Pulmonary xenon-129 MRI: new opportunities to unravel enigmas in respiratory medicine

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^{129}Xe MRI provides rapid, sensitive, non-invasive, high spatial resolution and simultaneous measurements of pulmonary ventilation, tissue microstructure and gas exchange, and is poised for routine clinical assessments in patients with chronic lung disease http://bit.ly/2PKkFcU

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Computed tomography (CT) of the chest is the imaging modality of choice for the non-invasive, quantitative evaluation of chronic lung diseases, because thoracic CT protocols are nearly ubiquitously available and provide rapid, high-resolution images of the airway, and parenchymal structure and anatomy. Pulmonary magnetic resonance imaging (MRI) has not been used clinically, mainly because of complexity (pulmonary MRI signal decays rapidly), cost and because conventional MRI is dependent on proton density (hydrogen atoms in tissue), which is exceptionally low (around 0.1 g·cm^{-3}) in the healthy lung, because it mainly comprises air rather than tissue or being water-filled [1, 2]. Using conventional MRI methods, the lungs mainly appear as dark, signal-deficient voids and the pulmonary MRI signal is further degraded because of the millions of lung air-tissue interfaces that cause local magnetic field distortions, and respiratory and cardiac motion. While anatomical proton MRI of the lung is now developing rapidly to overcome these technical limitations, it still does not provide information beyond that of a low-dose CT, so there is a drive towards functional MRI. One of these approaches involves the use of inhaled gas contrast agents, primarily hyperpolarised (or magnetised) helium-3 (^{3}He) and xenon-129 (^{129}Xe), both of which provide a way to rapidly (<10 s) and directly visualise inhaled gas distribution with high spatial resolution (~3 mm x, y and z planes). Pulmonary functional MRI is also possible using inhaled fluorinated gas [3], oxygen-enhanced techniques [4] and free-breathing proton methods [5, 6]; however, hyperpolarised inhaled gas MRI has been the most widely used and described. Because inhaled contrast gases have different resonant frequencies than hydrogen protons as used for conventional MRI, these methods inherently have no background signal and excellent contrast.