Performance of CT:V Quantitative Ventilation Imaging Against PET Ventilation Imaging

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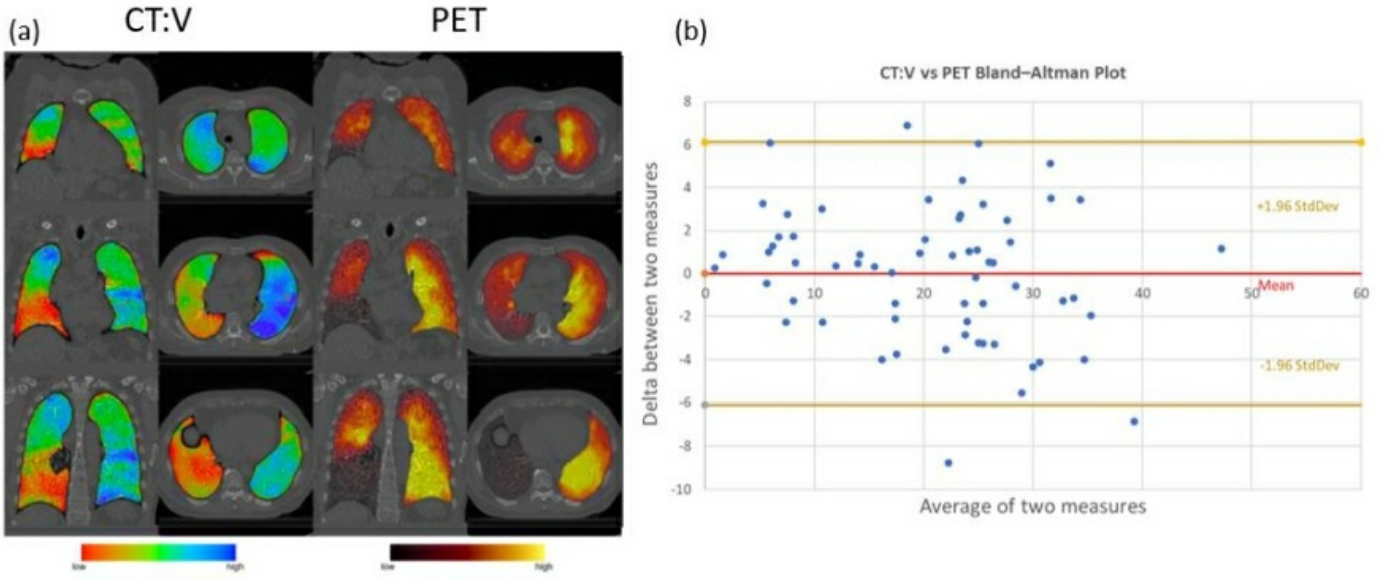
RATIONALE: Ventilation imaging is most commonly acquired via radionuclide scintigraphy using nuclear medicine modalities, including single positron emission computed tomography (SPECT) and positron emission tomography (PET). Because these techniques have inherent logistical complexity, as well as spatial resolution limitations, deriving information about regional pulmonary function from respiratory-correlated computed tomography (CT), such as inspiratory and expiratory CTs acquired without exogenous contrast, holds considerable clinical value. We aimed to determine the agreement between CT:V (CT Lung Ventilation Analysis Software, 4DMedical, Australia) and 68-Ga (Galligas) PET. METHODS: Thirteen lung cancer patients were enrolled in the study approved by the University of Sydney Human Ethics Committee after completing an informed consent. Inspiratory and expiratory CTs and PET ventilation were acquired for each patient. CT:V is a software-based image processing technology that quantifies ventilation in pulmonary tissue by analysing the respiratory motion apparent within a paired CT (inspiratory/expiratory) acquired without contrast. CT:V generates a volumetric image of a patient's ventilation which allows for a direct quantitative comparison with PET. Both PET and CT:V datasets were further analysed to determine the proportion of total ventilation in each lobe. Bland-Altman analysis was then used to quantitatively assess the agreement. RESULTS: CT:V and PET principally measure different physiological quantities: CT:V calculates ventilation for each lung voxel from a recovered motion field describing respiratory motion, while PET measures the percentage of photon counts within a region of interest, reflecting the proportion of inhaled tracer in that same region. Paired t-test demonstrated that there were no statistically significant lobe to lobe differences in ventilation between CT:V and PET (p=.50). There was a strong positive correlation in ventilation distribution between two modalities (r(61)=.93, p<.001) with lower and upper confidence intervals between .90 and .96. CONCLUSION: CT:V demonstrated good agreement with PET in the assessment of ventilation distribution at a lobar level. When also considering the relative convenience of CT imaging acquired without exogenous contrast compared to nuclear medicine modalities, CT:V represents a powerful functional lung imaging tool that can serve as a reliable and more readily available alternative to nuclear imaging for a range of applications, including surgical or targeted treatment planning, disease characterization, and general lung health assessment.

Figure 1: (a) A representative comparison of CT:V vs PET ventilation outputs. (b) Bland-Altman plot of CT:V vs PET demonstrates good agreement between two modalities in the assessment of lung ventilation at a lobar level. PET renders were normalized between the 0 and 90th percentiles.



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