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LUNG MASS QUANTIFICATION ON THORAX COMPUTED TOMOGRAPHY IN PATIENTS WITH LUNG EMPHYSEMA

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Background, Motivation and Objective. Total lung volume estimation for the detection and quantification of emphysematous regions with densities thresholds are often used for emphysema progression assessment. However, considering that volume increase in emphysema results from extracellular matrix and alveolar septum destruction, the quantification of lung mass reduction could be a better marker of emphysema location and its extent. We aim to propose a method to assess lung mass deterioration based on quantitative computed tomography (CT) and to verify the association between lung mass reduction, emphysema extent, and pulmonary function impairment.

Methods. Sixteen subjects with alpha-1 antitrypsin deficiency (AATD) and 21 smokers with no AATD (Non-AATD) were studied. Twenty-seven non-smokers served as controls. All subjects performed pulmonary function tests (PFTs). Inspired CT images were obtained, and lung parenchyma was segmented. Cumulative lung mass (M_K) and volume (V_K) were sequentially computed from the lowest (-1000 Hounsfield Units, HU) to the highest (+50 HU) voxels density in the lung parenchyma. Thereafter, the mass content in a given fraction of the total lung volume was calculated and compared among subjects and with PFTs variables.

Results. AATD and Non-AATD patients presented significantly lower M_{15} either taking for the whole lung volume as well as at the basal, middle and apical lung thirds when compared to controls subjects ($P < 0.001$). M_{15} was also significantly lower in the AATD compared to Non-AATD for whole lung, basal and middle thirds ($P <= 0.0014$), thus strengthening in accordance to the predominance of panlobular emphysema in AATD and centrilobular in Non-AATD patients. M_{15} reduction was also associated with abnormalities in PFTs ($R >= 0.70$).

Discussion and Conclusions. CT-based lung tissue estimation with M_{15} might be applied to phenotype emphysema independent of its etiology identifying its regional distribution and possibly indicating the extent of pulmonary function impairment.

Table 1 - Characteristics of the subjects

	Control (N=27)	Non-AATD(N=21)	AATD (N=16)
Age (y)	34 (23)	60 (11)*	53 (10.2)*
Male:Female	11:16	7:14	7:9
Weight (kg)	73 (22.5)	68 (23.5)	67.2 (22.5)
BMI (kg/m^2)	26.9 (9.3)	25.8 (5.0)	25.5 (6.2)

Packs-years of smoking	-	57.5 (26.5)	25 (30.2)#
GOLD stage	-	1(0);2(12);3(6);4(3)	1(1);2(4);3(7);4(4)
Alpha-1 antitrypsin concentration (mg/dL)	-	3.1 (1.1)	1.35 (0.6)#
Total lung volume (L)	4.5 (1.6)	5.1 (1.8)	6.0 (1.8)*
DL_{CO} (mL/min/mmHg)	23.1 (8.5)	17.5 (8.6)*	12.9 (7.1)*

*Significant difference against controls with p<0.001. #Significant difference against Non-AATD with p<0.01.

Figure 1 - Quantitative assessment of M_{15}. Panels A to D presented the differences in M_{15} among groups from the whole lung (Panel A), basal, middle and apical thirds (Panels B to D, respectively).

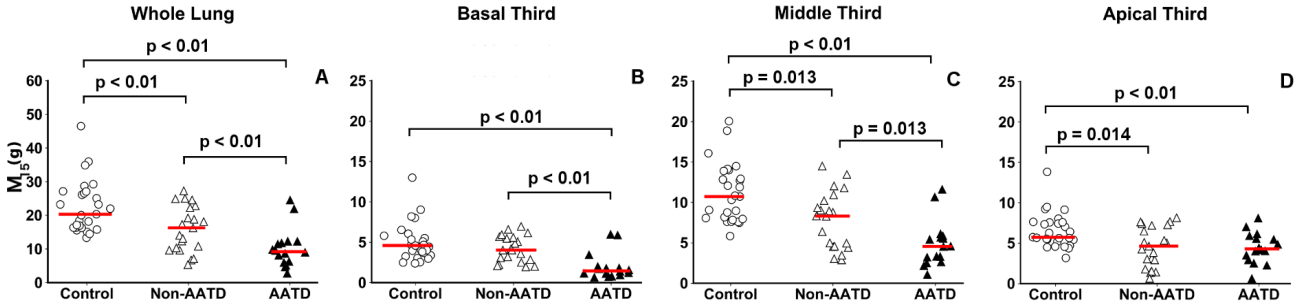
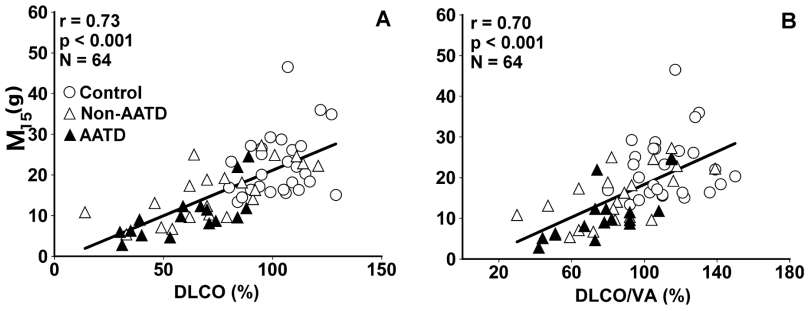


Figure 2 - Correlation between M_{15} and pulmonary function tests variables.



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Keywords. Quantitative CT-scan; lung parenchyma mass; emphysema; pulmonary function tests; alpha-1 antitrypsin deficiency