Cancer Imaging (2002) **2,** 99–100
DOI: 10.1102/1470-7330.2002.0011

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REVIEW

Indeterminate bone lesion: the diagnosis

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Date accepted for publication 30 January 2002

Keywords: *Bone tumors; CT; MRI.*

Introduction

The diagnostic approach is statistical[1,2]. Age is important: before 5 years old, malignant tumour is almost always metastatic neuroblastoma; between 5 and 15 years old, it is often osteosarcoma or Ewing's sarcoma; after 40 years old, it tends to be metastasis or myeloma. Clinical symptoms vary little and are most often pain and swelling. Although fever suggests infection, it may also be found in Ewing's sarcoma.

The first step in the evaluation of a tumour is to determine its aggressiveness by conventional radiology. Important parameters include the tumour size, type of matrix, and periosteal reaction. Certain tumours are more common in particular bones. Adamantinoma, usually found in the adult, selectively involves the tibia and fibula. The most common epiphyseal tumour in childhood is the chondroblastoma. In addition, the aggressiveness of some tumours may relate to their location in the axial or appendicular skeleton: in the hand, cartilaginous tumours are almost always benign, whereas in the pelvis, they are often malignant. If necessary, multiple lesions may be estimated with bone scanning. Multiple lesions are seen in chondromas, osteochondromas, histiocytosis X and metastases.

The first necessary step is to definitively diagnose benign lesions based on clinical and radiologic signs, and for which biopsy is not necessary. These lesions are fibrous cortical defect, non-ossifying fibroma, periosteal desmoid, fibrous dysplasia, osteochondroma or exostoses, chondroma, simple bone cyst, vertebral angiomas and myositis ossificans.

Diagnosis may be difficult. In these cases, the next step is CT. Problems can result from bone locations which are difficult to evaluate on conventional X-ray (short, flat bones especially the pelvis, sacrum, sternum, and vertebrae). Sometimes, the study of the tumour matrix can provide features necessary for the diagnosis. It can be fluid density, small calcifications allowing diagnosis of cartilaginous tumour, osteoid matrix, or fat[3]. CT is the examination of choice in the diagnosis of the nidus of osteoid osteoma in dense bone[4]. Small lytic lesions of the cortex, localized involvement of the soft tissues and thin peripheral periosteal reaction can be seen; lesions with slow evolution which displace and expand the cortex peripherally can be distinguished from more aggressive lesions which cross the cortex. CT can show the tumour on both sides of the cortex before it is destroyed. This is the case for Ewing sarcomas and osteosarcomas[5]. CT allows measurement of the thickness of a non-calcified cuff of a cartilaginous tumour: the cuff is thin in benign lesions and thick (more than 3 cm) in chondrosarcomas[6,7].

In other cases, evidence favours a malignant lesion. Examination for metastases, and MRI examination before biopsy, must be performed.

Staging examination

Local

Focal extent and staging is based on magnetic resonance imaging (MRI)[8–10]. The main advantages are high contrast and the possibility of choosing the plane of examination without moving the patient. On the other hand, MRI is rarely useful for diagnosis. Tl and T2 measurements are not reliable and reproducible because

1470-7330/02/000099 + 02

most large tumours are heterogeneous with variable signal intensity. Therefore, it is impossible to characterize such tumours and to distinguish benign from malignant lesions[11]. MRI is rarely useful in the diagnosis of fluid levels in blood-filled cavities, especially anevrismal bone cysts.

Intramedullary extension

In the medullary cavity, diaphyseal and metaphyseal extension in both adult and child, and extension across the growth plate in the child, are best demonstrated on MR images, due to their excellent contrast and ability to image in the longitudinal plane. Although CT can also evaluate extension, it is limited to the axial plane. Both CT and MRI have other limitations: the inability to detect very small lesions and the overestimation of the tumour volume on T2-weighted sequences because of peritumoral edema[12]. With accurate evaluation of tumour extent, the surgeon can determine the level of bone resection and the size of the prosthesis. The growth plate in children and the joints in adults can sometimes be preserved when uninvolved.

In periosteal tumors, MRI demonstrates the periostal location, its extension into cortex, and the medullary cavity[13]. CT can also define extent of diaphyseal periosteal lesions, but not of metaphyseal periosteal tumours.

Intraarticular extension is detected with better sensitivity than with any other imaging technique because of direct visualization of joint cartilage.

Skip lesions (small metastases separated from the main tumour by healthy tissue) are easily detected on MR scans parallel to the long axis of the bone.

MRI also shows excellent demonstration of vessels and their relationship to the tumour without injecting contrast media.

Both CT and MRI can show skin and subcutaneous extension.

In summary, MRI should be used as the principal test for evaluating extension of malignant tumours.

Examination of distant spread

Bone metastases are best detected on radionuclide bone scans. Pulmonary metastases are evaluated on conventional chest radiographs and chest CT[14].

Conclusion

Imaging should begin with the plain radiograph, which defines a lesion as benign and requires no treatment. When the type of matrix needs to be clarified, CT should be performed. MRI however, should be the primary study for staging the tumour extent.

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