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Title: Comparison of lung ventilation volume measurements made with single and separate breath-hold hyperpolarized 3-helium and proton MRI

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Body: Overview Hyperpolarized (HP) gas MRI can be combined with spatially registered proton (¹H) images of the lung to calculate percentage lung ventilation (PV). However, any lung inflation difference between separate ¹H and ³He breath-holds results in errors. Aim To increase PV accuracy using a novel single breath-hold ³He and ¹H acquisition. Methods 10 asthma patients were scanned with ³He MRI. The protocol was repeated at baseline to assess short-term reproducibility. Patients inhaled 1L (35% ³He/65% N₂) from FRC. Immediately following this (in the same breath-hold) ¹H MRI was acquired. A separate breath-hold set of ¹H images were also acquired at FRC+1L. Ventilated volume (vV), lung volume (LV) and PV(vV/LV) were calculated. PV_{Single} used ³He and ¹H images from the same breath hold. PV_{Separate} used ¹H images from the separate breath hold. Results Figure 1 shows how lung inflation variation between separate breath-hold ³He (a) and ¹H (b) MRI affects PV (c). Acquisition of ³He and ¹H MRI during single breath-hold (a,d) gave a more accurate PV measurement (e).

Mean baseline difference was $2.19 \pm 10.1\%$ for PV_{Single} and $9.79 \pm 22.5\%$ for PV_{Separate}, a significant difference ($p < 0.04$). Conclusion Percentage lung ventilation measurements using single breath-hold ³He and ¹H acquisition were more reproducible than measurements using separate breathhold ³He and ¹H images. Funding AIRPROM FP7 and Novartis.