Magnetic resonance direct thrombus imaging (MRDTI) is the first technique that directly visualizes thrombus in humans in vivo. Thrombus is associated with a substantial reduction in T1 caused by the paramagnetic properties of methaemoglobin, and this produces high signal intensity (bright) on T1-weighted images against a background of suppressed blood and fat (dark). This displays a positive image of thrombus without having to use intravenous contrast. Furthermore, direct visualization of thrombus rather than its indirect detection as a filling defect in flowing blood, or by surrogate markers such as changes in venous flow dynamics, overcomes many of the pitfalls of conventional imaging techniques and should provide direct thrombus imaging (MRDTI) is the first technique that directly visualizes thrombus in humans in vivo. Thrombus is associated with a substantial reduction in T1 caused by the paramagnetic properties of methaemoglobin, and this produces high signal intensity (bright) on T1-weighted images against a background of suppressed blood and fat (dark). This displays a positive image of thrombus without having to use intravenous contrast. Furthermore, direct visualization of thrombus rather than its indirect detection as a filling defect in flowing blood, or by surrogate markers such as changes in venous flow dynamics, overcomes many of the pitfalls of conventional imaging techniques and should provide direct visualization of thrombus rather than its indirect detection as a filling defect in flowing blood, or by surrogate markers such as changes in venous flow dynamics, overcomes many of the pitfalls of conventional imaging techniques and should provide direct visualization of thrombus rather than its indirect detection as a filling defect in flowing blood, or by surrogate markers such as changes in venous flow dynamics, overcomes many of the pitfalls of conventional imaging techniques and should provide

**Figure 1** Coronal section through the calves showing bilateral below knee deep venous thrombosis. The ‘polo mint sign’ is indicated by arrows – the high signal ring represents methaemoglobin, which forms first next to the endothelium, and then spreads into the centre of the clot as it matures. Several other thrombosed veins are also visible as bright circular structures.

**Figure 2** Coronal section through the calves and lower thighs showing deep venous thrombosis extending to the proximal segments (arrows), more obvious in the left than right leg. The slightly high signal in the left femoral vein proximal to the obvious bright clot in the calf is where fat suppression is incomplete.

© 2003 Blackwell Publishing Ltd
High frequency of venous thromboembolism in patients with acute ischaemic stroke demonstrated with magnetic resonance direct thrombus imaging

An immediate definitive answer as to the presence or absence of clot. Moreover, simultaneous imaging of the legs and chest allows a comprehensive ascertainment of thrombus load.

Preliminary studies have shown that MRDTI is highly accurate for the diagnosis of both deep venous thrombosis and pulmonary embolism (Crossley et al. 2001; Fraser et al. 2002). Ongoing studies are evaluating the safety of withholding treatment in patients with suspected venous thromboembolism on the basis of negative MRDTI alone.

We have used this technique to investigate the frequency of venous thromboembolism in acute ischaemic stroke patients receiving standard thromboprophylaxis with aspirin and compression stockings as recommended in the recent National Clinical Guidelines for Stroke. We were therefore surprised by the high 40% frequency of venous thromboembolism within 3 weeks of stroke onset. While most thromboses were subclinical, clinically apparent venous thromboembolism was as often overlooked as it was recognized by the attending team.

Examples of venous thromboembolism imaged using MRDTI are shown in Figs 1–4.

REFERENCES


Figure 3 Coronal section showing bilateral deep venous thrombosis, extending into the external iliac vein on the left. Thrombus indicated by arrows.

Figure 4 Coronal section through the thorax showing a large embolus in the right main pulmonary artery (arrow).