Improved Lung Disease Diagnostic Using Gas Contrast Agent Diffusion Weighted MRI to Segment the Lumen

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for imaging the human airway tree using hyperpolarized noble gases and diffusion weighted magnetic resonance imaging.

Overview

Diagnosis of lung disease, such as emphysema, typically is made using whole lung pulmonary function tests to characterize airway obstruction and diffusion abnormalities. Breath-hold high speed X-ray computed tomography (CT) commonly is used to image lung tissue. However, when using CT scans, it is difficult to differentiate between particular disease-induced conditions, and repeated imaging is restricted because of risks associated with exposure to ionizing radiation.

Nuclear magnetic resonance imaging (NMRI) is another method of medical imaging that uses strong magnetic fields and radio frequency pulses to measure the spin of protons in the tissue. MRI provides better contrast between tissues than CT and does not use harmful ionizing radiation. A contrasting agent also may be used to enhance MR images; for example, water can be used to promote contrast in MRI of the gastrointestinal tract.

The Invention

UW-Madison researchers have developed an improved method of segmenting the airways to diagnose lung disease. This method involves segmenting the lumen of the large airways, which consists of the void space in the bronchi. It uses diffusion weighted MR images after inhalation of a hyperpolarized gas contrasting agent. As with segmented imaging of blood vessels, observation of varying contrast agent diffusion allows differentiation between tissue volume elements.

In the new method, a NMR responsive gas such as hyperpolarized helium is used as the contrasting agent in the lung. Then, diffusion weighted image (DWI) data of the lung is acquired via the MRI system. From the DWI data an apparent diffusion coefficient (ADC) image can be reconstructed to map how the NMR responsive gas diffuses in the lung. A segmentation image is produced from the ADC image, allowing the radiologist to differentiate between the void space comprising the airway tree and the lung tissue volume elements. The segmentation image then is used to segment the final diagnostic resonance image of the airways.

The new method improves upon conventional technologies by using the ADC to produce a diagnostic image of the airway tree without using ionizing radiation. The method also may allow for cataloging airway tree structures in terms of lung ventilation, an important tool in diagnosing obstructive lung diseases. With an improved segmentation and less invasive nature, the new MRI method surpasses conventional lung imaging techniques and will enhance the diagnosis and treatment of patients with respiratory diseases and cancers.

Applications

- Diagnosis of lung malady such as asthma, emphysema, cystic fibrosis, chronic obstructive pulmonary disease or cancer

- Verification of treatment efficacy

Key Benefits

- Does not expose patients to ionizing radiation
- Allows for multiple measurements
- More practical for pediatric or neonatal applications
- Allows diagnosis of obstructive lung diseases
- More sensitive to small airway structures
- Provides map of airway tree to aid in surgery or therapy
- High signal to noise ratio

Stage of Development

High quality images have been produced using this technique.

Additional Information

For More Information About the Inventors

- Sean Fain

Publications

- Fain et al. 2008. Evaluation of Structure-Function Relationships in Asthma using Multidetector CT and Hyperpolarized He-3 MRI. Acad. Radi. 15, 753-762.

Tech Fields

- Medical Imaging : MRI

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846