SICKLE CELL DISEASE AND SILENT AVASCULAR NECROSIS OF THE HIP

H. E. WARE, A. P. BROOKS, R. TOYE, S. I. BERNEY

From St Bartholomew's Hospital, London

We reviewed the prevalence of avascular necrosis (AVN) in a series of patients with sickle cell disease, using radiography and magnetic resonance imaging. We found AVN of at least one hip in 11 of 27 patients (41%). This is a significantly greater prevalence than reported. MRI was not as helpful in patients with sickle cell disease as it is in patients with AVN from other causes; it detected no more cases than radiography.

The orthopaedic complications of sickle cell disease have been documented by several authors (Golding 1956; Chung and Ralston 1969; Engh et al 1971; Sennara and Gorry 1978). Aseptic skeletal conditions have two main causes: chronic haemolytic anaemia leads to bone marrow hyperplasia; and red cell sickling, secondary to hypoxia, results in bone infarcts. The infarcts are typically seen in areas supplied by end arteries, such as the femoral and humeral heads.

In the English-language literature there are reports on groups from Africa, the West Indies and America (Golding 1956; Chung and Ralston 1969; Lee, Golding and Serjeant 1981; Iwegbu and Fleming 1985) but there do not appear to be any prospective studies on the prevalence of the complications of sickle cell disease in the United Kingdom. A recent report from Liverpool, a retrospective radiographic review, may have underestimated the size of the problem (Theis and Owen 1988).

The reported prevalence of avascular necrosis of the femoral head varies, but the two largest series quote 5% (Lee et al 1981) and 3.2% (Iwegbu and Fleming 1985). In both series the results were based on a retrospective review of the radiographs of symptomatic patients only. Magnetic resonance imaging (MRI) has been successful in detecting early AVN of the femoral head in a number of conditions (Totty et al 1984; Mitchell et al 1987).

We have used plain radiography and MRI to detect AVN in adults in the United Kingdom with sickle cell disease.

PATIENTS AND METHODS

Of the 150 patients in our district known to have sickle cell disease, 46 were aged 15 years or over at the time of the study. We examined the hips of 27 adult SCD patients who consecutively attended the routine haematology clinic. Prior ethical approval was obtained and a consent form was signed by each patient.

Both hips of the 27 patients were assessed by the method of Merle d’Aubigné and Postel (1954) for pain, mobility and function, which gives a maximum score of 18 for a normal hip.

An anteroposterior radiograph of the pelvis of each patient was graded using Mitchell’s modification of Ficat’s classification (Table I).

MRI scans of the hips were then performed on 26 patients, using an updated 0.08 Tesla resistive M&D 800

<table>
<thead>
<tr>
<th>Stage</th>
<th>Radiograph</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Normal</td>
</tr>
<tr>
<td>2</td>
<td>Cysts and/or sclerosis</td>
</tr>
<tr>
<td>3</td>
<td>Subcortical lucency (crecent sign)</td>
</tr>
<tr>
<td>4</td>
<td>Subchondral collapse</td>
</tr>
<tr>
<td>5</td>
<td>Narrowing of joint space</td>
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scanner. The one patient not examined with MRI had already undergone bilateral total hip replacements for advanced AVN. A series of contiguous 1 cm coronal images were taken through the femoral heads, using a spin echo sequence with a repetition time of 400 ms and time to echo of 40 ms. The scans were examined for localised regions of low signal intensity compatible with marrow infarction within the femoral head.

Blood was taken for a full count and for fetal haemoglobin levels; haemoglobin electrophoresis was performed to confirm the sickle cell status of each patient.

**RESULTS**

There were 16 male and 11 female patients with a mean age of 24.8 years (15 to 68).

**Avascular necrosis.** Eleven of the 27 patients (41%) had avascular necrosis of the femoral head (Fig. 1), visible both on the MRI scan and the radiographs. Seven patients had bilateral disease (26%) including the one with bilateral replacement. In all, 18 of the 54 hips were abnormal (33%), ten on the right and eight on the left. There were seven hips with stage 5 disease, one with stage 4 and ten with stage 2, all the last showing focal sclerosis, lucency, or both changes in the femoral heads.

The 11 patients with AVN had a mean age of 28.4 years (18 to 68); six were male (mean age 24.2 years) and five were female (mean age 24.8 years). The 16 patients with no AVN had a mean age of 22.2 years (15 to 30); the difference was not statistically significant.

**Clinical scores.** Only two patients had a hip score of less than 15. One had bilateral AVN (stage 5 both hips) and the other had a normal radiograph but had had a stroke.

We attempted to relate the number of previous crises to the risk of AVN, but the documentation was too poor.

**Electrophoresis.** Twenty-three patients had HbSS disease, three had HbSC disease, and one had Hbs/hereditary persistence of fetal haemoglobin. Of the patients with AVN one, with stage 2 changes, had SC disease and the others had SS disease.

**Haematology.** Full haematological data was available for 24 patients. In the nine patients with AVN the mean total haemoglobin level was 9.2 g/dl (7.1 to 12.2); in the 15 radiographically normal patients it was 10.0 g/dl (7.4 to 14.2). The mean values for the level of fetal haemoglobin, were 3.5 g/dl (0.5 to 11.8) in the group with AVN, and 4.1 g/dl (1.0 to 14.1) in the normal group. The differences were not statistically significant.

**DISCUSSION**

The prevalence of AVN was 41% in the 27 patients studied, and 33% of their hips were affected. This gives a minimum prevalence of 24% (19.5% of all hips) in the 46 adults (92 hips) in our district. The largest non-UK study (Lee et al 1981) found a prevalence of symptomatic AVN of 3.2%, the same as that found by Theis and Owen (1988) in the only published UK study of sickle cell disease.

Our results suggest that the prevalence of AVN in this disease has been significantly underestimated. We performed radiological investigation on all of our patients, many of whom had no significant symptoms. If the risk had been assessed solely on the symptoms a large number of patients with hip pathology would not have been identified.

In previous reports HbSC disease seemed to have the highest prevalence of AVN. Iwegbu and Fleming
bejustified sickle assessed. anatomy obvious, haemoglobinopathies MRI signal, Cortical present, patients, importance these surgery a.

The results of the conservative management of AVN from non-haematological causes are reported to be poor (Patterson, Bickel and Dahlin 1964; Musso et al 1986), but there is some evidence to suggest that in sickle cell disease the early stages are reversible. Chung, Alavi and Russell (1978) reported that several patients with sickle cell disease and early AVN, treated by strict non-weight-bearing, gained both symptomatic and radiographic improvement.

Once advanced changes, to stage 3 or more, have developed, there is little chance of improvement and surgery is the only option. The results of arthroplasty in sickle cell patients are generally disappointing (Gunderson, D’Ambrosia and Shoji 1977; Bishop et al 1988; Hanker and Amstutz 1988), with a very high incidence of infection and revision. Bishop et al (1988) also reported a significant number of peri-operative complications, and emphasised the considerable anaesthetic risks for these patients.

Hanker and Amstutz (1988) calculated a mean survival of 5.4 years for replacement arthroplasty, using an actuarial life table method. This establishes the importance of detecting the early phase of the disease in an attempt to avoid the need for arthroplasty.

MRI is an effective and safe method of detecting pre-radiographic changes of AVN from causes other than sickle cell disease, particularly in renal transplant patients, but once severe changes from any cause are present, the diagnostic value of MRI actually diminishes. Cortical bone and small bony fragments produce no signal, and although collapse of the femoral head is obvious, early subchondral fractures and the precise anatomy of bony fragments cannot be adequately assessed. Computed tomography has an advantage over MRI in this respect (Mitchell et al 1986).

Like Rao et al (1989), we have assumed that, in the absence of positive evidence of other causes, the focal abnormalities seen on radiographs and MRI relate to regions of bone infarction. The definitive diagnosis of AVN requires invasive tests: bone marrow pressure measurements, intramedullary venography and core biopsy (Ficat 1985), and the use of such tests could not be justified in our patients.

We started a neonatal screening programme for haemoglobinopathies in 1980: about ten new cases have been detected each year since then. Early detection, improved care and long-term follow-up of patients with sickle cell disease will increase the number of patients known to be at risk of developing AVN. Screening for hip pathology must therefore be considered. In theory MRI, as a safe, non-invasive method which avoids ionising radiation, would be the preferred investigation. However, as a screening procedure, we found that it had no advantage over plain radiography, which is cheaper and more widely available.

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


