

Comparison of the thoracic CT-based computational model with hyperpolarized Xenon-129 MRI and SPECT images to assess pulmonary ventilation in COPD patients

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Introduction: Thoracic computed tomography (CT) is a clinically established diagnostic technique to detect structural pulmonary abnormalities but provides no functional pulmonary information.

Objectives: The current study aims to demonstrate the use of the CT-based full-scale airway network (FAN) flow model to assess ventilation in COPD patients and to compare the modelling results obtained with hyperpolarized Xenon-129 (HPX) magnetic resonance imaging (MRI) and single-photon emission computed tomography (SPECT) imaging data.

Methods: Pulmonary ventilation in nine COPD patients was modelled using the CT-based FAN flow model. Pulmonary tissue density information extracted from the CT and Pulmonary Function Test (PFT) results were used for the patient-specific modelling. The ventilation calculated in the FAN model was compared to the PFT data, and the ventilation HPX-MRI and ventilation SPECT (V-SPECT) imaging.

Results: Pulmonary ventilation calculated from the FAN model was visually similar to ventilation demonstrated on the ventilation HPX-MRI and SPECT images (Fig 1), and statistically significant, Pearson correlation of the ventilation profiles between the FAN model and HPX-MRI and SPECT images, $r_{\text{Mod-HPX}}=0.67$; $r_{\text{Mod-SPE}}=0.61$, $P<0.001$.

Conclusions: The CT-based FAN model utilizes structural imaging data to provide ventilation images comparable to functional imaging techniques.

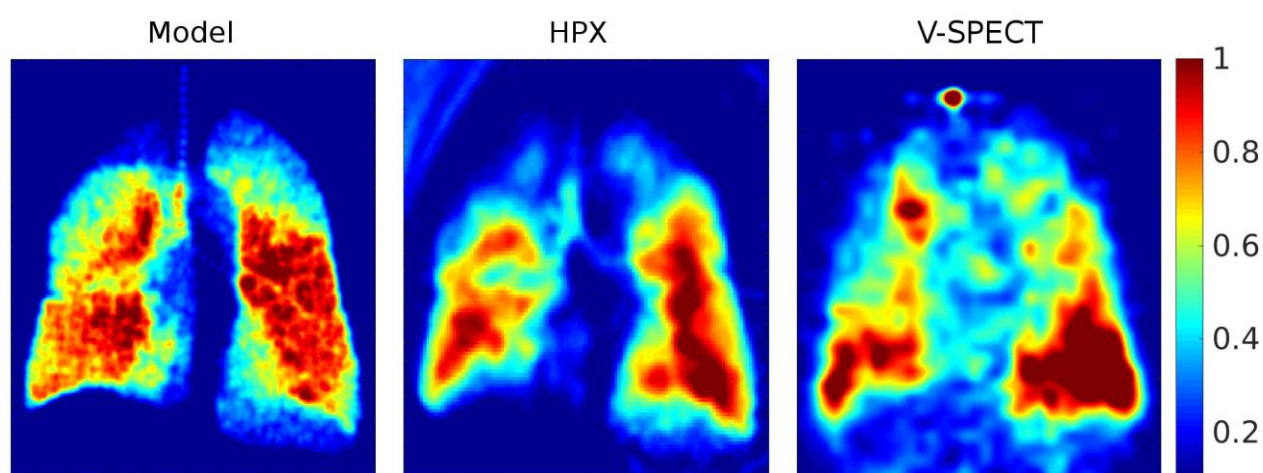


Figure 1. Comparison of the ventilation distribution projected on a coronal plane in a COPD patient's lung.