The effect of inspiration on airway dimensions measured in CT images from the Danish Lung Cancer Screening Trial

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FWHM and EI both showed statistically significantly lower values using IR instead of standard FBP (FWHM: B30/I30=111.3 vs. 92.1; B50/50=167.6 vs. 115; B70/I70=197.8 vs. 137.5; EI: B30/I30=4.8 vs. 2.8; B50/50=11.3 vs. 5.8; B70/I70=20 vs. 6.6). There was a significant lower variation between the different kernels using IR when compared to FBP. Image noise was reduced by 27% when compared to FBP.
Conclusion: Variation of quantitative emphysema chest CT parameters between different reconstruction kernels is significantly reduced with IR when compared to FBP and may increase the robustness for therapy planning.

B-0161 14:09

Assessing pulmonary perfusion in emphysema: automated quantification of perfused blood volume in dual-energy CTPA

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Purpose: To determine whether automated quantification of lung perfused blood volume (PBV) in dual-energy computed tomography pulmonary angiography (DE-CTPA) can be used to assess the severity and regional distribution of pulmonary hypoperfusion in emphysema.
Methods and Materials: We retrospectively analysed 40 consecutive patients (mean age 67 ± 13 years) with pulmonary emphysema, no cardiopulmonary co-morbidities and a DE-CTPA negative for pulmonary embolism. Automated quantification of global and regional pulmonary PBV was performed using the syngo dual-energy application (Siemens Healthcare). We further quantified the global and regional percentage of voxels with a CT density <-900 HU. Emphysema severity was rated visually and pulmonary function tests were obtained by chart review.
Results: Global pulmonary PBV showed a moderate but highly significant negative correlation with residual volume (RV) in % of predicted RV (r=-0.62, p=0.002, n=23) and a positive correlation with forced expiratory volume in 1 second (FEV1) in % of predicted FEV1 (r=0.67, p < 0.001, n=23). Global PBV values strongly correlated with diffusing lung capacity for carbon monoxide (DLCO, r=0.80, p < 0.001, n=15). Pulmonary PBV values decreased with visual emphysema severity (r=-0.46, p=0.003, n=40). Moderate negative correlations were found between global PBV values and parenchymal hypodensity in a per-patient (r=-0.63, p < 0.001, n=40) and per-region analyses (r=-0.62, p < 0.001, n=40).
Conclusion: DE-CTPA allows simultaneous assessment of lung morphology, parenchymal density and pulmonary PBV. In patients with pulmonary emphysema, automated quantification of pulmonary PBV in DE-CTPA can be used for a quick, reader-independent estimation of global and regional pulmonary perfusion, which correlates with pulmonary function tests.

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Densitometry on MDCT in cystic fibrosis: radiological evidence for emphysema

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Purpose: The present study was conducted to employ computational densitometry based on multi-detector computed tomography (MDCT) of the chest to characterise and quantify emphysema in cystic fibrosis (CF), identical to its routine clinical application in chronic-obstructive pulmonary disease (COPD). Results were validated against pulmonary function testing (PFT, i.e. forced expiratory volume in 1 s percent predicted [FEV1%], residual volume [RV] and total lung capacity [TLC]). Patients without lung disease (NORMAL) served as controls.
Methods and Materials: MDCT from n=41 CF (median FEV1%=46, median age 20a) and n=20 NORMAL (FEV1%=102, 30a) were subjected to densitometry. Lung volume (LV) and emphysema volume (EV) were segmented (threshold -950 Hounsfield units), and the emphysema index was computed (EI). All results were correlated with paralleled PFT (median gap 0d, range 0-73d).
Results: Mean LV was 4681 ml in CF and 3967 ml in NORMAL (n.s). Significant EV was found in CF (mean 457 ml) compared to NORMAL (78 ml) (p < 0.05). Median EI was elevated to 7% in CF patients, but 1% in NORMAL. EI correlated well with FEV1% in CF (rs=-0.55) and NORMAL (rs=0.67), but with RV (rs=0.69), and RV/TLC (rs=0.47) in CF only (p < 0.05). Importantly, EI increased markedly with age in CF (rs=0.67, p < 0.001), starting at 13a.
Conclusion: Our results indicate the development of progressive emphysema in chronic CF, which should be considered for new therapeutic approaches. Densitometry may introduce new quantitative and prognostic parameters into severity assessment of CF lung disease.

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The effect of inspiration on airway dimensions measured in CT images from the Danish Lung Cancer Screening Trial

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Purpose: Airway dimensions measured from CT are increasingly being used to investigate diseases such as chronic obstructive pulmonary disease (COPD). In this study, we investigate the effect of differences in inspiration level on such measurements in voluntary inspiration breathhold scans.
Methods and Materials: We selected from the Danish Lung Cancer Screening Trial 978 subjects without COPD who were scanned annually for 5 years with low-dose multi-slice CT. Using in-house developed software, the lungs and airways were automatically segmented and corresponding airway branches were found in all scans of the same subject using image registration. Mixed effect models were used to predict the relative change in lumen diameter (LD) and wall thickness (WT) in airways of generation 0 (trachea) to 6 based on relative changes in the segmented total lung volume (TLV).
Results: On average, 1.0, 2.0, 3.9, 7.6, 15.0, 25.0 and 27.3 airways per subject were included from generations 0, 1, 2, 3, 4, 5 and 6, respectively. Relative changes in LD were positively related to changes in TLV and coefficients increased with generation: 0.20 (+-0.02), 0.19 (+-0.02), 0.21 (+-0.01), 0.25 (+-0.01), 0.29 (+-0.01), 0.34 (+-0.01), 0.37 (+-0.01). Relative changes in WT were inversely related to changes in TLV and generation: -0.01 (+-0.02), 0.01 (+-0.01), -0.02 (+-0.01), -0.03 (+- 0.01), -0.05 (+-0.01), -0.09 (+- 0.00), -0.08 (+-0.00).
Conclusion: Subjects who inspire deeper prior to scanning tend to have larger LD and smaller WT. This effect is more pronounced in higher generation airways. Thus, adjustment for inspiration level is needed to accurately assess airway dimensions.

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Chronic bronchitis in large airway: airway wall measurements on thin-slice low-dose CT

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Purpose: Chronic bronchitis (CB) is usually caused by smoking and characterised by chronic inflammation and remodelling of the airway wall, commonly in large airways. The study purpose is to determine differences in airway wall thickness (AWT) and wall area percentage (WA%) between subjects with and without CB symptoms.
Methods and Materials: 50 heavy smokers with CB symptoms (cough, mucus, dyspnoea and wheezing) and 50 heavy smokers without CB symptoms were randomly selected from 1,413 participants in a lung cancer screening trial. Airway walls were measured on images in thin-slice low-dose CT with a dedicated software tool, for airways with a luminal diameter ³5 mm in 5 selected bronchi (RB1, RB4, RB10, LB1+2 and LB10). Differences in measurements between the groups were assessed by t-test. The association between CB symptoms and AWT and WA% was analysed using multiple linear regression adjusted for age, body mass index, smoking habit, amount of emphysema, and lung function.
Results: Mean AWT measured at 5 bronchi was 1.55±0.44 mm and 1.42±0.40 mm in subjects with and without CB symptoms, respectively (P < 0.001). WA% was 47±12% and 43±11%, respectively (P < 0.001). With adjustment for confounders, a significant positive association between both airway wall measurements (AWT and WA%) and CB symptoms was found for airways with a luminal diameter from 5 to 10 mm (P < 0.01). In airways with a luminal diameter ³10 mm, no significant association was found (P> 0.05).
Conclusion: Patients with chronic bronchitis symptoms have thicker airway walls of airways between 5 and 10 mm diameter, not in larger diameter.

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Value of inspiratory and expiratory lung volume und lung density for detection of bronchiolitis obliterans syndrome (BOS): a feasibility study

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Purpose: To evaluate whether quantitative assessment of lung density and volume in computed tomography (CT) show differences in patients with and without BOS after lung transplantation.
Methods and Materials: 210 CT examinations were carried out in lung transplant patients in full inspiration/expiration using a 64 row MDCT (120 kVp, rotation time 0.8 s, pitch 0.984, collimation 1.25 mm, reconstruction increment 1 mm, standard reconstruction kernel). 26/184 examinations were performed in patients with/with-