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Lung densitometry: Why, how and when?

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Introduction: Lung densitometry aims to measure by computed tomography (CT) in vivo the X-ray attenuation by the pulmonary tissue which reflects both degree of inflation and structural abnormalities implying decreased or increased attenuation, as typically in emphysema, cystic lung diseases and pulmonary fibroses.

Why? Two main reasons justify adoption of lung densitometry as a supplement to visual assessment of CT in diffuse lung diseases. They are: 1) better accuracy in reflecting pathologically measured pulmonary emphysema and 2) improved reproducibility.

How? Lung densitometry requires attention to several critical technical and methodological issues. They include, before acquisition, CT scanner calibration with water and air phantom and selection of the slice collimation, number of slices (few at predefined levels or whole lung) and dose, and reconstruction filter. Notably the reconstruction filter recommended for lung densitometry is "regular" and not the sharp adopted for visual lung assessment on CT. One crucial step is consideration of the lung volume reached by the subject at the time of scanning which can significantly influence lung density values. This can be controlled with spirometric gating or with subsequent computation of the lung volume with automatic or semiautomatic segmentation in inspiratory or expiratory scans. The latter is rapidly performed by commercially dedicated software and represents the last step before measurement of lung density parameters. Several measurements can be taken on the lung density histogram and have been variably validated for quantitative assessment of lung changes in diffuse lung diseases. They include mean and standard deviation of density, relative area (RA) at -970, -960 or -950 HU for emphysema in inspiratory scans and at -910 HU for emphysema in expiratory scans, 1rst percentile for emphysema in inspiratory scans, 40th and 80th percentiles, kurtosis and skewness for pulmonary fibroses in inspiratory scans.

When? Established indications for lung densitometry include phenotype differentiation of emphysema and chronic bronchitis in patients with COPD, longitudinal evaluation of pulmonary emphysema, to serve as surrogate marker of replacement therapy in alpha1 antitrypsin emphysema, evaluation of patients' candidate to lung volume reduction surgery for emphysema and lung tumor surgery. Additional potential indications include prognostic evaluation in patients with lymphangio leiomyomatosis and idiopathic or secondary pulmonary fibroses.

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Data-driven radiology workflow: from science to reality

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Radiology workflow presents a complex mixture of planned events and unforeseen deviations. The old radiology management approach was to set certain expectations and hope that they would be met. Instead, we propose to use big data (readily found in radiology databases) and advanced data analysis tools to monitor all workflow events in real time, taking immediate action when necessary. Exploring large volumes of healthcare data, largely unused until now, provides us with unique opportunities to derive new logic, to optimize healthcare services, and to develop new intelligent applications. In this presentation, we will talk about our work and the problems we solve.

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