease and average PI-RADS score of 4 and above for suspected clinically significant disease: 1.5T: TPR 100%, FPR 29%, NPV 100%, PPV 30% 3.0T: TPR 100%, FPR 16%, NPV 100%, PPV 33% Combined: TPR 100%, FPR 22%, NPV 100%, PPV 31% [True positive rate (TPR), False positive rate (FPR), Negative predictive value (NPV), Positive predictive value (PPV)]

CONCLUSION
MP-MRI, without an ER coil, can achieve very high NPV for significant prostate cancer (in our case 100%). There was no difference between the NPV when using a 1.5T or 3T MR system. The positive predictive value was higher for 1.5T (60%) vs 3T (45%) when choosing a threshold of Gleason 7 for significant disease. This equalised [1.5T 30% vs 3T 33%] with a threshold of Gleason 8. The false positive rate was higher at 1.5T vs 3T for both Gleason thresholds.

CLINICAL RELEVANCE/APPLICATION

Given the different costs and availability, knowing the relative strengths and limitations of assessment on 1.5T and 3.0T scanners allows planning in thier use in the diagnosis of prostate cancer.

SSK08-04 ● The Cost-effectiveness of MR-guided Targeted Biopsy versus Systematic TRUS-guided Biopsy in Diagnosing Prostate Cancer: A Modeling Study

Maarten De Rooij MD (Presenter) ; **Simone Crienen** ; **Fred Witjes** MD, PhD ; **Jelle O Barentsz** MD, PhD ; **Maroeska M Rovers** PhD ; **Janneke P Grutters** PhD

PURPOSE
To develop and apply a decision analytic model to determine whether multiparametric magnetic resonance imaging (mp-MRI) and targeted magnetic resonance guided biopsies (MRGB) are cost effective in the diagnosis of prostate cancer compared with standard systematic transrectal ultrasound guided biopsies (TRUSGB).

METHOD AND MATERIALS
A combined decision tree and Markov model was used to evaluate the quality-adjusted life years (QALYs) and healthcare costs of the MRI strategy (mp-MRI and targeted MRGB) compared with the standard strategy of systematic TRUSGB for a cohort of patients with clinical suspicion of prostate cancer. Input data were derived from systematic literature searches, including meta-analyses, and expert opinion. Probabilistic and threshold analyses were performed to assess uncertainty.

RESULTS
Expected costs of the MRI strategy per patient (€2349) were similar to those for the TRUSGB strategy (€2356). The corresponding QALYs were higher for the MRI strategy (6.97 versus 6.74). Threshold analysis revealed MRI is the dominant strategy (less costly and more effective) when the sensitivity of MRGB is 60% or higher. Probabilistic sensitivity analysis showed that in 92% of simulations, the MRI strategy was most effective. In 52% of the simulations MRI was more effective and less costly. The probability that the MRI strategy is cost effective is 90% at willingness to pay thresholds over €1.000/QALY.

CONCLUSION
When the sensitivity of mp-MRI and targeted MRGB for the detection of prostate cancer is proven to be 60% or higher, this new diagnostic strategy appears to be more efficient in detection of prostate cancer when compared with the current standard of systematic TRUSGB.

CLINICAL RELEVANCE/APPLICATION
When sensitivity of this new diagnostic MRI stategy is proven to be satisfactorily high, it appears to be more efficient in diagnosing prostate cancer compared with the standard systematic TRUSGB.

SSK08-05 ● Validation of the European Society of Urogenital Radiology Score System for Prostate Cancer Diagnosis on Multiparametric MRI in a Cohort of Primary Biopsy Patients

Raphaele M Renard Penna (Presenter) ; **Pierre Mozer** MD, PhD ; **Daniel Portalez** MD ; **Francois Cornud** MD ; **Eva Comperat** ; **Bernard Malavaud** PhD, MD

PURPOSE
To assess the ESUR score system in the context of primary biopsies.

METHOD AND MATERIALS
IRB-approved, bicentric prospective study. 119 consecutive patients referred for primary prostate biopsies with normal DRE but elevated PSA (4-20ng/ml). Transfer of mpMRI suspicious areas on 3D-Transrectal ultrasound images by three-dimensional elastic surface registration (Koelis, UroStation, France) random systematic and targeted cores followed by core-by-core analysis of pathology and mpMRI characteristics. Relationships between ESUR scores and biopsy results were assessed by the Mann-Whitney U test. A teaching set was randomly drawn to construct the ROC curve of the ESUR sum of scores (ESUR-S). The threshold to recommend biopsy was obtained from the Youden J-statistics and tested in the remaining validation set in terms of predictive characteristics.

RESULTS
Higher T2-weighted, Dynamic Weighted Imaging and Dynamic Contrast Enhanced ESUR scores were observed in areas yielding cancer-positive cores. The proportion of positive cores increased with the ESUR sum of scores aggregated in five increments from less to more suspicious (percentage and 95%CI): 2.3%(1.2-3.3), 5.8%(3.5-8.0), 24.7%(18.3-31.1), 51.8%(42.4-61.1) and 72.1%(66.2-77.9) for increasing increments of ESUR-S, p for trend p
CONCLUSION
In primary prostate biopsies, the ESUR score system was shown to provide clinically relevant stratification of the risk of showing prostate cancer in a given location.

CLINICAL RELEVANCE/APPLICATION
MRI-TRUS fusion technology could provide optimal method to sample the prostate gland, reduce the number of cores needed to demonstrate cancer.

SSK08-06 ● The Role of Multi-parametric MRI for Assessment of Detection in Patients with a Low-risk Prostate Cancer

Jin Young Kim (Presenter) ; **See Hyung Kim**

PURPOSE
To assess the diagnostic performance of multi-parametric MRI in cancer detection categorized by cancer volume and Gleason grade in clinically low-risk prostate cancer.

METHOD AND MATERIALS
One hundred consecutive patients with clinically low-risk cancer received multi-parametric MRI before radical prostatectomy, including T2-weighted (T2W), diffusion-weighted (DW) and dynamic contrast enhanced (DCE) MRI. By using scoring systems, two radiologists independently assessed likelihood of cancer per sextant on multi-parametric MRI. Cancer lesions of = 0.5cm3 identified on whole-mount step-section were correlated with multi-parametric MRI. The diagnostic performance of multi-parametric MRI was assessed for cancer volumes and Gleason grades.

RESULTS
The inter-observer agreement for detection at the sextant level was in perfect agreement. In detecting pathologic cancer volume of = 0.5cm3, DW MRI and DCE MRI had a higher accuracy than T2W MRI. The accuracy of detection for cancers volume > 1cm3 or Gleason grade = 7 was significantly higher than cancers of volume 0.5 to 1cm3 or Gleason grade = 6, and multi-parametric MRI had a significantly higher diagnostic performance than T2W+DW MRI and T2W+DCE MRI. The multi-parametric MRI was more accurate with high pathologic cancer volume and Gleason grades. For lesions of cancer volumes > 1cm3 and Gleason grades = 7, the accuracy was significantly higher than with cancers of volume 0.5 to 1cm3 and Gleason grade = 6 (82.3% vs. 90.2%, P< 0.05).

CONCLUSION
In clinically low-risk cancer, the detection of multi-parametric MRI is significantly dependent on cancer volumes and Gleason grades. The higher cancer volumes and Gleason grades have high sensitivity, specificity and accuracy in detection.

CLINICAL RELEVANCE/APPLICATION
In clinically low-risk cancer, the detection of multi-parametric MRI is significantly dependent on cancer volumes and Gleason grades.

SSK08-07 ● Prospective Comparison of Computed Tomography, Diffusion-weighted Magnetic Resonance Imaging and [11C] Choline Positron Emission Tomography/Computed Tomography for Preoperative Lymph Node Staging in Intermediate and High Risk Prostate Cancer

Matthias J Eiber MD (Presenter) * ; **Matthias Heck** ; **Michael Souvatzoglou** ; **Tobias Maurer** ; **Markus Schwaiger** MD * ; **Ernst J Rummeny** MD ; **Bernd Krause**

PURPOSE
Computed tomography is of limited value for lymph node (LN) staging in prostate cancer (PCa) patients scheduled for radical prostatectomy (RP). To prospectively compare computed tomography (CT), diffusion-weighted magnetic resonance imaging (DWI) and [11C]choline positron emission tomgraphy/computed tomography ([11C]choline PET/CT) for LN staging in PCa patients undergoing RP and extended pelvic lymph node dissection (ePLND).

METHOD AND MATERIALS
Between June 2010 and May 2012, we preoperatively performed CT, DWI and [11C]choline PET/CT in 33 intermediate and high risk PCa patients without neoadjuvant treatment. All patients underwent open RP and ePLND including the LN-fields obturatoric fossa, external, internal and common iliac vessels. Patient- and field-based performance characteristics for all 3 imaging techniques in comparison with histopathology are reported. Imaging techniques were compared by AUC-analyses (area under the curve).

RESULTS
LN metastases were detected in 92 of 1012 (9%) LNs from 14 of 33 (42%) patients. ePLND achieved a median of 30 dissected LNs per patient (range 9-61). On a patient-based analysis, sensitivity for CT, DWI and [11C]choline PET/CT were identical (57.1%, 57.1% and 57.1%, respectively), but specificity was best for [11C]choline PET/CT (68.4%, 78.9% and 89.5%, respectively). On a LN-field-based analysis, sensitivity was best for [11C]choline PET/CT followed by DWI and CT (61.8%, 55.9% and 47.1%, respectively) whereas specificity was similar for all 3 imaging techniques (96.5%, 96.0% and 94.3%, respectively).

However, neither DWI nor [11C]choline PET/CT performed better than CT in a pair-wise comparison of AUCs of patient- and field-based results (p>0.05, respectively).

CONCLUSION
Neither DWI nor [11C]choline PET/CT perform statistically significant better than CT for preoperative detection of LN-metastases in PCa patients scheduled for RP and ePLND. All 3 imaging techniques have a low sensitivity with less than two thirds of LN metastases being detected on a patient-/ or LN-field-based analysis.

CLINICAL RELEVANCE/APPLICATION
Our data indicate that neither [11C]choline PET/CT nor DWI can be recommended to replace adequate ePLND for determining a patient's LN status or to define the extent of a PLND on an individual basis.

SSK08-08 • Dynamic Contrast Enhanced MR Imaging Features of the Normal Central Zone of the Prostate

Barry G Hansford MD (Presenter) ; **Ibrahim Karademir** MD ; **Yahui Peng** PhD ; **Yulei Jiang** PhD ; **Gregory S Karczmar** PhD * ; **Stephen Thomas** MD ; **Ambereen Yousuf** MBBS ; **Tatjana Antic** ; **Scott Eggener** * ; **Aytekin Oto** MD *

PURPOSE
Evaluate qualitative dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) characteristics of normal central zone (CZ) based on recently described CZ MR imaging features.

METHOD AND MATERIALS
Retrospective, HIPAA compliant study with Institutional Review Board approval. Evaluated 82 patients with prostate cancer (PCa) who underwent pre-operative, multi-parametric endorectal MR before radical prostatectomy.19 patients with tumor involving portions of the CZ or prostate base on histopathology were excluded, as were four patients with MR artifacts. Final cohort of 59 patients: mean age, 59.9 years; age standard deviation (SD), 7.0; age range, 43-72; average serum prostate-specific antigen (PSA) level, 8.7 mL/ng; PSA SD, 8.0; and PSA range, 1.7–40.9. Two readers independently reviewed T2-weighted images and ADC maps to identify normal CZ based on its low signal intensity and characteristic location. Next, two readers drew bilateral CZ regions of interest on DCE-MRI images in consensus and then independently recorded enhancement curve types as: type 1 (progressive enhancement), type 2 (plateau) and type 3 (wash-out). Identification rates of normal CZ and enhancement curve type were recorded and compared for each reviewer.

RESULTS
CZ identified in 92% to 93% of patients on T2-weighted images and 78% to 88% on ADC maps without a significant difference between identification rates (p=0.63 and p=0.15 and Inter-reader agreement, ?, is 0.64 and 0.29, for T2-weighted images and ADC maps, respectively). All CZs rated as either curve type 1 or 2 by both radiologists. Type 1, progressive enhancement (24/104 or 23% of curve types), type 2, plateau enhancement (80/104 or 77% of curve types) and type 3, wash-out (0/104 or 0% of curve types). No statistically significant difference between the two radiologists (p = 0.19) and inter-reader agreement was ? = 0.37.

CONCLUSION
Normal CZ demonstrates type 1 or type 2 enhancement curves on DCE-MRI which can potentially be useful to differentiate CZ from PCa which classically demonstrates a type 3 (wash-out) curve. CZ identified in majority of patients based on characteristic location and low signal on T2-weighted images and ADC maps.

CLINICAL RELEVANCE/APPLICATION
Our study shows that the normal CZ demonstrates either type 1 or type 2 enhancement time-curves on DCE-MRI, which can be potentially used to differentiate the CZ from PCa.

SSK08-09 • "Dynamic Active Surveillance"? for Low-to-Intermediate Risk Prostate Cancer: Combined Results of a Phase I/II Trial of MRI-guided Focal Laser Ablation, Feasibility and Features Predictive of Recurrence

Tristan Barrett MBBS, BSc (Presenter) ; **Sangeet Ghai** MD * ; **Eugen Hlasny** PhD ; **Sean R Davidson** PhD ; **Masoom A Haider** MD * ; **Mark R Gertner** PhD ; **Jeremy Cepek** PhD ; **Aaron Fenster** PhD ; **John Trachtenberg** MD

PURPOSE
To assess the feasibility of MRI-guided focal laser ablation therapy for prostate cancer and evaluate predictors of a successful treatment outcome.

METHOD AND MATERIALS
Institutional review board approval was granted for prospective recruitment. Inclusion criteria: biopsy-proven intermediate, or less, risk PCa; exclusion-criteria: high-risk disease, or prior PCa treatment. All patients underwent diagnostic MRI, with target lesions outlined. A modified brachytherapy MR-guidance template was used for transperineal placement of catheter/s, with Indigo-Optima– laser fibres placed within. The zone of ablation was monitored in real-time by MRI thermography. Post-procedure coagulation volume was determined by contrast-enhanced T1-weighted imaging.

RESULTS
Treatment was successfully completed in all 40 patients. Two patients were lost to follow-up. Mean follow-up was 671 days (range 150–1,157). At 4-6 month or subsequent biopsy, 13/38 patients (34.2%) had residual/recurrent cancer in the region treated, 25 patients (65.8%) had no recurrence. Between these groups there was no significant association between baseline Gleason-grade, PSA, risk category, number of positive biopsy cores or %core involvement, or tumor size/location/marginal extension. The likelihood of tumor on diagnostic MRI (P=0.004) and complete lesion coverage by thermal ablation zone (P
CONCLUSION
Focal laser ablation is a feasible and effective therapy for patients with low-to-intermediate risk PCa. Predictors of successful therapy include confident presence of the lesion on diagnostic MRI and full peri-procedural coverage of the target.

CLINICAL RELEVANCE/APPLICATION
We show the feasibility of focal laser ablation therapy. Focal therapy is an option for lower risk PCa patients uncomfortable with the risks of active surveillance or side effects of radical therapy.

Genitourinary (Functional and Anatomic Imaging in Staging and Follow-up of Gynecologic Cancers)

Wednesday, 10:30 AM - 12:00 PM • N228

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OI NM MR GU

SSK09 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Andrea G Rockall , MRCP, FRCR *
Moderator
Elizabeth A Sadowski , MD

SSK09-01 • Anatomical and Functional Volume Concordance between FDG-PET, T2 and Diffusion Weighted MRI for Cervical Cancer: A Hybrid PET/MRI Study

Hongzan Sun (Presenter) ; **Jun Xin** MD ; **Shaomin Zhang** ; **Qiyong Guo** MD

PURPOSE
To evaluate the concordance of imaging by [18F] fluorodeoxyglucose (FDG) - positron emission tomography (PET), T2 weighted imaging (T2WI) and apparent diffusion coefficient (ADC) maps with diffusion-weighted imaging (DWI) in cervical cancer using hybrid whole-body PET/MRI.

METHOD AND MATERIALS
Cervical cancer patients (N=35) were prospectively recruited to undergo pretreatment 18FDG-PET/MRI. 18FDG-PET and MRI images were fused using standard software. The percent of the maximum standardized uptake value (SUVmax) was used to contour tumors on PET images and volumes were auto calculated. Tumor volumes measured by T2WI and DWI were calculated with standard techniques of tumor area multiplying slice profile. Data analysis used parametric statistics.

RESULTS

CONCLUSION
Hybrid PET/MRI showed strong concordance between FDG-PET, T2WI and DWI in cervical cancer. Cutoff at 35% or 40% of SUVmax is recommended during 18FDG PET-MRI SUV-based tumor volume estimation. Tumor subvolumes with increased metabolic activity on FDG-PET also have greater cell density by DWI.

CLINICAL RELEVANCE/APPLICATION
Hybrid PET/MRI was demonstrated a reliable method in cervical cancer imaging, and will benefit its clinical decision making by combining accordant anatomical and functional information together.

SSK09-02 ● Radiologists' Adherence to the 2010 Society of Radiologists in Ultrasound Guidelines for the Management of Incidental Adnexal Cysts Imaged at Ultrasound: Frequency and Associated Factors

Andrea S Kierans MD (Presenter) ; **Andrew B Rosenkrantz** MD

PURPOSE
To evaluate adherence to the 2010 Society of Radiologists in Ultrasound (SRU) guidelines for management of incidental adnexal cysts imaged at ultrasound.

METHOD AND MATERIALS
398 adnexal cysts initially detected at ultrasound were included; all studies had been performed after publication of the SRU guidelines and guideline review at departmental conferences. The ultrasound reports were retrospectively reviewed to determine whether the management recommendations were adherent to the guidelines. Non-adherent cases were categorized as over-management, under-management, or as incomplete in their recommendation. Impact of categories determining appropriate recommendation (menopausal status, cyst size, and other cyst imaging features) was assessed via the chi-square test, and the primary cause for non-adherence (over- vs. under-management) in each sub-category was identified.

RESULTS
Among all 398 adnexal cysts, the frequency of adherence was 55%, over-management was 27%, under-management was 12%, and incomplete recommendation was 6%. Menopausal status, cyst size, and other cyst imaging features all significantly impacted adherence rate (all p 5 cm, adherence was 24% (under-management in 42%). Lesions adherent in most instances were simple cysts (55%), para-ovarian cysts (71%), corpus luteums (88%), and cysts suggestive of, but not classic for, a hemorrhagic cyst, endometrioma, or dermoid (57%). Lesions with under-management in most instances were cysts with multiple thin septations (83%), thick irregular septations (33%), or an avascular nodule (67%), and dermoids (78%). Lesion with over-management in most instances was cyst with one thin septation (64%).

CONCLUSION
Radiologists at our institution adhered to the SRU guidelines for incidental adnexal cysts at ultrasound in 55% of cases. Non-adherence was greater in post-menopausal patients, larger cysts, and cysts with greater complexity.

CLINICAL RELEVANCE/APPLICATION
Our findings will be used to direct future efforts to improve adherence to the SRU guidelines, which in turn will improve patient care. Causes of both under- and over-management will be addressed.

SSK09-03 ● Early Response Assessment to Concurrent Chemoradiotherapy in Cervical Cancer: Value of Diffusion-weighted and Dynamic Contrast-enhanced MR Imaging

Sohee Song (Presenter) ; **Chan Kyo Kim** MD, PhD ; **Jung Jae Park** MD ; **Sung Yoon Park** ; **Byung Kwan Park** MD ; **Seung Jae Huh** PhD

PURPOSE
To prospectively investigate the value of diffusion-weighted (DWI) and dynamic contrast-enhanced MR imaging (DCEI) as early and reproducible response predictors in cervical cancer patients who received concurrent chemoradiotherapy (CCRT).

METHOD AND MATERIALS
Sixteen consecutive patients with biopsy-proven cervical cancer who treated with CCRT were evaluated with MR imaging at 3T, including DWI and DCEI. Four serial MR examinations were performed before CCRT (preTx), after 1 week of therapy (postTx1), after 4 weeks after therapy (postTx2), and after 1 month after the end of therapy (postTx3). At each time point, apparent diffusion coefficient (ADC) and DCEI parameters were calculated in the tumor, gluteus muscle and normal uterus and the results were compared. Tumor response at postTx2 or postTx3, as determined by changes in tumor size or volume using MRI was correlated with tumor ADC or DCEI parameters at preTx and postTx1, or correlated with changes in tumor ADC and DCEI parameters between preTx and postTx1. For reproducibility of ADC and DCEI parameters measurement, 10 patients had two separate pretreatment DWI and DCEI at an interval of < 2 weeks.

RESULTS
At each time point, ADC and DCEI parameters (i.e., K^{trans} and V_e) in the tumors showed consecutive increase (all P< 0.05), while those of gluteus muscle and normal uterus did not reveal a significant difference (all P>0.05). At postTx1 tumor ADCs showed a significant correlation with tumor size response at postTx2 (P= 0.003). Changes in tumor ADCs between preTx and postTx1 had a significant correlation with tumor size (P= 0.001) and volume response (P= 0.021) at postTx2. At preTx, tumor K^{trans} showed a significant correlation with tumor volume response at postTx3 (P= 0.033); tumor K_{ep} and V_e had a significant correlation with tumor size response at postTx2 (P= 0.043 and P= 0.019, respectively). Reproducibility of ADC versus DCEI parameters measurements in the tumor, gluteus muscle and normal uterus was confirmed with a mean difference of 0.3% versus 0.6%±16.6%, 1.7% versus 0.5%±12.3%, and 2.2% versus 0.9%±17.8% in sequence, respectively.

CONCLUSION
DWI and DCEI, as early and reproducible biomarkers, have the potential to evaluate therapeutic response to CCRT in patients with cervical cancer.

CLINICAL RELEVANCE/APPLICATION
As imaging biomarkers, ADC and DCEI parameters may aid in the development of more individualized, effective therapy regimens for the patient group.

SSK09-04 ● Clinical Application of Diffusion-weighted MR Imaging in Uterine Cervical Cancer

Ying Liu (Presenter) ; **Zhao Xiang Ye**

PURPOSE
To investigate the application value of apparent diffusion coefficient (ADC) values in evaluating the histological type as well as pathologic grade of uterine cervical cancer; and to investigate whether ADC values could reflect tumor cellularity density.

METHOD AND MATERIALS
Ninety-eight patients with histopathologically proven uterine cervical cancer were included in this prospective study. All of them received conventional MRI and DWI examinations before surgery or concurrent chemoradiation. Mean ADC value and minimum ADC value of the tumor were measured. Tumor cellularity density was counted using CMIAS (colored multifunction imaging analyzing system).

RESULTS
Both mean ADC value and minimum ADC value of squamous cell carcinoma were significantly lower than that of adenocacinoma (P=0.001; P=0.000). Using mean ADC criteria (=0.965×10-3mm2/s) and minimum ADC criteria (=0.844××10-3mm2/s), the sensitivity and specificity for differentiating squamous cell carcinoma from adenocarcinoma were 83.5% and 76.9%, 77.6% and 92.3%, respectively. The Az of mean ADC was not statistically greater than minimum ADC (P=0.990). Tumor cellularity density, mean ADC value and minimum ADC value of different pathological grade varied significantly (P=0.000, P=0.000, P=0.000). There was a significant positive linear correlation between tumor cellularity density and the pathological grade of tumor (P=0.000). Both mean ADC value and minimum ADC value correlated negatively with cellularity density (P=0.000, P=0.000) and the pathological grade of tumor (P=0.000, P=0.000). Comparisons of correlation coefficients showed no significant differences (P=0.656, P=0.631).

CONCLUSION
DWI has a potential ability to indicate the histologic type of uterine cervical cancer. ADC measurements of uterine cervical cancer can represent tumor cellularity density, thus providing a new method for evaluating the pathological grade of tumor. Mean ADC value instead of minimum ADC value was recommended to fully reflect the whole tumor.

CLINICAL RELEVANCE/APPLICATION
DWI with ADC measurement may be helpful for the noninvasive and preoperative prediction of the histologic type and degree of differentiation of uterine cervical cancer.

SSK09-05 ● Tumor ADC Value Is Associated with Depth of Myometrial Invasion and Is Negatively Correlated to Tumor Volume in Endometrial Carcinomas

Jenny A Husby MD (Presenter) ; **Inger J Magnussen** ; **Jone Trovik** MD ; **Oyvind Salvesen** ; **Line Bjorge** ; **Helga Salvesen** MD, PhD ; **Ingfrid S Haldorsen** MD

PURPOSE
Explore possible correlations between tumor apparent diffusion coefficient (ADC) values, morphological imaging findings and clinical and histological patient and tumor characteristics in endometrial carcinomas. To investigate interobserver agreement between readers on preoperative staging by MRI, including diffusion weighted imaging (DWI).

METHOD AND MATERIALS

RESULTS

CONCLUSION
Low tumor ADC value is associated with presence of deep myometrial invasion and the ADC value is negatively correlated to tumor volume in endometrial carcinomas. Preoperative staging by MRI with DWI is prone to considerable interobserver variability. Calculation of tumor ADC values may aid in the prediction of deep myometrial invasion in endometrial carcinomas.

CLINICAL RELEVANCE/APPLICATION
Low tumor ADC value is associated with presence of deep myometrial invasion, and DWI may aid in the prediction of deep myometrial invasion in endometrial carcinomas.

SSK09-06 ● Temporal Changes of Imaging Parameters of MRI and FDG-PET/CT during Treatment in Cervix Cancer

Saba N Elias MSc (Presenter) ; **Guang Jia** PhD ; **Nina A Mayr** MD ; **William T Yuh** MD ; **Jun Zhang** PhD ; **Michael V Knopp** MD, PhD ; **Nathan C Hall** MD, PhD *

PURPOSE
To prospectively assess the temporal changes of multi-imaging parameters from MRI and PET/CT, including ADC, tumor size, and standardized uptake value (SUV) for early therapy monitoring in cervix cancer patients.

METHOD AND MATERIALS
Ten cervical cancer patients with stage IB2-IVA underwent: 4 multi-parametric 1.5 T MRI (pre-, early-, mid-and post-therapy) and 3 PET/CT using 18F-fluorodeoxyglucose (FDG), (pre-, early-, and mid-therapy). A total dose of 4500 cGy was given with external beam radiation therapy, as well as concurrent weekly chemotherapy with Cisplatin (25-40 mg/m ^{2}). 3-dimentional tumor region of interest were identified using MIM software. ADC map values and T2W based tumor size were calculated using MIPAV software for the four sequential MRIs. Max SUV body weight (bw) was calculated using MIM software for the 3 sequential PET/CT scans.

RESULTS
Multi-parametric MRI showed gradual reduction in tumor size and an increase in the ADC values while PET/CT SUV decreased from pre-therapy to mid-therapy; the mean values of these parameters are : pre-therapy ADC 0.0010 ± 0.0002 mm^2/s, tumor size 47.8±34.6 cm^3 and max SUVbw 15.8±5.4, early-therapy ADC 0.0011±0.0002 mm^2/s, tumor size 34.4±24.3 cm^3 and max SUVbw 11±5.1, mid-therapy ADC 0.0012 ±0.0002 mm^2/s, tumor size 15.4± 15.5 cm^3 and max SUVbw 7±2.3, and post-therapy ADC 0.0012±0.0002 mm^2/s and tumor size 6.9±3.8 cm^3. A negative correlation between pre-therapy ADC and max SUV was found (r =-0.56). A tumor size reduction rate from pre-therapy to post-therapy is negatively correlated to ADC increase rate (r =-0.73).

CONCLUSION
Imaging parameters from the MR and PET/CT, standard modality for the assessment of treatment response in cervical cancer, correlate significantly and our limited data suggest both modalities are efficacious during early treatment. Our research establishes an opportunity to further investigate the comparative effectiveness of each parameter at different treatment time points and further augment the potentials of these parameters for the early responsiveness assessment and long-term outcome prediction.

CLINICAL RELEVANCE/APPLICATION
Current research paves the foundation for cost-effective analysis of the presumed expensive MR and PET/CT and potential augmentation efficacy from the combined-modality approach.

SSK09-07 ● Blood Oxygenation Level-Dependent MR Imaging: Early Changes to Concurrent Chemoradiotherapy in Cervical Cancer

Jungmin Bae (Presenter) ; **Chan Kyo Kim** MD, PhD ; **Seung Hee Choi** ; **Sung Yoon Park** ; **Byung Kwan Park** MD

PURPOSE
To investigate the feasibility of blood oxygenation level-dependent (BOLD) MR imaging (MRI) in assessing early changes to concurrent chemoradiotherapy (CCRT) in patients with cervical cancer.

METHOD AND MATERIALS
This prospective study was approved by our institutional review board. 15 consecutive patients with biopsy-proven cervical cancer who treated with CCRT were evaluated with MRI at 3T, including BOLD MRI. Three serial MR examinations were performed before CCRT (preTx); after 1 week of therapy (postT1); and after 4 weeks after therapy (postT2). BOLD MRI was performed using a multiple fast field echo (mFFE) sequence with 8, 12, 16 and 20 gradient echoes. At each time, the rate of spin dephasing (R2*) values at 4 different gradient echoes were measured in the tumor and normal uterus using manufacturer-supplied software (PRIDE Relaxation Maps Tool, version 2.1.1, philips Healthcare), and the results were compared. For reproducibility of R2* measurements, 8 patients had two separate pretreatment MRI at an interval of < 1 week. Repeated measures analysis of variance with a Bonferroni correction and Altman-Bland test were used for statistical analyses.

RESULTS
The mean R2* values of the tumors from preTx to postT2 tended to have consecutive increase at 8 echoes (20.7, 22.4 and 34.1), 12 echoes (20.9, 22.7 and 32.1), 16 echoes (21.3, 22.5 and 34.1) and 20 echoes (20.9, 22.8 and 33.3); however, compared with preTx, postT2 showed a significant increase in R2* values ($P < 0.001$), while postT1 had no significant difference ($P > 0.05$). At each time, the mean R2* values of the normal uterus were not significantly different at 4 different gradient echoes ($P > 0.05$). At 4 different gradient echoes, the reproducibility of R2* measurements in the tumor and normal uterus was confirmed with a mean difference of 0.1%2.8% and 0.2%7.6%, respectively.

CONCLUSION
BOLD MRI is a feasible, reproducible technique and may demonstrate early physiologic changes to CCRT in patients with cervical cancer.

CLINICAL RELEVANCE/APPLICATION
As a noninvasive, reproducible biomarker, BOLD MRI can be used to evaluate early therapeutic response to CCRT in patients with cervical cancer.

SSK09-08 ● Diagnostic Accuracy of PET/MRI in Gynaecological Malignancies: Initial Results

Patrick Veit-Haibach MD (Presenter) * ; **Nik Hauser** MD ; **Bianca Chilla** MD ; **Gustav K Von Schulthess** MD, PhD * ; **Rahel A Kubik-Huch** MD

PURPOSE
To assess and to compare the diagnostic accuracy of PET/CT and PET/MRI in primary and metastatic gynaecological malignancies.

METHOD AND MATERIALS
13 patients (13 female, mean age: 64, range 55-76years) with different primary and recurrent gynaecological diseases underwent a contrast-enhanced tri-modality PET/CT-MRI examination (PET/CT D 690 and 3T MRI 750W, GE Healthcare). Patients were first injected with an average of 320 MBq F18-FDG and then rested for 30 minutes. Then, a full diagnostic, contrast-enhanced MRI of the abdomen and pelcis, based on the current guidelines, was acquired with the following sequences: coronal T2 SSFSE pelvis, axial T2 SSFSE liver, axial T1 LaveFlex whole abdomen, axial diffusion pelvis, sagittal/axial T2 propeller pelvis, sag/axial T1 LavaFlex post contrast whole abomden. After the MRI, patients were transferred on a dedicated shuttle to the PET/CT. Here, a standard PET/CT with /without intravenous contrast media was acquired (FOV mid-thigh to the vertex of the skull. CT: 50-79 mAs/slice, automated dose modulation 120 kVp, 3.75 mm slice thickness. PET: 3D mode, 2 minutes/bed, iterative reconstruction with 3 iterations, 18 subsets). All data were evaluated on a commercially available workstation and can be displayed as PET, CT, PET/CT and PET/MRI. PET/MRI and PET/CT were evaluated concerning detection and conspicuity of the primary tumor, lymph node metastases and distant metastases. Readers also evaluated if the PET/MRI revealed relevant additional information compared to PET/CT.

RESULTS
Acquisition of PET/CT-MRI and PET/CT vs. PET/MRI evaluation was feasible in all patients. Concerning the primary tumour, the PET/CT was superior in 2 cases, PET/MRI in 5 cases, concerning lymph nodes PET/CT was superior in 2 cases, PET/MRI in 2 cases, in abdominal metastases PET/CT was superior in 2 cases, PET/MRI in none. PET/CT overall showed additional relevant additional information in 9 cases mainly concerning distant metastases, while PET/MRI showed relevant additional information in 3 cases concerning the primary tumour.

CONCLUSION
PET/MRI is well feasible within a tri-modality PET/CT-MRI system. The PET/MRI shows mainly advantages concerning the evaluation of the pimary tumor/local pelvic situation while the PET/CT has advantages concerning distant metastases.

CLINICAL RELEVANCE/APPLICATION
PET/MRI might be eligible to replace PET/CT in the work-up of OB-Gyn cancers.

SSK09-09 ● 18F-FDG PET/MRI versus MRI Alone for Whole Body Staging of Patients with Recurrent Malignancies of the Female Pelvis

Karsten J Beiderwellen MD (Presenter) ; **Johannes Grueneisen** ; **Verena Hartung** ; **Philipp Heusch** MD ; **Rainer Kimmig** ; **Thomas C Lauenstein** MD ; **Lale Umutlu** MD *

PURPOSE

To evaluate the diagnostic benefit of integrated 18F-FDG PET/MRI for whole-body staging of female patients with recurrent pelvic malignancies compared to MRI alone.

METHOD AND MATERIALS

RESULTS
In 10 of 13 patients malignant lesions were present. A total of 41 lesions, comprising 29 malignant and 12 benign lesions were detected. PET/MRI offered correct and respectively superior identification of all 10 patients with cancer lesions, compared to MRI (without DWI, 6/10; including DWI 8/10). Additionally, 18F-FDG PET/MRI exhibited higher conspicuity (PET/MRI: median: 4, range: 3-4; MRI: median: 4, range 1-4; MRI + DWI: median: 4, range 2-4) and diagnostic confidence (PET/MRI: median: 3, range 2-3; MRI: median: 2, range 1-3, MRI +DWI: median: 3, range 1-3) in the detection of malignant lesions (p
CONCLUSION
Our results demonstrate the superiority of 18F-FDG PET/MRI in detecting malignant lesions compared to MRI alone. Thus, whole body PET/MRI may be utilized as a stand-alone imaging technique for staging of patients with suspected pelvic malignancies, allowing for significant time reduction due to omission of T2w and DWI MRI.

CLINICAL RELEVANCE/APPLICATION
Whole-body 18F-FDG PET/MRI may be applied as a stand-alone staging technique for patients with suspected pelvic malignancies.

ISP: Molecular Imaging (Oncology II)

Wednesday, 10:30 AM - 12:00 PM ● S504CD

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SSK12 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
David A Mankoff , MD, PhD
Moderator
Michael S Gee , MD, PhD

SSK12-01 ● Molecular Imaging Keynote Speaker: Molecular Imaging and Biomarkers in Cancer
David A Mankoff MD, PhD (Presenter)

SSK12-02 ● Molecular Ultrasound Imaging Using Microbubbles Targeted to Endoglin, VEGFR2 and Integrin

Ingrid Leguerney (Presenter) ; **Jean-Yves Scoazec** ; **Laure D Boyer** ; **Nicolas Gadot** ; **Sandraa Robin** ; **Nathalie B Lassau** MD, PhD *

PURPOSE
The aim of this study was to investigate the use of targeted contrast-enhanced high-frequency ultrasonography for molecular imaging to determine the expression levels of endoglin, ?v integrin and vascular endothelial growth factor receptor 2 (VEGFR2) biomarkers in murine melanoma tumor models.

METHOD AND MATERIALS
Melanoma-bearing nude mice (B16F10) were explored using dynamic contrast-enhanced ultrasonography with a VEVO2100 imaging system (Visualsonics, Canada). Microvasculature and expression levels of biomarkers were investigated at 20 MHz using specific contrast agents (CA) (MicroMarkerTM, Visualsonics). The lyophilized CA were conjugated with biotinylated rabbit anti-mouse endoglin, ?v integrin and VEGFR2 monoclonal antibodies. Specificity of these functionalized CA was evaluated in comparison with an isotope control antibody (immunoglobulin G) which was bounded on the surface of the CA. Boluses injections of each targeted CA were performed and ultrasound signal intensity from bounded CA was evaluated on the different groups of mice. Two groups of mice were evaluated, control and treated with sorafenib with a daily dose of 62 mg/kg. Tumor samples were harvested for analysis of endoglin, integrin and VEGFR2 expression levels by immunohistochemistery.

RESULTS
The mean ultrasound signal intensity amplitude caused by backscatter of the retained endoglin/integrin/VEGFR2-targeted ultrasound CA after fixation into the vasculature was assessed. Endoglin biomarkers were more expressed than ?v integrin and VEGFR2 in the tumor model. Endoglin tend to increase with time in the control group whereas a decrease in the level expression was observed in the sorafenib group between D0 and D3. These differences in biomarkers expression were also observed by immunostaining.

CONCLUSION
Targeted ultrasound CA coated with antibodies enable in vivo molecular imaging of biomarkers expression on the tumor vascular endothelium and may be used for noninvasive evaluation of tumor angiogenesis during growth or therapeutic treatment in preclinical studies. Endoglin protein which plays an important role in angiogenesis seems to be a target of interest for detecting cancer and for predicting therapy efficacy.

CLINICAL RELEVANCE/APPLICATION
Being able to propose to most appropriate therapy depending on biomarkers expression

SSK12-03 ● Radiolabeled Antibody to gp41 HIV Glycoprotein Kills ART-treated Lymphocytes from HIV Patients and HIV-infected Monocytes in Human Blood Brain Barrier Model

Ekaterina Dadachova PhD (Presenter) ; **Dina Tsukrov** ; **Alicia McFarren**

PURPOSE
Eliminating virally infected cells is an essential component of HIV eradication strategy. In addition, many patients on antiretroviral therapy (ART) suffer from HIV-associated neurocognitive disorders as the brain becomes a reservoir for infection. Thus, the drugs that can enter into the CNS and eradicate the infection are needed.

METHOD AND MATERIALS
Radioimmunotherapy (RIT), a clinically established method to kill cells using radiolabeled monoclonal antibodies (mAbs), was recently used to target the HIV gp41 glycoprotein expressed on the surface of infected cells. As gp41 expression by the infected cells is downregulated in patients on ART, we evaluated the ability of RIT to kill infected cells treated with ART in vitro using patients lymphocytes. We also tested the ability of the same radiolabeled mAb 2556 to gp41 to cross the blood brain barrier (BBB) and kill HIV infected monocytes in the CNS.

RESULTS
We found that RIT was able to specifically kill ART-treated lymphocytes and to reduce HIV p24 to undetectable levels. ART and RIT worked in concert to decrease viral production when compared to ART or RIT alone, indicating that expression of gp41 under ART was still sufficient to allow 2556 mAb binding and killing infected cells. A 4 ΦCi dose of
213Bi-2556 successfully killed over 80% of PBMCs (p9 compared to isotype control 1418 mAb pI of 8. 213Bi-2556 killed significantly more HIV infected than uninfected monocytes on the astrocyte side of the BBB in dose response manner (p
CONCLUSION
In conclusion, RIT in concert with ART eliminated infected cells. Co-treatment was effective in both Atripla and tenofovir/emtricitabine/atazanavir cohorts. We demonstrated the unique ability of 213Bi-2556 mAb to cross the BBB and specifically kill HIV infected monocytes. These findings demonstrate the feasibility of an RIT-based strategy for use with ART to achieve HIV eradication systemically and in CNS.

CLINICAL RELEVANCE/APPLICATION
HIV/AIDS remains an incurable disease. Our goal is to develop RIT-based strategies for therapy of systemic and CNS HIV for use with other anti-retroviral strategies to achieve complete HIV eradication

SSK12-04 ● Early Multi-modal Tumor Perfusion Monitoring upon Anti-vascular tTF-NGR Therapy by USPIO-MRI, CE-US, SPECT, and FRI

Thorsten Persigehl MD (Presenter) ; **Janine Ring** ; **Sven Hermann** ; **Wolfgang E Berdel** ; **Walter L Heindel** MD ; **Rolf Mesters** ; **Christoph B Bremer** MD ; **Christian Schwoppe**

PURPOSE
The purpose of this study was to investigate multi-modal USPIO-enhanced MR imaging (MRI), contrast-enhanced Ultrasound (CE-US), 123I-tTF-NGR-SPECT, and Fluorescence Reflectance Imaging (FRI) for early monitoring of anti-vascular treatment effects of the thrombogenic tTF-NGR protein with a specific binding to CD13 on tumor endothelial cells.

METHOD AND MATERIALS
Fibrosarcoma (HT1080) bearing nude mice (n=12/12/14) were injected with the thrombogenic tTF-NGR with and without earlier blocking of CD13 by pure NGR peptide (GNGRAHA), or saline as control respectively. USPIO-enhanced MRI for determination of the relative blood volume (rBV), 123I-tTF-NGR-SPECT, and FRI for fluorescence imaging of Alexa-Fluor647-labelled fibrinogen were acquired about 4-8 hours after treatment initiation. CE-US was performed during and within 30 minutes after tTF-NGR application. Treatment response and blocking effectiveness were analyzed by histological grading of vascular thrombosis

and/or necrosis (score: 0-5).

RESULTS

CONCLUSION
Multi-modal USPIO-MR, CE-US, SPECT, and FR imaging allow an early complementary assessment of treatment efficacy of the thrombogenic vascular targeting agent tTF-NGR.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates the feasibility of a complementary early multi-model monitoring of anti-vascular therapies for better understanding of the molecular mechanism of action.

SSK12-05 • Whole-body Diffusion-weighted MRI with ADC Mapping in Patients with Diffuse Large B Cell and Hodgkin Lymphoma at Staging and during Treatment

Sarah M Toledano-Massiah (Presenter) ; **Emmanuel Itti** MD ; **Alain Luciani** MD, PhD * ; **Violaine Safar** ; **Sandrine Katsahian** ; **Chieh Lin** MD ; **Bertrand Bresson** ; **Anais Charles-Nelson** ; **Karim Belhadj** ; **Jehan Dupuis** ; **Pierre Zerbib** ; **Benhalima Zegai** ; **Julien Moroch** ; **Michel Meignan** MD, PhD ; **Corinne Haioun** MD ; **Alain Rahmouni** MD

PURPOSE
Evaluation of whole body diffusion weighted MRI (WB-DW-MRI) using apparent diffusion coefficient (ADC) parametric images for staging and response assessment in diffuse large B-cell lymphoma (DLBCL) and Hodgkin lymphoma (HL) by comparison with PET/CT as the reference standard.

METHOD AND MATERIALS
27 consecutive patients presenting with newly diagnosed DLBCL (n=15) and HL (n=12) prospectively underwent both WB-DW-MRI and 18-F FDG-PET/CT at staging, after 2 cycles of chemotherapy (26 patients at interim) and at the end of treatment (23 patients at closure). WB-DW-MRI analysis included size and visual ADC analysis - more or less restricted than muscle-, for the 23 defined nodal regions and the 6 defined organs allowing Ann Arbor staging at baseline and for response assessment. PET/CT data were analyzed using Deauville international criteria. WB-DW-MRI and PET/CT images were both independently analyzed by a junior and a senior reader. The baseline stages and the interim and closure responses based on WB-DW-MRI and PET/CT were compared. Agreement between junior and senior readings were compared on a per-site basis (Kappa).

RESULTS
At baseline, Ann Arbor stages were concordant between WB-DW-MRI and PET/CT in 22 patients: 4 patients were understaged on WB-DW-MRI because of overlooked lung (n=2), iliac node (n=1), and bowel involvement (n=1); one was overstaged (bone marrow involvement). Using size criteria, WB-DW-MRI and PET/CT showed concordant responses in 12/26 patients at interim and in 18/24 patients at closure; with combined size and visual ADC analysis, WB-DW-MRI was concordant with PET/CT in 19/26 patients at interim and in 21/23 patients at closure. At closure, only 1 patient had persistent low ADC with no abnormal uptake on PET/CT, and 1 patient had abnormal FDG uptake not detected on MRI (mediastinal mass). Interobserver agreement for PET/CT reading ranged 0.63-0.70 (good) while for WB-DW-MRI reading the range was 0.86-0.96 (excellent).

CONCLUSION
WB-DW-MRI with ADC mapping is a potentially valuable technique for initial staging, interim and final response assessment, with excellent interobserver agreement.

CLINICAL RELEVANCE/APPLICATION
Our study opens a path towards the use of WB-DW-MRI with ADC mapping complementary to PET/CT in lymphoma patient care; these results should be confirmed in a larger population.

SSK12-06 • A Hybrid Radioactive and Fluorescent Tracer for Sentinel Node Biopsy in Melanoma Patients

Nynke S Van Den Berg MSc ; **Gijs Kleinjan** MD ; **Martin Klop** ; **Omgo Nieweg** ; **Renato Valdes Olmos** ; **Fijs Van Leeuwen** (Presenter)

PURPOSE
The purpose of this study was to explore the value of the hybrid tracer indocyanine green (ICG)-99mTc-nanocolloid for the sentinel biopsy in a large cohort of melanoma patients. A comparison was made with optical detection of blue dye (conventional approach).

METHOD AND MATERIALS
One-hundred-and-four patients with melanoma of the head and neck (n=53), trunk (n=33) or an extremity (n=18) were evaluated. Lymphoscintigraphy with subsequent SPECT/CT was performed after intradermal administration of ICG-99mTc-nanocolloid. The operation was performed 3-27 hours after tracer injection. Patent blue dye was injected prior to the start of surgery, except in patients with a melanoma in the face (n=35). Intraoperatively, sentinel nodes were pursued via gamma ray tracing, followed by optical verification using fluorescence and/or blue dye. A portable gamma camera was used to confirm removal of all radioactive sentinel nodes.

RESULTS
Preoperative imaging revealed at least one sentinel node in all patients. Intraoperatively, in 17 patients (16%) a sentinel node could only be localized using fluorescence imaging; these sentinel nodes were mainly located near the injection site or in the parotid area. Of all harvested sentinel nodes (n=300), 97% of sentinel nodes exhibited fluorescence intraoperatively. In the patients in whom blue dye was used, only 60% of sentinel nodes were stained blue at the time of excision (p
CONCLUSION
ICG-99mTc-nanocolloid allowed for preoperative lymphoscintigraphy and SPECT/CT imaging as well as intraoperative radio- and fluorescence-guided sentinel node detection in all 104 included patients. Optical fluorescence-based identification of the sentinel node was particularly useful in head and neck melanoma with nodes located close to the injection site and/or in the parotid area.

CLINICAL RELEVANCE/APPLICATION
Fluorescence imaging, in addition to the conventional radioguided approach, may allow the accuracy with which sentinel nodes can be removed, possibly improving the false-negative rates.

SSK12-07 • Novel Fluorescent Nanoparticle Imaging Allows Non-invasive Assessment of Immune Cell Modulation within the Esophageal Tumor Microenvironment

Peiman Habibollahi MD (Presenter) ; **Todd Waldron** ; **Pedram Heidari** MD ; **Hoon Sung Cho** ; **David Alcantara** PhD ; **Timothy C Wang** ; **Anil Rustgi** ; **Umar Mahmood** MD, PhD

PURPOSE
Repeat endoscopic imaging combined with administration of fluorescent nanoparticles highly phagocytized by subpopulations of immune cells in the tumor microenvironment allows for their temporal evaluation. We employed this approach to understand changes in the myeloid derived suppressor cell (MDSC) immune cell subpopulation, a central modulator of tumor initiation and progression.

METHOD AND MATERIALS
A novel imaging probe (FH-CyAL5.5) was developed based on Feraheme, a monocrystaline dextran coated iron oxide nanoparticle, conjugated to a near infrared (NIR) fluorochrome, CyAL5.5. Two groups of L2Cre;p120ctnflox/flox mice (n=5 each), a transgenic mouse model of esophageal squamous cell carcinoma, were imaged simultaneously for white light and fluorescent NIR signal using a custom-built dual channel upper GI endoscope 3 hrs after receiving the imaging probe, with or without dexamethasone (dex) pretreatment. Immune cell modulation was quantified by means of immunophenotyping (FACS), confocal microscopy and compared to the signal intensity during fluorescent endoscopy.

RESULTS
A high level of uptake of the fluorescent nanoparticles was observed in the esophageal lesions of L2Cre;p120ctnflox/flox mice which significantly decreased after dex treatment (TBR 2.65±0.15 vs. 1.98±0.09, p
CONCLUSION
These observations suggest that FH-CyAL5.5 is highly taken up by the MDSC immune cell component of the esophageal tumor microenvironment and can be used for assessment of specific immune cell modulation in response to targeted or non-targeted therapies.

CLINICAL RELEVANCE/APPLICATION
This translatable technology may be used for the early detection of dysplastic changes as well as the serial assessment of immune-modulatory therapy in the esophageal tumor microenvironment.

SSK12-08 • 18F-fluorocholine PET/CT Detecting Prostate Cancer Recurrence: Is Dual-phase Imaging Really Beneficial?-Singapore Experience

Aaron K Tong MBBS, MRCP ; **Zoe X Zhang** PhD ; **Sean X Yan** MD (Presenter)

PURPOSE
In the last decade, choline PET/CT scan has been evaluated in diagnosing prostate cancer, particularly recurrence. The ability of choline PET /CT to detect

prostate cancer recurrence may be enhanced by dual-phase acquisition presumably due to the different kinetics of choline in cancer tissue and in benign tissues. However, for this young imaging modality, the optimal protocol and the added value of performing dual-phase scan are still debatable. This study aimed to better define the imaging protocol for 18F-fluorocholine PET/CT.

METHOD AND MATERIALS
A total of 34 patients with suspected prostate cancer recurrence were scanned during the period of 04/2010 to 02/2013 in our hospital and were followed up for an average of 16 months. Final diagnosis was made on biopsy, correlating with other imaging modalities, PSA trend and clinical course. Each patient was given 5-10 mCi 18F-fluorocholine. Immediate acquisition (early phase, 2$\hat{\square}$ post injection) of the pelvis and subsequently whole body acquisition (late phase, 30$\hat{\square}$ post injection) were performed. Two blinded physicians read the scans independently with final consensus achieved in all cases. Standard Uptake Value (SUV) in the dominant lesions was recorded. Statistical analysis was done by SPSS program.

RESULTS
The accuracy of 18F-fluorocholine PET/CT for diagnosing prostate cancer recurrence was 85% with sensitivity of 81% and specificity of 100%. Uptrend change of SUV on the late phase vs early phase was significantly associated with recurrent cancer (P=0.05). The PSA level is closely associated not only with the likelihood of a positive scan (P=0.001), but also with the SUV (R2=0.51, P=0.000) and the change in SUV between two phases (R2=0.25, P=0.014).

CONCLUSION
18F-fluorocholine PET/CT is a useful imaging modality in evaluating prostate cancer recurrence. The dynamic change of SUV between early and late phase images facilitates differentiating malignancy from benignity. The value of dual-phase imaging in improving the performance of 18F-fluorocholine PET for detecting prostate cancer recurrence is confirmed.

CLINICAL RELEVANCE/APPLICATION
Dual-phase 18F-fluorocholine PET/CT scan is more accurate than single phase scan and is recommended in detecting prostate cancer recurrence.

SSK12-09 • [18F]-FLT PET to Predict Early Response to Neoadjuvant Therapy in Rectal Cancer

Eliot McKinley (Presenter) ; **Ronald C Walker** MD ; **Anuradha Bapsi Chakravarthy** MD * ; **M. Kay Washington** ; **Robert J Coffey** ; **H. C Manning** PhD

PURPOSE
Effective implementation of personalized medicine in oncology requires tailoring an individualized therapeutic regimen for a given patient based upon the molecular characteristics of their disease, and deploying effective biomarkers that predict responses early in the course of therapy. In this pilot study, we evaluated [18F]-FLT PET, a non-invasive molecular imaging biomarker of thymidine salvage pathway activity, as a means to predict response to neoadjuvant therapy that included cetuximab in wild-type KRAS rectal cancer patients.

METHOD AND MATERIALS
Baseline [18F]-FLT PET was collected prior to treatment initiation. Followup [18F]-FLT was collected after three weekly infusions of cetuximab, and following a combined regimen of cetuximab, 5-FU, and radiation. Imaging-matched biopsies were collected concomitantly with each PET study.

RESULTS
Diminished [18F]-FLT PET was observed in 3/4 of patients following cetuximab treatment alone and in all patients following combination therapy. Reduced [18F]-FLT PET following combination therapy predicted disease free status at surgery. Overall, [18F]-FLT PET imaging agreed with Ki67 immunoreactivity from biopsy samples and surgically resected tissue and was predictive of treatment-induced p27 levels.

CONCLUSION
To our knowledge, this study represents the first clinical evaluation of [18F]-FLT PET to predict response to neoadjuvant therapy that included EGFR blockade with cetuximab in patients with rectal cancer. Our results suggest that [18F]-FLT PET is a promising imaging biomarker of treatment response in this setting.

CLINICAL RELEVANCE/APPLICATION
This study reports the utilization of [18F]-FLT PET to predict early response to neoadjuvant therapy in patients with rectal cancer. Early detection of therapeutic efficacy can improve clinical outcom

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SSK17 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Terence Z Wong , MD, PhD *
Moderator
Farrokh Dehdashti , MD *

SSK17-01 • Effects of Ferumoxytol on Quantitative Accuracy of PET in Simultaneous PET/MR Imaging - A Validation Study

Ronald J Borra MD, PhD (Presenter) ; **Ulrike I Attenberger** MD * ; **Spencer L Bowen** PhD ; **Ciprian Catana** MD, PhD ; **Grae E Arabasz** ARRT ; **Bruce R Rosen** MD, PhD * ; **Jacob M Hooker** PhD ; **Alexander R Guimaraes** MD, PhD *

PURPOSE
Simultaneous PET/MR imaging depends on MR-derived attenuation maps (mu-maps) for accurate attenuation correction (AC) of the PET data. MRI Contrast agents (MRCA) have the potential to affect obtained mu-maps and in turn reduce the quantitative accuracy of the PET measurements. Currently, the effects of i.v. administered ferumoxytol, which is FDA approved for iron replacement and is a MRCA belonging to the class of ultrasmall superparamagnetic iron oxides (USPIO), are unknown. The purpose of this study is to study the possible effects of ferumoxytol on simultaneously obtained PET/MR data.

METHOD AND MATERIALS
An agarose phantom was constructed with homogeneous concentrations of ferumoxytol (Feraheme$\hat{\square}$, AMAG Pharmaceuticals, Inc.) ranging from 0-20 mg/kg. The phantom was scanned on a Siemens Biograph mMR PET/MR scanner, using a 2-point DIXON 3-D (VIBE) sequence. The default algorithm for reconstruction of the mu-map was used, including selection of the $\hat{\square}$lung compartment$\hat{\square}$ option. In addition, repeated in-vivo PET/MR ^{18}F-FDG studies were performed in a 13.2 kg male baboon, in an animal committee approved protocol, at four different time points: baseline (before and after injection of 10mg/kg ferumoxytol i.v.), 1, 3 and 5 weeks after the baseline scan. All studies were performed using a body Matrix coil and the built-in spine coil as the receiving coil elements.

RESULTS
Phantom experiment: Misclassification was observed in the mu-maps of the phantom regions with ferumoxytol concentrations of 10 mg/kg and higher. *Baboon imaging:* In data obtained later than 5 minutes after the i.v. ferumoxytol injection, significant signal loss was observed in the mu-maps, particularly in the liver, resulting in liver tissue being misclassified as lung. This translated in a decrease of observed standard uptake value (SUV) of liver tissue from 1.23 to 0.54 (-57%) within the first 57 minutes. This change persisted over the next 5 weeks (SUV 0.48, -61% compared to baseline).

CONCLUSION
Our data suggests that ferumoxytol, when used as an MRCA (at FDA approved clinical doses (e.g. 10 mg/kg Fe)) in simultaneous PET/MR imaging, has the potential to cause misclassification of tissues on AC maps resulting in >50% changes in observed SUV.

CLINICAL RELEVANCE/APPLICATION
Ferumoxytol has good vascular, lymph node and macrophage activity, however, our data suggests that PET/MR AC algorithms and dose response need improvement prior to its utilization for cancer staging.

SSK17-02 • Performance of Whole-body Integrated 18F-FDG PET/MR for Evaluation of Malignant Bone Lesions in Comparison to PET/CT

Matthias J Eiber MD (Presenter) * ; **Marius E Mayerhoefer** MD, PhD ; **Michael Souvatzoglou** ; **Markus Schwaiger** MD * ; **Ernst J Rummeny** MD ; **Ambros J Beer** MD *

PURPOSE
Whole-body PET/MR offers potential advantages compared to PET/CT for evaluation of bone lesions due to a higher soft tissue contrast.Opposed to PET/CT, in PET/MR the contribution of cortical bone in the attenuation map is ignored.The aims of this study were to evaluate the diagnostic performance of 18F-FDG PET/MR for bone lesions and to analyze differences in SUV-quantification compared to PET/CT.

METHOD AND MATERIALS
119 patients with FDG-avid malignancies underwent a single-injection/dual-imaging protocol on a PET/CT-scanner and a subsequent PET/MR-scan (Biograph mMR) with a T1w VIBE Dixon for attenuation correction (AC) and coronal T1w TSE sequence.Three sets of images (CT with PET [from PET/CT; set A], T1w VIBE Dixon with PET [set B] and T1w TSE with PET [both from PET/MR; set C]) were analyzed.Every lesion was rated using a 4-point-scale for conspicuity of

PET, a 4-point-scale for anatomical allocation of PET positive lesions and a 5-point-scale for the nature dignity. For all lesions and regions of normal bone SUV-analysis was performed in PET/MR and PET/CT.

RESULTS
98 bone lesions were identified in 33 pts. 630 regions of normal bone were analyzed. Visual lesion conspicuity in PET was comparable (PET/CT: mean rating 2.82±0.45; PET/MR: 2.75±0.51; p=0.3095).Anatomical delineation and allocation of suspicious lesions was significantly superior in T1w TSE (mean rating 2.84±0.42) compared to CT (2.57±0.54, p=0.0001) and T1w VIBE Dixon (2.57±0.54, p=0.0002). No significant difference could be found for correctly classifying all malignant bone lesions for set A (85/90), set B (84/90) and set C (86/90), respectively. For bone lesions and regions of normal bone a highly significant correlation could be found between the SUVs (R=0.950, R=0.917,respectively, p
CONCLUSION
Fully integrated whole-body 18F-FDG PET/MR is technically robust for evaluation of bone lesions despite differences in AC compared to PET/CT.PET/MR including diagnostic T1w sequences was superior compared to PET/CT for anatomical delineation/allocation of bone lesions, which might be of clinical relevance in selected cases.

CLINICAL RELEVANCE/APPLICATION
Neglecting bone in AC for PET/MR is clinical not relevant for bone lesions.A higher rate of concordant findings between T1w and PET in PET/MR could improve diagnostic certainty.

SSK17-03 • FDG PET/MR for the Assessment of Lymph Node Involvement in Lymphoma: Preliminary Results and Role of Diffusion Weighted MR

Ivan Platzek MD (Presenter) ; **Bettina Beuthien-Baumann** MD ; **Jens Langner** PhD ; **Michael Laniado** MD ; **Jorg Van Den Hoff** PhD

PURPOSE
The purpose of this study was to evaluate the sensitivity and specificity of PET/MR (positron emission tomography/magnetic resonance imaging) with FDG (18F-fluorodeoxyglucose) for nodal involvement in malignant lymphoma and to assess the additional value of DWIBS (diffusion weighted MR imaging with background supression) as a part of the PET/MR examination.

METHOD AND MATERIALS
Eighteen patients with malignant lymphoma (10 m, 8 f, mean age 44 y) were included in this retrosprective study (Hodgkin`s disease: n=10; non-Hodgkin lymphoma: n=8). The patients underwent FDG PET/MR on a whole-body hybrid system after intravenous injection of FDG (176 - 357 MBq FDG, 276 MBq on average). The PET/MR examination included DWIBS images of the neck, thorax, abdomen and pelvis. Ten patients underwent FDG PET/MR for initial staging, while 8 patients had PET/MR for assessment of therapy response. Lymph node involvement was documented according to the scheme introduced by the German Hodgkin Study Group. Follow-up imaging and histology served as the standard of reference. The sensitivity and specificity of FDG PET/MR and DWIBS were calculated and compared using the McNemar test. In patients referred for initial staging, disease stage according to the Ann Arbor classification was determinded with FDG PET/MR and DWIBS.

RESULTS
Ninety out of 468 lymph node stations were rated as having lymphoma involvement based on the standard of reference. No evidence for organ involvement was found. Eighty-four lymph node stations were rated as positive by PET/MR and 78 by DWIBS. The sensitivity and specificity of FDG PET/MR for nodal involvement was 93.3% and 99.5%, while DWIBS had a sensitivity of 89.6 % and a specificity of 97.4%. Both the sensititivity (p=0.03) and specificity (p=0.008) of FDG PET/MR were significantly better in comparison to DWIBS. In patients referred for initial staging, Ann Arbor stage determined by PET/MR and DWIBS was identical in nine cases and differed in one case (?=0.81).

CONCLUSION
FDG PET/MR allows for lymphoma staging with high sensitivity and specificity for nodal involvement. The use of DWIBS is not recommended as a part of FDG PET/MR examinations in lymphoma, because it does not provide relevant additional information.

CLINICAL RELEVANCE/APPLICATION
FDG PET/MR is a promising method for lymphoma staging which allows for metabolism evaluation in analogy to PET/CT, while ionising radiation associated with CT is eliminated.

SSK17-04 • PET/MRI in the Detection and Characterization of Pulmonary Lesions: Technical and Diagnostic Evaluation in Comparison to PET/CT

Isabel Rauscher (Presenter) ; **Matthias J Eiber** MD * ; **Sibylle Ziegler** * ; **Ernst J Rummeny** MD ; **Markus Schwaiger** MD * ; **Ambros J Beer** MD *

PURPOSE
PET/MRI differs substantially from PET/CT concerning PET-detector technology and attenuation correction, which might be of special relevance in the lung. We thus compared PET/MRI and PET/CT for evaluation of pulmonary lesions.

METHOD AND MATERIALS
Forty patients (23 men, 17 women; mean age 53.2 years) underwent a single injection dual imaging protocol with [18F]FDG PET/CT (Siemens Biograph 64) and PET/MRI (Siemens Biograph mMR). Pulse sequences for the lung included T1-weighted VIBE Dixon for attenuation correction and contrast-enhanced VIBE pulse sequences. All patients had a diagnostic CT of the chest in deep inspiration. Two blinded readers assessed in consensus all images randomly concerning quality, detection, standardized uptake value (SUV) and size of pulmonary nodules. Correlations were performed using linear correlation.

RESULTS
All scans together revealed 47 pulmonary lesions (mean size 10.0±11.4mm; range 2-60mm) in 25/40 patients. The PET datasets of PET/MRI and PET/CT revealed both 22/47 pulmonary lesions with focal [18F]FDG uptake. SUV-values of lung lesions in PET/MRI and PET/CT correlated significantly (r=0.9; p=0.0001) with a tendency for higher SUVs in PET/MRI. There was a significantly lower image quality comparing Dixon and VIBE sequence with CT whereas PET from PET/CT and PET from PET/MRI showed similar results. Dixon images detected 15/47 lung lesions while VIBE images detected 32/47 lesions, respectively. The detection rates for small lung lesions < 1cm diameter (n=33) of CT and MR imaging was significantly lower with a detection rate of 9/33 for Dixon sequence and 15/33 for VIBE sequence. There was a high correlation of pulmonary lesion size of CT versus VIBE (r=0.97; p
CONCLUSION
PET image quality and detection rate of [18F]FDG positive lung lesions in PET/MRI is equivalent to PET/CT despite differences in attenuation correction techniques. Additionally, a high linear correlation coefficient in the SUV mean for the PET images form PET/CT and PET/MR was found. The detection rate of lung lesions can be significantly improved by adding a diagnostic contrast-enhanced VIBE sequence to the PET/MRI protocol. However, the detection rate of small lung lesions is still inferior compared to PET/CT with diagnostic CT of the chest.

CLINICAL RELEVANCE/APPLICATION
Also for lung evaluation the PET part of PET/MRI is equivalent to PET/CT.

SSK17-05 • Whole-body PET/MRI: The Effect of Ignoring Bone during MR-based Attenuation Correction in Oncology Imaging

Thomas Beyer PhD (Presenter) * ; **Rachida Sersar** ; **Julie Sabyee** ; **Johan Lofgren** ; **Claes Ladefoged** ; **Flemming L Andersen** MSc, PhD ; **Rasmus Larsen** ; **Marianne C Aznar** MS

PURPOSE
Standard PET attenuation correction (AC) in integrated PET/MRI is based on tissue segmentation following in-/opposed phase MR imaging (ACin_op) and does not account for bone tissue. We evaluate PET quantification in whole-body (WB)-PET/MRI following MR-AC without and with accounting for bone tissue using separate CT.

METHOD AND MATERIALS
20 oncology patients referred for a PET/CT were injected with [18F]-FDG or [18F]-NaF and scanned on PET/CT (mCT, Siemens) followed by a PET/MR scan (mMR, Siemens) following clinical WB-protocols. PET(/MR) images were reconstructed using standard MR-AC and four modified attenuation maps. These were created by co-registering (b-spline) the CT images to (ACin_op) and adding CT bone mask values representing cortical bone: 1200HU (ACcortCT), spongiosa bone: 350HU (ACspongCT), average CT value (ACmeanCT) and original CT values (ACorgCT). PET images were reconstructed after MR-AC using AW-OSEM (3iterations, 21subsets, 4mm Gaussian) on 344-matrices. Relative difference images of PET following modified MR-AC and MR-AC using ACin_op were compared. Mean/max standardized uptake values (SUVbw) were calculated in anatomical reference regions and PET-positive lesions.

RESULTS
Visual assessment of the AC-PET and relative difference images indicated most prominent changes over standard MR-AC (ACin_op) limited to the skeletal system. The average relative difference of PET following MR-ACorgCT was 14% across reference regions in healthy bone structures and slightly less (12%) in PET-positive bone lesions. Mean SUV in soft tissue lesions in the neck following MR-ACorgCT was 10% higher than MR-ACin_op.

CONCLUSION
Ignoring bone tissue during MR-AC causes an average underestimation of (10-14)% in reference tissues, bone and soft tissue lesions, which is visually insignificant but considerable during follow-up.

CLINICAL RELEVANCE/APPLICATION
Standard MR-AC appears acceptable in clinical routine for now but mandates improvements in accuracy and reliability for quantitative follow-up examinations.

SSK17-06 ● 18-FDG PET/MRI Compared with 18-FDG PET/CT and Whole Body MRI for Lesion Detection, Confidence and Radiation Dose in the Evaluation of Metastatic Breast Cancer

Amy N Melsaether MD ; **Akshat C Pujara** MD (Presenter) ; **Rajan Rakheja** ; **Mohammed B Shaikh** MD ; **Eric Sigmund** PhD ; **Sungheon Kim** ; **Christian Geppert** * ; **Linda Moy** MD

PURPOSE
PET/CT is often used to evaluate for systemic breast cancer (BC), but provides low contrast at a relatively high radiation dose. Whole body (WB) MRI is also being investigated in this role. Simultaneous PET/MRI scanners are recently available. We therefore evaluated PET/MRI performance for lesion detection, reader confidence and radiation dose as compared with PET/CT and contrast enhanced WB MRI.

METHOD AND MATERIALS
For this HIPPA compliant, IRB approved prospective study, 26 women (age 37-76 mean 56) with n=1 newly diagnosed T2 BC or n=25 history of metastatic disease underwent WB simultaneous 18-FDG PET/MRI on an integrated 3T PET/MR scanner (Siemens Biograph mMR), after PET/CT,
RESULTS
Compared with PET/CT, PET/MRI detected treatment changing brain and bone metastases and a primary endometrial cancer in one patient each. PET/MRI also detected breast cancers in two patients which were not seen on PET/CT. WB MRI detected the brain metastases and endometrial cancer, but did not see the treatment changing bone metastasis. In addition, PET/MRI detected liver, bone, lung, pleural and nodal metastases in 2, 7, 1, 1 and 6 patients with high confidence. PET/CT saw the same lesions with lower overall confidence. WB MRI saw bone metastases in only 6 of these patients and detected the same liver, lung, pleural, nodal and brain metastases with lower confidence. WB MRI detected additional low confidence nodal and liver lesions in 9 and 2 patients. Mean PET/MRI radiation dose was 50% less than PET/CT (10.4 mSv vs 20.7 mSv).

CONCLUSION
18-FDG PET/MRI may outperform PET/CT and WB MRI at half the radiation dose of PET/CT. Further investigation is warranted.

CLINICAL RELEVANCE/APPLICATION
18-FDG PET/MRI may provide greater lesion detection and confidence at half the radiation dose as compared with PET/CT and greater specificity and confidence as compared with WB MRI in BC patients.

SSK17-07 ● PET/MRI as an Alternative Reduced Radiation Staging Algorithm in Patients with Lymphoma

Alexander R Guimaraes MD, PhD (Presenter) * ; **Onofrio A Catalano** MD ; **Wendy Atkinson** MS ; **Michael A Blake** MBBCh * ; **Ciprian Catana** MD, PhD ; **Bruce R Rosen** MD, PhD *

PURPOSE
In patients with lymphoma, FDG PET-CT is critical in the initial staging with early interim PET CT being a strong independent predictor of progression free survival. Diffusion weighted MRI is also a biomarker of malignancy with an uncertain role in lymphoma. The goal of this work was to evaluate the diagnostic performance of simultaneous PET/MR compared to PET/CT in patients with lymphoma.

METHOD AND MATERIALS
15 subjects with lymphoma underwent an IRB approved, single-injection/dual-imaging protocol, consisting of a PET/CT and subsequent PET/MR scan. PET-images of both modalities were reconstructed iteratively. Attenuation, decay and scatter correction and regional allocation was performed using low dose CT data for PET/CT and Dixon-MR sequences for PET/MR. Whole body DWI was performed using a respiratory gated SSEPI (TI/TE/TR 220/68/7800ms) with 3 b- values (0,50,800). ADC was calculated using a mono-exponential fit. SUVmax for FDG-avid lesions were measured and compared using ROI analysis by a single radiologist and Osirix (Osirix ®, Lausanne, Switzerland) for each imaging modality. ROI analysis was performed as well comparing ADC fused to FDG-PET/MR SUVmax. Strength of correlation between variables was measured using the Spearman rank correlation coefficient (rs).

RESULTS
Of the 15 subjects, 4 had Hodgkin's and 11 had non-Hodgkin's (NHL) lymphoma. The mean age was 53 +/- 16 years. Thirty-seven FDG-avid lesions were identified. The mean difference in time between PET/CT and PET/MR acquisitions was (209.9 +/- 43.9 min). SUVmax from FDG-PET/MR (mean 8.5 +/- 4.6) versus FDG-PET/CT (mean 4.6 +/- 2.7) was on average higher and demonstrated a strongly positive correlation (rs=0.84 (0.71, 0.92); p
CONCLUSION
FDG-PET/MR offers an equivalent whole body staging examination as compared with PET/CT with an improved radiation safety profile (by negating the CT component) in lymphoma patients. Correlation of ADC to SUVmax was weak understating the potential importance of both biomarkers in this disease process.

CLINICAL RELEVANCE/APPLICATION
The equivalence of PET/MRI both qualitatively and quantitatively offer a provocative, future clinical staging and surveillance option in patients with lymphoma with dramatic savings in radiation dose.

SSK17-08 ● Utility of a Dedicated [18F]-FDG-PET/MRI Protocol for Thoracic Staging in Lung Cancer: Comparison to [18F]-FDG-PET/CT

Philipp Heusch MD (Presenter) ; **Jens Kohler** ; **Christian Buchbender** ; **Felix Nensa** MD ; **Verena Hartung** ; **Till A Heusner** MD

PURPOSE
Therapeutic decisions in non®small cell lung cancer (NSCLC) patients depend on the tumor stage. Positron emission tomography/ computed tomography (PET/CT) with [18F]-FDG is widely accepted as the diagnostic standard of care. The feasibility of pulmonary tumor staging with simultaneous [18F]-FDG-PET/MRI has recently been proven, but no state-of-the-art lung MRI protocol was used in this early study. The purpose of this study was to compare a dedicated pulmonary [18F]-FDG-PET/MRI protocol to [18F]-FDG-PET/CT for thoracic staging in NSCLC patients.

METHOD AND MATERIALS
38 patients (23 male, 15 female, mean age 63.9±10.5 years) with histopathologically confirmed NSCLC underwent [18F]-FDG-PET/CT followed by a [18F]-FDG-PET/MRI (including a dedicated pulmonary MRI protocol). The TNM stage was determined in separate sessions for PET/CT and PET/MRI by two readers in consensus. The mean and maximum standardized uptake values (SUVmean; SUVmax) and the maximum diameter of the primary tumor were measured. TNM stages, SUVmean/max and tumor size obtained from PET/CT and PET/MRI were compared and Pearson correlation analysis and Bland-Altman plots were performed for quantitative parameters.

RESULTS
PET/MRI and PET/CT agreed on T-, N- and thoracic M-stages in 33/38 (87%), 32/38 (84%) and 35/38 (92%) of patients. Compared to PET/CT, T-stages, N-stages and thoracic M-stages were staged down by PET/MRI in 3 (8%), 3 (8%) and 3 (8%) and were staged up in 2 (5%), 3 (8%) and 0 (0%) patients, respectively. Pearson correlation coefficients for the primary tumors® SUVmean, SUVmax and maximum diameter in PET/CT and PET/MRI were 0.89, 0.90 and 0.98, respectively. Using Bland-Altman analysis, the lower and upper limits of agreement between PET/CT and PET/MRI were -3.45 to 3.15 for SUVmean, -7.43 to 6.55 for SUVmax and -0.86 to 0.96 for the tumor size, respectively.

CONCLUSION
PET/MRI using a dedicated pulmonary MRI protocol and PET/CT generally show a good agreement on thoracic TNM- stages in NSCLC patients. Comparability of primary tumor sizes measured in PET/CT and PET/MRI is substantial and is very well for quantitative measures of [18F]-FDG uptake.

CLINICAL RELEVANCE/APPLICATION
In NSCLC the choice of therapeutic options is based on the individual tumor stage. Hence, comparability of thoracic TNM- stages and primary tumor sizes assessed by PET/CT and PET/MRI is essential.

SSK17-09 ● PET/MRI Attenuation Correction: Differences in Correlation Based on Bone Density

Shaunagh McDermott FFRRCSI ; **Michael A Blake** MBBCh * ; **Ciprian Catana** MD, PhD ; **Dushyant V Sahani** MD ; **Bruce R Rosen** MD, PhD * ; **Alexander R Guimaraes** MD, PhD (Presenter) *

PURPOSE
PET/MRI attenuation correction (AC) is derived from tissue classifications based on DIXON in and out of phase images, which ignore bone density. The aim of this study was to evaluate whether there were regional differences in correlation between PET/CT and PET/MRI SUVmax within the same subject.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Although there is a very high overall correlation between maximum SUVs of suspicious lesions on PET/MR and PET/CT, the location of the lesion does have an effect with combined soft tissue and bone attenuation (abdomen and pelvis) lowering the correlation as compared to air and soft tissue (chest). The low correlation in neck lesions warrants further study, but may be related to lack of coil overlap in this region with only a subset of patients having head/neck coils for the examination.

CLINICAL RELEVANCE/APPLICATION

PET/MRI is a unique tool for oncologic staging. The data presented here elucidates a possible limitation in the attenuation correction that might have impact on SUV and therefore patient management.

Wednesday Plenary Session

Wednesday, 01:30 PM • Arie Crown Theater

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RO OI

PS40 • *AMA PRA Category 1 Credit* ™: 1.25 • ARRT Category A+ Credit: 1
To receive credit, relinquish attendance voucher at end of session.
Presiding
Sarah S Donaldson , MD , *Palo Alto, CA*
President, Radiological Society of North America

Announcement of the Education Exhibit Awards

Dedication of the Annual Oration in Radiation Oncology to the Memory of K. Kian Ang, MD, PhD (1950-2013)

Sarah S Donaldson , MD , *Palo Alto, CA*

Annual Oration in Radiation Oncology: Beneficial Liaisons: Imaging and Therapy

Paul M Harari , MD * , *Madison, WI*
Introduction by
Nina A Mayr , MD , *Seattle, WA*
Chairman of the Subcommittee on Radiation Oncology and Radiobiology, Scientific Program Committee

LEARNING OBJECTIVES
See the tumor, treat the tumor. How complicated can this be? Surgeons, radiation oncologists and interventional radiologists are guided by imaging each day to effectively deliver their craft to cancer patients. Not long ago, external anatomy and plain X-rays served as the primary guide for radiation therapy. Broad field design was the prevailing paradigm with the knowledge that the tumor surely resided within. Collateral normal tissue damage was a necessary accompaniment of treatment and tumor dose was largely limited by normal organ tolerance. Today we deliver ablative radiation doses to complex three-dimensional tumor shapes virtually anywhere in the body. We create sharp dose gradients between tumor and critical normal tissues and seek high precision for daily treatment across thousands of patients. However, this remarkable achievement requires rigorous and meticulous interaction between imaging and treatment. The revolution in imaging and treatment technology has fostered meaningful gains for patients. Intensity modulated radiation therapy (IMRT) and daily image guidance have become routinely available thereby enabling improved dose profiles, high tumor control rates and preservation of salivary, pulmonary, cardiac, bowel and many other normal tissue functions that benefit patient quality of life. The complementary use of CT, MR and PET imaging routinely influence tumor staging, treatment recommendations and outcome. Using head and neck cancer and other tumor types for illustration, this presentation highlights several major contributions of imaging to improved cancer therapy. Cooperative group trials now routinely incorporate imaging into the enrollment, treatment and follow up of cancer patients. Despite these magnificent steps forward, we are only scratching the surface of possibility. Seeing inside individual tumors and characterizing heterogeneity profiles (including proliferation, hypoxia, metabolism) with functional and molecular imaging can further personalize treatment. Tracking small clusters of tumor cells is lowering the threshold of detection. Visualizing early tumor response to treatment is providing new opportunities to tailor individual treatment plans. We are poised to move well beyond "see the tumor, treat the tumor". We are on the threshold of unparalleled visualization within tumors, tracking individual tumor cells, developing diapeutic agents to simultaneously image and treat, and harnessing early response profiles to shape more personalized and effective future therapies. Strengthening the bond of interaction between diagnostic and therapeutic practitioners in oncology has never been more vital and gratifying.

Interventional Oncology Series: Progress, Challenges and Opportunities

Wednesday, 01:30 PM - 06:00 PM • S405AB

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RO OI IR

VSIO41 • *AMA PRA Category 1 Credit* ™:3.75 • ARRT Category A+ Credit:4
Moderator
S. Nahum Goldberg , MD *

LEARNING OBJECTIVES
1) Characterize and appreciate the most important advances of interventional oncology over the last two decades within a well-defined optimization model. 2) Identify key challenges, and greatest opportunities facing the interventional oncology community. 3) Determine under which particular clinical scenarios specific ablation energy sources will have particular benefits over their clinically-available competitors.
ABSTRACT
From a practical perspective, six main basic research areas in which interventional oncology has made substantial progress over the last two decades have been identified including: Ablation devices, Transcatheter therapy, Combination Therapy (including nano-technologies), Understanding local and systemic ablation biology, Procedural Image-guidance, and Post-Ablation Follow-up. Along these lines, for the first half of the session speakers will initially present the 3 - 5 most important advances that have occurred over the last decade for each of these areas. For each topic, this will be followed by a critical assessment of the most pressing current challenges facing and the greatest opportunities presented to advance these key components of current interventional oncologic practice. An additional presentation on 'Future directions for IO' and a panel discussion 'which factors will most drive future progress' will complement these discussions. The second half of the session will be dedicated to addressing another hotly debated key issue facing the IO community that is becoming ever more relevant with the proliferation of new ablation devices namely: 'When should I be using that specialized device ?' Speakers will sequentially present the benefits and limitations of various ablation energy sources for given clinical scenarios including: microwave, cryotherapy, irreversible electroporation, HIFU, and radiofrequency.

VSIO41-01 • Ablation Devices

Christopher L Brace PhD (Presenter) *

LEARNING OBJECTIVES
1) Identify the most common ablation modalities. 2) Compare each modality in terms of energy delivery physics and clinical utility. 3) Analyze common devices for each modality. 4) Evaluate each device's potential clinical value.

ABSTRACT
Thermal ablation devices continue to evolve at a rapid pace. While more established modalities such as radiofrequency (RF) and cryoablation have seen less technological growth in recent years, much is still to be gained from their respective devices. Microwave ablation and irreversible electroporation (IRE) device are now expanding into the clinical marketplace. Six microwave systems are cleared by the FDA, leading to some confusion about how to differentiate those systems from a clinical perspective. IRE as a treatment modality has been slower to emerge as many users await further scientific evaluation of existing systems. The objective of this presentation will be to provide an overview of the basic underlying physics of each treatment modality, present the systems and devices available for clinical use, and elucidate some of the important features of each system to help physician's decide which may be right for their practice.

VSIO41-02 • Transcatheter Therapies

Jean-Francois H Geschwind MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-03 • Novel Navigation Technique for Superselective TACE to Obtain 3D-safety Margin for HCC

Toshihiro Tanaka MD (Presenter) ; **Hideyuki Nishiofuku** ; **Hiroshi Anai** MD, PhD ; **Shinsaku Maeda** ; **Hiroshi Sakaguchi** MD ; **Kimihiko Kichikawa** MD

PURPOSE
Our previous report presented at RSNA 2012 demonstrated the importance of the 3-dimmensional embolization margin (3D-safety margin) in superselective transcatheter arterial chemoembolization (TACE), which could significantly prolong disease free survival. We developed novel navigation TACE using hybrid CT/Angio with a workstation to obtain 3D-safety margin, and prospectively evaluated the feasibility of this technique.

METHOD AND MATERIALS
Fifteen patients with small HCC (size: 1.2-2.9cm, mean 1.8cm) and good liver function (Child-Pugh score: 5-7, mean 5.5) were enrolled in this pilot study. Firstly, a maximum intensity projection (MIP) imaging of the hepatic arteriography was created using CT during hepatic arteriography (CTHA) via the common

hepatic artery (CHA). Secondly, a catheter was superselectively inserted into the tumor feeding artery, and presence or absence of the 3D-safety margin was evaluated by the 3D-fusion images reconstructed using whole liver CTHA via CHA and superselective CTHA via the targeted artery. Thirdly, in the cases without 3D-safety margins, the regions, which lacked safety margins, were marked by a workstation (ZIOSTATION®). These markings automatically appeared on the MIP images, which showed the arterial branches supplying the tumor surrounding areas.

RESULTS
In 13 of 15 patients, 3D-safety margins were absent in the initial fusion images. In all 13 cases, the MIP images of the hepatic arteriography clearly showed the supplying branches into the marginal areas. Superselective TACE using lipiodol (mean volume 2.7ml) mixed with epirubicin (mean volume 23mg) were conducted via both the tumor feeding arteries and the marginal branches. 3D-safety margins were obtained in all 15 patients. No severe complications including liver dysfunction were observed. The mean Child-Pugh score after TACE was 5.5, and no local recurrence was seen during follow-up periods (mean 233 days, range: 171-344 days).

CONCLUSION
Superselective TACE using this novel navigation technique can achieve 3D-safety margin for HCC patients. Currently, a phase II study using this technique is ongoing to evaluate the local tumor recurrence rate for long term period.

CLINICAL RELEVANCE/APPLICATION
Superselective TACE using this navigation technique can achieve 3D-safety margin, which could prevent local recurrence.

VSIO41-04 ● Combination Therapy

Muneeb Ahmed MD (Presenter)

LEARNING OBJECTIVES
1) Demonstrate how understanding tissue responses in and around the ablation zone can be used to develop mechanism-based approaches to combination therapy. 2) Demonstrate how combination strategies for IO using nanoagents offer significant promise for improving minimally-invasive thermal therapy.

ABSTRACT

VSIO41-05 ● Comparison of Transarterial Administration of Survivin siRNA Combined with Transarterial Chemoembolization (TACE) and TACE Alone in the Treatment of Rats with Hepatocellular Carcinoma (HCC): Experimental Study

Thomas J Vogl MD, PhD (Presenter) ; **Jun Qian** MD ; **Andreas Tran** ; **Elsie Oppermann** ; **Ulli Imlau** ; **Yousef Hamidavi** ; **Huedayi Korkusuz** MD ; **Wolf-Otto Bechstein**

PURPOSE
To evaluate the effects of transarterial administration of survivin siRNA combined with transarterial chemoembolization (TACE) vs. TACE alone for treating hepatocellular carcinoma (HCC) in rats.

METHOD AND MATERIALS
Subcapsular implantation of a solid Morris hepatoma 3924A in the liver was carried out in 20 male ACI rats (day 0). Tumor volume (V1) was measured by MRI (day 12). After laparotomy and retrograde placement of a catheter into the gastroduodenal artery (day 13), the following different agents were injecteed into the hepatic artery: TACE (0.1mg of mitomycin + 0.1ml of lipiodol + 5.0mg of degradable starch microshperes) + 2.5nmol survivin siRNA (group A, n=10) or TACE alone (group B, n=10). Tumor volume (V2) was assessed by MRI (day 25), tumor growth ratio (V2/V1) was calculated. Western blot analysis was performed to assess the protein expression level of survivin in each treatment. The progressional potential of the tumors was assessed for quantification of positive VEGF tumor cells via immunohistochemical analysis.

RESULTS
Mean tumor growth ratio (V2/V1) was 1.1313 + 0.1381 in group A, and 3.1911 + 0.1393 in group B. Compared with group B, group A showed significant inhibition of tumor growth (p
CONCLUSION
Combined TACE and transarterial administration of survivin siRNA is more effective than TACE alone for inhibiting the growth of HCC in rats.

CLINICAL RELEVANCE/APPLICATION
Combined TACE and transarterial administration of survivin siRNA may be a relevant treatment option in hepatocellular carcinoma.

VSIO41-06 ● Understanding Local and Systemic Ablation Biology

Joseph P Erinjeri MD, PhD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-07 ● Adoptive Immunotherapy for Hepatocellular Carcinoma with MRI-monitored Transcatheter Delivery of Ferumoxytol Nanocomplexes-labeled Natural Killer Lymphocytes

Kangan Li MD (Presenter) ; **Zhuoli Zhang** MD, PhD ; **Andrew C Gordon** BA ; **Alexander Y Sheu** BS ; **Weiguo Li** ; **Reed A Omary** MD * ; **Gui-Xiang Zhang** MD ; **Andrew C Larson** PhD *

PURPOSE
Natural killer (NK)-lymphocytes adoptive immunotherapy (AIT) has advantages over other immunotherapy approahces in being non-MHC-restricted, non-immunogenic and highly cytotoxic for Hepatocellular Carcinoma (HCC). To improve the AIT efficiency, it is essential to visualize and quantify both the biodistribution of NK cells and the AIT responses.The purpose of this study was to test the hypotheses that: a) Magnetic resonance imaging (MRI) will allow quantitative visualization of transcatheter infusion for targeted delivery of ferumoxytol-heparin-protamine(HPF) nanocomplexes-labeled NK cells to HCC; 2) NK cell AIT responses may be predicted based upon MRI measurements.

METHOD AND MATERIALS
NK-92MIs were labeled with HPF. 24 Sprague Dawley rats were implanted with McA-RH7777 tumors; 6 rats each comprised intra-arterial(IA)NK, intraportal(IP)NK, IA+IP NK, and IA saline groups. Catheter was placed in hepatic artery or/and portal vein for IA NK/saline or/and IP NK infusions. MRI tumor size, T2*, apparent diffusion coefficient (ADC) and volume transfer constant (Ktrans) measurements were compared pre and 12 days post infusion. Tumor size changes, ?T2*, ?ADC, and ?Ktrans were compared; Prussian blue staining was used for histological identification of labeled NK cells;CD56 and CD34 staining qualitatively confirmed NK cells delivery and tumor angiogenesis. ANOVA and Pearson correlation coefficients were used for statistical analyses.

RESULTS
Initial tumor diameters were not different between groups (p=0.23), but final tumor diameters were different between all groups (p
CONCLUSION
The IA or/and IP distribution of HPF-labeled NK cells were quantitatively visualized with MRI, and labeled NK cell delivery as measured by histology and ?T2* were well-correlated with tumor response as determined by change in tumor size, ?ADC, and ?Ktrans, with IA+IP NKs demonstrating the strongest response.

CLINICAL RELEVANCE/APPLICATION
This technique has potential for in-vivo evaluation of the distrbution of NK-cells and AIT responses which can help adjust the patient-specific therapeutic regimens during the clinical application.

VSIO41-08 ● Radiofrequency (RF) Ablation: Does the Primary Site of Ablation Affect Distant Tumor Growth?

Gaurav Kumar PhD (Presenter) ; **S. Nahum Goldberg** MD * ; **Marwan Moussa** MD ; **Nir Rozenblum** MA ; **Muneeb Ahmed** MD

PURPOSE
To determine the effect of primary target site of radiofrequency ablation (RFA) on growth rates of distant subcutaneous tumors in two small animal models.

METHOD AND MATERIALS
This study was performed in two different tumor models in Fisher 344 rats. Firstly, R3230 single subcutaneous adenocarcinoma tumors were randomized at 10-11 mm to receive standardized RFA (21g electrode, 1cm active tip, tip temperature 70ºCx5min) or sham procedure (electrode placement without RF) to normal liver or normal kidney(4 groups, n=6 each, total n = 24). Next, two subcutaneous R3230 tumors were implanted, and animals were randomized to either RFA or sham arms (2 groups, n=6 each, total 12 animals). Finally, RFA or sham of normal liver or kidney was performed in animals with a single MATIIIB subcutaneous tumor (4 groups, n=6 each, total 24 animals). Animals were sacrificed and tumors harvested at 3.5d (MATIIIB) or 7d (R3230) post-treatment. Tumor growth analysis and proliferative indices (Ki67 staining) was performed.

RESULTS
RFA of liver and kidney increased distant R3230 tumor size at 7d compared to sham (17.1±2.2mm and 19.6±1.8mm vs. 14.0±1.1mm, p
CONCLUSION

RF ablation of various tissues, including liver, kidney, and tumor, can increase the growth rate of distant untreated tumors in two different animal models. RFA of certain organs (such as kidney or tumor) exhibit a stronger growth stimulatory effect. Further study of underlying mechanisms will be critical to minimizing these potentially negative effects.

CLINICAL RELEVANCE/APPLICATION
RFA is applied in many tumors and organs. Our study suggests that potentially harmful tumor stimulatory effects likely need to be characterized in an organ-specific manner.

VSIO41-09 ● Procedural Image-Guidance

Bradford J Wood MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-10 ● Imaging Follow-up

Riccardo A Lencioni MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-11 ● Radiologic-pathologic Correlation of Three-dimensional Shear-wave Elastographic Findings after Radiofrequency Ablation

Katsutoshi Sugimoto MD, PhD (Presenter) ; **Saori Ogawa** ; **Hisashi Oshiro** ; **Takeshi Hara** PhD ; **Yasuharu Imai** ; **Fuminori Moriyasu** MD, PhD

PURPOSE
To characterize the findings of three-dimensional (3D) shear-wave elastography (SWE) after radiofrequency (RF) ablation to determine the utility of these findings in the accurate assessment of ablation margins and volumes.

METHOD AND MATERIALS
RF ablation (n = 10) was performed in vivo in 10 rat livers using a 15-gauge expandable RF needle. 3D SWE including B-mode ultrasound (US) was performed 15 minutes after the ablation. The acquired 3D volume data were rendered as multislice images (interslice distance, 1.10 mm), and estimated ablation volumes were computed. We compared the 3D SWE findings with digitized gross pathologic and histopathologic photographs obtained in the same image planes as those of the 3D SWE multislice images. Ablation volumes were also estimated by gross pathologic assessment. These measurements were compared with each other.

RESULTS
In B-mode US, the ablation zone appeared as a hypoechoic area with a peripheral hyperechoic rim 15 minutes after RF ablation; however, the findings were largely obscure for estimating the ablation area. 3D SWE depicted ablation area and volume more clearly. At the largest ablation area, the mean kPa values of the peripheral rim, central zone, and non-ablated zone were 13.1 kPa ± 1.5, 59.1 kPa ± 21.9, and 4.3 kPa ± 0.8, respectively. The ablation volumes obtained by 3D SWE showed the highest correlation ($r = 0.9646$: $p < 0.00001$) with those estimated from gross pathologic assessment. Infiltration of red blood cells observed by histopathologic examination was greater in the peripheral rim of the ablation zone than in the central zone.

CONCLUSION
These findings suggest that SWE outperformed B-mode US. 3D SWE can be a reliable technique for spatially delineating thermal lesions resulting from RF ablation.

CLINICAL RELEVANCE/APPLICATION
3D SWE could potentially be used for routine assessment of thermal therapies.

VSIO41-12 ● Future Directions for IO

S. Nahum Goldberg MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-13 ● Panel: Which Factors Will Most Drive Future Progress?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-14 ● When Should I Be Using that Speicalized Device: MW Systems

Fred T Lee MD (Presenter) *

LEARNING OBJECTIVES
1) Explain basic microwave physics. 2) Demonstrate the differences between radiofrequency and microwave devices. 3) Show illustrative cases where microwave was either useful or contraindicated.

VSIO41-15 ● Development of New Materials for Tissue Hydrodissection: An Analysis of Heat Transfer in Liquids and Gels

Alexander Johnson BS (Presenter) ; **Christopher L Brace** PhD *

PURPOSE
Hydrodissection is used during image-guided interventions to protect critical tissues from damage collateral to the treatment site. Liquids such as normal saline and 5% dextrose in water (D5W) have been used during thermal ablation, but thermoreversible poloxamer 407 (P407) gels may offer greater stability and robustness. The goal of this study was to evaluate the relative importance of conductive and convective heat dissipation in liquid P407, gel P407, and liquid D5W.

METHOD AND MATERIALS
Radiofrequency (RF) and microwave (MW) ablations were created in ex vivo bovine liver for 10 minutes adjacent to an 11 mm barrier of either gel P407, liquid P407 or liquid D5W. Temperatures were recorded at multiple locations inside the barrier using fiberoptic probes. All experiments were performed in triplicate. Temperature increases at each position within each setup was compared using two-tailed, unpaired Student's t-tests.

RESULTS
All materials adequately protected the adjacent tissue during RF and MW ablation (mean temperature increase .05). Gel P407 reduced heat flow compared to liquids as indicated by a greater range in mean temperature elevation within the barrier (10.2 ± 0.5°C for gel P407, 1.3 ± 0.8°C and 1.1 ± 0.9°C for liquid P407 and D5W, respectively; P
CONCLUSION
Both P407 and D5W provided adequate thermal protection during RF and MW ablation. Heat dissipation in gel P407 was conduction dominated, but was convection domination in D5W and liquid P407. Additionally, P407 switches its primary mode of heat dissipation from convection to conduction after gelation. Thus, fluids convectively dissipate heat and may require a large reservoir for adequate protection while gel materials may need a greater thickness but provide more thermal protection due to lower heat dissipation rates. Further in vivo evaluation seems warranted.

CLINICAL RELEVANCE/APPLICATION
The clinical use of novel hydrodissection materials can now be educated by empirical evidence of protective ability and general guidelines for barrier creation.

VSIO41-16 ● When Should I Be Using that Specialized Device: Cryo

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of nearly any tumor location (e.g., the "1-2 Rule"). 2) Understand unique benefits of cryoablation for soft issue locations of head and neck, bone, intra/retroperitoneum and superficial locations (i.e., chest/abdominal wall), as well as more central locations for chest liver and renal ablations. 3) Understand techniques to minimize morbidity, assessing tumor location and approach. 4) Identify major imaging follow-up criteria for ablation success and any early failures. 5) Describe the overall cost-efficacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of tumors in difficult-to-treat locations offers a lower pain alternative than heat-based modalities, especially for multiple soft tissue and central organ locations. Major cryoablation benefits include its excellent visualization of ablation zone extent, low procedure pain and flexible hydrodissection very close to skin surface and adjacent crucial structures. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. US-guidance can augment cryoablation, especially for smaller superficial masses and/or placement of interstitial metallic markers during biopsy for selected cases requiring better eventual CT localization. MR-guidance has little clinical benefit or cost-efficacy.
For safety, cases will be considered for choosing the most amenable approach for a wide variety of anatomic locations. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the "1-2 Rule" of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of

VSIO41-17 • When Should I Be Using that Specialized Device: IRE

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-18 • When Should I Be Using that Specialized Device: HIFU

David C Gianfelice MD (Presenter)

LEARNING OBJECTIVES
1) Introduction to technology of focused ultrasound ablation. 2) Review of thermal monitoring as an aid to treatment. 3) Review of FDA approved treatment protocols to date, uterine fibroids and bone metastases. 4) Update on research protocols in progress. 5) Future applications.

VSIO41-19 • RF Ablation: Still the Preferred Ablation Technology in Practice!

Alison R Gillams MBChB (Presenter) *

LEARNING OBJECTIVES
1) To learn the relative merits of radiofrequency ablation over other ablation technologies. 2) To understand the limitations of radiofrequency and how to overcome them.

VSIO41-20 • Panel Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

BOOST: Genitourinary-Case-based Review (An Interactive Session)

Wednesday, 03:00 PM - 04:15 PM • S103CD

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RO OI GU

MSRO43 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5
Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Fergus V Coakley , MD
Deborah A Kuban , MD
Colleen A Lawton , MD *

LEARNING OBJECTIVES
1) State the modalities, rationale, and indications for imaging local and distant spread of prostate cancer. 2) Describe the evidence-basis for imaging approaches to prostate cancer. 3) List the emerging modalities for prostate cancer imaging. 4) State the appropriate therapy(s) for low intermediate and high risk prostate cancer treament.
ABSTRACT
This course will be a case based review of all aspects of the treatment of prostate cancer from early stage disease through metastatic disease. We will focus on radiation aspects of treatment in particular and imaging as appropriate for all stages of disease.
URL's
http://www.radiology.ucsf.edu/research/meetings/rsna

Chest (Thoracic Malignancy)

Wednesday, 03:00 PM - 04:00 PM • S404CD

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OI CT CH

SSM05 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Kyung S Lee , MD, PhD
Moderator
Georgeann McGuinness , MD

SSM05-01 • Preoperative Staging of Non-small Cell Lung Cancer with Co-registered Whole Body MR Imaging and Positron-emission Tomography (MRI-PET): Comparison with PET-CT

Chin A Yi MD, PhD ; **Kyung S Lee** MD, PhD ; **Ho Yun Lee** MD ; **Seonwoo Kim** ; **O. Jung Kwon** ; **Joon Young Choi** MD ; **Byung-Tae Kim** MD ; **Jung Won Moon** (Presenter) ; **Hee Young Lee** MD ; **Eun Young Kim** ; **Young Mog Shim** MD

PURPOSE
We compared the diagnostic accuracy of co-registered whole body (WB) MRI-PET with that of WB PET-CT in determining the preoperative stage of non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS
From January 2010 through November 2011, we prospectively enrolled 141 NSCLC patients (86 men, 55 women; mean age, 62 years) who had resectable disease on conventional staging using chest CT. They underwent whole body MRI including diffusion weighted MR imaging of the thorax and PET-CT, which were postprocessed for co-registration of MRI and PET. Two independent, blinded readers determined preoperative stage in the review of WB MRI-PET or PET-CT. Reference standards were obtained for T (n = 106) and N (n = 126) stages based on pathologic results, while M stage (n = 141) were obtained based on pathologic or follow-up imaging findings. The accurate staging, over staging, and under staging were compared by using the McNemar test.

RESULTS
The accuracy of TNM stage grouping were higher with WB MR-PET (95/141, 67%) than with PET-CT (82/141, 58%) (P =.009) and WB MR-PET significantly decreased the number of under stage (27% in PET-CT vs. 16% MR-PET, P
CONCLUSION
WB MRI-PET can be a superior diagnostic modality to PET/CT for T and M staging of NSCLC. For N staging, both MRI-PET and PET-CT show comparable results.

CLINICAL RELEVANCE/APPLICATION
The development and application of simultaneous WB MRI-PET would be advantageous for the tumor evaluation and the detection of metastasis in cancer imaging and staging.

SSM05-02 • Comparison of Diffusion Weighted Imaging with Background Suppression (DWIBS) Sequence and Classic Spectral Diffusion Sequence (DWI) in Mediastinal Lymph Node Analysis at 3T

Caroline Mesmann MD (Presenter) ; **Adva Abergel** MD ; **Francois Tronc** MD, PhD ; **Yves Berthezene** MD, PhD ; **Philippe Douek** MD, PhD ; **Loic Boussel** MD

PURPOSE
To compare DWIBS sequence with DWI both with and without respiratory gating in mediastinal lymph node analysis at 3T.

METHOD AND MATERIALS
26 patients (27-79 years-old) scheduled for surgical lymph node analysis, prospectively undergone a whole thoracic exploration with DWIBS (TR/TE 6674/44; FatSat STIR with IR=260ms; Slice Thickness=5mm) and DWI sequences (TR/TE 1291/59.; Spectral FatSat; Slice Thickness=5mm) with and without (free breathing) respiratory gating with 0, 400 and 800 b-values at 3T.
For each of the four sequences, a qualitative analysis, defined by fat-sat homogeneity and presence of motion artefacts, rated from 0 to 4, was independently performed by two radiologists. The signal to background (STB) of mediastinal lymph nodes was also calculated as the signal of the lymph node dived by the mean signal of the thoracic muscles.
Kruskal Wallis and ANOVA tests were performed to compare respectively the qualitative and the quantitative data of DWI and DWIBS images with adapted post-hoc tests.

RESULTS
Quality of fat suppression was better for DWIBS in comparison with DWI both for the ungated (image quality score 3.9±0.33 vs 1.5±1.2, p Furthermore, motion artefacts were significantly reduced in DWIBS both for ungated (image quality score 3.13±0.55 vs 1.86±0.76, p Quantitative analysis showed a significantly higher STB in lymph nodes for DWIBS images in comparison with DWI both for the ungated (score 3.9 ±0.33 vs. 1.5± 1.2, p
CONCLUSION
DWIBS sequence improves the fat-sat homogeneity, reduce motion artefacts and increase the STB of mediastinal lymph node in comparison with DWI. Respiratory gating doesn't improve significantly DWIBS image quality.

CLINICAL RELEVANCE/APPLICATION
DWIBS sequence improves image quality in mediastinal lymph node imaging in comparison with the standard DWI sequence.

SSM05-03 ● Lung Adenocarcinomas Presenting with Concurrent Lymphangitic Metastasis at the Initial CT: Clinical Characteristics and Prognostic Implications- Work in Progress

Hyun-Ju Lim MD (Presenter) ; **Kyung S Lee** MD, PhD ; **Myung-Ju Ahn** ; **Myung Jin Chung** MD * ; **Joonghyun Ahn**

PURPOSE
To evaluate the clinical characteristics and prognostic implications of patients with lung adenocarcinoma presenting with concurrent lymphangitic metastasis at CT

METHOD AND MATERIALS
We retrospectively reviewed the clinical data base of patients who were newly diagnosed to have non-small cell lung cancer (NSCLC) from 2007 through 2010. We searched for the cases in which radiologic report text harbored the term "lymphangitic metastasis" and clinically ensured that the findings are suggestive of lymphangitic metastasis by excluding those who were proven to have pulmonary edema on follow-up study. The extent of lymphangitic metastasis was classified into having involved the same lobe, the ipsilateral lung but the different lobe, and the different lung. Two chest radiologists reviewed CT scans and decisions were reached by consensus. We excluded the patients with non-adenocarcinoma pathology or with surgery or irradiation history.
After restaging with CT and PET/CT results by the new 7th TNM classification, CT and clinico-demographic data were investigated for those in subject group (with lymphangitic metastasis) and in control group (without lymphangitic metastasis). New clinical stage group, sex, age and history of chemotherapy were matched to assess the impact of lymphangitic metastasis on patient overall survival.

RESULTS
The subject group (n = 54) consisted of four stage IIIB (7.4%) and 50 stage IV (93.6%) lung adenocarcinoma patients (34 men, 20 women; mean age 59 ± 10 years). Of these patients, lymphangitic metastasis was depicted in the same lobe in 10, in the ipsilateral lung but different lobe in 32 and in the different lung in 12 patients. Forty two patients received chemotherapy and 12 patients did not. There was no significant difference in overall survival between lung adenocarcinoma patients with and without lymphangitic metastasis (p = .758). The extent of lymphangitic metastasis also showed no significant correlation with patient prognosis (p = .121).

CONCLUSION
Stage IIIB or IV lung adenocarcinoma patients with lymphangitic metastasis at the initial CT does not show significantly different prognosis compared with those without the condition, and the extent of lymphangitic metastasis also does not affect on patient overall survival.

CLINICAL RELEVANCE/APPLICATION
In advanced stage (IIIB and IV) lung adenocarcinoma, the presence of lymphangitic metastasis or its extent does not have any impact on patient prognosis.

SSM05-04 ● Prognostic Value of Metabolic Tumor Volume in Patients with Esophageal Carcinoma

Sonia L Betancourt Cuellar MD (Presenter) ; **Wayne L Hofstetter** ; **Arlene M Correa** PhD ; **Osama R Mawlawi** PhD ; **Diana M Palacio** MD ; **Edith M Marom** MD

PURPOSE
To determine if ^{18}F-fluorodeoxiglucose (FDG) metabolic tumor volume (MTV) imaged by positron emission computed tomography (PET-CT) in newly diagnosed patients with esophageal carcinoma can determine overall survival.

METHOD AND MATERIALS
185 patients with esophageal carcinoma, treated with surgery alone (n=62) or multimodality therapy: neoadjuvant chemoradiotherapy followed by surgery ((n=123) were included in this study. SUVmax, volumetric metabolic measurements such as MTV and other clinical variables, including clinical staging were assessed by Cox's proportional hazards regression model to test prognostic significance.

RESULTS
Univariable Cox regression analysis of the entire group of 185 patients showed that clinical staging, and maximal tumor length as assessed by endoscopic ultrasound and all methods for assessing FDG uptake were associated with overall survival (p
CONCLUSION
Some pretreatment FDG tumor uptake measurement techniques can be useful for tailoring therapy to either surgery or multimodality therapy in patients with esophageal carcinoma.

CLINICAL RELEVANCE/APPLICATION

SSM05-05 ● Dual-energy CT in Differentiating Thymic Epithelial Tumors: An Initial Experience

Suyon Chang MD (Presenter) ; **Jin Hur** MD ; **Young Jin Kim** MD ; **Hye-Jeong Lee** MD ; **Yoo Jin Hong** MD ; **Byoung Wook Choi** MD

PURPOSE
The WHO histological classification reflects both the clinical and functional features of thymic epithelial tumors and thus contributes to the clinical assessment and treatment of patients with these tumors. The purpose of this study was to evaluate the diagnostic value of dual-energy computed tomography (DECT) in differentiating thymic epithelial tumors.

METHOD AND MATERIALS
We prospectively enrolled 14 patients (3 males; mean age: 53.3years) who were pathologically confirmed as thymic epithelial tumors. All patients underwent dual-energy CT using gemstone spectral imaging (GSI) mode (GE HD750). For quantitative analysis, two investigators measured the following parameters; CT attenuation density (HU values), iodine-related HU (IHU), and iodine concentration (mg/ml). Pathological results were used as a final diagnosis. Statistical analysis included calculation of means and standard deviations, and the t-test.

RESULTS
There were a total of 8 low-risk thymomas (6 type AB and 2 type B1) and 6 high-risk thymomas (4 type B2 and 2 type C). The mean HU values of tumors were significantly different between the low-risk and high-risk thymoma groups (90.73 ± 17.04 vs 43.09 ± 20.08 HU; p = 0.0009). The mean iodine concentration and IHU values were significantly different between the two groups (2.18 ± 0.61 vs 0.64 ± 0.32; p = 0.0001 and 42.62 ± 14.36 vs 9.31 ± 5.39 HU; p = 0.0002, respectively).

CONCLUSION
Dual-energy CT using a quantitative analytic methodology can be useful in the differentiation between low-risk thymomas and high-risk thymomas.

CLINICAL RELEVANCE/APPLICATION
Dual-energy CT with quantitative measurements could be a helpful complementary tool to differentiate low-risk thymomas and high-risk thymomas in cases in which conventional CT is inconclusive.

SSM05-06 ● Volume Perfusion Computer Tomography Monitors the "Vascular Normalization"? Effects of Antivascular Therapy in Preclinical A549 Lung Adenocarcinoma Model

Zeng Xiong (Presenter) ; **Jin-Kang Liu** ; **Hui Zhou**

PURPOSE
Numerous recent studies have shown that anti-angiogenic therapy can improve oxygenation and blood flow of aberrant tumors, thereby enhancing the efficacy of subsequent radiation and chemotherapy. This is referred to as ��normalization�� of aberrant tumor vasculature. Application of immunohistochemical techniques in quantitative evaluation of �vascular normalization� effect has always been limited by difficulties in generating reproducible data. This study demonstrates that volume perfusion computer tomography (VPCT) parameters may indicate vascular abnormality in a lung tumor model and reflect the �Vascular Normalization� effect after Bevacizumab treatment.

METHOD AND MATERIALS

RESULTS
In treated mice, BF was increased at day2 (p.0.035) and significantly increased at day4 (p.0.000) as compared to the baseline. In control mice, BF gradually decreased during treatment with significant difference on the baseline (p.0.05). Microvessel pericyte coverage index (MPI) was significantly increased and hypoxia was significantly reduced in tumors at day4-6 after Bevacizumab treatment compared to those treated with saline (p.0.000). This study clearly demonstrates the �vascular normalization� effect and it is perfectly correlated with VPCT parameters.

CONCLUSION
VPCT is a novel method for investigating lung tumor vascular architecture, and this might be considered as an innovative complementary tool for precise quantification of �vascular normalization� effect.

CLINICAL RELEVANCE/APPLICATION
VPCT might be considered as an additional complementary tool for precise quantification of Vascular Normalization effects,assessment of antitumor treatment effects.

Gastrointestinal (Esophagus)

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OI CT GI

SSM07 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Lisa M Ho , MD
Moderator
Jinxing Yu , MD

SSM07-01 • Esophageal Carcinoma: Evaluation with Diffusion-tensor MR Imaging and Tractography Ex Vivo

Ichiro Yamada MD (Presenter) ; **Keigo Hikishima** PhD, MS ; **Naoyuki Miyasaka** MD ; **Yutaka Tokairin** MD ; **Tatsuyuki Kawano** MD ; **Eisaku Ito** MD ; **Daisuke Kobayashi** MD ; **Yoshinobu Eishi** MD ; **Hideyuki Okano** MD, PhD ; **Hitoshi Shibuya** MD

PURPOSE
To determine the usefulness of diffusion-tensor MR imaging and tractography for evaluating the depth of mural invasion by esophageal carcinomas.

METHOD AND MATERIALS
Twenty esophageal specimens containing 20 carcinomas were studied using a 7.0-T MR system with a four-channel phased-array surface coil. Diffusion-tensor MR imaging was performed by using a diffusion-weighted spin-echo pulse sequence based on a Stejskal-Tanner diffusion preparation. The imaging parameters were: repetition time, 3000 msec; echo time, 25 msec; field of view, 50-60 x 25-30 mm; matrix, 256 x 128; section thickness, 1 mm without intersection gaps; voxel size, 0.195-0.234 x 0.195-0.234 x 1 mm (0.038-0.055 mm3); number of excitations, two; b value, 0 sec/mm2 or 1000 sec/mm2; and motion-probing gradient, in seven noncollinear directions. Diffusion-tensor tractographic images were computed with TrackVis software. MR images were compared with the histopathologic findings as the gold standard.

RESULTS

CONCLUSION
Diffusion-tensor MR imaging and tractography are capable of clearly depicting the individual tissue layers of the normal esophageal wall, and they have excellent diagnostic accuracy for evaluating the mural invasion of esophageal carcinomas. Thus, they may make it possible to noninvasively diagnose the depth of mural invasion by esophageal carcinomas.

CLINICAL RELEVANCE/APPLICATION
Diffusion-tensor MR imaging and tractography may provide a new tool to noninvasively diagnose the depth of mural invasion by esophageal carcinomas.

SSM07-02 • Is PET-CT a Better Tool than EUS for Preoperative Staging of Esophageal Cancer? A Comparative Study

Seyed Mahdi Abtahi MD (Presenter) ; **Azadeh Elmi** MD ; **Yingbing Wang** MD ; **Yuen Chi Ho** ; **Sandeep S Hedgire** MD ; **Mukesh G Harisinghani** MD

PURPOSE
Currently, there is no single ideal staging modality for preoperative staging of esophageal cancer. The aim of this study was to assess the role of PET-CT in the pretreatment staging of esophageal cancer. We also compared the diagnostic accuracy of PET-CT with endoscopic ultrasound (EUS) in distinguishing low-stage disease (T1 and T2) from advanced T-stage disease.

METHOD AND MATERIALS

RESULTS
The overall accuracy of PET-CT in predicting the correct stage was significantly higher than EUS (p=0.002). However, there was no significant difference in comparison made for T-staging between the two modalities (p-value= 0.247). Correct T-staging was performed by PET-CT in 72.2% and by EUS in 55.58% of the patients. Overstaging was more observed by EUS (p=0.008). The sensitivity of the modalities was similar for distinguishing advanced T-stage from low-stage disease; however, the specificity was significantly higher for PET-CT (93.8% vs. 62.5%, p=0.006). The performance of PET-CT for evaluating nodal involvement was significantly higher than EUS (accuracy of 91.4% and 73.6%, respectively, p=0.002). The sensitivity and specificity for distant metastasis were 82.5% and 93.7% for PET-CT and 75% and 81% for EUS.

CONCLUSION
Combination of PET-CT has a superior overall staging ability over EUS in our study group especially for nodal and distant disease staging. The tests showed similar performance in tumoral staging while PET-CT demonstrated improved specificity in distinguishing advanced T-stage disease.

CLINICAL RELEVANCE/APPLICATION
Integration of PET-CT into the staging work-up of esophageal cancer may improve the accuracy compared with EUS alone. PET-CT may contribute to better treatment planning for advanced T-stage disease.

SSM07-03 • Chemotherapy Response in Gastroesophageal Tumours with Magnetic Resonance and 18F-FDG-PET/CT: Correlation of Apparent Diffusion Coefficient (ADC) and Partial Volume Corrected Standardized Uptake Value (PVC-SUV) with Tumour Regression Grade (TRG)

Francesco Giganti MD (Presenter) ; **Francesco A De Cobelli** MD ; **Carla Canevari** MD ; **Francesca Gallivanone** ; **Carlo Staudacher** MD ; **Alessandro Del Maschio** MD

PURPOSE
Patients with locally advanced gastroesophageal tumours (GT) or adenopathies are treated with neoadjuvant chemotherapy (NC) to make radical resection possible. TRG is a histological objective indicator of treatment response which scores residual tumour in 5 grades, after resection. Aim of our study was to compare ADC and PVC-SUV changes during NC with TRG to evaluate if molecular imaging biomarkers from Diffusion Weighted Imaging (DWI) Magnetic Resonance (MR) and 18F-FDG-PET/CT may help to differentiate between Responders (R) and Non Responders (NR) to NC.

METHOD AND MATERIALS
31 patients affected by GT (7 esophageal,3 gastro-esophageal junction, 21 stomach) were evaluated on a 1.5-T MR system including DWI performed using b value of 0 and 600 s/mm2, before and 3 weeks after the end of NC and ADC were calculated. Patients also underwent a basal and a follow up 18F-FDG-PET/CT scan, before and after NC, and PVC-SUV were obtained, as quantitative PET biomarkers.

RESULTS

CONCLUSION

DWI-MR, which can be performed in a relatively short examination time compared to 18-FDG-PET/CT, may become an important imaging technique in evaluating CT response in patients with GT. Our study suggests that DWI-MR is potentially capable of offering more accurate information for treatment reponse than 18F-FDG-PET/CT in these Patients and modifications of ADC may represent a reproducible tool to assess tumor response to NC.

CLINICAL RELEVANCE/APPLICATION
DWI-MR and ADC modifications are potentially capable of offering more accurate information for treatment reponse than 18F-FDG-PET/CT in gastroesophageal cancers.

SSM07-04 ● Diagnosing Leak after Esophagectomy for Esophageal Cancer by CT-esophageal Protocol (CTEP) and Standard Esophagram (SE): Is the Old School Still the Best School?

Diana M Palacio MD (Presenter) ; **Wayne L Hofstetter** ; **Arlene M Correa** PhD ; **Sonia L Betancourt Cuellar** MD ; **Edith M Marom** MD

PURPOSE
This retrospective study,compares CTEP and SE, alone or in combination, to the clinical diagnosis of leak established by endoscopy, operation and/or clinical course.

METHOD AND MATERIALS
We reviewed the charts of patients who underwent esophagectomy for esophageal cancer between 1/2005 to1/2009. A final diagnosis of leak was made based on a combination of clinical course, endoscopic and/or surgical evaluation: Type0= No leak. Type1= Subclinical leak, imaging diagnosis only. Type2= Clinical suspicion for leak +/- positive imaging, conservative management. Type3= Clinical suspicion for a leak, +/- positive imaging, requiring an intervention. Type 4= Conduit necrosis diagnosed at re-operation, +/- positive imaging. Reports of all diagnostic CT-EP and SE performed < 31 days post-op were reviewed and the diagnosis of leak classified as either small/contained vs. large /uncontained. A cross match between the clinical leak diagnosis and the imaging results was made.

RESULTS
382 patients underwent esophagectomy. 23 patients did not have any imaging and were excluded. Of the remainder 359, 274 had SE only, 19 CTEP only, and 66 CTEP+SE. SE was done 4-31 d post-op (mean=13), and CTEP done 1-31 d post-op (mean=9). If CT+SE, both were performed
CONCLUSION
SE alone has higher S, S, PPV, and NPV than CTEP alone for identification of leak. Although SE+CTEP slightly improves sensitivity, the specificity only improves compared to CTEP alone. CTEP had greater false+ and false- than SE. SE may continue to be the imaging method of choice to evaluate anastomotic leak.

CLINICAL RELEVANCE/APPLICATION
Despite the increased availability and usage of Chest CT-EP, when an esophageal leak is suspected after esophagectomy, an esophagram is recommended due to its greater accuracy as compared to CT.

SSM07-05 ● The Sensitivity and Specificity of Diagnosing Eosinophilic Esophagitis in Adults on Barium Swallow Examination with Histology as the Gold Standard

Dhiraj Joshi MD, MRCS (Presenter) ; **Jonathan C Rodrigues** MBBCh, MRCP ; **James P Virjee** MBChB, FRCR

PURPOSE
Eosinophilic esophagitis (EE) is a chronic inflammatory condition of the esophagus that presents with symptoms of dysphagia and food bolus impaction. The patients are referred for barium swallow examination (BSE) either from the community or following inconclusive endoscopy. The aim of this study was to determine the sensitivity and specificity of BSE for diagnosing EO by using histology as the gold standard. Established radiological features from previous studies were used.

METHOD AND MATERIALS
The number of radiologically diagnosed cases of EE from all outpatient BSE performed over a 2-year period was determined from the radiology database. The total number of histologically proven cases of EE was determined from the histopathology database. This data was cross-referenced and used to calculate sensitivity and specificity of BSE for diagnosing EE.

RESULTS
A total of 824 outpatient BSE were performed for a variety of oesophageal symptoms. Sixteen patients were diagnosed as EE of which 14 patients were confirmed to have EE on subsequent histology. Fifteen patients were diagnosed with EE on histology, which also included the 14 patients that were diagnosed by BSE. One patient was diagnosed on a random endoscopic biopsy but had not undergone BSE. The most common symptom was intermittent dysphagia (14 patients) followed by food bolus obstruction (10 patients). The most common radiological feature was presence of ring deformity (16 patients), followed by a fixed stricture (5 patients). The true positives were 87.5 %; false positives, 12.5%; true negatives, 100%; false negatives, 0 %. This sensitivity of diagnosing EE on BSE was 100 % and specificity was 99.7 %.

CONCLUSION
In an appropriate clinical setting, BSE can be used as a reliable investigation for the diagnosis and management of EE.

CLINICAL RELEVANCE/APPLICATION
EE is often erroneously treated for reflux esophagitis. BSE can help in appropriate diagnosis and management of difficult cases.

SSM07-06 ● Oral Effervescent Powder Administration for Multidetector CT Evaluation of the Esophagus - A Validation Study

Kristina I Ringe MD (Presenter) ; **Simone Meyer** ; **Frank K Wacker** MD * ; **Hans-Juergen Raatschen** MD

PURPOSE
To quantitatively and qualitatively assess the value of oral effervescent powder administration for CT evaluation of the esophagus in patients without underlying esophageal disease.

METHOD AND MATERIALS
This prospective study was IRB approved. 42 patients (27 males/15 females, mean age 57y) who where referred for thoraco-abdominal staging CT were included. Contrast-enhanced CT was performed on a 64-slice scanner after oral administration of 3g effervescent powder immediately before image acquisition. Distension of the esophagus was assessed at three levels (proximal/middle/distal) by volumetry of the inner (ID) and outer diameter (OD), using a thin client software. In addition, esophageal distension in the corresponding segments was evaluated qualitatively separately by two blinded readers on a three-point scale. Further, at an interval of two weeks, both readers in consensus decided on the number of diagnostic esophageal segments in each patient in terms of the possibility to decide upon a potentially underlying pathology. Findings were compared with results from an age and sex matched control group (42 patients; 30 males, 12 females; mean age 62 y). Quantitative and qualitative results of both groups were compared (T-Test, Mann-Whitney-U-Test). Inter-observer variability was calculated (weighted-Cohen-?).

RESULTS
ID and OD in all esophageal segments were significantly larger after effervescent powder administration as compared to the control group (p
CONCLUSION
Correctly timed oral administration of effervescent powder results in good distension of the esophagus, allowing readily assessment of the wall at contrast enhanced CT as compared to studies without effervescent powder.

CLINICAL RELEVANCE/APPLICATION
Oral administration of effervescent powder is a feasible technique resulting in good distension of the esophagus, allowing readily assessment of the wall at contrast enhanced CT.

Gastrointestinal (Liver Imaging)

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OI MR GI

SSM08 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Ihab R Kamel , MD, PhD *
Moderator
Vahid Yaghmai , MD

SSM08-01 ● The Activity Grade of Hepatitis Affects Liver Stiffness Measured Using MR Elastography

Tomohiro Takamura (Presenter) ; **Shintaro Ichikawa** MD ; **Utaroh Motosugi** MD ; **Katsuhiro Sano** MD ; **Hiroyuki Morisaka** MD ; **Tomoaki Ichikawa** MD, PhD *

PURPOSE
To elucidate the relationship between activity grade of hepatitis and liver stiffness measured using MR elastography (MRE).

METHOD AND MATERIALS
This study included 123 patients who underwent liver biopsy or surgery less than 2 months after MRE. The histological fibrosis scores and activity grades were as follows: F1, n = 19 (A1 = 12, A2 = 7, and A3 = 0); F2, n = 40 (A1 = 19, A2 = 20, and A3 = 1); F3, n = 32 (A1 = 9, A2 = 16, and A3 = 7); and F4, n = 32 (A1 = 6, A2 = 17, and A3 = 9). MRE was performed using 1.5T or 3T (Signa EXCITE HD or Discovery 750; GE Healthcare) scanners to measure liver stiffness in kilopascals (kPa). Stepwise multiple linear regression modeling was performed using the following variables as potential indicators: age, gender, body mass index (BMI), international normalized ratio of prothrombin time (PT-INR), platelet count, and METAVIR F score. Multiple linear regressions included variables maximizing the adjusted R2 in each stepwise regression to identify significant independent explanatory factors for liver stiffness and to delineate any inflammatory effects on liver stiffness after adjusting for nothing (model 1), alanine aminotransferase/upper limit of normal (ALTmeas/31 IU/L) categories (model 2), and METAVIR A grades (model 3).

RESULTS
After adjusting for activity grade or ALT/ULN, the platelet count and METAVIR F score were found to be strongly associated with liver stiffness. The R2 value of model 3 (0.7390) was higher than those of model 1 (0.6821) and 2 (0.6852), indicating that activity grade correlates with liver stiffness.

CONCLUSION
While staging liver fibrosis using MRE, it is important to remember that the activity grade of hepatitis can affect liver stiffness measurement independent of the degree of fibrosis.

CLINICAL RELEVANCE/APPLICATION
Although liver stiffness measurement using MRE is useful for staging liver fibrosis, we should be aware that the activity grade of hepatitis can be a confounding factor in stiffness measurement.

SSM08-02 ● Usefulness of Shear Wave Elastography (SWE) to Differentiate in Diffuse Hepatic Diseases

Min Yeong Kim MD (Presenter) ; **Yong-Soo Kim** MD, PhD ; **Woo Kyoung Jeong** MD ; **Soon-Young Song** ; **Byung-Hee Koh** MD ; **On-Koo Cho** MD, PhD

PURPOSE
To evaluate the values of liver stiffness (LS) measured by Supersonic shear wave elastography (SWE) in diffuse hepatic parenchymal abnormalities and to find the difference according to severity and kinds of liver diseases.

METHOD AND MATERIALS
Of 663 patients who underwent ultrasonography coupled with SWE, normal group (n=24) was defined as the person without any clinical evidence of underlying cause and normal laboratory and ultrasonographic features. Diffuse liver disease groups consisted of as follows: 1)fatty liver disease (n=136), 2)acute hepatitis (n=9), 3)chronic hepatitis (n=240), 4)cirrhosis (n=254) and cause of diseases are classified as 1)viral infection (n=362), 2)alcohol (n=176), 3)others (n=125) by clinicopathologic settings. We compared mean values and standard deviation (SD) provided by SWE and calculated median values.

RESULTS
Mean values of LS as follows: normal, 6.19±1.83kPa; fatty liver disease, 7.88±5.96kPa; acute hepatitis, 12.66±6.31kPa; chronic hepatitis, 8.47±5.57kPa; cirrhosis, 19.54 ±13.70kPa. There is significant difference of mean values and SD between cirrhosis and each other liver disease (p0.1). According to causes of liver diseases, mean values of LS were significantly different: chronic hepatitis by virus, 8.04±4.01kPa; by alcohol, 12.60±11.56kPa (p
CONCLUSION
LS values by SWE is significantly higher in cirrhosis than in other hepatic diseases and also affected by causes of chronic hepatic diseases. Degree of alcoholic liver disease cannot be possible by SWE.

CLINICAL RELEVANCE/APPLICATION
SWE could help to distinguish cirrhosis from diffuse liver diseases. In chronic hepatic diseases, the measured values by SWE have to be adjusted according to causes such as virus and alcohol.

SSM08-03 ● Visual Assessment of Diffusion MRI of the Liver: Do We Need Conventional Sequences and Contrast Enhanced Images in Every Case?

Veysel Akgun MD (Presenter) ; **Murat Kocaoglu** MD ; **Bilal Battal** ; **Yalcin Bozkurt** ; **Mustafa Tasar** MD

PURPOSE
The aim of this study is to assess the value of visual assessment of DWIs and ADC maps in determining hemangiomas and simple cysts without additional sequences and contrast medium administration and its capability in exclusion of malignancy.

METHOD AND MATERIALS
283 focal liver lesions (FLL) (69 malign, 214 benign) in 130 patients (74 men, 56 women, mean age 50.7, age range 15 to 80 years) that were detected in ultrasonography or computed tomography underwent MR and diffusion weighted imaging with non breath-hold single-shot echo-planar spin echo sequences. Most of the benign FLLs were cysts (n=89, 38.7%) and hemangiomas (n=96, 41.7%). The lesions that were hyperintense in all sequences and the lesions that were hyperintense on diffusion weighted images (DWI) with low b value and ADC maps and hypointense on DWIs with high b value were noted as hemangiomas and simple cysts, respectively. The signal intensities of the FLLs on DWIs with low and high b values and ADC maps were noted by two radiologists blinded to the pathological and radiological diagnoses in consensus. All FLLs were classified according to pathological diagnoses or radiologic follow-up. Then we formed a cross table to determine sensitivity, specifity, positive and negative predictive values for characterization of the simple cysts and hemangiomas and for exclusion of malignancy.

RESULTS
The sensitivity and specifity were 98.6% and 99.5%, respectively. The positive predictive value was 98.6% and negative predictive value was 98.6% for the visual assessment of the DWIs and ADC maps for the characterization of the hemangiomas and simple cysts and in exclusion of malignancy for these 185 FLLs.

CONCLUSION
Visual assessment of DWIs and ADC maps can be useful in characterization of the hemangiomas and simple cysts, and in exclusion of malignancy without additional sequences and contrast medium administration. As a consequence, this technique can decrease study time and cost.

CLINICAL RELEVANCE/APPLICATION
By using DWIs and ADC maps we can characterize most of the hemangiomas and simple cysts and exclude malignancy without additional sequences and contrast medium administration.

SSM08-04 ● Clinical Significance of Signal Heterogeneity in the Hepatobiliary Phase of Gadoxetic Acid-enhanced MR Imaging in Hepatocellular Carcinoma

Nobuhiro Fujita MD, PhD (Presenter) ; **Akihiro Nishie** MD ; **Yoshiki Asayama** MD ; **Yasuhiro Ushijima** MD ; **Yukihisa Takayama** MD * ; **Hiroshi Honda** MD ; **Dai Shimamoto** ; **Ken Shirabe** ; **Yuichiro Kubo** MD

PURPOSE
To clarify the relationship between biological behavior of hepatocellular carcinomas (HCCs) and signal intensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging with a special focus on its heterogeneity.

METHOD AND MATERIALS
A total of 68 patients with 70 pathologically proved HCCs who underwent gadoxetic acid-enhanced MR imaging prior to surgery were enrolled. Based on the signal intensity in the hepatobiliary phase, lesions were classified as homogeneously hypointense (n = 44), heterogeneously hyperintense (n = 20) and homogeneously hyperintense (n = 6) groups, by comparing with the signal intensity of the background liver. The clinicopathological findings were compared among these three groups by Fisher's exact test, Kruskal-Wallis test and Mann-Whitney U test where appropriate. The patient disease-free survival analysis was performed by the Kaplan-Meier method with the log-rank test and Cox proportional hazard model.

RESULTS
The tumor size and serum level of PIVKA-II were significantly higher in heterogeneously hyperintense group than homogeneously hypointense (P = .0155 and P = .0215) and hyperintense (P = .0330 and P = .0220) groups. In univariate analysis, heterogeneously hyperintense group showed lower disease-free survival rates than homogeneously hypointense group (P = .0125). In multivariate analysis, heterogeneous hyperintensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging was an independent prognostic factor for disease-free survival (P = .0308).

CONCLUSION
Heterogeneously hyperintense HCCs in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging have more malignant potential than other HCCs.

CLINICAL RELEVANCE/APPLICATION

Our study suggests that heterogenous hyperintensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging is a new imaging biomarker to indicate malignant potential of HCCs.

SSM08-05 ● Intrahepatic Mass Forming Cholangiocarcinomas (IMCC): Utility of Feature Analysis for Differentiation from Other Intrahepatic Mass Lesions

Laura Heacock MS, MD (Presenter) ; **Andrew B Rosenkrantz** MD ; **Sooah Kim** MD ; **Nicole M Hindman** MD

PURPOSE
To evaluate the imaging features of intrahepatic mass-forming cholangiocarcinomas (IMCC) at contrast-enhanced dynamic CT and MRI , which allow for differentiation from other common intrahepatic tumors.

METHOD AND MATERIALS
Study was IRB approved with waiver of informed consent. 41 patients with 41 pathologically confirmed IMCCs underwent dynamic contrast-enhanced CT or MRI. Size-matched lesions of pathological proven hepatocellular carcinoma (HCC, n=36), isolated hepatic metastases (n=43), liver abscesses (n= 39) and imaging proven (stability over >2 years) hemangiomas (n=42) were evaluated. Two blinded readers (R1, R2) retrospectively assessed all lesions for morphologic and enhancement features and assigned a diagnosis from the tumor types included. Features analyzed were: heterogeneous rod-like internal enhancement, a peripheral complete rim of enhancement, progressive delayed central enhancement, presence of capsular retraction, portal vein thrombosis, or biliary dilatation proximal to the mass. Imaging feature frequencies were compared between lesion types.

RESULTS
Readers correctly identified 51.2% of IMCCs, 86.9% of hemangiomas, 87.5% HCCs, 77.4% metastases and 83.4% of abscesses. The most frequently seen imaging features in IMCC were biliary dilatation proximal to the mass (R1: 53.7%; R2: 61%) and portal vein thrombus (R1: 46.3%; R2 46.3%); these features were present significantly more frequently in IMCCs than other lesions (p
CONCLUSION
Differentiation of IMCC from other liver masses is best determined by the presence of portal venous thrombosis and proximal biliary dilatation. Heterogeneous rod-like internal enhancement helps distinguish IMCC from HCC and may be particularly useful in cirrhotic patients, for whom other focal hepatic lesions are less likely.

CLINICAL RELEVANCE/APPLICATION
The presence of portal vein thrombosis, proximal biliary dilatation and heterogeneous internal rod-like enhancement are important imaging features for distinguishing IMCC from other hepatic lesions.

SSM08-06 ● Liver Remnant Regeneration in Donors after Living Donor Liver Transplantation: Long-term Follow-up Using CT and MR Imaging

Andreas Koops MD (Presenter) ; **Philipp Simon** MD ; **Harald Ittrich** MD ; **Lutz Fischer** ; **Thorsten Klink** MD ; **Gerhard B Adam** MD

PURPOSE
To assess liver remnant volume regeneration and maintenance, and complications in long-time follow-up of donors after living donor liver transplantation using CT and MRI.

METHOD AND MATERIALS
47 patients with a mean age of 33.5 years who donated liver tissue for transplantation and were available for follow-up imaging were included in this retrospective study. Contrast-enhanced CT and MR images were acquired according to standardized protocols of the upper abdomen. Two observers evaluated pre- and postoperative images, analyzed liver volume regeneration, and documented postoperative complications.

RESULTS
47 preoperative and 89 follow-up studies covered a mean period of 22.4 months (range, 1-84). Right liver lobe (segments V-VIII) was donated in 18 cases, left liver donation of segment II and III was performed in 24 cases, and of segments II-IV in 5 cases. Liver remnants regenerated rapidly within the first 6 months. After 36 months, the remnant volume was not significantly reduced compared to the preoperative liver volume (p=0.2155), and was maintained at a minimum of 80% in most patients. Minor postoperative complications were found early in 4 patients. No severe or late complications or mortality occurred.

CONCLUSION
Remaining liver volume regenerated rapidly in all donors, and was restored and maintained in most patients despite minor complications. No severe or late complications occurred during long-term follow-up.

CLINICAL RELEVANCE/APPLICATION
CT and MRI are valuable tools in the follow-up of donors after live liver transplantation.

Neuroradiology (Neuro-Oncology)

Wednesday, 03:00 PM - 04:00 PM ●N227

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OI NR

SSM15 •*AMA PRA Category 1 Credit* ™:1 •ARRT Category A+ Credit:1
Moderator
Rivka R Colen , MD

SSM15-01 ● Myeloperoxidase Inhibition Worsens Survival after Radiation Therapy in a Murine Model of Glioblastoma

Muhammad Ali MBBS (Presenter) ; **Giulia Fulci** PhD ; **Benjamin Pulli** MD ; **Gregory R Wojtkiewicz** MSc ; **Anning Li** PhD ; **Jenny J Linnoila** MD, PhD ; **John Chen** MD, PhD *

PURPOSE
Radiation therapy is widely used in treatment of glioblastoma (GBM) with resultant tissue inflammation. We hypothesized that radiation will upregulate the key inflammatory enzyme myeloperoxidase (MPO) that could be tracked in vivo with the specific and sensitive molecular MRI probe MPO-Gd (bis-5HT-DTPA-Gd), and that inhibition of MPO activity could change outcome.

METHOD AND MATERIALS
Twenty-nine C57BL/6J mice were injected with 005 mouse glioma stem cells by intracranial injections. 2 weeks after tumor implantation, mice were irradiated with 10 Gy unfractionated to the head. Inflammation was quantified by MPO activity assay and flow cytometry of brain leukocytes at 1 or 2 weeks post irradiation. To evaluate the role of MPO, mice were treated with the specific irreversible MPO inhibitor 4-aminobenzoic acid hydrazide (ABAH) or saline as control, and imaged at 4.7T with the molecular MRI probe MPO-Gd at 2 weeks post irradiation. Tumor size and contrast-to-noise ratios (CNRs) were computed from MRI images.

RESULTS
Irradiated brain tumors had significantly increased MPO activity (figure, A; 9.7 ± 2.4 vs. 1.1 ± 0.3 RFU/sec/mg; P=0.03), and MPO-secreting inflammatory monocytes were also elevated (B; P=0.13). ABAH administration decreased MPO-Gd enhancement (C+E; P=0.03), consistent with successful partial MPO inhibition in vivo. Surprisingly, tumor size was ~1.5 times larger with ABAH treatment compared to saline (C+D; P=0.11), and we also observed decreased survival with MPO inhibition compared to saline control (F, median survival with ABAH: 37 days vs. saline: 50 days; P=0.04).

CONCLUSION
Our results show that MPO has an important role in host defense against GBM and inhibition of its activity after radiation therapy increased tumor growth and decreased survival. MPO-Gd MRI is a sensitive noninvasive method to measure MPO activity in gliomas and can follow treatment response, evaluating both tumor volume and degree of inflammation.

CLINICAL RELEVANCE/APPLICATION
Our study suggests a role for pro-inflammatory anti-tumor therapies in conjunction with radiation. Upon translation, MPO-Gd can be used to monitor inflammation and post-radiation treatment response.

SSM15-02 ● Differentiation of Pseudoprogression and Real Progression in Glioblastoma Using ADC Parametric Response Maps

Alexander Radbruch (Presenter) * ; **Caroline Reimer** ; **Markus Graf** ; **Katerina Deike** ; **Ralf Floca** PhD ; **Martin Bendszus** ; **Sabine Heiland** PhD ; **Benedikt Wiestler**

PURPOSE
Pseudoprogression describes the radiologic phenomenon that patients with high-grade glioma undergoing their first or second radiation MRI show increased contrast enhancement that eventually subsides without any change in treatment. Currently it is not possible to differentiate real progression and pseudoprogression using conventional T1- and T2-weighted images. Here we tested if a voxel-wise analysis of Apparent Diffusion Coefficient (ADC) values can

differentiate between true progression and pseudoprogression using the parametric response map, a new postprocessing procedure.

METHOD AND MATERIALS
29 patients with proven progression and 7 patients with pseudoprogression were identified in a retrospective case study. For all patients ADC baseline and follow-up maps were available. The ADC baseline map and the ADC follow up map were coregistered on the contrast enhanced T1-weighted follow up images. Subsequently the enhancement in the follow up contrast enhanced (Dotarem (Gadoterate meglumine)) T1-weighted image was manually delineated and a reference ROI was drawn in the contralateral white matter. Both ROIs were transferred to the ADC images. Relative ADC(baseline)/reference ROI(baseline) values and ADC(follow up)/reference ROI(follow up) values were calculated for each voxel within the ROI. The corresponding voxels of rADC (follow up) and rADC (baseline) were subtracted and the percentage of all voxels within the ROI that exceeded the threshold of 0.25 was quantified.

RESULTS
rADC voxels showed an increase of 21.9+-26.3 % above 0.25 in patients with real progression and in 55.7 +- 28.3% in patients with pseudoprogression. ROC analysis revealed a very good diagnostic performance (AUC = 0.82).

CONCLUSION
The introduced parametric response map for rADC maps provides a potential tool for the differentiation between pseudoprogression and real progression. Generally an ADC increase is supposed to be correlated with a decrease of cellularity and hence with therapy response. Therefore our findings of an increased number of voxels with increased ADC values in patients with pseudoprogression are in line with these basic pathophysiologic considerations.

CLINICAL RELEVANCE/APPLICATION
The reliable differentiation of real progression and pseudoprogression is crucial not only for the therapeutic decision but also for the correct radiological assessment within clinical studies.

SSM15-03 ● Prognostic Value of ADC in Glioblastoma Multiforme and Its Correlation with Histopathologic Biomarkers

Romina Zalazar MD ; **Miguel D Hernandez Arguello** MD ; **Pablo D Dominguez** MD ; **Maria Paramo Alfaro** MD ; **Pedro Slon** MD (Presenter) ; **Jon Etxano** MD ; **Ricardo Diez-Valle** MD, PhD ; **Miguel Idoate** ; **Jose Luis Zubieta** ; **Maria De Los Reyes Garcia De Eulate**

PURPOSE
To analyse whether apparent diffusion coefficient (ADC) values derived from diffusion-weighted imaging (DWI) MRI correlate with overall survival (OS), progression-free survival (PFS) and with molecular status on glioblastoma multiforme (GBM)

METHOD AND MATERIALS
Retrospective study in 60 patients with untreated GBM that underwent DWI study before surgery (mean time 6 days). Patients included were followed-up for at least 12 months or until death. Circular 5 mm2 ROI were drawn on ADC map. First on the solid enhancing tumor with the highest restriction value, without evidence of bleeding on SWI.Then on peritumoral area with hyperintensity on T2 FLAIR . Finally on the normal-appearing contralateral white matter (NCWM). Minimum, maximum, and mean ADC (ADCmin, ADCmax, ADCmean) were evaluated as well as ADCindex defined as a ratio between tumoral ADCmin and NCWM ADCmean. The methylguanine-DNA-methyltransferase (MGMT) promoter methylation, epidermal growth factor receptor (EGFR) amplification and EGFRvIII status, tumoral volume, residual volume, OS and PSF were evaluated.ROC curves, Student's t-test, Kaplan-Meier curves and Cox regression model were performed.

RESULTS
30 males and 30 females (median age 60.5, range 28-78) were evaluated. 48 patiens had complete resection (80%). Presurgical tumoral volume (mean=41.02 cm3, range 2.2-111.8) and post-surgical volume (mean=0.55, range 0.2-13) had no asociation with PFS and OS. MGMT promoter status (n=54) was not methylated in 26.EGFR amplification (n=51) was positive on 19.EGFRvIII mutation (n= 25) was present on 6. MGMT promoter methylation, EGFR amplification and EGFR overexpression status had no correlation with ADC.MGMT status correlated with PFS p
CONCLUSION
ADCmin values of solid component of the tumor as well as ADCindex have a significant correlation with PFS and OS independent of the molecular status of MGMT and EGFRvIII and EGFR amplification in GBM. ADCindex could be a stronger predictor of overall survival

CLINICAL RELEVANCE/APPLICATION
ADCindex value is a new parameter that could predict the prognosis in GBM

SSM15-04 ● Variability of rCBV Measurements of Glioblastoma between Three FDA-approved Software Packages

Zachary S Kelm BS (Presenter) ; **Leland S Hu** MD ; **Panagiotis Korfiatis** PhD ; **Ravi Lingineni** MPH ; **Rickey Carter** PhD ; **John Daniels** RT ; **Bradley J Erickson** MD, PhD *

PURPOSE
We measured the variability between three FDA-approved perfusion software packages with respect to their relative cerebral blood volume (rCBV) output for dynamic-susceptibility contrast MRI of glioblastomas. The hypothesis is that they should produce the same rCBV values when obtaining measurements of the same image locations.

METHOD AND MATERIALS
We retrospectively identified 45 glioblastoma cases where within 6 months post-radiation therapy, an MRI was interpreted to contain a worrisome increase in hyperintensity on the T1w post-gad and/or T2w images. Using IB Neuro, GE Functool, and nordicICE, we generated rCBV images for each case, repeating the processing with three different operators for Functool and nordicICE, but just one operator for IB Neuro since it did not require manual input. For each of the 7 operator-software combinations, we calculated a representative rCBV value for each brain, using measurements of the exact same regions. The tumor regions were semi-automatically defined using only enhancement information in the post-gad volume that we had mapped to the same space as the rCBV volumes. We normalized the tumor rCBV values by the mean of a normal-appearing white matter region in the contralateral hemisphere. In addition to the mean normalized rCBV value for the tumor, we calculated the 95% rCBV value to robustly represent a tumor 'hot-spot' analysis.

RESULTS
For the mean and 95% normalized rCBV values for the tumors, the intra-class correlation coefficients (ICCs) (with 95% confidence interval in parentheses) for the 7 operator-software combinations were 0.835 (0.766, 0.893) and 0.727 (0.630, 0.817) respectively. For inter-operator analysis, the ICCs for GE Functool were 0.880 (0.813, 0.928) for the mean rCBV, and 0.910 (0.858, 0.946) for the 95% rCBV. For nordicICE, they were 0.971 (0.953, 0.983) and 0.959 (0.933, 0.976) respectively. The higher ICCs for nordicICE were expected since it requires less manual input in the rCBV processing than GE Functool.

CONCLUSION
Due to the variability in rCBV determination, we recommend that the software package be considered and potentially adjusted for when using results and thresholds published in the literature.

CLINICAL RELEVANCE/APPLICATION
Glioblastomas are often imaged using perfusion-weighted acquisitions, but the determination of rCBV is not standardized. This results in different rCBV measurements depending on the software used.

SSM15-05 ● Fast Whole-brain Magnetic Resonance Spectroscopy (MRS) for Patients with Brain Tumors

Yi Zhang (Presenter) ; **Jinyuan Zhou** PhD ; **Paul A Bottomley** PhD

PURPOSE
The clinical application of multi-voxel MRS is often limited by long scan times. It is shown here that a recently proposed method, spectroscopy with linear algebraic model (SLAM), combined with parallel imaging or 'SENSE', offers dramatically faster MRS acquisitions than conventional chemical shift imaging (CSI).

METHOD AND MATERIALS
The SLAM method reconstructs spectra from multiple compartments using a small subset of CSI phase-encodes from central image k-space. Compartments are segmented from co-registered MRI, and compartment-average spectra are reconstructed using linear algebra. 8 patients with brain tumors were scanned with a 32-channel head coil in a 3T Philips MR system. A ~6 min three-slice conventional proton MRS SENSE CSI sequence and a five-slice pro-active SENSE SLAM sequence providing whole-brain coverage (thickness 83.6 mm) in ~1.5 min were acquired. Five compartments were segmented on a multi-slice 'FLAIR' image: tumor; contra-lateral brain; rest of the brain; scalp; and background. For quantitative validation, retroactive SENSE SLAM spectra were reconstructed retroactively from the central 20% of k-space extracted from the SENSE CSI acquisition, for an effective scan-time of 1.1 min. Choline (Cho), creatine (CR) and n-acetyl aspartate (NAA) levels were quantified in SENSE SLAM spectra, and compared to those from compartmental average SENSE CSI spectra in tumor and contralateral brain compartments.

RESULTS
The validation analysis revealed differences between SENSE SLAM and SENSE CSI (percentage mean ± standard deviation) of: Cho, -4.2 ±4.5%; CR, -3.1 ±5.7%; NAA, 1 ±10%, which are considered negligible. Applied pro-actively, SENSE SLAM could achieve whole-brain coverage in just 1.5 min, which was not feasible for SENSE CSI due to the limited time available for spectroscopy in the current study protocol.

CONCLUSION

SLAM combined with SENSE can produce quantitatively the same results as the standard CSI method much faster (5-fold demonstrated). This speed advantage enables inclusion of brain MRS in studies that may otherwise by precluded by scan-time limitations. SENSE SLAM could potentially supplant CSI for clinical studies in which lesion-averaged MRS measures can suffice.

CLINICAL RELEVANCE/APPLICATION
With SLAM, whole-brain proton MRS studies of brain tumor patients can be conducted within 1-2 min, greatly increasing its potential clinical utility.

SSM15-06 ● Effect of 3T Contrast-enhanced 3D Fast Spin-echo Imaging on the Detection of Small Brain Metastases in a Prospective Multicenter Trial

Minako Azuma (Presenter) ; **Toshinori Hirai** MD ; **Masayuki Maeda** MD ; **Yoshiyuki Watanabe** MD, PhD ; **Mika Kitajima** MD ; **Yasuyuki Yamashita** MD * ; **Yoshikazu Uchiyama** ; **Junji Shiraishi** *

PURPOSE
To evaluate the effect of contrast-enhanced three-dimensional (3D) T1-volume isotropic turbo spin-echo acquisition (T1-VISTA) imaging at 3T on the performance of readers in detecting small brain metastases in a prospective multicenter clinical trial.

METHOD AND MATERIALS
We enrolled 200 consecutive patients with suspected brain metastases who underwent contrast-enhanced brain MRI on 3T units at 3 sites in Japan. We used 3D T1-VISTA and 3D turbo field echo (TFE) sequences. Conventional gadolinium doses were delivered and the order of the two 3D MR sequences was randomized. When the size of the lesion was decreased after therapy or increased on follow-up MRI it was regarded as metastatic. Our observer performance study included 24 metastatic lesions less than 5 mm in diameter in 10 patients and 6 patients with no metastases. The number of metastatic lesions ranged from 1 to 8, (mean, 3). Six radiologists (3 neuroradiologists, 3 radiology residents) interpreted the 3D TFE images first without- and then with 3D T1-VISTA images and their performance without and with these images was evaluated using the jack-knife free-response receiver operating characteristic method (JAFROC 4.1).

RESULTS
For all 6 observers, the figure of merit (FOM) values for the detection of brain metastases was increased significantly (from 0.757 to 0.897, P = 0.002) when they used the 3D T1-VISTA images. The FOM values for the residents and neuroradiologists increased from 0.704 to 0.871 (P = 0.008) and from 0.811 to 0.923 (P = 0.008), respectively. In terms of the FOM value, the performance improvement was much greater for the residents than the neuroradiologists and the performance of residents using 3D T1-VISTA (FOM = 0.871) was slightly better than of neuroradiologists without 3D T1-VISTA (FOM = 0.811).

CONCLUSION
3T contrast-enhanced 3D T1-VISTA images improved the performance of neuroradiologists and radiology residents for the detection of small brain metastases. The addition of the 3D T1-VISTA sequence holds promise for the better assessment of brain metastases.

CLINICAL RELEVANCE/APPLICATION
The contrast-enhanced 3D fast spin-echo sequence is useful for evaluating small brain metastases and adds information to the contrast-enhanced 3D gradient-echo sequence.

Controversy Session: Lung Cancer Screening: Conflict of 'Dollars and Sense?'

Wednesday, 04:30 PM - 06:00 PM ● E450A

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HP OI CH

SPSC41 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Ned Patz , MD
Ned Patz , MD
Caroline Chiles , MD

LEARNING OBJECTIVES
1) Understand the primary objectives of the NLST. 2) Describe the results of the NLST and assess their potential applications to clinical practice. 3) Assess advantages and limitations of LDCT screening. 4) Consider financial implications of widespread screening.
ABSTRACT
URL

BOOST: Genitourinary Hands-on Contouring (In Cooperation with ASTRO)

Wednesday, 04:45 PM - 06:00 PM ● S104B

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RO OI GU

MSRO49 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5

Co-Director
Fergus V Coakley , MD
Co-Director
Bruce G Haffty , MD
Mark K Buyyounouski , MD *
Jelle O Barentsz , MD, PhD

LEARNING OBJECTIVES
1) To use MRI in contouring local prostate cancer as well as pelvic lymph nodes.

Interactive Game: Interactive Quiz Cases in Body Oncologic Imaging

Thursday, 08:30 AM - 10:00 AM ● E353A

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OI

RC618 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
This interactive session will use RSNA Diagnosis Live. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

RC618A ● Chest Masses

Cristina Fuss MD (Presenter)

LEARNING OBJECTIVES
1) Describe characteristic imaging features of malignant chest masses. 2) Characterize benign pulmonary masses that may mimic malignancies. 3) Describe common imaging pitfalls in differentiating benign from malignant masses. 4) Determine the need for further imaging vs. invasive procedures of pulmonary masses depending on their imaging appearance.

ABSTRACT
Two common descriptors are used in describing pulmonary lesions: nodules and masses. A nodule is small and measures less than 3 cm. Masses by definition are larger than 3 cm. Given their larger size, masses are usually not as difficult to detect as are the smaller nodules. But once detected the differential diagnosis entails more than just primary pulmonary malignancy, although the majority may end up being diagnosed as cancer. Tissue sampling of large masses is usually one of the first steps, but several imaging criteria may help guide and sometimes even obviate invasive procedures. The chronicity, location of the mass and associated symptoms are important factors that should always be taken into consideration when evaluating pulmonary masses, only to name a few.

RC618B ● Abdominal Masses

Chandana G Lall MD (Presenter)

LEARNING OBJECTIVES
1) Learn typical and atypical features of some benign and malignant abdominal masses on CT and MRI. 2) Characterize features on CT and MRI that may mimic malignancy in benign lesions and vice versa. 3) Discuss logical work-up of lesions, further imaging, need for intervention and follow-up guidelines.

ABSTRACT
1. Describe characteristic imaging features of a few benign and malignant abdominal masses on CT and MRI
2. Illustrate benign masses that may mimic malignancy and imaging pitfalls in differentiating benign and malignant lesions
4. Logical work up of lesions; further imaging and need for intervention

RC618C • MSK/Soft Tissue Masses

Sandra Schmahmann MD (Presenter)

LEARNING OBJECTIVES
1) Recognize common benign soft tissue masses with characteristic MRI features, that do not require follow up or biopsy. 2) Evaluate soft tissue masses by location, signal intensity characteristics, size and relationship to certain anatomic structures in order to develop a differential diagnosis. 3) Suggest appropriate management of the soft tissue mass based on MRI features.

ABSTRACT
Several common benign soft tissue masses, such as lipoma, hemangioma, gangion, peripheral nerve sheath tumor, myositis ossificans and hematoma, have characteristic MRI features that allow the radiologist to make the diagnosis, and do not require follow up or biopsy. Lesions that arise from specific structures (e.g. giant cell tumor of the tendon sheath and peripheral nerve sheath tumor) or in certain anatomic locations (e.g. elastofibroma deep to the scapula) can further aid characterization. Size and signal intensity characteristics are additional criteria that help develop an appropriate differential diagnosis. Based on MRI features, the radiologist can suggest appropriate management and advise whether a biopsy is necessary.

Breast Imaging (Ultrasound Screening)

Thursday, 10:30 AM - 12:00 PM • Arie Crown Theater

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US OI BR

SSQ01 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Ellen B Mendelson , MD *
Moderator
Paula B Gordon , MD *

SSQ01-01 • Initial Experience of Technologist Performed Whole Breast Screening Ultrasound

Glenys Da Costa MBBS (Presenter) ; **Janice S Sung** MD ; **Christopher E Comstock** MD ; **D. David Dershaw** MD ; **Elizabeth A Morris** MD

PURPOSE
To evaluate the added cancer detection and false positive rate of a technologist-performed handheld screening breast ultrasound program

METHOD AND MATERIALS
IRB approved retrospective review was performed on 890 consecutive women who underwent screening hand held high resolution breast ultrasound performed by a breast ultrasound technologist between October 2011-February 2013. Radiologist performed targeted ultrasound only in cases if a solid or indeterminate lesion was identified by the sonographer. Clearly benign findings, such as simple and complicated cysts, were neither recorded nor re-evaluated by the radiologist. 63 probably benign or suspicious lesions were identified.

RESULTS
Of the 890 women, 299 (34%) were pre-menopausal and 591 (66%) peri/post-menopausal. 288 (32%) had a personal history of breast cancer, 67(8%) a prior biopsy proven high-risk lesion, and 592(67%) a family history of breast cancer. 769/875(88%) patients had a mammogram within 6 months of the ultrasound. Breast density was predominantly fatty in 31 (3%), scattered fibroglandular densities in 171 (20%), heterogeneously dense in 521 (60%), and extremely dense in 152(17%). 837 (94%) studies were assessed as BI-RADS 1 or 2, 20 (2%) as BI-RADS 3, and 43 (5%) as either BI-RADS 4 or 5. Biopsy was performed for 39/43 suspicious lesions, yielding malignancy in 3/39 (PPV 8%). The cancers were all solid masses between 1.0-1.3 cm in size in heterogeneously dense breasts. Of the 3 women with cancers, 2 had a personal history of breast cancer and the other had no additional risk factor. 2 had a negative mammogram within 5 weeks of the ultrasound and the third within 7 months. The overall cancer detection rate was 3.4 cancers per 1000 women.

CONCLUSION
Technologist performed handheld screening breast ultrasound demonstrates a cancer detection rate (3.4/1000) and PPV (8%) of biopsy similar to that reported for physician performed ultrasound screening.

CLINICAL RELEVANCE/APPLICATION
Screening breast ultrasound performed by technologists is a feasible alternative to physician performed ultrasound screening, reducing radiologists time and cost.

SSQ01-02 • Comparison of an Automated Breast Volume Scanner and a Hand-held Ultrasound in the Detection of Breast Cancer: An Analysis of 5576 Patient Evaluations

Woo Jung Choi MD (Presenter) ; **Seonah Jang** ; **Joo Hee Cha** ; **Hak Hee Kim** MD ; **Hee Jung Shin** MD ; **Hyunji Kim** MD ; **Eun Young Chae** ; **Sun Hye Jeong** MD

PURPOSE
To retrospectively compare the accuracy and effectiveness of automated breast volume scanning (ABVS) and hand-held ultrasound (HHUS) in the detection of breast cancer in a large population group with a long-term follow-up, and to investigate whether different ultrasound systems may influence the estimation of cancer detection.

METHOD AND MATERIALS
A total of 1870 ABVS and 3706 HHUS participants, who underwent these procedures at our institute between September 2010 and August 2011, were included in this study. Cancers occurring during the study and subsequent follow-up were evaluated. The reference standard was a combination of histology and follow-up imaging (=12 months). The diagnostic accuracy, sensitivity, specificity, and positive (PPV) and negative (NPV) predictive values were calculated with exact 95% confidence intervals.

RESULTS

CONCLUSION
ABVS shows a comparable diagnostic performance to HHUS. We thus find that ABVS as an effective supplemental tool for mammography in breast cancer detection in a large population.

CLINICAL RELEVANCE/APPLICATION
In this study, ABVS shows comparable diagnostic performance when compared with HHUS in the detection of breast cancer in a large population group with a long-term follow-up.

SSQ01-03 • Impact of Radiologists' Professional and Practice Characteristics on Breast Cancer Detection in Women with Dense Breasts; A Reader Study Combining Mammography and Automated Breast Ultrasound

Karen Drukker PhD (Presenter) * ; **Maryellen L Giger** PhD *

PURPOSE
Evaluate variability in the clinical assessment of breast images, and its dependence on radiologists' professional and practice characteristics, in a retrospective reader study combining X-ray mammography (XRM) and 3D automated breast ultrasound (ABUS) for breast cancer detection in women with dense breasts.

METHOD AND MATERIALS
The study involved 17 breast radiologists of which 7 came from academic radiology practices, 6 from private practice, and 4 from community clinics. A sequential study design was employed with readers first interpreting 'XRM alone' followed by an interpretation of the combined 'XRM+ABUS', with each interpretation including a forced BI-RADs scale and a likelihood that the woman had breast cancer. The analysis included 164 asymptomatic patients, including 31 breast cancer patients, with dense breasts and a negative screening XRM. Of interest were inter-reader variability in scoring for 'XRM alone',

�XRM+ABUS�, and the dependence on reader experience, fellowship training, and type of practice. Performance analysis included Receiver Operating Characteristic (ROC), percentile, Kappa statistics, correlative, and Bland-Altman analyses. The statistical significance of the impact of consecutive reads was assessed for the kappa statistics using bootstrapping.

RESULTS
The median change in area under the ROC curve after ABUS interpretation was 0.12 (range 0.04�0.19). Reader agreement was fair with the median inter-reader kappa being 0.26 (0.05�0.48) for �XRM alone� and 0.34 (0.11�0.55) for �XRM+ABUS� (95% confidence interval for the difference in kappa [0.06;0.11]). The only factor that appeared to have a substantial effect on reader performance was the type of clinical radiology practice, with the increase in area under the ROC curve the largest for the 3 radiologists from academic practices, with changes of 0.18, 0.19, and 0.19 respectively.

CONCLUSION
A modest, but statistically significant, increase in inter-reader agreement was observed after interpretation of ABUS, while radiologists from academic practice seemed to benefit the most from ABUS interpretation.

CLINICAL RELEVANCE/APPLICATION
Understanding reader variability and factors such as training and clinical practice will yield informed decisions on the use of multimodality imaging in breast cancer screening.

SSQ01-04 • Whole Breast Ultrasound: Comparison of the Visibility of Suspicious Lesions with Automated Breast Volumetric Scanning versus Hand-held Breast Ultrasound

Cherie M Kuzmiak DO (Presenter) * ; **Eun Young Ko** MD, PhD ; **Laura Tuttle** ; **Doreen Steed** ARRT * ; **Donglin Zeng** PhD

PURPOSE
To assess how well radiologists visualize relevant features of lesions seen with automated breast volumetric scanning in comparison to hand-held breast ultrasound in population of women going to biopsy.

METHOD AND MATERIALS
Twenty-five patients were consecutively recruited from women who were scheduled to undergo a breast biopsy for at least one BIRADS 4 or 5 lesion identified in a diagnostic setting in this IRB approved study. The enrolled subjects subsequently underwent imaging of the breast(s) of concern using a dedicated FDA-approved ultrasound system that allowed both a hand-held breast ultrasound (HHBUS) and automated breast volumetric scanning (ABVS) to be performed with the same imaging parameters. Five experienced breast imaging radiologists reviewed the randomized cases in a reader study. Each reader was asked to compare side-by-side the breast ABVS exam to the HHBUS exam, including the lesion recommended for biopsy. Each reader was asked to specify the lesion type, size and imaging features, BIRADS score, probability of malignancy for each lesion for each modality and then they were asked to compare the lesion characteristics of shape and margins between the two modalities using a seven-point confidence scale for two sets of modality comparisons.

RESULTS
There were thirty biopsied lesions in this study. All were masses. Seven (23.3%) masses were malignant and 23 (76.4%) were benign. Across all lesions regardless of size or final pathology, there was no significant difference between the two modalities in the readers' BIRADS classification, probability of malignancy, sensitivity or specificity ($P > 0.15$). For malignant lesions, the reader visualization confidence scores between the two ultrasound modalities were not significantly different ($P > 0.1$). However, analysis for non-malignant cases showed a statistically significant increase in reader visualization confidence in lesion shape and margins with ABVS ($P < 0.001$).

CONCLUSION
Radiologists showed equal confidence in visualization of suspicious masses with automated breast volumetric scanning in comparison to hand-held breast ultrasound mammography and increased confidence in visualization of non-malignant lesions with automated breast volumetric scanning.

CLINICAL RELEVANCE/APPLICATION
Dedicated automated whole breast ultrasound is a novel imaging technology that has the potential application for decreasing hand-held breast imaging use in a busy diagnostic clinic.

SSQ01-05 • Comparison of Transverse versus Coronal View of Automated Breast Ultrasound in Lesion Detection

Sun Young Lee MD (Presenter) ; **Joo Hee Cha** ; **Eun Young Chae** ; **Hak Hee Kim** MD ; **Hee Jung Shin** MD ; **Hyunji Kim** MD

PURPOSE
To compare the performance of coronal view of automated breast ultrasound (ABUS) with that of transverse view in the lesion detection

METHOD AND MATERIALS
Three breast radiologists independently interpreted the ABUS images from 113 women, 14 with negative findings and 99 with known breast lesions (99 benign and 53 malignant findings). The readers were asked to detect the presence or absence of the abnormalities using transverse and coronal view in the different reading session. If a lesion was detected, we evaluated the location, characteristics of lesions. Intraclass correlation coefficients and kappa statistics were used for statistical analysis. Time to review and interpret an examination was also evaluated.

RESULTS
The detection rate of malignant lesions was 95.6% and 87.4% for transverse and coronal view (p=0.0089). The detection rate of benign lesions was 72.4% and 56.6% for transverse and coronal view (p=0.0001). Larger lesions are more consistently detected by coronal view: detection rates were 7.4% at 5 mm or smaller; 48.4% at 6-10 mm; 80.1% at 11-15 mm; 89.1% for lesions larger than 15 mm (pp
CONCLUSION
The detection rate of coronal view was significantly lower than that of transverse view for both benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION
Coronal view can be used as an additional method to transverse view. However, the role of coronal view by ABUS is not yet established, which needs to undergo further studies.

SSQ01-06 • Performance of Whole Breast Ultrasound in Women with Dense Breasts Following 3D Tomosynthesis Mammography

Regina J Hooley MD (Presenter) * ; **Jaime L Geisel** MD ; **Madhavi Raghu** MD * ; **Melissa A Durand** MD ; **Cary P Gross** MD ; **Susan H Busch** ; **Liane E Philpotts** MD *

PURPOSE
Both whole breast ultrasound (WBUS) and 3D tomosynthesis (DBT) mammograms are being more widely utilized in the United States and both modalities can detect cancers not visualized on conventional digital mammography. The purpose of this study is to determine the performance of WBUS in women with a recent prior normal DBT mammogram.

METHOD AND MATERIALS
A retrospective chart review was performed on 1039 consecutive women who underwent handheld WBUS between 10/1/2011 and 9/20/2012 and who had a prior normal DBT mammogram performed within 12 months before the WBUS examination. All WBUS exams were performed by a breast ultrasound technologist and were immediately reviewed and interpreted by a radiologist.

RESULTS
The average patient age was 52.3 years (S.D. +/- 9.5 years, range 27-94). The average time between the mammogram and WBUS was 32 days (639 patients had both exams on the same day). Of the 1039 WBUS exams, 599 were prevalence screenings and 440 were incidence screenings. 906 (87.2%) were BI-RADS 1 or 2, 102 (9.8%) were BI-RADS 3 and 31 (3.0%) were BI-RADS 4. There were no BI-RADS 5 lesions. Ultrasound guided aspiration or biopsy was performed in 38 women, including 10 BI-RADS 3 and 30 BI-RADS 4 lesions. Two BI-RADS 4 lesions were malignant infiltrating ductal carcinomas. Both cancers were found on a prevalence WBUS and both were not seen on DBT, even in retrospect. The overall positive predictive value of BI-RADS 4 lesions was 6.5%. The cancer detection rate was 1.9/1000.

CONCLUSION
Supplemental WBUS performed in addition to DBT can detect mammographically occult breast cancers, although the rate is lower than previous studies of WBUS performed in addition to conventional mammography

CLINICAL RELEVANCE/APPLICATION
Multiple studies have demonstrated that supplemental WBUS has a cancer detection rate of 3-5/1000, although the performance of WBUS as a supplement to DBT mammography has yet to be determined.

SSQ01-07 • Supplemental Ultrasound (US) Screening in Patients with a History of Lobular Neoplasia (LN)

Kanchan Phalak MD (Presenter) ; **Basak E Dogan** MD ; **Denai Milton** MS ; **Therese Bevers** MD ; **Wei T Yang** MD

PURPOSE

To investigate the role of US screening as an adjunct to annual mammography (M) in breast cancer detection in women with a history of LN

METHOD AND MATERIALS
A retrospective review was performed of the clinicopathology database at a single institution between 11/2004 and 11/2011 and yielded 195 women with biopsy proven lobular carcinoma in situ (LCIS) and/or atypical lobular hyperplasia (ALH) who underwent screening M, screening US, and/or screening MR. Patients with a concurrent diagnosis of breast cancer or those lost to follow-up were excluded. M, US, and when available, MRI findings were reviewed. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and cancer detection rate of each screening test was determined.

RESULTS
A total of 138 patients who had mammography, US, or MR available for review and were included in the study. Mean patient age was 53 years (range 30-83).All 138 patients underwent a mean of 3.0 years of screening with M, 115 (83%) a mean of 2.7 years of screening with US, and 30 (20%) patients a mean of 1.9 rounds of screening with MRI. Eleven (8.0%) patients were diagnosed with cancer. Of 115 patients who received both M and US, 10 (8.7%) were diagnosed with cancer. Mammographic cancer detection rate 2.6%. US cancer detection rate was 2.6%, and all these cancers were mammographically occult. A subgroup of 30 patients with LN and lifetime risk >20% received supplemental MRI screening; 5 (16.7%) of whom were diagnosed with cancer. US did not detect any of these 5 cancers, M detected 1 (3%) and MRI detected 2 (6.7%) while remaining 2 were detected clinically. The sensitivity (95% CI) of screening US was 30% (7%-65%), specificity (95% CI), PPV (95% CI), and NPV (95% CI) were 100% (97%-100%), 100% (29%-100%), and 94% (88%-97%), respectively. The sensitivity (95% CI) of screening M was 27% (6%-67%), specificity (95% CI), PPV (95% CI), and NPV (95% CI) were 100% (97%-100%), 100% (29%-100%), and 94% (89%-97%), respectively. The sensitivity of screening MRI was 50% [95% CI: 12%-88%], while NPV was 89% [95% CI: 71%-98%].

CONCLUSION
Annual screening US as a supplement to screening M resulted in an incremental cancer detection rate of 2.6% in patients with a history of LN

CLINICAL RELEVANCE/APPLICATION
Supplemental US screening in patients with LN who do not fulfill the American Cancer Society criteria for high risk MRI screening may help detect mammographically occult malignancy

SSQ01-08 • Reassessment and Follow-up Results of BI-RADS Category 3 Lesions Detected on Screening Breast US

Jung Lim Yoo MD (Presenter) ; **Joo Hee Cha** ; **Eun Young Chae** ; **Hak Hee Kim** MD ; **Hee Jung Shin** MD ; **Hyunji Kim** MD

PURPOSE
To determine the frequency and the malignancy rate of BI-RADS category 3 lesions detected on screening breast ultrasound and reassess whether they satisfied the ACRIN 6666 protocol.

METHOD AND MATERIALS
During two years, 28,796 asymptomatic women underwent screening mammography. Among them, 8359 women underwent additional breast ultrasound as part of a screening examination. Radiologists analyzed US lesion features and provided a final BI-RADS assessment. We retrospectively reviewed the initial US images with BI-RADS category 3 lesions and their mammography as well. We also investigated the outcome of these lesions. The reference standard was a combination of pathology and clinical follow-up for at least 24 months.

RESULTS
The frequency of category 3 lesions detected on breast US was 16.8% (1403/8359). Of 941 patients with follow up for at least 24 months or biopsy, six eventually proved to be malignant (0.6%). The malignancy rate was 1.5% (4/805) for patients with abnormal mammogram and 0.5% (2/136) for those with negative mammogram. When the ACRIN (American College of Radiology Imaging Network) 6666 protocol were strictly applied, 147 (15.6%) were retrospectively recategorized as BI-RADS 4 (n=7) or BI-RADS 2 (n=140).

CONCLUSION
The malignancy rate of BI-RADS category 3 lesions is very low, especially with negative mammogram.

CLINICAL RELEVANCE/APPLICATION
With BI-RADS category 3, careful assessment is needed to avoid unnecessary biopsy or short-interval follow-up.

SSQ01-09 • Review of Interval Cancers in a Mammographic Screening Programme: What Can We Learn? Are We Being Too Hard on Ourselves?

Katerina Lekanidi MRCP, MBBCh (Presenter) ; **Phillip Dilks** ; **Tamara Suaris** MBBS ; **Hema N Purushothaman**

PURPOSE
To determine the features of interval breast cancers considered to be detectable on previous screening.

METHOD AND MATERIALS
This study was approved by the clinical governance committee. As a requirement of the national breast screening programme, the previous screening mammograms for all interval breast cancers are reviewed and classified as: no signs, minimal signs or suspicious appearances. Patients with interval breast cancer over a period of 21 years were included in this study if minimal or suspicious signs were seen on most recent screening mammogram. 3 radiologists, individually and blinded to the site of interval cancer, reviewed the mammograms and documented the presence, site, characteristics and BIRADS classification of any abnormality. Findings were compared with the appearances of the subsequent symptomatic mammogram.

RESULTS
111/590 interval cancers documented in the study period fulfilled the study inclusion criteria. The mean age at the time of screening mammogram was 59.04 (range 51- 75). The mean interval to the diagnosis of breast cancer was 17.30 months (range 1- 36). 61.3% of cases were considered as "minimal signs" and 38.7% as suspicious. In 17.1% of the cases none of the readers identified a relevant abnormality on the screening mammogram. In 21.6% of the cases 1/3 readers identified the abnormality, 27.6 % of cases 2/3 readers and 33.3% all 3 readers identified the abnormality. In 50% of one-reader recalls, the mammographic abnormality was an asymmetric density, followed by ill-defined mass (20.8%) and architectural distortion (20.8%). In three-reader recalls, microcalcification was the most common finding (35.1%), followed by asymmetric density (27%) and an ill-defined mass (24.3%). Overall, the most common abnormality was asymmetric density (36%), followed by ill-defined mass (15.3%) and microcalcification with or without a mass (15.3%).

CONCLUSION
The most common retrospectively and unanimously identified sign of breast cancer is microcalcification and the most common subtle sign is asymmetric density. Interval cancer mammographic review not blinded to the position of subsequent cancer overestimates the percentage of "minimal signs " cases.

CLINICAL RELEVANCE/APPLICATION
Review of interval breast cancers is a valuable learning tool in breast screening programmes and is more valid if done initially blinded to the position of the subsequent breast cancer.

Thursday Plenary Session

Thursday, 01:30 PM • Arie Crown Theater

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PS50 • *AMA PRA Category 1 Credit* ™: 1.25 • ARRT Category A+ Credit: 1.5
To receive credit, relinquish attendance voucher at end of session.

RSNA/AAPM Symposium

Moderator
Jeffrey H Siewerdsen , PhD * , *Baltimore, MD*
AAPM Liaison to the RSNA Scientific Program Committee

LEARNING OBJECTIVES
1) Learn how multi-modality imaging methods are being used in combination with high-precision radiation therapy delivery techniques to understand fundamental mechanisms of cancer pathogenesis, progression, and treatment response. 2) Learn the challenges and advances associated with quantitative imaging, and understand how more accurate and quantitative imaging is central to advancing the understanding of major questions in 21st century medicine. 3) Learn how imaging in partnership with medical physics and other technical and clinical disciplines provides a vital tool and multidisciplinary expertise for such advances.

Imaging in Partnership: With Radiation Therapy

David A Jaffray , PhD * , *Toronto, ON, CANADA*

LEARNING OBJECTIVES
View learning objectives under main course title.

Imaging in Partnership: With Physics and Quantitative Medicine

James A Deye , PhD , *Bethesda, MD*

LEARNING OBJECTIVES
View learning objectives under main course title.

Interventional Oncology Series: Liver Metastases and Bone

Thursday, 01:30 PM - 06:00 PM • S405AB

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VSIO51 • *AMA PRA Category 1 Credit* ™:4.25 • ARRT Category A+ Credit:5
Moderator
Matthew R Callstrom , MD, PhD *

LEARNING OBJECTIVES
1) Describe the characteristics of liver metastases and bone tumors amenable to interventional oncologic treatment. 2) Describe new techniques for the percutaneous treatment of liver metastases and bone tumors. 3) Describe the role of percutaneous ablation for liver metastases and bone tumors in the context of other treatments including surgery and radiation oncology.
ABSTRACT

VSIO51-01 • Which Ablation - Where and Why

Riccardo A Lencioni MD (Presenter)

LEARNING OBJECTIVES
1) To describe the different methods and techinques used for image-guided tumor ablation. 2) To understand the use of image-guided ablation in focal cancer therapy. 3) To understand the role of image-guided ablation with respect to surgical and medical treatments.

VSIO51-02 • IRE for Liver Metastases

Govindarajan Narayanan MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO51-03 • Chemo ± RFA; Does RFA Provide a Benefit?

Alison R Gillams MBChB (Presenter) *

LEARNING OBJECTIVES
1) To learn the survival results for patients treated with ablation, chemotherapy and combinations of ablation and chemotherapy. 2) To learn the optimal timing of ablation and chemotherapy in different clinical situations.

ABSTRACT
Chemotherapy regimes in the 80;s and early 90;s using 5 fluorouracil (5FU) based regimens did not improve survival. They did result in a morphologic response on imaging in just 30% of patients. Median survival was about 9 months. It was not until the late 90;s with the introduction of irinotecan and oxaliplatin that a change in survival was seen. Response rates increased to 50% and the use of sequential oxaliplatin and irinotecan produced a further small increase in survival. The introduction of Cetuximab and Bevacizumab saw a further increase in response rates to approximately 75% and a further increase in survival. This improvement was further honed with the realisation that only Kras wild type patients responded and Kras testing is now routine prior to Cetuximab administration. Kras status may differ between the primary lesion and the metastatic disease but the difference is small. Median survival for patients who receive all the possible chemotherapeutic options is now approximately 21 months, 5 year survival remains exceptional. Ablation is generally used in small volume, liver only disease in inoperable patients The median survival is of the order of 36 months with 5 year survival of 30%. This is better than has been achieved with any chemotherapy regime and so ablation should be offered to all suitable patients. Adjuvant chemotherapy has been shown to be useful in post resection patients and there is some anecdotal evidence that it is useful post ablation. Neo adjuvant chemotherapy is used to downsize metastases in patients who are not initially resectable or ablatable in the hope that they will become suitable for definitive treatment. Although some tumours will disappear on imaging, the chances of recurrence are very high (96%) and therefore treatment should be aimed to encompass all the original sites of disease.

VSIO51-04 • Microwave Ablation (MWA) Therapy of Liver Metastases from Colorectal Carcinoma Post Systemic Chemotherapy

Nour-Eldin A Nour-Eldin MD, MSc (Presenter) ; **Nagy N Naguib** MSc ; **Tatjana Gruber-Rouh** ; **Thomas Lehnert** MD ; **Thomas J Vogl** MD, PhD

PURPOSE
to evaluate the safety, efficiency, effectiveness, and overall outcome in patients treated with microwave thermal ablation of colorectal metastases post systemic chemotherapy.

METHOD AND MATERIALS
An institutional review board-approval was obtained with informed consent of all patients. Retrospective analysis of prospective intention to treat study was performed from January 2008 to January 2013, and included 92 patients (mean age 56 years SD: 2.6) with 132 liver metastases measuring 0.7–5.0cm, who were treated with microwave ablation (MWA). Local tumor control, complications, and long-term survival were analyzed.

RESULTS
The mean follow-up period was 32.5 months. Complete ablation was achieved in 117 of 132 (88.6%) nodules. Seventeen of the 117 (14.5%) successfully treated nodules developed local recurrence. Univariate analysis showed that tumor size of < 3 cm is a significant risk factor (P = 0.04). Multivariate analysis showed that number of cycles of chemotherapy (FOLFOX) was a significant prognostic factor for overall recurrence (P=0.03), whereas disease-free interval was the significant prognostic factor for distant recurrence (P=0.03). Major complications occurred in 1.1% of patients. No procedure-related mortalities were observed. The 1, 2, 3, and 5-year overall survival rates after the initial ablation were 82, 61.2, 51.2, and 38.3%, respectively. The main cause of death was systemic tumor progression in 65.3% of the patients.

CONCLUSION
MWA is a safe and effective treatment therapeutic option for patients with liver metastases from Colorectal Carcinoma post systemic chemotherapy.

CLINICAL RELEVANCE/APPLICATION
Thermal ablative techniques such as MWA are safe and effective minimally invasive therapeutic option in the management of patients with hepatic metastasis, especially after systemic chemotherapy.

VSIO51-05 • Surgery for CRC Liver Mets - When Is Ablation Indicated?

Yuman Fong MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the available ablative options for metastatic colorectal cancer. 2) To understand the determinants of success and failure for ablative treatment for colorectal metastases. 3) To understand the use of ablative therapy as an adjunct to surgery in the care of patients. 4) To understand the use of ablative therapy in the treatment of recurrent liver metastases.

VSIO51-06 • Treatment of Difficult Liver Metastases

Thierry J De Baere MD (Presenter) *

LEARNING OBJECTIVES
1) To know what are the most difficult situations when treating liver metastasis with percutaneous ablation techniques. 2) To know tips and tricks that can help to improve quality of targeting during percutaneous ablation of liver metastases. 3) To know what are the limitations of different ablation technologies of percutaneous ablation according to tumor size and location.

ABSTRACT
Percutaneous ablation of liver metastases allows for complete ablation in approximately 90% in weel selected indications. Some metastases are more difficult to ablate due to either difficulty in targeting, or their location close to large vessels, close to fragile neighboring organs, or in proximity to the liver hilum. Difficulties in targeting are often due to poor visualization of the targeted tumor with image guidance. We will present possible benefit of fusion imaging between US and enhanced CT and discuss accuracy of such technique. We will described technique end results of tumor tagging with either percuteanously inserted metallic coils or tagging with intra-arterial injection of Lipiodol. Location close to large vessels favors convective tissue cooling and is responsible for lower rate of complete ablation with RFA for such tumor. Combining RFA with percuatneous balloon occlusion of hepatic or portal veins can improve results and the technique will be presented. Other ablative technologies can improve results of ablation close to large vessels and will be discussed namely with regards to microwaves ablation and irreversible electroporation. Neighboring organ can be preserved from any damage by using aerodissection (air or carbon dioxide) or hydrodissection (dextrose, G5%, G10%) for shielding, and tips and trick to achieve such dissection will be presented.

VSIO51-07 ● Assessing Geometric RF Ablation Accuracy and Predicting Outcome within 24h after Treatment by Mapping the Preprocedure Liver Lesion to the Postprocedure Ablation Zone

Frederik Vandenbroucke MD (Presenter) ; **Jef Vandemeulebroucke** PhD, MSc ; **Nico Buls** DSc, PhD * ; **Pablo R Ros** MD, PhD * ; **Johan De Mey** *

PURPOSE
In RF ablation, complete coverage of the lesion by the ablation zone, is considered the primary indicator for treatment success. The purpose of this study was to evaluate the predictive value of early assessment of the geometrical accuracy of the procedure by using contrast enhanced CT images acquired before and within 24h after ablation.

METHOD AND MATERIALS
Twenty-three patients, with a total of 45 liver lesions, received a CT scan before and 24 hours after RF ablation. Follow up PET/CT scans were performed every 2-3 months after the intervention. Pre- and post-ablation CT images were aligned using commercial registration software. Lesion and ablation zone were semi-automatically segmented and masked during registration. A global, rigid registration based on mutual information was performed. If required, this was followed by an interactive local registration based on a smaller region of interest. Using the registered images, we verified the geometrical accuracy of the RF ablation treatment by measuring the minimal distance between the lesion and the outer edge of the ablation zone, and correlated this to local tumor progression (LTP) as recorded during follow up.

RESULTS
Eleven lesions (24.4%) showed LTP during a mean follow up of 62 weeks. Registration was successful for all lesions, although 5 were perceived as challenging. Based on the registered images, 29 lesions were completely covered by the ablation zone, while 10 were not. For 6 lesions, the edge was found to coincide with the edge of the ablation zone. Incomplete coverage of the lesion was found to be a powerful predictor for LTP (Se = 100%, Sp = 85%, PVV = 69%, NPV = 100%). Interestingly, two lesions only showed LTP after 5-6 months, and both belonged to the group were the edges of lesion and ablation zone coincided.

CONCLUSION
Verifying the coverage of liver metastases by an ablation zone through registration of pre- and early post-ablation CT images is feasible and has a strong predictive power for treatment outcome. Increasing the robustness and degree of automation of the procedure could further improve the accuracy and reproducibility of the method.

CLINICAL RELEVANCE/APPLICATION
Early and accurate detection of RF ablation failure may allow for reablation and will ultimately improve the efficacy of this minimally invasive procedure.

VSIO51-08 ● Liver Metastases Tumor Board

Matthew R Callstrom MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the characteristics of liver metastases amenable to interventional oncologic treatment. 2) Describe new techniques for the percutaneous treatment of liver metastases. 3) Understand the role of percutaneous ablation for treatment of liver metastases in the context of other treatments including surgery and radiation oncology.

ABSTRACT

VSIO51-09 ● Surgery vs Ablation for Bone Tumors

Peter Rose MD (Presenter)

LEARNING OBJECTIVES
1) To understand the factors that decide whether a lesion is best treated with surgery or ablation.'

VSIO51-10 ● SBRT for Bone and Soft Tissue Metastases

Kenneth R Olivier MD (Presenter)

LEARNING OBJECTIVES
1) Review the technique of Stereotactic Body Radiotherapy. 2) Discuss cases where SBRT has been used in soft tissue and non-spine bone metastases. 3) Review literature and Mayo Clinic experience with SBRT in these situations. 4) Discuss opportunities for collaboration with Interventional Radiology in complex patients.

ABSTRACT
Stereotactic Body Radiotherapy (SBRT) is a useful treatment modality for solitary metastases in many locations. SBRT has been used more recently for spinal metastases with good results. The use of SBRT for non-spine bone metastases is not as widely reported, but can be useful in certain situations. Mayo Clinic has been treating select patients with SBRT and the experience will be discussed.

VSIO51-11 ● Soft Tissue Cryoablation Is Crucial for Patients with Oligometastatic Disease

Peter J Littrup MD (Presenter) * ; **Hussein D Aoun** MD ; **Barbara A Adam** MSN ; **Evan N Fletcher** MS, BA ; **Mark J Krycia** BS

PURPOSE
To assess whether diverse tumor location(s) show differences in local cryoablation outcomes of cancer control, morbidity, and ablation volume reduction for many soft tissue tumor types. We hypothesize that non-organ cryoablation locations respond similarly in terms of recurrence, complication and/or healing rates, regardless of anatomic location and tumor type.

METHOD AND MATERIALS
220 CT and/or US-guided, percutaneous cryotherapy procedures were performed for 251 oligometastatic tumors from multiple primary cancers in 126 patients. Tumor location was grouped according to regional sites: retroperitoneal, superficial, intraperitoneal, bone, and head and neck. PCA complications were graded according to Common Terminology Criteria for Adverse Events Version 4.0 (CTCAE). Local tumor recurrence and resorption was calculated from ablaStion zone measurements, grouped into 1-, 3-, 6-, 12-, 18- and =24-month statistical bins.

RESULTS
Tumor and procedure numbers for each site are: 75, 69 - retroperitoneal; 76, 62 - superficial; 39, 32 - intraperitoneal; 34, 34 [illegible] bone; and 27, 26 - head and neck. Average diameters of tumor and visible ice during ablation were 3.4 and 5.5 cm, respectively. Major complications (CTCAE Grade >3) occurred after 7 procedures (3.2%). At 11 months average follow-up (range: 0-82), 10% local recurrence rates (26/251) were noted, of which 3 occurred within the ablation zone for a PCA procedural failure rate of 1.2%. Average time to recurrence was 4.9 months. At 21 months following the procedure, the initial ablation zone had reduced in volume by 93%.

CONCLUSION
CT-guided PCA is a broadly safe, effective local cancer control option for oligo-metastatic patients with soft tissue tumors in most anatomic sites. Other than bowel and nerve proximity, PCA also shows good healing if proper visualization and precautions are followed. Cryoablation thus allows highly successful tumor control with minimal morbidity and healing, especially near skin, subcutaneous and osseous locations that would not be readily amenable for heat-based ablations.

CLINICAL RELEVANCE/APPLICATION
Oligometastatic disease is becoming widely recognized with improved systemic treatments. Soft tissue cryoablation contributes to improved cancer-specific survival for many tumor types, despite locatio

VSIO51-12 ● Mid-term Outcome of Percutaneous Image-guided Cryoablation on Inoperable Extra-abdominal Desmoid Tumors

Marion Havez (Presenter) ; **Francois Cornelis** MD ; **Paul Sargos** ; **Sultan Al Ammari** ; **Agnes Neuville** ; **Eberhard Stoeckle** ; **Michele Kind** MD ; **Antoine Italiano** MD

PURPOSE
To report the effectiveness and mid-term outcome of percutaneous image-guided cryoablation on extra-abdominal desmoid tumors.

METHOD AND MATERIALS
The institutional review board approved this study and informed consent was waived. Between 2011 and 2012, 13 patients (17 tumors), with a median age of 39.3 years (15–74), consecutively treated with cryoablation under ultrasound (n=8), computed tomography (n=1) or both (n=8) guidance for extra-abdominal desmoid tumors were retrospectively selected and prospectively followed until 2013. The study included 2 patients with Gardner syndrome and 12 recurrences on ablative site after initial surgical treatment. Maximal tumor volumes were between 0.8 to 127.2 mm3 (median: 28 mm3). Disease free survival (DFS) and local control were calculated on clinical (pain evaluation) and imaging (according to RECIST criteria) follow-up, respectively. The Kaplan-Meier method was used for calculation of DFS.

RESULTS
Cryoablation was technically possible for all lesions under general (n=15) or local (n=2) anesthesia. Two probes were used in mean (range: 1-4) per procedure. Mean follow-up was 14.1 months (4–27 months). The disease-free survival rates based on clinical evaluation were 100%, 92% and 73% at 6, 12 and 24 months, respectively. The rates of local tumour progression based on RECIST criteria were 0% at 6, 12 or 24 months. However, 10 patients (59%) presented asymptomatic residual tumors surrounding the ablative site on imaging follow-up. The major complications rate was 5.8% per session (1/17).

CONCLUSION
Despite high rate of partial ablation, percutaneous image-guided cryoablation appears to be safe and effective for mid-term local control in case of inoperable extra-abdominal desmoid tumors.

CLINICAL RELEVANCE/APPLICATION
Cryoablation is a well-tolerated technique according to mid-term results. Mid-term efficacy of cryoablation was close to that of formal conservative surgery

VSIO51-13 • MRgFUS for Palliation of Painful Metastatic Disease

Mark D Hurwitz MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO51-14 • Cementoplasty Beyond the Spine

Giovanni Carlo Anselmetti MD (Presenter) *

LEARNING OBJECTIVES
1) To learn indications and contra-indications to cementoplasty beyond the spine. 2) To learn the optimal technique, regarding materials and image guiding systems, in performing percutaneous cementoplasty.

ABSTRACT
Bone is one of the most frequent sites of spread for many common cancers. In such case, when appropriate systemic treatment for the underlying cancer fails, patients should be considered for specific treatment, the principal modalities being radiotherapy and bisphosphonates. These therapies leave approximately one third of cases with inadequate pain control. This failure prompted the search for other strategies aimed at bone pain control through local bone augmentation such as percutaneous cementoplasty (PC).
PC can be performed under combined Computed Tomography (CT) and Fluoroscopic guidance; flat panel angiographic suite with integrated CT can also be used. Both systems allow precise positioning of the needle within the bone lesion. Most frequently PC is executed in sacrum, hip and femur but this procedure is also successful and feasible in fingers, astragalus, calcaneus, ribs, sternum, etc. Local anesthesia is employed in most cases.
Bone lesions are localized on CT and the most adequate access point is identified. A dedicated vertebroplasty beveled needle is then advanced into the bone lesion.
Bone cement is injected under continuous fluoroscopic control. After PC a CT scan of the treated region is carried out to assess the extent of lesion filling and to visualize possible PMMA leaks.
Patients are discharged the same procedural day.
In our experience PC was technically successful in all cases with no immediate severe complications. In lesions with lost integrity of the cortical bone, asymptomatic leakage of PMMA in the soft tissues can occur but, normally, it not requires any treatment.
Delayed complications such as fractures in metastases of the femoral diaphysis can occur; lytic lesions of the long bones shaft cannot be treated with PC due to high risk of fracture during ambulation.
PC, in our opinion, should be proposed in all patients with painful or invalidating bone lesions when conventional therapies fail or surgery is not feasible.

VSIO51-15 • Chondrolysis and Femoral Head Osteonecrosis: A Complication of Periacetabular Cryoablation

Michael V Friedman MD (Presenter) ; **Jack W Jennings** MD ; **Travis J Hillen** MD * ; **Daniel E Wessell** MD, PhD *

PURPOSE
Cryoablation is an emerging alternative in the treatment of primary osseous malignancies or metastatic diseases that are not amenable to more conventional therapies. As experience compounds with this newer, less-invasive technique, associated complications will be continually defined. We describe a novel complication associated with percutaneous cryoablation of periacetabular bone tumors.

METHOD AND MATERIALS
Between 2008 and 2013, 41 patients with a total of 100 musculoskeletal lesions were treated by cryoablation at our institution. 12 patients were referred to our department specifically for treatment of periacetabular osseous malignancies. There were a total of 15 lesions, with 3 of the 12 patients having bilateral lesions. Follow-up clinical notes and imaging of the patients were retrospectively reviewed for a minimum of 2 months. Generalized estimating equations were performed to assess the effect that patient demographics and treatment parameters (including ablation time, cycle distribution, and probe proximity to the femoral head and fovea) had on development of chondrolysis and osteonecrosis.

RESULTS
Chondrolysis or femoral head osteonecrosis developed in 31% (4 of 13) of periacetabular lesions. Of the remaining patients with non-periacetabular lesions that underwent cryoablation, none subsequently developed osteonecrosis. Patients who developed chondrolysis or osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution. Chondrolysis or osteonecrosis developed within a 5 month period, with a mean of 89 days. 3 of the 4 patients who developed chondrolysis have undergone total joint replacement.

CONCLUSION
Chondrolysis or femoral head osteonecrosis developed in 31% of periacetabular malignancies treated by cryoablation, ultimately requiring joint replacement in 3 of 4 patients. Careful pre-ablation planning and risk/benefit analysis should be considered before performing periarticular cryoablation, and patients should subsequently be monitored for developing chondrolysis.

CLINICAL RELEVANCE/APPLICATION
Periarticular cryoablation can be associated with osteonecrosis and chondrolysis, and therefore, careful pre-ablation planning and risk/benefit analysis should be performed prior to proceeding.

VSIO51-16 • Percutaneous Image-guided Ablation of Metastatic Renal Cell Carcinoma

Brian T Welch MD (Presenter) ; **Matthew R Callstrom** MD, PhD * ; **Jonathan M Morris** MD ; **Anil N Kurup** MD ; **Grant D Schmit** MD ; **Thomas D Atwell** MD ; **Adam J Weisbrod** MD ; **Manish Kohli** MD ; **Brian Costello** MD ; **Christine Lohse** ; **Stephen Boorjian** ; **Robert Thompson** MD

PURPOSE
Over 65,000 new cases of RCC will be diagnosed this year in the United States. Approximately 50% of RCC patients will present with or subsequently develop metastases after primary treatment. Our purpose is to assess the safety, local control, complications, and adjunctive survival of ablation in treatment of mRCC in this selected cohort.

METHOD AND MATERIALS
A retrospective review was performed of 61 patients who underwent 74 ablation procedures to treat 82 mRCC lesions with intent of local control (i.e. not palliative). Technical success, safety, local control, complications, and survival were analyzed according to standard criteria.

RESULTS
Four (4.9%) technical failures were observed. Time to recurrence was assessed for the subset of 76 (93%) tumors that were followed past ablation. Six (7.9%) tumors recurred at a mean of 1.6 years following ablation (median 1.4; range 0.6 -2.9). The mean duration of follow-up for the 70 tumors that did not recur was 1.9 years (median 1.2; range 10 days - 7.5 years). Estimated local recurrence-free survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were 94% (88 – 100; 41), 94% (88 – 100; 32), 83% (70 – 97; 17), 83% (70 – 97; 5), and 83% (70 – 97; 3), respectively. Estimated overall survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were 87% (79 – 97; 42), 83% (73 – 94; 31), 76% (63 – 90; 19), 52% (35 – 76; 6), and 52% (35 – 76; 2), respectively. Recognizing this highly selected patient population and additional concurrent or

subsequent treatment, estimated cancer-specific survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were 91% (83 – 99; 42), 86% (76 – 96; 31), 82% (71 – 95; 19), 62% (46 – 85; 6), and 62% (46 – 85; 2), respectively. Four (5%) CTCAE grade 3 or greater complications were observed; there were no deaths related to the ablation.

CONCLUSION
Image guided ablation of mRCC is a relatively safe procedure with acceptable local control rates. In carefully selected patients, adjunct ablation with systemic therapy, radiation, and surgery may confer a survival benefit, although further follow-up and validation are needed.

CLINICAL RELEVANCE/APPLICATION
In carefully selected patients, adjunct ablation with systemic therapy, radiation, and surgery may confer a survival benefit, although further follow-up and validation are needed.

VSIO51-17 • Bone Metastases Tumor Board

Matthew R Callstrom MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the characteristics of bone tumors amenable to interventional oncologic treatment in the context of other treatments including surgery and radiation oncology. 2) Describe the techniques to avoid complications in the percutaneous treatment of metastatic bone tumors. 3) Describe characteristics of metastatic bone tumors that benefit from combination treatments.

Ultrasound/Opto-Acoustic Molecular Imaging

Thursday, 04:30 PM - 06:00 PM • S504CD

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US OI MI

RC717 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Juergen K Willmann , MD *

LEARNING OBJECTIVES
In this course, attendees will learn the principles and applications of molecular imaging using ultrasound and photoacoustic imaging techniques. In the first part, principles and applications of ultrasound molecular imaging will be reviewed. In the second part, principles and applications of molecular imaging using photoacoustic imaging techniques will be presented. In the third part, ultrasound guided drug delivery approaches will be reviewed. At the end of this course, the attendees will understand the principles and potential clinical applications of ultrasound and optoacoustic molecular imaging as well as of ultrasound guided drug delivery.

RC717A • Photoacoustic Imaging

Stanislav Emelianov PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the fundamental principles of photoacoustic imaging and major components of photoacoustic imaging system. 2) Knowing how photoacoustic images are formed and how to interpret photoacoustic images. 3) Understand how imaging contrast agents or imaging probes affect contrast, penetration depth and specificity in photoacoustic imaging. 4) Understand the ability of photoacoustic imaging system to visualize anatomical, functional and molecular properties of imaged tissue. 5) Identify the role of photoacoustic imaging in pre-clinical and clinical applications.

ABSTRACT
Photoacoustic imaging or tomography – a non-ionizing, non-invasive, real-time imaging technique capable of visualizing optical absorption properties of tissue at reasonable depth and high spatial resolution, is a rapidly emerging biomedical and clinical imaging modality. Photoacoustic imaging is regarded for its ability to provide in-vivo morphological and functional information about the tissue. With the recent advent of targeted contrast agents, photoacoustics is capable of in-vivo molecular imaging, thus facilitating further molecular and cellular characterization of tissue.
This presentation is designed to provide both a broad overview and a comprehensive understanding of photoacoustic imaging. With a brief historical introduction, we will examine the foundations of photoacoustics, including relevant governing equations, optical/acoustic properties of the tissues, laser-tissue interaction, system hardware and signal/image processing algorithms. Specifically, penetration depth and spatial/temporal resolution of photoacoustic imaging will be anlyzed. Integration of photoacoustic and ultrasound imaging systems will be discussed. Techniques to increase contrast and to differentiate various tissues in photoacoustic imaging will be presented. Furthermore, design, synthesis and optimization of imaging probes (typically, nanoconstructs or dyes) to enable molecular/cellular photoacoustic imaging will be presented. Special emphasis will be placed on contrast agents capable of multiplexed imaging, multi-modal imaging and image-guided therapy including drug delivery and release. The presentation will continue with an overview of several commercially available and clinically-relevant systems capable of photoacoustic imaging. Regulatory aspects of photoacoustic imaging systems and imaging contrast agents will be presented. Finally, current and potential biomedical and clinical applications of photoacoustics will be discussed.

RC717B • Ultrasound Molecular Imaging

Juergen K Willmann MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the acquisition and quantification principles of ultrasound molecular imaging. 2) To understand the characteristics and biodistribution of molecularly targeted ultrasound contrast agents. 3) To understand the role of ultrasound molecular imaging in preclinical and clinical applications.

ABSTRACT
Ultrasound imaging is a widely available, relatively inexpensive, and real-time imaging modality that does not expose patients to radiation and which is the first-line imaging modality for assessment of many organs. Through the introduction of ultrasound contrast agents, the sensitivity and specificity of ultrasound for detection and characterization of focal lesions has been substantially improved. Recently, targeted contrast-enhanced ultrasound imaging (ultrasound molecular imaging) has gained great momentum in preclinical research by the introduction of ultrasound contrast agents that are targeted at molecular markers over-expressed on the vasculature of certain diseases. By combining the advantages of ultrasound with the ability to image molecular signatures of diseases, ultrasound molecular imaging has great potential as a highly sensitive and quantitative method that could be used for various clinical applications, including screening for early stage disease (such as cancer); characterization of focal lesions; quantitative monitoring of disease processes at the molecular level; assisting in image-guided procedures; and, confirming target expression for treatment planning and monitoring.
In this refresher course the concepts of ultrasound molecular imaging are reviewed along with a discussion on current applications in preclinical and clinical research.

RC717C • Sonographically-guided Drug Therapy

Alexander L Klibanov PhD (Presenter) *

LEARNING OBJECTIVES
1) To identify the basic principles of ultrasound energy deposition as applied to molecular imaging and image-guided therapeutic interventions. 2) To combine the general physical principles of ultrasound-microbubble interaction, drug-carrier systems pharmacokinetics and ultrasound contrast imaging, apply this knowledge for the development of triggered delivery approaches in the setting of personalized medicine. 3) To understand advantages and disadvantages of ultrasound application in the potential image-guided intervention designs. 4) To identify and compare potential clinical applications of ultrasound-guided drug delivery.

ABSTRACT
The reason of ultrasound use in drug delivery is to enhance drug action specifically in the area of disease. The design of such therapeutic intervention should assure that drug deposition or action enhancement take place only in the disease site, with the general goal to improve the therapeutic index. There are several approaches to ultrasound-assisted drug delivery. The first approach, closest to clinical practice, takes advantage of existing ultrasound contrast agents (intravenous gas microbubbles approved in US for cardiac imaging). When these bubbles are co-injected intravenously with the drugs, and ultrasound energy applied to the areas of disease, localized energy deposition leads to endothelium activation or transient 'softening' of blood brain barrier (BBB). Drugs (including antibodies or liposomes) can thus transit BBB and achieve therapeutic action. Ultrasound imaging can be used for targeted focusing of ultrasound energy in the areas of disease. Second approach suggests attaching microbubbles to the drug or a drug carrier (including nucleic acid drugs). Microbubbles can be complexed with drug or gene carrier nanoparticles, so that local action of ultrasound would result in triggered drug release/deposit or transfection in the ultrasound-treated area. Third approach involves targeted microbubble design, as in ultrasound molecular imaging. Combination of targeted microbubbles with drug carrier makes possible unfocused ultrasound use, to act only in the areas of the target receptor expression, where microbubbles adhere and ultrasound energy is then deposited. Lately, formulation moved from microbubbles to smaller nanodroplet drug carriers, to reach interstitium, where drug release could take place upon ultrasound treatment. Overall, combination of ultrasound imaging, including contrast (molecular) imaging, focused ultrasound, and drug carrier systems will lead to novel image-guided therapies, especially applicable in the era of personalized medicine.

Advances in Cross-sectional Oncologic Imaging

Thursday, 04:30 PM - 06:00 PM • S402AB

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RO OI

RC718 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC718A • Microbubble-enhanced Ultrasound in Oncology

Hyun-Jung Jang MD (Presenter)

LEARNING OBJECTIVES
1) To identify when and where CEUS is useful in oncologic patients relevant to clinical practice. 2) To understand advantages of CEUS in oncologic imaging including a real-time dynamic imaging and purely intravascular property of microbubble contrast agents. 3) To understand the background rationales and potential role of CEUS in monitoring antivascular treatment and tumor perfusion measurement.

ABSTRACT

RC718B • Dual-Energy CT in Oncology

Anno Graser MD (Presenter) *

LEARNING OBJECTIVES
1) To understand basic principles of dual energy CT in imaging of soft tissues. 2) To learn about the properties of iodine distribution maps in dual energy CT, and how to exploit them in the characterization of malignancy. 3) To understand the perspectives of dual energy CT in response assessment based on DECT quantification of iodine uptake. 4) To learn how to build succesful dual energy CT examination protocols for disease characterization in patients with malignancy. 5) Dose issues in dual energy CT will also be explained in this refresher course lecture.

RC718C • Practical Utilization of 3D Techniques in Cancer Imaging

Zhen J Wang MD (Presenter)

LEARNING OBJECTIVES
1) Review 3D imaging techniques available for common modalities in oncologic imaging. 2) Illustrate uses of 3D imaging in everyday clinical practice. 3) Review cases where 3D imaging makes a difference.

ABSTRACT

Imaging and Treating Gynecologic Cancer 2013: What Really Works and What Is Most Cost Effective

Friday, 08:30 AM - 10:00 AM • N226

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OI OB GU

RC807 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES

RC807A • What Really Works: Overview of Imaging Procedures and Algorithm for Staging Gynecology

Julia R Fielding MD (Presenter)

LEARNING OBJECTIVES
1) To review the appearance of gynecologic cancer on CT, PET and MR images. 2) To determine when and why radiologic staging is necessary. 3) To show an algorithm that meets the needs of surgical and radiation oncology colleaues.

ABSTRACT
Staging gynecologic malignancies has evolved over the years to include multi-modality imaging. Although the official international standards (FIGO) allow for cross sectional imaging in some cases, examination under anesthesia remains the mainstay of diagnosis. In experienced hands and with the addition of biopsy results, manual staging of cervical cancer is excellent, while endometrial cancers are often understaged. It is now routine to stage advanced ovarian cancer with CT scans. The goal of this course is to impart 1) best imaging practices based on ACR guidelines, 2) review cost effectiveness of current staging algorithms and new imaging techniques and 3) show the important interactions required between radiology and radiation oncology to provide state of the art care.

RC807B • Radiology Findings: Impact on Radiation Therapy

Nina A Mayr MD (Presenter)

LEARNING OBJECTIVES
1) To review current types of radiation therapy in use for gynecologic cancer. 2) To show the essential anatomic information required from imaging tests. 3) To demonstrate the value of functional and/or fused imaging in radiation therapy.

RC807C • What Does It Cost? Appropriate Use of Imaging Technology

Katarzyna J Macura MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To assess the appropriateness of utilization of imaging modalities in the work-up of women with gynecologic malignancies. 2) To discuss the cost of imaging technologies and oncologic outcome optimization.

Right Upper Quadrant Ultrasound

Friday, 08:30 AM - 10:00 AM • E351

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US OI GI

RC810 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC810A • Sonography of Focal Liver Lesions

Mitchell E Tublin MD (Presenter)

LEARNING OBJECTIVES
1) Describe a practical approach for the characterizaton of liver lesions at ultrasound. 2) Illustrate usefull imaging features of typical and atypical hemangiomas. 3) Demonstrate the potential use of ultrasound contrast agents for liver mass characterization.

ABSTRACT
Despite improvements in ultrasound technology, the approach to characterization of liver lesions at ultrasound has changed little over the past thirty years. A recommendation for further evaluation by either MRI or CECT is typically given, though in many cases, the ultrasound features (in combination with clinical history) are sufficient for diagnosis. Microbubble contrast agents may improve ultrasound diagnostic specificity in the near future.

RC810B • Liver Elastography

Thomas H Grant DO (Presenter)

LEARNING OBJECTIVES
1) What are these techniques. 2) When should they be used. 3) How effective are they. 4) Future innovations.

ABSTRACT
Noninvasive assessement of liver fibrosis is challenging given that chronic liver disease affects hundreds of million patients worldwide. Fibrosis is reversible with effective intervention. Therefore an effective, relatively fast method to detect fibrosis is essential.

RC810C • Gallbladder and Biliary Disease

Anthony E Hanbidge MBBCh (Presenter)

LEARNING OBJECTIVES
1) Discuss the value of ultrasound when evaluating the gallbladder and bile ducts. 2) Identify the imaging features of acute conditions of these structures and complications. 3) Recognize common pitfalls to avoid misinterpretation. 4) Describe other conditions of the gallbladder and bile ducts including adenomyomatosis, sclerosing cholangitis, gallbladder cancer and cholangiocarcinoma.

Essentials of Molecular Imaging

Friday, 08:30 AM - 10:00 AM • S505AB

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OI MI

RC817 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Steven M Larson , MD *

RC817A • Molecular Imaging as a Guide for Better Cancer Therapies

Steven M Larson MD (Presenter) *

LEARNING OBJECTIVES
1) The participants will learn the definition of theranostic radiotracer. 2) The participants will learn the role of MEK in non-avid thyroid cancer. 3) The participants will learn why expression of Prostate Specific Membrane antigen (PSMA) offers potential for improved diagnosis and therapy of prostate cancer. 4) The participants will learn the contribution of radioactive nanoparticles both now and in the future for staging and drug delivery.

RC817B • Pediatric Molecular Imaging

Heike E Daldrup-Link MD (Presenter)

LEARNING OBJECTIVES
1) To understand advantages and limitations of radiation-free whole body diffusion MRI techniques for tumor staging in children. 2) To recognize the value of immediately clinically applicable iron oxide nanoparticles for tumor staging and tumor characterization in pediatric patients. 3) To learn about clinically relevant PET/MR applications in pediatric patients.

ABSTRACT
Pediatric Molecular Imaging
How much does Molecular Imaging matter in our clinical environment? Molecular Imaging spurs the discovery of fundamentally new targets for imaging diagnoses, thereby leading to new knowledge and new concepts that substantially advance our approach to detecting, characterizing and treating disease. Translational molecular imaging approaches are increasingly integrated into the clinical care of adult patients, but applications in pediatric patients are still limited due to safety considerations and regulatory and administrative hurdles. The clinical need for more specific information along with the success of molecular imaging techniques in adult patients will ultimately penetrate into pediatric applications. New, child-adapted molecular imaging approaches are currently utilized to improve our knowledge of the biology of pediatric diseases, and to support personalized diagnostic and therapeutic approaches. This presentation will show three immediately clinically applicable molecular imaging applications for pediatric patients: (1) Novel approaches for radiation-free whole body staging, (2) Improved tumor characterization with clinically approved iron oxide nanoparticles and (3) clinically relevant MR/PET applications in pediatric patients. Further developments aim to integrate the advantages of multi-modality molecular imaging tools towards more comprehensive and quantitative diagnoses that can direct early decision making, guide individualized clinical care procedures, and ultimately, accelerate and improve positive treatment outcomes.

RC817C • Molecular Imaging of Breast Cancer: Clinical and Biologic Insights

David A Mankoff MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Review breast cancer clinical and biologic concepts relevant to treatment. 2) Discuss how molecular imaging may be used to guide targeted breast cancer therapy. 3) Describe future directions in breast cancer biomarker imaging.

ABSTRACT
This talk will review molecular imaigng in the context of currentknowledge of breast cancer biology and the increasing trend towards individualized and targeted breast cancer therapy. The discussion will emphasize molecular imaging, especially PET, and biomarker applications to guide treatment selection. Insights gained into the in vivo biology of breast cancer from quantitative molecular imaging will also be discussed.

RC817D • New Tools and Targets for Molecular Imaging

Martin G Pomper MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Discuss emerging molecular imaging agents. 2) Discuss new targets for molecular imaging. 3) Focus on translation of molecular imaging agents to the clinic.

ABSTRACT
We will discuss how one goes about identifying a suitable target for molecular imaging and then actually generates the imaging agent - for a variety of modalities, whichever is appropriate to answer the question at hand. There will be a focus on clinical translation and discussion of combined diagnostic/therapeutic (theranostic) agents.

Techniques for Quantitative Cancer Imaging: Current Status

Friday, 08:30 AM - 10:00 AM • S404CD

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RO OI BQ

RC818 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC818A • Computed Tomography

Binsheng Zhao DSc (Presenter)

LEARNING OBJECTIVES
1) Familiarize the audience with conventional CT response assessment methods and their limitations, especially in the era of new drug development. 2) Provide examples of modified RECIST methods in several types of cancers. 3) Raise awareness of the need to re-evaluate RECIST guidelines and establish new response assessment criteria based on tumor volume and density changes. 4) Discuss the effects of CT imaging parameters on tumor measurement and the importance of standardizing an imaging acquisition protocol in response assessment.

ABSTRACT
Computed tomography (CT) has been widely used in assessing tumor response to therapy. This refresher course will familiarize the audience with conventional response assessment methods and their limitations, especially at a time of target drug development. Potential improvements will be discussed, including re-evaluating the RECIST (Response Assessment Criteria in Solid Tumors) guidelines and establishing new response assessment criteria based on tumor volume and density changes on CT. Several examples of modified RECISTs for lymphoma, mesothelioma, hepatocellular carcinoma (HCC) and gastrointestinal stromal tumor (GIST) will be provided. Last but not least, measurement variability will be addressed and the importance of standardizing an imaging acquisition protocol in oncologic response assessment will be discussed.

RC818B • Magnetic Resonance Imaging

Gregory S Karczmar PhD (Presenter) *

LEARNING OBJECTIVES
1) Gain familiarity with methods used for accurate measurements of tumor volumes with MRI, advantages of MRI, challenges, and sources of error. 2) Understand basic principles and clinical applications of dynamic contrast enhanced MRI; possibilities for standardized measurements of perfusion and capillary permeability, and sources of error. 3) Understand basic principles and clinical applications of diffusion-weighted imaging, measurements of the apparent coefficient of diffusion (ADC), and sources of error.

ABSTRACT
Anatomic and functional MRI is increasingly used for diagnosis and staging of cancer, and for detection of response to therapy. However, standardized, quantitative measurements remain challenging. We will review use of MRI to reliably measure tumor volume, and two widely used functional MRI methods dynamic contrast enhanced MRI (DCEMRI) and diffusion-weighted imaging (DWI). We will discuss methods used to standardize DCEMRI measurements, including quantitative measurements of contrast media as a function of time, measurement of the arterial input function, and use of an appropriate model for calculation of perfusion/capillary permeability, as well as 'model-free' approaches. We will discuss methods used to measure the apparent diffusion constant (ADC) and the relationship between the ADC and underlying physiology/anatomy at the microscopic level.

RC818C • Positron Emission Tomography

Paul E Kinahan PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the advantages and disadvantages of PET/CT as a quantitative imaging technique. 2) Understand sources of bias and variance in quantitative PET/CT imaging, both in data acquisition and analysis. 3) Learn techniques for limiting variability in quantitative PET/CT imaging.

ABSTRACT
Dual-mode positron emission tomography / x-ray computed tomography (PET/CT) imaging has become a standard tool in cancer imaging for detection, diagnosis and staging over the last decade, and is increasingly being used in therapy planning and assessing response to therapy. This refresher course will familiarize the audience with response assessment methods used in PET/CT imaging and their limitations. Recently proposed criteria will be discussed, including the PERCIST (PET Response Criteria in Solid Tumors) guidelines. Measurement variability will be addressed and the importance of standardizing an imaging acquisition protocol in oncologic response assessment with PET/CT will be discussed.

US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment (How-to Workshop)

Friday, 08:30 AM - 10:00 AM • E450B

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US OI NR HN

RC831 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Jill E Langer , MD *
Kathryn A Robinson , MD
Sheila Sheth , MD *

LEARNING OBJECTIVES
1) Describe the sonographic characteristics of thyroid nodules that are suspicious for malignancy. 2) a. Discuss the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. b. Describe the indications for two new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. 3) a. Describe the technique of US-guided biopsy of thyroid nodules and cervical lymph nodes in patients who have undergone thyroidectomy for thyroid cancer. b. Discuss the rationale and method of performance of US-guided ethanol ablation of malignant cervical adenopathy in post thyroidedctomy patients.
ABSTRACT
This presentation will consist of a three individual presentations. The first will review the sonographic characteristics of thyroid nodules that are suggestive of malignancy. Recommendations for selecting which thyroid nodules require ultrasound-guided biopsies which have been provided by both Radiology consensus conferences and published Endocrinology guidelines will be discussed. The second presentation will review with the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. Additionally this presentation describes the indications for two new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. The last presentation will provide a detailed description of the technique for performing ultrasound guided biopsy of thyroid nodules and cervical lymph nodes. Various methods will be discussed and required equipment outlined. Possible complications, though rare, will be described. A comparison of the typical sonographic features of normal versus abnormal lymph nodes will be presented in an effort to identify those patients in whom sonographic follow up can be used instead of biopsy. A discussion of the possible advantages of adding thyroglobulin assay to cytologic evaluation will be provided. The rationale for and technique of performing ultrasound guided ethanol ablation of malignant cervical lymph nodes in patients with thyroid cancer will be undertaken.

Targeted Treatment and Imaging of Liver Cancers: Basic to Advanced Techniques in Minimally-Invasive Therapies and Imaging (How-to Workshop)

Friday, 08:30 AM - 10:00 AM • E260

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OI IR GI

RC850 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
John J Park , MD, PhD
Jinha Park , MD, PhD
Jonathan M Kessler , MD
Steven S Raman , MD
Marcelo Guimaraes *

LEARNING OBJECTIVES
1) Discuss the role of the interventional radiologist in the treatment and management of patients with primary and metastatic liver cancer as part of the multidisciplinary team. 2) Learn best practice techniques in the treatment of liver cancers, with emphasis on both locoregional and focal therapeutic approaches, and indications for treatment. 3) Explore various tips and tricks for each treatment modality and learn how to avoid complications through good patient selection, choosing the appropriate techniques, and knowing what common mistakes to avoid. 4) Learn about newer and developing techniques and devices, their potential roles and indications, and potential pitfalls. 5) Explore advanced imaging modalities in the detection of tumors and for monitoring treatment response.
ABSTRACT

Disclosure Index

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