Imaging in COPD: Tools for Detection, Classification, and Prognosis

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Irreversible destruction of emphysematous parenchyma and small airway disease can occur even before chronic obstructive pulmonary disease (COPD) is detectable through spirometry. This underscores the importance of identifying individuals who exhibit pathophysiological abnormalities and clinical outcomes akin to those with spirometry-confirmed COPD and who are at high risk of developing the disease. This lecture will explore the current understanding and potential of chest computed tomography (CT) imaging in identifying high-risk individuals and facilitating personalized COPD management.

The development of COPD primarily follows two pathways: rapid decline in lung function after adulthood, and insufficient lung function attainment at a younger age. These pathways appear to be associated with centrilobular emphysema (CLE) and smaller airways relative to lung size (dysanapsis), respectively. In our studies of lung cancer screening CT smokers, identifying CLE, along with quantifying emphysema severity and central wall thickening, can aid in detecting airflow limitations (Respir Med. 2025:244:108169), and a combination of CLE and dysanapsis may cause lower lung function in younger smokers (ERJ Open Res 2024;10:00695-2023).

A recent study (JAMA. 2025;333:2164-2175) proposed that, in addition to individuals with airflow limitation, those without airflow limitation are also diagnosed with COPD when CT findings show emphysema and/or central airway wall thickening with worsening patient-reported outcomes. In our CT study, CLE showed stronger links to poor prognosis than paraseptal emphysema (Chest. 2023: 16:327-338). Nonrigid registration of inspiratory and expiratory CT estimates local ventilation, and a smaller ventilation distribution discordance between emphysema and non-emphysema regions is associated with rapid lung function decline and poor prognosis in emphysematous COPD (Thorax. 2023;78:344-353). We also showed that mucus plugs in the central airways are associated with lower lung function and loss of health-related independence in patients with COPD (Respirology. 2024; 29:951-961).

These findings emphasize the clinical importance of CT in the management of COPD.