The effect of inspiration on airway dimensions measured in CT images from the Danish Lung Cancer Screening Trial
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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 second percent of predicted, FEV1%).

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 parallelld 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 (r=0.55) and NORMAL (r=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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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%) by 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 ≥5 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 4.2±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 5 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.

Conclusion: Patients with chronic bronchitis symptoms have thicker airway walls of airways between 5 and 10 mm diameter, not in larger diameter.