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Bone scintigraphy in tuberculous spondylodiscitis*

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Abstract Tuberculous affection of the spine can present in different ways. Plain radiographs may fail to show any abnormality. Bone scintigraphy can be a very useful tool in the diagnosis and management of patients with tuberculous spondylodiscitis. This is a retrospective study of 40 patients in whom bone scan was performed using ^{99m}Tc-MDP (technetium methylene diphosphonate) before starting anti-tuberculous therapy or any surgical intervention. Four different types of uptake were noted. The uptake was abnormal in 38 out of 40 patients, giving a sensitivity of 95%. Multicentricity was picked up in 25% of cases. No skull lesion was noticed in any of these patients. Rib lesions were found in six patients (ten ribs affected). The rib lesion was always a typical band pattern. This paper outlines the advantages as well as limitations of bone scan in tuberculous affection of the spine.

Key words Bone scintigraphy · Tuberculous spondylodiscitis · Sensitivity and specificity

Introduction

Bone and joint tuberculosis continues to be a major problem in most developing countries and there has been evidence of a resurgence in the western world. Tuberculous spondylodiscitis can have a varied clinical presentation. The clinician may well be presented with patients in whom clinical examination, radiographs, as well as routine haematological investigations, may fail to locate the lesion. Bone scintigraphy and MRI are being increasingly used in the diagnosis and localisation of pathology in such cases.

Review of English literature failed to produce significant information on the use of bone scan in tuberculous affection of the spine. It was therefore thought worthwhile to undertake a study to determine the advantages and limitations of bone scintigraphy in the diagnosis and management of patients with tuberculous affection.

Materials and methods

A retrospective study of 40 patients suffering from tuberculous spondylodiscitis was carried out at King Edward Memorial Hospital, Bombay, between January 1990 and December 1993. Their ages ranged from 21 to 65 years (average age: 36.3 years). The study included 22 male and 18 female patients. Baseline investigations including plain radiographs, and blood tests including ESR were performed. The bone scan was done prior to any surgical intervention or commencement of anti-tuberculous therapy. Only patients with histopathological confirmation were included in this study.

The histopathological confirmation was done by CT-guided biopsy of the affected vertebra. In patients with rib lesions, open biopsy of the affected site was performed. All the patients had a typical tuberculous lesion on histopathological examination i.e., a nodular pattern with a central area of necrosis. Typical Langerhans giant cells with peripheral nuclei were also noted. Presence of acid and alcohol fast bacilli, as shown by the Ziehl-Neelsen method of staining, and/or presence on histology of a granuloma with caseation was considered to be diagnostic of tuberculosis.

A four-phase static bone scan (including a 24-h image) using ^{99m}Tc MDP (technetium methylene diphosphonate) as a marker

was performed. A dose of 10–15 MCi was injected intravenously and a gamma camera was used for imaging. The scans were analysed and the following points were taken into consideration:

1. Skeletal areas of abnormal uptake
2. Types of uptake in the affected skeleton
3. Extravertebral sites of skeletal affection

Anti-tuberculous chemotherapy was the cornerstone of treatment for these patients. Complete neurological deficit at the time of presentation, worsening of the neurological deficit while on chemotherapy (as judged by Frankel's grading) or persistent painful instability were used as indications for surgical intervention.

Results

Scintigraphy

The uptake was increased in 38 out of 40 patients, while it was normal in remaining two patients, giving a sensitivity of 95%. The abnormal uptake was either of homogeneous or heterogeneous nature. Four different types of uptake were noted.

Type I: Diffuse with disc space obliteration

In type I cases, uptake in the affected vertebrae was uniformly increased (homogeneous) in the entire vertebral body, with intervening disc space obliteration. This was the most common type of uptake, seen in 22 patients and affecting 56 vertebrae (Fig. 1).

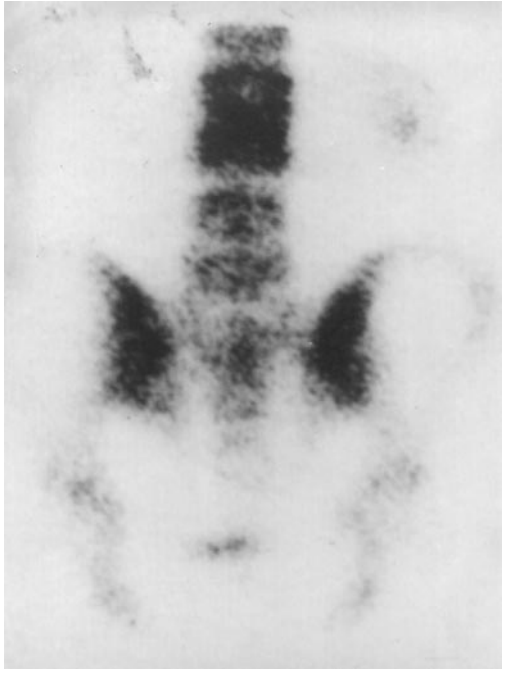

Fig. 1 Bone scan showing type I pattern: diffuse with disc space obliteration

Type II: Diffuse with central cold spot

Type II uptake was diffusely increased with a central cold spot and a tendency to spare the adjoining disc spaces. This pattern was noted in ten patients, affecting 12 vertebrae (Fig. 2).

Fig. 2 Bone scan showing type II pattern: diffuse with central cold spot

Fig. 3 Bone scan showing segmental pattern (type III)

Fig. 4 Bone scan showing multicentricity (increased uptake in mid lumbar, lower thoracic regions as well as ribs)

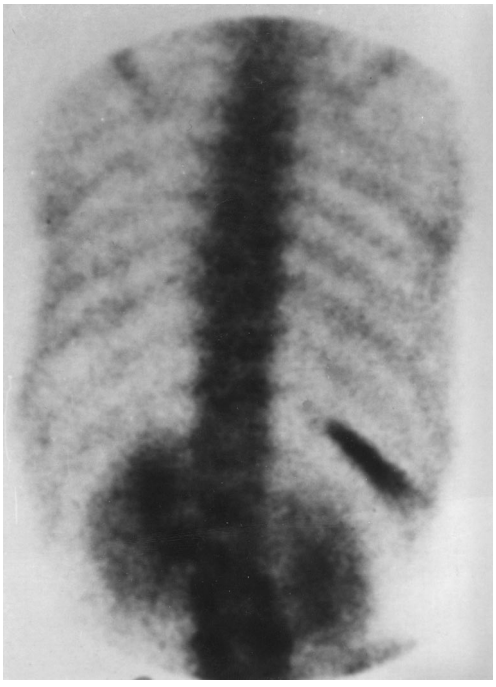

Fig. 5 Bone scan showing a typical rib lesion

Type III: Segmental

The increase in uptake in the type III pattern was patchy in the affected vertebra, with intervening areas of normal uptake. It was noted in six patients, affecting ten vertebrae (Fig. 3).

Type IV: Normal

Two of the patients with affection of lumbosacral junction had normal uptake, although the pathology was obvious on radiographs as well as at the time of surgery.

Multicentricity was picked up in ten patients (25%) (Fig. 4). Rib lesions were noticed in six patients, affecting ten ribs. The lesion was always a diffuse band of increased uptake of varying length (Fig. 5). No skull lesion was noted in any of the patients. Six patients had vertebral skip lesions, two of which also had a rib affection.

Plain radiographs

Four different types of radiographic presentation were noted on radiological examination of the affected skeleton.

1. Paradiscal affection with disc space narrowing
2. Vertebra plana
3. Anterior scalloping
4. Normal

Table 1 Correlation between different types of X-ray findings and the scintigraphic patterns. The figures refer to the number of patients and not the number of vertebrae affected

Bone scan pattern	X-ray findings			
	Paradiscal affection	Vertebra plana	Anterior scalloping	Normal
Diffuse with disc space obliteration	14	–	–	8
Diffuse with central cold spot	2	6	2	–
Segmental	–	–	2	4
Normal	2	–	–	–

Table 1 shows the correlation between different types of radiographs and the scintigraphic patterns. In six patients with vertebral skip lesions, radiographs failed to demonstrate any abnormality at the site of skip lesion.

The radiographs failed to show any abnormality in 12 patients (30%). In this subgroup, the scan showed increased uptake of segmental pattern in four patients, while in the remaining eight the uptake was of diffuse nature with disc space obliteration.

Histopathology

The diagnosis was confirmed by microbiology and histopathology of the sample collected at the time of biopsy.

Acid and alcohol fast bacilli could be seen in 21 patients, while a typical tuberculous lesion was seen in all 40 patients included in this study. No correlation was noted between different scan types and histopathological findings. The rib lesion was not biopsied. Presence of a tuberculous lesion elsewhere and favourable response to anti-tuberculous therapy were considered to be adequate evidence for the rib lesion to be tuberculous.

Surgery

Surgery was performed in eight patients. Four had complete paralysis below the level of affection at the time of initial presentation, three worsened in their neurology while on treatment, while one patient had persistent pain at the end of 6 months of anti-tuberculous therapy, requiring anterior debridement and fusion.

Discussion

Radionuclide bone scintigraphy with ^{99m}Tc-MDP is far more sensitive than radiographs in picking up a pathology that causes alteration in local osseous blood supply. In this study, a four-phase bone scan was used, as the uptake of ^{99m}Tc-MDP stops at about 4 h in lamellar bone (normal skeleton), but continues for about 24 h in woven bone (e.g. abnormal bone around the affected site) [8]. The fourth phase has sometimes been useful to differentiate between early osteomyelitis and a deep-seated infection in the vicinity of the bone. Some degree of washout is seen in hyperaemic but non-involved bone, whereas primary bone infection continues to acquire some radiopharmaceutical or else shows little change. Abnormal skeletal findings on a bone scan are intrinsically nonspecific and may reflect secondary alteration of bone activity at the abnormal site itself or at the periphery, where normal bone is affected by changes in the physiologic parameters. The intensity of the 'hot lesion' reflects the degree of reactive new bone formation as well as increased blood flow. An intact vasculature is required in order for osseous abnormalities to manifest their typical appearance as hot lesions [11]. Photopoenic defects (cold spots) are less common, but may be due to inadequate blood supply or a lytic lesion with loss of osseous tissue [3]. The blood supply may be affected by pus or by vasospasm [9]. Occlusion of the intraosseous blood vessels due to oedema or a bone infarct is also a possibility. These possibilities must be kept in mind in analysing a bone scan.

Widespread availability and relative ease of performing whole-body skeletal survey make bone scan a better tool in the initial evaluation of the patient. Imaging of the entire body helps to pick up clinically silent skeletal lesions, which need not be vertebral. Identification of skip lesions can change the management protocol to a great extent in such patients. Bone scan not only helps in picking up multicentricity, but also describes the spatial extent of the lesion at the affected site. Although non-specific, this non-invasive investigation can help to narrow the differential diagnosis in a patient with vague clinical presentation. Presence of a typical rib lesion with absence of a skull lesion can be used as a supplementary evidence in suspicious cases.

Although quantification was not used in this study, it can probably be used in future not only to demonstrate the severity of the affection but also to judge the response of the patient to antituberculous therapy (follow-up scans). The pitfalls of non-specificity and false-negativity limit the use of bone scan as a complementary tool in the diagnosis of suspected cases of tuberculous spondylodiscitis.

Sarkar et al. used ^{67}Ga to detect and follow up extrapulmonary tuberculosis [8]. They found it to be a reliable and simple method of screening patients at risk. Defiore et al. have used ^{85}Sr scintigraphy of the spine to permit precise topographic and quantitative evaluation. They found it to be of value in differentiating recent compression fractures from old ones, evaluation of activity in a spondylitic focus and differentiation between degenerative spondyloarthroses and specific entities. In the subgroup of infective spondylitis, the authors felt that scintigraphy was a useful tool in confirming pathology when the radiographs were dubious [4].

Lifeso et al. found ^{99m}Tc bone scan to be negative in 35% of cases with radiographic and clinical evidence of active disease. The authors noted a high incidence of negative Ga scans as well (7 out of 10) in the series [6].

Bahk et al. used pinhole collimator scintigraphy (PCS) to differentiate between tuberculous spondylitis, pyogenic spondylitis, compression fractures and a metastatic lesion [1]. The authors in their prospective study found the uptake to be homogeneous throughout the affected vertebra in tuberculosis, while it was increased in the end plates, giving a sandwich-like appearance, in cases of pyogenic spondylitis. In cases of compression fractures the pattern was a characteristic board-like accumulation along the entire length of the vertebral end plate, while a metastatic lesion manifested as diffuse or focal homogeneous accumulation within the vertebral body. We did not use Pinhole Collimator Scintigraphy (PCS) in our study, but the type of increased uptake in our study was either homogeneous (type I) or heterogeneous (types II, III).

Desai argued that scintigraphy is a sensitive method, which can be used as a relatively inexpensive investigation in early diagnosis of spinal tuberculosis. In his series of 24 patients, the author commented on findings of scintigraphy in 16 patients in whom it was performed. Fourteen had positive results, while the uptake was normal in two patients, giving a sensitivity of 87.5%. In both these cases, the lesion was limited to posterior elements, with the vertebral body being essentially normal as confirmed by MRI scan [5]. In our study, we did not encounter any patient

where the pathology was restricted to only posterior elements. Both the false-negative scans in our study had L5-S1 affection, as confirmed by operative findings and histopathology. As mentioned earlier, the vascularity of the affected region may have been reduced, giving a false-negative scan.

MRI has the ability to detect the disease early. Desai described three different patterns, i.e. osteitis, osteitis with an abscess and osteitis with or without an abscess with discitis, depending on the stage of the disease [4]. He noted decrease in the signal intensity of involved bone and soft tissues on T1-weighted and increased signal intensity on T2-weighted images. MRI with Gd contrast is useful to differentiate abscess from granulation tissue and is helpful in delineating both the soft tissue mass and amount of soft tissue destruction. However, MRI has its own limitations [10]. Presence of intracardiac wires, some heart valves, some intracranial aneurysmal clips or presence of ferromagnetic intraocular foreign body precludes use of MRI. In a developing country, cost as well as ready availability also remain important considerations.

With the widespread occurrence of AIDS and ever-increasing number of immunocompromised patients, bizarre clinical presentation of tuberculosis is becoming more common. In the Unites States, recent immigrants, patients with AIDS, the homeless population and ethanol and drug abusers are found to be groups at risk to contract tuberculosis [7]. In a recent series, initial radiographs failed to localise the spinal infection in 20% of cases of intravenous drug abusers with proven spinal infection [2]. In such cases as well, bone scan may prove to be of value.

Conclusions

Bone scintigraphy is an economical and highly sensitive tool in the armamentarium of the treating surgeon to localise a lesion in suspected cases of tuberculous spondylodiscitis. It picks up clinically silent lesions with ease. Associated typical rib lesion and absence of skull lesion may prove to be supplementary in reaching a diagnosis in doubtful cases. The pitfalls of non-specificity and false-negativity limit its use to that of a relative rather than absolute tool in the diagnosis of suspected cases of tuberculous spondylodiscitis.

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