Emphysema quantification and lung volumetry in chest X-ray equivalent ultralow dose CT - Intra-individual comparison with standard dose CT

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OBJECTIVES
To determine whether ultralow dose chest CT with tin filtration can be used for emphysema quantification and lung volumetry and to assess differences in emphysema measurements and lung volume between standard dose and ultralow dose CT scans using advanced modeled iterative reconstruction (ADMIRE).

METHODS
84 consecutive patients from a prospective, IRB-approved single-center study were included and underwent clinically indicated standard dose chest CT (1.7 ±0.6mSv) and additional single-energy ultralow dose CT (0.14±0.01mSv) at 100kV and fixed tube current at 70mAs with tin filtration in the same session. Forty of the 84 patients (48%) had no emphysema, 44 (52%) had emphysema. One radiologist performed fully automated software-based pulmonary emphysema quantification and lung volumetry of standard and ultralow dose CT with different levels of ADMIRE. Friedman test and Wilcoxon rank sum test were used for multiple comparison of emphysema and lung volume. Lung volumes were compared using the concordance correlation coefficient.

RESULTS
The median low-attenuation areas (LAA) using filtered back projection (FBP) in standard dose was 4.4% and decreased to 2.6%, 2.1% and 1.8% using ADMIRE 3, 4, and 5, respectively. The median values of LAA in ultralow dose CT were 5.7%, 4.1% and 2.4% for ADMIRE 3, 4, and 5, respectively. There was no statistically significant difference between LAA in standard dose CT using FBP and ultralow dose using ADMIRE 4 (p=0.358) as well as in standard dose CT using ADMIRE 3 and ultralow dose using ADMIRE 5 (p=0.966). In comparison with standard dose FBP the concordance correlation coefficients of lung volumetry were 1.000, 0.999, and 0.999 for ADMIRE 3, 4, and 5 in standard dose, and 0.972 for ADMIRE 3, 4 and 5 in ultralow dose CT.

CONCLUSIONS
Ultralow dose CT at chest X-ray equivalent dose levels allows for lung volumetry as well as detection and quantification of emphysema. However, longitudinal emphysema analyses should be performed with the same scan protocol and reconstruction algorithms for reproducibility.

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