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

Petersen, Jens; Wille, Mathilde; Thomsen, Laura; Feragen, Aasa; Dirksen, Asger; de Bruijne, Marleen

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FHW and EI both showed statistically significantly lower values using IR instead of standard FBP (FWHM: B30/30=111.3 vs. 92.1; B50/50=167.6 vs. 115; B70/ 
I70=197.8 vs. 137.5; EI: B30/30=4.8 vs. 2.8; B50/50=11.3 vs. 5.8; B70/70=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 
F.G. Meinel, A. Graef, S. Diener, F. Barmbarg, C. Neurohr, M.F. Reiser, 
T.R.C. Johnson; Munich/DE (felix.meinel@med.uni-muenchen.de)

Purpose: To determine whether automated quantification of lung perfused blood 
volume (FBV) in dual-energy computed tomography pulmonary angiography (DE- 
CTPA) can be used to assess the severity and regional distribution of pulmonary 
hyperperfusion in emphysema.

Methods and Materials: We retrospectively analysed 40 consecutive patients 
(mean age 67 ± 13 years) with pulmonary emphysema, no cardiopulmonary comorbidities 
and a DE-CTPA negative for pulmonary embolism. Automated quanti- 
fication of global and regional pulmonary FBV was performed using the symo 
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 FBV showed a moderate but highly significant nega- 
tive 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 FBV values strongly 
related with diffusing lung capacity for carbon monoxide (DLCO, r=0.80, p<0.001, 
n=15). Pulmonary FBV values decreased with visual emphysema severity (r=-0.46, 
p=0.003, n=40). Moderate negative correlations were found between global FBV 
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.

Author Disclosures: 
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B-0162 14:18 Densitometry on MDCT in cystic fibrosis: radiological evidence for 
emphysema 
M.O. Wielopoulo1, O. Weinheimer2, M. Eichinger1, M. Wiebel1, J. Biederer1, 
H-U. Kauczor, C-P. Heussel, M.A. Mall3, M. Puderbach; Heidelberg/DE, 
Mainz/DE (mark.wielopu@web.de)

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 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 parallelled 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. Densi- 
tometry may introduce new quantitative and prognostic parameters into severity 
assessment of CF lung disease.

B-0163 14:27 The effect of inspiration on airway dimensions measured in CT 
images from the Danish Lung Cancer Screening Trial 
J. Petersen1; M.W. Willer1, L.H. Thomersen1, A. Feragen1, A. Dirksen1, 
M. de Brujhine1; Copenhagen/DK, Hellerup/DK, Rotterdam/NL (phup@dku.dk)

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 
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.

Author Disclosures: 
M. de Brujhine: Grant Recipient; AstraZeneca.

B-0164 14:36 Chronic bronchitis in large airway: airway wall measurements on 
thin-slice low-dose CT 
Groningen/NL ((xueqian@rad.umcg.nl)

Purpose: Chronic bronchitis (CB) is caused by smoking and characterised 
by chronic inflammation and remodelling of the airway wall, commonly in large 
airways. The study purpose is to determine whether automated quantification of 
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, 
dyspnea 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 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 >10 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.

B-0165 14:45 Value of inspiratory and expiratory lung volume und lung density for 
detection of bronchiolitis obliterans syndrome (BOS): a feasibility study 
S. Dettmer1; O. Otten1, C. de Wall1, J.-M. Kuhnigk2, F. Wacker1, H.-O. Shin1; 
Hannover/DE, Bremen/DE (sabine-dettmer@t-online.de)

Purpose: To evaluate whether quantitative assessment of lung density and volume 
computed in 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/without...