

LTRC Concept Sheet # 07-05-0003

Correlation of Pulmonary CT Quantitative Parenchymal Measures with Radiologist Visual Assessment, Physiologic and Clinical Data

ABSTRACT

The Mayo Clinic Rochester serves as the Radiology Core Laboratory (RCL) for the LTRC, where radiological data from the patients enrolled in the LTRC project are interpreted, stored and processed. Part of the analysis of the RCL includes characterization of the lung tissue on volumetric high-resolution computed tomography (HRCT) scans through histogram and texture-based measures of the CT image data. The novel work we have done to characterize fibrotic interstitial lung diseases including idiopathic interstitial pneumonias (IIP's) such as usual interstitial pneumonitis (UIP) requires correlation with other clinical data available in the LTRC database to prove its potential clinical utility.

Specifically, our laboratory has utilized novel algorithms to analyze volumetric high-resolution CT data including dynamically binned histogram fingerprinting in addition to traditional first-order statistics of analyzed voxels (mean, standard deviation, skewness, kurtosis) co-occurrence matrices (energy, entropy, invariance difference moment, correlation, shade, prominence) and run-length matrices (Short, Long, high-grey level, low-grey level, run nonuniformity and run percentage). Preliminary data from our laboratory suggests that combinations of these quantitative/mathematical measures of volumetric high-resolution chest CT data correspond to specific visual features of disease described by radiologists, including honeycombing, ground glass infiltrates, reticular opacities and emphysema. One of the goals of the RCL is to show that the amount of abnormal lung detected through quantitative analysis correlates with the extent of visually apparent disease described by a radiologist. Also, since the extent of these visual features generally correlates with that of the overall extent of disease demonstrated through pulmonary function testing and quality of life questionnaires, we predict that the quantitative measures will likewise show a relationship with changes in physiologic and other clinical data.

Even 'gold standard' pulmonary function data is highly influenced by patient effort. Radiographically subtle changes in extent of pulmonary involvement on HRCT are difficult to assess visually in an accurate and reproducible manner. Repetitive lung tissue sampling to assess for active pathological changes is too invasive and potentially harmful. Therefore, it is hoped that if quantitative assessment by analysis of volumetric CT proves to be an accurate means of assessing the extent of pulmonary involvement in fibrotic interstitial lung disease, then this might provide an automated non-invasive measure that can be used as a tool for objective assessment of disease extent, progression or response to therapy. This type of analysis could potentially have large clinical utility for prognosis assessment or be useful for detecting subtle HRCT changes in response to therapy in clinical trials.