Repeatability of Hyperpolarized Xenon MRI in Stable Pulmonary Artery Hypertension

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Introduction. Pulmonary artery hypertension (PAH) is a disease of pulmonary vasculature, leading to right heart failure and death. Right heart catheterization is the gold standard for diagnosis, but other methods of evaluating disease status are limited. Xenon MRI (XeMRI) is an imaging method enabling measurement of lung function, including gas uptake by red cells (RBC) and pulmonary tissue/blood plasma (membrane). Additionally, oscillations in RBC signal from XeMRI provide a measure of microvascular health. Patients with PAH exhibit reduced oscillation amplitude versus healthy individuals. This imaging method may provide a non-invasive measure of microvascular dysfunction; however, short- and long-term repeatability has not been assessed. This study examines same-day and six-week repeatability of XeMRI in patients with stable PAH.

Methods. Seven participants with PAH were imaged at baseline and six-week timepoints. At baseline, imaging was repeated twice over 10 minutes. Standard gas exchange metrics were calculated, including RBC/Membrane, Membrane/Gas, and RBC/Gas ratios. RBC oscillation amplitude was calculated.

Results. Six participants completed same-day imaging. Seven completed six-week repeatability imaging. Same-day imaging showed strong correlation between RBC/Membrane ($R = 0.996$, $P = <0.001$), Membrane/Gas ($R = 0.92$, $P = 0.009$), and RBC/Gas ($R = 0.94$, $P = 0.005$) ratios, but poor repeatability for RBC oscillation ($R = 0.38$, $P = 0.45$). Six-week imaging showed strong correlation between RBC/Membrane ($R = 0.93$, $P = 0.003$), Membrane/Gas ($R = 0.95$, $P = 0.001$), and RBC/Gas ($R = 0.89$, $P = 0.007$) ratios, but poor repeatability for RBC oscillation ($R = 0.24$, $P = 0.6$).

Conclusions. Gas exchange metrics are highly repeatable in patients with PAH in both same-day and six-week XeMRI imaging, but RBC oscillation demonstrated poor repeatability at both timepoints, highlighting the need for further research.