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Magnetic resonance imaging features in the tubercular spine: A cross sectional study from North India

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Abstract: Introduction: Spinal TB (Pott's disease) is the most common, as well as one of the most potentially dangerous forms of skeletal TB, with an incidence of neurological complications as high as 10**Objective:** This retrospective cross-sectional study was conducted to identify common patterns of tubercular spinal osteomyelitis on MRI.
Materials and Methods: The current study is a cross-sectional observational study conducted by reviewing existing MRI images in the radiology department. The MRI spine studies of subsequently proven cases of spinal TB were included in the study. These images were re-evaluated and compiled by experienced radiologists.
Results: The thoracic spine was the most common site of involvement. Vertebral body wedge collapse or compression fracture was seen in 64**Conclusion:** MRI is an excellent imaging modality for spinal tuberculosis due to its ability to pick up early as well as advanced changes of the disease and provide the best possible anatomic demarcation of the extent of the disease.

Keywords: Spinal TB; MRI; Tubercular spinal osteomyelitis; Neurological complications; Vertebral body collapse.

1. Introduction

Tuberculosis can affect any part of the human body besides the lungs, with skeletal tuberculosis being a well-known site of the disease. Among these cases, spinal TB (Pott's disease) is the most common and alarming form of skeletal tuberculosis, accounting for almost half of all cases of skeletal TB. Although spinal involvement occurs in less than 1% of patients with TB [1], its frequency is increasing, and it continues to be a major health problem [2]. Spinal TB is potentially dangerous, with the incidence of neurological complications being as high as 10% to 43% [3], and accounts for 50% of all cases of skeletal TB. The thoracolumbar junction seems to be the most commonly affected site of the spinal column involvement in spinal TB; however, any part of the spine can be affected [4].

Tubercular infections are more insidious than pyogenic infections. Symptoms may last for months and years before diagnosis. Spinal tuberculosis is usually a secondary infection from a primary site in the lung or genitourinary system. Spread is thought to be hematogenous in most instances. A granulomatous inflammatory response results in tubercle formation, which then undergoes caseation necrosis, leads to tissue breakdown, and results in a tubercular paraspinal abscess. The pus may be localized, or it may track along tissue planes. Progressive necrosis of bone leads to a kyphotic deformity. Typically, the infection begins in the anterior aspect of the vertebral body adjacent to the disc. There is subligamentous spread of infection to contiguous vertebral bodies. Noncontiguous (skip) lesions are not unknown [5].

The favored sites of the tubercular bacillus in the spine are the lower thoracic and lumbar vertebrae, followed by middle thoracic and cervical vertebrae. There are mainly four patterns of involvement: vertebral-paradiscal, central, anterior subligamentous, and appendiceal [4].

CT can reveal abnormalities earlier than conventional radiography. The bone destruction may be fragmentary, osteolytic, localized and sclerotic, and subperiosteal. Other findings include soft tissue

involvement and paraspinal tissue abscess. CT can demonstrate calcification better than any other modality [6].

The main drawback of CT is its decreased accuracy in defining the epidural extension of the disease and its effect on neural structures. MRI has the inherent advantage of improved soft tissue contrast resolution for bones and soft tissues, in addition to its ability for multiplanar imaging. The accuracy of detecting and categorizing edema, abscess, and granulation tissue is increased with the addition of intravenous contrast. MRI can reveal more extensive involvement than other modalities. MRI clearly demonstrates the extent of soft tissue disease and its effect on the thecal sac, cord, and foramina [7].

MRI features in spinal TB are varied. Endplate involvement may appear heterogeneously enhancing with surface irregularity on post-contrast sequences. Marrow edema appears as hyperintense areas on T2W and STIR images. Vertebral body lesions usually appear hypointense on T1W images, hyperintense on T2W images, with heterogeneous enhancement on post-contrast T1W images. Intervertebral disc involvement appears hypointense on T1W and hyperintense on T2W images, with heterogeneous enhancement on post-contrast T1W images. Tubercular abscesses appear as heterogeneous lesions with peripheral enhancement and central non-enhancing hypointense areas on post-contrast T1W images. Granulation tissue appears as heterogeneously enhancing soft tissue on post-contrast T1W images [3].

2. Materials and Methods

2.1. Study Setting

This retrospective cross-sectional observational study was conducted at the Department of Radiodiagnosis, SMHS Hospital, Srinagar, Kashmir.

2.2. Sampling Method

We reviewed already existing MRI images of patients with subsequently proven spinal tuberculosis in our institution. All CE-MRI spine studies of these patients were included in the study. Experienced radiologists with more than 8 years of experience in radiology re-evaluated and compiled the MRI studies.

2.3. Inclusion Criteria

The study included all cases of proven spinal tuberculosis who had undergone CE-MRI of the spine in our institution.

2.4. Exclusion Criteria

Trauma and immunocompromised patients were excluded from the study.

2.5. Imaging Technique

MRI imaging was performed in a closed configuration superconducting 3-T system (Siemens MAGNETOM Skyra). The following MRI sequences were studied: sagittal and axial T1-weighted (T1 FSE), sagittal and axial T2-weighted (T2 FSE), coronal and sagittal STIR sequences followed by post-contrast T1-weighted sequences in axial, coronal, and sagittal planes. Postcontrast T1W sequences were obtained by using intravenous administration of Gd DTPA in a dose of 0.1 mmol/kg body weight.

2.6. Study Aim

The aim of our study is to describe the common patterns of MRI manifestations of spinal tuberculosis in patients from Kashmir. We re-examined the cases to identify the key imaging patterns in our study population and tabulated the data for documentation. Key emphasis was laid on the assessment of epidural involvement, the extent of vertebral body/posterior element involvement, presence of any wedging or compression, disc involvement, subligamentous spread of disease, locoregional complications like abscess formation, and presence or absence of tubercular myelitis.

3. Results

We included 20 cases of MR documented and subsequently lab or histopathology proven spinal tuberculosis in our institution. The age of patients ranged from 32 to 75 years, with a mean age of 53.5 years. Thirteen patients were male and seven were female. The thoracic spine was the most commonly involved site, with 70% of cases affecting the thoracolumbar spine, 20% affecting the cervical spine, and 10% affecting the sacral vertebrae. Among dorsal vertebrae, D4-D6 levels were commonly involved in the upper thoracic spine, while D10-D12 were more involved in the lower thoracic spine. L3-L5 levels were commonly involved in the lumbar region. Vertebral body compression/collapse was seen in 60% of cases. Pre- and paravertebral collection was seen in 14 (70%) cases, and involvement of the psoas muscle leading to psoas abscess was seen in 9 of 20 patients with pre/paravertebral collection. The epidural soft tissue component was seen in 60% of cases. Among the 18 cases of thoracic and cervical cord involvement, epidural soft tissue leading to spinal cord compression was seen in 8 patients, and cord changes in the form of edema were seen in 3 cases.

The anatomic distribution of spinal TB is summarized in Table 1, while a spectrum of MRI findings in spinal tuberculosis is presented in Table 2. We observed various MRI findings in the study population, including:

- A post-contrast T1 coronal FATSAT image revealing bilateral enhancing paraspinal collection with intervertebral disc enhancement and end plate erosions (Figure 1).
- T2-weighted sagittal images revealing multilevel T2 hyperintense prevertebral collection with disc destruction, localized gibbus, and posterior disc protrusion (Figure 2).
- T2-weighted axial images revealing paravertebral collection with right pedicular involvement (Figure 3).
- T1-weighted FS coronal images showing mid-dorsal peripherally enhancing paravertebral collections (Figure 4).
- Post-contrast T1-weighted FS axial images revealing thick solid enhancing granulation tissue and locules of paravertebral collection around the mid-dorsal vertebral region (Figure 5).
- Post-contrast T1-weighted FS sagittal and coronal images revealing enhancing paravertebral collection with ankylosis of D6-D7 vertebrae (Figure 6).
- T2 STIR coronal images revealing hyperintense signal within the pedicles consistent with edema (Figure 7).
- T1-weighted FS post-contrast images revealing multiloculated enhancing paravertebral collection in a patient (Figure 8).
- T1-weighted FS axial and sagittal post-contrast images revealing vertebral body destruction with spread of enhancing inflammation into bilateral costovertebral joints and pedicles (Figure 9).
- T1-weighted FS sagittal image showing enhancing posterior epidural collection with enhancement and destruction of mid-dorsal vertebrae with kyphosis. Patchy spinal cord enhancement suggesting tubercular myelitis was also noted (Figure 10).

Table 1. Anatomic Distribution of spinal TB

Level of Lesion	**Number of Patients**	**Percentage**
Cervical	4	20
Thoracic	9	45
Lumbar	5	25
Sacral	2	10
Total	**25**	**100**

Table 2. Spectrum of MRI findings in Spinal tuberculosis

MRI Finding	No. of Patients	Percentage
Intervertebral disc involvement	**16**	**80**
Wedge compression/ collapse of body	**10**	**50**
Posterior element involvement	**4**	**20**
Epidural collection	**14**	**70**
Pre and paravertebral collection	**13**	**65**
Spinal cord compression	**11**	**55**

Figure 1. Post contrast T1 coronal FATSAT image reveals bilateral enhancing paraspinal collection with intervertebral disc enhancement and end plate erosions

Figure 2. T2W Sag images reveal multilevel T2 hyperintense prevertebral collection with disc destruction, localised gibbus and posterior disc protrusion

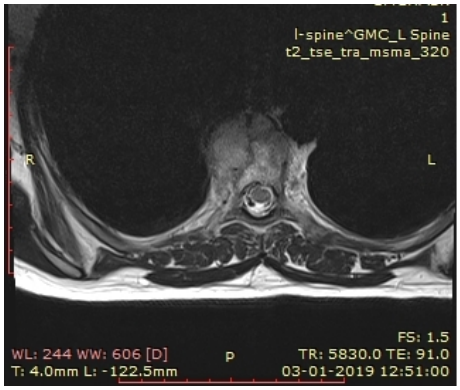

Figure 3. T2W axial images revealing paravertebral collection with right pedicular involvement

Figure 4. T1W FS coronal images showing mid dorsal peripherally enhancing paravertebral collections

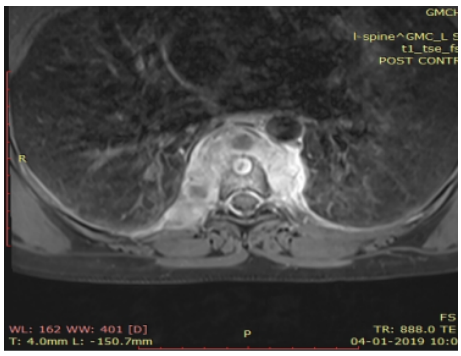

Figure 5. Post contrast T1W FS axial images revealing thick solid enhancing granulation tissue and locules of paravertebral collection around the mid dorsal vertebral region

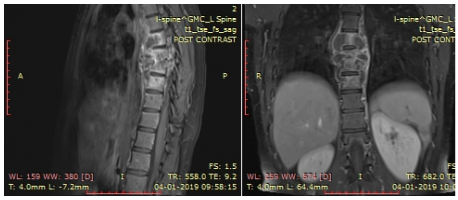

Figure 6. Post contrast T1W FS saggital and coronal images revealing enhancing paravertebral collection with ankylosis of D6-D7 vertebrae

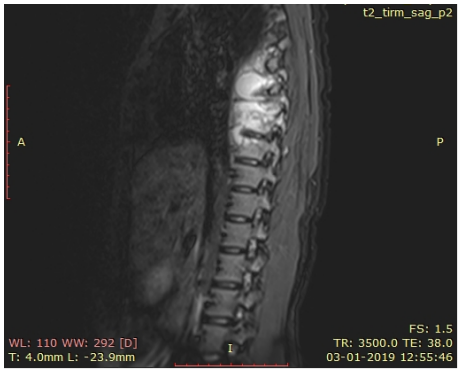

Figure 7. T2 STIR coronal images revealing presence of hyperintense signal within the pedicles consistent with edema

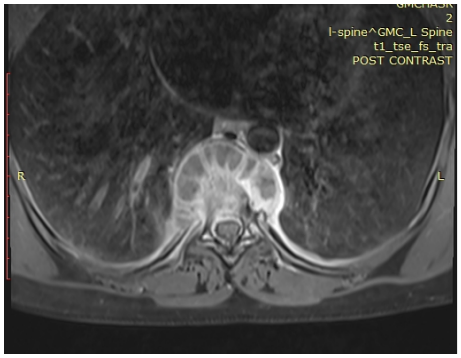

Figure 8. T1w FS post contrast images revealing multiloculated enhancing paravertebral collection in this patient

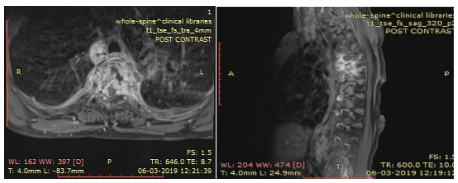

Figure 9. T1W FS AXIAL and saggital post contrast images revealing vertebral body destruction with spread of enhancing inflammationinto bilateral costovertebral joints and pedicles

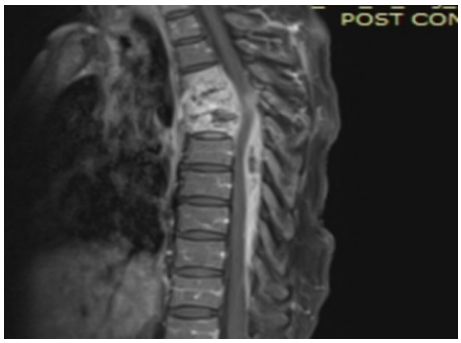

Figure 10. T1w FS saggital image showing enhancing posterior epidural collection with enhancement and destruction of mid dorsal vertebrae with kyphosis. Note to be made of patchy spinal cord enhancement suggesting tubercular myelitis

4. Discussion

Tubercular vertebral osteomyelitis remains a significant medical problem in developing countries. Spinal TB constitutes the most common site of skeletal TB and presents with various neurological symptoms. Neurological complications and spinal deformities are frequently seen.

The present study was conducted on 20 patients in the Department of Radiodiagnosis, GMC Srinagar and SMHS Hospital. The current study is a retrospective cross-sectional observational study conducted by reviewing already existing MRI images in the radiology department. Twenty Spinal MRI studies of subsequently lab or histopathology proven cases who had MRI features of spinal tuberculosis were included in the study. The MRI studies of these patients were re-evaluated and compiled by experienced radiologists with more than 8 years of experience in radiology. The aim was to evaluate the role of MRI in diagnosis and to study the spectrum of various findings that help in assessing the extent and severity of spinal involvement for planning early and accurate management.

Age of patients in the present study varied from 32 to 75 years with the mean age of 53.3 years. Males were more commonly affected with this disease. Out of 20 cases, 13 (65%) were males and 7 (35%) were females. Alavi SM et al. [8] also reported in their study on cases of spinal TB that male gender was a predisposing factor.

In the present study, the most common site of involvement was thoracic spine and was seen in 9 (45%) out of 20 cases followed by lumbar 5 (25%), cervical spine 4 (20%) and 2 cases of TB involving the sacral vertebrae. Moore SL et al. [9] (2001), Ho EKW et al. [10] (1996) also reported that the most common site of involvement of spinal TB was dorsal spine followed by lumbosacral spine.

Contrast-enhanced MRI was very helpful in diagnosing paraspinal collections, fibrous and caseation tissue, and determining the level of vertebrae involved along with its signal intensities. The lesions show marked patchy or peripheral enhancement. In the present study, vertebral body edema was seen in 17 cases, disc involvement in the form of reduced disc height and enhancement on contrast scan was seen in 15 (75%) cases. Similar patterns of involvement were seen by Sinha et al. [11] (2003) and Jung NY et al. [12] (2004) in their study on patients with spinal TB.

Pre- and paravertebral collections were observed in 13 patients. Paraspinal abscesses in the lumbar region can gravitate along the psoas sheath and extend to the femoral region and groin area. Reduced vertebral height with compression/collapse was observed in 50% of the cases. Epidural collections were seen in 14 (70%) cases, and cord compression due to epidural granulation tissue or vertebral compression/collapse was seen in 11 cases in the present study.

Similar studies on MRI features in spinal TB have been conducted by Bajwa GR et al. [13](2009) and Andronikou S et al. [14](2002), and our study is consistent with their findings.

Posterior element involvement was observed in 4 cases, i.e., 20%. Similar observations were also reported by Narlawar RS et al. [15](2002) and Sinan TH et al. [16](2004).

5. Conclusion

We conclude that MRI imaging is a valuable tool in the diagnosis of tubercular spinal osteomyelitis. It can aid in detecting contiguous vertebral involvement, skip lesions, paraspinal collections, and nerve root integrity. Additionally, it can assess the anatomic extent of associated collections in patients presenting with deformities and neurological deficits. Familiarity with the spectrum of MRI findings in tuberculous spondylitis, especially in high-risk patient populations, can prevent delays in diagnosis and limit the morbidity caused by this aggressive but curable infectious disease. MRI is also useful in differentiating spinal TB from pyogenic spondylitis in the early stages, enabling optimal management and preventing the catastrophic sequelae of tubercular spinal osteomyelitis.

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Conflicts of Interest: "Authors declare that they do not have any conflict of interests."

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