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Moderators: Drs. R Kuzo and A Bierhals
A Prospective Randomised Evaluation of Radiation Dose Reduction and Image Quality Using Adaptive Statistical Iterative Reconstruction (ASIR) in Thoracic CT

LEIPSIC J, Nguyen G, Brown J, Sin D, Mayo JR

Adaptive statistical iterative reconstruction (ASIR) incorporates statistical modeling to reduce image noise, which may permit preserved image quality with reduced absolute photon number and tube current, thereby permitting lower radiation dose.

**Purpose:** To compare image quality and radiation dose between chest CT scans reconstructed using a statistical reconstruction technique, ASIR and conventional filtered back projection (FBP)

**Methods:** We randomly allocated 255 consecutive chest CT patients to ASIR reconstruction (GE Discovery HD 750 (DHD)) and FBP (GE VCT XT (VCT)). Standard auto mA dose modulation was used with both; noise index 25 (DHD) 21 (VCT) with a BMI based tube voltage protocol in place for both scanners with 120 kVp used for patients with BMI>30 kg/m2. Comparisons were performed using univariate and multivariate regression modeling for; demographics, scan parameters, radiation dose, signal to noise ratio (SNR) and subjective image quality (Likert scale) assessed by 2 independent radiologists blinded to randomization codes.

**Results:** Using univariate analysis radiation dose was significantly (p<0.05) inversely related to the use of ASIR reconstruction and directly related to body mass index and tube potential. In multivariate analysis radiation dose was significantly (p<0.0001) related to ASIR and BMI. Interobserver image quality agreement was excellent for ASIR and good for FBP (Cronbach’s alpha=0.92; p<.0001 alpha=0.85; p<.0001 respectively). There was no significant SNR difference (p=0.243) between ASIR and FBP.

**Conclusions:** ASIR provided similar image quality and signal to noise ratio with significant (p<0.001) radiation dose reduction compared to filtered back projection.

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Xenon Ventilation CT Using Dual Energy Technique in Asthmatics: Dynamic Changes After Methacholine Provocation and Bronchodilator Inhalation

LEE CH, Kim WH, Goo JM, Park SJ, Kim JH, Park EA, Lee HJ, Park CM

**Introduction:** To investigate the feasibility of xenon ventilation CT using dual energy technique in asthmatics

**Methods:** A total of 10 patients with positive methacholine provocation test underwent WI and WO phase xenon ventilation CTs and PFTs. Three stage CT scans (basal, after methacholine provocation and after bronchodilator inhalation) were performed consecutively. Areas of xenon gas were visually quantified in each segment. Xenon mean density was also automatically quantified using VIDA Pulmo2 software in the WI and WO phase. Wilcoxon signed rank test and Spearman correlation were used for statistical analysis.

**Results:** With visual assessment, areas of xenon gas significantly decreased after methacholine provocation and increased after bronchodilator inhalation in the WI phase (ventilation defect). In the WO phase (gas trapping), areas of xenon gas significantly increased after methacholine provocation and decreased after bronchodilator inhalation (P<0.05). Basal FEV1/FVC correlated with the WO phase gas trapping after bronchodilator inhalation (P<0.01). Automatically quantified total xenon mean density was also increased after methacholine provocation and decreased after bronchodilator inhalation in WO phase (gas trapping) (P<0.01). However, automatically quantified total xenon mean density was not significantly different in the wash-in phase between basal, after methacholine provocation and after bronchodilator inhalation CT scans (P>0.05). Compensatory ventilation shifts occurred adjacent to the ventilation defect in the wash-in phase after methacholine provocation test.

**Conclusion:** Xenon ventilation CT using dual energy technique may be useful to show dynamic response to drugs and functional change in asthmatics.
Evaluation of an Optical Computer Needle Guidance System for Lung CT-FNAB

PAUL N, Hoang D, Carillo M, Alturkstany S, Summerfield R, Chung T, Patsios D, Rogalla P

Purpose: Evaluation of an optical computer needle guidance system for lung CT-FNAB.

Method: CT-FNAB was performed by an experienced staff thoracic radiologist or fellow, using a 19/21G co-axial needle system. The optical guidance system (Actiview, Actisight, Israel) uses a self-adhesive patch, containing fiducial markers, on the patients’ skin and a small optical camera attached below the hub of the 19G needle to provide continuous real time feedback of needle trajectory during deployment without additional patient irradiation. A prospective, single arm, study commenced 1/09, recruiting 40 patients into the study arm (Gp A) with a control group (Gp B) of 40 patients referred for CT-FNAB matched for lesion size, location and operator.

Results: To date: 35/40 patients have enrolled (22F), age 60y (46-81). All procedures resulted in obtaining lesional material. The following analyses are based on 24 Gp A patients with complete datasets and 24 Gp B controls. The data are expressed as mean (s.d.): lesion size (mm), Gp A= 26 (18), Gp B= 27 (22), skin-lesion distance (mm), Gp A= 72 (24), Gp B= 68 (32), needle redirects*, Gp A= 1.4 (2), Gp B= 3.3 (3.7), repeat CT scans to check needle position*, Gp A= 1.9 (1.8), Gp B= 3.7 (3.6), skin puncture-biopsy time (min), Gp A= 21 (5), Gp B= 21 (11). No serious adverse effects were reported and there was no significant difference in the incidence of pneumothorax (30%). * p= 0.06.

Preliminary Conclusion: The optical guidance computer system evaluated in this trial is a promising, safe and accurate technique for needle guidance during CT-FNAB. It can be used with a conventional co-axial needle biopsy system and results in fewer biopsy needle re-directs and check CT scans during the procedure, reflecting increased operator confidence.

Incidence and Clinical Outcomes of Occult Malignancies Detected by Computed Tomographic Pulmonary Angiography in Patients with Acute Pulmonary Embolism

DENNIE C, Shen Y, Carrier M, Wells P.S.

Introduction: Venous thromboembolism (VTE) can be the earliest sign of malignancy. Approximately 10% of patients with unprovoked VTE will be diagnosed with cancer within the next 12 months. Diagnosis of pulmonary embolism (PE) using computed tomographic pulmonary angiography (CTPA) allows the visualization of anatomy in addition to thoracic vasculature. CTPA might be useful for detecting occult cancers in patients with PE.

Objective: To evaluate the incidence and clinical outcomes of occult cancers detected by CTPA in patients with acute PE.

Methods: This is a retrospective cohort study of consecutive patients with suspected PE undergoing CTPA from Jan 1, 2007 to Dec 31, 2008. Occult malignancy was defined as any new cancer first detected by CTPA with index PE diagnosis in patients with no known history of malignancy. All patients were followed for a minimum of 6 months after the index PE.

Results: A total of 4410 CTPA were reviewed and 748 (17%) were positive for acute PE. Of these, 57 (7.6%; 95% CI: 5.7 to 9.5) revealed abnormalities suggestive of possible occult cancers. Twenty-two (2.9%; 95% CI: 1.7 to 4.2) patients were diagnosed with occult cancers. Among these 22 patients with occult cancers, 20 (91%) had unprovoked PE. Thirteen (59%) patients had occult lung cancer and 16 (73%) had advanced stage (stage 3 or 4) cancers. Sixteen (73%) patients have died following the diagnosis of occult cancer, and their median survival following the diagnosis of PE was 51 days.

Conclusion: CTPA detected occult cancer in approximately 3% of patients with acute PE. Most of these cancers were detected at an advanced stage and were associated with high mortality and short survival.
CT Pulmonary Angiography in the ED: Patterns of Ordering and Results During a Two-year Period

LEVIN DL

Purpose: To review all CT pulmonary angiography (CTPA) studies performed over a two-year period from an emergency department (ED) and to evaluate study results and patterns of ordering.

Methods: All CTPA studies ordered by the ED from 1/1/06 through 12/31/07 were reviewed. Data available included ordering time and date, patient demographic data, results of CTPA and chest radiographs (if obtained), daily ED census, and total number of daily ED chest radiographs obtained.

Results: 2161 studies were obtained in 2019 patients during the two-year period. Of these, 212 (9.8%) were positive. Of the 2161 studies, 1472 (68.1%) had a chest x-ray obtained prior to the CTPA. However, the incidence of pulmonary embolism was significantly higher among patients that did not get a chest x-ray (12.2% vs. 8.7%). The daily ordering of CTPA studies was correlated with the number of ED patient visits and with a recent positive test result, but was not correlated with the daily number of chest radiographs.

Conclusion: The incidence of positive CTPA was slightly greater in this study than is typically reported. A positive CTPA was statistically more likely among patients who did not have a preceding chest x-ray. The ordering of CTPA studies was influenced by a recent positive study.

CT Angiography in Pregnant Patients: Comparison of Breast and Pelvic Irradiation Using Standard- and Reduced-dose Protocols - Phantom Experiments

LITMANOVICH D, Boiselle PM, Lin PP, Tack DM, Raptopoulos VD, Bankier AA

Purpose: A reduced-dose CTA protocol has been previously shown to provide images of comparable quality to those obtained with a standard dose technique, but its impact upon breast and pelvic irradiation has not been quantified. Thus, our purpose is to compare radiation doses delivered to the breast and pelvis between standard- and reduced-dose 64-MDCT angiography (CTA) protocols.

Methods: Experiments were performed on a 64-row multidetector CT using an anthropomorphic RAN 110 Rando phantom. Calibrated MOSFET detectors were placed 1) on the skin of the breast, 2) in mid-breast parenchyma, 3) in the upper pelvis and 4) the lower pelvis at the expected location of the uterus. Respective acquisition parameters were A) Standard: 120 kV, dose modulation index 17 with varying 100–147 mAs, CTDI vol 15.1 mGy and B) Low-dose: 100 kV, fixed 100mAs, CTDI vol 5.2 mGy. Ten measurements were acquired per protocol and compared with analysis of variance for repeated measurements.

Results: As compared to standard CTA, the low-dose protocol for delivered significantly lower radiation to the skin of the breast (4.77 mGy vs. 13.14 mGy, P=0.002), the breast parenchyma (5.21 mGy vs. 13.20 mGy, P<0.001). There was no difference in radiation dose to the upper pelvis (0.08 mGy vs. 0.09 mGy, P=0.716) and the lower pelvis (0.06 mGy vs. 0.09 mGy, P=0.504). The upper and lower pelvis fractions of the CTDI vol for both protocols were 1.5% or below.

Conclusion: Because of its potential to substantially decrease breast irradiation, a reduced-dose CTA technique is preferable to a standard-dose technique for imaging pregnant women with suspected PE.