Clinics in Diagnostic Imaging (82)

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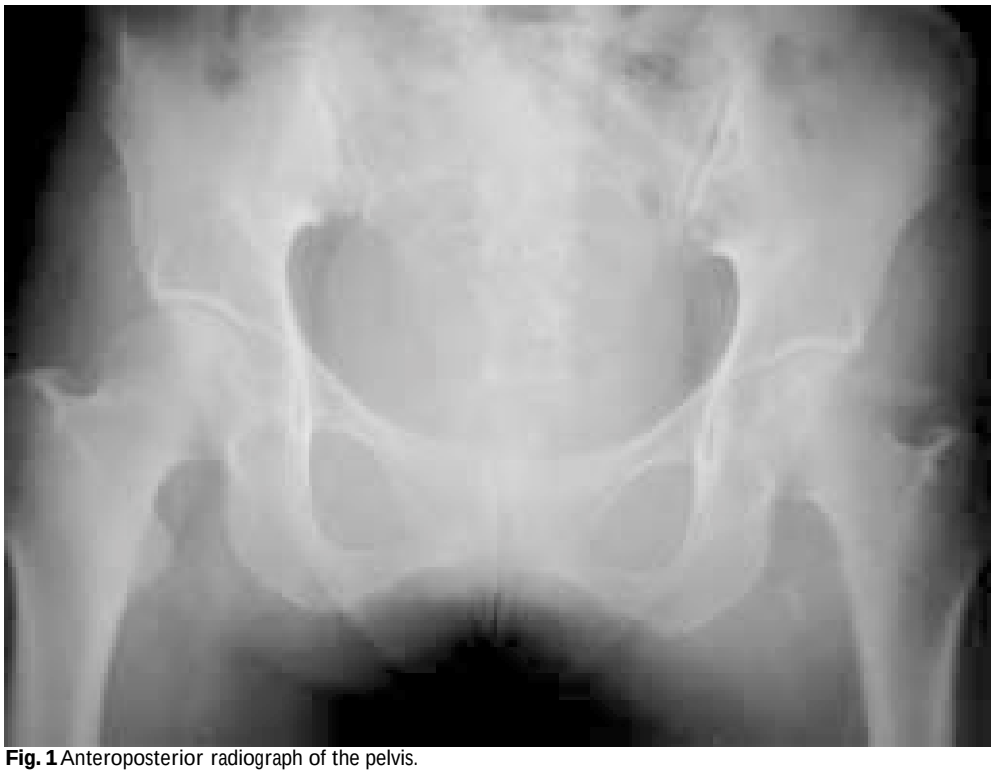

Fig. 1 Anteroposterior radiograph of the pelvis.

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CASE PRESENTATION

A 73-year-old woman presented with pain over the left hip area for two to three months. The pain was persistent, and was worse on weight-bearing. There was no radiation. She did not have any other site of pain. She had a past history of breast carcinoma for which a mastectomy was performed. What does the pelvic radiograph show (Fig. 1)? What is the diagnosis?

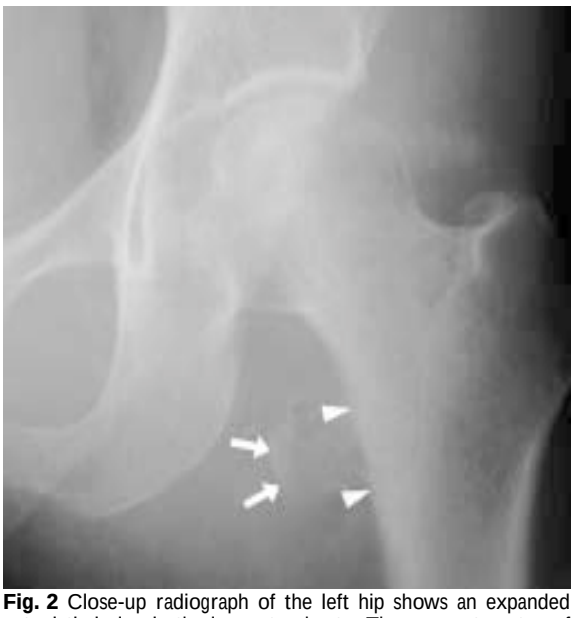

Fig. 2 Close-up radiograph of the left hip shows an expanded osteolytic lesion in the lesser trochanter. The remnant cortex of the lesser trochanter is arrowed. Adjacent cortical destruction (arrowheads) and subtle permeative lesions in the inter-trochanteric region are noted.

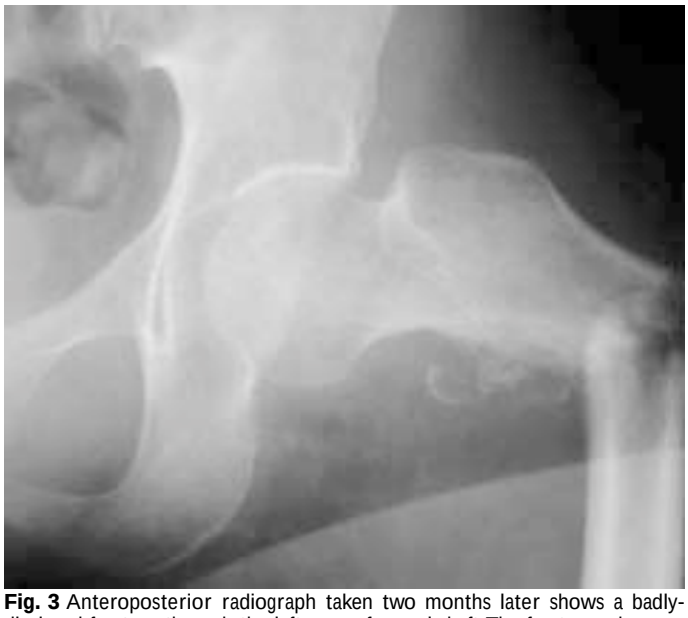

Fig. 3 Anteroposterior radiograph taken two months later shows a badly-displaced fracture through the left upper femoral shaft. The fracture edges are ill-defined and irregular. The lesser trochanter is destroyed and fragmented, with osteolytic lesions in the inter-trochanteric region. Appearances are those of a pathological fracture.

IMAGE INTERPRETATION

The pelvic radiograph (Fig.1) showed an osteolytic lesion expanding the lesser trochanter of the left femur. There were ill-defined destructive changes in the cortex of the adjacent femoral shaft (Fig. 2). The left hip joint was normal. No bone lesion was seen on the right side.

DIAGNOSIS

Lesser trochanter metastasis.

CLINICAL COURSE

Unfortunately, the clinician attending to the patient did not detect the radiographic lesions. The patient was reassured and discharged with oral analgesics. Two months later, the patient sustained a low impact fall at home. This resulted in very severe pain of the left upper femur, and she was unable to stand up. She was brought to the accident and emergency department where radiographs of her pelvis and left hip were performed.

The radiograph (Fig. 3) showed a badly-displaced fracture of the left upper femur. The fracture edges were ill-defined and irregular, with indistinct cortices. Compared to the previous radiograph, there was progression of the lesser trochanteric lesion to involve the adjacent femoral shaft. Final diagnosis was pathological fracture secondary to lesser trochanteric metastasis from breast carcinoma.

DISCUSSION

Metastases involving the skeleton are far more common than primary bone tumours. Bone metastases are usually found in the middle-aged and elderly age groups, with a much less frequent occurrence in children. The most common causes of widespread metastases in children are neuroblastoma and leukaemia. The frequency of bone metastases depends on the prevalence of a particular cancer in a particular community. For example, hepatocellular and nasopharyngeal carcinomas are more prevalent in the Far East than in developed Western countries. There is also a sex-related prevalence for bone metastases. In North America, the frequencies of bone metastases for men are, in descending order: prostate, lung, bladder, stomach, rectum and colon; while those for women are: breast, uterus, colon, stomach, rectum and bladder[1].

In a patient with a known primary carcinoma, development of bone pain is considered to be suggestive of bone metastasis. Occasionally, patients with bone metastasis may present with a pathological fracture or its complications, e.g. neurological impairment due to extradural compression from vertebral metastasis. As expected, patients with bone metastases typically have an impaired quality of life and reduced life expectancy. Metastases involve bone through three main mechanisms, namely: direct extension, retrograde venous flow, and blood-borne seeding by tumour emboli[2]. Retrograde venous extension is probably the major mechanism by which the vertebra are involved by spread from intra-abdominal cancer. An increase in intra-abdominal pressure diverts blood from the systemic caval system to the valveless vertebral venous plexus of Batson.

Blood-borne seeding occurs initially in the red marrow, accounting for the predominant lesion

distribution in red marrow-containing areas in adults. In adults, the lesions usually affect the vertebra, pelvis, proximal femur, ribs, proximal humerus and skull. In children, bone metastases tend to be more widespread. Certain carcinomas may have a predilection for certain anatomical sites. For example, primary pelvic tumours tend to spread to the lumbosacral spine while 50% of hand metastases arise from lung cancers (Fig. 4).

Imaging has an important role in the detection, diagnosis, prognostication, treatment planning and follow-up of bone metastases. Bone scintigraphy, usually using a technetium (Tc)-99m compound, is widely used and is the currently the most cost-effective technique for whole body screening for bone metastases. For lesions detected by bone scintigraphy, conventional radiographs are the best means for providing lesion characterisation. CT and MR imaging are useful for assessing suspicious bone scintigraphic abnormalities that appear radiographically-occult or equivocal. MR imaging has the additional advantage of demonstrating metastatic lesions before they appear positive on bone scintiscans. Whole body MR imaging and fluorine-18-fluorodeoxyglucose (FDG) positron emission tomography (PET) have recently been advocated to be accurate in early detection of bone metastases but are currently limited by their high costs.

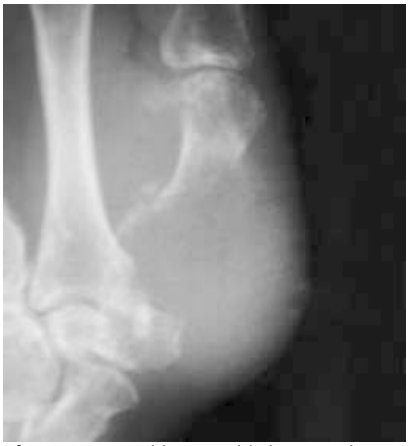

Fig. 4 55-year-old man with lung carcinoma. Lateral radiograph shows an expanded osteolytic metastatic deposit in the thumb metacarpal.

The radiographical appearances of bone metastases depend on the relationship between the degree of bone resorption or deposition, which in turn is influenced by the tumour type and location. The amount of osteoclastic or osteoblastic remodelling determines whether the bone lesion is predominantly lytic, sclerotic or mixed in pattern. Lesions usually initially occur in the medullary cavity, then spreads throughout the medullary bone, before destroying the cortex. Metastases from certain primary tumours are almost always osteolytic e.g. renal and thyroid carcinomas (Fig. 5), while others are usually sclerotic e.g. prostatic carcinoma. On the other hand, finding a sclerotic metastasis can virtually exclude an untreated renal cell carcinoma or hepatocellular carcinoma. In the spine, metastatic compression fractures typically have pedicle destruction (Fig. 6), associated soft tissue mass, and irregular end-plate deformity[1-3].

CT is more sensitive than radiographs in the detection of bone metastasis. Besides superior depiction of osteolytic, sclerotic (Fig. 7) and mixed lesions, CT has the added advantage of better

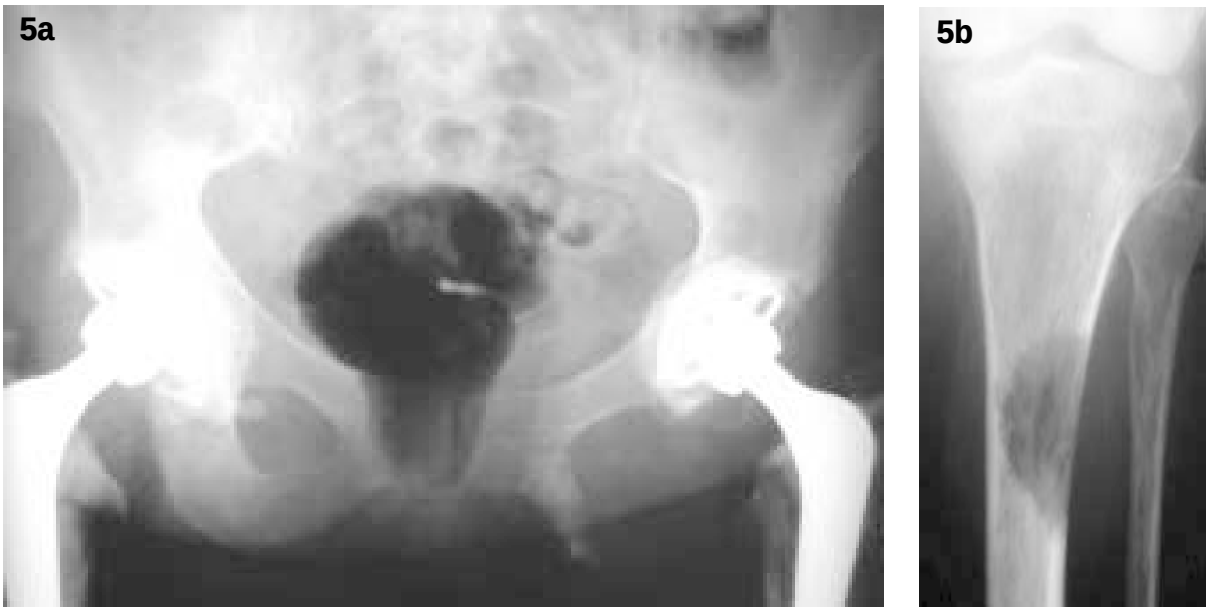

Fig. 5 59-year-old woman with renal cell carcinoma. Anteroposterior radiographs of the (a) pelvis and (b) left tibia show expanded osteolytic lesions in the left inferior pubic ramus and upper shaft of the tibia.

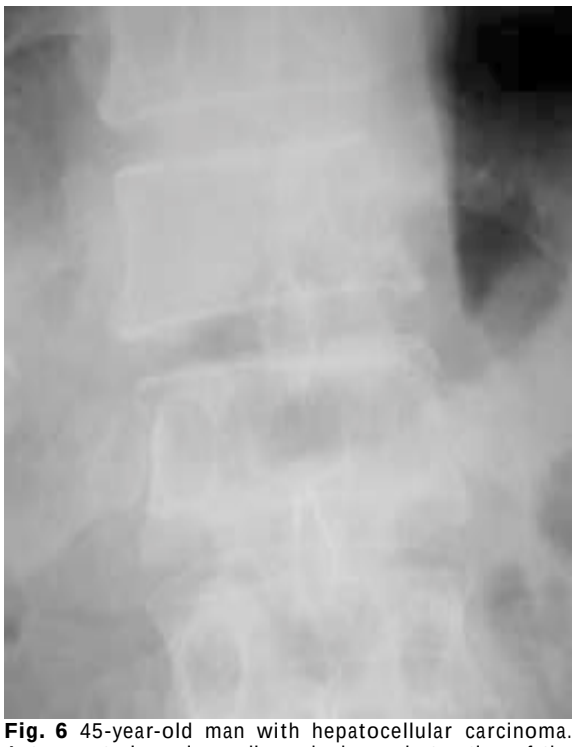

Fig. 6 45-year-old man with hepatocellular carcinoma. Anteroposterior spine radiograph shows destruction of the right T12 pedicle.

Fig. 7 73-year-old man with prostatic carcinoma. Axial CT scan of the lower pelvis shows several sclerotic metastases.

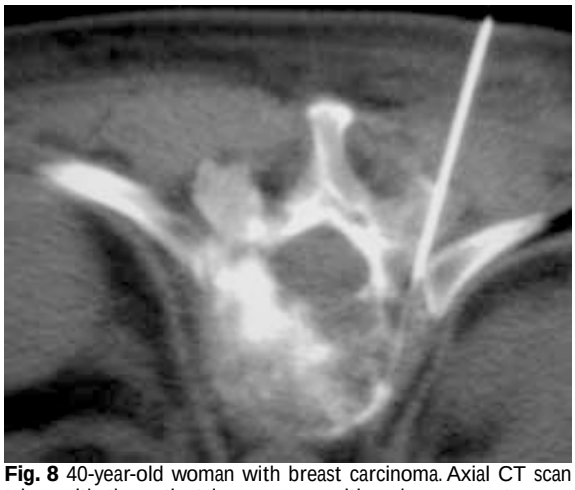

Fig. 8 40-year-old woman with breast carcinoma. Axial CT scan taken with the patient in a prone position shows percutaneous needle biopsy of an osteolytic metastastic deposit that predominantly involves the left side of T12 vertebra.

demonstrating trabecular and cortical destruction, soft tissue extension and neurovascular involvement. CT is also useful for guiding percutaneous needle biopsy of lesions within complex-shaped bones such as the vertebra and pelvis[1-3] (Fig. 8).

Tc-99m bone scintigraphy is an effective method of screening the whole body for bone metastases. Areas of increased uptake are seen where metastatic bone deposits induce increased osteoblastic activity. The classical pattern of bone metastases consists of multiple randomly distributed focal lesions throughout the skeleton (Fig. 9). Other variant patterns that may lead to diagnostic difficulties include a solitary uptake area, superscan (diffuse uptake), cold lesions (no or minimal uptake) and the flare phenomenon[1-3]. In general, bone scintigraphy is a sensitive (62-89%) but non-specific technique. FDG PET has the ability to detect early increased glucose metabolism of tumour cells. As FCG PET is limited by its low spatial resolution, complementary CT or MR imaging is usually required for better lesion localisation[4].

Some studies have shown MR imaging to be a feasible alternative to Tc-99m bone scintigraphy for evaluation of metastatic disease[5,6]. On MR imaging, metastatic lesions are typically T1 hypointense and T2 iso- or hyperintense (Fig. 10). Differentiating benign from malignant compression vertebral fractures may be difficult, particularly if secondary criteria, such as posterior vertebral body bulging, signal intensity changes extending into the pedicle and paravertebral soft tissue spread, are absent. Recent reports describing the use of diffusion-weighted imaging and apparent diffusion coefficient values appear promising[7-9].

ABSTRACT

A 73-year-old woman who had previous mastectomy for breast carcinoma presented with persistent pain over the left hip area for two to three months. Pelvic radiograph showed an expanded osteolytic lesion involving the lesser trochanter of the left femur, with adjacent ill-defined destructive changes. She subsequently developed a displaced pathological fracture through the lesser trochanteric metastasis. The clinical features and pathophysiology of bone metastases are discussed. The role of imaging, with additional illustrative examples, is emphasised.

Keywords: breast carcinoma, bone metastasis, radiograph, magnetic resonance imaging, bone scintigraphy

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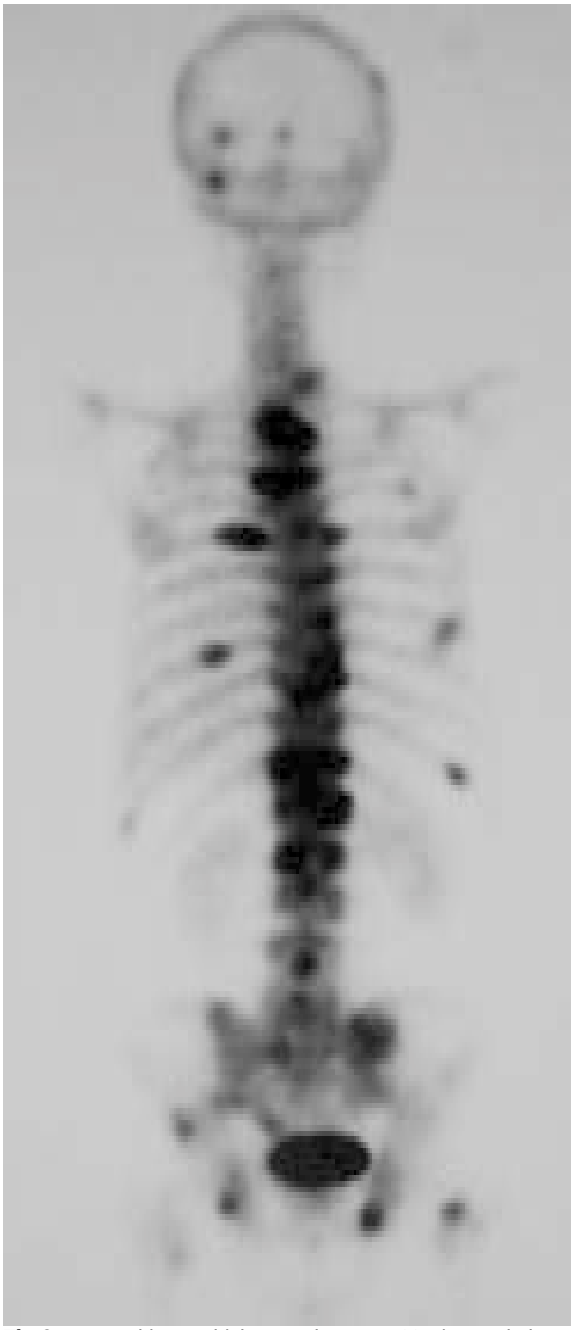

Fig. 9 74-year-old man with lung carcinoma. Tc-99m bone scintiscan (posterior projection) shows multiple areas of increased uptake that are randomly scattered throughout the skeleton, typical of bone metastases.

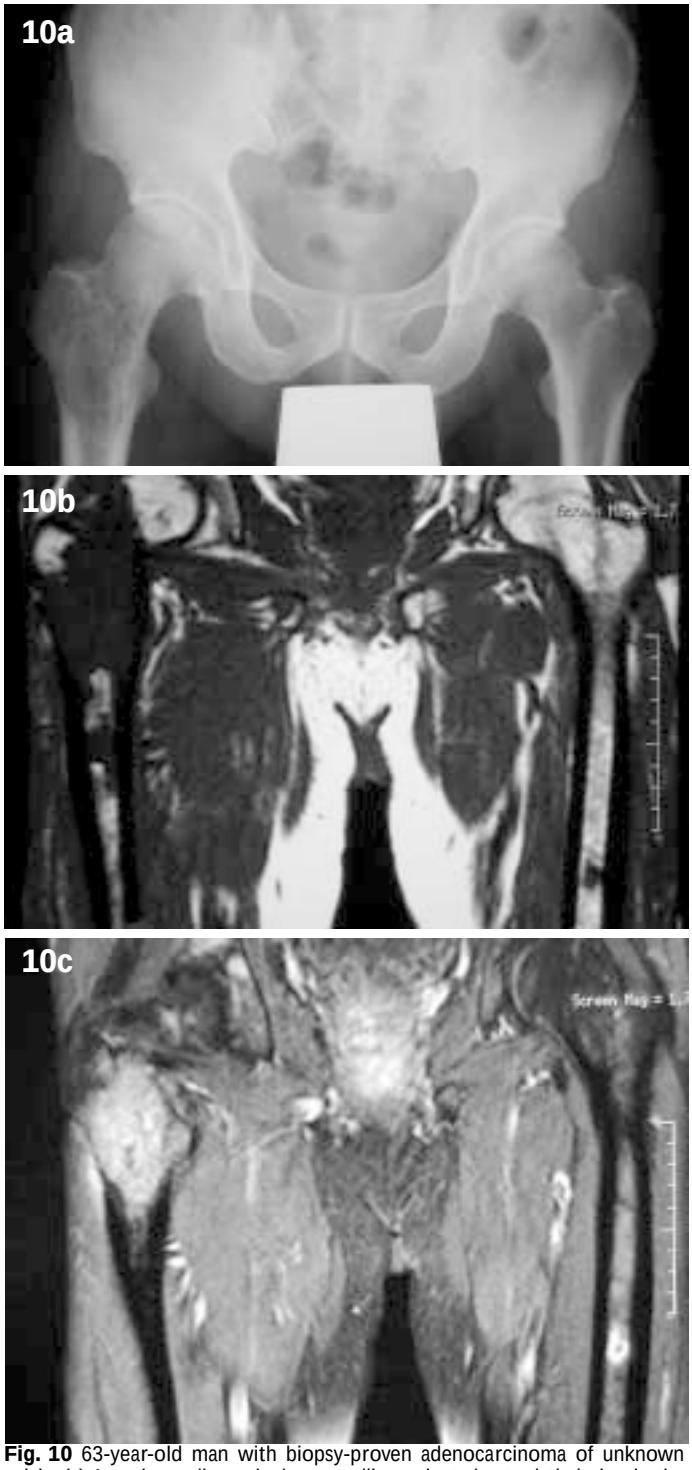

Fig. 10 63-year-old man with biopsy-proven adenocarcinoma of unknown origin. (a) Anterior radiograph shows an ill-marginated osteolytic lesion in the right trochanteric region. Coronal (b) T1-weighted and (c) enhanced fat-suppressed T1-weighted MR images show the true extent of the right femoral lesion which involves the lesser trochanter, as well as a small radiographically-occult lesion in the left upper femoral shaft. Both metastatic lesions are T1 hypointense, T2 hyperintense (not shown) and display marked enhancement.

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