Medical imaging of hyperpolarized gases

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Since the introduction of hyperpolarized helium-3 and xenon-129 as gaseous MRI contrast agents more than a decade ago, a rich variety of imaging techniques and medical applications have been developed. Magnetic resonance imaging of the inhaled gas depicts ventilated lung airspaces with unprecedented detail, and allows one to track airflow and pulmonary mechanics during respiration. Information about lung structure and function can also be obtained using the physical properties of the gas, including spin relaxation in the presence of oxygen, restricted diffusion inside alveolar airspaces, and the NMR frequency shift of xenon dissolved in blood and tissue. Application of these techniques in lung diseases such as asthma, emphysema and cancer are providing new insights into the pathophysiology of certain disease processes, and in some cases offer the promise of early detection and improved treatment.