
Proceedings Paper:
Tahir, B. orcid.org/0000-0003-0531-3519, Marshall, H., Hughes, P. et al. (9 more authors) (2016) WE-AB-202-07: Ventilation CT: Voxel-level comparison with hyperpolarized helium-3 & xenon-129 MRI. In: Medical Physics. Fifty-eighth annual meeting of the American Association of Physicists in Medicine, 31 Jul - 04 Aug 2016, Washington, DC. Wiley , pp. 3795-3796.

https://doi.org/10.1118/1.4957748

Ventilation CT: Voxel-level comparison with hyperpolarized Helium-3 & Xenon-129 MRI

Tahir BA[1,2], Marshall H[2], Hughes PJ[2], Stewart NJ[2], Horn FC[2], Collier GJ[2], Norquay G[2], Hart KA[1], Swinscoe JA[1], Hatton MQ[1], Wild JM[2] and Ireland RH[1,2]

[1]Academic Unit of Clinical Oncology and [2]Academic Radiology, University of Sheffield, UK

Purpose: To compare the spatial correlation of ventilation surrogates computed from inspiratory and expiratory breath-hold CT with hyperpolarized Helium-3 & Xenon-129 MRI in a cohort of lung cancer patients.

Methods: 5 patients underwent expiration & inspiration breath-hold CT. Xenon-129 & ^{1}H MRI were also acquired at the same inflation state as inspiratory CT. This was followed immediately by acquisition of Helium-3 & ^{1}H MRI in the same breath and at the same inflation state as inspiratory CT. Expiration CT was deformably registered to inspiration CT for calculation of ventilation CT from voxel-wise differences in Hounsfield units. Inspiration CT and the Xenon-129's corresponding anatomical ^{1}H MRI were registered to Helium-3 MRI via the same-breath anatomical ^{1}H MRI. This enabled direct comparison of CT ventilation with Helium-3 MRI & Xenon-129 MRI for the median values in corresponding regions of interest, ranging from finer to coarser in-plane dimensions of 10 by 10, 20 by 20, 30 by 30 and 40 by 40, located within the lungs as defined by the same-breath ^{1}H MRI lung mask. Spearman coefficients were used to assess voxel-level correlation.

Results: The median Spearman's coefficients of ventilation CT with Helium-3 & Xenon-129 MRI for ROIs of 10 by 10, 20 by 20, 30 by 30 and 40 by 40 were 0.52, 0.56, 0.60 and 0.68 and 0.40, 0.42, 0.52 and 0.70, respectively.

Conclusion: This work demonstrates a method of acquiring CT & hyperpolarized gas MRI (Helium-3 & Xenon-129 MRI) in similar breath-holds to enable direct spatial comparison of ventilation maps. Initial results show moderate correlation between ventilation CT & hyperpolarized gas MRI, improving for coarser regions which could be attributable to the inherent noise in CT intensity, non-ventilatory effects and registration errors at the voxel-level. Thus, it may be more beneficial to quantify ventilation at a more regional level.