SSA06-01 • Relevance of Abdominal CT Radiation Dose Reduction beyond Childhood: What Does New Data Show?

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PURPOSE
Recent data from lifespan study from Japanese Atomic Explosion estimate increased Excess Lifetime Risks (ELR) of certain radiation-induced solid cancers, when exposure occurs at middle age rather than in childhood. The purpose of our study was to assess population based estimated ELR for solid cancers following abdominal CT in different age groups using size adjusted CT protocols in a large tertiary health care center.

METHOD AND MATERIALS
Our IRB approved study included 2902 consecutive “routine” abdominal CT. Dose monitoring software (Exposure, Radimetrics) was used to obtain patient demographics, scanning parameters as well as radiation dose information (Size Specific Dose Estimate (SSDE) estimated effective doses (EED) and organ doses). Patients were stratified by age groups of 11-20, 21-30, so on, >70 years. Estimated ELR from the time of exposure from chest CT was estimated based on recently reported literature on risk estimation from radiation induced solid cancer risks published from 2007-2012.

RESULTS
SSDE for routine abdominal CT examinations were highest for age group 61-70 years (11 mGy) and lowest for 10-20 years (9.4 mGy). EED (ICRP 103) were 6.9-8.7 mSv and 11.4-9.1 mSv for these age groups (p

CONCLUSION
SSDE and estimated effective doses are suboptimal for cancer risk estimation and organ doses should be used for solid cancer radiation induced risk estimation, regardless of patient’s age

CLINICAL RELEVANCE/APPLICATION
Contrary to the prior belief, dose concerns are not only important for the younger age groups (0-20) but also for older patients (30-60 years), especially for risk estimations of lung, breast cancers

SSA06-02 • Multi-reader Detectability of Simulated Low-contrast, Low-attenuation (LCLA) Liver Lesions on MDCT: Effect of Dose and Reconstruction Method

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PURPOSE
To assess the effect of reduced radiation exposure and reconstruction method on detection of lesions that are low-contrast, low-attenuation (LCLA) relative to the background liver

METHOD AND MATERIALS
Semi-anthropomorphic phantom containing custom inserts with 36 spherical liver lesions of 3 sizes and attenuations (10 and 15-mm at 6, 12 and 18HU, and 5-mm at 12, 18 and 24HU below 90HU simulated liver)
was scanned at 120kVp, 0.6-mm collimation, 200 (CTDIvol 13.49), 150, 100 and 50mAs on a 128-slice MDCT scanner (Definition Flash, Siemens).Lesions were distributed non-uniformly to reduce memory bias. Images were reconstructed at 3-mm thickness using filtered back projection (FBP) and sinogram-affirmed iterative reconstruction (SAFIRE, S3). A randomized dataset containing 256-images was generated for each reader (12 images with one lesion, 12 with two lesions and 8 without lesions, for each dose and reconstruction method). Eighteen Radiologists blinded to phantom and study design independently reported region-level lesion presence or absence on a 5-point diagnostic confidence scale. Statistical evaluation included multi-reader, multi-case (MRMC) ROC analysis using nonparametric methods with the area under the ROC curve (AUC) considered accuracy.

**RESULTS**

Pooled AUC decreased with each 25% reduction from 100% dose: 0.848, 0.842, 0.792 and 0.743 for FBP; and 0.862, 0.855, 0.785 and 0.735 for SAFIRE. At a given dose, improvement in AUC with SAFIRE was, however, not statistically significant. For both FBP and SAFIRE, accuracy at 75% dose was statistically equivalent to 100% dose FBP (p = 0.002 and

**CONCLUSION**

In this LCLA liver lesion model, a 25% dose reduction did not reduce detection of the lesions studied. However, detection was inferior with each subsequent dose reduction regardless of reconstruction method. For lesions with attenuation differences larger than or equal to 12HU, lesion detection was not reduced even at 50% dose with FBP.

**CLINICAL RELEVANCE/APPLICATION**

Estimates of loss of accuracy at reduced doses and limits of iterative reconstruction should be known especially for low contrast, low attenuation liver lesions to enable dose optimization in practice.
significantly for any levels of ASiR reconstruction between the 1st and 2nd session (P

CONCLUSION
Reader’s experience with ASiR does not significantly change diagnostic accuracy for hypervascular liver lesion detection, but may decrease the number of false positive findings as well as improve reader’s perception of image quality.

CLINICAL RELEVANCE/APPLICATION
Reader's experience with ASiR improves subjective perception of image quality and may significantly decrease false-positive findings.

SSA06-04 • Potential of Radiation Dose Savings in Abdominal and Chest CT Using Automated Tube Voltage Selection in Combination with Automated Tube Current Modulation

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PURPOSE
To evaluate the simultaneous use of automatic tube current modulation (ATCM) and automatic tube voltage selection (ATVS) for abdominal and thorax contrast-enhanced CT examinations regarding radiation dose reduction and image quality.

METHOD AND MATERIALS
In total 617 consecutive patients were enrolled in this retrospective single center study who all either underwent a portal-venous abdomen CT examination or a contrast-enhanced arterial phase chest CT examination and were divided into two groups. In group A, 317 patients were enrolled using ATCM with a fixed body-mass-index adjusted tube voltage of either 120 kV or 100 kV. In group B, consisting of 300 patients, ATCM as well as ATVS was used. Image attenuation and noise was measured in different abdominal and thoracic regions for each patient. To compare the CT density and image noise, signal-to-noise ratio, contrast-to-noise ratio and radiation parameters between both groups a 1-way analysis-of-variance was preformed.

RESULTS
The mean contrast-to-noise ratio and the signal-to-noise ratio of abdomen and chest CT scans was higher in group B if compared to group A (p

CONCLUSION
The simultaneous use of ATVS and ATCM allows for significant radiation dose reduction in abdominal and thoracic contrast-enhanced CT examinations when compared to the use of ATCM alone while maintaining adequate image quality and diagnostic confidence without user interaction. The ATVS tool reduced tube voltage effective in the majority of patients (49%) resulting in a dose reduction of 18%, demonstrating the potential of this new dose modulation tool.

CLINICAL RELEVANCE/APPLICATION
Simultaneous use of ATCM and automatic tube voltage selection allows for significant radiation dose reduction in abdominal/thoracic CT examinations of up to 18% when compared to ATCM alone.

SSA06-05 • Model Based Iterative Reconstruction Algorithm for Abdominal CT at Variable Radiation Doses: Assessment of Image Quality, Lesion Conspicuity and Radiation Dose in Anthromorphic Liver Phantoms

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PURPOSE
To assess the image quality, lesion conspicuity and radiation dose of model-based iterative reconstruction algorithm (IMR) compared with filtered back projection (FBP) and hybrid iterative reconstruction algorithm
METHOD AND MATERIALS
Small and large anthropomorphic phantoms with 4 simulated hypervascular tumors and 4 hypovascular tumors were scanned using a 256-channel CT scanner using 120 and 100kVp with 20, 40, 60, 80, 100, 130, 150, 180 and 200mAs. CT images of both phantoms at the two kVp were classified by radiation dose: standard dose (200mAs); mild dose reduction (DR) (130-180mAs), moderate DR (60-100mAs), severe DR groups (20-40mAs). All scans were reconstructed using FBP, iDose level 4 and IMR. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated in the organs and compared among the different reconstruction modes. In addition, two radiologists assessed the image quality and lesion conspicuity of 8 focal liver lesions (FLLs).

RESULTS
SNR and CNR of IMR images were significantly higher than those of others, at the same radiation dose in both phantoms by reducing noise effectively (p

CONCLUSION
IMR significantly reduces noises and improved SNR and CNR compared with FBP and iDose, and provide the similar image quality with mild to moderate dose reduction in variable body habitus. However, IMR can improve FLL conspicuity only with mild to moderate dose reduction.

CLINICAL RELEVANCE/APPLICATION
IMR can reduce noise and improve image quality and allows use of lower radiation dose for abdominal CT. Lesion conspicuity can be improved with IMR at mild to moderate dose reduction, severe dose redu

SSA06-06 • Assessment of Hybrid and Pure Iterative Reconstruction with Filtered Back Projection Technique for Low Dose Abdominal CT

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PURPOSE
To evaluate standard and low dose abdominal CT images reconstructed with filtered back projection (FBP), hybrid (hIRT) and pure (pIRT) iterative reconstruction techniques.

METHOD AND MATERIALS
In an IRB approved, prospective clinical study, 20 patients (mean age 59 ± 14 years, mean weight 181±41 lbs, M:F 13:7, undergoing routine abdomen CT on a 64 channel MDCT (Discovery CT750 HD) gave written informed consent for acquisition of an additional sub-milli-Sievert (submSv) abdomen CT series. The latter series were acquired with reduced tube current but identical scan length compared to the routine abdomen CT. Sinogram data of submSv series were reconstructed with FBP, hIRT (SS50, SS70, SS90 GE Healthcare) and pIRT (GE Healthcare) and compared with FBP images of standard dose chest CT (n= 6*35=210 series). Three board certified abdomen radiologists performed independent and blinded comparison for lesion detection, lesion margin, visibility of small structures and diagnostic acceptability. Objective measurements, noise spectral density was obtained.

RESULTS
Mean CTDIvol were 9.3±3.5 and 1.3±0.2 mGy for standard and submSv CT, respectively. Lesion conspicuity was improved from poorly visualized margins in FBP and hIRT images to well defined margins on submSv pIRT. All 3 radiologists found suboptimal noise in submSv FBP and hIRT images, whereas noise was acceptable with pIRT. Except for minor pixilated appearance of pIRT images, no significant artifacts were seen. Noise power spectrum analyses showed hIRT retains the noise spectral signature as FBP, in spite of lowering the noise, whereas pIRT had lower noise as well as more regularized noise spectral pattern.
CONCLUSION
SubmSv abdominal CT examinations when reconstructed with pIRT improves the visualization of lesion margins and normal abdominal structures and are associated with lower image noise as compared to hIRT and FBP, without any significant image artifacts affecting diagnostic interpretation.

CLINICAL RELEVANCE/APPLICATION
Pure iterative reconstruction technique can allow use of submsv radiation dose for routine abdominal CT with retained diagnostic confidence.

SSA06-07 • Comparison of Dose from Single Energy and Dual Energy Multi-detector Computed Tomography Examinations in the Same Patient Screened for Hepatocellular Carcinoma
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PURPOSE
To compare the dose and noise level between single energy (SE) and dual energy (DE) multi-detector computed tomography (MDCT) examinations in patients undergoing screening for Hepatocellular Carcinoma (HCC).

METHOD AND MATERIALS
IRB-approved, HIPPA-compliant prospective study of 59 adult subjects (mean age 59.5yrs) undergoing HCC screening with 3-phase CT (unenhanced, arterial and portal-venous phases), who were each examined on both SE (Sensation 64, Siemens Healthcare) and DE CT scanners (Flash, Siemens Healthcare) on different dates. SE scans were performed using 120kVp and weight-based mAs (mAs=patient's weight), and DE scans at 100kVp and 140kVp, with mAs adjusted to match the estimated CTDIvol of a weight-based mAs SE scan. The CTDIvol and DLP of each phase were recorded. Maximum anteroposterior and transverse dimensions measured from CT radiographs were used to calculate the effective diameter (ED) and size-specific dose estimate (SSDE). Regions of interest (ROI) were drawn in liver, retroperitoneal (RP) fat, IVC, and aorta and Hounsfield unit values with Standard Deviation (SD) recorded. Paired t-tests were used to compare BMI, weight, and ED at the time of the two imaging studies. Distributions of outcome variables (dose and noise) were examined using Q-Q plots and Shapiro tests.

RESULTS
BMI and weight of the subjects were highly correlated with the ED (r=0.75 and 0.87) and did not differ significantly between the two scans. CTDIvol and SSDE were significantly lower for all the phases on DE scans compared to SE scans (p-values

CONCLUSION
Dose with the MDCT DE scanning protocol was significantly lower when compared to SE examinations, with either similar or lower noise levels.

CLINICAL RELEVANCE/APPLICATION
DE scanning protocols can be an alternative to decrease dose in patients undergoing HCC screening who require repetitive imaging.

SSA06-08 • Ultra Low-Dose CT for Patients with Clinically Suspected Acute Appendicitis: Optimal Strength of Sinogram Affirmed Iterative Reconstruction for Image Quality and Diagnostic Performance
Seung Ho Kim MD (Presenter); Janghee Lee MD; Kyeong Hwa Ryu MD; Een Young Cho MD; Jung Hee Yoon MD; Yun-Jung Lim; Choong K Eun MD

PURPOSE
To evaluate the optimal strength of Sinogram Affirmed Iterative Reconstruction (SAFIRE) to obtain the best image quality on ultralow-dose CT (ULDCT) and to compare its diagnostic performance with that of the half-dose CT (HDCT) for the diagnosis of acute appendicitis.
METHOD AND MATERIALS

This prospective study was IRB approved, and informed consent was obtained from all patients. A total of 102 consecutive patients (47 men, 55 women; mean age, 41.2 years; range, 15-82 years) with right lower quadrant pain underwent low dose CT, which consisted of enteric phase HDCT (120 kVp, 100 mAs, effective dose=3.6 mSv) and portal phase ULDCT (120 kVp, 30 mAs, 1.5 mSv). ULDCT images were reconstructed separately with five levels strength levels (S1-S5). Two blinded radiologists recorded scores for the subjective image quality of the ULDCT data set (S1-S5 and S0 [filtered back projection]) according to the European guidelines on quality criteria for CT, as well as confidence scores for the diagnosis of acute appendicitis on each set and HDCT. Histopathological findings served as a reference standard for diagnostic performance. For the quantitative analysis, CT image noise was measured for each set. Subjective image quality data were analyzed by Wilcoxon rank test, measured noise data by repeated measures ANOVA, and diagnostic performance by pair-wise comparison of ROC curves.

RESULTS

The study population consisted of 58 positives and 44 negatives. There was no significant difference in diagnostic performance between HDCT and ULDCT with any strength for both readers (AUC for reader 1, S0-S5=0.965, HDCT=0.933, p > 0.05; for reader 2, S0=0.963, S1-S5=0.964, HDCT=0.966, p > 0.05). The measured noise decreased as the strength increased from S0 to S5 (mean, 19.1>17.3>15.1>13.0>10.9>8.8, p S4>S5, p

CONCLUSION

Although measured noise declined as SAFIRE strength increased, S3 seems optimal for the best subjective image quality on ULDCT. The diagnostic performance of ULDCT with any strength is comparable to that of HDCT for the diagnosis of acute appendicitis.

CLINICAL RELEVANCE/APPLICATION

For reducing radiation dose and maintaining diagnostic performance in patients with clinically suspected acute appendicitis, ULDCT with S3 reconstruction can be recommended.

SSA06-09 • Imaging of Acute Appendicitis: Role of Low-Dose CT

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PURPOSE

The clinical diagnosis of acute appendicitis is not always accurate and twin objectives of imaging are to avoid negative appendicectomies and to diagnose alternate pathologies. There is controversy about optimal imaging techniques and accuracy of imaging modalities. This study compared the diagnostic accuracy of ultrasonography (USG), low dose CT and standard dose CT in diagnosis of acute appendicitis.

METHOD AND MATERIALS

Subjects were hundred patients of all age group and either sex with clinical suspicion of acute appendicitis. Informed consent and clearance from institutional ethical committee was taken. USG was conducted by two reviewers and Low dose CT images obtained at predefined protocols were presented to the two reviewers, who were blinded to clinical findings. Standard dose CT was done thereafter only if required (in 36 cases). Patients who refused consent, had contrast allergy, fulminant peritonitis or pregnancy were excluded from the study. A control group was 75 patients who had USG / CT done for non-GI complaints. The sensitivity, specificity, PPV, NPV of each modality and finding was calculated in comparison to operative findings.

RESULTS

The overall sensitivity , specificity, PPV, NPV and accuracy of USG was 98.6%, 96.2%, 98.6%, 96.2% and 97.4 and low dose CT was 95.9%- 97.2%, 95.7%, 98.6% and 88%-91.7%respectively. Standard dose CT had highest sensitivity and specificity of 100%.

Overall detection rate of appendix was 88% on USG, 100% on standard dose CT and 85.6% to 87.6% on low dose CT. On USG statistically significant association was found between acute appendicitis and thickened wall
of appendix (>2mm), fluid in lumen and peri-appendicular fluid and on low dose CT between acute appendicitis and hyperdense wall, periappendicial fluid and stranding. Mean radiation dose was 0.664mSv on low dose CT (eff mAs 20) and 4.286mSv on standard dose (eff mAs 120).

CONCLUSION
Overall diagnostic performance of USG and low dose CT was good and was almost similar. There were no false positives or negatives on imaging, using USG and low dose CT together and a diagnosis was possible in most cases. Alternative diagnoses were seen in 17% cases and could be detected in all cases.

CLINICAL RELEVANCE/APPLICATION
Low dose CT in association with sonography has the potential to be used as a less radiating alternative for standard dose CT for diagnosing acute appendicitis or alternative diagnosis.