

Sunday, December 01, 2013

- 10:45-12:15 PM • **SP0111** • Room: E353C • Oncodiagnosis Panel: Pediatric Sarcoma (An Interactive Session)
10:45-12:15 PM • **SSA12** • Room: S504CD • ISP: Molecular Imaging (Oncology I)
10:45-12:15 PM • **SSA22** • Room: S104A • Radiation Oncology and Radiobiology (Lung I)
12:30-01:00 PM • **LL-ROS-SUA** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Sunday Posters and Exhibits - (12:30pm - 1:00pm)
01:00-01:30 PM • **LL-ROS-SUB** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Sunday Posters and Exhibits (1:00pm - 1:30pm)
01:30-06:00 PM • **VSI011** • Room: S405AB • Interventional Oncology Series: Controversies and Emerging Questions in the Management of Renal Tumors
02:00-03:30 PM • **RC120** • Room: E352 • Radiographic Evaluation of the Post-Radiotherapy Brain
02:00-03:30 PM • **RC122** • Room: S504AB • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Image Guidance in the Treat...

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 • **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 • **RC220** • Room: S104A • Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology
08:30-10:00 AM • **RC222** • Room: S102C • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Margins and Margin Design
10:30-12:00 PM • **MSRO22** • Room: S103AB • BOOST: Head and Neck-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • **MSRO25** • Room: S103CD • BOOST: Gynecology-Integrated Science and Practice (ISP) Session
10:30-12:00 PM • **SSC06** • Room: E451A • Gastrointestinal (Oncology: Surveillance and Tumor Response)
10:30-12:00 PM • **SSC15** • Room: S104A • Radiation Oncology and Radiobiology (Lung II)
12:15-12:45 PM • **LL-ROS-MOA** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Monday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • **LL-ROS-MOB** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Monday Posters and Exhibits (12:45pm - 1:15pm)
01:30-05:45 PM • **SPPH22** • Room: S102C • Physics Symposium: Uncertainties in Radiation Therapy 2
01:30-06:00 PM • **VSI021** • 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 • **SSE18** • Room: N230 • Neuroradiology/Head and Neck (ENT Oncology)
03:00-04:00 PM • **SSE24** • Room: S404AB • Physics (Image-guided Radiation Therapy I)
03:00-04:00 PM • **SSE25** • Room: S104A • Radiation Oncology and Radiobiology (CNS)
04:45-06:00 PM • **MSRO29** • Room: S104B • BOOST: Head and Neck Hands-on Contouring (In Cooperation with ASTRO)

Tuesday, December 03, 2013

- 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 • **RC320** • Room: S504AB • Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometas...
08:30-10:00 AM • **RC322** • Room: E261 • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Incorporation of Imaging as...
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 • **SSG16** • Room: S104A • Radiation Oncology and Radiobiology (Genitourinary)
12:15-12:45 PM • **LL-ROS-TUA** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Tuesday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • **LL-ROS-TUB** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
01:30-06:00 PM • **VSI031** • 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)
03:00-04:00 PM • **SSJ25** • Room: S104A • Radiation Oncology and Radiobiology (Outcomes)
04:30-06:00 PM • **RC422** • Room: S102D • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Imaging for Target Definiti...

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 • **RC520** • Room: S504AB • New Paradigms for the Treatment of Hodgkins and non-Hodgkins Lymphomas: The Crucial Role of Imaging
08:30-10:00 AM • **RC522** • Room: N229 • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Site-specific IGRT Applicat...
10:30-12:00 PM • **MSRO42** • Room: S103CD • BOOST: Genitourinary-Integrated Science and Practice (ISP) Session
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)
10:30-12:00 PM • **SSK22** • Room: S104A • Radiation Oncology and Radiobiology (Gastrointestinal)
12:15-12:45 PM • **LL-ROS-WEA** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Wednesday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • **LL-ROS-WEB** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Wednesday Posters and Exhibits (12:45pm - 1:15pm)
01:30-02:45 PM • **PS40** • Arie Crown Theater • Wednesday Plenary Session
01:30-06:00 PM • **VSI041** • 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 • **SSM22** • Room: S104A • Radiation Oncology and Radiobiology (Breast)
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 • **RC622** • Room: S102D • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Imaging Moving Targets
10:30-12:00 PM • **SSQ12** • Room: S504CD • Molecular Imaging (Oncology and Subspecialties)
12:15-12:45 PM • **LL-ROS-THA** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Thursday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • **LL-ROS-THB** • Room: Lakeside Learning Center • Radiation Oncology and Radiobiology - Thursday Posters and Exhibits (12:45pm - 1:15pm)
01:30-02:45 PM • **PS50** • Arie Crown Theater • Thursday Plenary Session
01:30-06:00 PM • **VSI051** • Room: S405AB • Interventional Oncology Series: Liver Metastases and Bone
04:30-06:00 PM • **RC718** • Room: S402AB • Advances in Cross-sectional Oncologic Imaging
04:30-06:00 PM • **RC722** • Room: S502AB • Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Image Registration

Friday, December 06, 2013

- 08:30-10:00 AM • **RC818** • Room: S404CD • Techniques for Quantitative Cancer Imaging: Current Status
10:30-12:00 PM • **SST15** • Room: S403A • Physics (Image-guided Radiation Therapy II)

Assessment of Lung Inflammation Following Radiation Therapy Based on Quantitative Image Analysis Techniques

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LL-ROE3087

Ali Salavati, MD, MPH
Babak Saboury, MD, MPH
Abass Alavi, MD

PURPOSE/AIM

To describe the role of molecular imaging biomarkers in the early detection and management of patients with radiation pneumonitis (RP).

CONTENT ORGANIZATION

- Importance of early detection of radiation pneumonitis in patients undergoing chest radiation therapy
- High diagnostic uncertainty of clinical criteria for the diagnosis of radiation pneumonitis
- The role of molecular imaging biomarkers in the management of patients with radiation pneumonitis
- Overview of our experience and current literature on the potential role of quantitative FDG PET-CT imaging in the management of radiation pneumonitis

SUMMARY

Radiation pneumonitis is the most severe dose-limiting complication in patients receiving chest radiation therapy. Clinical criteria for diagnosis of RP have been reported to be imprecise in a significant proportion of patients because of pre-existing lung or cardiac diseases. Structural imaging modalities have been also reported to have limited capabilities in the early detection of RP. In this presentation we will review our experience on quantitative PET imaging and current

Prostatic Carcinoma (Pc) Treated with Focal Brachytherapy (FB): Magnetic Resonance (MR) Imaging Evaluation

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LL-ROE4188

Gianpiero Cardone, MD
Maurizio Papa, MD
Andrea Losa, MD
Antonella Messina, MD
Massimo Lazzeri, MD
Paola Mangili, PhD
Daniele Vergnaghi, MD
Pietro Panizza, MD
Giorgio Guazzoni, MD
Giuseppe Balconi

PURPOSE/AIM

To illustrate MR imaging effectiveness in the early evaluation of post-implant dosimetry in patients treated with focal brachytherapy. To report the spectrum of MR findings of prostate gland treated with Focal Brachytherapy. To show the evolution, as time passed, of the signal intensities of prostate treated with Focal Brachytherapy.

CONTENT ORGANIZATION

1) FB of the prostate: technical aspects 2) MR imaging techniques 3) MR patterns of prostate gland after FB a) size b) morphology c) contrast enhancement e) radiation therapy seeds MRI evaluation d) periprostatic changes after treatment 4) Post-implant dosimetry, performed on fused transverse T1w and T2w MR images, using dedicated image fusion software.

SUMMARY

Morphologic MR evaluation showed reduction in size of the treated area of the gland and diffuse reduction of signal intensity on T2w images due to parenchymal fibrosis and atrophy. Dynamic ce MR evaluation showed reduction of the vascularization of the treated area of the gland. Radiation therapy seeds were seen as small foci of focal signal intensity void. MR can be an effective imaging technique in the follow-up of prostate tumors treated with FB, in particular in the early evaluation of post-implant dosimetry.

Functional Imaging Biomarkers for Response Assessment in Cervical Cancer - Emerging Applications in Radiation Oncology

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LL-ROE4189

Ravivarma Balasubramaniam
Sarah E Swift
Rachel Cooper
Andrew F Scarsbrook, FRCR
Chirag Patel, FRCR

PURPOSE/AIM

1. To describe the role of functional imaging to assess tumor response in radiation oncology; 2. To review the range and use of novel imaging techniques as surrogate biomarkers of treatment response in cervical cancer

CONTENT ORGANIZATION

SUMMARY

Integrating 4D PET-CT into Radiotherapy Treatment Planning: Promises and Problems

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LL-ROE4190

Patricia Arce-Calisaya, MRCS
Robin Prestwich, PhD, FRCR
Ganesh Radhakrishna, MBBS
David Keane
Sarah Kirwin
Garry Mcdermott
Chirag Patel, FRCR
Andrew F Scarsbrook, FRCR

PURPOSE/AIM

1. To illustrate potential pitfalls caused by organ/lesion movement 2. To discuss the use of personalized motion information to improve target volume definition (TVD) with PET-CT 3. To review the range of data acquisition and processing techniques in use for respiratory-gated PET-CT

CONTENT ORGANIZATION

SUMMARY

Accurate tumor target definition is essential for future improvements in the therapeutic ratio for organ-preserving treatment. The recent advent of 4D PET-CT offers the prospect of incorporating state-of-the-art diagnostic imaging techniques into the radiotherapy planning process. However implementation presents technical, clinical and organization challenges. A thorough understanding of these is required in order that the potential benefits on individual patient management can be realised. This technique shows great promise for guiding more accurate target definition and may improve the efficacy of radiation treatment.

Implications of Radiologic Findings and Pathologic Pathways of Spread for Radiation Treatment Planning in Oropharyngeal Cancer

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LL-ROE4191

Jennifer L Shah, MD
Nancy J Fischbein, MD
Wendy Hara, MD

PURPOSE/AIM

Oropharyngeal cancer is a commonly treated malignancy of the head and neck by radiation oncologists. Prescribed treatment dose and volumes are variable among practitioners, however. Published pathologic studies should be used to create evidence-based treatment plans.

CONTENT ORGANIZATION

- Normal anatomy of the oropharynx with correlation of normal structures seen on CT and MRI.
- Local pathways of spread of tumors of the soft palate, tonsillar region, oropharyngeal wall, and the base of tongue with radiological correlation
- Rates of the nodal involvement (e.g. levels 1 through 6) seen for these malignancies as evidenced by published pathologic data
- Discuss the process of deciding which nodal levels are at high risk, intermediate risk, and low risk and how this impacts the prescribed radiation dose and treatment volumes
- Present examples of treatment plans to illustrate the concepts above
- Review patterns of failure, differences in HPV-positive vs HPV-negative patterns of spread, and CT perfusion as prognostic indication of response

SUMMARY

This presentation will demonstrate how radiation treatment planning for oropharyngeal cancer is affected by a combination of radiologic findings and evidence-based pathologic studies.

Clinical Value of Spectral CT Imaging during CT Guided Radioactive Seed 125I Implantation and in the Follow-up Evaluation after Intervention

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LL-ROE4192

Qinglong Shen
Rui Gang Huang
Yiyong Cai
Yankun Huang

PURPOSE/AIM

To explore the clinical value of spectral CT imaging during CT guided radioactive seed 125I implantation and in the follow-up evaluation after intervention.

Oncodiagnosis Panel: Pediatric Sarcoma (An Interactive Session)**Sunday, 10:45 AM - 12:15 PM • E353C**

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[Back to Top](#)**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.

ISP: Molecular Imaging (Oncology I)**Sunday, 10:45 AM - 12:15 PM • S504CD**

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[Back to Top](#)**SSA12 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5****Moderator****Daniel C Sullivan**, MD**Moderator****Heike E Daldrop-Link**, MD**SSA12-01 • Molecular Imaging Keynote Speaker: Multi-modal Molecular Imaging of Cancer****Heike E Daldrop-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 MBThy1 and MBControl in a randomized order during the same imaging session using a VEO2100 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 MBThy1 to PDAC xenografts was assessed using US molecular imaging. A targeted signal using MBThy1 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-weighted 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 posttreatment 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** FFRCSI (Presenter) ; **Sarah Thayer** ; **Carlos Fernandez-Del Castillo** MD ; **Mari Mino Kenudson** MD ; **Ralph Weissleder** MD,

PURPOSE

The purpose of this study was to assess the ability of a lymphotropic 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 radiopharmaceutical 111-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

18F-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 octadecylamine 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.

Radiation Oncology and Radiobiology (Lung I)

Sunday, 10:45 AM - 12:15 PM • S104A



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SSA22 • AMA PRA Category 1 Credit™: 1.5 • ARRT Category A+ Credit: 1.5

Moderator

Zhongxing Liao, MD

Moderator

Matthew M Harkenrider, MD

SSA22-01 • Increased Risk of Chest Wall and Rib Toxicity in Lung SBRT Patients Treated with RTOG-0813 Protocol and Monte Carlo Based Planning

Supriya Jain MS, BA (Presenter) ; Anil Sethi PhD ; Edward Melian MD ; Bahman Emami MD

PURPOSE

To evaluate Monte Carlo (MC) based lung stereotactic body radiotherapy (SBRT) plans for dosimetric parameters correlated with the development of chest wall pain and rib fracture.

METHOD AND MATERIALS

Twenty consecutive lung SBRT patients treated from 2010-2012 with heterogeneity corrected Pencil Beam (PB) plans were selected. Chest wall (CW) was contoured as a 3 cm expansion of the ipsilateral lung. Treatment plans were normalized to deliver 50 Gy PTV dose in 5 fractions using 7-12 non-coplanar, conformal, 6 MV fields. Using MC dose algorithm, each plan was optimized for PTV dose coverage as per RTOG-0813 protocol. Patients were classified based on PTV location: island tumors (8), adjacent to CW (9), or mixed (3); and PTV size (cc): small (< 25), medium (25-60), or large (> 60). Treatment plans were evaluated for toxicity risk based on four dosimetric thresholds - CW: Dmax < 50 Gy, V30 < 30 cc, V40 < 5 cc and Ribs: Dmax

RESULTS

Tumor size and location were strong predictors of risk of toxicity to CW and ribs. With MC planning, 0% (0/6) of small, 50% (4/8) of medium, and 100% (6/6) of large tumors exceeded all four CW and ribs toxicity thresholds. 78% (7/9) of tumors located adjacent to CW surpassed every CW / ribs threshold vs. 67% (2/3) of mixed and 25% (2/8) of island tumors. Mean Dmax for ribs was significantly higher for tumors adjacent to CW than for island tumors (61.6±11.7 Gy vs. 45.00±11.7 Gy, p = .007). Transitioning from PB to MC planning resulted in a higher overall risk of toxicity. Mean relative dose increases from PB to MC plans were 32.4±12.7%, 24.8±10.4%, and 20.3±6.4% for small, medium, and large tumors, respectively, and 32.5±11.6%, 26.6%±8.8%, and 19.5±7.2% for island, mixed, and chest wall tumors respectively.

CONCLUSION

MC based lung SBRT plans that satisfy RTOG-0813 criteria for PTV dose coverage result in an increased risk of chest wall and rib toxicity. Large tumor size and proximity to CW predict highest absolute dose to CW and ribs. However, relative increase in CW / rib dose from PB to MC planning is directly proportional to tumor distance from CW and inversely proportional to tumor size. Low-risk small island tumors experience the greatest increase in CW/rib dose when planned with MC algorithm.

CLINICAL RELEVANCE/APPLICATION

With Monte Carlo based planning, revision of RTOG-0813 guidelines for PTV dose coverage may be necessary to prevent chest wall pain and rib fractures.

SSA22-02 • Prospective Study Evaluating the Use of IV Contrast on IMRT Treatment Planning for Lung Cancer

Hua Li PhD (Presenter) ; Beth Bottani ; Todd DeWees ; Daniel A Low PhD * ; Jeff M Michalski MD ; Sasa Mutic MS * ; Jeffrey D Bradley MD ; Cliff G Robinson MD

SSA22-03 • Lung Injuries after Stereotactic Body Radiotherapy in Patients with Emphysema Who Had Stage I Non-small Cell Lung Cancer

Moeko Ishijima (Presenter) ; Hidetsugu Nakayama ; Yu Tajima ; Sachika Nogi ; Ryuji Mikami ; Koichi Tokuyue MD, PhD ; Soichi Akata MD

SSA22-04 • Incidence of Radiation Pneumonitis after Stereotactic Body Radiation Therapy for Lung Cancer Patients with Pulmonary Interstitial Changes

Tadamasa Yoshitake MD (Presenter) ; Katsumasa Nakamura MD, PhD ; Tomonari Sasaki MD, PhD ; Saiji Ohga MD ; Kotaro Terashima ; Kaori Asai ; Yoshio Matsuo ; Takeshi Kamitani MD ; Hideki Hirata ; Hiroshi Honda MD

SSA22-05 • Stereotactic Body Radiation Therapy for Stage I Non-small Cell Lung Cancer: A Community Hospital Experience

Charles C Vu BSE (Presenter); **Janna Z Andrews** MD; **Karen Episcopia** MS; **Jeffrey G Schneider** MD; **Scott L Schubach** MD; **Jonathan A Haas** MD *

ABSTRACT

Purpose/Objective(s): Stereotactic body radiation therapy (SBRT) has been shown to have increased local control and overall survival relative to conventional external beam radiation therapy in patients with medically inoperable stage I non-small cell lung cancer (NSCLC). Excellent rates of local control have been demonstrated both in clinical trials as well as in single-center studies at academic institutions. However, there is limited data on the experiences of community hospitals with SBRT for Stage I NSCLC. The purpose of this study is to report the local control and overall survival rates in patients treated with SBRT for Stage I NSCLC at Winthrop-University Hospital (WUH), a community hospital.

Materials/Methods: This is a retrospective review of 78 Stage I central and peripheral NSCLC tumors treated between December 2006 and July 2012 with SBRT at WUH. Treatment was given utilizing fiducials and a respiratory tracking system. If the fiducials were not trackable, a spine tracking system was used for tumor localization. CT-based planning was performed using the ray trace algorithm. Treatment was delivered over consecutive days. The Kaplan-Meier method was used to calculate local control and overall survival.

Results: The median age was 77.4 years. 53% of the patient population was female. 67% of the tumors were Stage IA (T1N0M0), and 33% of the tumors were Stage IB (T2N0M0). 53% of the tumors were adenocarcinomas and 29% were squamous cell carcinomas, with the remainder being of unknown histology or NSCLC, not otherwise specified. Median dose prescribed was 48Gy given in 4 fractions with a median follow-up time of 11.0 months. The 2-year local control rate was 86.6%, and the two-year overall survival was 63.8%.

Conclusions: Our findings support that local control and overall survival at WUH, a community hospital, are comparable to that of academic institutions' published experiences with stereotactic body radiation therapy for Stage I NSCLC.

SSA22-06 • Intensity-modulated Radiation Therapy Following Extrapleural Pneumonectomy for Malignant Pleural Mesothelioma: A Single Institution Experience

Sameer Jhavar MD, PhD (Presenter); **Mehul Patel**; **Divya Patel**; **Nitika Thawani** MD; **Dharanipathy Rangaraj**; **Philip Rascoe**; **Scott Reznik**; **Alan Gowan**; **W Roy Smythe**; **Subhakar Mutyala** MD

SSA22-07 • Volumetric-modulated Arc Therapy for Lung Tumors: A Dosimetric Comparison with 3d Technique

Shino Kobayashi-Shibata (Presenter); **Akihiro Haga**; **Hideomi Yamashita**; **Keiichi Nakagawa** MD, PhD

ABSTRACT

Purpose/Objective(s): We compared a dose volume histogram (DVH) in stereotactic body radiotherapy (SBRT) and volumetric-modulated arc therapy (VMAT) and 3D conformal method.

Materials/Methods: The investigation period was from July 2010 to January 2013. The solitary lung nodule was 20 cases. SBRT was performed by 11 ports using non-coplanar beams. VMAT used a single arc. The prescription dose was 50Gy/4fr in 95% of PTV. The aspiration suppression was performed by abdominal pressure. We created respiratory curves using ANZAI belt and divided 10 phases by respiratory phase. ITV was made by the sum of 10 GTVs in each 10 respiratory phase. PTV-ITV margin was 5 mm. Leaf-PTV margin was 5 mm in 3D conformal and SBRT.

Results: The mean of GTV, CTV, and PTV were 2.7cc, 4.2cc, and 18.5cc. The mean of homogeneity index (HI) was 1.34 +/- 0.10 in multi-ports, 1.20 +/- 0.09 in VMAT, and 1.41 +/- 0.12 in 3D-conformal. The mean lung dose was 356.5 cGy in multi-ports, 373.3 cGy in VMAT, and 380.3 cGy in 3D-conformal. The mean of lung V20 (%) was 5.1%, 5.6%, and 4.8%. V15% was 7.1%, 7.9%, and 7.0%. V10% was 10.7%, 11.0%, and 10.3%. V5(cc) was 632.4cc, 553.2cc, and 703.5cc.

Conclusions: Lung VMAT SBRT was not inferior to multi-ports SBRT or 3D-conformal SBRT not only in the homogeneity but in lung low dose volume.

SSA22-08 • Are There Computed Tomography Features Predictive of Local Recurrence in Patients with Early Stage Non-small Cell Lung Cancer Treated with Stereotactic Body Radiation Therapy?

Darragh Halpenny MBBCh, MRCPI (Presenter); **Carole A Ridge** MD; **Sara A Hayes** MBBCh; **Junting Zheng**; **Chaya Moskowitz**; **Andreas Rimner** MD *; **Michelle S Ginsberg** MD

PURPOSE

Stereotactic body radiation therapy (SBRT) is a therapeutic option for patients with stage I non-small cell lung cancer who may not be surgical candidates. SBRT delivers highly targeted, high dose radiation. The post-treatment radiological appearance is different compared with conventional radiotherapy (CRT). The objective of this study is to identify computed tomography (CT) features predictive of local recurrence after SBRT

METHOD AND MATERIALS

The institutional review board approved this study. 218 consecutive patients underwent SBRT (4000-6000 cGy, 3-5 fractions over 1-2 weeks) for local control of lung cancer from Jan 1, 2006-Mar 1, 2011. CT images were retrospectively, independently reviewed by 2 radiologists. CT studies prior to SBRT and at 6, 12 + 24 months after SBRT were evaluated. Signs of local recurrence recorded were: opacity with a new bulging margin, opacification of air bronchograms, new or enlarging pleural effusion, new or enlarging mass and increase in lung density at the treatment site. End points assessed were local recurrence (biopsy proven or on PET/CT) and death. Landmark analyses at 6 months, 12 months and 24 months were performed to examine the association between CT features and local recurrence free survival (LRFS).

RESULTS

89 of the 218 treated patients were included as they had radiologic follow-up of at least 24 months. 10 (11.2%) patients had local recurrence. 31 (34.8%) patients died within the period of follow up. None of the 5 morphological features usually associated with CRT were significantly associated with LRFS after SBRT (p>0.05). Nodal recurrence at 12 and 24 months was significantly associated with LRFS. Nodal recurrence at 12 months conferred a 50% (95%CI: 19%-100%) chance of being event free at 36 months compared to those with no nodal recurrence (66%, 95%CI: 54%-79%, p = 0.023 both readers, kappa=1.00). Patients had a higher chance of local recurrence or death at 36 months when they had nodal recurrence at 24 months (47% vs 29%, p=0.026, and 64% vs 26%, p

CONCLUSION

No local recurrence features identified on CT associated with CRT were associated with SBRT. Nodal recurrence was significantly associated with local recurrence free survival.

CLINICAL RELEVANCE/APPLICATION

Radiological patterns of local recurrence associated with CRT may not be predictive of local recurrence in patients receiving SBRT for early stage lung cancer

SSA22-09 • Stereotactic Body Radiation Therapy for Unbiopsied Early Stage Lung Cancer - A Multi-institutional Analysis

Matthew M Harkenrider MD (Presenter)

ABSTRACT

Purpose/Objectives: Medically inoperable lung cancer patients often have comorbidities that preclude pathologic diagnosis from being attained. We perform a multi-institutional analysis to determine if unbiopsied early stage lung carcinoma can be safely and effectively treated with SBRT.

Material/Methods: 34 patients with unbiopsied lung cancer treated with SBRT at the University of Louisville or University of Virginia. Patients had CT and PET imaging clinically consistent with lung malignancy. Median SBRT dose was 50 Gy (range 30-55 Gy) in a median of 5 fractions (range 3-10 fractions) with static field SBRT or VMAT.

Results: Median follow up is 16.7 months. Primary tumors had a median longest dimension on the original CT of 1.6 cm (range 0.5-3.3 cm) and post-treatment CT scan of 1.25 cm (range 0.0-4.5 cm) (p=0.025). Median pretreatment SUV on initial PET scan is 4.6 (range 0.0-16.2) and at a median of 7.6 months after SBRT, decreased to 2.25 (range 0.0-10.9) on post-treatment PET (p=0.002). Crude local control is 97.1%. The estimated 2 year regional control is 80%, distant control 85%, and overall survival 85%. There were no Grade 3 or greater acute toxicities and only three Grade 3 chronic treatment-related toxicities.

Conclusions: In medically inoperable patients with unbiopsied lung cancer, local control can be achieved in with minimal toxicity with the use of SBRT. The use of SBRT for unbiopsied early stage lung cancer patients should be performed in a multidisciplinary setting and after detailed discussion with the patient about risks and benefits of SBRT.

Radiation Oncology and Radiobiology - Sunday Posters and Exhibits - (12:30pm - 1:00pm)

Sunday, 12:30 PM - 01:00 PM • Lakeside Learning Center

RO

LL-ROS-SUA • AMA PRA Category 1 Credit™:0.5

Host
Nina A Mayr, MD

LL-ROS-SU1A • Dosimetric Impact of Interfractional Variation during the Treatment of Pancreatic Cancer Using Tomotherapy

Daniel Glick MD (Presenter); **Eric Vorauer**; **Lee Chin**; **Hans Chung** MD; **Frances Tonoletto**

ABSTRACT

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Purpose/Objective(s): Intrafractional and interfractional variation exists during the treatment of pancreatic cancer due to respiratory motion, bowel gas, patient weight loss, tumor response and peritumoral edema. This study sought to investigate interfraction organ motion and its dosimetric consequences.

Materials/Methods: Initial planning KVCT images were compared to day 1 and day 30 MVCT images for 7 unresectable, locally advanced pancreatic cancer patients treated with radical radiotherapy (dose >45 Gy) using Tomotherapy. Organ motion was calculated by measuring centroid translation. Dice Similarity Coefficient (DSC) was performed to evaluate overlapping volumes on planning and daily scans. Dose distribution was calculated on electron density calibrated daily MVCT images and projected onto daily MVCT with daily physician drawn GTV, liver, kidney and spinal cord contours. This dose distribution was also deformed onto a reference planning KVCT image using SlicerRT to create a cumulative dose volume histogram that could be compared to the original treatment plan.

Results: Mean GTV and organ at risk translation were less than 1 cm with considerable variation between patients and fractions (Table 1). There was no significant difference in translation or DSC for day 1 and day 30, and for all subsequent analysis n=14. Mean DSC for GTV, liver, right kidney, left kidney and spinal cord were 0.61, 0.78, 0.74, 0.78 and 0.53, respectively. Compared to original plan, mean GTV dose was 99.5%, mean right kidney dose was 99.9%, mean left kidney dose was 103.7% and maximum spinal cord dose was 93.7%. Deformed doses were similar with mean GTV dose 100.3%, mean right kidney dose 91.2%, mean left kidney dose 93.8% and max cord dose 92.8% compared to planned. Thirteen of the fourteen daily plans evaluated had recalculated GTV V95 greater than 99%.

Conclusions: This study demonstrates that there is sub-centimeter variation in anatomy between planning CT scan and daily treatment scans which vary between patients and fractions. These variations have minimal impact on GTV dose. By better understanding organ motion and its impact on dose deposition, one can potentially customize or shrink PTV margins to improve OAR sparing and allow for dose escalation to tumor.

Mean organ displacement

	Superior-Inferior		Anterior-Posterior		Left-Right	
	Mean (mm)	Standard Deviation	Mean (mm)	Standard Deviation	Mean (mm)	Standard Deviation
GTV	7.12	5.88	3.26	2.17	3.41	2.67
Right Kidney	4.89	3.79	3.63	3.40	2.71	2.31
Left Kidney	6.72	4.31	3.31	3.11	3.06	2.70
Liver	4.19	3.47	9.56	9.33	4.89	3.62
Spinal Cord	6.26	3.01	3.47	2.72	2.56	1.97

LL-ROS-SU2A • Clinical and Dosimetric Factors Associated with Prolonged Percutaneous Endoscopic Gastrostomy (PEG) Tube Usage in Intensity Modulated Radiation Therapy (IMRT) Treated Head and Neck Cancer Patients

Wuyang Yang (Presenter)

ABSTRACT

Purpose/Objective: Post radiotherapy dependency on Percutaneous Endoscopic Gastrostomy (PEG) tube feeding following radiotherapy (RT) in head and neck squamous cell carcinoma (HNSCC) patients has been associated with poor patient swallowing function and weight loss. As such, it is important to identify potential risk factors associated with prolonged PEG use. In this retrospective analysis, we incorporated clinical and dosimetric factors in expectation to find factors that are associated with prolonged PEG usage.

Methods: PEG tube use data was collected from our institutional clinical database and SQL relational dosimetric database from 2010 to 2012. HNSCC patients treated with intensity modulated radiotherapy (IMRT) with recorded PEG usage were retrospectively evaluated. PEG tube prolonged use was defined as greater than 30 days and binarized as the primary outcome variable. Clinical and dosimetric factors associated with prolonged use was pulled from both databases and included in a stepwise multivariate logistic regression model.

Results: A total of 56 evaluable patients were identified. Univariate analysis identified multiple predictors associated with prolonged use of PEG tube. After a stepwise exclusion of variables for the logistic multivariate regression model, race (African American), minimum dose of inferior constrictor muscles and patient smoking pack years were selected into the multivariate model. Minimum dose of inferior constrictor muscle ($CI = [0.00, 0.00]$, $p = .33$) and pack years ($CI = [0.02, 0.10]$, $p = .01$) are positively associated with prolonged PEG use, race (African American) was not associated with the outcome variable.

Conclusions: Our results demonstrate that dose to the inferior constrictor muscles and smoking status are two important predictors of prolonged PEG use.

LL-ROS-SU3A • Imaging and Oxygen Radiation Sensitization under Normal Breathing Conditions by Using Targeted Folate Receptor (FR)-mediated Endocytosis via Radiotherapy

Satoshi G Harada MD (Presenter); Shigeru Ehara MD; Keizo Ishii PhD; Takahiro Satoh DSc; Koichiro Sera; Goto Shyoko RT

PURPOSE

We aimed to treat SKOV3 (FR+) cell micrometastasis in SCID-bg mice by using microcapsule-encapsulated nanoparticles in 2 radiotherapy sessions. In the 1st session, CT-detectable microcapsules containing P-selectin and folated nanoparticles were intravenously injected into the mice to detect micrometastasis via VEGFR-1 and -2 antibody-antigen accumulation. In the 2nd session, the micrometastatic cells were sensitized using folated and O₂-rich nanoparticles released from microcapsules by radiation and endocytosed by lesions through the folate receptor (FR).

METHOD AND MATERIALS

In the 1st session, nanoparticles (1.0 × 10¹⁴) prepared from folated poly-G-glutamic acid (FA-PGA) and 0.5 nm chitosan (CH) along with 0.5 nmol dexamethasone and 5% iopamiron were mixed with 1.0 ml of a solution of 4.0% alginate, 3.0% hyaluronate and 1 μg/mL P-selectin, which was then sprayed into 0.5 mmol/L FeCl₂ solution supplemented with 1 μg/mL VEGFR-1 and -2 antibodies. In the 2nd session, nanoparticles prepared from FA-PGA and CH with 120 ppm O₂-rich water were mixed with the above mentioned mixture and sprayed into 0.5 mol/L FeCl₂ solution containing 0.1 μmol/L FcSv antibody against P-selectin. In the 1st session, the microcapsules were intravenously injected into the mice. Nine hours after injection, the mice were exposed to 10 or 20 Gy ⁶⁰Co γ-radiation. In the 2nd session, 1 × 10¹⁰ microcapsules were intravenously injected and allowed to interact with P-selectin for 9 h to treat the micrometastatic lesions. Both sessions were conducted in a similar manner.

RESULTS

Anti-VEGFR-1/-2 microcapsules accumulated around micrometastatic sites and were detected using CT. These microcapsules released the P-selectin antigen and nanoparticles with iopamiron and dexamethasone in response to the 1st irradiation treatment. The nanoparticles were endocytosed via FRs, prolonging micrometastasis detection by iopamiron and increasing FR expression by dexamethasone. In the 2nd session, the microcapsules released O₂-rich nanoparticles, which were endocytosed by the metastatic cells via enhanced FR expression and reduced metastasis by 90.4 ± 2.1%.

CONCLUSION

Targeting metastatic cells using nanoparticles allowed better diagnosis and treatment of micrometastasis.

CLINICAL RELEVANCE/APPLICATION

Imaging and Oxygen radiation sensitization using nanoparticles targeted by folate receptor-mediated endocytosis via radiotherapy will enable better diagnosis and treatment of micrometastasis.

LL-ROS-SU4A • Is There a Role for Intensity Modulated Radiation Therapy (IMRT) in the Treatment of Locally Advanced Lung Cancer?

Sudha Amarnath (Presenter)

ABSTRACT

Purpose/Objective(s): Lung cancer continues to be the leading cause of cancer mortality in the United States. The introduction of concurrent chemoradiation therapy has significantly improved the survival rates for locally advanced lung cancer to 20-30% in phase III randomized trials from historical rates of 1% with chemotherapy alone and 5% with radiation (XRT) alone. The standard XRT dose for locally advanced lung cancer is 60-74 Gy. However, due to normal tissue constraints, it is not always feasible to deliver adequate doses to tumor with 3D-conformal radiation (3DCRT). In cases where 3DCRT cannot achieve adequate dose due to normal tissue constraints, intensity modulated radiation therapy (IMRT) is sometimes used. We sought to evaluate the

dosimetric benefits of IMRT compared to 3DCRT in a select subset of patients where 3D-CRT plans were not feasible.

Materials/Methods: Ninety-seven patients with LA-LC (AJCC version 7 stage IIIA/IIIB) treated definitively with radiation therapy between 2010-2011 were identified in our database. Sixteen patients (16.5%) were treated using IMRT plans. Fourteen out of 16 patients received concurrent chemotherapy. None received prior thoracic surgery or XRT. All patients underwent simulation using four-dimensional computed tomography (4D-CT). No elective nodal coverage was performed. Each patient initially underwent 3DCRT planning, and only if normal tissue constraints (per NCCN guidelines) could not be met was IMRT planning initiated. Doses ranged from 45 Gy (BID fractionation for small cell) to 73.8 Gy (1.8 Gy daily).

Results: Thirteen patients had NSCLC and 3 patients had SCLC. One patient could only be planned to 54 Gy with 3DCRT; all others were re-planned using 3DCRT techniques to equivalent doses as the IMRT plan. Mean PTV volume was 645 cc (range: 229-2052 cc). Dosimetric comparisons between the IMRT and 3DCRT revealed significant differences in tumor coverage: mean 95% PTV coverage 92% vs. 77%, respectively, and mean 98% GTV coverage 94% vs. 76% when normal tissue constraints were respected (mean lung V20 28.7% vs. 28.4%, max cord dose 44.7 Gy vs. 47.8 Gy, and mean heart dose 15.5 Gy vs. 13.9 Gy). The benefit in IMRT tumor coverage was seen in 13/16 patients.

Conclusion: From a dosimetric standpoint, IMRT does show a significant benefit over 3DCRT for a subset of patients that would otherwise not have been able to receive an adequate dose of radiation, compromising their chance at long-term survival. Further analysis is needed to determine if there are specific predictive patient/anatomic factors that could select which patients would benefit from IMRT planning versus 3DCRT.

LL-ROS-SU5A • Feasibility of Simultaneous Integrated Boost for Dose Escalation in Spine Radiosurgery

Stephen L Lewis MD (Presenter) ; Zheng Chang PhD ; Pretesh R Patel MD ; John P Kirkpatrick MD, PhD ; Alvin Cabrera MD

LL-ROE-SU6A • Comparison of Soft-Tissue Matching on Cone-Beam Computed Tomography and Fluoroscopy-based Bony-Structure Matching in the Target Localization for the IMRT of Prostate Cancer

Hiraku Sato MD (Presenter) ; Eisuke Abe ; Hidefumi Aoyama MD, PhD

PURPOSE

To evaluate the set-up accuracy of cone-beam computed tomography (CBCT) compared with fluoroscopy-based bony-structure matching in prostate intensity-modulated radiotherapy (IMRT).

METHODS

Twenty patients with localized prostate cancer examined between November 2010 and March 2012 at our institution. Each patient underwent simulation in the supine position with a customized vacuum immobilization device using a sixteen-slice CT scanner with 2.5-mm slice thickness. IMRT plans were generated using an Eclipse treatment planning system with seven coplanar beams and 6-MV photons. All patients were treated on a Novalis-Tx stereotactic radiosurgery system. After an initial set-up based on skin markers, bony-structure matching was carried out using a fluoroscopy-based set-up system. After that, CBCT was taken and soft-tissue matching using the prostate-rectal interface as a landmark was carried out. A shift of the coordinates of the isocenter between the CBCT-based set-up and the fluoroscopy-based set-up was recorded in the anterior-posterior (AP), superior-inferior (SI), and left-right (LR) axes and was considered a potential inter-fractional shift when the bony structure-based set-up was employed. Post-treatment CBCT was also taken once a week in order to measure the intra-fractional shift. Inter-fractional and intra-fractional shifts were analyzed using 577 pre-treatment CBCTs and 131 post-treatment CBCTs, respectively.

RESULTS

The mean and standard deviation (SD) of the inter-fractional shifts when only the bony structure-based set-up was used was 0.97 ± 2.8 mm in AP, -0.97 ± 2.2 mm in SI, and 0.17 ± 0.7 mm in LR axes. The mean and SD of the intra-fractional shifts was -0.37 ± 1.4 mm in AP, -0.17 ± 1.2 mm in SI, and -0.17 ± 0.7 mm in LR axes. The SDs of the inter-fractional and the intra-fractional shifts were 2.8 and 1.4 mm in AP, 2.2 and 1.2 mm in SI, and 0.7 and 0.7 mm in LR.

CONCLUSION

The application of CBCT-based prostate-rectal interface matching may reduce the inter-fractional shift compared to fluoroscopy-based bony-structure matching in all coordinates with a standard deviation ranging from 0.7 mm to 2.8 mm.

Radiation Oncology and Radiobiology - Sunday Posters and Exhibits (1:00pm - 1:30pm)

Sunday, 01:00 PM - 01:30 PM • Lakeside Learning Center

RO

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LL-ROS-SUB • AMA PRA Category 1 Credit™: 0.5

LL-ROS-SU1B • The Impact of Pre-treatment Prostate Volume on Gastrointestinal or Genitourinary Complications in Prostate Cancer Patients Treated with Intensity Modulated Radiation Therapy IMRT (Two Different Methods of Measurement)

Samar Azawi (Presenter) ; Juying Zhang PhD ; Mina Behdad BA

ABSTRACT

. retrospective review of 300 patients (2003-2012).

We identified 52 prostate cancer patients who were treated with IMRT (2008-2012) . we were able to obtain prostate volumes and DVH.

Prostate size was measured based on transrectal ultrasound at time of biopsy and CT scan during treatment planning.

Patients received a median dose of 7560 Gys delivered using IMRT (range 7000-

7740).

Radiation dose classification are as follows:

7740 Gy/180, n=19 ; 7560 Gy/180, n=28 ; 7380Gy/180, n=3 ; 7000 Gy/250 , n=2

Prostate volume measurements by transrectal ultrasound were performed prior to treatment.

Target size was defined as less than or greater than 50 cc.

The prostate volume classification and the corresponding number of patients are as follows :

V=25-50 cc, n=16; V=51-60 cc, n=18

V= 61-80cc, n=15 ;

V > 100cc ,n=3(160cc,137.2cc, 119cc).

Evaluation of the acute and late GU complications included acute urinary retention ,hematuria and high grade frequency.

Evaluation of the acute and late GI complications included rectal bleeding .

mean follow-up time of 19 months. (Max: 48months, Min 4 months)

Results:

, 5/48 patients developed rectal bleeding (10.41%). Four of them had prostate size greater than 50 cc, with the mean of 63.92 cc per CT measurement.

All of them received 40 Gy on 78.8 % , 69.8%, 71.73%, 65.3% of the rectum volume respectively.

They received 65 Gy on 27.5 % , 31.2%, 29.6%, 31.7% of the rectum volume respectively.

One patient developed gross hematuria 8 months after completion of the radiation therapy. In this patient prostate volume is 34.48 per CT measurement .

Rectal bleeding resolved with APC

There was no evidence of acute urinary retention (AUR) requiring intervention due to treatment in long term follow up.

The average volume of the prostate was 55.27 (range 25.72-160.65) according to CT

and 47.09 cc (range 12- 119) according to TRUS.

Mean of CT sizes was 11.28 cc higher than TRUS sizes (59.96 vs.48.68) which is 35%.

There is a significant difference between patients who received 65 Gy to the rectum with

GI complications.

Study patients with radiation of 65 Gy to 27.5%, 31.2% and 29.6% of their rectum respectively, had higher GI complications (p-value:0.04).

There is a significant difference between patients who received 65 Gy to the 26.4%,

45.2% and 24.9% of the bladder volume respectively. These patients who received 65

Gy to the bladder had higher GU complications (p-value:0.05).

There is a significant difference in patients who received 40 Gy to the 65% of the bladder. These patients had higher GU complications (p-value:0.05).

There is no correlation between pre-treatment CT measured volume of the prostate with GI and GU complications (p-value:0.97).

Conclusion:

There was no acute urinary retention requiring intervention.

LL-ROS-SU3B • Definitive Chemoradiation Boosted by Low-dose-Rate Brachytherapy in Cervical Cancer: Long Term Clinical Outcomes

Tamer Refaat Abdelrhman MD,PhD (Presenter) ; Eric D Donnelly MD ; Caroline Novak ; Ye Yuan ; Jonathan B Strauss MD ; William Small MD ; Irene Helenowksi ; Alfred W Rademaker PhD ; Julian C Schink MD ; John R Lurain

ABSTRACT

Purpose: To review and report the long-term treatment induced adverse events and clinical outcomes of concomitant chemoradiotherapy boosted by low-dose-rate (LDR) conventional brachytherapy (BT) in patients with locally advanced cervical cancer.

Patients and Methods: After obtaining institutional review board approval, we reviewed the records of patients with stage IB1 through IVA, intact cervical cancer who were treated at our institution between 1983 and 2009. Eligible patients underwent definitive radiotherapy with external beam radiation concomitant with cisplatin-based chemotherapy and boosted by LDR brachytherapy. Patients and tumor characteristics, treatment induced adverse events including gastrointestinal (GI), genitourinary (GU) and skin toxicities, as well as clinical outcomes including local control (LC), distant metastases free survival

(DMFS), disease free survival (DFS) and overall survival (OS) were reviewed and reported.

Results: A total of 135 patients were eligible and included; the median age was 46 (range 26 to 81), stages IB, II, III, IVA were 28.9%, 48.2%, 17.8% and 5.2% respectively, 92, 41 and 2 patients were treated with concurrent cisplatin, cisplatin and 5 Fu and cisplatin and bevacizumab respectively. For all patients OS at 5 and 10 years was 68.3% and 62.7%, DFS was 69.8% and 59.3%, LC was 84.7% and 84.7%, and DMFS was 74.0% and 68.1% respectively. At 5 years, stages IB, II, and III specific OS was 73.0%, 69.4%, and 59.4%, DFS was 74.6%, 72.3%, and 54.6%, LC was 86.7%, 85.8%, and 77.4%, and DMFS was 77.6%, 77.9%, and 54.6%, respectively. At 10 years, stages IB, II, and III specific OS was 58.4%, 64.4%, 59.4%, DFS was 49.0%, 67.2%, and 54.6%, LC was 86.7%, 85.8%, and 77.4% and DMFS was 67.9%, 72.3%, and 54.6%, for stages IB, II, and III respectively. GI, GU, and skin Grade 3 and 4 acute toxicities were reported in 3.7%, 0.0% and 3.7% of patients while chronic Grade 3 and 4 toxicities were reported in 17.8%, 11.1% and 3.7% of patients respectively.

Conclusion: Definitive chemoradiation followed by conventional LDR BT boost is effective, feasible and tolerable treatment modality for locally advanced cervical cancer. The treatment induced adverse events and clinical outcomes are comparable with other recent reports using image-guidance BT planning. The favorable outcomes we report are reflective of the inherent radiobiological advantage of LDR BT. This highlights the importance of further evolution in image-guided BT to obtain superior toxicity profile or treatment outcomes compared to the conventional BT planning.

LL-ROS-SU4B • Comparison of Stereotactic Body Radiotherapy and Conventionally Fractioned Radiotherapy in Inoperable Non-small Cell Lung Cancer

Mohammad Jaffar (Presenter)

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

Sunday, 01:30 PM - 06:00 PM • S405AB

[RO](#) [OI](#) [IR](#) [GU](#)

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VSI011 • 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.

VSI011-01 • Controversy 1-T1a Renal Tumor: Resect, Ablate, or Follow

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI011-02 • Small Renal Mass (T1a): The Case for Resection

Adam S Feldman MD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI011-03 • 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 optimal choice as a first-line therapy. RCTs are still necessary to assess if RFA is better than surgery for early RCC.

VSI011-04 • 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.

VSI011-05 • 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.

VSI011-06 • Controversy 2-Small Renal Mass (T1a) Ablation is Chosen. Heat or Cold?

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI011-07 • Small Renal Mass (T1a): The Case for Heat Based Ablation

Debra A Gervais MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI011-08 • 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. Univariate 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 • Bopsy or No Bopsy 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 • Bopsy or No Bopsy 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 Vlamincck 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.

Radiographic Evaluation of the Post-Radiotherapy Brain

Sunday, 02:00 PM - 03:30 PM • E352

RO **OI** **NR**

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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-Shiple, MD

LEARNING OBJECTIVES

1) Discuss the expected radiographic findings following radiation therapy including radiosurgery. 2) Discuss the occurrence 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

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Image Guidance in the Treatment Room

Sunday, 02:00 PM - 03:30 PM • S504AB

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PH **RO**

RC122 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator
Laurence E Court , PhD

LEARNING OBJECTIVES

1) Terminology to describe uncertainties. 2) Methodologies for evaluating uncertainties in IGRT. 3) Uncertainties in IGRT technologies, including mitigation strategies (generic, not site-specific).

RC122A • Terminology to Describe Uncertainties and Methodologies for Evaluating Uncertainties in IGRT

Laurence E Court PhD (Presenter)

LEARNING OBJECTIVES

1) Understand the different sources of uncertainty in radiation therapy. 2) Be able to identify the different terminology used to categorize uncertainties in radiation therapy. 3) Have the rationale to judge published work, and determine whether the reported uncertainties are appropriate and applicable to the local institution.

ABSTRACT

IGRT is now standard-of-care for many treatment sites. The appropriate use of IGRT has the potential to reduce uncertainties in the radiation therapy treatment, and can potentially allow for reducing treatment margins. The first step in reducing margins is to understand the different sources of uncertainty. Institutions may establish their own uncertainties, and may also utilize published data. In order to do this, it is important that the physicist understands the different potential sources of uncertainty in radiation therapy, and also understands different approaches to categorizing uncertainties, systematic and random. There is currently no consensus on how these uncertainties are measured or reported, and this can lead to confusion when interpreting published data. This presentation will describe the different sources of uncertainty, and introduce the learner to different approaches used in the literature to quantify these uncertainties.

RC122B • Uncertainties in IGRT Technologies, Including General Mitigation Strategies

Timothy Craig PhD (Presenter) *

LEARNING OBJECTIVES

1) Appreciate the breadth of IGRT technologies used in the radiation therapy treatment room. 2) Understand the different sources of uncertainty for different IGRT approaches. 3) Understand approaches to mitigating the limitations of different IGRT technologies.

ABSTRACT

There is a large variety of technologies available for image-guided radiation therapy (IGRT), including 2D projection x-ray imaging (kilovoltage (kV) and megavoltage (MV)), computed tomography (conventional, MV, and cone-beam), ultrasound, and radiofrequency emitting markers. There are also different methodologies for using these technologies, or combinations of these technologies. Each technology has its own uncertainties and limitations which should be well described and understood. Similarly, each technology has different approaches available for mitigating these uncertainties that need to be appreciated. In this presentation we will describe and compare the different technologies and IGRT approaches, and give an overview of the uncertainties involved in the use of each.

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

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 nodes of the neck. 2) Review the radiological anatomy and landmarks for identifying lymph node groups. 3) Review the primary eschelon drainage patterns of various head and neck subsites.

ABSTRACT

1. Review the normal anatomy of the lymph nodes of the neck
2. Review the radiological anatomy and landmarks for identifying lymph node groups
3. Review the primary eschelon drainage 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 inelastic 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

RO **OI** **OB** **GU**

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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 Hohenwarter, 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 brachytherapy 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.

Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology

Monday, 08:30 AM - 10:00 AM • S104A

RO **OI** **MI**

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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

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Margins and Margin Design

Monday, 08:30 AM - 10:00 AM • S102C

PH **RO**

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RC222 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator

Laurence E Court, PhD

LEARNING OBJECTIVES

1) Incorporating IGRT uncertainties into treatment margins. 2) Approaches to using margins to mitigate uncertainties.

RC222A • Incorporating IGRT Uncertainties into Treatment Margins

Timothy Craig PhD (Presenter) *

LEARNING OBJECTIVES

1) Be able to identify the different terminology used to describe margins in radiation therapy. 2) Understand how different types of uncertainty contribute to the appropriate treatment margin. 3) Demonstrate an understanding of the many factors that can influence the margins required to account for treatment uncertainties. 4) Have the rationale to determine which approaches could/should be applied in their own practice.

ABSTRACT

During treatment planning a safety margin is added to the clinical target volume to ensure that the planned dose is actually delivered to the target. This margin may be calculated by correctly combining the contributions to the overall treatment uncertainty from numerous individual uncertainties. Once the uncertainties have been categorized, there are many ways in which they can be combined to give the actual treatment margin, and this must be done in a considered way. In this presentation we will describe how different uncertainties should be combined. We will describe published margin recipes, including the impact of different assumptions made in each recipe. These concepts will be discussed in the context of guidance documents from the International Commission on Radiation Units and Measurements.

RC222B • Approaches to Using Margins to Mitigate Uncertainties

Laurence E Court PhD (Presenter)

LEARNING OBJECTIVES

1) Understand practical approaches used to determine appropriate treatment margins. 2) Have the knowledge/skills to apply margin formulae in the IGRT era. 3) Appreciate the limitations and risks of applying margin formulae.

ABSTRACT

One advantage of IGRT is the potential for reducing margins. Clinical margins are typically determined in one of 3 ways: (1) Use same margins as before (pre-IGRT), (2) Reduce margins based on supposed improvement in accuracy/precision, perhaps based on published data, or (3) Evaluate institutions own uncertainties, and establish appropriate margins. The first two are probably the most common. However, each of these approaches has its own pitfalls: (1) does not take full advantage of our new technologies, (2) is fraught with potential error, including the fact that many published works do not adequately assess uncertainties, and (3) can be difficult, and not all physicists have the background knowledge to do this. In this presentation we will describe some practical approaches to using margin formulae and other methods used to determine safe clinical margins. The limitations, risks and pitfalls will be described.



MSRO22 • 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
Sung Kim, MD
Moderator
Simon S Lo, MD

MSRO22-01 • Invited Speaker:
John C Grecula MD (Presenter) *

MSRO22-02 • Induction Chemotherapy Plus Intensity Modulated Radiation Therapy for Locally-advanced Oropharyngeal Cancer: Prognostic Value of PTV

Carlo Furlan (Presenter)

ABSTRACT

Purpose: To assess the prognostic value of the PTV dimension in patients affected by locally advanced oropharyngeal carcinoma (OPC) treated with induction chemotherapy (CT) followed by radical IMRT.
 Patients and methods: 38 consecutive stage III-IV OPC patients who underwent induction CT followed by SIB-IMRT were analyzed. CT consisted of TPF (docetaxel, platinum and 5-FU) delivered for 3 cycles before radiotherapy in all patients.
 The maximum radiation dose, consisting of 66 Gy-70.95 Gy in 30-33 fractions, was prescribed to the PTV70, that included the initial extent of disease (pre-CT GTV plus 0.5-0.8 mm margin). The node-negative neck received a total dose of 54-62.70 Gy in 30-33 fractions. Patients were divided into two groups according to the PTV70 dimensions: 97.5cc.
 Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was to test potential risk factors including PTV70 volume.
 Results: The median follow-up was of 28 months (range, 6-141 months). The median age was of 59 years (range, 36-80 years), and 24 patients (63%) were male. Eight patients were stage III (21%), and 30 (79%) stage IV. All patients were staged with CT-scan and/or MR. Twenty-nine patients (76%) were staged with FDG-PET/CT.
 The median PTV70 dimension was of 95,7 ml (range, 45 ml-512 ml). Eighteen patients (47%) had a PTV70 < 97.5 ml (mean volume 78,2 ml), and 20 (53%) patients had a PTV70 > 97.5 ml (mean volume 341,6 ml).
 After induction CT, 11 patients had CR (29%), 24 PR (63%), and 2 SD (5%); one experienced locoregional progression of disease.
 The actuarial rates of DFS and OS were 71% and 88% at 3 years, respectively.
 At the univariate analysis PTV70 dimension does not correlate with DFS and OS (p = 0,77).
 Conclusions: Treatment with 3 cycles of induction TPF followed by SIB-IMRT is not influenced by PTV70 volume in terms of DFS and OS in locally-advanced OPC.

MSRO22-03 • Radioprotection of Murine Salivary Glands by Botulinum Toxin

Youssef Zeidan MD, PhD (Presenter) ; **Nan Xiao** PhD ; **Hongbin Cao** ; **Christina Kong** MD ; **Davud Sirjani** MD ; **Quynh-Thu X Le** MD

PURPOSE

Xerostomia is the most common chronic radiation toxicity affecting the quality of life of head and neck cancer (HNC) patients. Botulinum toxins (BTX) have been successfully used in treating sialorrhea in pediatric patients and radiation-induced cystitis, proctitis, fibrosis and facial pain. This study evaluates the effect of BTX on radiation-induced salivary gland damage.

METHOD AND MATERIALS

Submandibular glands (SMGs) of male C5BL6 mice (10-12 wks) were directly injected with saline or botulinum toxin via an open procedure. After 72 hrs, a focal submandibular field was irradiated on a kilovoltage machine to a total dose of 15 Gy. Pilocarpine-induced saliva flow was measured at 3, 7 and 28 days post irradiation. At different time points, submandibular glands were collected for weight, immunofluorescence and Western blotting analysis. Myeloperoxidase staining was used to study neutrophil infiltration. TUNEL staining was used to evaluate cell death. A cytokine array, consisting of 40 different mouse cytokines was used to evaluate cytokine profiles after radiation treatment.

RESULTS

Histologically, BOT pretreated glands showed relative preservation of acinar volume post irradiation and less periductal fibrosis compared to saline control. At 3 days post irradiation, saline-injected mice showed a 50% reduction in basal saliva flow. However, mice preinjected with botulinum toxin maintained 75% of initial saliva flow (p

CONCLUSION

Taken together, these data indicate that BTX intraglandular injection reduces radiation-induced salivary dysfunction through modulation of neutrophil infiltration and CXCL5 levels. Our findings have important implications for future targeting of xerostomia in HNC patients.

CLINICAL RELEVANCE/APPLICATION

This work uncovers a novel mechanism for radiation-induced salivary gland damage.

MSRO22-04 • Radiation Therapy in Tri-modality Treatment for Esthesioneuroblastoma
Jonathan Wallach (Presenter)

MSRO22-05 • Percutaneous Computed Tomography-guided Permanent I125 Implantation for Treating Recurrent Head and Neck Cancer

Suqing Tian (Presenter)

ABSTRACT

Abstract

Background: To investigate the therapeutic efficacy of computed tomography (CT)-guided permanent percutaneous implantation of iodine-125(¹²⁵I) for treating recurrent head and neck cancers.

Methods: Thirteen patients with recurrent head and neck cancer (previously treated with a total cumulative dose exceeding 100 Gy) were included in this study. ¹²⁵I seeds were implanted into recurrent head and neck lesions by CT-guided needle puncture. Treatment responses were evaluated during follow-up by contrast-enhanced CT. Survival was analyzed using the Kaplan-Meier method.

Results: The tumor response rate was 84.0%. The overall median control time was 24.0 months. The local control rate was 57.8% and 34.5% at 1 and 2 years, respectively. The overall 1- and 2-year survival rates were 61.9% and 38.1%, respectively. No serious complications were observed postoperatively and during the follow-up period.

Conclusion: Ultrasound-guided brachytherapy using ¹²⁵I seed implantation is safe and effective for treating recurrent head and neck cancer.

MSRO22-06 • Development of a Standardized Method for Contouring the Larynx and Its Substructures

Mehee Choi MD (Presenter) ; **Tamer Refaat Abdelrhman** MD,PhD ; **Ian Bacchus** PhD ; **Malisa S Lester** MD ; **Alfred W Rademaker** PhD ; **Bharat B Mittal** MD *

PURPOSE

Limiting radiation dose to the larynx can diminish effects of laryngeal dysfunction. However, no clear guidelines exist for defining the larynx and its substructures consistently on cross-sectional imaging. This study presents computed tomography (CT)- and magnetic resonance imaging (MRI)-based guidelines for contouring laryngeal organs-at-risk (OARs).

METHOD AND MATERIALS

Using published anatomic information and radiologic data, standardized guidelines for delineating the larynx and its substructure organs at risk (OARs) on 3-mm axial CT images were devised. Based on the guidelines, the OARs were delineated on CT and MRI for five consecutive patients with non-laryngeal head and neck cancer. Volumetric comparisons between CT and MRI contours were performed to validate that the guidelines can be applied consistently to radiotherapy-planning CT scans as well as MRI scans in a reproducible manner. The guidelines were then used to delineate the OARs on radiotherapy-planning CT scans of 44 additional patients treated with chemoradiation for head and neck cancer. Further volumetric comparisons were made to establish the consistency of guideline-based contours.

RESULTS

The larynx and its substructures were successfully created on CT and MRI datasets for five patients, using the proposed guidelines. Differences in OAR volumes

were not statistically different between CT and MRI. Comparisons of 44 additional CT-based contours with the five initial CT-based contours and MRI-based contours showed no significant differences in OAR volumes.

CONCLUSION

The contouring guidelines developed provide a precise, reproducible method for delineating the larynx and its substructures on treatment-planning CT scans. Similar guidelines could be used for MRI-based planning. Clinical implementation of the guidelines should reduce observer variability, leading to an improved understanding of the relationship between radiation dose volume effects on laryngeal substructures and toxicity outcomes.

CLINICAL RELEVANCE/APPLICATION

This study presents guidelines for contouring the larynx and its substructures on axial CT and MR images for use in future investigations of radiation dose-volume effects on larynx dysfunction.

MSRO22-07 • Single Fraction Spine Stereotactic Body Radiation Therapy for Treatment of Chordoma

Edward W Jung MD (Presenter)

ABSTRACT

Purpose/Objective(s):

Chordoma is a rare, slow growing locally aggressive bone tumor arising from embryologic notochord that affects 300 new patients each year in the United States. Only 10% to 20% of tumors arise in the cervical, thoracic, or lumbar spine. Because chordomas are radioresistant, involvement of the spine presents a therapeutic challenge due to the high doses of radiation needed for local control along with proximity to the spinal cord, a dose-limiting organ. There are currently no published reports in the literature exclusively looking at outcomes of spine Stereotactic Body Radiation Therapy (sSBRT) treatment of chordoma. The purpose of this study is to determine the efficacy and safety of treatment with single fraction sSBRT for chordoma of the spine.

Materials/Methods:

A retrospective review of our IRB approved registry from 2007 to 2012 identified 6 patients with chordoma of the spine who were treated with sSBRT for a total of 9 treatments. Five of six patients were treated with curative intent. Surgical resection was performed in 5 of 9 cases. All patients were treated on a Novalis Radiosurgery unit with coplanar beams. A thermoplastic head mask or a vacuum-form body immobilization device (BodyFix) was used depending on tumor location. Cone beam CT or ExacTracTM image guidance systems were used for positioning and localization. The treatment volume was defined by the bony vertebral level of the lesion along with soft tissue extension appreciated on MRI scans (T1 and STIR sequences) as per RTOG 0631 guidelines. Post treatment MRI scans were assessed for local control, recurrence, and disease progression. Individual patient records were reviewed to assess for symptomatic relief and failure. Treatment toxicity was evaluated using the Common Terminology Criteria for Adverse Events v4.0.

Results:

Median age was 58 years (22 - 83). Median KPS was 70 (40 - 90). Median target volume was 19 cm³ (1 - 304). Median prescription dose was 16 Gy (11 - 16). Median conformality index was 1.35 (1.15 - 3.21). Median homogeneity was 1.12 (1.05 - 1.19). Median follow-up time was 10 months (0.5 - 34). Local control at 12 months was 88.8% with one local failure. All patients presented with spinal pain, and pain was improved in 50% of patients treated. One patient developed limited cord myelopathy that resolved with steroids. There were no other treatment toxicities from sSBRT.

Conclusion:

Spine SBRT can be safely and effectively delivered to treat chordoma of the spine with the potential to improve pain symptoms. Single fraction sSBRT compares favorably with other treatment platforms and techniques based on this early data. Longer follow-up with more patients is necessary to determine the exact role of sSBRT in the treatment of chordomas of the spine.

MSRO22-08 • Re-irradiation of the Head and Neck Using Highly Conformal Tomotherapy IMRT

Daniel A Jones MD (Presenter)

ABSTRACT

Purpose/Objective(s): There is no standard of care regarding re-irradiation of the head and neck. The difficulty of balancing the benefit of tumor control with that of increased normal tissue toxicity may be partially negated with proper patient selection and highly conformal radiation therapy. The purpose of this study was to analyze the outcomes of patients with a second primary and/or recurrent head and neck cancer treated with re-irradiation and to identify patients who are most likely to benefit.

Materials/Methods: We retrospectively reviewed 24 patients treated with re-irradiation to the head and neck, between March 2008 and July 2012. There were 17 patients with recurrent tumors, 5 with second primaries, and 2 with both second primaries and recurrences. Tumor factors included volume of recurrence (median 12.5 cm³, range 1.5-400,) and recurrence location (local only (12,) neck only (5,) local + neck (3,) and local + distant (3.) Patient factors included age, median 62 (27-77,) and performance status, (20 with ECOG 0-1, 4 with ECOG 2-3.) Three patients were unresectable and underwent biopsy only. Four underwent subtotal resection or debulking. Seventeen underwent gross total resection, thirteen with positive margins, and four with negative margins. All but two patients were treated with conventionally fractionated tomotherapy IMRT. Fourteen underwent concurrent chemoradiation, typically with platinum based regimens.

Results: Patients were followed for a median of 10 months, minimum of 8 months among survivors. Patients were treated with a median dose of 60 Gy (44-70.) Kaplan-Meier estimates for 1 year local control, recurrence free survival, and overall survival was 58% (95% CI 36-75,) 40% (95% CI 20-59,) and 68% (95% CI 44-83.) Kaplan-Meier estimates for 2 year local control, recurrence free survival, and overall survival was 41% (95% CI 17-64,) 20% (95% CI 6-41,) and 25% (95% CI 8-46.) Median survival was 15 months (95% CI 10-20.) There were 3 long term survivors, at 24, 24, and 32 months, all of which are disease free. Toxicity was significant with twelve patients permanently dependent on a feeding tube and two dying of carotid artery bleeds.

Conclusions: In our series, patients were mostly treated with highly conformal conventionally fractionated Tomotherapy IMRT. Outcomes are similar to those achieved in other published series. Local control at one and two years was encouraging at 58% and 41%, and re-irradiation likely reduced morbidity associated with local progression. The heterogeneity and the small sample size limit generalizability of the study results to future patient management. Likely, treatment with highly conformal techniques such as with Tomotherapy IMRT, improve the ability to control disease and reduce toxicity.

MSRO22-09 • Metastatic Carcinoma of Unknown Primary to Cervical Lymph Nodes: Treatment Patterns, Outcomes, and Patterns of Failure

Varun K Chowdhry MD (Presenter) ; Michael Farris MD ; Seung S Hahn MD ; Jack M Hsu MD ; Michael A Lacombe MD

ABSTRACT

Purpose/Objective: Metastatic squamous carcinoma of unknown primary origin to the cervical lymph nodes poses a complicated diagnostic and therapeutic challenge. Due to rare nature of the disease, treatment is based on retrospective data.

Materials/Methods: Thirty-four patients with head and neck cancer of unknown primary were treated at Upstate Medical University between 2000-2012. The charts were retrospectively reviewed for treatment patterns, toxicity, outcomes, and patterns of failure. The volume and dose for each patient was at the discretion of the treating physician based on patient factors, pathology, location of disease, and clinical stage.

Results: The median age of patients in this series was 57.5 (range, 41-89). Sixteen patients (47%) had a neck-dissection prior to radiotherapy. Eleven patients (32.4%) were treated with either 2D or 3D planning and 23 patients (67.6%) were treated with Intensity Modulated Radiotherapy (IMRT). The median dose to gross disease 6600 cGy (range 3000-7200). The median dose to high risk mucosal sites was 5800 cGy (range, 0-6500 cGy), and median dose to uninvolved cervical chains was 6000 cGy.

Two patients were treated to the neck only (5.9%), 3 patients (5.9%) were treated to the oropharynx only, 9 patients were treated to oropharynx and nasopharynx (26.5%) using laryngeal sparing IMRT, and 15 patients were treated to the oropharynx, nasopharynx, hypopharynx and larynx. Dosimetric analysis of patients treated with a laryngeal sparing technique was performed and it estimated that the dose to the larynx and hypopharynx was approximately 4000 cGy.

Four patients (13%) developed distant metastatic disease. Four patients (13%) recurred loco-regionally in the neck, and 3 of these (9%) were neck only recurrences. One patient (2%) had a primary surfaced after definitive therapy, and the primary was found to be in the oral cavity. There was no statistically significant difference between sites treated and incidence distant disease (p=.203). Seven patients (20.5%) had a neck dissection after definitive radiotherapy or chemoradiotherapy, and one patient (14.2%) was found to have residual disease at the time of neck dissection. Median survival calculated using Kaplan-Meier method 2509 days, 95% CI (2067,2950) days. Median follow-up was 22 months.

Conclusions: We report overall low rates of treatment failures, which were noted to be primarily in neck and distant. We noted only one primary site local failure in the oral cavity, a site not traditionally treated in patients with unknown primary head and neck cancer. We did not note increased local, loco-regional or distant failures in patients treated with laryngeal sparing IMRT, oropharynx only, or neck only. However, proper patient selection is critical in determining which patients can be treated with limited volumes.

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

Monday, 10:30 AM - 12:00 PM • S103CD

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] patient's 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 / m² 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-planned 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-scaled 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			%			Rigid	Deformable
	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.

Gastrointestinal (Oncology: Surveillance and Tumor Response)

Monday, 10:30 AM - 12:00 PM • E451A

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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 Alkadhhi** 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, $P=0.010$). 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 >55 HU 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 >12 s 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, 0.08 m/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, $36 \sim 77$ 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 gadoteric 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, gadoteric 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 metastatic 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 $\diamond true \diamond$ 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 $\diamond true \diamond$ 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) ($10^{-3} \text{ mm}^2/\text{s}$) 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

Radiation Oncology and Radiobiology (Lung II)

Monday, 10:30 AM - 12:00 PM • S104A

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SSC15 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Moderator

Allen G Meek, MD

Moderator

Zhongxing Liao, MD

SSC15-01 • Assessing Response to Radiochemotherapy Treatment on 18F-FDG PET in Non-small Cell Lung Cancer Using Approaches of Histogram and Gray Level Co-occurrence Matrix

Changsheng Ma MS (Presenter) ; **Yong Yin**

ABSTRACT

Purpose: The aim of this study was to propose and investigate gray level histogram and texture features information provided by 18F-FDG PET to assess patient's imaging response to radiochemotherapy in non-small cell lung cancer (NSCLC).

Methods: Twelve patients with newly diagnosed NSCLC treated with combined radiochemotherapy were involved in this study. Patients were categorized under three headings (non-responders, partial responders and complete responders) by experienced radiologists on the basis of RECIST according PET scans changes between pretreatment and 1 month after treatment. We analyzed the percentage variation of PET density using histogram analysis approach which characterizes global change of tumor region on PET. Texture parameters variation between pretreatment and 1 month after treatment completion which describe local voxel spatial distribution were extracted from Gray Level Co-occurrence Matrix (GLCM). Correlation between characteristics' variation and three type response status were analyzed.

Results: The uniformity of gray level histogram on the whole and the maximum percentage decrease in histogram was well associated with tumor shrinkage and response status. The above indices derived from histogram were capable to differentiate three groups tumor response to radiochemotherapy. Texture parameters' variation (ASM, ENT and IDM) were able to differentiate the 3 response groups considering a high correlation with response status.

Conclusion: We demonstrated that histogram and texture analysis methods on baseline 18F-FDG PET scans provided robust, discriminative stratification in assessing response to combined radiochemotherapy and may have a good application prospect in clinical practice.

SSC15-02 • SPECT-based Functional Lung Imaging for the Prediction of Radiation Pneumonitis: A Clinical and Dosimetric Correlation

Douglas Hoover (Presenter) ; **Robert Reid** ; **Eugene Wong** PhD ; **Eric Sabondjian** ; **George Rodrigues** ; **Brain P Yaremko**

SSC15-03 • Pleural Invasion by Lung Cancer: Evaluation with 3 Dimensional CT

Yoshiyuki Takahashi (Presenter) ; **Shodayu Takashima** ; **Hodaka Numasaki** PhD ; **Daisuke Morimoto** ; **Binghu Jiang**

PURPOSE

We studied the value of computer-aided 3 dimensional (3D) CT for diagnosing pleural invasion by lung cancer.

METHOD AND MATERIALS

This series included 207 peripheral lung cancer of 3 cm or smaller in 205 consecutive patients (mean age, 67±9 years; 125 men and 86 women) who had contrast enhanced 16-slice MDCT with 1-mm collimation before surgery. All nodules were in contact with the pleura on CT images. Greatest transverse and vertical diameters of nodules, greatest contact length and contact areas between nodules and pleura, and incidence of pleural thickening, angle patterns (acute or obtuse) of nodules and pleura, and our originally classified 4 3D rendering patterns of the pleura (flat, skirt-like, rectangular solid, and waving) were compared between nodules with and without pleural invasion and statistically significant factors were assessed with stepwise logistic modeling to study the most significant factor for predicting pleural invasion and then its diagnostic statistics were calculated.

RESULTS

Pleural invasion was pathologically verified in 61 (29%) of 207 nodules. Greatest transverse diameters of nodules (p

CONCLUSION

Computer-aided 3D rendering analysis of the pleura was useful for diagnosing pleural invasion by lung cancer.

CLINICAL RELEVANCE/APPLICATION

3D rendering analysis of the pleura may provide useful information on staging of lung cancer and therefore may contribute to management of patients with peripheral lung cancer.

SSC15-04 • Rate of 18FDG-PET Parameter Decline Early During Radiotherapy Predicts Clinical Outcomes in Locally-advanced Non-small Cell Lung Cancer (LA-NSCLC)

Victor Mangona MD (Presenter) ; **Larry L Kestin** MD ; **Dan Ionascu** PhD ; **Ovidiu Marina** ; **Bor-Tau Hung** ; **Mackenzie C McGee** MD ; **Ching-Yee O Wong** MD, PHD ; **Di Yan** ; **Inga Grills** MD

PURPOSE

To determine on-treatment (OT) 18FDG PET-CT parameters predictive of clinical outcomes for response-based adaptive radiotherapy (RT).

METHOD AND MATERIALS

16 consecutive patients from 2009-11 with node+ cstage IIIA (n=9) and IIIB (n=7) NSCLC received 1.5 Gy BID RT with concurrent chemotherapy on a prospective phase I/II protocol. RT dose was 60-72 Gy (n=12) (54 Gy if neoadjuvant, n=4) using IMRT with daily online CBCT. 4D dual-phase PET-CTs were obtained weekly during RT. Actual and %baseline max dimension (cm), bidimensional product (BDP, cm²), SUVmean, SUVmax, PET volume (vol), and total glycolytic activity (TGA=SUVmean x PETvol) were assessed. Rate of change was estimated with slope of linear regression. All PET vols were measured with the PET edge tool (MIM software™) = 25 times (average reported) attempting coverage of 50% SUVmax. Clinical outcome groupings were compared with the Mann-Whitney U test (medians listed) and Cox proportional hazards.

RESULTS

Overall and potential FU was 19.4m (30.4 in living pts) and 33m (25-42), age 66y, dose 65Gy, max dim. 6.2 cm, vol 40cc, and 4 OT PETs per pt (66 total). At 2y, 7 of 16 had locoregional recurrence (tumor/LNs, LRR); 5 distant metastasis (DM); 8 death, and 5 death of disease (DOD). Time until LRR, DM, death, and DOD events were 10.8, 7.6, 11.4, and 11.8 mos, respectively. Despite higher baseline SUVmean (7.3 v 5.5) and SUVmax (13.8 v 10.2) (p

CONCLUSION

Rates of decline of multiple metabolic parameters within the first 3 wks of treatment carry potential for predicting long-term outcomes after RT for NSCLC. In this sample, TGA was most predictive for LRR, DM, and DOD. During-treatment response-based adaptation of dose is worthy of investigation.

CLINICAL RELEVANCE/APPLICATION

Early PET response parameters during RT, particularly total glycolytic activity (TGA), predict long-term clinical outcomes. Such parameters may facilitate a treatment response-based dose modification.

SSC15-05 • SUVmax and GLUT-1 Expression Correlate with Treatment Failure in Stage I Lung Adenocarcinoma

Todd Aguilera MD, PhD (Presenter) * ; **Maximilian Diehn MD, PhD *** ; **David Shultz MD, PhD** ; **Nicholas Trakul MD, PhD** ; **Viswam S Nair MD** ; **Robert West MD, PhD** ; **Billy W Loo MD, PhD ***

PURPOSE

Stage I non-small cell lung cancer (NSCLC) can be treated with surgery or stereotactic ablative radiotherapy (SABR) and predictors of treatment failure may enable selection of patients for adjuvant treatment. Glycolytic metabolism, as assessed by SUVmax in 18F-fluorodeoxyglucose PET, glucose transporter type I (GLUT-1 or SLC2A1) protein or mRNA expression, may correlate with outcome in Stage I NSCLC. We set out to explore if FDG uptake, and SLC2A1 protein or RNA expression correlate with outcomes in Stage I NSCLC patients treated with SABR or surgery.

METHOD AND MATERIALS

To determine disease free survival (DFS) We examined the records of 100 adenocarcinoma (AC) and 78 squamous cell carcinoma (SCC) Stage I NSCLC patients treated at Stanford. Thirty-five AC and 16 SCC tumors received SABR and 65 AC and 62 SCC received surgery. SUVmax was determined for SABR patients, and GLUT1 protein was evaluated in surgical patients. Lastly, we examined the association of SLC2A1 mRNA expression with outcomes in 778 NSCLC surgically treated patients.

RESULTS

Among radiotherapy patients, 11 AC and 3 SCC, failed treatment locally, regionally or distantly. The median SUVmax for AC of 7.8 (range 1.4-31.8) was significantly associated with 5-year DFS (Hazard Ratio [HR] 1.12, Confidence Interval [CI] 1.01-1.24) while the median SUVmax for SCC of 14.3 (range 3.1-25.4) did not associate with 5-year DFS (HR 1.06, CI 0.87-1.29). In surgical patients GLUT-1 was high in 23% and 62%, intermediate in 37% and 24%, and low in 40% and 13% in AC and SCC patients respectively. There were 10 AC and 15 SCC failures and GLUT-1 staining significantly associated with 5-year DFS for AC (HR 2.39, CI 1.07-5.33) but not SCC (HR 0.74, CI 0.39-1.41). SLC2A1 expression in 778 NSCLCs profiled using DNA microarrays confirmed association of SLC2A1 expression with outcome in AC and non-SCC patients (HR 1.44, CI 1.25-1.66), but not for SCC patients (HR 1.07, CI 0.84-1.37).

CONCLUSION

SUVmax in SABR patients, and SLC2A1 expression in surgical patients strongly associate with outcomes in stage I lung AC but not SCC. Therefore, SUVmax and/or SLC2A1 expression may be useful biomarkers for identifying stage I AC patients at highest risk for disease recurrence.

CLINICAL RELEVANCE/APPLICATION

In the assessment of curable early stage lung cancer risk stratification based on imaging characteristics can guide clinical management. FDG-PET will play an important role in this assessment.

SSC15-06 • Comparison of Auto-segmented PET Volumes in Lung Tumors with CT Based Manual Contours: Implications in Radiotherapy Planning

Madhava Kanakamedala MD (Presenter) ; **Shankar P Giri MD** ; **William N Duggar** ; **Srinivasan Vijayakumar MD**

ABSTRACT

Purpose/Objective(s):

The aim of this study was to compare GTV volumes drawn manually on CT scans with GTV delineation on FDG PET scans utilizing an automatic threshold (SUV 3) and gradient-based (PET Edge) auto-segmentation methods in lung tumors and discuss implications in radiation planning.

Materials/Methods:

Nineteen patients with lung carcinoma treated with radiation therapy, whose PET scans were done within 30 days of simulation CT were enrolled. FDG-PET/CT and planning CT were transferred to the MIM software (MIM Vista Corp, Cleveland, OH) and fused using a deformable registration algorithm. For each patient three GTV's were defined. GTV for CT was manually contoured on CT scans using lung window for lesions well within the lung parenchyma and a mediastinal window when it was adjacent to mediastinum or chest wall. For GTV SUV3, a circle of interest was created with a margin around the lesion, excluding blood pool (heart) and auto segmented with SUV value of 3. The GTV-PET Edge was auto segmented using a PET Edge tool centered on the hyper metabolic area.

Statistical Methods: Spearman correlation coefficients were constructed to view relationships between variables, and sign tests were used for inference.

Results:

Among 19 patients 3 were small cell, 16 were with non-small cell carcinomas (9 squamous cell and 6 adenocarcinoma). As per the AJCC 7th Ed, 7- they had 3 stage I, 8 stage II and 8 were stage IIIA. Only two patients had associated consolidation and atelectasis.

Median CT volume for all lesions was 18.96 (range 0.82-630.9), PET Edge median 8.9 (range 0.74-507.610), SUVs 3 median 26.93 (058-723.15). Correlation between CT and SUV 3, SUV 3 and PET edge, CT and PET Edge were 0.9474, 0.9526 and 0.9211 respectively.

No significant differences between CT and SUV 3 volumes ($p=0.648$). But PET edge volumes were significantly less compared to CT volumes ($p=0.032$). On average PET edge volumes were 10.06 cc less than the CT volumes.

Conclusions:

CT overestimates GTV volume in lung tumors with no additional or negative margins required to create CTV (Chan et al). Surgical pathologic studies determined CTV margins of 6mm for SCC and 8mm for ADC, beyond gross pathological tumor. In phantom studies auto segmentation using PET edge tool was shown to be superior to other methods and better correlated with pathology.

In our study the GTV based on CT and SUV 3 was similar while the GTV based on PET edge was consistently smaller. PET SUV 3 is valuable when contouring a GTV using PET/CT fusion as it could include tumor and microscopic extensions. The use of PET edge tool needs to be studied clinically to assess if the smaller volume maybe useful in small low risk tumors suitable for SBRT.

Surgical pathologic studies with larger number of patients are required to further confirm the CTV margins based on the GTV volumes generated on CT and PET auto segmented tools.

SSC15-07 • To Investigate 4D CT Images in Defining Contours Using QUASUR Programmable Respiratory Motion Simulation Platform and Lung Phantom

Changsheng Ma MS (Presenter)

PURPOSE

To analyze 4D CT images in defining contours of lung phantom using Programmable Respiratory Motion Platform.

METHOD AND MATERIALS

Acquiring 4D CT images of the respiratory motion lung phantom using varian Real-time Position Management (PRM) system. The lung portion from the Computerized Imaging Reference Systems (CIRS) phantom (Computerized Imaging Reference Systems, Inc., Norfolk, VA), was scanned using a CT scanner (Philips Big core CT) to obtain a CT HU-density table as for baseline dose calculation and stability comparison. The Quality Assurance System for Advanced Radiotherapy (QUASARTM) supports the testing of a wide variety of dosimetric and nondosimetric functions of Radiation Therapy Planning Systems and CT Simulators using a set of innovative quality assurance (QA) tools. The phantom was performed followed by a 4D CT scan of simulating free breathing phantom on a 16-slice CT scanner (Philips Brilliance Bores CT). The Translation Stage amplitude is fixed at 40mm peak to peak for the moving chest wall platform. The Display shows the speed of motion in breaths per minute 20 BPM and seconds per breath 3 SPB.

RESULTS

Compared to the actual movement, lung density phantom geometry center displacement for X axis is 1mm, 2mm for Y axis and 1mm for Z axis in 4D CT reconstruction image.

CONCLUSION

4D CT of PRM system in acquiring the respiratory motion images is accurate, easy to use, and fast. It allows for clean imaging and treatment of lung sites which affected by the respiratory motion.

CLINICAL RELEVANCE/APPLICATION

No

SSC15-08 • Radiation-induced Fibrosis after Lung Stereotactic Body Radiation Therapy (SBRT) Is Correlated with Radiation Treatment Parameters: A Timeline of Computed Tomography (CT) Changes

Mary M Salvatore MD (Presenter) ; **Miriam Knoll MD** ; **Ren-Dih Sheu PhD** ; **Sarah L Kerns PhD, MPH** ; **Abraham Knoll MD** ; **Yeh-Chi Lo PhD** ; **Kenneth E Rosenzweig MD ***

PURPOSE

Patients treated with stereotactic body radiation therapy (SBRT) for lung cancer are followed by computed tomography (CT) and most patients are found to have evidence of radiation-induced fibrosis (RIF) surrounding the treated tumor. There is no consensus regarding the size and anatomic pattern of RIF and we investigated whether treatment isodose levels could predict RIF.

METHOD AND MATERIALS

We selected 37 lung lesions in 32 patients who were treated with SBRT and had received post-treatment follow up CTs (FU-CT). Each FU-CT was fused with the patient's original simulation CT, and treatment isodose levels were overlaid onto the CT. The RIF surrounding the treated lesion was contoured. The fibrosis extension index (FEI) was defined as the volume of RIF extending outside a given isodose level relative to the total volume of RIF on FU-CT and was expressed as a percentage.

RESULTS

32 patients underwent SBRT to the planned target volume (PTV) to a total dose of 45-54 Gy in 3-5 fractions. The 1st, 2nd, and 3rd FU-CT were at a median of 6 (n=36), 10 (n=26), and 16.5 (n=6) months. The mean RIF volume at 1st, 2nd, and 3rd FU-CT was 69, 47, and 42 cc. Univariate analysis using Pearson's correlation revealed that the PTV was positively correlated with RIF volume (correlation coefficient [CC]=0.628 and $p < 0.0001$ at 1st FU; CC=0.401 and $p=0.021$ at 2nd FU; CC=0.265 and $p=0.306$ at 3rd FU). FEI40 Gy at 1st FU was significantly positively correlated with FEI40 Gy at subsequent FU's (CC=0.689 and $p=0.001$ at 2nd FU; 0.901 and $p=0.020$ comparing 2nd and 3rd FU). A similar trend was seen for FEI20 Gy, FEI30 Gy and FEI35 Gy, where 1st FU positively correlated with 2nd FU and 2nd FU positively correlated with 3rd FU. 96% and 94% of the RIF was found within the 20 Gy isodose line at the 1st and 2nd FU, respectively. 65% of patients were found to have a decrease in RIF at 2nd FU.

CONCLUSION

We have shown that radiation-induced fibrosis evolves over time and 1st FU-CT correlates well with subsequent CTs. 96% of the RIF can be found to occur within the 20 Gy isodose line, which may prove beneficial to radiologists attempting to distinguish recurrence vs. RIF.

CLINICAL RELEVANCE/APPLICATION

Communication of treatment isodose information to radiologists may improve the accuracy of reporting CTs after SBRT, and may aid with distinguishing recurrence vs. RIF.

SSC15-09 • Application of Bone Suppression Technique to Real-time Tracking Radiotherapy

Rie Tanaka PhD (Presenter) ; **Shigeru Sanada** PhD * ; **Makoto Oda** ; **Mitsutaka Suzuki** ; **Keita Sakuta** RT ; **Hiroki Kawashima** MS

PURPOSE

A recently developed image processing methodology, the bone suppression technique, can suppress the conspicuity of bones on chest radiographs, creating sort of soft-tissue images obtained by the dual-energy subtraction technique. This study was performed to evaluate the usefulness of bone suppression fluoroscopy in real-time tracking radiation therapy.

METHOD AND MATERIALS

Dynamic chest radiographs of 9 patients with lung nodules during respiration were obtained using a flat panel detector (FPD) system (CXDI-50RF; Canon Inc.) (120 kV, 0.1 mAs/pulse, 5 fps, SID = 1.0 m). Commercial bone suppression image-processing software (SoftView version 2.0; Riverain Medical) was applied to the dynamic chest radiographs to create corresponding bone suppression images. Region of interests (ROIs) were manually located on lung nodules and automatic target tracking was conducted with in-house software based on the template matching technique (MATLAB ver. 2012b; MathWorks). The size of the ROI and its search area were determined to achieve the greatest accuracy. To evaluate the accuracy of target tracking, the maximum tracking error in the resulting images was compared between bone suppression and conventional fluoroscopic images.

RESULTS

The accuracy of target tracking was significantly improved in 8 of 9 cases. For better accuracy, the ROIs and search area were set to a larger size than for conventional images. The average maximum tracking errors in bone suppression and conventional fluoroscopic images were 1.3 ± 1.0 mm and 3.3 ± 3.3 mm, respectively. The bone suppression technique was especially effective in the lower lung area where pulmonary vessels, bronchi, and ribs showed complex movements (Fig. 1). In contrast, there was no significant improvement in a patient with severe interstitial pattern that resulted in a faint shadow of ribs on the original images.

CONCLUSION

The bone suppression technique improves tracking accuracy without special equipment and additional patient dose in real-time tracking radiation therapy. Our results indicated its usefulness especially in the lower lung area with complex movements of lung structures and ribs.

CLINICAL RELEVANCE/APPLICATION

Bone suppression fluoroscopy is a useful new technique for respiratory displacement of the target. Automatic target tracking can be conducted without rib shadows.

Radiation Oncology and Radiobiology - Monday Posters and Exhibits (12:15pm -12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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LL-ROS-MOA • AMA PRA Category 1 Credit™: 0.5

Host
Nina A Mayr, MD

LL-ROS-MO1A • The Initial Experience of Dose Escalation for Refractory Leukemia and the Influence on Bone Marrow Microenvironment

Yutaka Takahashi PhD (Presenter) ; **Micheal R Verneris** MD ; **Kathryn E Dusenbery** MD ; **Daniel J Weisdorf** MD ; **Mohammad S Islam** PhD ; **Susanta K Hui** PhD

PURPOSE

To present interim report of dose escalation clinical trial of total body and marrow irradiation (TBMI) for patients with refractory leukemia. We further investigated the microenvironment damage and repair of bone marrow specifically focused on mesenchymal stem (MSC) cells.

METHOD AND MATERIALS

Patients received 15Gy (n=2) followed by 18Gy (n=3) following cyclophosphamide and fludarabine chemotherapy. One day post TBMI, patients were infused with two umbilical cord blood (UCB) units or related donor stem cells. To reduce lung dose, dynamic (4D) CT images with or without shallow breathing while using a respiratory belt were acquired. Marrow aspirates are obtained before treatment, after treatment but before transplant, and post BMT day 21, 60, and 100. MSC cells were separated; morphology and differentiation to adipocyte and osteocytes were studied.

RESULTS

Thoracic rib motions were substantially reduced by 14%, 24%, and 70% at maximum in cranial-caudal, lateral, and anterior-posterior directions, respectively. Mean doses to the lung were within 10Gy, even in the 18Gy group. Average dose to whole body (apart from critical organ) were kept at approximately 14Gy. Two patients treated at 15Gy had prompt neutrophil engraftment at days 17 and 27 after BMT. In 18Gy group, the first patient did not engraft and developed severe regimen-related toxicities including respiratory failure, sepsis and hyper-bilirubinemia and died at day 58. The next two patients had neutrophil engraftment at days 23, and 37 after transplant, respectively. No severe acute adverse effects were observed. Common toxicities are nausea, oral mucositis, and diarrhea. Contrary to the belief that radioresistant MSC maintains niche, host MSC cells were reduced significantly (only one colony was formed) after treatment. Post-transplant marked recovery of MSC cells with time and its function to produce osteoblastogenesis, suggesting a potential role of donor UCB derived MSC proliferation (supporting micro-environment niche).

CONCLUSION

Reduction of lung dose using shallow breathing may be useful for dose escalation study. So far engraftment at 18 Gy has been safely achieved. Marrow microenvironment is seriously damaged by increased radiation but donor cells may contribute to reconstitution of marrow environment.

CLINICAL RELEVANCE/APPLICATION

The dose escalation of total marrow irradiation could be safely achieved and offered engraftment.

LL-ROS-MO2A • Involvement of the Central Glutamatergic System in the Development of Radiation-induced Nausea in Rats

Kouichi Yamamoto PhD (Presenter) ; **Atsushi Yamatodani** MD, PhD

PURPOSE

Most of patients undergoing total body irradiation (TBI) experience nausea and vomiting. Since the peripheral serotonergic pathway is involved in these symptoms, serotonin 5-HT₃ receptor antagonists such as granisetron used as prevention. They can prevent vomiting, but patients still suffer from nausea and refuse potentially curative treatment. Glutamate is known as the major excitatory neurotransmitter and involved in the autonomic symptoms accompanied with nausea, such as gastric discomfort. However, its neuropharmacological basis is incompletely understood. We previously reported that pica, kaolin ingestion behavior, could be used to evaluate nausea in rats. To investigate the role of the glutamate in radiation-induced nausea, we investigated the effect of TBI on pica, and on the in vivo hypothalamic glutamate release in rats. Furthermore, the effects of two types of glutamate receptor antagonists (NMDA and AMPA) on the pica were examined.

METHOD AND MATERIALS

Rats received 4Gy of TBI with or without pretreatment of granisetron (0.1mg/kg), and then their kaolin consumption was monitored hourly after the irradiation. A microdialysis probe was inserted into the anterior hypothalamus of rats and dialysis samples were collected for 3h after the TBI and subjected to HPLC assay of glutamate. Finally, rats were intracerebroventricularly injected NMDA receptor antagonist (MK-801: 3mg/rat) or AMPA receptor antagonist (CNQX: 1mg/rat) before the TBI and then kaolin ingestion was determined.

RESULTS

TBI induced pica within 1h after the irradiation and the increased kaolin intake was inhibited by a pretreatment of granisetron (p

CONCLUSION

Results suggest that a central pathway involving glutamate receptors in the hypothalamus contributes to radiation-induced nausea in rats through the central AMPA receptors.

CLINICAL RELEVANCE/APPLICATION

We assumed that the inhibition of glutamatergic system in the brain served as a therapeutic target for the treatment of radiation-induced nausea in patients.

LL-ROS-MO3A • Intensity Modulated Radiation Therapy (IMRT) for Intracranial Germ Cell Tumors (GCT)

Mirna Abboud MD (Presenter); Jack Su MD; Murali Chintagumpala MD; Bin S Teh MD; Pamela New; E. Brian Butler MD; Arnold D Paulino MD

LL-ROS-MO4A • Radiation Dose to Brachial Plexus in Treatment of Head and Neck Malignancies Using 3D Conformal Radiation Therapy

Vikram Manoor Maiya (Presenter); Sumeet Basu MD; Sathiyarayanan Vatyam MSc; Sujai Hegde; Minish Jain; Sanjay Deshmukh; Nikhil Vaid; Jaon Bos

LL-ROS-MO5A • The Effect of Dose Volume Histogram Adoption on Locoregional Control and Esophagitis in Limited Stage Small Cell Lung Cancer

Kevin R Kotamarti BS (Presenter); Daniel R Gomez MD; Pamela Allen; Ritsuko U Komaki MD

ABSTRACT

Purpose: Because small cell lung cancer has a high sensitivity to chemotherapy and radiotherapy, there has been some delay of more sophisticated radiotherapy in the management of small cell lung cancer. We examined the effect of dose volume histogram (DVH) on a large number of patients that were treated at our institution over the past 20 years. Our hypothesis was that the incorporation of DVH would improve the rates of treatment failure and survival, as well as rates of high-grade esophagitis.

Materials/Methods: Four hundred forty one patients with limited stage SCLC were treated with concurrent chemoradiation at MD Anderson Cancer Center between 1990 and 2009. 26.9% of patients received induction chemotherapy including 41.3% of patients prior to DVH adoption and 34.3% after its adoption. The median RT dose was 45Gy (range 45-70Gy). The ECOG performance levels from 0-3 were 19%, 69.1%, 8.8%, and 1.8% respectively. Fifty two percent of patients received PCI. DVH was adopted at our institution in June 1999 and 171 patients were treated prior to its adoption. Esophagitis was graded utilizing the Common Terminology Criteria for Adverse Events v3.0. A Cox proportional hazards model was utilized to determine the relationship of DVH adoption with locoregional failure free survival (LRFSS), distant metastasis free survival (DMFS), and overall survival (OS) and controlling for the factors above.

Results: The LRFSS for cases from 1990- June 1999 was 55.55% and 48.61% at two and five years respectively, and 69.50% and 64.43%, respectively, for patients treated between July 1999-2009 (Logrank P=0.01). The OS for cases from 1990- June 1999 was 51.39% and 21.40% at two and five years respectively, and 63.30% and 36.56%, respectively, for patients treated between July 1999-2009 (Logrank P=0.03). Multivariate analysis showed improved overall survival in patients treated after the adoption of DVH (HR 0.74, P=0.01) and PCI (HR=0.68, P=0.001) and reduced OS in patients older than 65 (HR=1.02, P=0.001). In addition, there was improved LRFSS in patients treated after the adoption of DVH (HR 0.65, P=0.01) and reduced LRFSS in patients with an ECOG of 2-3 (HR 1.52, P=0.109). There were a total of 397 patients who experienced esophagitis, 25% of whom experienced grade 3 or 4 toxicity. Of the esophagitis patients, 61.4% were diagnosed post-DVH adoption. Of these high grade patients, 63.4% were diagnosed post-DVH adoption.

Conclusion: The adoption of DVH appeared to reduce rates of locoregional failure in SCLC. However, there was not a substantial impact through this technologic advancement alone on the incidence of esophagitis or specifically high-grade esophagitis, which remains a significant side-effect with chemoradiation in this context.

LL-ROS-MO6A • Assessing Response to Radiochemotherapy Treatment on 18F-FDG PET in Non-small Cell Lung Cancer Using Approaches of Histogram and Gray Level Co-occurrence Matrix

Changsheng Ma MS (Presenter); Yong Yin

ABSTRACT

Purpose: The aim of this study was to propose and investigate gray level histogram and texture features information provided by 18F-FDG PET to assess patient's imaging response to radiochemotherapy in non-small cell lung cancer (NSCLC).

Methods: Twelve patients with newly diagnosed NSCLC treated with combined radiochemotherapy were involved in this study. Patients were categorized under three headings (non-responders, partial responders and complete responders) by experienced radiologists on the basis of RECIST according PET scans changes between pretreatment and 1 month after treatment. We analyzed the percentage variation of PET density using histogram analysis approach which characterizes global change of tumor region on PET. Texture parameters variation between pretreatment and 1 month after treatment completion which describe local voxel spatial distribution were extracted from Gray Level Co-occurrence Matrix (GLCM). Correlation between characteristics' variation and three type response status were analyzed.

Results: The uniformity of gray level histogram on the whole and the maximum percentage decrease in histogram was well associated with tumor shrinkage and response status. The above indices derived from histogram were capable to differentiate three groups tumor response to radiochemotherapy. Texture parameters' variation (ASM, ENT and IDM) were able to differentiate the 3 response groups considering a high correlation with response status.

Conclusion: We demonstrated that histogram and texture analysis methods on baseline 18F-FDG PET scans provided robust, discriminative stratification in assessing response to combined radiochemotherapy and may have a good application prospect in clinical practice.

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LL-ROS-MOB • AMA PRA Category 1 Credit™:0.5

LL-ROS-MO1B • Utility of Combining Whole Body Diffusion with Post Contrast 3D m-Dixon Imaging to Assess the Disease Load in Patients Presenting with Single Organ Involvement

Krishan K Jain MD (Presenter); Anoop K Pandey MD; Bhaswati Roy; Sandeep Vaishya MChir, MS; Rana Patir MChir, MS; Rakesh K Gupta MD, MBBS

PURPOSE

To assess the disease load in patients who presented with localized symptoms related to infective or neoplastic etiology with whole body MR imaging (WB-MRI) using a combination of diffusion-weighted whole-body (DWIBS) and post contrast 3D m-Dixon imaging.

METHOD AND MATERIALS

45 patients underwent MRI for various localized disorders. After completion of local examination including post contrast study, 3D m-Dixon and DWIBS data sets were collected at five stations to cover whole body from skull to knees in these patients. The mean additional time for WB-MRI was 25-30 minutes. Studies were read by 2 experienced radiologists.

RESULTS

Out of 45 patients (15 females), 12 had initial diagnosis of tuberculosis (TB), 16 had neoplastic etiology and 17 did not have any significant abnormality. Out of 12 TB patients, 7 presented with localized symptoms related to spine, 3 with brain and 2 with lung involvement. Out of 7 patients with spinal involvement, 3 had disease localized to spine and other 4 had extra lesions in brain (n=1), brain with breast (n=1), lung (n=1) and lung with musculoskeletal tissues (n=1). Among 3 patients with brain involvement, 2 had disease localized to brain and 1 showed lesions in lower lobe of left lung confirmed as non-small cell lung carcinoma on biopsy. Other 2 TB patients had disease localized to lungs. In 16 patients with neoplastic etiology, 8 had disease localized to area of abnormality, 6 patients showed multiple metastatic lesions in brain, bone, lung, spleen and liver, 1 patient with pituitary tumor showed multiple bony lesions with right chest wall abscess confirmed as tubercular on aspiration and one patient previously operated for left ureteric tumor showed unrelated brain mass lesion confirmed as gliosarcoma on histopathology.

CONCLUSION

The combination of these two techniques is complimentary in providing information regarding multi-organ involvement in patients presenting with symptoms relating to the localized disease. It provides high resolution images and has potential to use as one stop imaging technique to assess the disease load in infective and neoplastic pathologies to detect multi-organ involvement.

CLINICAL RELEVANCE/APPLICATION

Disease load assessment in infective and neoplastic pathologies with DWIBS and post contrast 3D m-Dixon whole body imaging in patients presenting with single organ involvement.

LL-ROS-MO2B • CyberKnife® Stereotactic Radiosurgery for Arteriovenous Malformation

June Kim MD (Presenter) ; James K Goddard MD ; Leslie Nussbaum MD ; Eric Nussbaum MD ; Lori Copsey BS, RT ; Rachel Dayton MPH ; Amy Fehrer MPH ; Camille Schwarzrock RN ; Michelle Smith BS,RT

PURPOSE

To examine the treatment parameters and clinical outcomes of patients with arteriovenous malformation (AVM) treated with CyberKnife® (CK) stereotactic radiosurgery (SRS).

METHOD AND MATERIALS

Patients with AVM who underwent CK SRS and had at least 1 year follow-up were included in this study (n=67). Medical records were reviewed and demographic, treatment parameter and outcome data were gathered and analyzed.

RESULTS

Age of patients ranged from 14-75 years (mean 45). Pre-SRS AVM volume ranged from 0.027-62.72 ml (median 4.4 ml). The median prescription dose was 24 Gy in 3 fractions. Per Spetzler-Martin grading, 6 patients had grade 1, 18 had grade 2, 18 had grade 3, 8 had grade 4 and none had grade 5 AVMs. According to the Cognard classification, there were 14 dural AV fistulas (21%). Two patients had AVMs located in the vein of Galen. The rate of re-bleed was 4% (n=3). One patient experienced ischemic stroke post-SRS. Procedure related gliosis was observed in 19 patients (28%). The mean time to complete obliteration was 29 months. Thirty-four patients had malformations of ≤ 15 ml and ≥ 3 year follow-up. Of these patients, the obliteration rate for parenchymal AVMs was 75% (18/24) and 50% (4/8) for dural AV fistulas. One-hundred percent (2/2) of vein of Galen AVMs were obliterated. Eight patients had parenchymal AVMs larger than 15 ml and ≥ 3 year follow-up. The obliteration rate for these patients was 25%. No dural AV fistulas greater than 15 ml were reported. The obliteration rate was higher in patients with compact (67%) versus diffuse (22%) nidus. Five patients had obliteration prior to 3 year follow-up; two were parenchymal AVMs and three were dural AV fistulas. Although the sample size was small, there appeared to be a trend towards favorable outcomes with a dose equivalent to 15 Gy or higher in a single fraction. Three cases were re-treated following SRS. Of those, two underwent surgery and one had embolization followed by repeat SRS.

CONCLUSION

The results suggest CK SRS is an effective treatment for AVM and dural AV fistula comparable to similar treatment modalities.

CLINICAL RELEVANCE/APPLICATION

Our data show favorable outcomes for parenchymal AVM and dural AV fistula obliteration with low rates of re-bleed and re-treatment.

LL-ROS-MO3B • Conformal Intracavitary Brachytherapy Planning for Carcinoma Cervix Using Transabdominal Ultrasound and Assessment of Quality of Life

Pavankumar Lachi (Presenter)

LL-ROS-MO4B • Hippocampal Sparing Whole Brain Irradiation with Boost to Metastases-A Retrospective Evaluation

Franziska Fels (Presenter)

ABSTRACT

Purpose/Objective(s):

For patients with multiple brain metastases a whole brain radiotherapy (WBRT) is indicated. Using new irradiation techniques, dose to the hippocampus, center for learning and memory and location of neuronal stem cells, can be reduced to < 10 Gy. Thereby a neurocognitive decline after radiotherapy could be avoided. However, theoretically there is an increased risk for the appearance of new metastases in the dose-reduced hippocampal avoidance zone. Furthermore, by the use of IMRT/VMAT-technique, it is possible to escalate the dose to the brain metastases to obtain a better local tumor control. This study evaluates the tumor control, morphological alterations in MR and the appearance of new metastases inside the hippocampus in patients who have been treated with hippocampal sparing WBRT (HS-WBRT) and boost to individual brain metastases.

Materials/Methods:

From 08/2011 to 01/2013, 16 patients were treated with HS-WBRT. The hippocampus was contoured as organ at risk and enlarged with safety margins of 7-10mm to ensure appropriate dose decline around the hippocampal avoidance volume. Whole brain was irradiated with 30Gy in 12 fractions with a restriction for the hippocampus < 10 Gy maximum dose. Additionally a simultaneously integrated boost (SIB) to individual (up to 7) brainmetastases of 51Gy or 42Gy for resection cavities, was performed. Follow-up-MRIs were planned 6 weeks after radiotherapy and then 3-monthly.

Results:

5/16 patients were lost to follow-up. The median follow-up-time was 4 (1.5 -14) months. Evaluation of tumor control showed a complete remission in 5 patients (45.45%), stable disease in 1 patient (9.1%) and mixed response in 1 patient. 3 patients had a progression of their metastases (27.2%), 1 patient showed a doubtful progression in terms of a temporary irradiation reaction. 2 patients had an increase in leukoaraiosis, 1 patient showed radionecrosis within 2 boosted metastases. No patients had intrahippocampal metastases. The avoidance volume was free of metastases as well. Mean dose to hippocampus was < 10 Gy (calculated from EQD2, average mean dose 7.4Gy).

Conclusions:

This study is the first to report about HS-WBRT and SIB to metastases. Good tumor control was seen and no patient had intrahippocampal metastases. An upcoming prospective multicenter-study will evaluate this question further and analyze the effect on neurocognition.

LL-ROS-MO5B • Stereotactic Ablative Radiotherapy (SART) to Whole vs. Partial Vertebral Body for Spinal Metastasis

Anton E Khouri MD (Presenter)

ABSTRACT

Purpose/Objective(s): Controversy exists as to whether whole or partial vertebral body (VB) should be treated when SABR is used for treatment of spinal metastases. This study aims to compare the treatment outcomes of patients with spinal metastases treated to whole or partial VB with SABR.

Materials/Methods: A CyberKnife unit was used for the delivery of SABR for all patients. Clinical target volumes (CTVs) was contoured by individual physicians with the help of a fused volumetric MRI (T1 with and without contrast and T2), so that the gross tumor could be better delineated. Whole VB was defined as inclusion of the whole VB in the CTV, whereas partial VB was defined as inclusion of only part of the vertebral body.

Results: 20 patients were included in the analysis. Vertebral levels included 5 cervical, 11 thoracic and 4 lumbar. Histologies include adenocarcinoma, squamous cell carcinoma. 11 patients received SABR as postoperative treatment. Prescribed dose was 12-30Gy in 1-5 fractions to 75%. 11 and 9 patients received SABR to whole and partial VB, respectively. With a median follow-up of 13 months (1-19mo range), the gross tumor control rate was 76%. The index spinal segment free-from-progression rate was 62% for the whole group and 56% for the partial VB group.

Conclusions: Gross tumor control appears to be similar for both whole and partial stereotactic ablative radiotherapy for spinal metastasis. Further research is needed to determine the optimal CTV for spinal SABR.

LL-ROS-MO6B • Which Pre-treatment FDG-PET Parameters Predict Outcome in Oropharyngeal Cancer?

Ankeet Shah (Presenter) ; Shlomo A Koyfman MD ; John Greskovich ; Ping Xia

PURPOSE

Prior analysis of pretreatment FDG PET/CT of patients with head-and-neck cancer (HNC) indicates mixed results for predicting outcome using maximum standardized uptake value (SUVmax). Recently, metabolic tumor volume (MTV) has been identified as a predictive FDG PET parameter in HNC. It is not clear, though, if primary MTV or nodal MTV is more predictive of outcome. The purpose of this study is to assess the predictive value of various FDG PET parameters, as well as primary and nodal contribution, for outcome in HNC patients.

METHOD AND MATERIALS

The dataset included 70 patients with oropharyngeal squamous cell cancer who underwent FDG PET/CT scanning prior to radiation therapy. Pretreatment parameters of SUVmax, SUVmean, total glycolytic activity (TGA), and MTV were collected as indicators of total tumor burden, stratified into the primary tumor, total involved lymph nodes, and the largest involved lymph node. We also assessed the largest diameter of primary tumors and largest diameter of involved lymph nodes as an alternative measure of tumor burden. The findings were compared between the subsets of patients that had no evidence of disease (NED) on follow-up (n=54), and those patients that had persistent disease (PD) on follow-up FDG PET/CT (n=16).

RESULTS

Among the pretreatment FDG PET parameters, MTVs in cm^3 for total tumor burden and primary tumors, as well as maximum diameter in cm of primary tumor demonstrated statistically significant differences between patients with NED and PD. For total tumor burden, the PD average MTV = 49.2, and NED average MTV = 28.5. At a cutoff of 50cm^3 , odds ratio (OR) = 10.2 (CI 95%: 2.2-47.7). For primary volume, PD average MTV = 33.5 and NED average MTV = 9.8. At a cutoff of 30cm^3 , OR = 24.1 (CI 95%: 2.6-227.0). MTV differences in total involved nodal volume or largest involved nodal volume were not statistically significant. Average maximum diameter in cm of primary tumor of PD patients = 5.03 and in NED patients = 3.44. At a cutoff of 5.5cm, OR = 11.8 (CI 95%: 2.0-69.0).

CONCLUSION

This study supports the use of MTV and maximum diameter of the primary tumor, as well as MTV of total tumor burden, to assess risk of disease progression.

Other FDG PET parameters were not predictive of outcome in oropharyngeal HNC.

CLINICAL RELEVANCE/APPLICATION

FDG PET scans that are commonly used to for staging and treatment planning can also help predict outcome of treatment in oropharyngeal cancer.

Physics Symposium: Uncertainties in Radiation Therapy 2

Monday, 01:30 PM - 05:45 PM • S102C

QA PH RO

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SPPH22 • AMA PRA Category 1 Credit™:4 • ARRT Category A+ Credit:4.5

LEARNING OBJECTIVES

1) Describe the limitations of traditional QA/QM programs in radiation oncology. 2) Understand the rationale for establishing risk-based QA/QM programs in radiation oncology. 3) Learn how to apply FMEA methodology in radiation oncology.

SPPH22A • New Paradigms of QA/QM

Jatinder R Palta PhD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

The increasing complexity, functionality, and site-to-site variability of modern radiation therapy planning and delivery techniques challenge the traditional prescriptive quality assurance/quality management (QA/QM) programs that ensure safety and reliability of treatment planning and delivery systems under all clinical scenarios. The manufacturing industry has historically relied on extensive testing and use of techniques such as probabilistic reliability modeling for developing and maintaining new products. Among the most widely used method of risk analyses are Failure Modes and Effects Analysis (FMEA). This is a methodology for analyzing potential reliability problems early in the development cycle where it is easier to take actions to overcome these issues, thereby enhancing reliability through design. FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. From a manufacturer's perspective, FMEA is a valuable method to systematically evaluate a device design's potential for inducing use errors. User errors are defined as a pattern of predictable human errors that can be attributable to inadequate or improper design. When these risk analyses are done early in the development cycle, potential faults and their resulting hazards are identifiable and much easier to mitigate with error-reducing designs. These risk management methods are excellent complements to other important user-centered design best practices. Risk analysis, or hazard analysis, is a structured tool for the evaluation of potential problems which could be encountered in connection the use of a device. The early and consistent use of FMEAs in the design process allows the engineers to design out failures and produce reliable and safe products. FMEAs also capture historical information for use in future product improvement. Such an approach should result in a QA/QM program in Radiation Oncology that has

URL

SPPH22B • QA/QM of the Reference Dosimetry

Larry A DeWerd PhD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

SPPH22C • QA/QM of the Treatment Planning Process

Jeffrey V Siebers PhD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

SPPH22D • QA/QM of the Treatment Delivery Process

Thomas R Mackie PhD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

SPPH22E • QA/QM of the Treatment Guidance Process

Lei Dong PhD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

Interventional Oncology Series: Hepatocellular Carcinoma

Monday, 01:30 PM - 06:00 PM • S405AB

RO OI IR GI

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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 agent 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 Chemoembolization 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 $982.21 \pm 103.93 \times 10^{-3} \text{mm}^2/\text{sec}$. 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 $1682.7 \pm 149.7 \times 10^{-3} \text{mm}^2/\text{sec}$. 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 ; Katsuhiko 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 \pm 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 \blacklozenge AM-plus, \blacklozenge AM completely surrounding the tumor; \blacklozenge AM-zero, \blacklozenge partly discontinuous AM without tumor protrusion; or \blacklozenge AM-minus, \blacklozenge 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 agent 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 Perdigo** ; **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

RO OI NR HN

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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 management and treatment.

ABSTRACT

This session will be tumor board that includes a head and neck radiologist, head and neck surgeon, medical oncologist and radiation oncologist. We will discuss a variety of head and neck cancer 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

RO OI OB GU

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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 gynecologic 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 gynecologic 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 management 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 impact of imaging and its importance in multidisciplinary care will be highlighted in this session.

Neuroradiology/Head and Neck (ENT Oncology)

Monday, 03:00 PM - 04:00 PM • N230

RO NR HN

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SSE18 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator

Julia Fruehwald-Pallamar, MD

Moderator

Barton F Branstetter, MD

SSE18-01 • Initial Clinical Experience of Core Needle Biopsy with BRAF V600E Mutation Analysis in Thyroid Nodules

Eun Ju Ha ; **Jung Hwan Baek** ; **Hun Cho** MD (Presenter) ; **Jeong Hyun Lee** MD, PhD

PURPOSE

To evaluate the role of core-needle biopsy (CNB) with BRAFV600E mutation combined analysis in thyroid nodules having non-diagnostic or atypia of undetermined significance (AUS) results on fine-needle aspiration (FNA).

METHOD AND MATERIALS

From January 2011 to March 2012, CNB +BRAFV600E mutation combined analysis was performed on thyroid nodules with previously non-diagnostic (n=32) or AUS (n=97) results. Direct DNA sequencing technique was used for BRAF V600E mutation analysis. The diagnostic value of CNB +BRAFV600E mutation analysis was evaluated.

RESULTS

The sensitivity and positive predictive value of BRAFV600E mutation in CNB specimens were 66.3% and 100%, respectively. Of 32 nodules with previously non-diagnostic results, CNB showed 81.3% (26/32) of conclusive results with 6 cases of AUS and no cases of non-diagnostic results. There was no additional value of CNB+BRAF V600E mutation analysis. Of 97 nodules with previously AUS results, CNB showed 93.8% (91/97) of conclusive results with 5 cases of AUS and 1 case of non-diagnostic results. There was 3.1% (3/97) additional value of CNB+BRAF V600E mutation analysis.

CONCLUSION

CNB of the thyroid nodule demonstrate high rates of conclusive diagnoses in patients for whom previous FNA results are non-diagnostic or AUS. The CNB +BRAFV600E mutation analysis may be helpful for patients with previously AUS results.

CLINICAL RELEVANCE/APPLICATION

This is an initial report to demonstrate the feasibility and usefulness of CNB with BRAFV600E mutation combined analysis in thyroid nodules.

SSE18-02 • Bimodal Histogram Analysis of Apparent Diffusion Coefficient Values for Detection of Occult Tonsil Cancer in Patients Presenting with Neck Metastasis from an Unknown Primary

Young Jun Choi MD (Presenter) ; **Jeong Hyun Lee** MD, PhD ; **Jung Hwan Baek**

PURPOSE

To explore the role of bimodal histogram analysis of apparent diffusion coefficient (ADC) values for detecting occult palatine tonsillar squamous cell carcinoma (PTSCC) in patients with neck metastasis from an unknown primary.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board, and informed consent was waived. We enrolled 19 patients with occult PTSCC presenting with neck metastasis from an unknown primary, 20 with overt PTSCC on physical examination, and 20 with normal palatine tonsils. DWI was performed with b values of 0 and 800 sec/mm². ADC values of the entire volume of palatine tonsil were measured by manual drawing of regions-of-interests. Bimodal histogram parameters of the ADC values were obtained using in-house and statistically tested for difference (Kruskal-Wallis test, Mann-Whitney U test). Receiver operating characteristic (ROC) analysis was employed to determine the best differentiating parameter between occult PTSCCs and normal tonsils. We also analyzed added values of histogram analysis of ADC values to conventional MRI and 18F-FDG PET/CT.

RESULTS

The bimodal histogram analysis showed statistically significant differences in mean, 50 \diamond and 90 \diamond ADC values between overt PTSCCs and occult PTSCCs/normal palatine tonsils. Between occult PTSCCs and normal tonsils, standard deviation ($[0.54\pm 0.20]\times 10^{-3}\text{mm}^2/\text{sec}$ vs $[0.41\pm 0.09] \times 10^{-3}\text{mm}^2/\text{sec}$), skewness ($[0.52\pm 0.38] \times 10^{-3}\text{mm}^2/\text{sec}$ vs $[0.30\pm 0.25]\times 10^{-3}\text{mm}^2/\text{sec}$), and 90 \diamond value of ADC ($[1.75\pm 0.27]\times 10^{-3}\text{mm}^2/\text{sec}$ vs $[1.52\pm 0.25]\times 10^{-3}\text{mm}^2/\text{sec}$) were significant higher (P

CONCLUSION

Adjunctive histogram analysis of ADC values detected five more occult PTSCCs (26.3%) than conventional MRI and 18F-FDG PET/CT, therefore, adjunctive histogram analysis can be helpful when conventional MRI and 18F-FDG PET/CT failed to detect occult PTSCCs.

CLINICAL RELEVANCE/APPLICATION

Adjunctive bimodal histogram analysis can be helpful when conventional MRI and 18F-FDG PET/CT failed to detect occult PTSCCs.

SSE18-03 • Role of ARFI in the Assessment of Thyroid Nodules

Bagyam Raghavan MBBS, DMRD (Presenter) ; **Sounak Paul** MBBS ; **Sathyasree Viswanathan** MBBS ; **Atif Wasim Haneef Mohamed** ; **Jayaraj Govindaraj** MD ; **Saravanan Shanmugasundaram** DMRD, MBBS

PURPOSE

The purpose of the study was aimed at improving diagnostic significance of thyroid sonography in predicting cytological type of thyroid nodules by additional use of ARFI.

METHOD AND MATERIALS

110 nodules were evaluated by B-mode imaging and color Doppler and ARFI. Shear wave elasticity measurements according to ARFI (Acoustic Radiation Force Impulse) imaging was performed for 110 nodules in 52 patients. Images obtained by Virtual Touch tissue imaging (VTI) were classified into three groups: Soft, Intermediate hardness, and Hard. Numerical values were also computed for the nodules Virtual touch tissue Quantification (VTQ). The results of B-mode imaging, color Doppler and ARFI were compared with the cyto-pathological diagnosis and analyzed statistically using Chi square test, and Logistic regression analysis to find out the correlation between the sonographic variables and final cytological end result. The significant VTQ values of each subgroup of hardness were evaluated by ANNOVA (Analysis of Variants). \diamond SSPS for Windows, Version 17 \diamond was used for the statistical analysis.

RESULTS

Multi nodular goiter and Thyroiditis nodules can remain indeterminate after B-mode and Color. In our study we found that tissue hardness assessment obtained by ARFI helped in categorization of such nodules and reducing negative cytology rates. The concordance between B-mode, color and FNAC was 81% which after ARFI the concordance with FNAC increased to 89%. In this study however we obtained a significant statistical correlation of intermediate hardness in predicting thyroiditis, odds ratio of 9.22 (95% confidence interval from 3.09 to 27.45) (p value Multi nodular goiter and Thyroiditis nodules can remain indeterminate after B-mode and Color .

CONCLUSION

In our study we found that tissue hardness assessment obtained by ARFI helped in categorization of such nodules and reducing negative cytology rates. In this study however we obtained a significant statistical correlation of intermediate hardness in predicting thyroiditis, odds ratio of 9.22 (95% confidence interval from 3.09 to 27.45) (p value

CLINICAL RELEVANCE/APPLICATION

ARFI with Virtual Touch Tissue Imaging Analysis is a quick additional parameter in the diagnosis of thyroid nodules

SSE18-04 • Preliminary Evaluation of MR Diffusion Kurtosis Imaging at 3-Tesla for Head and Neck Squamous Cell Carcinoma: A New Monitoring Tool for Early Treatment Response

Yukie Shimizu (Presenter) ; **Noriyuki Fujima** MD ; **Daisuke Yoshida** ; **Tomohiro Sakashita** ; **Akihiro Homma** ; **Kohsuke Kudo** MD ; **Hiroki Shirato** MD, PhD

PURPOSE

The purpose of this study is to investigate the usefulness of 3-T MR diffusion kurtosis imaging (DKI) for the assessment of patients with head and neck squamous cell carcinoma (HNSCC).

METHOD AND MATERIALS

Eighteen patients who were histopathologically diagnosed as HNSCC were included in this study. All patients were treated with super-selective arterial infusion of cisplatin with concomitant radiotherapy. TDKhey underwent magnetic resonance imaging (MRI) using DKI sequence before the treatment and at the early treatment period (at time point of 15-25 Gy in total 65 Gy radiotherapy). All MR scanning was performed by using a 3-T unit (Achieva TX; Philips Medical Systems, Best, The Netherlands) with a 16-channel neurovascular coil. DKI was obtained by using single-shot echo planar diffusion weighted imaging with 4 different b values of 0, 800, 1000, 2000s/mm². Three orthogonal motion probing gradient was used. The quantitativeDKI value of the tumor in each of the 18 patients was calculated usingDKI datasets. The change ratio of DK value between pre-treatment and early treatment period was also calculated. After the treatment, thirteen patients were classified into complete remission (CR) group and the other five were into non-CR group judging from multi-modality assessment and clinical follow-up. Mean of value in pre-treatment, early treatment period, and its change ratio were compared between CR and non-CR groups using non-paired T-test.

RESULTS

The change ratio of DK value in CR group was significantly lower than non-CR group(0.78 ± 0.13 vs 0.93 ± 0.05 , P

CONCLUSION

DKI can be useful as monitoring tool for early treatment response for the assessment of patients with HNSCC.

CLINICAL RELEVANCE/APPLICATION

DKI can be useful as monitoring tool for early treatment response for the patients with HNSCC by evaluating change ratio of DK value between pre-treatment and early treatment period.

SSE18-05 • Treatment of Metastatic Lymph Nodes in the Neck from Papillary Thyroid Carcinoma by Percutaneous US-guided Interstitial Laser Ablation: Three Years Experience

Giovanni Mauri MD (Presenter) ; **Luca Cova** MD ; **Tania Tondolo** ; **Tiziana Ierace** MD ; **Enzo Di Mauro** ; **Claudio M Pacella** MD ; **S. Nahum Goldberg** MD * ; **Luigi Solbiati** MD

PURPOSE

We report our three year experience with percutaneous US-guided interstitial laser ablation for metachronous cervical nodal metastases from papillary thyroid carcinoma.

METHOD AND MATERIALS

RESULTS

Laser ablation was technically feasible and well tolerated in all patients, with no either immediate or late complications. In 5 cases a second PLA was performed to treat recurrent disease (3 pt) or new lymph node metastases (2 pt) At a mean follow up time of 19 months local control was achieved in 19/26(73%) patients, with 11 (42%) having serum Tg/TgAb normalized. Complete ablation (lack of enhancement at CEUS, no uptake at 18F-FDG PET) was achieved in 38/46 (83%) 4 patients developed distant disease progression.

CONCLUSION

Percutaneous US-guided interstitial laser ablation seems to be an effective, low cost and safe therapeutic tool for the treatment of metachronous nodal metastases from papillary thyroid carcinoma in the neck which would otherwise require often challenging further resections.

CLINICAL RELEVANCE/APPLICATION

Interstitial laser ablation seems to be safe and effective for the treatment of metachronous nodal metastases from papillary thyroid carcinoma in the neck.

SSE18-06 • Intravoxel Incoherent Motion MR Imaging: Emerging Applications for Nasopharyngeal Carcinoma at the Primary Site

Shui Xing Zhang MD (Presenter) ; **Qianjun Jia** MD ; **Zhong-Ping Zhang** ; **Chang Hong Liang** MD ; **Wen-Bo Chen** BArch ; **Qian-Hui Qiu**

PURPOSE

To compare pure molecular diffusion, D , perfusion-related diffusion, D^* and perfusion fraction, f , determined from diffusion-weighted (DW) magnetic resonance (MR) imaging on the basis of the intravoxel incoherent motion (IVIM) theory in patients with nasopharyngeal carcinoma (NPC) at the primary site.

METHOD AND MATERIALS

This prospective study was approved by the appropriate ethics committee, and written informed consent was obtained from all patients. Between December 2011 and October 2012, 35 consecutive patients (22 men, 13 women; mean age, 49 years; age range 16-69 years) with suspected of having NPC were examined on a 3.0T MR scanner. DW imaging was performed by using a single-shot echo-planar sequence with 13 b-values (0, 10, 20, 30, 50, 80, 100, 150, 200, 300, 400, 600, 800 sec/mm²). MR imaging was compared with endoscopy and biopsy for the detection of NPC. Mean interval between MR imaging examination and subsequent nasopharyngeal biopsy was 3 days (range, 0-11 days). The initial study population comprised of 21 patients with newly diagnosed NPC (13 men, 8 women; mean age, 55 years) and 14 patients with adenoids enlarge (9 men, 5 women; mean age, 35 years). The lesion D , D^* and f were measured and compared in patients with primary NPC and benign hyperplasia.

RESULTS

CONCLUSION

IVIM DWI is a feasible technique for investigating primary NPC although limited in 11.4% patients due to susceptibility artifacts around the skull base. D is significantly decreased in primary NPC. The elevation of D^* reflects increased blood vessel generation and parenchymal perfusion in primary NPC, indicating that D^* can provide insight into the physiological activities related to the disease.

CLINICAL RELEVANCE/APPLICATION

Intravoxel incoherent motion (IVIM) can differentiate benign and malignant head and neck disease, and differentiating certain histological types of malignancy.

Physics (Image-guided Radiation Therapy I)

Monday, 03:00 PM - 04:00 PM • S404AB

PH RO

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SSE24 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator

David A Jaffray, PhD *

Moderator

Sandy Napel, PhD *

SSE24-01 • PET Image-guided Dose Escalation Study for Cervical Cancer Patients Receiving HDR Brachytherapy

James W Anderson PhD (Presenter) ; **Krystyna D Kiel** MD ; **Yixiang Liao** ; **Rui Yao** PhD ; **Damian Bernard** PhD ; **Julius Turian** ; **James C Chu** PhD *

PURPOSE

To study the feasibility and benefit of boosting dose to active regions of cervical cancer identified by positron emission tomography (PET) imaging during brachytherapy.

METHOD AND MATERIALS

5 patients imaged with both MRI and PET/CT were retrospectively studied. An experienced physician contoured the GTV and HR-CTV using the MRI scan alone, and then contoured the region of PET-hot activity using a PET/CT image. The MRI and PET/CT images were then fused, and a PET-HR-CTV volume was constructed from the union of the HR-CTV and PET-GTV.

Each patient had been treated using a Syed or TandR applicator with 4-20 interstitial needles. Two new plans were optimized using Oncentra's IPSA package with the following objectives: 1) a plan using only the MRI contours in which the HR-CTV-D90 received the prescription dose (Rx), and 2) a plan where the HR-CTV D90 received Rx and the PET-GTV D90 was boosted to 1.5Rx. In both cases the EQD2 D2cc dose to the bladder and rectum were kept below the GEC-ESTRO guidelines of 90 and 75 Gy, including the contribution from external beam therapy. Dose-volume parameters calculated for the all volumes.

RESULTS

Significant differences were seen between the MRI-GTV and PET-GTV contours (average size difference 21.8cc, average overlap 50%, see Figure 2). The PET-GTV boost to 150% was possible in four out of five cases, with the last case reaching 127% before reaching the rectal D2cc limit (Table 1). In 3 of the test cases, the PET-GTV also received about 150% of the Rx dose in the MRI-only plans; the two other cases were those in which the PET-GTV volume extended the most outside of the HR-CTV.

CONCLUSION

PET imaging modality has the potential to identify residual cervical cancer otherwise not visible on MRI and CT studies. This work has found that MRI target contouring regularly does not include regions of PET activity, and PET-based planning can lead to improved coverage over plans using MRI alone without sacrificing OAR sparing.

CLINICAL RELEVANCE/APPLICATION

PET/CT scans for cervical brachytherapy planning provide more accurate GTV contours and allow increased dose to regions of active tumour.

SSE24-02 • An Evolutionary Algorithm for the Optimization of Parameters in Radiation Beam Profile Modeling for the CyberKnife X-band Linear Accelerator

Matthew R Witten PhD (Presenter) ; **Owen Clancey** PhD

ABSTRACT

Purpose/Objective(s): To optimize parameters for the modeling of the beam profile of the CyberKnife X-band linear accelerator, and to investigate the dependencies of the parameters on depth and collimator size.

Materials/Methods: The measured data for the CyberKnife linear accelerator were acquired using the M3000-RS scanning system (Advanced Radiation Measurements, Inc., Port Saint Lucie, FL) and two 60012 p-type stereotactic dosimetry diodes (PTW, Inc., Freiburg, DE). The scanning system was used to precisely and accurately position the diodes to acquire both depth-dose data (the variation in radiation dose as the beam penetrates the surface of the water and interacts deeper and deeper in it), as well as beam profile data (the variation in dose in the plane perpendicular to the direction of travel of the beam). The beam profile shape is a consequence of the circular collimators, which range in diameter from 5 mm to 60 mm. The dose is at the maximum at the central axis of the beam. The dose is then relatively constant until the beam meets the physical edge of the collimator. Near the edge, the dose precipitously decreases, from nearly 100% of the maximum just inside the field, through 50% at the field edge, and finally to approximately 1-3% far from the field edge, where the dose is primarily attributable to scatter, as there is no primary irradiation outside the collimator. Accurately modeling the penumbra can be difficult, as the shape of the curve used to model the penumbra needs to be finely tuned to reflect the reality of the physical decrease in dose. The model used to calculate the beam profile assumed that there were three Gaussian scattering kernels which contributed to the dose, and the convolution of the kernels in the dose calculation formalism produced an analytical form of the off-center ratio involving the sum of error functions. Associated with each scattering kernel is an amplitude and standard deviation. The amplitudes and standard deviations associated with the scatter kernels were optimized with an evolutionary algorithm, where each individual was represented by a sextuple of real numbers. No a priori assumptions were made regarding the functional dependence of the scatter kernel amplitudes and standard deviations upon these variables.

Results: The optimization was able to produce an acceptable agreement, to within 2%, with measurement for the off-center ratio (OCR) values for full range of collimator sizes and at all depths (15 mm, 50 mm, 100 mm, 200 mm, 300 mm). There were depth- and collimator size-dependencies of the scatter kernel amplitudes, and the standard deviations possessed a dependence upon depth.

Conclusions: An evolutionary algorithm can be successfully used to optimize scatter kernel parameters in the modeling of the beam profile of the CyberKnife x-band linear accelerator.

SSE24-03 • Volumetric Modulated Arc Therapy for Intracranial Stereotactic Radiosurgery with Multiple Lesions: Image Guidance and Dosimetric

SSE24-04 • Effect of a Low-strength Magnetic Field on Ionization Chamber Reference Dosimetry

Eric Pepin PhD (Presenter) ; **Olga Green** PhD *

PURPOSE

To evaluate the impact of a 0.32-Tesla magnetic field present in the first commercial MRI-IGRT system on various ionization chamber dosimetry correction factors and to discover any directional dependence thereon.

METHOD AND MATERIALS

Various ionization chambers were evaluated to determine polarity, ion recombination, and stem effect correction factors using a Cobalt-60 MRI-IGRT system. Correction factors were determined using techniques outlined in the AAPM Task Group 51 report and various other publications. Correction factors were determined as a function of ion chamber orientation in the magnetic field and compared to readings taken on a linear accelerator in the absence of a magnetic field.

RESULTS

The various ionization chambers with a central anode were within prescribed tolerance limits for P_{pol} and P_{ion} in the presence of a magnetic field. Parallel plate ionization chambers exceeded tolerance limits for P_{pol} , but were within tolerance for P_{ion} in the presence of a magnetic field. There are no established tolerance limits for a stem correction factor, but several ionization chamber of both design types showed significantly different stem correction factors in the presence of a magnetic field compared to when not in a magnetic field. All ionization chambers showed a directional dependency in the stem correction factor in the presence of a magnetic field.

CONCLUSION

The ability of central anode ionization chambers to satisfy TG-51 correction factor tolerance limits seems uninhibited by the presence of a magnetic field, however parallel plate chambers were strongly affected by the presence of a magnetic field. Chambers of all design types may require bi-directional commissioning due to variations in the stem correction factor when in the presence of a magnetic field.

CLINICAL RELEVANCE/APPLICATION

Certain designs of ionization chambers seem unaffected by a magnetic field and are suitable for use with the first MRI-IGRT machine.

SSE24-05 • Analysis of Predictive Maintenance of Linear Accelerator Beam Uniformity Using Statistical Process Control

Charles M Able MS (Presenter) * ; **Alan Baydush** PhD * ; **Michael T Munley** PhD *

CONCLUSION

PdM monitoring of beam uniformity using a new method for determining SPC control limits is more effective than using traditional control limits. SPC false alarms are reduced thereby eliminating unwarranted service intervention. We are working to develop code that will provide an SPC evaluation using the new formula.

Background

The focus of this study is to determine the effectiveness of revisions to statistical process control (SPC) chart limits for linear accelerator steering coil current (beam uniformity) predictive maintenance (PdM) monitoring

Evaluation

We have re-evaluated calculation of the limits for steering coil current (SCC) SPC charts based on our observations that the changes in SCC required for 1% change in measured beam uniformity will generally exceed the traditional limits calculated using the standard deviation of the subgroup values alone. Using empirical data obtained from controlled experiments varying the SCC while measuring the beam uniformity, we have developed a formulism that incorporates a scaling factor (Cm) in the calculation of control limits.

Discussion

SCC monitoring of an 18 MV photon beam using the new limits indicated a change in the transverse position coil operating current 2 weeks prior to multiple EXQ2 faults and unscheduled downtime. A change in beam uniformity of greater than 3% was found once the beam was scanned using a computerized water phantom and ion chamber. SPC charts of this steering coil using traditional limits would have resulted in 5 false positives prior to the first positive alarm indicated by the new limits

SSE24-06 • Forcing Lateral Electron Disequilibrium to Spare Lung Tissue: A Novel Technique for Stereotactic Body Radiation Therapy of Lung Cancer

Brandon Disher (Presenter) ; **George Hajdok** ; **Stewart Gaede** ; **Matthew Mulligan** ; **Jerry J Battista**

PURPOSE

Stereotactic Body Radiation Therapy (SBRT) is a treatment option for inoperable early stage lung cancer patients. SBRT uses tightly conformed megavoltage (MV) x-ray beams to ablate the tumour in only a few treatment sessions. Small MV x-ray fields may cause lateral electron disequilibrium (LED) to occur within lung tissue, which can reduce the dose to the tumour to a variable extent. These dose effects may be challenging to predict using commercially-available dose calculation algorithms. Thus, to avoid LED, previous authors suggested using low energy photons and larger fields for lung cancer patients. We propose a new form of SBRT, named LED-optimized SBRT (LED-SBRT), which utilizes RT parameters designed to exploit LED to advantage. It will be shown that LED-SBRT can be used to reduce the dose within healthy lung tissue while enabling escalation of tumour dose levels.

METHOD AND MATERIALS

The DOSXYZnrc Monte Carlo software was used to calculate dose within a typical SBRT patient. To mimic a 360° SBRT arc, 36 equally weighted fields were focused onto the small tumour (~1 cm). 6 or 18 MV x-ray energies were used to simulate different plans of various field sizes. The LED-optimized plan, 18MV(3x1cm²), was compared to a clinical standard arc using 6MV(3x3cm²) beam parameters. A planning target volume (PTV) was generated by considering the extent of tumour motion over the patient's breathing cycle. All dose results were normalized such that at least 95% of the PTV received at least 54 Gy (i.e. D95).

RESULTS

The LED-optimized plan produced a hot spot at the tumour center equal to 169Gy, which was approximately twice as large as the maximal dose found within the conventional plan. Despite escalated tumour dose levels, normal lung dose was still decreased. For example, the mean lung dose and V20 decreased by ~ 0.5 Gy and 1.1%, respectively, comparing the LED-optimized plan to the clinical standard.

CONCLUSION

This article introduces a novel SBRT technique, LED-SBRT, which exploits the LED phenomenon to reduce normal lung dose levels and permit tumour dose escalation.

CLINICAL RELEVANCE/APPLICATION

These results are significant as tumour dose escalation correlates well with tumour control (and overall survival), while lower lung dose metrics reduce the risk of lung toxicities (e.g. pneumonitis).

Radiation Oncology and Radiobiology (CNS)

Monday, 03:00 PM - 04:00 PM • S104A



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SSE25 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator
Simon S Lo, MD

Moderator
Albert C Koong, MD, PhD

SSE25-01 • DCE-MRI Measures of Tumor Tissue - Vascular Changes Post-radiation

James R Ewing PhD (Presenter) ; **Madhava Aryal** PhD ; **Tavarekere Nagaraja** PhD ; **Swayamprava Panda** PhD ; **Stephen L Brown**

PURPOSE

To study acute post-radiation changes in the tissue-vascular interface in a rat model of cerebral glioma.

METHOD AND MATERIALS

25 rats were implanted with U251 cells intracerebrally and irradiated 21 days later. Radiation was 20 Gy delivered using 6 MV photons, 8 Gy/min. A 4 mm dia.

circle covered the 95-100% isodose extending in a single anterior-posterior direction. Vascular parameters were measured using dynamic contrast enhanced MRI (DCE-MRI) in a Varian 7T, 20 cm bore system. Two DCE-MRI studies were conducted for each animal, 24 hrs apart. 5 groups, 5 animals per group, were studied, with 2, 4, 8, 12 or 24 hrs between radiation and the second DCE-MRI. A dual-echo gradient echo (2GE) sequence, with 4 s resolution between image sets was run to acquire a trace of the change in R1 ($R1=1/T1$) vs time, and thus estimate contrast agent (CA) concentration vs time. The CA Magnevist was injected as a bolus (0.1 mM/kg) at image 15. Spin-echo arterial spin labeled tumor blood flow TBF estimates were acquired in a single central slice.

RESULTS

TBF decreased in the 2 hrs post-irradiation group by 70 to 80% of pre-irradiation levels, followed by a steady increase in later groups, until, at 24 hrs post-irradiation, TBF exceeded pre-irradiation levels by 40%. The interstitial volume fraction, v_e , negative throughout the study, pointed to a significant loss of interstitial volume (i.e., cell swelling). At 2 hrs after radiation, v_e was 30% below pre-irradiated values. v_e temporarily increased to near pre-irradiated values 4 hrs after radiation, but subsequently decreased to 30% below pre-irradiated levels at 24 hrs post-irradiation. The vascular permeability, K_{trans} , demonstrated a bimodal response, increasing at 4-8 hrs, reaching 35% above pre-irradiated values, followed by a decrease at 24 hrs to 20 to 40% below the pre-irradiation level.

CONCLUSION

To our knowledge, this is the first measurement of changes in v_e and/or TBF in the hours immediately following 20 Gy irradiation. Since vascular changes have profound implications for the delivery of adjunct therapies, these findings provide direction for the optimization of combined therapies.

CLINICAL RELEVANCE/APPLICATION

Post-RT changes in the tissue-vascular interface in a model of cerebral glioma were measured. Knowledge of acute vascular dynamics can help optimize radiation combined with adjunct therapies.

SSE25-02 • Evaluating Response to Spine Radiosurgery with DCE-MRI Perfusion Parameters

Kiran A Kumar (Presenter) ; **Kyung K Peck** PhD ; **Sasan Karimi** MD ; **Eric Lis** MD ; **Mark Bilsky** MD * ; **Andrei I Holodny** MD * ; **Yoshiya Yamada** MD *

PURPOSE

Dynamic contrast enhancement MR imaging (DCE-MRI) offers noninvasive characterization of the vascular microenvironment and hemodynamics. In this study, we hypothesize that DCE-MRI can be used to evaluate treatment response and predict tumor recurrence in patients with spinal metastases undergoing high dose radiotherapy (RT).

METHOD AND MATERIALS

We conducted a retrospective study of 30 patients with spinal metastases who underwent DCE-MRI before and after RT. 20 patients received single-fraction SRS (24 Gy), while 10 received hypofractionated SRS (27-30 Gy total). Kaplan-Meier analysis was used to estimate the actuarial local recurrence rates, which were compared using a log-rank test. Two compartment model-based perfusion parameters (K_{trans} : vascular permeability and V_p : plasma volume) were measured for each metastasis, relative to normal-appearing bone marrow. Percent change in parameter values from pre- to post-treatment were calculated and statistically compared.

RESULTS

At 20-month median follow-up, 5/30 (17%) patients had pathological evidence of local recurrence (LR). 3/10 (30%) patients treated with hypofractionated SRS had LR, while 2/20 (10%) patients with single-fraction SRS had LR. 1- and 3-year actuarial local recurrence rates were 24% and 44% for the hypofractionated SRS group vs. 5% and 16% for the single-fraction SRS group ($p=0.20$). The average change in V_p and K_{trans} for patients without LR vs. those with LR was -76% (range, -99% to -12%) and -66% (range, -99% to -9%) vs. +28% (range, -19% to +102%) and -14% (range, -50% to +84%) (p < 0.001).

CONCLUSION

We demonstrated that changes in perfusion, particularly V_p , reflect tumor responses to high dose RT in spinal bone metastases. Additionally, these changes predicted local tumor recurrence on average >6 months earlier than standard imaging did.

CLINICAL RELEVANCE/APPLICATION

The ability of DCE-MRI to detect early treatment response and predict local recurrence has the potential to improve patient care and outcome.

SSE25-03 • Dual Payload Molecular Radiotherapy against Malignant Brain Cancer

Van T Nguyen PhD ; **Gilberto Zulato** ; **Jesse M Conyers** BS ; **Dongqin Zhu** ; **Waldemar Debinski** ; **Akiva Mintz** MD, PhD (Presenter) *

PURPOSE

Our overall goal is to therapeutically exploit a novel ligand-based delivery system that targets IL13R α 2, a tumor-restricted biomarker that we discovered to be overexpressed in majority of Glioblastoma Multiforme (GBM) as well as other tumors. Our hypothesis is that we can efficiently target GBM in vivo using a dual payload molecular strategy that that exploits our novel delivery system based on IL13R α 2-Targeted Quadruple Mutant of IL13 (TQM13). We therefore created a single TQM13 targeted agent that simultaneously delivers both a therapeutic radioisotope and an active bacterial toxin specifically to GBM tumors expressing IL13R α 2.

METHOD AND MATERIALS

We designed TQM13-cytotoxin (CTX) using the cDNA of TQM13 in frame with a modified form of Pseudomonas Toxin (PE4E). Protein was produced using a bacterial system. We used a cell-based cytotoxicity assay to test potency/specificity of TQM13-CTX to GBM cells that express IL13R α 2. We radiolabeled TQM13-CTX with [¹³¹I]iodine, a prototype β -emitter, using an iodogen kit. To test in vivo efficacy, we stereotactically implanted GBM cells intracranially in nude mice and monitored tumor formation with bioluminescent imaging. 7-10 days post-implantation, groups of mice were treated intracranially.

RESULTS

Results: We demonstrated that TQM13-CTX only killed GBM cells that express IL13R α 2. This killing was potent and in direct proportion to the number of IL13R α 2 binding sites. To test the in vivo efficacy of [¹³¹I]-TQM13-CTX, we radiolabeled TQM13-CTX with [¹³¹I] and treated groups on mice (n=9) with a single dose of either (i) [¹³¹I]-TQM13-CTX, (ii) unlabeled TQM13-CTX mixed with untargeted [¹³¹I], or (iii) saline. At the completion of the experiment (day 80), 100% of the [¹³¹I]-TQM13-CTX treated group was cured, compared to only 67% of the group treated with the unlabeled active TQM13-CTX (mixed with untargeted [¹³¹I]) and 0% in the saline control group.

CONCLUSION

This work confirms the potency of our dual payload molecular strategy that uses both radioimmunotherapy and an active bacterial cytotoxin to target the IL13R α 2 GBM-associated biomarker.

CLINICAL RELEVANCE/APPLICATION

GBM is an invariably fatal malignancy. We therapeutically exploited a dual payload molecular radiotherapy strategy that targets GBM via a novel molecular delivery system that we developed.

SSE25-04 • Dosimetric Implications of Setup Error in Craniospinal Irradiation with Volumetric Modulated Arc Therapy

Ben Durkee MD, PhD (Presenter) ; **Blaire Hargens** MS ; **Fred Van Den Haak** ; **Jennifer L Shah** MD ; **Sarah S Donaldson** MD

PURPOSE

1. To demonstrate the dosimetric advantages and drawbacks of volumetric modulated arc therapy (VMAT) planning for craniospinal irradiation (CSI).
2. To demonstrate that small errors in setup are dosimetrically acceptable for CSI with VMAT.

METHOD AND MATERIALS

A single pediatric patient was simulated in the supine position on a Styrofoam board. The head was immobilized by a custom headrest and thermoplastic mask. No specific measures were taken to immobilize the spine or pelvis. Craniospinal therapy was prescribed to a dose of 23.4 Gy using 3D conformal radiotherapy (3D CRT) and VMAT. The two plans were compared with attention to coverage of the target volume and dose to normal tissues. Normal tissues examined included thyroid, heart, lungs, kidneys, bowel and whole body. A small setup error was simulated by applying 3 mm and 5 mm lateral shifts to the dosimetric map. The plan was re-analyzed by the same metrics as above.

RESULTS

Both plans resulted in good coverage of the target and met our pre-defined constraints for normal tissue. VMAT was superior to 3D CRT in minimizing dose to normal tissues near the midline, including thyroid (mean 11.4 Gy versus 22.2 Gy) and small bowel (V15

CONCLUSION

Dosimetric implications of resultant setup errors must be considered when using highly conformal techniques such as VMAT. VMAT for CSI can spare dose to normal tissues near the midline, but at the expense of low-dose spill to large volume structures such as lung and whole body. Long-term implications, including risk for secondary malignancies, should be considered in patients selected for VMAT craniospinal irradiation. Planning with VMAT appears to be relatively resistant to small errors in setup, making it an appropriate modality for use in carefully selected children.

CLINICAL RELEVANCE/APPLICATION

Craniospinal irradiation with highly conformal techniques such as VMAT is relatively resistant to small errors in setup, and is appropriate for thoughtfully selected pediatric cases.

SSE25-05 • Pancreatic-sparing Cranio-spinal Irradiation (CSI) for Medulloblastoma: Dosimetric Comparison of Proton and Photon Modalities to Reduce the Risk of Diabetes Mellitus (DM)

Jeffrey Brower (Presenter)

ABSTRACT

Purpose/Objectives:

A recent multi-institution study demonstrated that radiotherapy dose >10 Gy to the pancreatic tail (PT) predicted an 11-fold increased risk of DM in childhood cancer survivors. These findings highlight the potential radiosensitivity of pancreatic islet cells responsible for insulin secretion. Cadaveric human studies have shown that up to 65% islet cells are located outside PT. These data suggest the importance of including the whole pancreas (P) as an organ-at-risk (OAR) during radiotherapy planning for pediatric tumors, such as CSI for medulloblastoma given its relatively favorable prognosis. This study compares CSI techniques of proton beam therapy (PBT), conventional photon fields (3DCRT), and helical tomotherapy (HT) to investigate their differential capacity for pancreatic sparing.

Materials/Methods:

5 average-risk medulloblastoma patients who received CSI to 23.4 CGE using PBT at a single institution were identified. P and PT had not been considered OARs during PBT planning. 3DCRT plans using opposed lateral cranial fields and posterior spinal fields were generated. P and PT were delineated as OARs on the PBT planning CT scan, and multiple HT plans were developed for each patient. HT plans delivering the lowest dose to P and PT without compromising target coverage were selected. Endpoints included mean dose (Dmean), maximum dose (Dmax), and volume receiving 10 Gy (V10). Comparisons were made using T-test; statistical significance was assigned to *p* values < 0.05.

Results:

All three modalities covered the PTV with the 95% isodose line.

Endpoint	3DCRT		PBT		HT	
	Mean	SD	Mean	SD	Mean	SD
Whole Pancreas (P)						
Dmean (Gy)	11.97	1.81	0.172	0.14	5.06	0.54
Dmax (Gy)	21.36	0.23	11.91	6.8	13.47	1.24
V10 (%)	59.05	9.65	0.3	0.61	4.48	1.9
Pancreatic Tail (PT)						
Dmean (Gy)	8.2	2.49	0.09	0.01	4.41	0.78
Dmax (Gy)	20.86	0.32	6.89	1.71	9.17	1.08
V10 (%)	39.28	13.13	0	0	0.41	0.92

D_{max} to P and PT and V₁₀ to PT were higher with 3DCRT as compared to PBT or HT (*p*=0.01 for 3DCRT vs. PBT for D_{max} to P; *pp*Conclusions: PBT and HT provided significantly lower D_{max} and V₁₀ to PT than 3DCRT. However, PBT provided even better pancreatic sparing compared to HT, reducing D_{max} to mean to P and PT and V₁₀ to P. Thus, PBT for CSI may be associated with the lowest risk of long-term DM in pediatric medulloblastoma survivors.

SSE25-06 • Feasibility of Simultaneous Integrated Boost Gamma Knife Planning For Malignant Gliomas and Brain Metastases

Nevine M Hanna MD (Presenter)

ABSTRACT

Purpose: Simultaneous Integrated Boost (SIB) in Gamma Knife planning defines and prescribes differential doses to the gross target volume (GTV) and the surrounding region of peritumoral infiltration or edema. The purpose of this is to report our preliminary assessment of the concept of the simultaneous integrated boost (SIB) applied to Gamma Knife radiosurgery in the treatment of recurrent gliomas and brain metastases.

Methods: 8 lesions in 6 patients underwent SIB Gamma Knife planning for recurrent glioma or resected brain metastases with a residual tumor nodule (2 lesions). SIB Gamma Knife planning was performed using Gamma Plan 8.2 according to a technique developed by the authors to differentially treat nested target volumes. The gross target volume (GTV) was defined by the contrast enhancing tumor nidus on T1 magnetic resonance imaging (MRI) sequences and the planning target volume-margin (PTV-m) was defined by the abnormal region on the T2 or FLAIR sequences. A higher dose was delivered to the gross target volume (GTV) defined by the contrast enhancing lesion as seen on the T1 contrast-enhanced SPGR sequences and a lower, volume-appropriate dose to the typically larger planning target volume (PTV-m) consisting of a margin of the T2 or FLAIR abnormal region or a metastasis surgical resection cavity. All patients were treated on the Gamma Knife Perfexion. Volume appropriate doses were prescribed: for the recurrent gliomas, 12-16 Gy to the GTV and 8 Gy to PTV-m. For the resected brain metastasis, 18-27 Gy was given to the residual tumor nodule (GTV) and 16-17 Gy to the cavity (PTV-m).

Results: Average age was 53 years (46-71). Brain lesions treated included malignant gliomas as well as metastases secondary to melanoma and squamous cell carcinoma. Mean prescribed dose was 17.1 Gy (12-27) at 78% (65-84). Mean coverage at prescription was 85% (70-100) and mean treatment volume was 5.1 cc (0.31-10.1). Mean PTV-m volume = 24.5 cc (7.0-57.9). Prescribed dose was 8 Gy for re-irradiation and 16-17 Gy for non-re-irradiation treatment. Mean PTV-m coverage was 98% (95-100) and mean PTV-m treatment volume was 40 cc (4.2-86). Mean number of shots was 29 (5-54) and mean on-beam time was 76 minutes (23.7-158.6). Median post-treatment follow up after treatments is 22 weeks (4-59) with 3 patients deceased and 3 patients alive without evidence of complications at last follow up. Further radiological response is being analyzed.

Conclusions: We conclude from this preliminary study that SIB Gamma Knife plans with target and treatment volume adjusted GTV and PTV-m doses are feasible for implementation for Gamma Knife radiosurgery. The lack of toxicity and the preliminary clinical outcomes suggest the potential future utility of the SIB concept for Gamma Knife radiosurgical treatment planning.

BOOST: Head and Neck Hands-on Contouring (In Cooperation with ASTRO)

Monday, 04:45 PM - 06:00 PM • S104B

[RO](#) [OI](#) [NR](#) [HN](#)

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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 intent of this course is to provide a hands-on contouring session for head and neck cancer. This session will be presented by a radiologist and radiation oncologist.

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

Tuesday, 08:30 AM - 10:00 AM • S103AB

[RO](#) [OI](#) [GI](#)

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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

RO **OI** **BR**

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MSR034 • 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 management in the current era of neoadjuvant systemic therapy and sentinel nodal evaluation.

ABSTRACT

The management 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 management of breast cancer, particularly with respect to the evaluation and management 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 radiotherapeutic 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 management, 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.

Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases

Tuesday, 08:30 AM - 10:00 AM • S504AB

RO **OI** **IR**

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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 management 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.

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Incorporation of Imaging as a Biomarker in RT

Tuesday, 08:30 AM - 10:00 AM • E261

PH **RO** **BQ**

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RC322 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator

Robert Jeraj

LEARNING OBJECTIVES

1) Anatomical imaging in treatment response (RECIST, volumetrics). 2) PET in treatment response assessment (PERCIST etc) with uncertainties. 3) MRI in treatment response assessment. 4) Imaging biomarkers.

RC322A • Introduction to Biomarkers

Robert Jeraj (Presenter)

LEARNING OBJECTIVES

1) Imaging biomarkers and surrogate endpoints. 2) Prentice's criteria vs real world. 3) Imaging biomarker characteristics. 4) Imaging biomarker validation and qualification.

RC322B • PET Assessment/Uncertainties

Paul E Kinahan PhD (Presenter) *

LEARNING OBJECTIVES

1) Understand the advantages and disadvantages of PET/CT as a biomarker for radiation oncology. 2) Understand sources of bias and variance in PET/CT imaging, both in data acquisition and analysis. 3) Understand the limitations of functional PET/CT techniques currently being used to evaluate treatment effect.

RC322C • MRI Assessment/Uncertainties

Edward F Jackson PhD (Presenter)

LEARNING OBJECTIVES

1) Understand the physical principles of functional MR techniques currently being used to evaluate treatment effect. 2) Understand selected applications of each of these techniques to the assessment of radiation therapy. 3) Understand current limitations of each of the techniques.

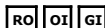
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web.me.com/efjackson

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

Tuesday, 10:30 AM - 12:00 PM • S103AB

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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 7th 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 thoracic 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 < .001).
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

RO **OI** **BR**

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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.

MSR035-03 • 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 Bonavita MD ; 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.

MSR035-04 • 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.

MSR035-05 • 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.

MSR035-06 • 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)

MSR035-07 • 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 criteria 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)

Radiation Oncology and Radiobiology (Genitourinary)

Tuesday, 10:30 AM - 12:00 PM • S104A

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SSG16 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Moderator

Phuoc T Tran, MD, PhD *

Moderator

Mehee Choi, MD

SSG16-01 • Real-time Prostate Tracking during VMAT Delivery Incorporating Prostate Rotation Estimation Based on a Single Projection Image

Ling Zhuang PhD (Presenter); Jun Zhou PhD; Xiaochao Xu PhD; Di Yan

PURPOSE

To develop a method to track the prostate 3D translations and rotations during VMAT delivery based on a single projection image.

METHOD AND MATERIALS

Centroid positions of three fiducial markers implanted in patient's prostate were extracted from 3D planning CT image through thresholding. The 3D translations and rotations of the prostate were determined through minimizing the summation of distances between the markers' centroid projection positions and their detected projection positions on a single projection image. The accuracy of our method was evaluated using simulated experiments. Three real patients' prostate motion patterns were used to drive the 3D markers' translation, while the markers continuously tilt around the left-right axis (0~20°, denoted by RX). The markers' 2D locations on the projections were simulated by projecting the moving 3D markers in the kV imaging plane with a frame rate of one projection per gantry angle. To simulate marker detection uncertainties, Gaussian random variations ($\sigma=0.0\text{mm}$, $S=0.5, 1.0$ and 2.0mm) were added to each marker's projection position. For each direction, tracking errors were calculated as the difference between the estimated value and the actual value. The correlations between the accuracy of the proposed method and the adding noise level were investigated.

RESULTS

The overall errors are $0.1\pm 0.1, 0.3\pm 0.3, 0.2\pm 0.3\text{mm}$ in LAT, AP and SI respectively and $0.7\pm 0.8^\circ$ in RX. The error in LAT is significantly less than errors from AP and SI ($p < 0, 0.7\pm 0.60, 1.2\pm 1.00$ in RX. The Pearson correlation between noise and error are 0.63, 0.61, 0.67, and 0.78 in LAT, AP, SI, and RX respectively. The correlations between noise and error in SI and RX are relatively high because there are approximately linear dependencies between SI motion/RX rotation and the markers' projection position shifts.

CONCLUSION

The approach proposed can accurately detect prostate's translations and rotations based on a single kV projection.

CLINICAL RELEVANCE/APPLICATION

Our method can be further used to track the prostate motion during treatment delivery, thus allowing the possibility to adjust the treatment if the prostate motion is out of a pre-defined tolerance.

SSG16-02 • Study of Selecting Optimal Monochromatic Level for Artifacts Reduction Using Spectral CT Imaging after 125I Radioactive Particles Implantation

Qiuxia Yang (Presenter); Sheng Peng; Rong Zhang; Jing Wu; Mingyan He; Chuanmiao Xie; Fujun Zhang

PURPOSE

To select the optimal monochromatic level for gemstone spectral imaging (GSI) to minimize both the image noise and metal artifacts caused by 125I radioactive particles after 125I particles implantation in non-enhanced CT scan.

METHOD AND MATERIALS

Nine patients (8males,1female, average age:57.8, 5cases of hepatocellular carcinoma,1case of cholangiocellular carcinoma, 3 cases of metastatic tumor) after 125I radioactive particles implantation underwent spectral CT examinations using Discovery CT750 HD scanner to evaluate the implant position and treatment. Both conventional 140kVp polychromatic and monochromatic images(40-140keV, interval 5keV) were generated from GSI scan acquisition and non-enhanced CT series were evaluated. The CT value and standard variations were measured in the region of 5mm and 10mm distance from particles while the background noise was measured in region of same tissue without artifacts. The artifact index (AI) 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

For the non-enhanced abdominal spectral CT images, 40keV was found the highest noise and Artifact Index of monochromatic images($SD=27.38, AI=206.40$). Slope of AI curve (k value) from 75keV images was smaller($k=1.02$) than that of rest lower keV images. The optimal monochromatic level was found at 75

keV which can provide almost the least image noise(SD=10.01)and good performance of artifact reduction(AI=102.73). Image noise and AI reduction was decreased by 63.44% and 50.23%, compared with 40keV. There was significant difference in CT value and variations between the region of inner 5mm and outer 5mm distance from particles(P0.017).

CONCLUSION

Monochromatic images obtained with spectral CT imaging can substantially reduce metal artifacts caused by 125I radioactive particles and provide more accurate CT images for estimating the efficacy of the treatment.

CLINICAL RELEVANCE/APPLICATION

Clinical relation: Spectral CT showed its potential applications in monitoring disease progressions after 125I radioactive particles implantation.

SSG16-03 • Clinical Results of Salvage Radiation Therapy after Prostatectomy for Patients with Prostate Cancer-Single Institute Experience

Tomonari Sasaki MD, PhD (Presenter) ; Katsumasa Nakamura MD, PhD ; Yoshiyuki Shioyama ; Saiji Ohga MD ; Tadamasu Yoshitake MD ; Hiroshi Honda MD ; Makoto Shinoto ; Kotaro Terashima ; Kaori Asai ; Keiji Matsumoto ; Hideki Hirata

PURPOSE

This study attempts to evaluate the efficacy of salvage radiation therapy (RT) after radical prostatectomy (RP) for patients with prostate cancer in our institute, and to identify specific operative and pre-RT characteristics associated with eventual success in this population.

METHOD AND MATERIALS

We performed a retrospective analysis of 80 males who received salvage RT after RP from 2005 to 2011 at our hospital. All patients had elevation of prostate specific antigen (PSA) level or clinical recurrence after RP. Patients who received hormone therapy concurrently with RT and who had short follow-up period less than 6 months were excluded.

RESULTS

A median dose of 66 Gy was delivered to the prostate bed. Sixty-nine patients irradiated to prostatic bed alone. Eleven patients received small or whole pelvic irradiation. After a median follow-up period of 60 months, 31 patients had experienced biochemical failure, and 5 of them had clinical failure (one regional , 4 distant). Actuarial 5-year overall, clinical relapse-free and biochemical relapse-free survival estimates were 96.7%, 93.3% and 60.2%, respectively. On uni- and multi-variate analyses, Gleason score 8-10 and serum PSA level >0.4 ng/ml before RT were significant for biochemical relapse survival. Only one patient experienced adverse event greater than grade 2.

CONCLUSION

Salvage RT after RP for patients with prostate cancer is safe and feasible. Patients with Gleason's score 8-10 prostate cancer or with pre-RT PSA greater than 0.4 ng/ml have an increased risk for biochemical relapse after salvage RT.

CLINICAL RELEVANCE/APPLICATION

Salvage radiation therapy after radical prostatectomy for patients with prostate cancer is safe and feasible.

SSG16-04 • Vagueness of Time-fixed Bladder Volume Control Assessed during Proton Beam Irradiation of Prostate Cancer

Shigeyuki Takamatsu MD, PhD (Presenter) ; Kazutaka Yamamoto MD, PhD ; Mariko Kawamura ; Satoko Asahi ; Tamaki Kondou ; Tsuyoshi Takanaka MD, PhD ; Yuji Tameshige ; Yoshikazu Maeda ; Makoto Sasaki ; Hiroyasu Tamamura MD

SSG16-05 • IMRT with MR Guidance for Prostate Cancer - A Dynamic Therapeutic Approach with Screening Implications

Joseph M Baisden MD, PhD (Presenter) ; Dana O Olson MD

PURPOSE

This study highlights the usefulness of magnetic resonance imaging (MR) in the treatment of prostate cancer with implications for screening. MR was used for planning prostate cancer radiation treatment and to evaluate the value of periodic limited MR during the course of therapy. This was evaluated in the community clinic setting.

METHOD AND MATERIALS

Planning CT images were acquired and individual treatment plans were performed for localized prostate cancer patients. MR images were acquired at 1.5 T at the community hospital. T2-weighted axial images were fused for planning purposes, and a second plan was generated using the fused images. Patients were treated with IMRT with daily CT image guidance using helical tomotherapy to a total dose of 81 Gy. Periodic limited MR imaging, including T2, diffusion and STIR were acquired twice weekly to evaluate the dynamic MR response to therapy.

RESULTS

Rectal doses were decreased significantly for the patients as treated with fused-MR planning, compared to plans generated with CT data only. Discrepancies in prostate volume and associated Planning Target Volume (PTV) were variable, highlighting the advantage of MR over CT in delineated prostate anatomy. There was a 29.3% decrease in mean prostate volume with MR compared to CT. Regarding rectal dose, the V80, V70, V60 and V50 were decreased by 82.6, 65.9, 54.7 and 43.7%, respectively. Similar improvements were seen in dose to the bladder and penile bulb. Patients tolerated the treatments with no Grade 3 or higher acute toxicities. The MR imaging during the course of therapy demonstrated changes including a general decrease in MR prostate spatial frequency and mild gland enlargement.

CONCLUSION

Fusion of MR for planning purposes results in significant sparing of normal organs for prostate cancer IGRT/IMRT in the community setting. Patients tolerated 81 Gy with side effect profiles consistent with other reports. Further dose escalation is being pursued. Periodic limited MR imaging may be useful for ongoing therapy guidance and the changes noted may provide a useful approach to using this technology as an effective screening tool.

CLINICAL RELEVANCE/APPLICATION

MR serves a valuable role in prostate cancer therapy, both guidance and outcome assessment. MR allows more accurate radiation targeting and normal organ sparing, permitting safe dose escalation.

SSG16-06 • Comparison of Testicular Dose Delivered by Intensity-modulated Radiation Therapy (IMRT) and Volumetric-modulated Arc Therapy (VMAT) in Prostate Cancer Patients

Jeffrey M Martin MD (Presenter) ; Elizabeth Handorf ; George Cherian ; Mark K Buyyounouski MD * ; David Y Chen MD ; Alexander Kutikov ; Robert A Price PhD ; Eric M Horwitz MD

SSG16-07 • Comparison of Image Guidance Techniques for the Post-prostatectomy Patient

Matthew E Johnson MD (Presenter) ; Tianyu Li ; Richard E Greenberg ; Alexander Kutikov ; Mark K Buyyounouski MD * ; Marc Smaldone ; Mark L Sobczak ; Eric M Horwitz MD

SSG16-08 • Prognostic Factors for Toxicity in Prostate Cancer Patients Treated with Arc Radiation Therapy

Jose Lopez ; Raul Matute ; Fernando Puebla ; Jose C Arduan MD, PhD (Presenter) ; Nicolas Isa ; Catalina Acebedo ; Rafael Lengua ; Maria Jose Ortiz Gordillo ; Javier Jaen ; Juan Manuel Praena-Fernandez ; Mercedes Arduan Perez ; Ignacio Azinovic

SSG16-09 • A Prospective Feasibility Study of Hypofractionated Radiotherapy in Localised Prostate Cancer in Indian Scenario

Shilpa Reddy (Presenter) ; Vijay Anand Palkonda ; Sajal Kakkar MD ; Kausik Bhattacharya MD ; Vinitha Reddy MD ; Prashanth Upadhyay MD ; Nanditha Sesikeran ; Shantling Nigudgi MD ; Vinod Reddy Maddireddy MBBS

Radiation Oncology and Radiobiology - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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LL-ROS-TUA • AMA PRA Category 1 Credit™:0.5

**Host
Nina A Mayr , MD**

LL-ROS-TU1A • Outcome of Patients with Stage I, II, and III Endometrial Cancers Managed with Adjuvant Therapy at a Single Institution

Aaron H Wolfson MD (Presenter) ; Joseph De La Garza MD ; Isildinha Reis PhD ; Steven Register ; Adrian Garza ; J. Matthew Pearson MD ; Fiona Simpkins MD

LL-ROS-TU2A • Reirradiation of Primary CNS Gliomas: A Single Institution Experience

Corey J Hobbs MD (Presenter) ; Laura A Vallow MD ; Kurt Jaeckle MD ; Michael Heckman ; Bhupendra Rawal ; Jennifer L Peterson MD

LL-ROS-TU3A • Glioblastoma Multiforme Metastasis Outside the Central Nervous System: Three Case Reports and Possible Mechanisms of Escape

ABSTRACT

Purpose/Objective(s):

Primary brain and central nervous system (CNS) tumor incidence is approximately 19 per 100,000 individuals per year in the United States (US) compared with 7 per 100,000 individuals worldwide. The most common intra-axial tumor is gliomas, which account for 32% of all primary CNS tumors and 80% of all malignant tumors of the CNS. The most common diffuse glioma is grade IV astrocytoma (glioblastoma, GBM), which makes up 54% of diffuse glial tumors. GBM is also the most aggressive brain tumor with poor prognosis. GBM metastases outside the CNS are rare, so therapeutic experience with these types of tumors is limited.

Materials/Methods:

Herein, we present 3 GBM patients with extra-CNS metastasis.

Results:

One patient developed GBM metastasis in the lung and pleura 5 years after his GBM diagnosis had been confirmed. Another patient who underwent resection of the primary GBM developed disease that extended through the sphenoid to involve the orbit and skull and subsequently invaded the parotid gland and neck nodes 1 year after diagnosis. A third patient developed GBM metastasis in the skull and L5 vertebra 2 years after her primary brain tumor had been resected.

Conclusions:

The exact mechanism of GBM metastasis outside the central nervous system is not well understood but likely involves the invasion of structures such as bone, lymphatics, and vasculature, especially veins. Above-average survival time and repeated surgical intervention may place GBM patients at higher risk for these unusual metastases

LL-ROS-TU4A • Comparison of Intra-fractional Prostate Shifts with or without an Immobilization Device for the External Beam Radiation Therapy of Prostate Cancer

Hiraku Sato MD (Presenter) ; Eisuke Abe ; Kensuke Tanaka ; Gen Kawaguchi ; Kaidu Motoki ; Hidefumi Aoyama MD, PhD

ABSTRACT

Purpose/Objective(s): To evaluate the effect of using an immobilization device on the intra-fractional prostate shifts in the external beam radiation therapy of prostate cancer

Materials/Methods: The subjects were 33 patients with localized prostate cancer treated between November 2010 and February 2013 at our institution. Nineteen patients were treated with a customized vacuum immobilization device in intensity-modulated radiotherapy (IMRT), and fourteen patients were treated without the device in three-dimensional conformal radiotherapy (3D-CRT). Each patient underwent simulation in the supine position using a computed tomography (CT) scanner. Both plans were generated using the Eclipse treatment planning system. All patients were treated on a Novalis-Tx system. In both IMRT and 3D-CRT, after an initial set-up, bony-structure matching was carried out using a fluoroscopy-based set-up system (ExacTrac). After that, in IMRT, cone-beam CT (CBCT) was taken, and soft-tissue matching using the prostate-rectal interface as a landmark was carried out. A shift of the coordinates of the isocenter was recorded in the anterior-posterior (AP), superior-inferior (SI), and left-right (LR) axes. Post-treatment CBCT was also taken once a week to measure the intra-fractional shift. In 3D-CRT, after every bony-structure matching, pre- and post-treatment CBCTs were taken once a week without soft-tissue matching. In both IMRT and 3D-CRT, the time from pre- to post-treatment CBCT was recorded. Intra-fractional shifts were analyzed using each of the 131 pre- and post-treatment CBCTs in IMRT, and each of the 37 CBCTs in 3D-CRT.

Results: The mean and standard deviation of the intra-fractional prostate shifts and bony-structure shifts, and the median of the time from soft-tissue matching to post-treatment CBCT, and the time from pre- to post-treatment CBCT were in Table 1. There was no significant difference in the intra-fractional prostate shifts between IMRT with the use of the immobilization device and 3D-CRT without the use of the device.

Conclusions: In IMRT, despite the fact that time from pre- to post-treatment CBCT was double that needed for 3D-CRT, and despite the larger intra-fractional bony-structure shifts compared with those measured during 3D-CRT, using the immobilization device and soft-tissue matching might minimize the intra-fractional prostate shifts.

Intra-fractional shifts

Intra-fractional	IMRT with the immobilization device (n=131)	3D-CRT without the immobilization device (n=37)	p-value
Prostate shifts	median 6.6 min. (from soft-tissue matching)	median 6.2 min. (from pre-treatment CBCT)	
in AP	-0.3 ± 1.4 mm	0.1 ± 1.7 mm	p=0.20
in SI	-0.1 ± 1.2 mm	0.2 ± 1.0 mm	p=0.09
in LR	-0.1 ± 0.7 mm	0.0 ± 1.0 mm	p=0.09
Bony-structure shifts	median 12.5 min. (from pre-treatment CBCT)	median 6.2 min. (from pre-treatment CBCT)	
in AP	0.8 ± 1.7 mm	-0.5 ± 0.7 mm	p
in SI	-0.8 ± 1.6 mm	-0.1 ± 0.5 mm	p
in LR	0.0 ± 0.8 mm	0.1 ± 0.6 mm	p=0.18

LL-ROS-TU5A • Evaluation of Artifacts Reduction and Image Quality Improvement Using Spectral CT Imaging after 125I Radioactive Particles Implantation

Qiuxia Yang (Presenter) ; Rong Zhang ; Sheng Peng ; Jing Wu ; Mingyan He ; Chuanmiao Xie ; Fujun Zhang

PURPOSE

To evaluate the performance of artifact reduction and image improvement around particles between monochromatic images with and without MARs after 125I particles implantation compared with polychromatic images.

METHOD AND MATERIALS

25 patients (18 males, 7 females, average age: 61, 10 cases of hepatocellular carcinoma, 1 case of cholangiocellular carcinoma, 14 cases of metastatic tumor) after 125I radioactive particles implantation were enrolled in this study. Each patient underwent enhanced spectral CT imaging and after a delay time of 15s, traditional 120kVp scan was performed focus on several slices of particles. Conventional 120kVp images and mono images of 75keV with and without MARs generated from GSI scan acquisition were evaluated. Images were also scored according to the visualization of 125I radioactive particles, artifact severity and surrounding tissue details. Comparison of percentages of diagnostic images (score=3) were performed. Iodine concentration was also used evaluating tissue response around particles. All the measurements were recorded and statistically compared.

RESULTS

There were 45 lesions found in 25 patients. Artifact was visible in 45 cases of traditional 120kVp CT images and 75keV images but invisible in 7 cases of 75keV images with MARs. The proportion of diagnostic images(score=3)for traditional 120kVp images, 75 keV images and 75keV images with MARs was 24.44%(11/45), 48.89%(22/45), 62.22%(28/45), respectively. Compared with 120kVp images, tissue evaluation around particles by using mono images plus mono images with MARs can increase the proportion of diagnostic images from 24.44%(11/45)to 84.4%(38/45). Patients were follow-up confirmed with good-response and it was found that iodine concentration of these 45 lesions were equivalent with normal tissue.

CONCLUSION

75keV images (with and without MARs)obtained with spectral CT imaging can substantially reduce metal artifacts caused by 125I radioactive particles and improve image quality around the particles. Spectral CT can provide more accurate CT images for estimating the efficacy of the treatment after125I radioactive particles implantation.

CLINICAL RELEVANCE/APPLICATION

Spectral CT showed its potential applications in monitoring disease progressions after125I radioactive particles implantation.

LL-ROS-TU6A • The Impact of Baseline Nutrition Status on Treatment Compliance and Toxicities of Adjuvant Chemoradiation in Locally Advanced Gastric Cancer

Qiwen Li (Presenter) ; **Guichao Li** MS ; **Zhen Zhang** ; **Yanong Wang** ; **Ziwen Long** ; **Xiaowen Liu**

LL-ROS-TU7A • Dosimetric Comparison of 3D-field-in-field Technique and Inverse Planning IMRT for Large Breasted Patients Treated in Prone Position

Rafi Kabarriti MD (Presenter) ; **Michelle A Savacool** PhD ; **Linda Hong** PhD ; **Wolfgang Tome** PhD ; **Jana Fox** MD ; **Shalom Kalnicki** MD

PURPOSE

Whole breast irradiation (WBI) leads to acute and late toxicities, which can be worse with plan dose inhomogeneities. This has been of clinical concern for large breasted patients, especially with hypofractionation. Two approaches of 3-D modulation of the radiation beam profile to optimize dose distribution and improve homogeneity are commonly employed. One is field-in-field forward planning wherein up to 3 or 4 subfields are generated within the initial radiation field. The other is inverse-planning IMRT, which typically utilizes 5 or more segments. In this study, we compare dosimetric parameters of WBI using the field-in-field technique with up to 3 subfields (3D-FiF) compared with inverse planning IMRT in large breasted patients.

METHOD AND MATERIALS

10 large-breasted patients (planning target volume [PTV] >2500 cc) treated between 2007-13 with WBI in the prone position with hypofractionation (42.4 Gy in 16 fractions) were selected. For each, an inverse planning IMRT and a 3D-FiF plan were created for the entire treated breast. Plans were normalized so that PTV coverage was the same (V95% = 95%). Dose-volume histograms were evaluated for volumes receiving > 105% (V105) and >107% (V107) of prescribed dose, and maximum dose (Dmax).

RESULTS

Median PTV volume was 3443cc (2675-3875) and the median separation distance at the chestwall posterior field edge was 25.9cm (23.7-27.3). IMRT significantly (p

CONCLUSION

3D-FiF can achieve a maximum point dose under 110% of prescribed dose with similar target coverage to IMRT for most large breast patients. However, IMRT can significantly reduce the V105 and V107 in these women. Improved dose homogeneity is expected to provide a meaningful benefit in terms of acute skin toxicities and late breast fibrosis in such large breasted women receiving WBI with hypofractionation, however further study is needed to prove its true clinical benefit.

CLINICAL RELEVANCE/APPLICATION

IMRT when compared to 3D- FiF technique can improve dose homogeneity by reducing V105 and V107 for large breasted cancer patients treated in the prone position.

LL-ROS-TU8A • Partial Breast Irradiation Using Stereotactic Body Radiotherapy to Deliver Adjuvant Treatment after Lumpectomy

Ken Dornfeld (Presenter)

PURPOSE

To determine the feasibility and safety of stereotactic body radiotherapy for adjuvant partial breast irradiation after lumpectomy.

METHOD AND MATERIALS

Women over 60 years old with T1N0M0 ER+ invasive ductal carcinomas resected with negative margins were invited to participate in a single arm prospective study. Adjuvant partial breast irradiation was delivered using CyberKnife to a dose of 38.5 Gy in 10 fractions over 5 treatment days. Fiducial markers were placed in proximity to the lumpectomy cavity to account for target motion during irradiation. Tumor control was assessed by standard period exam and imaging. Toxicity was scored clinically using the Harvard and RTOG toxicity scales.

RESULTS

16 women were enrolled, 14 completed treatment, one excluded after enrollment due to unacceptably high predicted skin dose after treatment planning, one declined further treatment after two doses. Treatment was delivered using a median of 146 unique beams (range 77-172). Median follow up is 12 months. RTOG scores for skin toxicity at the most recent assessment compared to pre-irradiation worsened for 5 patients, improved for one patient and was stable for 8 patients. RTOG scores for subcutaneous toxicity worsened for 5 patients and were stable for 9 patients compared to pre-irradiation assessments. Overall cosmetic scores remain stable for 11 patients and worsened slightly for 3 patients. Clinical toxicity scores for most patients reached a peak at 1 month post-treatment with subsequent improvement. Lumpectomy volumes ranged from 5 ccs to 135 ccs with a median of 37 ccs. The patient with the largest target volume developed a hematoma 3 months after radiation treatment. She underwent evacuation and is now doing well. No other significant toxicities were encountered. No recurrences have been noted.

CONCLUSION

Follow up is short but stereotactic body radiotherapy appears a safe and effective alternative for partial breast irradiation. Side effects may be dependent on lumpectomy volume and location.

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LL-ROS-TUB • AMA PRA Category 1 Credit™:0.5

LL-ROS-TU1B • Clinical Outcome of Reirradiation of Recurrent Glioblastoma Multiforme with Cyberknife Stereotactic Radiosurgery

Audre Claren (Presenter)

LL-ROS-TU2B • The Radiation Oncology Medical Student Clerkship: Implementation and Evaluation of a Multi-institutional Pilot Curriculum

Daniel W Golden MD (Presenter) ; **Alexander Spektor** MD, PhD ; **Sonali Rudra** MD ; **Mark C Ranck** MD ; **Monica Krishnan** MD ; **Rachel B Jimenez** MD ; **Akila N Viswanathan** MD ; **Matthew Koshy** MD ; **Andrew R Howard** MD ; **Steven J Chmura** MD, PhD

ABSTRACT

Purpose/Objective(s):Medical students considering a career in radiation oncology often complete multiple radiation oncology clerkships. On a nationwide survey students reported infrequent formal didactics during their rotations. To address this concern, we developed and implemented a multi-institutional curriculum designed to complement the radiation oncology clinical experience.

Materials/Methods:The curriculum consisted of three lectures on (1) an overview of radiation oncology, (2) radiation biology and physics, and (3) practical aspects of patient simulation. An interactive hands-on dosimetry session was also developed to expose students to radiation treatment planning. The curriculum was implemented in 2012 at two academic teaching hospitals. To ensure consistency the lectures and planning session were standardized between institutions. All students completed evaluations using Likert scales to rate the curriculum components (1 = "not at all" to 5 = "extremely"). Wilcoxon signed rank-sum was used to compare responses. IRB exemption was obtained.

Results:18 students completed the curriculum during a four-week rotation (University of Chicago n=13, Harvard n=5). Prior rotations completed included none (n=7), one (n=7), two (n=3), and n=1 did not respond. Overall, students rated the content of the lectures between "quite" and "extremely" important (mean Likert score: Overview 4.4, Radiation Biology/Physics 4.9, Practical Aspects 4.7, and Treatment Planning Workshop 4.9). After completing the interactive workshop students reported significantly improved comfort with radiation treatment planning (1.7 vs. 3.2, p **Conclusions:**A standardized curriculum for the four-week radiation oncology clerkship was successfully implemented at two institutions. Students reviewed the curriculum favorably. As a result of the curriculum students felt more comfortable with their specialty decision and better prepared to begin radiation oncology residency.

Table 1. Selected free-response quotes from medical students completing the pilot curriculum.

◆ I thought the course was very well thought out and very useful. It gave an excellent overview of the background of radiation therapy, practical elements, and the physics/biology underlying radiation therapy. The planning session was extremely helpful to visualize how the plan is implemented in practice. ◆

◆ This course was extremely helpful for me. As this was my first radiation oncology rotation this course gave me a very strong foundation in the field. ◆

◆ This course was very important in helping me become more comfortable with my decision to go forward with radiation oncology as a career. ◆

◆ I [think] a course like this would have made my first rotation much smoother. ◆

◆ Excellent course, I wish my home institution had a similar one. ◆

LL-ROS-TU3B • Role of External Beam Radiotherapy in Patients with Thyroid Cancer: One Center Experience

Sule Karaman ; Rabia Nergiz Dagoglu (Presenter) ; Seden Kucucuk MD ; Rasim Meral ; Ahmet Karadeniz ; Ethem N Oral

LL-ROS-TU4B • Predictors of Academic Career Selection in Radiation Oncology: A National Survey of Radiation Oncology Residency Programs

Sanjay Aneja BS (Presenter)

ABSTRACT

Purpose:

Changing dynamics of the US healthcare system coupled with the increasing demand for radiation therapy services has placed increased pressure on radiation oncology departments to maintain large clinical volumes often at the expense of the academic mission of their residency programs. The effect of these changes on resident career choice is unknown. The purpose of this study was to identify trends in academic career choice among radiation oncology residents and possible program qualities that may influence resident career choices.

Methods:

A survey was sent to 83 radiation oncology residency program directors within the United States regarding residency graduates between the years 2001 to 2011. The survey contained questions regarding the number of residents who pursued an academic position following graduation, research time during residency, and number of residents per class. Additionally, hospital data regarding the largest hospital for each residency program was obtained through publically available data from the U.S. News and World Report. A multivariate logistic regression model was built to test predictors of resident career choice.

Results:

Of the 83 radiation oncology programs contacted, 15 (18.0%) completed the survey representing approximately 26% of radiation oncology residency graduates from 2001-2011. Of the 306 residency graduates a total of 144 (47%) of residents initially chose academic careers following graduation. 45% of male graduates and 49% of female graduates initially chose academics. The percentage of residency graduates who pursued academics increased slightly over the period of the study (35% in 2001 vs. 48.5% in 2011). Residents from programs with more research months during residency (OR 1.02, p=.041), more residents per class (1.35, p=.005), and an affiliation with an NIH-Cancer Center (OR 1.39, p=.036) were more likely pursue academic careers. Conversely, residents who trained at hospitals with larger clinical volumes (as measured by number of discharges) were less likely to pursue academic careers following graduation (OR .98, p=.005).

Conclusions:

Over the last decade there has been a relative increase in the proportion of radiation oncology residents who have chosen academic careers following graduation. Although unrelated to gender, the choice to pursue academic radiation oncology is perhaps related to protected research time, exposure to an NIH Cancer Center, and manageable clinical volume that is divided among a large residency class. The radiation oncology community must be vigilant to promote aspects of residency programs that best train both academic and community radiation oncologists.

LL-ROS-TU5B • Expanding Oncologic Education in the United States: The Role of the Radiation Oncologist

Malcolm Mattes (Presenter) ; Evangelia Katsoulakis

ABSTRACT

Purpose/Objective(s): Cancer is the most common cause of mortality in the United States, and for most human cancers, the extent of disease at diagnosis is the most important predictor of survival. As such, primary care physicians play a crucial role in cancer outcomes, for their role in early diagnosis, prevention, screening, and support during treatment. Unfortunately, the majority of US medical students going into primary care will never do a clinical rotation in Oncology. In addition, because of the multidisciplinary nature of cancer care, a cohesive oncologic education during the clinical years is uncommon at most medical schools. Radiation Oncologists are in a unique position to take ownership of teaching the basic principles of clinical oncology to medical students, since they treat the entire spectrum of malignancies and collaborate with the entire spectrum of Oncologists. The goal of this project was to develop an Oncology curriculum at our institution, starting with a dedicated lecture on the basics of clinical oncology for third year medical students. In this study, we have evaluated the utility of that lecture to them.

Materials/Methods: An interactive 60 minute lecture was given by a Radiation Oncology resident to third year medical students during their internal medicine rotation. Over the course of the year all students would have attended once. Topics covered included an overview of cancer pathophysiology, natural history, diagnosis, imaging, staging, management with chemotherapy, radiation and surgery, clinical trial design, oncologic emergencies, and palliative care. An emphasis was placed throughout the session on the most common malignancies in the United States. Afterwards, students were emailed an electronic survey using SurveyMonkey. Descriptive statistics are reported below.

Results: To date, three lectures have been given to a total of 54 students, and 16 completed the survey (response rate 30%). Prior to attending the lecture, on average, respondents had completed 6.7 months of rotations and had received a total of 1.9 hours of dedicated oncology teaching during their rotations. 100% of respondents would like to have more oncology education during their clinical years, and 93% believe that every medical student should see a lecture of this type. After attending the session, 86% felt more competent interacting with Oncologists, and 71% felt more competent caring for cancer patients.

Conclusions: While the sample size so far is small, our findings suggest that a greater emphasis on clinical oncology education would be welcomed by most medical students. Future directions will include expanding to other medical schools, teaching more than a single lecture, and also including residents in primary care specialties in addition to medical students.

LL-ROS-TU6B • IMRT with MR Guidance for Prostate Cancer-A Dynamic Therapeutic Approach with Screening Implications

Joseph M Baisden MD,PhD (Presenter) ; Dana O Olson MD

PURPOSE

This study highlights the usefulness of magnetic resonance imaging (MR) in the treatment of prostate cancer with implications for screening. MR was used for planning prostate cancer radiation treatment and to evaluate the value of periodic limited MR during the course of therapy. This was evaluated in the community clinic setting.

METHOD AND MATERIALS

Planning CT images were acquired and individual treatment plans were performed for localized prostate cancer patients. MR images were acquired at 1.5 T at the community hospital. T2-weighted axial images were fused for planning purposes, and a second plan was generated using the fused images. Patients were treated with IMRT with daily CT image guidance using helical tomotherapy to a total dose of 81 Gy. Periodic limited MR imaging, including T2, diffusion and STIR were acquired twice weekly to evaluate the dynamic MR response to therapy.

RESULTS

Rectal doses were decreased significantly for the patients as treated with fused-MR planning, compared to plans generated with CT data only. Discrepancies in prostate volume and associated Planning Target Volume (PTV) were variable, highlighting the advantage of MR over CT in delineated prostate anatomy. There was a 29.3% decrease in mean prostate volume with MR compared to CT. Regarding rectal dose, the V80, V70, V60 and V50 were decreased by 82.6, 65.9, 54.7 and 43.7%, respectively. Similar improvements were seen in dose to the bladder and penile bulb. Patients tolerated the treatments with no Grade 3 or higher acute toxicities. The MR imaging during the course of therapy demonstrated changes including a general decrease in MR prostate spatial frequency and mild gland enlargement.

CONCLUSION

Fusion of MR for planning purposes results in significant sparing of normal organs for prostate cancer IGRT/IMRT in the community setting. Patients tolerated

81 Gy with side effect profiles consistent with other reports. Further dose escalation is being pursued. Periodic limited MR imaging may be useful for ongoing therapy guidance and the changes noted may provide a useful approach to using this technology as an effective screening tool.

CLINICAL RELEVANCE/APPLICATION

MR serves a valuable role in prostate cancer therapy, both guidance and outcome assessment. MR allows more accurate radiation targeting and normal organ sparing, permitting safe dose escalation.

LL-ROS-TU7B • Breast Cancer and Bone Metastases: MR Imaging of Axial Skeleton Metastases for Predicting Skeletal Related Events

Christian B Van Der Pol MD (Presenter) ; Mark E Schweitzer MD ; Gina A Di Primio MD ; Marcos L Sampaio MD ; Ania Z Kielar MD ; Mark Clemons ; Tinghua Zhang ; Arash Jaber MD

PURPOSE

Bone metastases from breast cancer are associated with significant morbidity and mortality. Skeletal related events (SREs) are defined as radiation/surgery to bone, pathologic fractures, malignant spinal cord compression and hypercalcemia. We hypothesized that certain skeleton MRI characteristics were associated with developing an SRE.

METHOD AND MATERIALS

Over a 3-year period, 250 unselected patients were identified with skeletal metastases on axial skeleton MRI, histologically proven breast cancer and no other malignancy. Two radiologists reviewed each study independently. Patients were divided into 3 groups: 1) metastatic marrow replacement, 2) > 20 skeletal metastases, and 3) = 20 metastases. Marrows were divided into 7 subregions (cervical, thoracic, lumbo-sacral spine, pelvis, proximal femurs, sternum and shoulder girdles). The number of regions with metastases was summed. Presence of a pathologic fracture was documented. Charts were reviewed for the subsequent development of SREs. Logistic regression was applied to determine the odds ratio (OR) for developing an SRE, with 95% CI and p-values.

RESULTS

176/250 (70%) patients developed an SRE. Presence of a prior pathologic fracture demonstrated the strongest association with developing an SRE; OR 2.506 (1.112-5.648, p=0.03). Marrow replacement and > 20 metastases were associated with developing an SRE compared with = 20 metastases; OR 2.048 (1.019-4.118) and 2.176 (1.086-4.361), respectively (p=0.03). A higher sum of involved skeletal regions was associated with developing an SRE; OR 1.251 (1.081-1.448, p=0.003). Metastases involving predominantly the axial skeleton, increasing metastases quantity, metastases T1 signal and signal uniformity were not statistically associated with SREs. Increased metastatic involvement of the proximal femur showed a trend for shorter time to hip fracture (Figure).

CONCLUSION

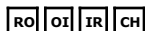
Several characteristics of axial skeleton metastatic disease on MRI are associated with developing SREs. These include presence of a pathologic fracture, marrow replacing process, > 20 skeletal metastases, and more skeletal regions of involvement. These findings require prospective confirmation.

CLINICAL RELEVANCE/APPLICATION

Features of bone metastases on axial skeleton MRI may be of utility for predicting development of skeletal related events in patients with breast cancer.

Interventional Oncology Series: Lung

Tuesday, 01:30 PM - 06:00 PM • S405AB



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VSI031 • 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.

VSI031-01 • 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 1-2 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.

VSI031-02 • Colorectal Lung Metastases

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI031-03 • Sarcoma and Other Non-CR Lung Metastases

Jean Palussiere MD (Presenter)

LEARNING OBJECTIVES

View learning objective under main course title.

VSI031-04 • 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 Electroporation (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.

VSI031-05 • 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 toxicities of thoracic SBRT.

VSI031-06 • 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.

VSI031-07 • 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

VSI031-08 • 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 contraindications to RFA of the lung. 2) Outline the RFA procedure including sedation, appropriate approach and positioning, equipment setup and treatment and followup protocols.

VSI031-09 • 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-to-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.

VSI031-10 • 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

VSI031-11 • 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

VSI031-12 • 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.

VSI031-13 • 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.

VSI031-14 • 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 encounter 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.

VSI031-15 • 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.

VSI031-16 • 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 determined 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.

VSI031-17 • 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 Blaszukowsky, 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 management 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 affects the radiotherapy approach. 3) To improve knowledge and understanding of appropriate imaging evaluation of the regional lymphatics in these various clinical scenarios. 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 management of patients, imaging issues, surgical issues and radiotherapeutic approach in the evaluation and management 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 management. 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.

Radiation Oncology and Radiobiology (Outcomes)

Tuesday, 03:00 PM - 04:00 PM • S104A

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RO

SSJ25 •AMA PRA Category 1 Credit™:1

Moderator
Anna Shapiro, MD
Moderator
Charles R Thomas, MD

SSJ25-01 • Mentoring Students in Radiation Oncology: A Nine-year Retrospective Analysis of Students Participating in a Radiation Oncology Mentorship Program

Ankit Agarwal BS (Presenter) ; **Nicholas J Denunzio** BS ; **Alexander E Rand** BA ; **Ariel E Hirsch** MD

ABSTRACT

Purpose/Objective(s):

Mentorship in academic medicine, including mentorship specifically in the field of radiation oncology, has been discussed in the literature. The purpose of this analysis is to document the impact of a mentorship program in radiation oncology at our institution.

Materials/Methods:

The analysis tracked 37 former medical students who took part in the Radiation Oncology Mentorship Program between 2004 and 2012 and graduated from our institution. The students participated in the clinical mentorship track, which included formal clinical experience in radiation oncology, or the research mentorship track, which included dedicated research time in radiation oncology, or both.

We analyzed the impact of the mentorship program on specialty choice and determined which mentorship track led to the greatest percentage of students choosing radiation oncology.

Results:

Of the 37 students tracked, 21 (56.8%) participated in the clinical mentorship program, ten (27.0%) participated in the research mentorship program, and 6 (16.2%) participated in both programs. In terms of specialty selection, 14 (37.8%) chose radiation oncology, seven (18.9%) chose internal medicine, four (10.8%) chose radiology, three (8.1%) chose general surgery, two (5.4%) chose ENT, two (5.4%) chose urology, two (5.4%) chose ob/gyn, one (2.7%) chose dermatology, one (2.7%) chose pediatrics, and one (2.7%) chose orthopedic surgery.

Three (30%) research students, seven (33.3%) clinical students and four (66.7%) students who obtained research and clinical experiences chose radiation oncology. Table 1 summarizes these results.

Conclusions:

Early and active mentoring of medical students in radiation oncology will enhance general understanding of the field as well as improve its professional base to enhance patient care. While the sample sizes are too small to reach statistical significance, they seem to indicate that the involvement in formal clinical and research mentorships in radiation oncology is common among students pursuing the field. Furthermore, other studies have shown a statistically significant increase in medical student knowledge about cancer and radiation therapy following formal radiation oncology experiences in medical school. Given the large epidemiological impact of cancer on the population, physicians must be competent in understanding and addressing their cancer patients' needs, regardless of chosen specialty.

Radiation Oncology Mentorship Program Outcomes

	Clinical	Research	Both	Total
Radiation Oncology	7	3	4	14
Other Specialty	14	7	2	23

SSJ25-02 • Outcomes of Stereotactic Body Radiotherapy (SBRT) Treatment of Skeletal Muscle/Soft Tissue Metastases
Reed Cope (Presenter); Kenneth R Olivier MD; Robert L Foote MD; Paul D Brown MD

SSJ25-03 • Achieving Optimal Patient Setup Imaging and Treatment Workflow Configurations in Multi-Room Proton Centers via Monte Carlo Simulation

Hao H Zhang (Presenter); Karl Prado; Katja M Langen PhD; Minesh P Mehta MD*; William F Regine MD; Warren D D'Souza PhD

SSJ25-04 • Toxicity Associated with Intensity-modulated Pelvic Radiation Treatment in the Post-operative Setting

Carla Hajj MD (Presenter); Abraham J Wu MD; Karyn A Goodman MD

ABSTRACT

Purpose/Objective(s):

Preoperative chemoradiotherapy (CRT) is the recommended standard therapy for patients with locally advanced rectal cancer and is associated with reduced grade 3 or 4 toxicities compared with post-operative CRT. However, pre-operative staging studies may not correctly identify all patients with node positive or T3 disease, thus, some patients undergo upfront surgical resection and are found to have more advanced disease. In the small subset of rectal cancer patients who require post-operative CRT, the question of potential toxicity may affect the decision to offer therapy. The toxicity of post-operative CRT is primarily related to the large volume of small bowel that falls into the pelvis after rectal resection. The aim of this study was to evaluate the role of intensity modulated radiotherapy (IMRT) planning in reducing toxicity of CRT in the post-operative pelvis, either for adjuvant therapy or for a local recurrence.

Materials/Methods:

We retrospectively reviewed records of 22 colorectal cancer patients treated between 2007 and 2012 who received CRT using IMRT after prior radical resection with a low anterior resection (LAR) or abdominoperineal resection (APR). We reviewed the patients' characteristics and analyzed the clinicians' reported toxicities (CTCAE v 3.0).

Results:

The median age at treatment was 63 years, and 12 patients (56%) were males. Fourteen patients (64%) received post-operative CRT for locally recurrent disease, whereas 8 (36%) were treated in the adjuvant setting, at initial diagnosis of locally advanced rectal cancer. The median radiation dose was 50 Gy (range: 45 to 56 Gy). The median dose to the bowel was 2380 cGy, with a median in-field bowel volume of 621 cc. Grade 2 dermatitis, diarrhea, and proctitis occurred in 9%, 14%, and 45% of the patients, respectively. None of the patients had grade 3 or 4 toxicities. None of the patients experienced grade 2 nausea, vomiting, or cystitis.

Conclusions:

In this small series, postoperative CRT with IMRT planning was associated with minimal acute GI or skin toxicity. While pre-operative CRT is preferable, if necessary, CRT in the adjuvant setting or for locally recurrent can be delivered safely using IMRT. While large prospective studies of IMRT in this setting are unlikely to be performed, retrospective studies can help clarify the role of IMRT planning for pelvic radiotherapy with the goal of reducing acute toxicity and ultimately minimizing late effects and long-term quality of life for these patients.

SSJ25-05 • Questionnaire Survey Regarding Radiotherapy of Metastatic Brain Tumors: Results from the North Japan Radiation Oncology Study Group

Kensuke Tanaka (Presenter); Gen Kawaguchi; Eisuke Abe; Hiraku Sato MD; Junyang Liu MD; Hidefumi Aoyama MD, PhD; Mika Obinata; Kaidu Motoki; Fumio Ayukawa MD

ABSTRACT

Purpose/Objective(s): Although brain stereotactic irradiation (STI) has been made increasingly in Japan in conjunction with the improvement of radiotherapy equipment, renewed measures are needed to form treatment policies on brain metastases and STI treatment planning in Japan. We conducted a questionnaire survey to investigate current radiation therapy practices for brain metastases in the North Japan Radiation Oncology Study Group.

Materials/Methods: In August 2011, questionnaires were sent to sixty institutions associated with the North Japan Radiation Oncology Study Group. The questionnaires consisted of questions on five major subjects; the availability of STI, treatment policies of brain metastases, STI treatment planning, whole brain radiotherapy (WBRT) and the treatment choice for four representative cases.

Results: Thirty-seven institutions responded. STI was available at 20 institutions (54%) at the time of the survey. Regarding treatment policy of brain metastases, WBRT and STI were equally emphasized (40%) at institutions where STI was available, whereas WBRT was given preference (69%) at institutions where STI was not available. Especially for patients with poor performance status (PS), STI monotherapy was used preferentially at institutions where STI was available, while WBRT was used frequently at institutions where STI was not available. Tumor size (94%), tumor number (91%), PS (91%), control of the primary site (64%) and extracranial metastasis (61%) were regarded as important factors in the choice of STI monotherapy. In STI treatment planning, more institutions used stereotactic radiotherapy than stereotactic radiosurgery, particularly in the treatment of lesions larger than 2 cm in diameter. The reference point for the dose prescription was set at the isocenter in 13 institutions (62%) and at the tumor margin in 6 institutions (29%), and 2 institutions (9%) used dose volume prescription. 30 Gy in 10 fractions (73%) was the most frequently used for WBRT, but for the patients with good PS or good prognosis, 2 or 2.5 Gy per fraction was also selected. The treatment decision for the four representative cases was made by majority agreement.

Conclusions: Brain STI has been carried out in more than half of the institutions in this survey. Because it is available at more institutions, STI is expected to be given higher priority in the treatment of brain metastases. Tumor size, tumor number, and PS are important factors when the respondents select STI monotherapy. For comparison between different STI treatments, the dose prescription in STI should be better defined.

SSJ25-06 • Impact of ASTRO 2011 Guideline for Palliative Radiotherapy for Bone Metastases on Treatment Patterns at a Multicenter Academic Radiation Oncology Practice

Jagdeep Raince MD (Presenter); Beatrice Bloom MD; Ankit Modh BS; Henry Chou; Jacob Pinsky

CONCLUSION

Our findings suggest that while the publication of ASTRO 2011 guidelines for palliative radiotherapy for uncomplicated bone metastases did shift our facility's treatment pattern to shorter course, i.e 5 fractions vs. 10 fractions, or SRS palliative treatment, it did not lead to adoption of a single 8 Gy fraction. Further exploration with data mining of our IMS is ongoing to determine the reasons for this apparent barrier.

Background

The ASTRO 2011 guideline for palliative radiotherapy for uncomplicated bone metastases stated that a single 8 Gy fraction would provide equivalent pain relief and/or prevention of morbidity as a more prolonged RT course. As part of a Quality Management initiative, we utilized our in house information management system (IMS) to determine if treatment patterns for metastatic bone disease shifted at our large, multicenter academic radiation oncology practice as a result of this guideline.

Evaluation

Through the use of our IMS we queried our electronic medical record for the diagnosis code of 198.5 (bone metastases) and the associated treatment prescriptions. The query period extended from January 1, 2010 through December 31, 2012 affording the opportunity to evaluate treatment pattern before and after the official publication of the Guideline. Between 2010 and 2012 a shift in treatment pattern away from 30Gy/10 fractions (28% in 2010 to 12% in 2012) in favour of 20 Gy/5 fractions (36% in 2010 to 39% in 2012). Increased utilization of stereotactic radiosurgery was also noted (4% in 2010 to 38% in 2012).

Discussion

Between 2010 and 2012 a shift in treatment pattern away from 30Gy/10 fractions (28% in 2010 to 12% in 2012) in favour of 20 Gy/5 fractions (36% in 2010 to 39% in 2012) and increased utilization of stereotactic radiosurgery (4% in 2010 to 38% in 2012).

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Imaging for Target Definition

Tuesday, 04:30 PM - 06:00 PM • S102D



RC422 • AMA PRA Category 1 Credit™: 1.5 • ARRT Category A+ Credit: 1.5

Co-Director, Moderator
Robert Jeraj

RC422A • Uncertainties in Physical Target Definition Using PET

Assen S Kirov PhD (Presenter) *

LEARNING OBJECTIVES

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1) PET segmentation requirements for target definition. 2) Types of PET auto-segmentation approaches. 3) Challenges for PET segmentation.

URL's
<http://www.mskcc.org/staff/assen-kirov>

RC422B • Practice and Uncertainties in Biological Target Definition

Robert Jeraj (Presenter)

LEARNING OBJECTIVES

1) Dose painting definitions. 2) Dose painting workflow. 3) Uncertainties in dose painting. 4) Dose painting studies.

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

Wednesday, 08:30 AM - 10:00 AM • S103CD

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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.

New Paradigms for the Treatment of Hodgkins and non-Hodgkins Lymphomas: The Crucial Role of Imaging

Wednesday, 08:30 AM - 10:00 AM • S504AB

[RO](#) [OI](#)

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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.

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Site-specific IGRT Applications: Impact of Different Approaches on Uncertainties

Wednesday, 08:30 AM - 10:00 AM • N229

[PH](#) [RO](#)

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RC522 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator

Laurence E Court, PhD

LEARNING OBJECTIVES

1) Impact of different approaches on uncertainties for specific sites, including pelvis, HandN, thorax, and abdominal sites.

RC522A • Pelvis

Emilie Soisson PhD (Presenter)

LEARNING OBJECTIVES

1) Be able to describe the sources and magnitude of positional uncertainty in irradiation of the pelvis. 2) Understand the role of image guidance in localizing pelvic targets. 3) Be able to compare the imaging strategies employed in the pelvis and understand residual uncertainties associated with each system. 4) Be able to compare published results with their own clinical practice.

ABSTRACT

Detection of organ motion is required for accurate targeting in radiation therapy of the pelvis. It is well known that pelvic targets change size, shape, and location as a result of changes in bladder and rectal filling and the size and location of these organs on the planning CT cannot be easily reproduced at treatment. While organ filling can be partially controlled through dietary regulation, complete immobilization is not possible. Image guidance (IGRT) provides the opportunity to monitor inter- and intra-fraction anatomical changes to better ensure plan delivery accuracy. In turn, IGRT has allowed for margin reduction and dose escalation, especially in the case of the prostate. The potential reduction in margin is then dependent on several factors including the ability to visualize the target and the frequency of imaging. Since target anatomy is generally not rigid with respect to bony landmarks, images used for localization must provide adequate soft tissue contrast or be used in combination with implanted surrogates. Due to the variety of IGRT approaches available and the possibility of having more than one imaging system in each treatment vault, it is now possible to inter-compare different localization methods to determine the uncertainty of a particular approach. Results of these studies are surprising and suggest that even though we think we can see the prostate with our chosen image guidance strategy, back-to-back imaging with different modalities will likely reveal that the prostate not only a different size but also often in a different place. In addition, intra-fraction motion is considerable in the prostate indicating that significant margins are might be required in the absence of intra-fraction tracking.

RC522B • Head and Neck

Laurence E Court PhD (Presenter)

LEARNING OBJECTIVES

1) Be able to describe the uncertainties in head and neck radiation therapy. 2) Appreciate the different approaches used. 3) Have an understanding of the range of margins used for head and neck treatments clinically, and the rationale for these. 4) Be able to logically compare published margins with their own clinical practice.

ABSTRACT

Head and neck cancer is a difficult site for radiation therapy because of the complexity in target delineation, normal tissue sparing and treatment planning. Typically, head and neck patients are immobilized using thermoplastic masks, which are custom-made to fit the individual patient. Generic, or patient-specific neck supports may be used. In many institutions IGRT is considered standard of care for these patients. Thus, many of the uncertainties in head and neck treatments are minimized. However, it is important to understand the residual uncertainties. The immobilization devices are good at minimizing intrafraction movement, but the complex motions of the head and neck region mean that there can be day-to-day variations in the relative positions of different regions, such as between the neck and head. The extent of these variations has been well studied, and will be described in this presentation. There are also different approaches to the IGRT process, including the use of 2D or 3D imaging. This session will explore the uncertainties in head and neck radiation therapy, including inter-fraction variations and also variability in contouring. Mitigation strategies will be discussed. We will describe the treatment margins used by different including their respective rationale.

Sonja Dieterich PhD (Presenter)

LEARNING OBJECTIVES

1) Be able to describe the sources of uncertainties in the thorax and abdomen. 2) Learn how different respiratory motion management influence margins. 3) Gain an understanding what typical ranges of margins are for the respective methods. 4) Be able to determine appropriate margins for their respective clinical practice.

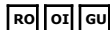
ABSTRACT

The uncertainties thorax and abdominal regions in the human body consists of overall patient setup uncertainty, respiratory motion, and organ deformation. Depending on the location of the target, a site-specific combination of these three components make up the total uncertainty. Respiratory motion compensation methods are increasingly used in clinical practice to minimize uncertainties. The most commonly used respiratory motion compensation methods are: breath-hold, abdominal compression, gating, and real-time tracking. Each method has a different impact on uncertainties. The simulation imaging also contributes to variations in uncertainties. CT artifacts which may change the contouring margins used depend on the data acquisition technology used during simulation. Free breathing, deep inspiration or expiration breath-hold, gated 4D-CT (both phase-gated and amplitude gated), scanner speed, pitch, and number of slices per revolution all influence the uncertainties. In addition to uncertainties in the position of the target, the relative position of organs at risk (OAR) to the target area may also change intra- or inter-fractionally. The concept of using OAR margins in the planning phase to anticipate potential relative shifts of OAR to target position will be discussed. Assessing OAR dose during daily image-guided patient setup can help identify setup variations exceeding OAR safe margins. Strategies to address setup variations exceeding uncertainty limits based on clinical experience will be discussed.

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

Wednesday, 10:30 AM - 12:00 PM • S103CD

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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 Ghouli** 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 $D = (T \ominus C)/C$ and localizability as $L = (T \ominus N)/N$; 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 125I 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 comparison. 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 after 125I 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)

MSRO42-09 • Practice Patterns in the Prescription of Elective Nodal Irradiation in Prostate Cancer
David Greene MD (Presenter)

ISP: Molecular Imaging (Oncology II)

Wednesday, 10:30 AM - 12:00 PM • S504CD

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RO **OI** **MI**

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, α_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 VEO2100 imaging system (Visualsonics, Canada). Microvasculature and expression levels of biomarkers were investigated at 20 MHz using specific contrast agents (CA) (MicroMarker™, Visualsonics). The lyophilized CA were conjugated with biotinylated rabbit anti-mouse endoglin, α_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 immunohistochemistry.

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 α_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 μ Ci 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 monocrySTALLINE 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 post injection) of the pelvis and subsequently whole body acquisition (late phase, 30 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

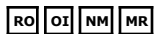
To our knowledge, this study represents the first clinical evaluation of [18F]-FLT PET to predict response to neoadjuvant therapy that included EGFR blockade with cetuximab in patients with rectal cancer. Our results suggest that [18F]-FLT PET is a promising imaging biomarker of treatment response in 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 outcome.

Nuclear Medicine (PET/MRI for Oncology)

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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, 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 lung compartment option. In addition, repeated in-vivo PET/MR 18F-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 clinical 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 suppression) 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 retrospective 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 determined 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 sensitivity (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 from 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 ; Sunghoon 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 HIPAA 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 FFRCSI ; **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.

Radiation Oncology and Radiobiology (Gastrointestinal)

Wednesday, 10:30 AM - 12:00 PM • S104A



SSK22 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5
Moderator

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SSK22-01 • Definitive Chemoradiation for Cervical Esophageal Carcinoma Using Altered Fractionation
Melissa H Lemieux MD (Presenter) ; Romy Pandey ; Daniel W Golden MD ; Daniel J Haraf ; Victoria M Villafior

SSK22-03 • Does Pet-CT Predict Histopathologic Response and Clinical Outcome after Neoadjuvant Chemo-radiotherapy for Locally Advanced Esophageal Cancer?

Jonathan Verma ; Stephen B Chiang MD (Presenter)

ABSTRACT

Purpose/Objective(s):

The purpose of this study is to assess the utility of PET in predicting pathologic complete response (pathCR) in patients treated with neoadjuvant chemoradiotherapy (chemoRT) for locally advanced esophageal cancer, and to evaluate the influence of PET response and pathCR on outcomes including disease-free (DFS) and overall survival (OS).

Materials/Methods:

We conducted a retrospective review of patients treated at our institution with neoadjuvant therapy and esophagectomy for T3 or N+ esophageal cancer. We collected data including the type of neoadjuvant therapy, Maximum SUV (SUVm) on PET imaging prior to and 6 weeks after neoadjuvant therapy, clinical and pathologic staging, surgical pathological findings, and overall and disease-free survival.

Results:

The data were collected for 25 patients, all treated with neoadjuvant chemoRT and esophagectomy. The 3-year DFS and OS were 27% and 57% respectively. The initial clinical staging was T3N0 for 9 patients (36%), cN1 in 12 (48%), cN2 in 4 patients (16%). Pre-treatment PET had a median SUVm of 8.9 (range 4-20.5). Post-treatment PET-CT was done a median 6.1 weeks (range 3.9-6.7 weeks) after completion of RT. Post-treatment PET had median SUVm of 4.6 (range 0-9). 8 patients (40%) had a pathCR. The pathCR rates was 0% in patients with post-therapy SUVm at background levels (n=4), 50% in patients with a post-therapy SUVm 5 (n=9). When comparing post- to pre-treatment PET, 4 patients had complete response, 6 patients had >50% reduction of SUVm, and 5 had 95% pathologic response in these groups were 50%, 50%, and 40% respectively. Nodal downstaging from N+ to N0 occurred in 7 (44%) of the 16 clinically N+ patients. Patients who had a pathCR had a trend to longer median DFS compared to those who did not (2.4 vs. 0.6 years, p=0.07). Patients who had >95% pathologic response had a prolonged median survival compared to those who did not (3.6 vs. 0.6 years, p=0.001). There were no differences in 1-year DFS between patients whose post-treatment SUVm was background, less than 5, or greater than 5.

Conclusions:

PET-CT did not predict pathCR or DFS in our population. PathCR after chemoradiotherapy may improve DFS in patients with locally advanced esophageal cancer.

SSK22-04 • Early Outcomes with the Use of Intensity Modulated Radiation Therapy with Simultaneous Integrated Boost as a Part of Neoadjuvant Therapy with Concurrent Chemotherapy for Advanced Stage Rectal Cancers

Shilpa Vyas MD (Presenter) ; Nitika Thawani MD ; Dharanipathy Rangaraj ; Niloyjyoti Deb MD ; Subhakar Mutyala MD

ABSTRACT

Title: Intensity Modulated Radiation Therapy decreases acute toxicity of neoadjuvant pelvic radiation with concurrent 5-Fluorouracil based chemotherapy for rectal cancer compared to Three Dimensional Conformal Radiation Therapies.

Objective: To compare the acute toxicity of neoadjuvant pelvic radiation with 5-FU based chemotherapy for rectal cancer using Intensity Modulated Radiation Therapy (IMRT) with simultaneous integrated boost (SIB) technique compared to 3D Conformal Radiation Therapy (3DCRT)

Methods: Forty two (42) consecutive rectal cancer patients treated with pelvic radiation and concurrent 5-FU based chemotherapy were analyzed. We compared twenty-two (21) patients treated on an institutional IMRT protocol versus twenty-eight (21) patients treated with 3DCRT. All patients received 45-50.4 Gy to the pelvis in 3DCRT group. All patients with IMRT received 45 Gy in 25 fractions to the pelvic nodes and primary rectal tumor along with a simultaneous integrated boost to a dose of 50 Gy in 25 fractions to areas of gross disease. IMRT planning was done with dose constraints for bladder, rectum, and small bowel and bone marrow. All patients in both groups received 5-FU based chemotherapy during radiation. Evaluation of toxicity was based on RTOG criteria. Two patients in the 3DCRT group and two in IMRT group received either growth factors or blood-products transfusion and needed hospitalization during treatment secondary to acute toxicities.

Results: All patients completed their prescribed course of radiation. Complete response rates were 5/21(23%) in 3DCRT and 4/21(19%) in the IMRT-SIB (p-value 0.74). 9/21(42%) and 15/22(71%) in the IMRT group underwent Low anterior resection according to the location of the tumor. There was no grade 4 toxicity in the IMRT-SIB group. Overall grade 2 toxicity in 3D Vs IMRT-SIB group was - GI -52% Vs 19%, GU- 8% Vs 8%, skin 42 Vs 4%, hematologic 33 Vs 47%. Overall Grade 1 toxicity in 3dCRT Vs IMRT group was- GI- 33% Vs 52%, GU 23% vs 28%, Skin 52% Vs 38%, hematologic 4% Vs 33%.

Table: Total Incidence of toxicity

	3D	IMRT
Grade 1	1(4%)	7(33%)
Grade 2	14(66%)	10(47%)
Grade 3	3(14%)	3(14%)
Grade 4	2(9.5%)	0

Conclusions: Neoadjuvant pelvic radiation with concurrent 5 FU for rectal cancer has less GI, skin and hematologic toxicity when delivered via IMRT-SIB versus 3DCRT with comparable complete response rates. Long-term follow up is needed to assess for chronic toxicity and disease outcomes.

SSK22-05 • Feasibility and Efficacy of Radiotherapy for Patients 80 Years Old or Older with Esophageal Cancer
Kazuuya Inoue ; Tetsuro Tamamoto (Presenter) ; Emiko Katayama MD ; Isao Asakawa ; Masatoshi Hasegawa

SSK22-06 • Advantages of Using Double Contrast Enema as a Low Cost Technique for Accurate Target Delineation during CT Simulation for Rectal Cancer Treated with Neoadjuvant Chemoradiation with Intensity Modulated Radiation Technique (IMRT)

Mammen Sam MD (Presenter) ; Nitika Thawani MD ; Sameer Jhavar MD, PhD ; Karen Stumph ; Shilpa Vyas MD ; Subhakar Mutyala MD

ABSTRACT

Purpose:

Neoadjuvant chemoradiation followed by surgery with adjuvant chemotherapy is the current standard of care for advanced rectal cancers. Target delineation in radiation treatment planning is central to tumor control probability and to limiting normal tissue radiation toxicity especially when using conformal techniques like IMRT. Metabolically active imaging such as PET/CT is increasingly used for identification and localization of biologically viable targets. This comes with high cost, limited availability, and additional radiation exposure. Use of an air contrast enema during CT simulation for radiation treatment planning is inexpensive, readily available and potentially allows for similar targeting results without additional radiation exposure.

Materials and Methods:

Twelve consecutive patients with biopsy-proven rectal cancers who were treated with neo-adjuvant chemoradiation were identified who underwent PET/CT imaging in treatment planning position. CT simulation was performed with double contrast barium enema. GTV was delineated on simulation CT by 1) double contrast enema, 2) FDG activity on pretreatment PET/CT, and 3) CT portion of the PET/CT. CTVs were generated to account for microscopic disease. GTVs generated using double contrast enema and CT/PET were compared with GTV generated by PET using correlation coefficients. We also compared the percent non-overlap between the CTV generated by PET and double contrast enema.

Results:

The mean and median GTV volumes based on PET were 21.9 and 20.1 cc respectively (range 4.27 - 53.7 cc). The mean and median GTV volumes based on double contrast enema were 47.5 and 49.1 cc respectively (range 5.7 - 95.2 cc). The mean and median GTV volumes based on CT/PET were 39.1 and 38.8 cc respectively (range 5 - 96 cc). The correlation coefficient between PET GTV and double contrast enema GTV was 0.74 and between PET GTV and CT/PET GTV was 0.85 suggesting strong correlation for both. The mean and median non-overlap volume between CTVs generated from PET and double contrast enema was 36% and 34% respectively (range 27% - 64.8%).

Conclusion:

In our pilot study we found that there was a good correlation between the GTVs generated both from PET and double contrast enema and also between PET and CT/PET. We also noticed that the CTV generated with double contrast enema accounts for internal target motion with a potential of missing the target if not used. Limitations include inability to assess nodal volume. Double contrast enema is low cost technique with several advantages.

SSK22-07 • The Use of a Neoadjuvant Hypofractionated Chemoradiation Approach for Unresectable Pancreatic Adenocarcinoma

Roberto Sabater (Presenter) ; Chance Matthiesen ; Salahuddin Ahmad PhD ; Terence Herman

ABSTRACT

Objective: Initial surgical resection is the most curative therapy approach for pancreatic cancer. Many patients are not resectable due to locally advanced tumor. For such patients, the optimal approach is unclear. Chemotherapy with and without standard fractionation radiation has been studied in multiple trials with conflicting results, and continues to be the subject of ongoing trials. We reviewed our institutional experience utilizing a neoadjuvant hypofractionated chemoradiation approach for inoperable pancreatic adenocarcinoma.

Methods: A retrospective review was performed identifying eleven patients diagnosed with adenocarcinoma of the pancreas and treated with RT from 2009-2012. Median age for the group was 65 years (range 50-80 years). Patients were deemed unresectable via radiographic (10, 90.9%) or endoscopic (1, 9.1%) criteria. Eleven were diagnosed with adenocarcinoma of the pancreatic head (8, 72.7%), body (2, 18.2%), or multicentric (1, 9.1%). Disease TNM staging included T4N0M0 (5, 45.5%), T2N0M0 (2, 18.2%), T3N1M0 (2, 18.2%), T3N0M0 (1, 9.1%), and T4N0M0 (1, 9.1%). Pretreatment PET/CT was performed in seven (63.6%) patients, with a median tumor SUV of 9.55 (range 3.8-13.7). Median pretreatment CA 19-9 was 428.7 (range 31.3-2526.1) in nine patients. Ten patients received induction chemotherapy with FOLFIRINOX (7, 70%), Gemcitabine (2, 20%), or Gemcitabine/Capecitabine (1, 10%). All patients received concurrent Capecitabine (5, 45.5%), Gemcitabine (1, 9%), or 5-FU (5, 45.5%) with radiation. Radiation therapy consisted of median treatment dose of 49.5 Gy in 18 fractions via IMRT (range 49.5 - 60 Gy in 18-30 fractions). Goals of neoadjuvant therapy in all patients were to achieve an R0 resection following therapy completion.

Results: All patients completed RT without complications or treatment interruption. Median follow up after RT was 6 months (range 0-21). Eight (72.7%) patients had post-RT PET/CT. Results showed four lesions with a complete resolution of hypermetabolic activity, and four lesions decreased to a median SUV of 4.4 (range 2.7-5.4). Median post-RT CA 19-9 nadir was 51 (range 0-2393.1). Five patients (45.5%) proceeded to surgical resection. All achieved a R0 resection. Pathologic staging was ypT3N1 (1, 20%), ypT1N0 (2, 40%), ypTxN0 (minimal residual disease) (1, 20%), and no residual disease (1, 20%). One (20%) patient died of surgical complications; the other four (80%) remain disease free. Six patients (54.5%) remained inoperable at completion radiotherapy. At the time of review, seven (63.6%) patients remain alive, three (27.3%) are deceased, and one (9.1%) was lost to follow up.

Conclusion: Hypofractionated chemoradiation is a well-tolerated treatment approach for unresectable pancreatic cancer. This approach can achieve resectability in some patients. Further investigation is warranted.

SSK22-08 • Adjuvant Chemoradiotherapy for Resected Hepatocellular Carcinoma

Ato O Wright MD (Presenter)

ABSTRACT

PURPOSE: Curative surgical approaches for hepatocellular carcinoma (HCC) include partial hepatectomy (PH) and liver transplantation. In other malignancy subsites, data demonstrate a benefit of adjuvant therapy for close or positive margins and/or nodal positivity; it may be reasonable to extrapolate these oncologic principles to the management HCC. The purpose of this study is to evaluate the outcomes and toxicity in patients with HCC treated with PH followed by adjuvant radiation therapy (RT). To our knowledge, this is the first study to evaluate the role of adjuvant RT for HCC.

METHOD: This study includes patients who underwent PH and adjuvant RT at our institution between 2001 and 2012 for HCC. Patients with distant metastatic disease were excluded.

RESULTS: Six patients were identified who met inclusion criteria. All patients were locally advanced, with stage III-IVA disease, based on AJCC 7th edition. Preoperative Childs-Pugh grade was class A for five patients and class B for one patient. Preoperative alpha fetoprotein (AFP) level was less than 200ng/mL for 5 patients and unknown for one patient. The median AFP level for the 5 patients was 3.5ng/mL. The resection margins ranged from 0 mm to 8 mm, with a median margin of 4 mm. Tumors from 4 patients demonstrated vascular invasion, one was negative for vascular invasion and unknown for one. Five of 6 patients had lymph node sampling with 3 having involved nodes. The median radiation dose was 45 Gy in 1.8 Gy fractions. Five patients received concurrent Capecitabine and one patient received concurrent infusional 5-fluorouracil. After a median follow up of 62 months (range 12-75 months), the overall survival rate is 83% (5 of 6 patients alive). The overall local and distant recurrence rates are 17% (1 of 6 patients) and 17% (1 of 6 patients), respectively. One patient had progression of disease within the liver and one patient developed distant lung disease. Two patients experienced acute grade 1 upper GI toxicity and 2 patients experienced grade 1 lower GI toxicity. One patient experienced grade 3 fatigue. There were no late grade 3/4 toxicities. One patient developed worsening liver dysfunction from Childs-Pugh A to B, 1 patient from B to A and the rest were unchanged.

DISCUSSION: The safety and efficacy of PH have greatly improved over the past two decades, largely due to advances in radiologic assessment, improved patient selection and perioperative care. In our retrospective study, we have demonstrated that adjuvant radiation therapy for patients undergoing PH for locally advanced HCC is safe and may potentially improve outcomes. Randomized studies are required to validate these findings.

Radiation Oncology and Radiobiology - Wednesday Posters and Exhibits (12:15pm - 12:45pm)

Wednesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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LL-ROS-WEA • AMA PRA Category 1 Credit™: 0.5

Host
Nina A Mayr, MD

LL-ROS-WE1A • Treatment Outcome, Prognostic Factors and Toxicities of Combined Modality Therapy in Medulloblastoma-Single Institute Experience

Subhashini John MD (Presenter); Rajesh Balakrishnan MBBS, MD; Saikat Das MBBS, MD; Rajesh Isiah; Patricia Solomon MBBS, MD

ABSTRACT

Introduction:

Medulloblastomas are one of the aggressive brain tumors found predominantly in childhood (20-30% compared to 1% in adults). In view of improved outcome with combined modality treatment (surgery, chemotherapy and radiation therapy), endocrine and neurological sequelae in long term survivors remain to be an important matter of investigation. Here we report our experience on treatment outcome, prognostic factors and treatment related toxicities in medulloblastoma.

Materials and Methods:

Data of fifty three patients with proven medulloblastoma, treated at our hospital between 2006 and 2012, were included in this retrospective analysis. All patients underwent craniospinal irradiation (CSI) following surgery. Treatment outcome was assessed based on local disease recurrence (recurrence free survival). The effect of residual disease volume, drop metastasis on disease recurrence was determined. Endocrinological and neurological functions (including hearing and visual assessment) were done at periodic intervals.

Results:

Forty patients (75%) were pediatric (3 cm and 19 had residual tumor < 3 cm. CSF was positive for malignant cells in 5 patients (9.4%), negative in 27 patients (50.94%) and was not evaluable in 21 patients (39.62%). MRI spine was done in 44 patients and it was positive for drop metastasis in 12 (27.27%). Radiation was initiated within 32.5 days after the surgery and majority of the patients (52) completed planned dose of radiation. The median duration of RT was 50.11 days (range 40 - 76). The median dose to the posterior fossa 54.24 Gy (range 54 - 56), and to the spinal axis 35.71 Gy (range 36-45). Concurrent chemotherapy was given in 40 patients (75.47%) and adjuvant chemotherapy was given in 41 patients (77.35%). The median follow-up was 21.94 months (range 2-75). Complete response was seen in 62% patients, stable disease (8%) progressive disease (11%) and not evaluable (18%) at the last follow up. The median time to progression is 365 days. 40% of the patients who had residual tumor more than 3 cm had disease recurrence. The toxicities that occurred during CSI were mainly alopecia, nausea and hematological toxicity. Other toxicities noted were sensory neuronal hearing loss (6, probably chemotherapy induced) and peripheral neuropathy (2, one had bilateral foot drop with bilateral polyradiculopathy) endocrine abnormalities (2, hypothyroidism) and vision defects (2).

Conclusions:

Multimodality treatment (Surgery, CSI) resulted in significant recurrence survival in this cohort and was well tolerated with minimal acute treatment related toxicity. The treatment of patients needs to be tailored to decrease toxicities as these patients have a good prognosis.

LL-ROS-WE2A • Dosimetric Comparison between Hippocampal Doses in Patients with Nasopharyngeal Cancer Treated with LA Based IMRT and Helical Tomotherapy

Naveen B Mummudi MBBS, MD (Presenter); Sarbani Laskar; Tejpal Gupta MD; Ashwini Budrukar MD; Vedang Murthy MD; Shshikant Juvekar; Vikas Kothavade; Ritu Raj Upreti MSc; Jaiprakash K Agarwal

PURPOSE

In patients with Nasopharyngeal carcinoma, significant amount of temporal lobe and hippocampus might be irradiated consequentially increasing the chance of cognitive decline in long term survivors. The present study compares and describes the magnitude of possible dose restriction to Hippocampus in two different IMRT delivery setting.

METHOD AND MATERIALS

Between 2010 and 2012, 11 adult patients with stage III/IV nasopharyngeal cancer, previously treated with LA based Intensity Modulated Radiation Therapy (to a dose of 66 to 70 Gy) were chosen, if they had co-registered MRI (T1 weighted with contrast) for contouring target and organs at risk. Bilateral Hippocampi were contoured in accordance with the RTOG atlas. Volume and dose received by bilateral hippocampi were evaluated on Eclipse (v8.6) workstation. For three representative patients, Helical Tomotherapy (v4.2) plans with similar DVH parameters were generated (no attempt was made to restrict doses to Hippocampus). Further, LA based IMRT and Tomotherapy plans with specific dose constraints to Hippocampus were generated. A comparison was made between the doses received by the Hippocampi across the plans.

RESULTS

The average volume of Hippocampus was 1.63 cc (range 0.9 - 2.20 cc); the average maximum dose and mean dose received by Hippocampus on LA based IMRT plan were 44.96 Gy (range 7.10 - 68.90 Gy) and 19.95 Gy (range 3.30 - 42.80 Gy), respectively. The hypothetical Tomotherapy plan resulted in average

maximum and mean doses of 35.70 Gy and 8.02 Gy respectively. When the hippocampal dose was restricted, average maximum and mean doses were 13.22 Gy and 4.22 Gy respectively with LA based IMRT plan; 9.71 Gy and 3.09 Gy respectively with Tomotherapy plan.

CONCLUSION

When no dose constraint was provided, Hippocampi received inadvertently higher doses of radiation with LA based IMRT and helical Tomotherapy. There is scope for restricting the hippocampal dose with both the techniques without compromising on dose homogeneity and target coverage. To test whether this dosimetric advantage prevents cognitive decline in paediatric and adult population needs to be tested in a prospective trial setting.

CLINICAL RELEVANCE/APPLICATION

Radiation dose to temporal lobe and hippocampus has been correlated with neurocognitive decline in patients with brain tumour and may hold true for long term survivors of nasopharyngeal malignancies.

LL-ROS-WE3A • Ionizing Radiation Exposure as a Result of Diagnostic Imaging in Patients with Hodgkin Lymphoma and Non-Hodgkin Lymphoma

Maeve P Crowley MBBCh, MRCPI ; **Siobhan O' Neill** MBBCh (Presenter) ; **Damien C O'Neill** MBBCh ; **Brian R Bird** MBBCh ; **Oisín J Flanagan** MBBCh, MRCPI ; **Michael M Maher** MD, FRCR ; **Mary R Cahill** MD ; **Derville M O' Shea** MBChB, PhD ; **Kevin N O'Regan** MD

PURPOSE

Exposure to ionizing radiation has been linked both epidemiologically and experimentally to an increased risk of malignancy. An increasing majority of patients with lymphoma achieve long-term survival. Late complications of treatment have emerged as a significant cause of death and morbidity. Long-term survivors are at risk for developing second malignancies due to treatment. Ionizing radiation exposure through diagnostic imaging may increase this risk.

METHOD AND MATERIALS

A retrospective review of 486 consecutive patients with biopsy proven Hodgkin and Non-Hodgkin lymphoma that were discussed at a multidisciplinary lymphoma meeting between January 2009 and July 2012 was conducted. The number and type of radiological procedures were obtained from the radiology databases in each of the 5 participating centers. The cumulative effective radiation dose was calculated using standardized procedure-specific radiation dose levels.

RESULTS

Mean (SD) age at diagnosis of lymphoma was 59 (17) and 15% (n=73) were under 40 years. Fifty-nine percent were men. Sixteen percent (n=78) had Hodgkin lymphoma eighty-four percent (n=408) had Non-Hodgkin lymphoma. The median estimated total cumulative effective dose (CED; IQR) per subject over the study period was 69.4mSv (42-118). Of the subjects, 46% had a total CED >75mSv and 14% had a total CED >150mSv. CT contributed 89% of the radiation dose and PET-CT contributed 8%. Patients aged under 40 had a median (IQR) CED of 89.44mSv (55.42-123.94). Patients who underwent a stem cell transplant had a median (IQR) CED at 161.94mSv (135.11-224.68). Fifty-nine percent of this group went on to have radiotherapy as part of their treatment protocol.

CONCLUSION

This study highlights the considerable ionizing radiation exposure from radiological imaging in lymphoma patients, especially in young people who would be considered the most radiosensitive and at highest risk for secondary malignancies.

CLINICAL RELEVANCE/APPLICATION

Low dose CT imaging and MRI are becoming increasingly important in the diagnosis of lymphoma as the focus moves towards minimizing treatment related morbidity.

LL-ROS-WE4A • Dosimetric Variability of Supraclavicular Irradiation in the Era of Image-guided Radiation Therapy of Breast Cancer

Indra J Das PhD (Presenter) ; **Peng Zhou** PhD ; **Gregory Bartlett** BS ; **Foster Lasley** MD ; **Jennifer E Zook** MD

LL-ROS-WE5A • Comparative Study of the Position and Volume of Esophagus between Quiet End-inspiration and End-expiration Three Dimensional CT Assisted with Active Breathing Control and Corresponding Phases in Four Dimensional CT

Huanpeng Qi (Presenter)

LL-ROS-WE6A • Prostatectomy versus Radiotherapy for Gleason Score (GS) 8-10 Prostate Cancer at Biopsy: Comparison of Disease Control

John M Watkins MD (Presenter) ; **Patricia Watkins** MS ; **Tarek Dufan** MD ; **Christopher Adducci** ; **Nadim Koleilat**

PURPOSE

To compare disease control outcomes between prostatectomy (RP) and radiotherapy (RT) for patients with high-grade prostate cancer at diagnosis.

METHOD AND MATERIALS

Retrospective comparative outcome analysis by treatment group. Eligible patients were identified by GS 8-10 prostate adenocarcinoma at biopsy, performed between 2003 and 2010, treated with either primary RP or RT. Owing to long-term hormone therapy (HT) use for the RT group, a minimum follow-up of 24 months post-treatment was required (unless prior recurrence or death). Patients with PSA >30 or clinically evident lymph node involvement at diagnosis were excluded. Standard definitions of disease recurrence were employed (RP: PSA of 0.2 and rising; RT: nadir plus 2; or at initiation of salvage HT for either group). Kaplan Meier curves were constructed to compare survival between groups and the log-rank test was used to determine statistically significant differences in survival.

RESULTS

Results: Between 2003 and 2010, 120 patients with GS 8-10 at biopsy were identified. Of these, 87 were eligible for the present analysis (41 RP, 46 RT). Race, PSA, clinical T-stage, primary Gleason grade, total GS, and bone scan at initial staging were similar between groups. RT patients were significantly older (median age 64 vs 73 years; p12 months, 30% >30 months). At a median follow-up of 52 months (similar between groups), 39 patients had experienced disease recurrence (30 RP, 9 RT). Estimated 5-year disease control was superior for RT (21% vs 74%; p

CONCLUSION

RT-based treatment of GS 8-10 prostate cancers appears to confer superior disease control when compared with RP; however, at 5 years, prostate cancer-specific survival appears similar. Prospective comparison with subset analyses is warranted in order to identify patients who may experience differential benefit from each approach.

CLINICAL RELEVANCE/APPLICATION

GS 8-10 prostate cancer is associated with poor disease control; in this population, up-front RT plus HT appears superior to RP for 5-year PSA control.

LL-ROE-WE7A • Image Guided Treatment in Hepatobiliary System: Role of Imaging in Treatment Planning and Post Treatment Evaluation

Surabhi Bajpai MBBS, DMRD (Presenter) ; **Alexander R Guimaraes** MD, PhD * ; **Avinash R Kambadakone** MD, FRCR ; **Ronald S Arellano** MD ; **Dushyanti V Sahani** MD

PURPOSE/AIM

Rapid advancements have occurred in targeted therapies for hepatobiliary tumors. Newer treatments like Transarterial chemo-embolization (TACE), ablation, stereotactic radiotherapy and Irreversible Electroporation (IRE) have emerged for their management. Advanced morphologic and functional imaging is integral for treatment delivery, in facilitating treatment plan and assessing response. This exhibit aims at discussing the principles of various therapies and describing the role of imaging in treatment planning and post treatment evaluation

CONTENT ORGANIZATION

1. Review of principles and technique of new targeted therapies in the hepatobiliary system like TACE, ablation, stereotactic radiotherapy and IRE
2. Discuss the role of morphological and functional imaging (CT/MR perfusion, DWI, PET-CT/MR-PET) in pretreatment planning and monitoring response.
3. Describe the role of advanced post processing methods like image fusion, target definition and dose estimation in treatment evaluation.
4. Discuss the role of emerging molecular imaging technique in cancer gene therapy and intra-arterial oncolytic virotherapy.

SUMMARY

Imaging is crucial in the successful management of hepatobiliary tumors with novel targeted therapies. Knowledge of role of imaging in pretreatment planning, therapy guidance and post treatment evaluation is essential for optimal results

Radiation Oncology and Radiobiology - Wednesday Posters and Exhibits (12:45pm - 1:15pm)

Wednesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

RO

LL-ROS-WEB • AMA PRA Category 1 Credit™:0.5

LL-ROS-WE2B • Total Body Irradiation: Description of Technique and Tolerability

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Lucas Caussa (Presenter)

ABSTRACT

Introduction and Objectives

Total body irradiation (TBI) is used for conditioning of bone marrow transplantation (BMT). Modern equipment and development of new treatment techniques allow to deliver and homogeneous dose and to protect organs at risk of toxicity with low rate of complications.

The objective of this study is to assess technical treatment and toxicity in patients treated with TBI for BMT.

Patients and Methods

Between september 2007 and July 2012 thirty five patients (pts) were treated, 13 women and 22 men, mean age 21.9 years (2.8-50.4) diagnosed with acute lymphatic leukemia 28 pts, 5 pts acute myeloid leukemia and non-Hodgkin lymphoma 2 pts.

Two linear accelerators were used, Primus (Siemens) and SL15 (Elekta) with 3.5 Gy/hour dose rate and total dose of 12 Gy in 6 applications over 3 days. The dose delivered was confirmed and adjusted with in vivo dosimetry.

Pulmonary protection was set at 9 Gy. Two TBI techniques are available: the first one uses anteroposterior 6MV photons; in this case the patient is positioned in lateral decubitus and 1Gy by each side is delivered. The second modality is lateral irradiation with 10MV photons, for which the patient is placed in dorsal decubitus and 2 Gy are delivered from left side in the morning, and 2 Gy from the right in the afternoon.

Acute toxicity related to treatment according international criteria for adverse events (CTCAEv4.0) was evaluated.

Results

Of 35 patients treated, 26 had acute toxicity related to TBI. Of these, 19 patients were Grade 1: nausea 10, vomiting 5, headache 5, asthenia 10, parotitis 2, erythema 1. Toxicity Grade 2 occurred in 8 patients: 5 nausea and 3 vomiting. There was not Grade 3-4 toxicity or treatment interruptions.

Conclusions

These fractionation and techniques for TBI are safe, reproducible, with acceptable tolerance in patients who should receive BMT.

Keywords: TBI, BMT

LL-ROS-WE3B • Whole Body MRI with Diffusion Imaging Compared to FDG-PET-CT in the Post-treatment Setting: The Restaging of Recurrent Lymphoma

Alessandro Stecco MD (Presenter) ; **Mariangela Lombardi** ; **Alberto Santagostino** ; **Francesco Buemi** MD ; **Marco Perchinunno** ; **Gianmauro Sacchetti** ; **Alessandro Carriero** MD

PURPOSE

The purpose of this study is to compare whole-body MRI, using diffusion weighted imaging (WB-DWI-MRI), with 18F-FDG-PET/CT in evaluating recurrence in patients previously treated for lymphoma.

METHOD AND MATERIALS

We enrolled 30 patients in follow-up for lymphoma suspected of recurrence.

All patients underwent 18F-FDG-PET/CT (PET-CT) and WB-DW-MRI.

Histopathology findings or 6-month clinical and radiological follow-up served as the gold standard.

The agreement between the techniques and the Ann Arbor Staging system and the diagnostic accuracy of WB-DW-MRI and PET-CT were compared. We analysed the sites of agreement between the two techniques, and the accuracy of stage diagnosis for individual lymphatic and extranodal sites.

RESULTS

WB-DW-MRI found 19 cases of recurrent disease, while PET-CT found 13. Staging by mean of WB-DW-MRI showed a better agreement with the Standard of Reference than PET-CT. The latter showed, on a 'by patient' basis, 100% sensitivity, 62% specificity, 85% diagnostic accuracy, 100% (2.96-0.96, C.I 95%) PPV (positive predictive value) and 50% (0.84-0.15, C.I 95%) NPV (negative predictive value), while WB-DW-MRI showed 89% sensitivity, 100% specificity, 90% diagnostic accuracy and 94% (1.04-0.83, C.I 95%) PPV and 100% (2.96-0.96, C.I 95%). There were no statistically significant differences between the two techniques, although with a 'borderline' p-value ($p=0.06$). Among discordant sites, on neck nodal sites, WB-DW-MRI showed a better specificity and the same diagnostic accuracy with respect to PET-CT, which displayed superior sensitivity. WB-DW-MRI also showed a better specificity and accuracy at retroperitoneal sites, while showed less sensitivity and better specificity than PET-CT for bone marrow evaluation.

CONCLUSION

WB-DW-MRI has a diagnostic value in restaging follow-up of lymphoma; in some specific anatomic districts outperforms the diagnostic accuracy of PET-CT.

CLINICAL RELEVANCE/APPLICATION

Whole Body MR with Diffusion can be indicated in follow-up after therapy in detecting recurrence of lymphoma's disease

LL-ROS-WE4B • Volumetric Modulated Arc Therapy More Adequately Covers Levels One and Two of the Axilla than Standard Tangential Breast Fields in Early Breast Cancer Patients Following Conservative Surgery with Positive Sentinel Node Biopsy

Raef S Awad MBBS, FRANZCR (Presenter) ; **April Wong** MBBS ; **Nicole Doughney** ; **Lauren Haydu** ; **Gerald Fogarty** MBBS, FRANZCR

PURPOSE

Z0011 study states that women with low volume sentinel lymph node (SLN) positive disease from low risk primaries in the breast do not need axillary lymph node dissection (ALND). It assumes that all left over axillary disease is treated in tangential whole breast radiotherapy (TWBRT) in conjunction with the planned systemic therapy; however, details about the radiation therapy techniques used were not reported. We hypothesize that breast volumetric modulated arc therapy (VMAT) can provide more adequate axillary coverage with comparable doses to organs at risk than TWBRT.

METHOD AND MATERIALS

Ten consecutive patients with early stage breast cancer treated with TWBRT were selected for this dosimetric analysis. A planning CT was obtained for each patient. CTV breast was defined to be the entire breast as delineated on the CT data set. CTV ipsilateral axillary level one and two nodes were defined with reference to the RTOG breast cancer atlas. No PTVs were generated. Right and left lungs, heart, and surrounding soft tissue were delineated for each patient as organs at risk. For TWBRT, beams-eye-view (BEV) display was used to design the optimal standard tangential beams. VMAT plans to cover breast and ipsilateral axilla were generated using 2 arcs. The prescription dose for both TWBRT and VMAT plans was 46 Gy/23 fractions prescribed to the isocenter, which was placed near the center of the breast. Isodose distributions and DVHs were compared.

RESULTS

Significant improvement in the doses to ipsilateral axillary level one and two nodes was achieved using VMAT compared with TWBRT. VMAT D95 axilla (dose to 95% volume) was significantly greater than TWBRT D95 axilla, 42 Gy and 1.25 Gy, respectively, ($p=0.005$). The percentage volume of the ipsilateral lung, total lung, and heart receiving 5 Gy was significantly higher for VMAT compared with TWBRT ($p=0.005$). However, the percentage volume of the ipsilateral lung, total lung and heart receiving 20 Gy, 20 Gy and 25 Gy, respectively, was not significantly different between both techniques.

CONCLUSION

VMAT provides adequate coverage of breast and axillary level one and two nodes with comparable significant doses to risk organs in patients with early breast cancer with positive SLN with no ALND. Standard TWBRT does not.

CLINICAL RELEVANCE/APPLICATION

Until longer follow up update of Z0011 trial, VMAT is quite feasible and easy radiation technique to ensure adequate coverage of breast and axilla.

LL-ROS-WE5B • Study of Puncture Needle Artifacts Reduction Using Spectral CT Imaging during CT-guided Radioactive Seed 125I Implantation

Rui Gang Huang ; **Qinglong Shen** (Presenter) ; **Huijun Xiao** ; **Weihua Lin**

PURPOSE

To explore the clinical value of puncture needle artifacts reduction using spectral CT Imaging during CT guided radioactive seed ¹²⁵I implantation in treatment of cancer.

METHOD AND MATERIALS

7 patients referred to CT guided radioactive seed ¹²⁵I implantation (6 cases of liver and 1 case of lung) underwent GSI examinations using Discovery CT750 HD scanner. During the process of implantation, traditional CT scans were performed for comparison. All data were transferred to Workstation (AW4.5, GE Healthcare) to obtain 11 sets of monochromatic images (40-140keV, interval of 10keV). 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

CLINICAL RELEVANCE/APPLICATION

Spectral CT showed its potential applications in monitoring disease progressions after ¹²⁵I radioactive particles implantation.

LL-ROS-WE6B • Feasibility and Efficacy of Radiotherapy for Patients 80 Years Old or Older with Esophageal Cancer
Kazuya Inoue ; Tetsuro Tamamoto (Presenter) ; Emiko Katayama MD ; Isao Asakawa ; Masatoshi Hasegawa

Wednesday Plenary Session

Wednesday, 01:30 PM • Arie Crown Theater

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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

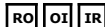
LEARNING OBJECTIVES

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 seeing 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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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-dimensional 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 injected into the hepatic artery: TACE (0.1mg of mitomycin + 0.1ml of lipiodol + 5.0mg of degradable starch microspheres) + 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 progression 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 Ferumoxylol 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 approaches 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 ferumoxylol-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-92MIIs 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 distribution 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 70°Cx5min) 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

MATIIIIB subcutaneous tumor (4 groups, n=6 each, total 24 animals). Animals were sacrificed and tumors harvested at 3.5d (MATIIIIB) 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.

VSI041-09 • Procedural Image-Guidance

Bradford J Wood MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI041-10 • Imaging Follow-up

Riccardo A Lencioni MD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI041-11 • 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.

VSI041-12 • Future Directions for IO

S. Nahum Goldberg MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI041-13 • Panel: Which Factors Will Most Drive Future Progress?

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI041-14 • When Should I Be Using that Specialized 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.

VSI041-15 • 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.

VSI041-16 • When Should I Be Using that Specialized Device: Cryo

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES

1) Understand the different approaches and techniques for through cryoablation of nearly any tumor location (e.g., the 1-2 Rule). 2) Understand unique benefits of cryoablation for soft tissue 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

VSI041-17 • When Should I Be Using that Specialized Device: IRE

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI041-18 • 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.

VSI041-19 • 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.

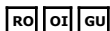
VSI041-20 • Panel Discussion

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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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 treatment.

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>

Radiation Oncology and Radiobiology (Breast)

Wednesday, 03:00 PM - 04:00 PM • S104A



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SSM22 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator

Allen G Meek, MD

Moderator

Katherine L Griem, MD *

SSM22-01 • Statistical Analysis Using a Quality Reports Program to Retrospectively Review Patients with Early Stage Left-sided Breast Cancer: A Pilot Project

Houman Vaghefi MD, PhD; **Fang Liu PhD**; **Adams W Moore MD ***; **Benjamin E Nelms PhD, MS ***; **Greg Robinson ***; **James A Wheeler MD, PhD** (Presenter); **Ingrid Bowser RN**

ABSTRACT

Purpose/Objective(s):

The evaluation of the radiation oncology treatment plan for patients with early stage left-sided breast cancer requires a balance between coverage of the target tissues and avoidance of the heart and lungs.

Quality Reports is a software system developed to allow the user to design dose volume constraints which can then be saved into statistical libraries for subsequent comparison with other patients who were already treated or for whom treatment planning is in progress.

Materials/Methods:

This is a pilot study of 20 patients with early stage breast cancer who were treated by a single physician to the whole left breast using tangent fields. These treatment plans were then retrospectively reviewed.

Two different scoring systems were evaluated. The first system gave a single point for each dose constraint satisfied. The second scoring system gave a weighted value for each dose constraint satisfied. The results of the two scoring systems were then compared.

Results:

Both scoring systems followed a normal distribution. There was good agreement between the two systems; the concordance correlation coefficient (95% CI) was 0.79 (0.62, 0.89). The weighted system (as a percent possible) was 2.75% higher on average than the unweighted scores (p-value = 0.002). The patients who developed skin desquamation tended to have lower quality scores on both systems compared to the rest (by 1.1% and 1.7%, for the unweighted and weighted systems, respectively), but given the small sample size and the relatively large variability in the difference of the scores, this was not statistically significant.

Conclusions:

It is possible with this methodology to compare the quality of breast treatment plans, but a much larger patient database including information on treatment outcomes is necessary to establish the optimal scoring system.

SSM22-02 • Influence of Registration Based on the Different Reference Markets on the Displacement of the Geometry Consisted of All Clips in the Cavity for External-beam Partial Breast Irradiation at Moderate Deep Inspiration Breath Holding
Jianbin Li (Presenter)

SSM22-03 • Intra-operative Radiotherapy in Early Breast Cancer-First Experience in the Middle East

Yasir Bahadur (Presenter)

ABSTRACT

Purpose: We report our early experience using the Intrabeam low-kV X-ray generator for intra-operative radiotherapy (IORT) in early breast cancer.
Methods: This phase 2 prospective study was performed between December 2010 and November 2012. All female patients eligible for breast-conserving surgery, with biopsy proven invasive ductal carcinoma, clinical mass 3 cm, lymphovascular invasion, multifocal lesion with area of > 3 cm, extensive DCIS (>25%, or >3 cm), or lymph node metastasis. Patients received 46 Gy in 23 fractions over 4.5 weeks, using 2 whole-breast tangential fields and photons in the range of 6-15 MV. Early and late toxicity features were recorded using RTOG toxicity criteria.
Results: 45 female patients were included, with a median age 54 years (range, 27-79 years); the majority was more than 45 years (37 cases, 73.3%). Most of patients (36 cases, 80%) had tumor. **Conclusion:** IORT for early stage breast cancer patients using the Intrabeam delivery system was easily implemented in our center, with an acceptable toxicity profile.

SSM22-04 • Comprehensive Chest Wall Irradiation: A Dosimetric Description of Tomotherapy and Linac-based IMRT

Christopher D Abraham MD (Presenter)

ABSTRACT

Purpose/Objectives(s)

Intensity modulated radiation (IMRT) for whole breast irradiation has been found to improve homogeneity while decreasing dose to critical structures including the heart and lung. However, there exists a paucity of data examining the role of IMRT in comprehensive chest wall and regional nodal irradiation. Therefore, the objective of this study is to generate dosimetric descriptions of two common inverse-planned IMRT delivery methods: Tomotherapy and linac-based IMRT (LB-IMRT).

Materials/Methods:

Women with locally advanced left sided breast cancer who underwent radiation to a PTV encompassing any residual breast tissue, chest wall, all levels of the axilla, interpectoral lymph nodes, infraclavicular lymph nodes, and the supraclavicular lymph nodes between April 2004 and March 2011 were retrospectively identified. A sample of 45 women were analyzed including 25 treated using Tomotherapy and 20 treated using LB-IMRT. The PTV and organs at risk were contoured at the time of initial treatment planning by the treating radiation oncologist. The dose to the PTV ranged from 50Gy to 50.4Gy. Mean dosimetric parameters were analyzed for the PTV, ipsilateral and contralateral lung.

Results:

The mean PTV V45Gy was 99% and 97% for Tomotherapy and LB-IMRT, respectively. The mean ipsilateral lung V5Gy was 79% for Tomotherapy and 75% for LB-IMRT. The ipsilateral lung mean V20Gy was 22% and 27% while mean ipsilateral lung dose was 15Gy and 17Gy for Tomotherapy and LB-IMRT, respectively. Contralateral lung mean V5Gy was 52% for Tomotherapy and 45% for LB-IMRT while V20Gy was 5.3% and 4.7%.

Conclusions:

Comprehensive chest wall irradiation using inverse-planned IMRT techniques remains to be adequately described in the literature. We retrospectively analyzed cases to better characterize the dosimetry of this treatment method. Further studies are required to validate these findings and to determine anatomic characteristics to optimize the benefits of both delivery methods for women undergoing comprehensive treatment.

SSM22-05 • Does Morbid Obesity Disadvantage Breast-conserved Treated Patients with Pre-invasive or Early Stage Breast Cancers?

Federico L Ampil MD (Presenter) ; Gloria Caldito PhD ; Benjamin Li MD ; Gary Burton MD ; Roger H Kim MD ; Quyen Chu MD

PURPOSE

The literature supports the association between obesity and poor prognosis of breast cancer (BCa) in both pre- and post-menopausal women. It is unclear whether these patients may benefit from standard of care interventions. This study compares the outcomes between morbidly obese (MO) and non-morbidly obese (NMO) breast-conserved treated (BCT) patients with pre-invasive or early stage breast cancers.

METHOD AND MATERIALS

We performed a retrospective cohort study of 100 patients who had undergone BCT (with negative surgical margins including postoperative whole breast 50 Gy irradiation) for minimally invasive BCa during the period from 1992 to 2005. Each patient's body mass index (BMI) was calculated and the subjects were classified into the NMO group (BMI score

RESULTS

At a median follow-up of 96 months (range 17-215 months), the local recurrence rates were similarly 4% in the MO and NMO patients (p=0.99); the corresponding regional failure rates were 8% and 3% (p=0.29). Although the 10-year overall survival prospect favored the NMO patients compared to the MO women (96% and 79% respectively, p=0.02), there was no significant difference in the 10-year disease-free survival rates between the compared groups (91% and 89% respectively, p=0.66). There were no differences between the MO and NMO patients in age, tumor estrogen/progesterone/HER-2 neu receptors and grade and the presence of co-morbid illness.

CONCLUSION

In this single institution's experience, morbid obesity did not adversely affect long-term patient outcomes after BCT for minimally invasive breast cancers. It is suggested that the treatment options for select women with BCa should not be lessened on account of an excessively large body habitus.

CLINICAL RELEVANCE/APPLICATION

Morbid obesity should not ordinarily disqualify breast cancer patients from receiving breast conserving therapy.

SSM22-06 • Clinical Outcomes with a Radiation Therapy System: Results of a Prospective Trial

Tamer Refaat Abdelrhman MD,PhD (Presenter) ; William Small MD ; Jonathan B Strauss MD ; Kevin Bethke MD ; Judith A Wolfman MD * ; Krystyna D Kiel MD ; Ellen B Mendelson MD *

PURPOSE

To report the treatment induced adverse events (AEs), and treatment outcomes of accelerated partial breast irradiation (APBI) delivered with the MammoSite Radiation Therapy System (RTS) in breast cancer patients undergoing breast conservative treatment.

METHOD AND MATERIALS

This is a prospective clinical trial that was approved by the IRB. The study included female breast cancer patients undergoing breast conservative treatment in the form of surgery and APBI delivered with the MammoSite RTS. The study included postmenopausal women with Invasive carcinoma =2cm, grade 1-2 ductal carcinoma in situ =2cm, or Grade 3 ductal carcinoma in situ =1cm. Exclusion criteria included extensive lobular carcinoma in-situ, Paget's disease of the breast, multifocal or multicentric tumor, extensive intraductal component, bilateral breast cancer, pregnancy or breast feeding, and patients with collagen vascular disease (except rheumatoid arthritis), bleeding disorder, postoperative infection, or prior breast irradiation. Patients and tumor characteristics, treatment-induced acute AEs based on CTC for AEs version 2.0, chronic AEs according to RTOG scale, treatment outcomes; local control (LC), disease free survival (PFS) and overall survival (OS) and cosmetic outcomes are reported.

RESULTS

The study included 36 eligible patients treated consecutively in Northwestern Memorial Hospital between November 2003 and August 2009. The age range was 45 - 83 years. A total of 29 patients had invasive disease (median size 1.1cm), while 7 patients had in situ disease only (median size 0.8cm). The skin distance in most of the patients (91.7%) was =1cm; only 3 patients (8.3%) had skin distance < 1 cm. The median balloon diameter was 5 cm (range 4 - 6 cm). At a median follow-up of 42 months (range 4 - 65 months), LC, PFS and OS were 100%. None of the patients experienced any grade III or IV acute or chronic AEs. However, cosmesis was not a focus of the study, 94% of patients stated good / excellent cosmesis during their last follow up visit.

CONCLUSION

APBI delivered with the MammoSite (RTS) is a feasible, tolerable and effective treatment modality in breast cancer patients undergoing breast conservative treatment.

CLINICAL RELEVANCE/APPLICATION

APBI delivered with the MammoSite Radiation Therapy System is a feasible, tolerable and effective treatment modality in breast cancer patients undergoing breast conservative treatment.

BOOST: Genitourinary Hands-on Contouring (In Cooperation with ASTRO)

Wednesday, 04:45 PM - 06:00 PM • S104B

RO **OI** **GU**

MSR049 • 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 Buyounouski, MD *
Jelle O Barentsz, MD, PhD

LEARNING OBJECTIVES

1) To use MRI in contouring local prostate cancer as well as pelvic lymph nodes.

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Imaging Moving Targets

Thursday, 08:30 AM - 10:00 AM • S102D

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PH **RO**

RC622 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator
Kristy K Brock, PhD *

LEARNING OBJECTIVES

1) Describe techniques for imaging moving targets. 2) Propose methods to account for uncertainties. 3) Highlight clinical integration.

RC622A • Uncertainties in Moving Targets

Jasper Nijkamp PhD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

RC622B • Clinical Practice

Laura A Dawson MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

Molecular Imaging (Oncology and Subspecialties)

Thursday, 10:30 AM - 12:00 PM • S504CD

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RO **MR** **MI**

SSQ12 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Hubert J Vesselle, MD, PhD *
Moderator
James P Basilion, PhD *

SSQ12-01 • Biochemical MRI with gagCEST (Glycosaminoglycan Chemical Exchange Saturation Transfer Imaging) of Finger Joint Cartilage in Rheumatoid Arthritis

Christoph Schleich (Presenter) ; **Anja Lutz** ; **Benedikt Ostendorf** ; **Philipp Sewerin** ; **Gerald Antoch** MD * ; **Falk R Miese** MD

PURPOSE

Rheumatoid arthritis (RA) frequently involves finger and hand joints. Joint damage may result in severe physical disability. gagCEST has recently been demonstrated to visualize biochemical alterations of cartilage in knee joints of patients following cartilage repair surgery as well as in intervertebral discs. The purpose of our study was to test the feasibility of gagCEST imaging in finger joint cartilage in healthy volunteers and patients with RA.

METHOD AND MATERIALS

Six volunteers (mean age 33; range: 21-45 years) and four patients (age 58; range: 52-64 years) were examined at a 3T MR scanner (Siemens Magnetom Trio) using two loop coils (4 cm diameter), one fixed on the palmar, the other on the dorsal side of the second metacarpophalangeal joint (MCP). For gagCEST imaging, CEST effects were prepared by a train of Gaussian RF pulses followed by signal readout with a 3D RF spoiled GRE sequence. The CEST curves were calculated for each pixel and were shifted for the water resonance to appear at 0 ppm of the Z-Spectrum. The MTR asymmetry curves were determined. The CEST effect of the cartilage was measured with the glycosaminoglycan saturation transfer [ST = CEST (+1.3 ppm) - CEST (-1.3 ppm)/CEST (+1.3 ppm)]. Joint space width (JSW) as a morphological feature of cartilage integrity was measured.

RESULTS

Cartilage ST values were significantly lower in patients compared to healthy volunteers (13.58 ± 6.11 vs. 27.38 ± 4.52; p=0.011). Cartilage CEST curves showed a decrease of CEST effect between 1.2 and 2.2 ppm, which corresponds to the resonance frequency of hydroxyl protons of glycosaminoglycans. There was no significant difference in JSW between healthy volunteers and RA patients.

CONCLUSION

CEST imaging revealed alterations in finger cartilage of RA patients compared to healthy controls in the absence of cartilage thinning. The decreased CEST effect in the spectral range of glycosaminoglycan resonances points towards depletion of glycosaminoglycans in RA.

CLINICAL RELEVANCE/APPLICATION

Biochemical imaging with gagCEST of cartilage composition is feasible at finger joints in RA.

SSQ12-02 • Application of 59Fe Labeled Triglyceride-rich Lipoproteins for Quantitative Activity Measurements of Brown Adipose Tissue at 7T MRI

Caroline Jung (Presenter) ; **Barbara Freund** ; **Markus Heine** ; **Michael G Kaul** ; **Jorg Heeren** ; **Harald Ittrich** MD ; **Gerhard B Adam** MD

PURPOSE

The aim was to determine metabolic activity of brown adipose tissue (BAT) with MRI at 7T using radioactively labeled superparamagnetic iron oxide nanoparticles (SPIO) embedded into the lipoprotein layer for visualisation of lipoprotein distribution and BAT metabolism after intravenous (iv) and intraperitoneal (ip) injection.

METHOD AND MATERIALS

59Fe labeled SPIOs were embedded into the lipid core of Triglyceride-rich lipoproteins (TRL; 59Fe SPIO-TRL). Cold exposed (24h), BAT activated mice (n=10) and thermoneutral control mice (n=10) were starved for 4 hours before 59Fe-SPIO-TRL application. MRI was performed before, 1 and 24 hours after ip (n=10) and iv (n=10) injection at a 7T small animal MRI using a T2*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°, NSA 4, 10 slices, eff. voxel volume 160x160x600mm³). R2* and ?R2* in liver and BAT were estimated. Ex vivo the biodistribution of 59Fe SPIO-TRL was analyzed using a large volume Hamburg whole body y counter (HAMCO). The amount of TRL in liver and BAT was calculated according to the results of percentage TRL accumulation arrived from activity measurements and correlated with MRI measurements. Uptake of TRL into tissue was confirmed by histological (Prussian blue) and TEM analyses.

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

SSQ12-03 • Macrophage Tracking with Heteronuclear Proton MRI

Rebecca Schmidt MD (Presenter) ; **Nadine Nippe** ; **Klaus Strobel** * ; **Max Masthoff** ; **Olga Festscheider** DIPLPHYS ; **Daniela Delli Castelli** ; **Cord Sunderkotter** MD ; **Uwe Karst** PhD ; **Silvio Aime** ; **Christoph B Bremer** MD ; **Cornelius Faber**

PURPOSE

To explore the feasibility of imaging Thulium (Tm)DOTMA labeled cells in a murine inflammation model by ultra-short echo time imaging (UTE).

METHOD AND MATERIALS

Bone marrow derived macrophages (BMDM) were labeled with 15 μ mol TmDOTMA/10⁶ cells by incubation for 24h. Cell viability and activity were tested by determination of cell death, adhesion, phagocytosis and NO production. Fluorescence microscopy due to the self-fluorescence of TmDOTMA (ex. 253nm; em. 460nm) and MR spectroscopy determined labeling efficiency. Inflammation was induced by s.c. injection of 100 μ l polyacrylamide (PAG) gel in both flanks of 3 nude mice. To intensify inflammation, lipopolysaccharide (30 μ g/100 μ l PAG) was added to one PAG pellet per mouse. 3 \times 10⁶ labeled BMDMs were injected i.v. 24h after gel implantation. MRI was performed on a Bruker Biospec 94/20 with a 35mm ¹H volume coil over a period of 8 days using 3D UTE sequence. On day 8, PAG-pellets, livers and spleens were explanted. Selective macrophage staining (MAC 3) and laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) were performed for correlation with the MR data.

RESULTS

Neither cell viability nor activity were affected by TmDOTMA labeling. Fluorescence microscopy showed an intracellular uptake of the complex. MR spectroscopy of labeled cells revealed an average of 8.97 \pm 0.85 \times 10¹⁰ TmDOTMA molecules per cell. *In vivo*, TmDOTMA signal was detected in the bladder (day 1) and in liver, spleen and gel pellets over 8 days. Within 2h scan time, signal-to-noise values within the PAG-pellets ranged between 1.49 and 3.98. From a reference tube with a 0.25 mM TmDOTMA solution, the *in vivo* detection limit was estimated to be slightly below 10⁴ BMDMs. Origin of the signal from migrated BMDMs was confirmed by histology and LA-ICP MS showing both BMDMs and Tm around the injected gel.

CONCLUSION

The highly shifted signal of the equivalent methyl protons of TmDOTMA can be detected independently from the water signal by UTE resulting in an increased sensitivity. This approach of heteronuclear proton MRI may provide a versatile tool for MR cell tracking *in vivo* and thus facilitate the application of molecular MRI without the need for extra MR equipment.

CLINICAL RELEVANCE/APPLICATION

Detection and tracking of labeled cells by means of noninvasive molecular imaging has become essential part of both preclinical research and medical diagnostics related to cellular therapies.

SSQ12-04 • In Vivo Ultrasound Imaging of Pancreatic Islets

Jose L Paredes MD (Presenter) ; **George Gittes** ; **Jiamjung Wang** ; **Flordeliza Villanueva**

PURPOSE

Imaging and quantifying pancreatic islets in vivo could revolutionize the treatment of diabetes mellitus. Currently, insulin levels and hemoglobin A1C are our main methods for determining beta cell mass in diabetic patients. These insensitive measures are grossly inadequate for proper guidance of therapy. An office-based, non-invasive method for determining islet mass serially in diabetics has long been sought-after, but with no success. Here we show that a sub-harmonic ultrasound probe, in conjunction with microbubble intravenous contrast, allows islets visualization in the mouse pancreas based on the increased blood flow compared to surrounding pancreatic tissue.

METHOD AND MATERIALS

RESULTS

The subharmonic ultrasound visualization rendered clearly delineated large blood vessels of the scanned region in the pancreas. We were also able to identify discrete, three-dimensional hyper-perfused areas that were of the size, number, and distribution of islets. To validate that these hyperperfused areas were indeed islets, we scanned the pancreas of transgenic mice that express GFP under the mouse insulin promoter

CONCLUSION

Using a mouse model, we now have strong evidence to show the potential feasibility of using ultrasound combined with intravenous administration of microbubbles to visualize and quantify islet mass.

CLINICAL RELEVANCE/APPLICATION

Imaging and quantifying pancreatic islets in vivo could revolutionize the treatment of diabetes mellitus.

SSQ12-05 • Automated Analysis of Metastatic Involvement in Bone Using Anatomical and Functional Information from FDG PET/CT Images

Omer Demirkaya (Presenter) ; **Abdulaziz Alsugair** MD ; **Mohei M Abouzi** MD

PURPOSE

Although overall incidence of bone metastasis is not known, over half of people who die of cancer in the US each year are thought to have bone involvement. In this study we developed a method to quantify the metabolic and anatomic changes induced by bone metastases in cancer patients using PET/CT images. The quantitative parameters along with the structural changes seen by CT bone window may serve as a useful tool in assessing the response of bone metastases to therapy.

METHOD AND MATERIALS

Seventy three patients with no prior history of chemo or radiotherapy who had bone metastases documented by PET/CT (Discovery ST, GE) and other conventional modalities were selected for the study. PET/CT images were resampled to the same pixel size. Then the bone structure was segmented using a threshold of 150 HU. After the segmentation, the 50% of the maximum SUV within the bone mask was used to identify bone lesions in each slice. Using the ROIs defined at 70% of the max, the lesion characteristics including the mean HUs were computed from the PET/CT images. The lesions were subjected to the visual confirmation by an experienced PETCT physician who also categorized them based on the appearances in the CT bone window as lytic, sclerotic, mixed, or no-change type. The lesion characteristics were compared using statistical methods.

RESULTS

340 lesions in 73 patients with different cancer types were analyzed. The lesions were categorized into four anatomical groups. The spine hosts the largest number of lesions, while thoracic cage bones had the least. The lumbar bones were the most preferential sites within the spine. Quantitatively, the mean SUVmax for the lytic, no-change, mixed and sclerotic lesions with no structural changes were 7.4, 6.1, 8.2 and 7.2, respectively. Comparison of SUVs showed that only no-change type was statistically different from the mixed type. Statistical comparison of CT values indicated that the difference between no-change and lytic types was significant. Uptake period did not seem to have an impact on no-change and sclerotic types as much as it did on the others.

CONCLUSION

The quantitative method for analysis of bone metastases may serve as a useful tool in monitoring and assessing therapy response.

CLINICAL RELEVANCE/APPLICATION

A quantitative method provides a convenient way to analyze the functional and structural characteristics of bone lesions and may serve as a useful tool for assessing the response to therapy.

SSQ12-06 • A Dual Isotope Hybrid MCT-PET System Reveals Functional Heterogeneity of Bone Lining Cells and Longitudinal Changes in Marrow from Local Radiation and Chemotherapy

Masashi Yagi (Presenter) ; **Luke Arentsen** BS, ARRT ; **Yutaka Takahashi** PhD ; **Leslie Sharkey** ; **Masahiko Koizumi** MD, PhD ; **Cory Xian** ; **Clifford J Rosen** ; **Douglas Yee** MD ; **Jerry W Froelich** MD ; **Susanta K Hui** PhD

PURPOSE

We report the skeletal and marrow response to clinically relevant local radiation and chemotherapy using ¹⁸F-PET and reveal a potentially important role for bone lining cells in mediating the skeletal response to local and systemic injury.

METHOD AND MATERIALS

Mice were given systemic methotrexate (MTX, 2.5mg/kg, 3 days) or 16Gy local radiation to legs. Longitudinal FDG (days -4, 2) and NaF (days -3, 3, 7, 14, 29) ¹⁸F-PET scans were performed. Eight skeletal regions were monitored. Distal femora were harvested for cellular histology.

RESULTS

We observed significant functional heterogeneity throughout the skeleton for bone mineral remodeling as measured by NaF (

CONCLUSION

Dual isotope ¹⁸F-PET revealed functional heterogeneity of the skeleton in response to local radiation or chemotherapy. These studies demonstrate an important role for bone lining cells in mediating the skeletal and possibly the marrow response to injury. This methodology also establishes a translational model for studying the skeletal health of cancer survivors.

CLINICAL RELEVANCE/APPLICATION

Dual isotope PET-CT-PET revealed functional heterogeneity of the skeleton in response to radiation or chemotherapy and establishes a translational model to study the skeletal health of cancer survivors.

SSQ12-07 • Direct Water Proton Saturation (DWS) Imaging of Prostate Cancer

Guang Jia PhD (Presenter) ; **Saba N Elias** MSc ; **Wenbo Wei** ; **Daniel J Clark** MSc ; **Jinyuan Zhou** PhD ; **Michael V Knopp** MD, PhD

PURPOSE

Conventional magnetization transfer (MT) can be used to study the interaction of free water protons to macromolecular protons in the prostate. However, MT only shows weak contrast between prostate cancer and benign regions due to a large frequency offset. Direct water proton saturation (DWS) may provide a stronger contrast by applying a smaller frequency offset. This study is to evaluate DWS imaging for prostate cancer detection.

METHOD AND MATERIALS

A total of 20 patients with prostate cancer were prospectively enrolled in this sub-study. All patients were imaged on a 3 Tesla MR system (Achieva, Philips Healthcare). DWS imaging was based on single-slice single-shot TSE sequence. The saturation pre-pulse was composed of a train of sixteen block pulses, each with a pulse length of 31 ms and a flip angle of 720° to 1800°. The single slice image was acquired with saturation pre-pulse at 33 different frequencies (8 to -8 ppm with an interval of 0.5 ppm) and the scan time was 3 min. Magnetization transfer ratio (MTR) at 8 ppm was calculated on tumor regions, non-cancerous peripheral zone, and central gland at four different saturation pre-pulse powers (1.6, 2.4, 3.2, and 4.0 \diamond T). Student t-test was used to compare MTR(8ppm) in the histology identified tumor region and non-cancerous regions.

RESULTS

The measured MTR at 8 ppm in prostate cancer was 10.2% \pm 0.6% at 1.6 \diamond T, 20.7% \pm 1.9% at 2.4 \diamond T, 29.0% \pm 3.0% at 3.2 \diamond T, and 37.2% \pm 3.6% at 4 \diamond T, indicating a linear relationship between MTR(8ppm) and the saturation pre-pulse power. Non-cancerous peripheral zone showed significantly smaller MTR(8ppm) at all four powers (7.3% \pm 2.3% at 1.6 \diamond T, 14.7% \pm 2.9% at 2.4 \diamond T, 21.4% \pm 4.7% at 3.2 \diamond T, and 28.2% \pm 5.6% at 4 \diamond T, $P < 0.01$). Non-cancerous central gland exhibited similar MTR(8ppm) values to prostate cancer regions (11.1% \pm 2.2% at 1.6 \diamond T, 20.1% \pm 2.0% at 2.4 \diamond T, 28.9% \pm 2.0% at 3.2 \diamond T, and 37.1% \pm 4.9% at 4 \diamond T, $P > 0.05$).

CONCLUSION

Direct water proton saturation imaging can generate a contrast that is different from T1 or T2 contrast. Malignant tumors consistently reveal higher MTR(8ppm) due to increased magnetization transfer and direct water saturation effects. By optimizing the saturation pre-pulse power and frequency offset, image contrast in the prostate can be substantially enhanced.

CLINICAL RELEVANCE/APPLICATION

The DWS-MRI approach has the potential to improve imaging of cancerous tissue within organs such as the prostate by better tissue contrast.

SSQ12-08 • Enhanced Delineation of Primary Pancreatic Adenocarcinoma Following Neoadjuvant Therapy Using -Ferumoxytol: Preliminary Findings with Histopathologic Correlation

Sandeep S Hedgire MD (Presenter) ; **Mari Mino Kenudson** MD ; **Carlos Fernandez-Del Castillo** MD ; **Sarah Thayer** ; **Ralph Weissleder** MD, PhD ; **Mukesh G Harisinghani** MD

PURPOSE

To evaluate role of MRI with ferumoxytol in delineating primary tumor in pancreatic adenocarcinoma patients undergoing preoperative neoadjuvant therapy.

METHOD AND MATERIALS

In institutional review board approved, HIPAA compliant prospective study, 10 patients with biopsy proven pancreatic adenocarcinoma were enrolled with the primary intention of detecting lymph node metastasis following administration of ferumoxytol. MRI scans were performed at baseline, immediate post and at 48 hrs time points with quantitative T2* sequences using single shot, monopolar, multiecho gradient echo (TE = 4.8 \diamond 24.8, TR = 169 ms, thickness = 4 mm). The patients were categorized into those who received preoperative neoadjuvant therapy (group A) and those who did not (group B). The T2* of primary pancreatic tumor and adjacent parenchyma was recorded at baseline and 48 hrs time point in both groups and the difference between T2* values was calculated. After Whipple surgery, the primary tumors were assessed histopathologically for fibrosis and inflammation.

RESULTS

Five of the 10 (50 %) patients had presurgical neoadjuvant therapy. The mean T2* of tumor and adjacent parenchyma at 48 hrs in group A were 22.11 ms and 16.34 ms respectively. In group B, these values were 23.96 ms for tumor and 23.26 ms for adjacent parenchyma. The T2* difference between the tumor and adjacent parenchyma in group A was more pronounced compared to group B. The tumor margins were subjectively more distinct in the group A compared to group B. Histopathologic evaluation showed prominent fibrosis with scattered residual tumor glands with therapeutic effects, and a rim of dense fibrosis with atrophic acini at the periphery of the lesion in the group A. Conversely, intact tumor cells/glands were present at the periphery of the tumor in the group B. Two patients didn't undergo Whipple surgery due to hepatic metastasis detected preoperatively.

CONCLUSION

Ferumoxytol may have potential application in depicting post neoadjuvant therapy induced fibrosis (especially at the periphery of the tumor) and thereby improving the ability for precise delineation of tumor margins.

CLINICAL RELEVANCE/APPLICATION

Indistinct tumor margin poses a challenge to the surgeon. MRI with ferumoxytol may be used for better delineation of the pancreatic cancer thereby affecting surgical planning and overall prognosis.

SSQ12-09 • Quantification of ADC and SUV Values in Tumors and Lymph Node Metastases of Patients with Cervical Carcinoma in a Simultaneous PET-MRI System

Philipp Brandmaier MD (Presenter) ; **Sandra Purz** MD ; **Martin Reinhardt** MD ; **Henryk Barthel** ; **Osama Sabri** MD ; **Thomas K Kahn** MD ; **Patrick Stumpp** MD, PhD

PURPOSE

Previous studies have shown discrepancies between standard uptake value (SUV) and apparent diffusion coefficient (ADC) parameters of different tumor entities with non simultaneous measurements on examination modalities such as PET-CT and MRI. The objective of this study was the quantitative evaluation of SUV and ADC values in patients with primary and recurrent cervical cancer and suspicious lymph nodes in a simultaneous PET-MRI system to exactly deteriorate an expectable correlation.

METHOD AND MATERIALS

We included 15 patients with histologically confirmed cervical carcinoma and lymph node metastases (total of 38 lesions; primary tumor n= 14; positive lymph nodes n=24) who all underwent a simultaneous whole body 18F-fluorodeoxyglucose (FDG) PET-MRI (T2-HASTE, TIRM, EPI-DWI with b values of 0 and 800 mm²/s) including a dedicated pelvic examination (EPI-DWI with b values of 0,50,400,800 mm²/s, T2 - TSE, T1-weighted TSE native and post-contrast \pm fat suppression). Reader defined volume-of-interest (VOI; 0.2-0.5 mm³) for ADC and SUV were placed in suspicious tumor lesions and FDG-positive lymph nodes (short axis diameter > 5mm) in regions with maximum FDG-uptake. ADC_{min}, ADC_{mean}, relative ADC value (ratio of ADC_{mean} / ADC_{reference tissue}) and SUV_{mean} was calculated with the M_{gluteus maximus} serving as reference tissue. Evaluation was performed by simultaneous analysis of specific lesions on a dedicated workstation (syngo.via, Siemens Medial Solutions \diamond , Erlangen, Germany). A value of

RESULTS

Local tumor lesions and lymph nodes showed average SUV_{mean} values of 12.7 (SE \pm 1.63), respectively 9.4 (SE \pm 1.59); corresponding ADC_{mean} averages amounted to 1.020 x 10⁻³ mm²/s (SE \pm 0.104) and 1.094 x 10⁻³ mm²/s (SE \pm 0.12). A significant difference to reference tissue (SUV 0.72 \pm 0, 17 SE, ADC 1.58 \pm 0.12 SE) was seen.

CONCLUSION

The present work demonstrates the ability of acquisition of quantitative parameters (ADC and SUV) in a simultaneous PET-MRI system. Values of ADC and SUV in tumor tissue apparently show an opposite behaviour to ADC and SUV values in non-tumor tissue.

CLINICAL RELEVANCE/APPLICATION

Simultaneous quantification of SUV and ADC parameters in PET-MRI show an opposite behaviour which might be useful for evaluation of therapy response and effective tumor grading.

Radiation Oncology and Radiobiology - Thursday Posters and Exhibits (12:15pm - 12:45pm)

Thursday, 12:15 PM - 12:45 PM • Lakeside Learning Center



LL-ROS-THA • AMA PRA Category 1 Credit TM:0.5

Host
Nina A Mayr, MD

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LL-ROS-TH1A • Can Baseline CT Features Be Used to Predict the Grade and Subtype of Non-Hodgkin's Lymphoma?

Jennifer Sammon MBBCh (Presenter) ; Maeve P Crowley MBBCh, MRCPI ; Maria Twomey MBBCh ; Derville M O' Shea MBChB, PhD ; Kevin N O'Regan MD

PURPOSE

Aggressive lymphomas commonly present acutely with rapidly growing masses and systemic B symptoms while indolent lymphomas present more insidiously with slow-growing lymphadenopathy. We hypothesize that baseline CT findings could help to predict the grade and subtype of lymphoma prior to biopsy.

METHOD AND MATERIALS

The baseline imaging of 104 patients (Male: Female = 57:47, Age range 19-85 and median age of 63.5) with Non-Hodgkin's lymphoma (NHL) was reviewed. The histological diagnosis was blinded to the radiologists analyzing the baseline CTs. Baseline CTs were reviewed and information about lymph node size, node morphology, location, spleen size and extra-nodal involvement was collected.

RESULTS

The presence of a conglomerate nodal mass and extra-nodal involvement had a high specificity for high-grade lymphoma, 89% (95%CI 0.8-0.9) and 84% (95%CI 0.75-0.94) respectively. The mean nodal size was significantly greater in the high-grade NHL versus low-grade NHL (5.7 cm compared to 4.1 cm, P-value = 0.032). The most common aggressive NHL subtypes was diffuse large B-cell lymphoma (DLBCL, n=34) and indolent subtype was follicular lymphoma (FL, n= 17). Seventy-five percent of patients with follicular lymphoma (FL) had discrete measurable lymph nodes, compared to 38% of the diffuse large B-cell lymphoma (DLBCL) group. Fifty-nine percent of the DLBCL group had extra-nodal involvement on their baseline CT compared to 11.8% of the FL group (P-value = 0.0001). The number of nodal regions involved was lower for DLBCL compared to FL (mean 2.6 versus 5.7) groups, (P-value= 0.0018).

CONCLUSION

Baseline CT scan characteristics can help to predict both the grade and subtype of NHL. Conglomerate nodal masses, bulky lymph nodes, fewer involved nodal regions, and extra-nodal involvement all showed a high specificity for high-grade NHL.

CLINICAL RELEVANCE/APPLICATION

This, to the best of our knowledge, has never been analyzed before and as lymphoma is a common malignancy, we feel this information is highly relevant to practicing radiologists.

LL-ROS-TH2A • Renal and Liver Dysfunction after Radiotherapy for Primary Gastric Lymphoma

Saiji Ohga MD (Presenter) ; Katsumasa Nakamura MD, PhD ; Tomonari Sasaki MD, PhD ; Tadamasu Yoshitake MD ; Kotaro Terashima ; Kaori Asai ; Keiji Matsumoto ; Hideki Hirata ; Hiroshi Honda MD

ABSTRACT

Purpose/Objective(s): To evaluate the renal and liver dysfunction after radiotherapy for primary gastric lymphoma.

Materials/Methods: From 2002 to 2011, thirty three patients with stage I/II gastric lymphoma were enrolled. Patient age ranged from 41 to 88 years (median: 66 years). Twenty three were male and ten were female. Initial clinical staging was I in 20 and II in 13 according to the Lugano staging system. Thirteen patients had mucosa associated lymphoid tissue (MALT) lymphoma and 20 had diffuse large B cell lymphoma. Dose of 30 - 46 Gy (median: 30 Gy) was delivered using involved field radiation therapy. Liver dysfunction was defined as 2-fold increase of alkaline phosphatase (ALP) or transaminase of pretreatment level exceeding upper normal limit within 4 months after the end of radiotherapy. Renal dysfunction was defined as the elevated creatinine (CR) or blood urea nitrogen (BUN) exceeding pretreatment value and upper normal limit within 4 months after the end of radiotherapy.

Results: The median duration of follow-up was 36 months. A more than 2-fold increase of pretreatment ALP or transaminase level exceeding upper normal limits was observed in 8 patients (24%). An elevated CR or BUN exceeding pretreatment value and upper normal limit was observed in 6 patients (18%). Age, gender, staging, total dose and so on were not correlated with renal and liver dysfunction. In dose volume histogram (DVH) analysis, liver volume receiving >20 Gy (V20) was significantly correlated with liver dysfunction. No DVH parameters related with renal dysfunction. Abnormal ALP or transaminase level has continued in three of all patients with liver dysfunction since one year following radiotherapy. All three patients received rituximab-CHOP (RCHOP) as chemotherapy before radiotherapy. In renal dysfunction abnormal CR or BUN level has continued in four patients since one year. Three of 4 patients also received CHOP or RCHOP.

Conclusions: The rates of renal and liver dysfunction were low after radiotherapy for primary gastric lymphoma.

However, we need to keep in mind that renal and liver dysfunction by the combined radiotherapy following chemotherapy continues for long time after radiotherapy. It is necessary to restrict V20 value of liver for preventing from liver dysfunction.

LL-ROS-TH3A • Optimal Fractionation Regimen for Electronic Brachytherapy for Treatment of Non-Melanomatous Skin Cancers

Michael K Cheung MD (Presenter) ; Benjamin G Slane MD ; John D Gordon MS ; Craig Hullet MD ; Baldassare Stea MD, PhD

LL-ROS-TH4A • External Beam Radiation Therapy for Locally Advanced and Metastatic Gastrointestinal Stromal Tumors

John J Cuaron MD (Presenter)

LL-ROE-TH5A • Challenges in Oncologic MR Imaging: HIT and MISS

Vadivel Devaraju PhD (Presenter) ; Derek J Hamlin MD ; Barry M McCook MD

PURPOSE/AIM

The objective of this presentation is to demonstrate the diagnostic difficulties encountered in patients with biopsy proven prostate carcinoma presenting for pre proton therapy MRI evaluation. Tumors may be missed even when utilizing state of the art multiparametric imaging. We present several clinical scenarios and challenges faced in interpretations, which may result in so called HIT and MISS outcomes. The hypothesis behind the multiparametric MR imaging and the underlying physics principles are discussed.

CONTENT ORGANIZATION

The multiparametric approach on Siemens 3T involves combining the morphological T1 and T2 weighted sequences with functional techniques of Diffusion Weighted Imaging (DWI) and Dynamic Contrast Enhancement Imaging (DCEI). The image findings are correlated with the biopsy determined qualitative grades of tumor. In tumors with small tumor volume in TRUS specimen, and low grade Gleason score of 6, the tumor can be missed even when using the above multiparametric approach to diagnosis.

SUMMARY

We demonstrate that even utilizing combined morphological and multifunctional imaging, the lesion can be missed in certain circumstances. Additional measures to optimize multiparametric imaging paradigm are proposed. This presentation will serve as a learning aid for radiologists to gain experience into the emerging trend of oncologic MR imaging.

Radiation Oncology and Radiobiology - Thursday Posters and Exhibits (12:45pm - 1:15pm)

Thursday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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LL-ROS-THB • AMA PRA Category 1 Credit™: 0.5

LL-ROS-TH1B • Value and Side Effects of Radiotherapy in the Treatment of Multiple Myeloma

Christiane Matuschek ; Edwin Boelke ; L. Anne Hayman MD * ; Axel Scherer MD ; Patric Kroepil MD ; Wilfried Budach MD ; Jackson D Hamilton MD (Presenter) * ; Thomas Ochtrup

LL-ROS-TH2B • Neurocognitive Outcomes Following Total Body Irradiation and a Cranial or Craniospinal Boost prior to Stem Cell Transplantation in Pediatric Leukemia Patients with CNS Involvement

Susan M Hiniker MD (Presenter) ; Rajni Agarwal MD ; Christine C Gray PhD ; Leslie A Modlin BA ; Jeremy P Harris BS ; Lynn Million MD ; Eileen F Kiamanesh MS ; Sarah S Donaldson MD

PURPOSE

Purpose: Acute lymphoblastic leukemia (ALL) is the most common pediatric malignancy. CNS involvement portends a poor prognosis and requires additional treatment, but late effects are an important consideration. We report the detailed neurocognitive outcomes from pediatric ALL patients with CNS involvement treated with total body irradiation (TBI) and a cranial or craniospinal boost (CSI) prior to stem cell transplantation (SCT).

METHOD AND MATERIALS

Methods and Materials: Sixteen children with ALL and CNS involvement underwent SCT with TBI plus CSI between 1986 and 2011. Pre-transplant preparative regimens included a mean total cranial dose of 24 Gy and mean total spinal dose of 18 Gy. 12 patients underwent post-transplant neurocognitive testing alone, and 4 patients underwent both pre- and post-transplant testing. Neurocognitive function was measured by the full-scale intelligence quotient (FSIQ) as determined by the age-appropriate Wechsler Intelligence Scale, by academic achievement as assessed by the Woodcock Johnson Test (WJ-III), and by

memory functioning as determined by the Wide Range Assessment of Memory and Learning, 2nd edition (WRAML2).

RESULTS

Results: Sixteen children (5 girls and 11 boys) were tested. The mean age at transplant was 11.8 years (range 3-20 years). At a mean of 4.4 years post-transplant, the mean overall IQ was 104.9 (range 84-143), and mean change in IQ for those tested pre- and post-transplant was +4.8 points (range -1 to +9). The mean post-transplant total academic achievement score was 99.6 (range 80-148). 5/16 children were noted to have significant relative deficiencies in processing speed on post-transplant testing, and 4/16 patients had deficits in working memory.

CONCLUSION

Conclusion: In a series of 16 children with ALL and CNS involvement treated with TBI plus CSI prior to SCT, neurocognitive testing revealed normal post-transplant IQs. Mean post-transplant total academic achievement scores were also normal. Nearly one-third of children were found to have deficits in processing speed and/or working memory when tested after transplant, although the number of patients available for comparison with both pre- and post-transplant testing is small.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: Children with ALL with CNS involvement appear to have normal IQs after TBI plus CSI prior to SCT; further study of effects on processing speed and working memory is warranted.

LL-ROS-TH3B • Solitary Fibrous Tumors: Radiographic and Pathologic Responses to Neoadjuvant Radiotherapy

Laura E Kollar MD (Presenter) ; **Alina Bischin** ; **Ashley Gullett** ; **Andrew D Trister MD, PhD** ; **Stephanie Punt** ; **Ernest Conrad MD** ; **Gabrielle Kane MB, EdD, FRCPC** ; **Edward Y Kim MD**

PURPOSE

Solitary fibrous tumors (SFT) are rare tumors, historically managed by surgery, with little data available regarding their response to radiotherapy (RT). We set out to review treatment effects of neoadjuvant RT and to investigate the correlation between radiographic and pathological response.

METHOD AND MATERIALS

We identified 87 patients with diagnosis of SFT through 2 prospectively collected databases (2000-13). Of those, 5 were treated with RT followed by surgical resection. Pathology and imaging were available for all patients. RECIST was utilized to determine response to treatment. Volumetric analysis was performed using MIM Software.

RESULTS

2 patients were male, 3 female. Average age at diagnosis was 57 years (range 34-72). 2 were extremity, 2 were pelvic, and 1 was pleural based. Histologically, 3 were benign/low grade and 2 were malignant. Median pre-RT tumor size was 12 cm in maximal dimension (range 6-29), with average volume of 1819.4 cc (range 63.2-7534.5). All patients received neoadjuvant RT, with doses ranging from 48-50 Gy. 1 patient received neoadjuvant chemotherapy. 3 patients had MR and 2 patients had CT imaging. By RECIST, 1 had PR and 4 showed SD. Volumetrically, tumors decreased on average by 26.8% (range 13.7-44.3%). Pathologically, 4 showed some degree of necrosis (range 5-95%); 1 was not reported. Radiographic response did not appear to correlate with pathological response. 1 patient with 95% necrosis on pathology only had 13.7% decrease in tumor volume. Of note, this patient also received neoadjuvant chemotherapy. After average follow up of 24 months (range 7-89), 4 patients were NED and 1 patient had LR 3 months after re-resection, though was noted to have extensive seeding of tumor after initial surgery.

CONCLUSION

This is the largest series we are aware of examining the use of pre-op RT in the management of SFTs. In this small series, all patients experienced a decrease in tumor volume after RT (average 26.8%), though the magnitude of response did not always correlate directly with degree of necrosis on pathology. 4 of 5 patients developed some degree of necrosis on final pathology. Volumetric analysis demonstrated decreases in tumor size more readily than RECIST measurements.

CLINICAL RELEVANCE/APPLICATION

This is the largest series to date evaluating the role and treatment responses to preoperative radiation in the management of solitary fibrous tumors, correlating radiographic and pathologic findings.

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 techniques 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.

VSI051-02 • IRE for Liver Metastases

Govindarajan Narayanan MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI051-03 • 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.

VSI051-04 • 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.

VSI051-05 • 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.

VSI051-06 • 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 well 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 percutaneously 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 percutaneous 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.

VSI051-07 • Assessing Geometric RF Ablation Accuracy and Predicting Outcome within 24h after Treatment by Mapping the Preprocedure Liver Lesion to the Postprocedure Ablation Zone

Frederik Vandembroucke 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 where 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.

VSI051-08 • 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

VSI051-09 • 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.'

VSI051-10 • 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.

VSI051-11 • 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 ablation 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 ♦ 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 location

VSI051-12 • 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

VSI051-13 • MRgFUS for Palliation of Painful Metastatic Disease

Mark D Hurwitz MD (Presenter)

LEARNING OBJECTIVES

View learning objectives under main course title.

VSI051-14 • 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.

VSI051-15 • 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.

VSI051-16 • 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.

VSI051-17 • 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.

Advances in Cross-sectional Oncologic Imaging

Thursday, 04:30 PM - 06:00 PM • S402AB



RC718 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

RC718A • Microbubble-enhanced Ultrasound in Oncology

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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 antivasular 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 successful 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

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Image Registration

Thursday, 04:30 PM - 06:00 PM • S502AB

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RC722 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator
Kristy K Brock, PhD *

LEARNING OBJECTIVES

1) Describe methods to perform QA/QC of deformable registration. 2) Propose methods to account for uncertainties. 3) Highlight clinical integration.

RC722A • Uncertainties in Deformable Registration

Kristy K Brock PhD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

RC722B • Clinical Practice

Patrick Kupelian MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

Techniques for Quantitative Cancer Imaging: Current Status

Friday, 08:30 AM - 10:00 AM • S404CD

RO **OI** **BQ**

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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 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.

Physics (Image-guided Radiation Therapy II)

Friday, 10:30 AM - 12:00 PM • S403A



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SST15 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Peter Balter, PhD *
Moderator
Lei Xing, PhD *

SST15-01 • Artifact-resistant Motion Estimation for Motion-compensated CT

Marcus Brehm; **Thorsten Heuser** (Presenter); **Pascal Paysan** PhD *; **Markus Oelhafen** DPhil, DSc *; **Marc Kachelriess** PhD

PURPOSE

Image quality of respiratory-correlated 4D volumes from flat detector cone-beam CT scans (4D CBCT) is deteriorated by severe sparse projection artifacts. These artifacts complicate motion estimation and therefore motion compensation. The aim is to robustly estimate motion in presence of dominating image artifacts and to allow for a subsequent motion-compensated image reconstruction that guarantees full dose usage.

METHOD AND MATERIALS

To estimate respiratory motion in artifact-dominated images we developed a patient-specific artifact model: A 3D reconstruction of the 4D data is segmented into air, soft tissue, and bone by simple but robust hard thresholding (at -800 HU, +300 HU). The resulting three-valued image is forward projected and the thus-obtained rawdata undergo a 4D reconstruction (phase binning and independent reconstruction of each respiratory phase) yielding 4D CBCT images free of patient motion but full of sparse projection artifacts. The artifacts change from respiratory phase to respiratory phase. Deformable registration of those artifact volumes yields an approximation of the motion induced by the artifacts. This information is used to correct motion vector fields that were estimated on the conventional 4D CBCT volumes. The method is verified using simulated rawdata obtained by deforming a clinical patient dataset by realistic deformation fields, and by processing patient data acquired with the TrueBeam 4D CBCT system (Varian Medical Systems).

RESULTS

The motion-compensated reconstructions, from simulated and patient data, do not contain any streak artifacts, they are free from motion blurring, and their image noise is similar to the standard 3D reconstruction. The high temporal resolution is maintained. Pulmonary blood vessels that have been hidden by motion blurring or streak artifacts before now become clearly visible.

CONCLUSION

The proposed patient-specific artifact model allows for a robust registration between images that are severely degraded by artifacts. Combined with motion compensation one is able to remove streak and motion artifacts while maintaining a good spatial and good temporal resolution. Full dose usage is guaranteed because now all data contribute to each time frame.

CLINICAL RELEVANCE/APPLICATION

High quality 4D images are a prerequisite for precise adaptive radiation treatment.

SST15-02 • The Effect of CT Image Quality on Deformable Image Registration in Radiotherapy

Vern P Hart PhD (Presenter); **Guang-Pei Chen** PhD; **Allen Li** PhD

PURPOSE

Various CT modalities of different image quality are used to plan and guide radiation therapy (RT). This work is to assess the effect of CT image quality on deformable image registration (DIR) and its impact on auto-segmentation and dose accumulation in adaptive RT (ART).

METHOD AND MATERIALS

A variety of CT data sets with different soft-tissue contrasts were acquired for prostate cancer patients in different treatment fractions. Conventional diagnostic CT with standard protocols (SCT) and high soft-tissue contrast protocols (increased dose) (HCT), kilovoltage cone beam CT (CBCT), and megavoltage tomotherapy CT (MVCT) were registered using an in-house DIR tool based on the symmetric force Demons algorithm. Targets and critical organs were contoured on the SCTs and populated to other CT images with DIR. Of particular interest was the impact of soft-tissue contrast on intensity-based algorithms. DIR results were assessed with the Dice similarity coefficient (DSC) and were correlated with differences in image quality observed between CT image types.

RESULTS

Differences in soft-tissue contrast had a significant impact on DIR accuracy, as demonstrated in the registration of SCT-SCT, SCT-HCT, SCT-CBCT, and SCT-MVCT between different fractions. The inclusion of binary masking partly compensated for this effect and yielded excellent results. In the case of SCT-CBCT registration, binary masking provided DSC values exceeding 96, 97, and 98% for rectum, prostate, and bladder, respectively. Initial results have also shown that contour smoothing using morphological warping can improve accuracy in the absence of binary masks on daily images, which is of interest for ART.

CONCLUSION

Decreased soft-tissue image contrast generally leads to decreased DIR accuracy during ART. A number of techniques can be implemented to improve the accuracy of contouring and dose mapping. Binary masking provides excellent results and research is currently underway to increase the clinical robustness of this approach, such as auto-segmentation for mask generation and morphological smoothing of image contours. These approaches would allow ART based on commonly used CT modalities.

CLINICAL RELEVANCE/APPLICATION

DIR is essential in ART for accounting for interfraction variations and thereby improving RT delivery accuracy. As such, compensating for decreased CT quality in DIR is of great interest to ART.

SST15-03 • Deformable Registration Guided Correlation of Post-radiotherapy Recurrent Disease to Pre-radiotherapy PET Positive Volume in Patients with Head and Neck Cancer

Michalis Aristophanous (Presenter); **Abdallah S Mohamed** MD, MSc; **Adam S Garden** MD; **David I Rosenthal** *; **Clifton D Fuller** MD, PhD *

PURPOSE

Investigate the predictive role of pre-radiotherapy (pre-RT) FDG-PET/CT scans for head and neck cancer local and/or regional recurrence (LRR).

METHOD AND MATERIALS

Thirty-five patients that developed LRR following radiotherapy (RT) for primary SCC of the head and neck between May 2003 and July 2010 were identified under an IRB approved protocol. Each patient had an FDG-PET/CT scan on average 2 months prior to RT. The PET-based gross tumor volume (GTV) was defined utilizing an automated segmentation algorithm developed in-house to obtain a pre-RT GTV-PET. The recurrent disease was identified and contoured on follow up post-radiotherapy (post-RT) CT imaging to obtain the GTV-REC. The post-RT CT scan was fused to the pre-RT PET/CT using an in-house developed deformable registration algorithm. The deformation map was applied to the contours to obtain GTV-REC_def that was registered to the pre-RT PET/CT. A uniform 1cm margin was added to the GTVs to account for the various uncertainties in the segmentation and registration process. Several SUV statistics inside the recurrent and PET defined GTVs were obtained and analyzed, along with the overlap of the GTV-REC_def with the GTV-PET.

RESULTS

Primary sites were oral cavity (8.6%), oropharynx (68.5%), and hypopharynx (22.9%). The mean (range) GTV-PET and GTV-REC_def were 29.2ml (3.1-145.6ml) and 10.9ml (0.9-92.9ml) respectively with the Pearson correlation coefficient between the two volumes being 0.82. The SUV maximum in the GTV-PET and GTV-REC_def+1cm was found to have no statistically significant difference. Finally, an overlap of 1 between GTV-REC_def and GTV-PET+1cm indicating complete inclusion of the recurrence in the pre-RT defined GTV-PET was obtained for 68.6% of the cases, and increased to 82.9% for an overlap greater than 0.5.

CONCLUSION

The results suggest that the volume of the PET positive GTV on a pre-RT FDG-PET scan can be predictive of the size of disease in cases of recurrence. In addition, utilizing deformable registration to relate the recurrent GTV to the pre-RT SUVs on the FDG-PET scan confirmed that greater than 80% of recurrence occurs within or at the PET positive volume boundary.

CLINICAL RELEVANCE/APPLICATION

Predictions of post-radiotherapy recurrent disease patterns based on pre-radiotherapy PET characteristics can result in treatment plan strategy modifications that improve loco-regional control.

SST15-04 • Monte Carlo Based Estimation of Pediatric Dose from CBCT Imaging Head Protocols for Patient Positioning and Target Localization in Radiotherapy

Kyle McMillan (Presenter) * ; **Maria Zankl** PhD ; **Michael F McNitt-Gray** PhD * ; **Dan Ruan** PhD *

PURPOSE

The purpose of this investigation is to estimate the organ doses to a pediatric patient undergoing repeat CBCT imaging as part of an image-guided radiation therapy (IGRT) procedure.

METHOD AND MATERIALS

A Monte Carlo model was developed with application to kV-CBCT dose quantification on the Varian On-Board Imager platform. This model was validated against experimental measurements with an average agreement within 4%. Using this validated model, dose to a pediatric patient was simulated for the GSF "Child" model. This whole-body voxelized phantom was derived from CT imaging data of a 7-year-old female and contains 144 slices of 8 mm thickness with each slice consisting of a 256 x 256 matrix of 1.54 mm x 1.54 mm pixels. Simulations were performed using a standard-dose, low-dose and high-quality head CBCT protocol. For each protocol, the clinical default x-ray field size of 27.2 x 18.4 cm² at 100 cm source-to-surface distance was simulated. The reference center of the scan was set in the infratentorial region of the brain, and dose was tallied in all relevant organs near the collimated x-ray beam. Results for each simulated protocol were reported for both an individual scan as well as the accumulated dose expected from 30 repeated scans throughout the course of an IGRT treatment regimen consisting of 5 treatment fractions a week for 6 weeks.

RESULTS

For a standard-dose protocol, dose per scan to the brain, skull, lens of the eye, head skin and cervical spine was 2.9, 10.6, 0.47, 3.3 and 14.9 mGy, respectively. These doses were decreased by a factor of 2 when the low-dose protocol was used and increased by a factor of 5 when the high-quality protocol was used. Accumulated dose as high as 2240 mGy was observed for the cervical spine when the high-quality protocol was used for all 30 repeated scans.

CONCLUSION

Dose to bony structures such as the skull and cervical spine is significantly higher than dose to soft tissue. In pediatric patients whose bones are in a proliferative state, this CBCT imaging dose increases the risk of retardation of growth and induction of bone cancer. Therefore, it is important that the dose from CBCT imaging of pediatric patients be carefully considered and monitored.

CLINICAL RELEVANCE/APPLICATION

Organ-specific dose quantification from this study provides distributional knowledge about CBCT imaging dose and facilitates designing protocols to reduce risk of late effects in pediatric patients.

SST15-05 • 4D Cone Beam CT in Image Guided Radiation Therapy without Data Truncation Artifacts

Kai Niu MS (Presenter) ; **Ke Li** MS ; **Guang-Hong Chen** PhD *

PURPOSE

To evaluate the capability of solving the data truncation and detector shift problem common in clinical applications of 4D cone beam CT (CBCT) using an adapted Prior Image Constrained Compressed Sensing (PICCS) reconstruction method and to quantify the robustness of the adapted PICCS-4DCBCT algorithm under different data truncation conditions.

METHOD AND MATERIALS

RESULTS

For PICCS-4DCBCT, the rRMSEs are 0%, 4%, 6%, 7% for each case from no data truncation to most aggressive data truncation. In contrast, for TV-CS, the corresponding rRMSEs are 4%, 6%, 8%, 9%, and for FDK, the rRMSEs are 17%, 18%, 19% and 20%. The UQIs for PICCS-4DCBCT images are 1, 0.996, 0.991 and 0.986 (score=1 means perfect); for TVCS, the UQIs are 0.970, 0.957, 0.951 and 0.947, and for FDK images, the UQIs are 0.630, 0.630, 0.630 and 0.629.

CONCLUSION

(1) PICCS-4DCBCT offers much better image quality and reconstruction accuracy compared with TV-CS and E-FDK at all data truncation levels. (2) No meaningful variations in performance were observed when the amount of truncation was changed.

CLINICAL RELEVANCE/APPLICATION

PICCS-4DCBCT can be performed accurately and stably with almost arbitrary data truncation scanning conditions in 4DCBCT to guided radiation therapy for lung cancers.

SST15-06 • Optimization of the Design of Portal Imaging Systems Incorporating Thick, Segmented Scintillating Detectors Employed for Megavoltage Cone-beam CT through a Novel Hybrid Modeling Technique

Langechuan Liu (Presenter) ; **Larry E Antonuk** PhD ; **Hao Jiang** ; **Youcef El-Mohri** PhD ; **Qihua Zhao** PhD

PURPOSE

Active matrix flat-panel imagers (AMFPIs) incorporating thick, segmented scintillators have demonstrated order-of-magnitude improvements in DQE at radiotherapy energies compared to systems based on conventional phosphor screens. Such improved DQE values facilitate megavoltage cone-beam CT (MV CBCT) at clinically practical doses providing distinct advantages over kV CBCT performed using additional on-board imaging equipment. However, the MV CBCT performance of such AMFPIs is highly dependent on the design parameters of the scintillators. In this presentation, a theoretical examination of imaging performance as a function of these parameters is reported.

METHOD AND MATERIALS

The imaging performance of various scintillator designs was examined through a hybrid approach involving Monte Carlo simulation of radiation transport and determination of optical point spread functions. For each design, a full tomographic scan of a contrast phantom incorporating various soft-tissue inserts was simulated at a total dose of 3 cGy. This novel technique was validated through comparisons of theoretical predictions of contrast, noise and contrast-to-noise ratio (CNR) with measurement results obtained from a 1.13 cm thick, 1016 μ m pitch BGO prototype.

RESULTS

Theoretical values for contrast, noise and CNR were found to be in close agreement with measurements for the BGO prototype, strongly supporting the validity of the modeling technique. For various other scintillator designs, results for CNR demonstrate improvement by a factor of \sim 2.2 when the scintillator thickness is increased from 1.13 to 6 cm, and an improvement by a factor of \sim 2.6 when the pitch is increased from 508 to 1016 μ m. Finally, optimization of design based on a trade-off between thickness and pitch, along with evaluation of the corresponding spatial resolution performance, is discussed.

CONCLUSION

A new technique to model both radiation and optical effects was validated and employed to accurately evaluate the MV CBCT performance of MV-AMFPIs incorporating various segmented scintillator designs. It appears that significant improvement in the imaging performance of such AMFPIs can be achieved through optimization of scintillator design parameters.

CLINICAL RELEVANCE/APPLICATION

Enhanced performance of MV-AMFPIs with segmented scintillators should greatly facilitate soft tissue visualization in external beam radiotherapy through MV CBCT imaging at clinically practical doses.

SST15-07 • 2D kV Orthogonal Pair vs. 3D Cone Beam CT Localization for Breathhold Breast Radiation Therapy Treatment

Michelle Howard BS (Presenter) ; **Sean S Park** MD, PhD ; **Robert W Mutter** MD ; **Elizabeth S Yan** MD ; **Deanna H Pafundi** PhD ; **Debra Brinkmann** PhD

PURPOSE

To assess the accuracy of breast and heart localization between 3D cone beam CT (3D-CBCT) registration to soft tissue and 2D kV orthogonal pair (2D-OP) registration to bony anatomy for assessment of matching criteria and imaging modality for accurate localization of breast and heart for left-sided breast patients treated with breath-hold (BH) technique. Previous research has shown a linear correlation between major coronary events and increased radiation dose to heart [1]. 1. Darby SC, et al. Risk of ischemic heart disease in women after radiotherapy for breast cancer. NEJM 2013; 368(11):987-98.

METHOD AND MATERIALS

3D-CBCT and 2D-OP from 9 left-sided breast cancer patients treated with BH were retrospectively reviewed. Weekly 3D-CBCTs were acquired after manual 2D-OP registration to chest wall (anterioposterior) and sternum (lateral) was applied. 3D-CBCT images were then compared offline to planning CT with automatch applied to breast tissue, heart, or spine using translations only. The role of 2D vs 3D imaging for daily patient positioning was also evaluated.

RESULTS

CONCLUSION

Shift differences between 3D breast tissue automatch and 2D bony manual match were = 5mm in 7 patients and = 1cm in 4 patients. Accurate patient positioning is sensitive to the breast tissue placement and the degree of body roll which are difficult to ascertain with 2D imaging. 3D-CBCT registration allows for improved assessment and accurate localization of breast tissue, heart, and body roll. Further analysis will evaluate the dosimetric impact to heart based on localization to 2D-OP manual registration and 3D-CBCT automatch to breast, heart, and spine.

CLINICAL RELEVANCE/APPLICATION

This investigation will directly impact clinical practice decisions on which imaging modality and matching criteria are used daily to localize left-sided BH breast radiation therapy patients.

SST15-08 • CT Number Changes Observed during Radiotherapy for Head and Neck Cancer

Ion Moraru (Presenter)

ABSTRACT

Purpose/Objective(s): Radiation induced anatomic changes, such as tumor regression, are common during the delivery of radiotherapy (RT) for head and neck cancer. In an effort to measure treatment response and identify indicators for adaptive RT, we investigate changes of CT number in target and organs at risk (OAR) from the CT data acquired during RT delivery and study correlations with anatomic variations.

Materials/Methods: Daily diagnostic-quality CT data acquired using an in-room CT (CT-on-Rails) for image-guided IMRT of 9 patients with stage III and IV squamous cell carcinoma of the oropharynx were analyzed. The patients were treated with 70 Gy in 35 fractions concurrently with chemotherapy. The gross tumor volume (GTV) and OARs were contoured on each daily CT set. All selected patients exhibited GTV reduction over the course of the treatment. We examined the distribution of CT numbers in Hounsfield units (HU) of various volumes of interest (VOI), including GTV and spinal cord, on daily CT sets. Statistical analysis of CT number distributions was performed for each patient for different fractions and trends were examined across the entire cohort. Various parameters including the mean, width, CT number of peak and asymmetry of each histogram were used to measure differences in the CT number distributions.

Results: Patient-specific changes in the CT number histograms as a function of fraction number for the GTV and spinal cord were observed. For the GTV, the mean CT number was observed to vary as much as +28% (+13 HU) and -27% (-12.5 HU) over 30 fractions, corresponding to +40% (+17.5 HU) and -38% (-18 HU) shifts in the CT number of the histogram peaks, respectively. These were associated with large differences in the histogram widths, namely 24% and 48%, and strong changes in symmetry, which may indicate that only part of the GTV experiences a shift CT numbers over the course of treatment for these patients. By contrast, a much more limited range of changes in the mean CT numbers was observed for the spinal cord, namely between +7.5% (+2.5 HU) and -11% (-4 HU), with less modifications in histogram width and symmetry. These maxima in the mean were not correlated with the data from those patients exhibiting the largest shifts in the GTV. This supports the idea that the observed differences in CT distributions of the GTV are largely radiation induced, as the spinal cord typically receives limited radiation dose.

Conclusions: Radiation induced non-negligible, patient-specific CT number changes were observed in volumes of interest during the delivery of RT for head and neck cancer. The pattern of variation is complex and no strong trend and/or correlation with tumor regression is identified for the small group of patients studied. More work is required to understand the mechanisms involved in these changes and how these will be used for adaptive RT to account for radiation response.

SST15-09 • Offline CBCT Quantification of Translational and Rotational Displacements Using Automated Image Matching in Head and Neck

Radiotherapy: A Feasibility Study

Jillian Hayes (Presenter) ; **Maeve L McGarry** BSc ; **Gregory Perkins** BSc ; **Rabih W Hammoud** MSc, BSc ; **Saju Divakar** ; **Mohamed P Riyas** MBBS, MD ; **Noora Al Hammadi**

Disclosure Index

A

Able, C. M. - Supported, Varian Medical Systems, Inc
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