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Role of MRI to Assess the Progress of Spinal Tuberculosis During the Course of Treatment

***Corresponding Author(s): Saurabh dwivedi**

SN medical college Agra India, Motikatra Agra 282002, India

Tel: 750 062 6495, Fax: +91 562 226 0965;

Email: dwivedi7500@gmail.com

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Abstract

Introduction: Spine is the commonest site of skeletal involvement in tuberculosis and constitutes more than 50% of all forms of osteo-articular tuberculosis. MRI is the most valuable non-invasive diagnostic and prognostic tool in the patients with spinal tuberculosis to promote early detection of disease and assess the response of treatment and change in regime of A.T.T. accordingly.

Objective: Magnetic Resonance Imaging pattern of Spinal tuberculosis during course of treatment, to promote early detection of spinal tuberculosis and assess the response of treatment and change in regime of A.T.T. accordingly.

Material and methods: In this study, the MRI scans of 49 consecutively managed spinal tuberculosis patients with or without neurological deficit over 1.5 year period were studied cross-sectionally in the Department of Orthopaedics, S. N. Medical College, Agra were analyzed, to determine the pattern of occurrence of various pathological lesions. They were followed up with anti-TB treatment (ATT) according to standard guidelines.

Result: It was found that spinal tuberculosis was most commonly observed in the 31-50 years age group with a male predominance. The dorsal and the lumbar vertebrae are commonly involved and multiple vertebrae were often affected with kyphotic deformity in 36% cases. Intervertebral disc involvement with pre and paravertebral collections were commonly seen in about 75% of the cases. Cord oedema was noted in 20% of the cases. Nerve root compression was seen in 63% of cases. Thirty-five patients had no neurological deficits while 14 had paraplegia of varying severity. The canal encroachment was observed in 75% cases. Serial MRI were done during the course of treatment to assess the disease progression.

Conclusion: This study showed that MRI is the most valuable investigation in the evaluation of spinal tuberculosis. The MRI scan is highly sensitive in the detection of various pathological conditions of spinal tuberculosis and their pattern of occurrence. Serial MRI scans can be used to assess the disease response to treatment.

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Introduction

Tuberculosis is a chronic granulomatous disease caused by infection with Mycobacterium species. Spine is the commonest site of skeletal involvement in tuberculosis and constitutes more than 50% of all forms of osteo-articular tuberculosis in India. Annually about 6 million people become ill with tuberculosis and two million die from disease worldwide [1]. In the developing countries, the disease has an aggressive course, particularly in children and young adults resulting in abscess formation. Consequently, neurologic complications and spinal deformities are frequently observed [2]. Spinal involvement occurs in less than 1% of patients with TB [3,4] but the increasing frequency of TB in both developed and developing countries has continued to make spinal TB a health problem [3,5]. Spinal tuberculosis is the most common as well as the most dangerous forms of skeletal TB and accounts for about 50% of all cases of skeletal tuberculosis. Although the dorsolumbar spine seems to be the most common site of the spinal column involvement in spinal tuberculosis, any part of the spine can be affected. Furthermore, the incidence of neurological complications in spinal TB varies from 10% to 44% [4]. Paraplegia may develop in 20 – 25% cases [5]. Tuberculosis of spine is the most common cause of non-traumatic paraplegia in the most parts of world. Conventional X-rays are useful in diagnosis of spinal tuberculosis but their main disadvantage is that more than 50% of bone has to be destroyed before a lesion can be seen on a plain radiograph, a process which takes nearly six months. Advanced imaging techniques like Magnetic Resonance Imaging (MRI) make the early diagnosis of spinal TB easier and a considerable number of patients with spinal TB are diagnosed earlier and treated before significant neurological deficits develop. However, patients can still present late with considerable spine deformity [6].

MRI because of the lack of ionizing radiation, high contrast resolution, ability to detect marrow infiltration and ease of assessment of extradural disease and status of spinal cord, has become the established optimal imaging technique in the diagnosis of spinal infections and their sequel. However, to date, differentiating tuberculous spondylitis from pyogenic spondylitis is a challenge, in view of varied presentation of the former. MRI has the ability to provide excellent contrast resolution in all planes, making the diagnosis and evaluation of tuberculous spondylitis and para-vertebral extension easier. Serial MRI examinations can be used to assess the response to treatment [7,8] and are very useful in the management of multilevel infection. Serial MRI scans can also be used to assess the healing of infection.

Materials and methods

A hospital based cross sectional study was evaluated. These cases were from the OPD and IPD from the Department of Orthopedics and the patients who were referred to the Department of Orthopaedics from Department of General Medicine, Pulmonary Medicine and Paediatric Department of S.N. Medical College, Agra on the basis of their clinical presentation over a period of 17 months from November 2017 to May 2019 who were fulfilling inclusion criteria. The inclusion criteria of study was those patients aged 21-60 years of age with or without neurological deficit at spinal level with strong clinical suspicion of spinal tuberculosis.

A detailed history along with complete clinical examination and laboratory investigations will be done before the MRI examination. Forty-nine patients with paradiscal spinal TB lesion, with/without paraplegia, aged over twenty years were enrolled. All patients having classical clinico-radiological diagnosis of spinal tuberculosis or who showed evidence of healing on treatment or with a proven histopathological/bacteriological/cytological diagnosis of TB spine were included in the study. The cases were (A) freshly diagnosed cases of TB spine and (B) patients who had completed treatment successfully and had a pre treatment MRI examination. Trauma patients, patients with metallic implants, patients with pacemaker or cochlear implants, patients with isolated intraspinal granuloma, isolated posterior complex involvement, isolated cranio-vertebral junction TB, isolated sacral tuberculosis or patients without a classical clinico-radiological diagnosis were not included in the study. Neurological assessment was performed by Jain and Sinha scoring system [6]. The radiological diagnosis was made on observations of demineralisation of the vertebra, fuzzy paradiscal margin, reduction or obliteration of disc space, along with one or more of the following findings:- destruction of end plates, wedging of vertebra, obvious kyphotic deformity, paravertebral shadows, anterior scalloping of verterbral body and pre and paravertebral abscess. The aspirate of abscesses (n-9) was sent for Z-N staining, pus culture and PCR. In all prospective patients, MRI was performed pre-treatment and repeated after eight months. Magnetic Resonance Imaging (MRI) examinations were done with 1.5 Tesla Philips Achieva machine using shoulder coil without contrast and the following sequences were taken:-

1. Sagittal and axial T1 weighted (T1 FRFSE),
2. Sagittal and axial T2 weighted (T2 FRFSE),
3. Coronal and sagittal STIR sequences

The following features were assessed by MRI:

Compartment of spine involved: Epidural/ Intradural/ Intramedullary/ Multiple

Epidural involvement assessed for the following

1. Extent of vertebral involvement: body / posterior involvement – signal changes.
2. Wedging or compression.
3. Involvement of disc.
4. Subligamentous extension.
5. Extent of abscess: Epidural / paravertebral / psoas.
6. Spinal cord changes.

Intradural/ intramedullary involvement

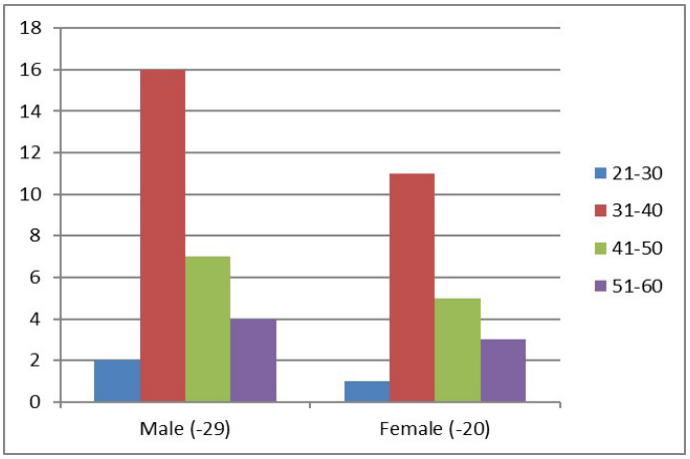
Results

Age and sex distribution

The study included total 49 patients. 32 patients were enrolled in group A and 17 patients in group B. There were 29 males and 20 females with mean age 30.69 years (21–60 years).

Table 1: Age and sex distribution.

Age Group	Male (-29)	Female (-20)	Percentage (overall)
21-30	2	1	6
31-40	16	11	55
41-50	7	5	24.5
51-60	4	3	14



Regional distribution of TB Spine

Five cervical spine cases (n-5), sixteen dorsal spine cases (n-16) and twenty eight lumbar spine cases (n-28) were seen. Seven patients had multilevel contiguous involvement spanning two or more regions on MRI. Nineteen patients were seen with kyphotic deformity with mean K angle of 32 degrees.

Table 2: Regional distribution of TB Spine

Regional Distribution	No of Cases	Percentage
Cervical	5	10
Thoracic	16	32.5
Lumbar	28	57
Multiple Levels	7	14
Kyphotic Deformity	19	38.5

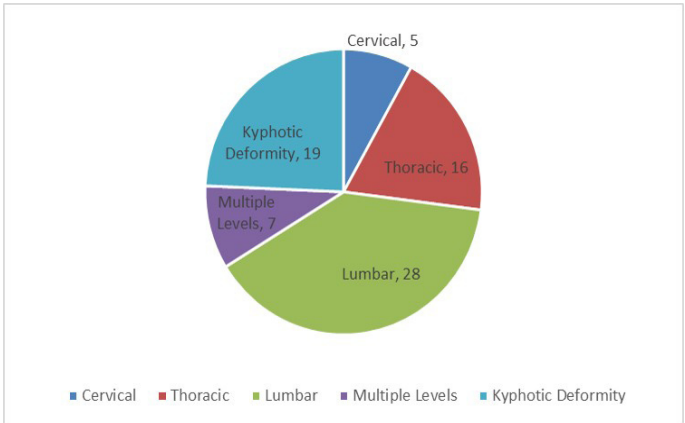


Table 3: Clinical profile of patients with Spinal Tuberculosis

	Fever	Backache	Malaise	Weight Loss
No of cases	25	31	19	9
Percentage	62.5	77	47.5	22.5

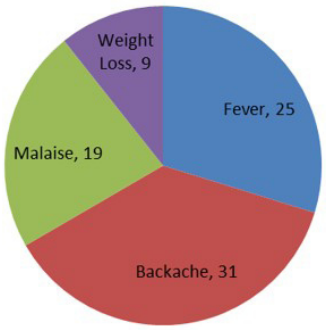


Table 4: Extent of tuberculosis spine in various compartments.

Features	No of cases	Percentage
Intervertebral disc involvement	37	75.5
Wedge collapse of body	22	44.8
Complete destruction of vertebra	9	18
Subligamental extension	21	43
Epidural collection	34	69
Itradural involvement	4	8
Intramedullary involvement	2	4
Pre and Paravertebral involvement	25	52
Discitis in preserved discs	47	95
Nerve root compression	31	63
Canal encroachment	37	75.5
Coed edema	10	20

Mr findings on healing

All cases were put on Anti Tuberculous Therapy (ATT) regimen as per Directly Observed Treatment Short course (DOTS) which consisted of daily dosage with Rifampicin [R] (8-12 mg/kg/day), Isoniazid [H] (4-6 mg/kg/day), Pyrazinamide [Z] (20-30 mg/kg/day), Ethambutol [E] (13-17 mg/kg/day) and Streptomycin [S] (20-40 mg/kg/day).

The healing of the vertebral lesion was recorded on complete resolution of marrow oedema, replacement of marrow by fat seen as a bright signal on T1WI and T2WI and complete resolution of paravertebral collections. On follow-up MRI seven showed complete resolution of cord oedema and neural deficit.

Cord atrophy was observed in three cases. The other some cases developed cord atrophy on completion of treatment. Demineralisation was seen in most of the cases. Myelomalacia, arachnoiditis, syringomelia, thickened arachnoid complex and

meningeal involvement were not found as contrast was not administered for pre-treatment MRI.

Discussion

Tuberculosis has prevailed as a major public health problem especiaily in our country. Tuberculosis of the spine is clinically important form of extra pulmonary tuberculosis accounting for majority of the musculoskeletal tuberculosis cases. First described in 1782 by Percival Pott, a British orthopedic surgeon usually occurs due to haematogenous seeding of the vertebra from a distant source. Typically, more than one vertebra is involved and usually affects the anterior aspect of the vertebral body adjacent to the subchondral plate and from there on spreads to involve adjacent intervertebral discs. Further with involvement of bone, wedge collapse and vertebral destruction occurs which results in kyphosis (Figure 2). Epidural abscess formation (Figure 2) results in narrowing of the spinal canal diameter with resultant cord compression and neurological deficits. In the present study, we have attempted to depict the various spectrum of presentations of spinal TB with clinical correlation.

The regional distribution of vertebra in our study was similar to the findings of DJ Kotzke [9] and Sajid Ansari [10]. Shanley DJ [11] evaluated radiographic manifestations of tubercular spondylitis like intraosseous and paraspinal abscess formation as seen in our study mentioned in Figure 1, paraspinal abscesses in the lumbar region gravitate along the psoas sheath (Figure 3) which can extend to the femoral region and cause erosion of overlying skin [9,11].

MRI is the gold standard of imaging in tuberculous spondylitis due to its superior soft tissue resolution and multi planar capability. MRI is very useful to see the classic pattern of spread of disease starting anteriorly and moving to opposing vertebrae via subligamentous route. As was observed in our study, T1-weighted images usually show hypointense signal within the affected vertebral marrow.

In our study, we had two cases showing intramedullary involvement (Figure 4), on MRI tuberculomas appear as low to intermediate signal intensity on T1W images and low signal on T2W images due to caseous necrosis in the tuberculoma, which has high protein content. The extent of spinal cord involvement, nerve root integrity, posterior elements involvement and also response to ATT therapy are best assessed by MRI.

It is important to differentiate tuberculous spondylitis from pyogenic spondylitis because proper treatment of the different types can reduce the rate of disability and functional impairment [12,13]. MRI has been shown to be accurate in differentiating tuberculous spondylitis from pyogenic spondylitis. If there are presence of well-defined paraspinal abnormal signal, smooth and thin walled abscess, subligamentous spread of three or more vertebral levels and multiple vertebral or entire body involvement it is more suggestive of tuberculous spondylitis than pyogenic spondylitis [13]. Early recognition and prompt treatment are therefore necessary to minimize residual spinal deformity and permanent neurological deficit.

Early diagnosis and conservative treatment by ATT has shown favorable results as anti- tuberculous drugs will be able to reach the tuberculous caseous material and cavities in spine. However in patients with severe bone involvement along with cord or root compression, surgical treatment is the only beneficiable measure [14].

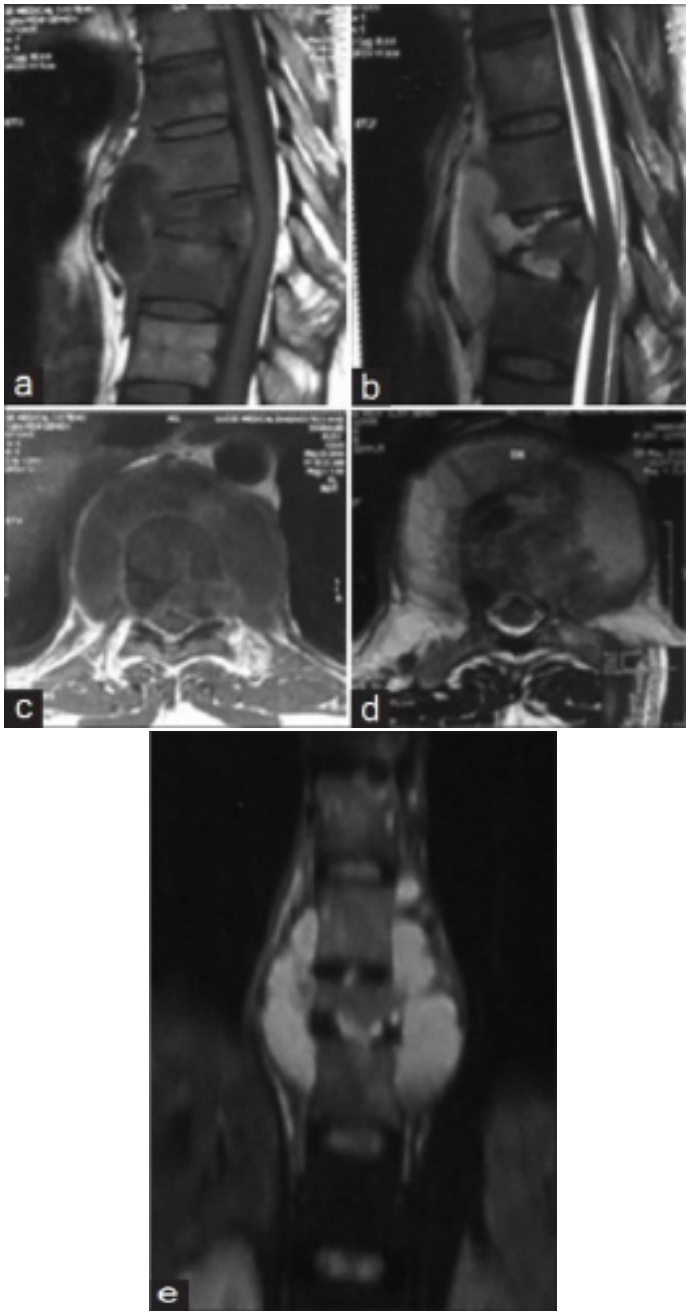


Figure 1: MRI of spinal tuberculosis: (a, c-sagittal; b, d-axial; e-coronal) images showing vertebral lesion hypo on T1 and hyper on T2W images, epiphyseal and discal involvement with anterior and paraspinal extension.

Figure 2: MRI of the thoracic spine in a paraparetic patient demonstrating a pre-vertebral and epidural abscess, bony destruction with kyphotic collapse and the spinal cord draped over an internal gibbus with intrinsic cord signal.

Figure 3: T2-weighted coronal MR image showing collapse of L1 vertebral body with irregularity of superior end plate of L2 along with bilateral psoas abscesses.

Figure 3: T2-weighted coronal MR image showing collapse of L1 vertebral body with irregularity of superior end plate of L2 along with bilateral psoas abscesses.

Conclusion

This study showed that MRI is the most valuable investigation in the evaluation of spinal tuberculosis. The MRI scan is highly sensitive in the detection of various pathological processes of spinal tuberculosis and their pattern of occurrence and also provides information of soft tissue & bone involvement, cord involvement and nerve root integrity and helps as staging of disease for planning treatment. It is an accurate investigation to differentiate spinal tuberculosis from pyogenic spondylitis and helps in diagnosing spinal TB in early stages and hence prompt treatment minimizes spinal deformity and permanent neurological deficits. Serial MRI scans can also be used during follow up of patients to monitor the response to treatment.

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