Clinics in Diagnostic Imaging (60)

W C G Peh

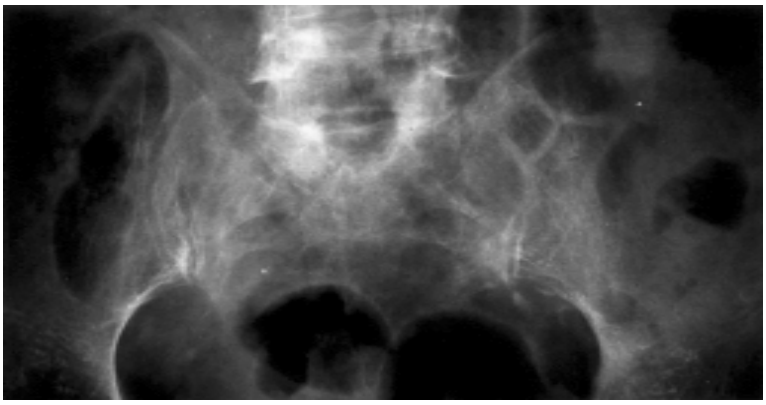

Fig. 1 Frontal radiograph of the sacrum.

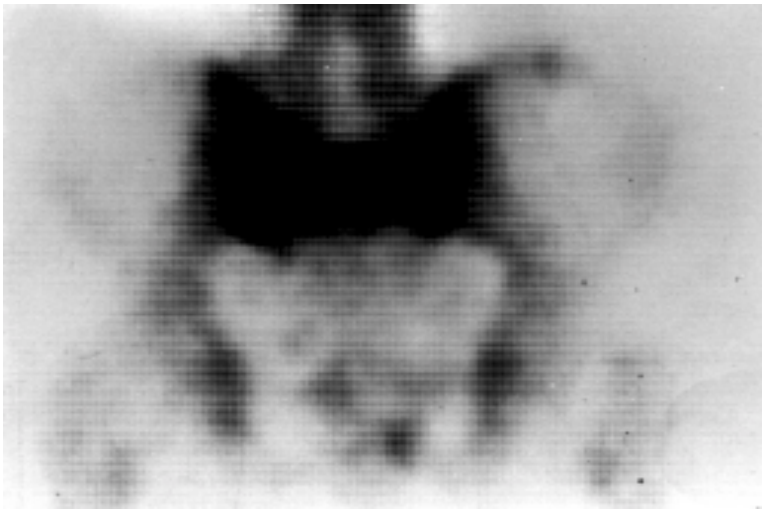

Fig. 2 Bone scintiscan (posterior projection) of the pelvis.

CASE PRESENTATION

An 80-year-old woman presented with severe low back pain of one month's duration. The pain was of gradual onset and worsened progressively. There was no history of trauma. The pain was so severe that she was unable to walk. She was previously fully ambulatory. She had undergone a laminectomy six years ago. Otherwise, there was no other medical history of significance.

On physical examination, she had tenderness over the lower lumbar region. Lower limb power was only slightly reduced (4+/5 bilaterally). Sensation, reflexes and straight leg raising tests were normal. Lumbar radiographs showed multiple levels of vertebral body compression at the thoracolumbar junction. As multiple myeloma was suspected clinically, she was referred for bone scintigraphy. What do the radiograph of the sacrum (Fig. 1) and bone scintiscans (Fig. 2) show? What further investigation would be useful in confirming the diagnosis?

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IMAGE INTERPRETATION

The radiograph (Fig. 1) showed generalised osteopaenia. No fracture or osteolytic lesion was detected. The bone scintiscan (Fig. 2) showed a butterfly (or Honda H)- shaped area of increased scintigraphic uptake in the sacrum. A further focal area of uptake was faintly seen in the pubis. The scintigraphic patterns of uptake were typical of those of insufficiency fractures of the pelvis. Computed tomography (CT) was useful for confirming the diagnosis, and showed fractures in both sacral ala as well as in the right pubis (Figs. 3a-b). There was no destructive bone lesion or soft tissue mass to suggest a malignancy.

DIAGNOSIS

Insufficiency fractures of the pelvis.

CLINICAL COURSE

The patient was managed conservatively. She was admitted and underwent an initial period of complete bed rest. She was also prescribed oral analgesics. Two weeks after admission, her painful symptoms had recovered sufficiently for her to walk with support. At five months' follow- up, she had continued to improve and recover.

DISCUSSION

Insufficiency fractures are a subgroup of stress fractures. Stress fractures are defined as fractures that are produced as a result of repetitive and prolonged muscular action on bone that has not accomodated itself to such action[1]. Unlike the other subtype, fatigue fractures, insufficiency fractures are caused by the effect of normal or physiological stresses upon weakened bone in which the elastic resistance is decreased. There is an increasing awareness of the occurrence of these fractures in elderly people. The most frequent sites affected by insufficiency fractures are the thoracic vertebra, tibia, fibula and calcaneum[1,2]. Insufficiency fractures of the pubic bone were identified in 1978[3], those of the sacrum in 1982[4], and the association of sacral and pubic fractures recognised in 1985[5,6].

Pathophysiologically, a fracture represents the end-result of the spectrum of a bone's response to an increasing level of stress. According to Wolff's law, stress that occurs beyond the bone's elastic range causes persistent plastic deformity due to microfractures. In this situation, osteoclastic resorption exceeds osteoblastic activity[2]. There is a strong association between fractures of the sacrum and those of the pubic bone (parasymphysis and pubic rami). It is postulated that pubic fractures develop due to increased anterior arch strain, secondary to initial failure of the posterior arch, i.e. the sacrum[6].

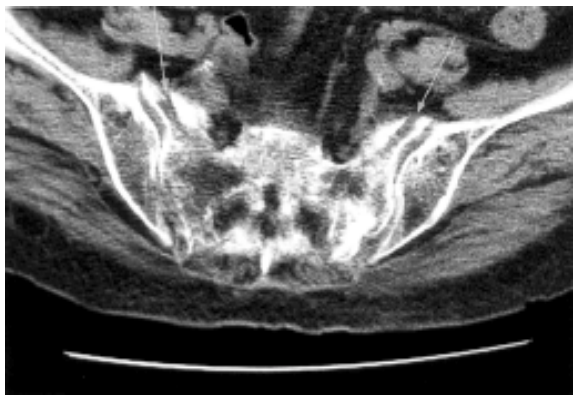

Fig. 3a CT scan of the sacrum shows fracture lines in both sacral ala (arrows).The fractures are surrounded by adjacent sclerosis.

Fig. 3b CT scan of the pubis shows a slightly-displaced right parasymphyseal fracture (arrow).There is no destructive lesion or soft tissue mass detected.The adjacent fascial planes are preserved.

Patients with insufficiency fractures of the pelvis typically present with groin, low back or buttock pain. Multiple sites of pain occur in a quarter of patients. In the majority of cases, pain is of a severity so as to render the patient non-ambulatory. There is usually either no history of trauma or only low impact trauma. Physical examination is usually non-specific or negative. The commonest physical signs are low back tenderness, groin tenderness and restricted hip movement. Neurological deficit is rare. In patients who have previously undergone pelvic irradiation for gynaecological malignancies, local soft tissue complications, especially affecting the rectum, are frequently encountered. There is a typical discordance between the patient's severe symptoms and mild or absent physical signs[7-10].

The incidence of insufficiency fractures is estimated to be in the range of 1%-5%, depending on the referral population. Women are predominantly affected, with a female:male ratio of 9:1 to 9.6:1. The vast majority of patients are over 60 years of age. Mean age in various series range from 62 to 74 years old. Although most studies to date have been from the developed Western countries, there is no racial predilection. American, European, Australian, Japanese and Chinese series of patients have been documented to date[7-11]. The main cause of insufficiency fractures

Fig. 4a 64-year-old woman with bilateral sacral insufficiency fractures. Frontal radiograph shows vertical linear areas in both sacral ala and surrounding sclerosis.

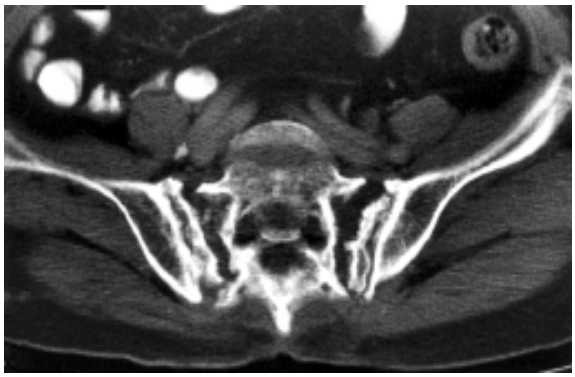

Fig. 4b Same patient as Fig. 4a. CT scan of the sacrum shows widened linear fracture gaps in both sacral ala, confirming the diagnosis of ununited sacral insufficiency fractures.

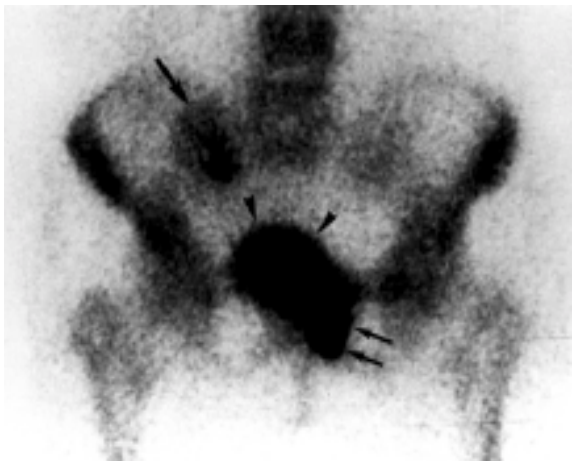

Fig. 5 79-year-old woman with multiple insufficiency fractures of the pelvis. Bone scintiscan (anterior projection) shows increased left parasymphyseal uptake (small arrows) as well as left sacral uptake (large arrow), typical of the pattern of associated insufficiency fractures. Excreted radioisotopes are noted in the bladder (arrowheads).

of the pelvis is postmenopausal osteoporosis. Other important causes are pelvic irradiation, corticosteroid therapy, and rheumatoid arthritis. Also reported are total hip replacement, Tarlov cyst, Paget's disease, fibrous dysplasia, scurvy, osteopetrosis, primary biliary cirrhosis, lung transplantation, tabes dorsalis, vitamin D deficiency and fluoride therapy[9-16].

The radiographic findings vary with the site of fractures. Parasymphyseal and pubic ramus fractures may have an aggressive appearance, depending on stage of fracture maturity. Findings are sclerosis, lytic fracture line, bone expansion, exuberant callus and osteolysis. Before they were fully recognised, parasymphyseal and pubic ramus fractures were often mistaken for malignant lesions, and many patients underwent unnecessary biopsy in the past. Sacral and other pelvic site (supra-acetabular and iliac blade) fractures may be negative or appear subtle on radiographs (Fig. 1). The only positive finding is usually a sclerotic band. A lytic fracture line or cortical break is rarely seen (Fig. 4a). Sacral fractures are often difficult to detect because of osteoporosis, overlying bowel gas shadows and calcified vessels. In general, the degree of confidence for the radiographic diagnosis of insufficiency fractures of the pelvic bones is low[3-9, 17-18].

Bone scintigraphy is the most sensitive technique for detection of insufficiency fractures of the pelvis. In the sacrum, the typical H-shape or butterfly pattern of uptake is diagnostic. The vertical limbs of the H lie within the sacral ala, parallel to the sacroiliac joints, while the transverse limb of the H extends across the sacral body (Fig. 2). Other sacral variant uptake patterns occur frequently. These include the unilateral ala, incomplete H and horizontal linear dot patterns. Iliac fractures are seen as linear areas of uptake. Pubic and supra-acetabular fractures have a linear or focal uptake. Concomitant findings of two or more areas of uptake in the sacrum and at another pelvic site are considered diagnostic of insufficiency fractures of the pelvis (Fig. 5). A limitation of bone scintigraphy is dependency on accurate interpretation of the uptake pattern, hence, atypical uptake patterns may be problematic[9,18].

On CT, sacral fractures are typically vertically-orientated and located parallel to the sacroiliac joints (Figs. 3a, 4b). A linear fracture line with surrounding sclerosis is seen. Pubic fractures are seen as a lytic fracture line often surrounded by callus (Fig. 3b). There is typically absence of a soft tissue mass, lack of bone destruction, and preservation of adjacent fascial planes. CT is also useful for detection of large bony sacral defects such as Tarlov cysts and in the diagnosis of co-existing malignant lesions. CT is considered the definitive imaging modality for the diagnosis of insufficiency fractures. It is specific, and is most useful when radiographs and bone scintigraphy are inconclusive. Disadvantages of CT include limited coverage due to radiation dose and poor detection of transversely orientated fractures[9,13,18-19].

MR imaging findings of insufficiency fractures in the sacrum are broad linear bands of decreased bone marrow signal on T1-weighted images. These signal changes are seen within the sacral ala and body, and are parallel to the sacroiliac joints. On T2-weighted images, the fracture line may be seen if it is surrounded by adjacent marrow oedema[16]. MR imaging is a very sensitive method for detection of soft tissue and marrow changes but the findings may not be specific. These fractures may easily be mistaken for malignancy. Recently, finding of fluid within the fracture has been suggested as being a diagnostic sign[20].

Management of insufficiency fractures of the pelvis is conservative, consisting initially of bed rest, reduced weight bearing and simple analgesics for pain relief. Graded exercises are started once there is symptomatic improvement. Prognosis is good with healing expected within four months[9,10,14,18]. The differential diagnoses of these fractures include metastasis and tumour recurrence after previous treatment. In summary, the clinical assessment of patients suffering from insufficiency fractures of the pelvis is not reliable. Imaging has an important role in the detection and diagnosis of insufficiency fractures of the pelvis. Bone scintigraphy is the imaging modality of choice. CT provides further definition of the fracture, especially if bone scintigraphy is inconclusive.

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ABSTRACT

An 80-year-old woman presented with severe low back pain of gradual onset. Her walking ability was affected. Physical examination was essentially negative. Bone scintiscans showed a butterfly-shaped area of increased sacral uptake as well as focal pubic uptake. The diagnosis of sacral and parasymphyseal insufficiency fractures was confirmed by CT. The patient recovered well with conservative management. The clinical and imaging features, and management of insufficiency fractures of the pelvis are discussed.

Keywords: Bone scintiscans, Computed tomography, Insufficiency fractures, Os pubis, Parasymphyseal fractures, Pelvic fractures, Sacral fractures, Stress fractures.

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