RC 01 CH-02 Computer assisted detection and quantification of thoracic disease

08:30-09:00 Grand Ballroom 102

Chairperson(s): Joon Beom Seo *Asan Medical Center, Korea*
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Quantitative CT imaging in COPD and ILD

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With the development of volumetric computed tomography (CT), numerous studies have assessed the objective quantification of the extent and severity of pulmonary emphysema and lung fibrosis and measurements of airway dimensions *in vivo*. It is now technically possible to quantify emphysema, air trapping, and large airway dimensions on CT scans of COPD patients with good correlation with histology, clinical and physiologic measures. Small airways cannot be visualized directly using current CT scanners, however the presence of air trapping on expiratory CT scans can be used an indirect sign to evaluate small airway dysfunction. To quantify the emphysema severity with CT, voxels below a fixed thresholds, the “density mask” was used and generally quantified as the “low attenuation area” (LAA) in the lung with Hounsfield Unit (HU) less than a fixed density threshold (e.g., −950 HU; LAA_{-950}). Another method is using the nth cutoff-percentile in the attenuation distribution curve, which provides the density value in HU under which n% of the voxels is distributed. With many quantification methods, all of these methods can be influenced not only by the applied density threshold or percentile, but also by image reconstruction algorithm, section thickness, inspiratory level, interscan variability, gravity, and radiation dose. With the development of automated 3D-programs, the thickened wall of larger airways in COPD is directly visible on CT. Bronchial wall thickening in COPD is an independent determinant of airflow limitation in patients, it has been suggested that thickening of the wall of larger airways reflects small airway abnormalities. To quantify the large airway, the most widely used method is the “full-width-at-half-maximum” (FWHM) principle. Although airway wall parameters, such as wall thickness, lumen area, wall area percentage, and airway perimeters are standardized and straightforward, this method systemically overestimates airway wall area, especially in small airways. However, there are many reports showing moderate correlations ($-0.56 < r < 0.62$) between airway wall measurements and airflow obstruction (FEV1 and % predicted FEV1). Recently, bronchial wall attenuation was also introduced as another index for airway abnormality in COPD. In large airway quantification, partial volume averaging and applied reconstruction kernel may significantly influence the quantitative measurement of the FWHM. CT quantification of air trapping has not been widely used in COPD. Recent trial method for the measurement of air trapping is the calculation of the percentage of lung voxels below −856 HU in expiration. However, the drawback of this single threshold method is that it does not compensate for the influence of emphysematous area and the optimal quantitative measure has yet to be identified. For the quantification of lung fibrosis, CT densitometry/CT histogram including mean attenuation, skewness, kurtosis can be used with minimal user intervention. Another methods of “CT-derived fractional tissue volume quantification analysis” (with increasing fibrosis severity, lung air volume decreased while the corresponding tissue volume increased), “adaptive multiple feature method (AMFM; identifying different lung tissue types using multiple computed texture features from CT data)” and “fast fourier transformation method” can be used.

In summary, still a lot of challenges in quantitative CT, CT quantification techniques have been improved and CT can now measure the different disease components of emphysema, large- and small airway diseases in COPD and lung fibrosis. With the

increased use of CT in both daily practice and lung cancer screening CT, quantitative CT might become a useful tool for the detection of new COPD and IPF subjects.

References

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