Imaging inflammation in abdominal aortic aneurysms with MRI

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Lay Summary

Ruptured abdominal aortic aneurysm has a mortality rate greater than 90%. Accurate assessment of risk of rupture would allow correct identification of those patients who would benefit from preventative surgery. Existing methods are reliant solely upon measuring the maximum diameter of the aneurysm from scans and do not take into account the biology of the disease.

Abdominal aortic aneurysm (AAA) disease is characterised by focal hotspots of neovascularisation, inflammation and proteolysis. These hotspots represent areas of AAAs at risk of expansion and rupture1-3. We have used Magnetic Resonance Imaging (MRI) scanning with ultrasmall superparamagnetic particles of iron oxide (USPIO) to detect areas of cellular (macrophage) inflammation.

Methods

Patients (n=29) with asymptomatic AAA (>4 cm in diameter) were imaged in a 3T MRI scanner before and 24 h after administration of USPIO. Multi-echo, gradient-echo T2*-weighted and TSE T2-weighted sequences were acquired. Images were registered, and custom written software calculated a mean per cent change in T2* value (ΔT2*) from a multi-voxel grid and presented on a colour map.

Results

USPIO administration resulted in differential changes in T2* value within the AAA. A change in T2* value in the peri-luminal thrombus was seen in the majority of patients. In addition, some patients had focal areas of USPIO uptake elsewhere within the AAA, consistent with inflammatory hotspots and aneurysm instability. The T2* value of skeletal muscle (control) was unchanged. Histological analysis of operative tissue samples from AAA wall showed USPIO co-localising with macrophages.

Discussion and Conclusions

We have demonstrated for the first time non-invasive, in vivo detection of macrophages and inflammation in AAA using MRI and USPIO. This represents a promising, highly relevant approach to the detection of AAA inflammation and the prediction of disease progression and rupture. In a wider context, this technique could be applied to non-invasive imaging of inflammatory processes in other parts of the body.

References


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