Direct thrombus magnetic resonance imaging: preliminary experience at 3 tesla field strength

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Introduction

MRI at 3 tesla holds promise in thrombus and vessel wall imaging owing to its potential for improved signal to noise characteristics compared to 1.5 tesla systems. However, the signal characteristics of thrombus at 3 tesla have not been extensively investigated. There are also general issues of field inhomogeneity and increased radio-frequency absorption at higher field strengths, as well as specific potential problems for thrombus imaging due to prolongation of T1 relaxation times and increased T2* effects.

Methods

A conventional sequence for direct thrombus imaging was optimized for use at 3 tesla field strength (Philips Intera) using a spine array coil. A T1-weighed 3D magnetization prepared gradient echo technique (MP-RAGE) was employed with a non-selective prepulse to suppress signal from blood and a spectrally selective prepulse for fat suppression. The thigh and calf vessels were imaged in patients with confirmed lower limb thrombosis on compression ultrasonography (deep venous thrombosis n=4, thrombophlebitis n=2) and compared with healthy volunteers (n=9).

Results

Thrombi were clearly visible as high signal intensity structures with good suppression of other potentially confounding sources of high signal such as fat and flowing blood (figure 1). A qualitative analysis was performed by a blinded reader who correctly identified all 9 negative cases and 5 positive cases, but over looked a thrombophlebitis in a small superficial vein. A quantitative analysis was performed by placing regions-of-interest within segments of vein demonstrating that the blood to muscle signal intensity ratio was 0.6+/- 0.1, whilst thrombus to blood signal intensity ratio in patent vessels was 2.6+/-0.6.

Conclusion

This preliminary study shows that blood degeneration products from thrombus can be directly visualized at 3 tesla and have similar characteristics to those that have been described at 1.5 tesla. Vessel-to-muscle signal intensity ratio is approximately 4-fold higher in thrombosed than in patent veins and the qualitative analysis revealed that thrombus is hyperintense in all affected vessels. The sequence design offered effective suppression of other sources of high signal in the lower limb and no limitations were encountered with specific absorption rate limits.

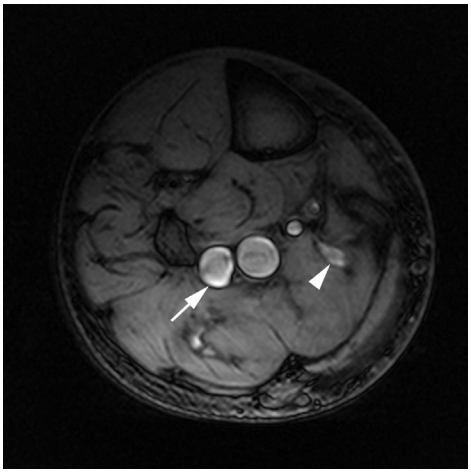

Figure 1 - The deep veins of the calf are expanded by high signal intensity thrombus on this MP-RAGE sequence (arrow). Thrombosed deep muscular branches are also visible (arrowhead). The image shows homogenous fat suppression.