EARLY DETECTION OF AVASCULAR NECROSIS OF THE FEMORAL HEAD BY MRI

M. J. F. FORDYCE, L. SOLOMON

From the University of Bristol and Southmead Hospital, Bristol, England

We used MRI to examine the hips of 32 asymptomatic patients at 9 to 21 months after renal transplantation covered by high-dose corticosteroids. Five hips in three patients showed changes which indicate avascular necrosis, although radiographs, CT scans and isotope scans were normal. These patients had repeat MRI scans after another two years and three years.

One patient with bilateral MRI changes developed symptoms and abnormal radiographs and CT and isotope scans in one hip nine months after the abnormal MRI. Intraosseous pressure was found to be raised in both hips, and core biopsies revealed necrotic bone on both sides.

The other three hips have remained asymptomatic with unchanged MRI appearances three years after the initial MRI. It seems that idiopathic avascular necrosis does not always progress to bone collapse in the medium term.

Received 13 July 1992; Accepted 29 October 1992

It has long been recognised that radiographic changes appear late in the course of avascular necrosis (AVN), and that the cardinal sign of increased bone density is mainly due to formation of new bone on the surfaces of dead trabeculae. This is a result of revascularisation from intact bone and myeloid elements and occurs weeks or months after bone death (Solomon 1973). Radioscintigraphy may help in the diagnosis of post-traumatic osteonecrosis, but gives unreliable information in the early stages of idiopathic changes (Conklin et al 1983).

Magnetic resonance imaging (MRI) may be of value in diagnosing bone ischaemia and osteonecrosis at a very early stage, possibly while the patient is still asymptomatic (Totty et al 1984; Mitchell et al 1986). No prospective study of a high-risk group has been performed, however, to establish the value of MRI as a 'pre-emptive' diagnostic tool.

There is a high incidence of AVN in renal transplant patients on high-dose corticosteroid immunosuppressive therapy. Radiographic changes may appear at from 6 to 75 months after operation (Levine et al 1977; Davidson et al 1985); during this long latent phase changes may be detectable by MRI.

We have studied a series of patients to assess the value of MRI in the early diagnosis of asymptomatic AVN and to monitor the progress and natural history of the condition.

PATIENTS AND METHODS

We performed MRI studies on the hips of 32 patients who had undergone renal transplantation, using a 0.5 Tesla Vista MRI scanner (IGE Medical Systems, Slough, UK) at 9 to 21 months after the operation. There were 22 men and 10 women; their average age was 42.1 years (17 to 64). All had a standard immunosuppressive regimen including high doses of corticosteroids, averaging 1680 mg of prednisolone in 30 days. All the hips were initially asymptomatic.

Patients with an abnormal MRI were examined clinically and by plain radiography, CT and radionuclide bone scanning using 99mTc hydroxydiphosphonate. They were followed up, and re-examined by MRI at two years and at three years after the initial examination.

RESULTS

At the first scan, 9 to 21 months after the transplant, five hips in three patients showed MRI changes. There were focal regions of decreased signal intensity in the sub-articular area of the femoral head in both T1- and T2-weighted images (Figs 1, 2), indicating ischaemia. The plain radiographs and the CT and bone scans were normal.

Case report. One patient with bilateral MRI changes developed acute pain in the right hip nine months after the first MR examination, with restriction of movement, particularly on rotation. Plain radiographs now showed flattening of the superior aspect of the femoral head and patchy sclerosis within the head. Similar changes were
MRI scans showing areas of decreased signal intensity in both femoral heads in an asymptomatic patient. Figure 1 – T1-weighted axial image. Figure 2 – T2-weighted coronal image.

MRI scans showing areas of decreased signal intensity in both femoral heads in an asymptomatic patient. Figure 1 – T1-weighted axial image. Figure 2 – T2-weighted coronal image.

...
were similar to those described by Totty et al (1984), the hallmark being a decrease in signal intensity in a subarticular location.

The normal high-intensity signal from the femoral head is due to the presence of hydrogen-rich marrow fat. Any process which invades or displaces this fat can cause a focal decrease in the MRI signal. There are a number of possible explanations for the decreased signal intensity in AVN. Fat necrosis would produce a decrease in the hydrogen-proton concentration, but some of the changes may be due to a very early repair response and not directly to marrow ischaemia. The pattern of change in the MRI does not appear to correlate with either the stage of the disorder (Totty et al 1984) or with the subsequent progress of necrosis (Thickman et al 1986). Our study has shown that, over a period of three years, the early MRI appearances of femoral head necrosis are not necessarily progressive and may remain asymptomatic. This finding has important implications in evaluating any non-destructive methods of treatment that are claimed to prevent or alleviate the effects of bone ischaemia.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


Totty WG, Murphy WA, Ganz WI, et al. Magnetic resonance imaging of the normal and ischemic femoral head. AJR 1984; 143:1273-80.