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Spectrum of Magnetic Resonance Imaging Findings in Spinal Tuberculosis

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Abstract

Aim: *To describe the radiological features of spinal tuberculosis on Magnetic Resonance Imaging and study the role of MRI in assessing the extent of disease.*

Materials and Methods: *This was a descriptive study conducted at the department of Radiodiagnosis in Government Medical College and Dr Susheela Tiwari Memorial (STM) Hospital, Haldwani. This study was carried out on 61 cases of tuberculosis of spine. Plain radiograph of spine and chest, followed by MRI features were observed on T1weighted, T2weighted and short tau inversion recovery (STIR) sequences. The diagnosis was based on history, clinical evaluation and characteristic radiological features on MRI along with response to treatment. Pathological correlation was done for detection of AFB wherever possible.*

Results: *The disease was most commonly seen in young adults and a male predominance was noted. Backache in 52 (86.6%) and low grade fever were found to be the most common clinical features followed by weight loss and paraparesis. Dorso-lumbar spine was most commonly involved in 25 (40%), followed by dorsal, lumbar and sacral vertebrae. MRI findings included bone marrow edema in 61(100%), end plate irregularities in 61(100%), disc space reduction in 30(50%), pre and paravertebral collection in 28(46.7%), calcification in 25(41%), spinal cord compression in 16(26.6%). Neurological symptoms were found in patients with degree of spinal canal compression exceeding 20%.Vertebral body wedge collapse in 30(50%), compression fracture in 16(26.6%) and combination of both were noted in 4(6.67%). Kyphosis in 26 (43.3%) and scoliosis in 5(8.3%) was also noted. Paradiscal pattern of involvement was most commonly found.*

Conclusion: *Tubercular spondylitis is best evaluated on MRI as it provides critical information ranging from simple edema involving vertebrae and intervertebral discs to paraspinal collections and abscesses and vertebral collapse leading to spinal cord compression in patients with neurological deficit. Knowledge of the spectrum of various MR imaging features in spinal tuberculosis is of utmost importance in limiting the morbidity caused by this disease by helping in early diagnosis and guiding the course of treatment.*

Introduction

Tuberculosis is an infection that has plagued humans throughout recorded history and is still very much prevalent today. This infection is a cause of high morbidity and mortality especially in the densely populated developing countries, with India being the country with highest burden. Tuberculosis can involve any organ system in the body. While pulmonary tuberculosis is the most common presentation, extra-pulmonary tuberculosis (EPTB) is also an important clinical problem. EPTB constitutes about 15-20% of all cases of TB

in immunocompetent patients and more than 50% of cases in HIV positive individuals.[1]

Approximately 10% of patients with extra pulmonary tuberculosis have skeletal involvement. Spine is the commonest site of skeletal involvement in tuberculosis and constitutes about 50% of the cases of skeletal tuberculosis. It is more common in children and young adults. Percival Pott first described the disease classically in 1778 and hence it is commonly referred to as Pott's disease.

Spinal tuberculosis is a significant cause of morbidity in developing countries such as India due to factors like poverty, overcrowding, malnutrition and improper implementation of antitubercular treatment. It has even emerged as an important healthcare threat in developed countries due to increasing immigrant population and in immunocompromised patients such as those with AIDS. Hence it is important to understand the disease and use various imaging modalities to aid in early diagnosis and treatment.

The infection spreads via a hematogenous route and in most cases enters the anterior inferior portion of the vertebral body. A late complication involves vertebral body collapse with herniation of the disc into the shell of the remnant of the vertebral body.

Tubercular spondylitis is a serious clinical problem because concomitant neurologic deficit frequently occurs. An early diagnosis and prompt treatment is of utmost importance.

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.

CT scan is useful in evaluating the extent of disease, and patterns of bone destruction. Disc space narrowing, para-vertebral soft tissue abscesses and calcification within them are seen, which are considered to be pathognomonic for tuberculosis. However it has a limited role in detecting discitis and may not detect epidural, thecal or spinal cord involvement without intrathecal or intravenous contrast material.

MRIis considered the gold standard for evaluating disc space infection and osteomyelitis of spine, and is most effective for demonstration of disease into soft tissues and the spread of tuberculous debris under the anterior and posterior longitudinal ligaments. MRI with contrast is helpful in differentiating from non-infectious causes and delineating the extent of disease. Serial MRI can be used to assess the response to treatment and regression of disease.[2]

Tubercular spondylitis has a varied spectrum of presentation and can be sometimes difficult to differentiate from pyogenic spondylitis. Discs are destroyed early with simple infection and later in tuberculosis. Calcification when present indicates tuberculosis.[5]

MR imaging provides critical information about the spinal cord and the extent of epidural pus in patients presenting with neurological deficits. Familiarity with the spectrum of MR findings in tuberculous spondylitis, especially in a high-risk patient population can prevent a delay in diagnosis and may limit the morbidity that can be caused by this aggressive but curable infectious disease[10].

Materials and Methods

The study was carried out on a prospective basis in the department of Radiodiagnosis Government Medical College and Susheela Tiwari Memorial Hospital, Haldwani. The period of study was one year, from November 2016 to October 2017. A total of 61 patients were included in the study. All patients having classical clinicoradiological features of spinal tuberculosis who showed evidence of healing on treatment, or with a proven histopathological, bacteriological or cytological diagnosis of TB spine were included in the study. An informed consent was taken from all the patients. A detailed history, clinical examination and lab investigations were done. A plain radiograph of the chest was also done. MRI examination was conducted using a 1.5 Tesla Siemens MRI in STM Hospital.

T1 weighted (T1W), T2 weighted (T2W) and short tau inversion recovery (STIR) sequences were obtained in axial, sagittal and coronal planes. Images obtained were studied and characterized.

The various parameters observed on MRI were as follows:

- The bone marrow oedema was defined as hypointense signal intensity on T1WI and hyperintense on T2WI. Evidence of ischemic necrosis with vertebral body destruction was seen as altered signal intensity in the body in both T1 and T2 images.
- The end plate erosion was defined as irregularity of margins of verterbral body endplates.
- Loss of vertebral body height was defined as a decrease in the average vertebral body height on comparison with adjacent uninvolved normal vertebrae.
- Reduction in disc height was defined as decrease in the average disc height in comparison with adjacent uninvolved normal discs.
- Discitis was defined as hyperintense signal in T2WI in the disc with loss of intranuclear cleft and/or reduction in disc height and enhancement of the disc margins on post contrast T1WI.
- Paravertebral collections were seen as low signal on T1WI and hyperintense signal on T2WI along with extent and location of collection was noted.
- Calcification if present was seen as signal void in all sequences.
- Sub- ligamentous spread was defined as spread of pus beneath the anterior longitudinal ligament. The vertical extent and location of subligamentous and epidural collections were noted.
- Epidural component was defined as epidural indentation/ canal encroachment by pus/granulation tissue. Epidural spread was defined as spread of pus within the vertebral canal outside the dura beyond a single vertebral level. Presence of epidural spread implies presence of epidural component but not vice versa.
- Percentage canal encroachment was calculated on axial images by dividing the spinal canal into four quadrants by drawing a vertical line and then drawing a perpendicular bisector line to the same and assessing the occupancy of the cord and the encroachment in each quadrant subjectively.
- Spinal cord oedema was seen as hyperintense signal on T2WI and hypointense on T1WI within substance of cord.

Fig. 1 MRI in the same patient (as in Fig. 2) revealed altered marrow signal intensity which is hyperintense on T2 and hypointense on T1 in L2 and L3 vertebrae with involvement of adjacent intervertebral disc leading to anterior wedge compression collapse of L2 and L3 vertebrae. Posteriorly there is soft tissue component seen protruding into the epidural space causing compression of cord and displacing it posteriorly with secondary narrowing of lumbar canal.

Fig. 2MRI study of lumbosacral spine in a 56 year old male patient who came with complaints of low back pain and fever, shows on sagittal T1WI (A) and T2WI (B) evidence of bone marrow edema with endplate and IV disc destruction at L5-S1 level with associated large epidural abscess causing indentation of the thecal sac and compression of the traversing nerve roots. Small prevertebral abscess is also noted.

Fig 3: A 45 year old male with back pain, fever and weight loss, there is evidence of altered signal intensity with paradiscal destruction of D11 and D12 vertebra. It appears heterogeneously hyperintense on T2WI and hypointense on T1WI. The involved vertebra and adjacent collection is seen to extend into the spinal canal causing its stenosis and compresses the thecal sac and spinal cord.

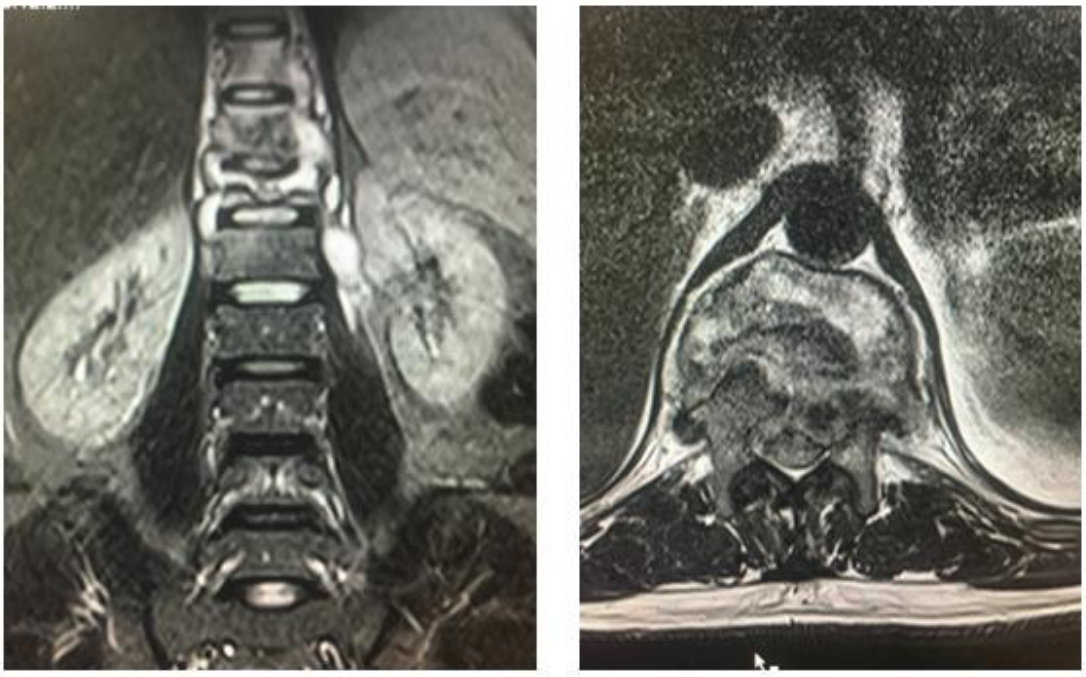

Fig 4: Coronal section of the same patient (as in **fig 3**) showing heterogenously T2 hyperintense collection in the paraspinal location surrounding the D11 and D12 vertebrae. The axial section shows the involved vertebra and adjacent collection extending into the spinal canal causing its stenosis and compressing the thecal sac and spinal cord. The compressed spinal canal shows T2 hyperintensity and likely represents cord edema.

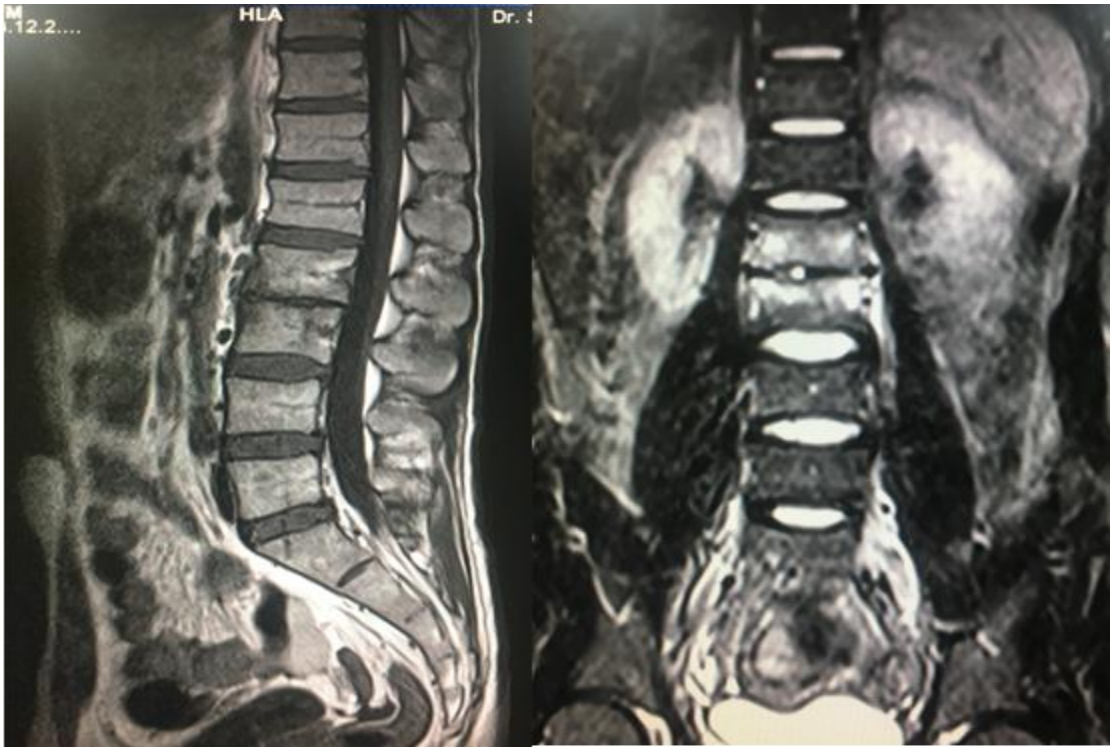

Fig 5: A 27 year male presented with chronic back pain, mild fever and weight loss. MRI shows altered signal intensity at contigious end plates of L2 and L3 vertebral bodies mostly at peridiscal margins with reduced intervening L2-L3 intervertebral disc height. Posterior appendages are intact. No spinal canal encroachment is seen.

Results

Out of a total of 61 patients diagnosed with spinal tuberculosis, 37 patients were males while 24 were females. The age range of patients was from 11 to 70 years and the mean age was found to be 30.5. The age distribution of patients has been depicted in Table 1. The maximum number of patients were noted to be young adults, in the age group of 21-30 years (46.6%).The clinical features noted include back pain, low grade fever, loss of appetite, weight loss, paraparesis, bowel-bladder dysfunction, kyphotic deformity and scoliotic deformity. Back pain emerged as the most common symptom, seen in 52 (86.6%), followed by fever and weight loss

The clinical findings have been elaborated in Table 2. The chest X ray was found to be normal in majority of cases, with only 8 patients (13.3%) showing features of pulmonary tuberculosis.

Table-1: Showing age distribution in spinal TB

Age Group	Number of patients (n=61)	Percentage (%)
11-20	7	11.6
21-30	28	46.6
31-40	15	25
41-50	6	10
51-60	3	5
61-70	2	3.2

Table-2: Showing clinical features in spinal TB

Clinical features	Number of patients (n=61)	Percentage (%)
Back pain	52	86.6
Low grade fever	50	83.3
Loss of appetite / weight loss	32	53.3
Paraparesis	18	30
Bladder boweldysfunction	12	20
Kyphosis	36	60
Scoliosis	10	16.6

The most common site of involvement was found to be dorso-lumbar spine, which wasseen in 24cases (40%), followed by dorsal vertebrae in 23 (38.3%) and lumbar vertebrae in 10 (16.6%) patients. Table 3 depicts the level of spine involved. Among the patterns of vertebral involvement, paradiscal type of involvement was found to be the commonest, in 19 (31.7%) followed by central type in 16 (26.7%). Anterior subligamentous involvement was found in 15(25%) cases. Posterior elements were least commonly involved, found in 9 cases (15%)

Table-3: Showing site of involvement in spinal TB

Site	Number of patients (n=61)	Percentage (%)
Cervical	0	0
Dorsal	23	38.3
Dorsolumbar	24	40
Lumbar	10	16.6
Lumbosacral	2	3.3
Sacral	1	1.6

The MRI findings have been depicted in Table 4. Severe vertebral body destruction was noted in as high as 50 patients with wedge collapse in 30 (50%), compression fracture in 16 (26.67%) and both in 4 (6.67%) cases. Bone marrow edema and endplate irregularities were found in all patients, while disc height reduction was found in 30 (50%).

Degree of spinal canal compression was noted to be between 15 to 65% and was seen in 16 (26.6%) patients. Neurological deficit was seen in 28 patients. Neurological symptoms were found in patients with degree of spinal canal compression exceeding 20%.

Table 4: MRI Findings in Spinal Tuberculosis

MRI PARAMETERS		NO. OF PATIENTS (N=61)	PERCENTAGE (%)
Severity of bone destruction	Wedge collapse	30	50
	Compression Fracture	16	26.67
	Both	4	6.67
End plate irregularities		61	100
Bone marrow edema		61	100
Disc height reduction		30	50
Epidural collection		23	38.3
Intra-dural abscess		04	6.5
Pre and Para vertebral abscess		28	46.7
Spinal cord edema		05	8.1
Spinal cord compression		16	26.6
Kyphosis		26	43.3
Scoliosis		05	8.3
Calcification		25	41

Discussion

Tubercular spondylitis can occur in any age. In our study, the mean age was found to be 30.5 yrs from an age range of 11 to 70 years. Hence we have observed that the disease mainly affects young adults.

Male predominance (60.4 %) was noted in our study which is similar to other studies done by S Khalequzzaman et al, in which involvement of spine in males was more common than females.

Backache was the most common presenting complaint, in 52 (86.6%), followed by low grade fever in 50 (83.3%). Similar findings were observed by Sajidansari et al in their study.

Most common MRI feature in our study was found to be marrow edema observed in 61 patients (100%) and end plate irregularities followed by vertebral collapse.

Similar results were noted in study by Khalequzzaman et al in bangladesh where signal change was noted in 42 patients (100 %), destruction and collapse 37 (88.1 %). Currie S et al demonstrated in their review the key magnetic resonance imaging features of tuberculous spondylitis like collapse of the vertebral body, collapse of intervertebral disc space, paraspinal infection and cold abscess formation[6].

Dorso-lumbar vertebrae are involved most commonly in our study as was also noted in various other studies such as Bajwa G.R[5.]

Multilevel vertebral involvement was the rule in all patients with involvement of two vertebrae in maximum number of patients (42) followed by 3 vertebrae (11). No patient presented with involvement of single vertebrae.

Paradiscal variant was most common in our study

Posterior spinal involvement was noted in 9 (15%) patients in our study. However none of the patient had isolated posterior spinal involvement. A study by Narlawar RS et al concluded that involvement of posterior elements due to tuberculosis is not so uncommon and MRI is extremely useful in evaluating the extent of involvement and response to therapy of isolated tuberculosis of posterior elements.[3]

In our study, 28 patients showed neurological deficit. We observed that neurological symptoms were found in patients with degree of spinal canal compression exceeding 20%. Similar findings were observed by Sajid Ansari et al in their study and they found that decompressive surgery along with anti tubercular chemotherapy was the best mode of treatment in such cases[4.]

Danchaivijitr et al in their study on the diagnostic

accuracy of Magnetic resonance imaging in TB spondylitis found 3 most useful Magnetic resonance imaging features for spinal-TB - end plate disruption, paravertebral soft tissue formation & high signal of inter vertebral disc on T2W. They found the overall sensitivity and specificity of MRI for diagnosis of spinal tuberculosis to be 100% and 88.2% respectively[7].

Khalid *et al* conducted a study to assess the role of magnetic resonance imaging (MRI) in evaluation of tubercular spondylitis and to correlate imaging findings with clinical severity of the disease. The authors concluded that MRI plays a vital role in early and accurate diagnosis of spinal infections. It is non-invasive and clearly demonstrates soft tissue anatomy and pathology which makes it superior to X-rays and Computed Tomography (CT)[8].

Harada.Y.et al compared MR imaging findings in 10 patients with tuberculous spondylitis retrospectively with 13 patients with pyogenic spondylitis. They concluded that MR imaging is useful in differentiation of TB spondylitis from pyogenic spondylitis[9].

Recent advances in imaging of Pott's spine include the use of diffusion-weighted magnetic resonance imaging (DW-MRI) and apparent diffusion coefficient (ADC) values which help in differentiating it from other lesions of similar morphology.

Conclusion

Tubercular spondylitis is best evaluated on MRI as it provides critical information ranging from simple edema involving vertebrae and intervertebral disc to paraspinal collections/ abscesses and vertebral collapse leading to spinal cord compression in patients with neurological deficit.

Knowledge of the spectrum of various MR imaging features in spinal tuberculosis is of utmost importance in limiting the morbidity caused by this disease by helping in early diagnosis and guiding the course of treatment.

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