Several methods for computed tomography (CT)-based severity staging of chronic obstructive pulmonary disease (COPD) utilize both inspiratory and expiratory acquisitions, which is not the clinical standard and increases patients’ exposure to radiation. We assess the feasibility of using a convolutional neural network (CNN) to stage COPD using only inspiratory CT, relative to inspiratory-expiratory CT. We obtained 8,893 inspiratory and expiratory lung CT series and spirometry measurements from the COPDGene Phase I cohort. CNNs were trained to predict spirometry measurements (forced expiratory volume in one second [FEV1], FEV1 to forced vital capacity ratio [FEV1/FVC], percent predicted FEV1 [FEV1pp]) using clinical data and either single-phase or multi-phase CT as input. Spirometry predictions were then used to predict Global Initiative for Obstructive Lung Disease (GOLD) stage. ICCs for FEV1, FEV1 percent predicted, and FEV1/FVC were 0.76-0.77, 0.78-0.80, 0.70 for single-phase CNNs and 0.80-0.85, 0.83-0.85, 0.76-0.78 for multi-phase CNNs. ICCs and accuracies for single stage, within one stage, and diagnosis were 0.72, 65.2%-65.7%, 84.3%-85.8%, 79.7%-80.7% for single-phase CNNs and 0.77-0.78, 67.6%-67.9%, 87.7%-88.0%, and 81.8%-82.2% for multi-phase CNNs. These results suggest CNN-based COPD diagnosis and severity staging is feasible using single routine non-contrast inspiratory CT and has comparable diagnostic and staging accuracy with multi-phase CT.

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