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OSTEONECROSIS

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Introduction

Osteonecrosis is defined as the ischaemic death of the cellular constituents of bone and marrow. The osseous components of the marrow are the cells that reside in the cancellous bone and the cellular components are the erthrocytic and the leukocytic cells in their various stages of development, fat cells and a few reticulum cells.

The bone marrow is the fourth largest organ of the body by weight after bone, muscle and fat, weighing up to 3 kg in adults.[1] By convention, the term osteonecrosis has been divided into two broad categories: the terms aseptic necrosis, ischaemic necrosis and avascular necrosis are equivalent, and refer to epiphyseal lesions, particularly those in a sub-articular location. The term bone infarction is applied to lesions in the metaphysis and diaphysis of the bone.

Aetiology

There are many causes for osteonecrosis. Among them are trauma, steroids, alcoholism, pancreatitis and sickle cell disease. Systemic lupus erythematosus (SLE) is now known to be associated with a very high incidence of hip osteonecrosis, occurring in up to 80% of patients. In many cases multiple aetiologies are involved, for example, alcoholism and steroid ingestion. In day to day radiological practice dysbaric osteonecrosis is uncommon.

Radiology

Table 1 shows the several modalities that are available.

TABLE 1

IMAGING MODALITIES FOR OSTEONECROSIS

Radiographs
Scintigraphy
Computed Tomography (C.T.)
Magnetic Resonance (M.R.)
(Venography)

PLAIN FILMS

Plain film findings are listed in Table 2. These are of limited use in the early diagnosis of osteonecrosis. One must therefore question their routine use in screening protocols, particularly in divers. The first sign one might expect to see is osteoporosis. Unfortunately both dead and living bone have the same density on X-rays. It is only during the healing phase, when hyperaemia induces an osteoporosis in normal

TABLE 2
PLAIN FILM FINDINGS IN OSTEONECROSIS OF THE HIP

Osteoporosis
Sclerosis and cysts
"Crescent sign"
Flattening of femoral head
Acetabular involvement
Advanced degenerative charges

Figure 1. 37 year old male with previous renal transplant. The subtle subchondral lucency in the femoral head (arrow) represents a fracture ("crescent sign").

Figure 2. Middle aged male who developed osteonecrosis of left hip while on steroid therapy. Note early flattening of femoral head, and prominent "crescent sign".

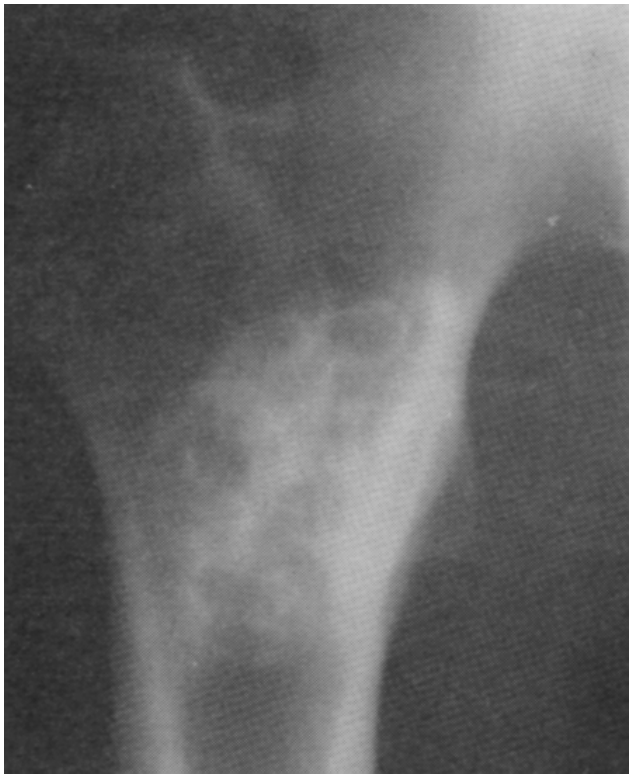

Figure 3. Typical "bubbly" calcified bone infarct in proximal femoral shaft.

bone, that the infarcted bone becomes obvious. The significance of small areas of sclerosis and cysts is controversal as these can be seen in normal people. The crescent sign is a specific sign of osteonecrosis representing a subchondral fracture (Figure 1). Unless treatment is effective at this stage, the late complications of osteonecrosis will become apparent. In the hip joint, these are flattening and fragmentation of the femoral head (Figure 2), eventual acetabular involvement and a destroyed joint.[2]

Bone infarcts have a very characteristic radiological appearance (Figure 3). The typical "bubbly" calcified lesion usually occurs in the diaphysis. These lesions are frequently seen by radiologists in daily practice, and are often asymptomatic.

C.T. SCANNING

C.T. scans are considerably more sensitive than plain films. Where early types of surgery, e.g. rotational osteotomy and bone grafting are contemplated, C.T. scanning is an important part of the work-up, as it demonstrates the architecture of the femoral head and neck well (Figure 4).

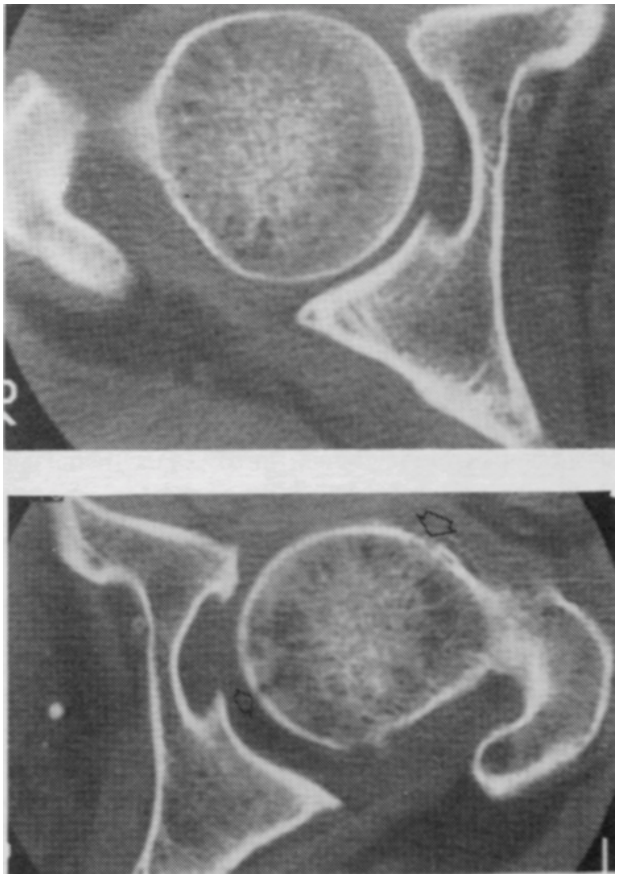

Figure 4. CT scan. 62 year old man with post-traumatic osteonecrosis left hip. Top shows a normal right hip. Bottom shows patchy areas of decreased bone density in the left femoral head. The cortex has been breached in several areas (arrows).

MAGNETIC RESONANCE IMAGING

This technique has many advantages, particularly in its ability to image anatomy in many planes and to detect early bone marrow pathology.[3] Disruptions in the bright signal of normal fat are easy to identify (Figure 5).

Figure 5. Coronal M.R. scan of pelvis in a man with osteonecrosis of the right hip. Note the absence of a bright signal in the right femoral head.

Diving surveys

Any bone survey in divers should concentrate on the areas affected which are the shoulders, hips, and the areas around the knee joints. Our protocol is listed in Table 3.

MRC classification

In the United Kingdom, the Medical Research Council has classified the radiographic appearance of dysbaric osteonecrosis into two categories, A and B (Table 4). The A category refers to the juxta-articular or epiphyseal lesions and the B. category relates to the lesions in the head and shafts of bones.

This reflects the two forms of osteonecrosis noted earlier, namely bone infarction and ischaemic necrosis. The A lesions are the most important because they occur in the weight bearing areas and are the ones prone to collapse and eventual deformity. However, the significance of A2 and A3 lesions is debatable. B lesions occur away from the weight bearing areas and are commonly asymptomatic.

TABLE 3

DIVER'S LONG BONE SURVEY

A.P. shoulder joints
A.P. hip joints
A.P. and lateral knee joints

TABLE 5

MRC CLASSIFICATION

A JUXTA-ARTICULAR LESIONS
- 1 Dense areas with intact cortex
- 2 Spherical opacities
- 3 Linear opacities
- 4 Structural failures
  - a. Translucent, subcortical band
  - b. Collapse of articular cartilage
  - c. Sequestration of cortex
- 5 Osteoarthritis

B MEDULLARY LESIONS OF THE HEAD, NECK AND SHAFT
- 1 Dense areas
- 2 Irregular calcified areas
- 3 Translucent areas and cysts

Summary

Plain films are of limited use in the early diagnosis of osteonecrosis. Although of high specificity, they are insensitive. Their usefulness in screening programmes are therefore limited.

REFERENCES

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3 Glickstein M F, Burk D L, Schiebler M L, et al. Avascular Necrosis versus other diseases of the hip: sensitivity of MR imaging. *Radiology* 1988; 169: 213-215.

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