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Title: Measuring red blood cell oxygenation in vivo using hyperpolarized 129Xe MRI

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Body: Introduction Red blood cell (RBC) oxygenation plays an important role in cell survival. However, measuring this parameter in deep tissues is difficult. We report a method of detecting RBC oxygenation in vivo using MRI chemical shift (CS) of hyperpolarized (HP) 129Xe dissolved in RBCs explored previously in vitro (Mag Res Med 43;4(491) 2000). Methods 400mL of HP 129Xe mixed with 600mL N_2 was delivered to 3 healthy volunteers who inhaled the gas and held their breath. Spectroscopy was performed on a 3T Philips Intera every 3 seconds for the length of the breath hold. CS was extracted from fits to the spectra. Surrogate oxygenation was measured using an SpO_2 monitor. Results Example spectra from one volunteer early(red) and at end of breath hold(blue) are shown in Fig 1(left). The CS change between the tissue/plasma and the RBC peak are plot as a function of time(green) in the panel right along with measured SpO_2(blue). A decrease in the separation between these two peaks is seen over the course of the breath hold corresponding with a measured decrease in SpO_2. Similar trends are seen in data from all subjects. Discussion The CS decrease with breath hold time correlates with in vitro data showing CS decrease with RBC deoxygenation. To our knowledge, this is the first demonstration in humans of the effect of RBC oxygenation on the CS of dissolved 129Xe. Localisation of this technique may provide insight into regional RBC oxygen non invasively.