Visualization of Interstitial Lung Disease by MRI

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Introduction & Method

Magnetic Resonance imaging of the lungs is problematic and infrequently performed. It has been demonstrated that cardiac gated short effective TE fast spin echo (TSE) MR imaging sequences provide optimum results in the chest[1,2,3] within the duration of a short breath-hold. The additional application of a dark blood preparation and an inversion pulse to null the signal from fat, result in images in which the primary source of signal from the lungs is pathology[3]. A centrically reordered phase encoding scheme for each FSE echo train provides the shortest obtainable effective echo time.

A study has been performed to compare the detection of interstitial lung disease (ILD) using optimized MRI with high resolution CT (HRCT). All patients routinely referred for a HRCT scan for the possibility of ILD were invited to attend for a MR scan within a month of their HRCT appointment. Ethical approval for the study and patient consent was obtained. HRCT imaging was performed using a Picker PQ6000, consisting of 1 mm thick slices every 15 mm. MRI was performed on a Siemens 1·5 T Vision, using a four quadrant quadrature phased array flexible chest coil. One transaxial 5 mm thick slice was acquired per breath-hold, with 15 mm slice spacing, repeated to cover the whole lungs. Two gated dark blood inversion recovery TSE imaging sequences were used, both with 33 echoes, 6 ms echo spacing, 256×192 matrix, 350 mm field of view, and minimum TR of 800 ms between cardiac gated echo trains. Inversion time was 170 ms to null fat. The first sequence was a standard Siemens sequence with conventional phase encoding resulting in an effective TE of 76 ms. The second was a modified version of the first to give centric phase reordering, with an effective echo time of 6 ms.

Results & Discussion

35 patients have been successfully imaged to date. Typical cardiac gated imaging times were 8-12 seconds. All patients managed to hold their breath for this duration for repeated image acquisitions. Examples of the images of similar slices obtained from the same patient are shown. Figure 3 is a HRCT image, Figure 2 an optimized TSE with TE_{eff}=76 ms. Figure 1 is the TSE with TE_{eff}=6 ms. Disease in the patient's lower right lung is clearly visible in all three images, as well as elsewhere throughout the lungs. No signal from normal structures within the lung is visible in the MR images, highlighting the disease. The short TE image contains disease with high signal intensity; the less distinct edges are due to the edges of *k* space being acquired late in the echo train.

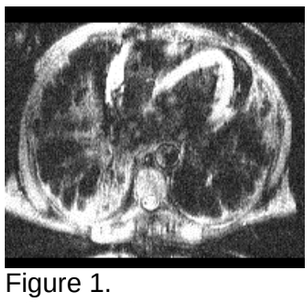

Figure 1.
TSE TE=6 ms

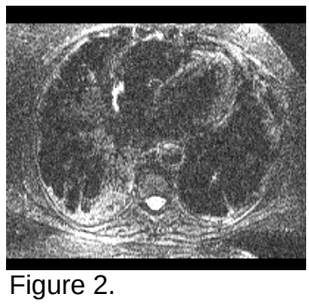

Figure 2.
TSE TE=76 ms

Figure 3. HR CT

A scoring system has been devised to clinically grade the disease in each image. High correlation is seen between the scores from CT and those from MRI.

Optimized MRI is suitable for the detection of ILD. There is a correlation between disease seen on HRCT to that seen on MRI. Although the spatial resolution is reduced compared to HRCT, the ability to null signal from blood and fat results in a visual enhancement of pathology. The examination technique for MRI is very similar to that existing for HRCT but without the risks from ionizing radiation.

References

1. M.E.Moseley *et.al.* "Application of very short TE spin-echo MRI: Imaging of lung" Proceedings SMRM p.686 (1989)
2. E.M.Olson *et.al.* "Fast SE MRI of the chest: Parameter optimization and comparison with conventional SE imaging" JCAT **19**(2) p.167-175 (1995)
3. A.R.Moody *et.al.* "Breath-hold Magnetic Resonance Techniques for the Detection of Bronchiectasis" *Proceedings ISMRM 6th meeting* p.960 (1997).

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