Tc99m Diphosphonate imaging - giant cell tumours on MDP scanning

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Abstract

Ten patients with histologically proven giant cell tumour (biopsy) were imaged with 3-phase bone scanning, using 99m Tc-MDP. The perfusion (Phase I) and uptake (Phase III) were compared to the normal contralateral side and the rest of the skeleton was inspected for other abnormalities. Ninety per cent of lesions showed a doughnut-type pattern of uptake and presented with moderately increased perfusion (2.9 normal ± 0.7) and markedly increased uptake of tracer (7.5 normal ± 1.4). The patient with diffuse uptake had a pathological fracture.

Introduction

Giant cell tumour of bone is a primary skeletal neoplasm of unknown cellular origin.[1,2] It is an expansile and highly vascular neoplasm that usually arises in the metaphyseal regions of long bones such as distal femur, proximal tibia and distal radius. It is now believed that the true giant cell tumour (GCT) is always malignant. Although it is late to metastasise, it has a high potential for local recurrence.[3] Radionuclide bone scan in GCT has been used to determine the anatomic extent of the lesion and to detect other skeletal lesions.[4]

We describe features to differentiate GCT on radionuclide bone scan from other lesions.

Materials and methods

Ten patients (7 males and 3 females, mean age 32,6) with biopsy proven GCT were evaluated using a 3 phase bone scan. 99m Tc Diphosphonate (MDP) was used as tracer and imaging was performed using a Sophy DSX camera with a low energy high resolution collimator. 700 Mbq 99mTc MDP were injected into an antecubital vein at 60 frames per second (Phase I) followed by a pool image of 1 minute (Phase II), acquired 3 hours later (Phase III). The maximum activity on the perfusion curve (Phase I) of the pathological side was compared to that of the normal side. Maximum uptake (Phase III) in the giant cell tumour was compared with contralateral normal bone uptake by image profile.

Results

Figure 1: Whole body scan which shows the lesion with a cold centre.

Of the 10 patients, 9 (90%) showed a doughnut pattern, that is markedly increased activity in the periphery of the lesion with a cold centre (Figure 1). The patient with diffuse uptake had a pathological fracture. All tumours were at least 6cm in size (mean 8,6cm±2,7) and occurred most commonly in the proximal tibia in 4 patients and distal radius in 2 patients. Mean perfusion of the tumour was 2,9 times normal (SD ±0,7) while mean uptake was 7,5 times normal (SD ± 1,4) see Table I. Normalised perfusion curves are shown in Figure 2 and perfusion images in Figure 3. An image profile of the uptake in

Table I: Results

Patient	MA	NJ	LA	MG	MM	TM	MJ	MF	ME	JM
Gender	M	M	M	F	F	M	F	M	M	M
Age	31	23	18	35	48	19	20	46	36	50
Position	DH	DF	DR	PT	DR	PH	DT	PT	PT	PT
Size (cm)	8	10	6	7	7	6	8	10	9	15
Doughnut	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Diffuse	Y	N	N	N	N	N	N	N	N	N
Fracture	Y	N	N	N	N	N	N	N	N	N
Perfusion	2,5:1	4:1	3:1	2,5:1	3:1	2:1	2:1	3:1	4:1	3:1
Uptake	7:1	6:1	7:1	6:1	8:1	10:1	9:1	8:1	8:1	6:1

DH - Distal humerus
DF - Distal femur
DR - Distal radius
PT - Proximal tibia
PH - Proximal humerus

to page 40

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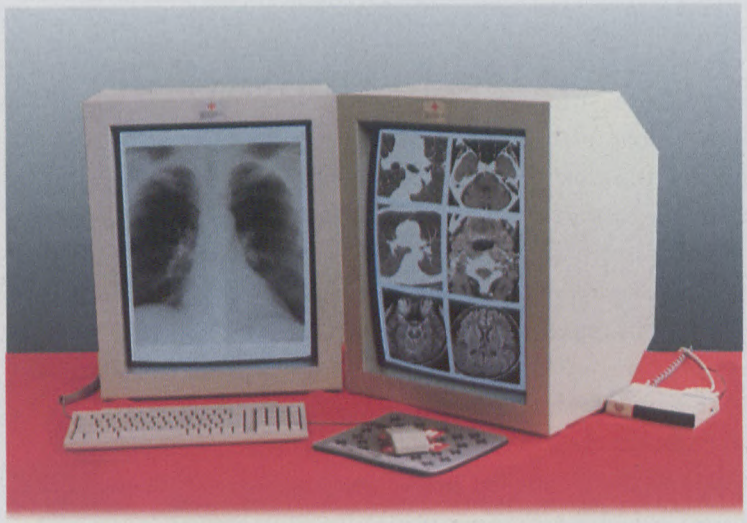

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from page 38

the pathological to the normal region is shown in Figure 4.

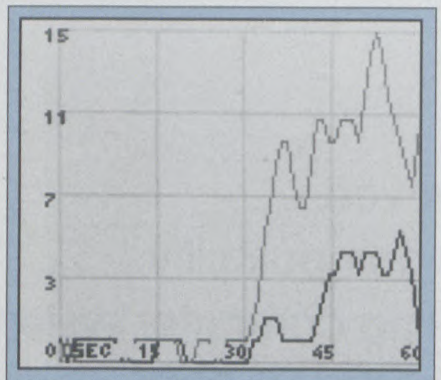

Figure 2: Normalised perfusion curves from regions of interest Phase I (dark curve from the contralateral, normal bone).

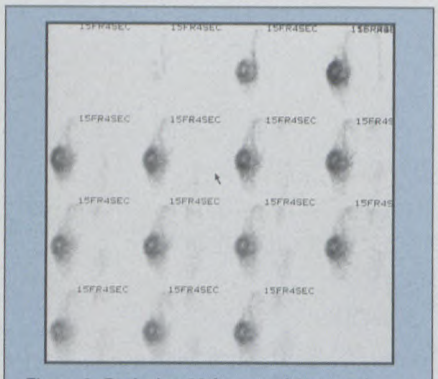

Figure 3: Perfusion 60 frames of 1 second compressed to 15 frames of 4 second (Phase I).

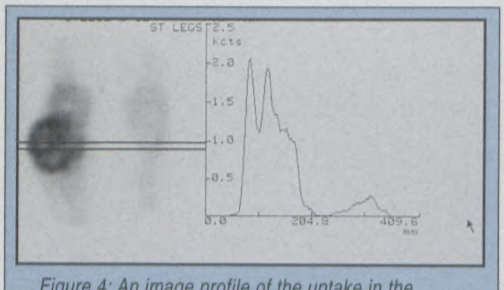

Figure 4: An image profile of the uptake in the pathological to the normal region (Phase III).

Discussion

Giant cell tumour is common between the ages of 20 and 40 as confirmed in our series. Often patients present with pain following trauma and sometimes with a mass or swelling. A pathological fracture occurs in 10 per cent of cases.[1] The origin of GCT is controversial. It is formed by multinucleated giant cells within intervening stromal cells and often there is a striking sinusoidal vascular bed with focal telangiectasia, sometimes with changes such as fibrosis, necrosis and cyst formation.[5] Osteoblastic activity is usually confined to the peripheral reactive margin.[6] We noted that GCT rarely involves the joint space, as confirmed by other authors. However, not infrequently a joint effusion may be present.[7]

Osteoblastic activity with bone formation in the periphery and little or none centrally has been cited as the major reason for the doughnut-type pattern of uptake in giant cell tumours.[7] Other factors such as secondary telangiectasia, cyst formation and necrosis may also contribute to this pattern.[7,8] Imaging technique also contributes to the ability to demonstrate a doughnut.[4] Some workers believe that lesions should show a doughnut rather than a diffuse pattern with improved techniques. This is shown in our series (9/10 GCT) and was confirmed with SPECT imaging (Figure 5). The differential diagnosis for this type of uptake includes aneurysmal cone cyst and nonosteogenic fibroma, which unlike GCT, have an unimpressive degree of tracer uptake. We found that the uptake was markedly increased while perfusion was moderately increased.

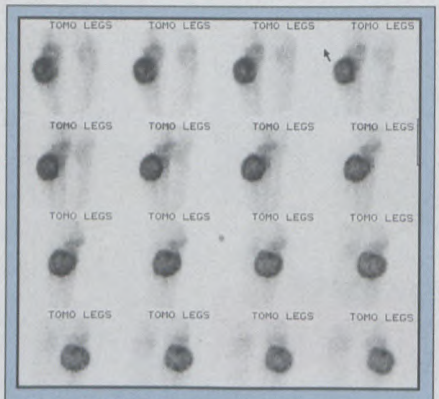

Figure 5: SPECT images demonstrating a doughnut-type pattern of uptake.

The patient with diffuse uptake of tracer in our series had a pathological fracture which could explain the obliteration of a doughnut pattern as suggested by other workers.[9] The reason for this could be osteoblastic activity with focal tracer accumulation in the centre of the fracture.[10] GCTs are rarely multicentric but may occasionally cause skip metastases.[11] These fractures are best evaluated by radionuclide scan, thus being helpful with the entire approach to the diagnosis and management of GCTs.

Conclusion

A doughnut pattern in a metaphyseal region of long bone with markedly increased uptake in the periphery and moderate perfusion makes the differential diagnosis of GCT likely. However, diffuse pattern can occur, especially in the presence of a pathological fracture or with poor imaging technique. Reasons for the doughnut pattern could be increased peripheral uptake due to reactive secondary bone formation or decreased activity in the centre secondary to cyst, telangiectasis or necrosis. Radionuclide bone scan is important in the management of GCT, especially in cases with skip lesions and multicentricity.

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