



FOCUS ON RESEARCH

TITLE

Researchers

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Aim

In this research study, we used an MRI dye containing microscopic iron particles (Ultrasmall superparamagnetic particles of iron oxide (USPIO)). An MRI scanner is a powerful magnet scanner that can detect small iron particles like this that are then seen on an MRI image. Cells called macrophages ingest the iron particles. Macrophages are cells that are produced in response to processes that cause inflammation, such as viral or bacterial infections, and help with healing. Macrophages can be found in inflamed tissues and organs including heart muscle. Therefore USPIO injection and subsequent MRI scanning is able to detect macrophages and areas of inflamed tissue.

We aimed to determine whether this test is useful in detecting inflammation in the heart of people with: (i) acute myocarditis (a condition where the heart can become inflamed after infections including pneumonia), (ii) heart transplantation (where the donor heart becomes inflamed when transplanted into another human recipient) and (iii) cardiac sarcoidosis (an inflammatory condition that affects multiple organs including the heart). We also aimed to report a range of normal values in healthy hearts and other tissues.

Project Outline/Methodology

We recruited 58 healthy volunteers and patients with the above conditions and conducted MRI scans with the iron dye agent. We first reported the results found in normal healthy hearts. We then compared results from the healthy volunteers with patients affected by the three inflammatory conditions.

Key Results

We reported a range of normal values in heart muscle and other organs. On MRI images of patients with acute myocarditis and prior heart transplantation, we found higher levels of general inflammation (oedema) in the heart on standard MRI images when compared to volunteers. However, in

both conditions, we did not see greater evidence of iron (USPIO) accumulation within the heart. There were insufficient patients recruited with proven cardiac sarcoidosis to enable analysis.

Conclusions

We reported normal reference USPIO values in healthy volunteers. In patients with acute myocarditis and stable heart transplantation, MRI images were suggestive of generalised inflammation (called oedema), but we did not detect any macrophage cells. This suggests that inflammation in these conditions is caused by other means, and macrophages do not play a significant role.

What does this study add to the field?

We determined a range of normal MRI values following USPIO injection should this technique ever enter clinical practice. We also describe the methods used and detail solutions to commonly encountered problems to improve the images generated.

It does not appear that this test using USPIO dye and MRI will become a clinically useful test in assessing patients with stable cardiac transplantation or acute myocarditis. We already knew this technique works is able to detect and monitor inflammation in people after 'heart attacks', but it is not known whether this technique will be useful in assessing other conditions where inflammation affects the heart.

Implications for Practice or Policy

Should this technique ever enter clinical practice to assess inflammatory conditions, we have established a range of 'normal' values for comparison.

Where to next?

Our group continue to develop scanning techniques assessing conditions with tissue inflammation. We have recently installed a combined MRI/PET scanner that is a 2-in-1 scanner providing accurate identification of inflammation within tissues. Using this technique, we are recruiting patients for research studies examining a variety of conditions where inflammation affects the body.

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