

Study of MRI Morphology of Spinal Tuberculosis

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ABSTRACT

BACKGROUND

Spinal tuberculosis is the infection by *Mycobacterium tuberculosis* of spine or one or more of its structures namely the vertebra, intravertebral discs, paraspinal soft tissues, and the epidural space. Thoracic vertebrae are commonly affected followed by lumbar and cervical vertebrae. MRI is the method of choice in evaluating spinal infection and their sequelae. We wanted to study the MRI morphology (vertebral body involvement, paravertebral involvement, intraspinal involvement, disc involvement, deformities and sequelae) of spinal tuberculosis.

METHODS

This is a cross-sectional observational study conducted among patients with suspected spinal tuberculosis, who reported to Department of Radiodiagnosis, GSL Medical College, Rajahmundry. The study was conducted over a period of 18 months. Statistical analysis was performed by SPSS version 21.0 & MS Excel 2013. Informed consent was obtained from all the patients. PHILIPS INGENIA CX which has a super conducting magnet of a magnetic field strength of 1.5 Tesla was used in this study.

RESULTS

In our study, the most common age group was 20-40 years with a mean age of 54 years. On MRI study, patients showed paraspinal and epidural inflammatory mass, subligamentous spread beneath the anterior longitudinal ligament and skip lesions. Few cases with wedge compression collapse showed gibbus deformity. Single vertebral involvement was seen in very few cases.

CONCLUSIONS

MRI with its high spatial resolution, multiplanar imaging capability, tissue characterization, is the imaging modality of choice for evaluating suspected cases of spinal tuberculosis. MRI is more sensitive in detecting involvement of posterior elements especially when plain films are normal.

KEYWORDS

Spinal Tuberculosis, Magnetic Resonance Imaging, *Mycobacterium tuberculosis*

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BACKGROUND

Spinal tuberculosis is caused by *Mycobacterium tuberculosis* and refers to an infection by *Mycobacterium tuberculosis* of spine or one or more of its structures namely the vertebra, intravertebral discs, paraspinal soft tissues, and the epidural space. TB incidence has been rising since the 1980s and early 1990s, causing 2–3 million deaths annually worldwide.¹ In some African countries, the number of reported cases of tuberculosis has doubled or even tripled with the spread of human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS).² Thoracic vertebrae are commonly affected followed by lumbar and cervical vertebrae.³ MRI is considered the method of choice in spinal infection and their sequelae, because it combines high sensitivity with satisfactory specificity. High contrast resolution, direct multiplanar imaging, ability to detect marrow infiltration, and ease of assessment of extradural disease are significant advantages. Although the excellent bony detail possible with CT is not matched by MR imaging, appropriate combination of pulse sequence can be used to take advantage of the different tissue characteristics to discriminate the various bony and soft-tissues structures of the spine and related tissues.^{4,5} A major advantage of MRI, compared with CT scan and plain radiography, is the higher sensitivity for the detection of the early inflammatory bone marrow changes and infiltrative end plate changes in the vertebra.⁶

We wanted to study the MRI morphology (vertebral body involvement, paravertebral involvement, intraspinal involvement, disc involvement, deformities and sequelae) of spinal tuberculosis.

METHODS

Patients reported to Department of Radio diagnosis, GSL Medical College, Rajahmundry, with suspected or diagnosed spinal tuberculosis were included into this cross-sectional observational study. The study was conducted over a period of 18 month (January 2016 to June 2017). Statistical analysis was performed by SPSS Software version 21.0 & MS EXCEL 2013. Descriptive data was presented in form of percentages. Informed consent was obtained from all the patients. All the MRI studies were obtained with "PHILIPS INGENIA CX" which has a super conducting magnet of a magnetic field strength of 1.5 Tesla. The first imaging investigation performed was a T1 weighted "sagittal localizer". A "coronal localizer" was also used in cases where the sagittal plane was inadequate to view the entire spine. Further imaging sequences were planned on the above stated localizers sagittal, axial and if required coronal imaging sequences were planned in accordance with the lesion and the area under evaluation.

Spin Echo (SE) T1 weighted sagittal and axial images are characterized by a short TR of 400 to 550 msec and a short TE of 10 to 20 msec used for obtaining anatomical

detail, adequately delineating the spinal cord, cerebrospinal fluid and extradural structures.

T2 FSE sagittal and axial images have a TR of 4,300 to 4,800 msec and a TE of 100 to 120 msec, with a Number of Excitations (NEX) of 2. T2 weighted images require a longer time of acquisition, rendering them more susceptible to "Artifactual degradation", that may be caused by motion and post-operative prosthetic implants. Post-contrast FSE T1 weighted images were acquired in both sagittal and axial planes using TR of 300-550 msec and TE of 20-30 msec with fat saturation for better contrast resolution. Acquisition in coronal plane may also be required for better delineation of the concerned lesion. For an adequate and diagnostic MRI study, the other imaging sequences that may be required are:

GRE T2 Sagittal* - This is planned on the coronal localizer and is characterized by a TR of 740 to 1040 msec, TE of 27 msec and a NEX of 2.

GRE T2 Axial Oblique* - This is planned on the sagittal localizer and is characterized by a TR of 740 to 1040 msec and TE of 27 msec and a NEX of 2. The slices being planned are angled parallel to the intervertebral disc space.

RESULTS

Fifty-seven patients presented to Department of Radio diagnosis, GSL Medical College, Rajahmundry with suspected or diagnosed spinal tuberculosis were included in this study. Out of 57 patients in this study, 28 were males (49%) and 29 were females (51%).

Age Distribution	No. of Cases	Percentage
0-10	1	2
11-20	6	10
21-30	15	24
31-40	17	28
41-50	6	12
51-60	7	14
61-70	3	6
71-80	2	4

Table 1. Age Distribution

MRI Findings	No. of Patients	Percentage
Disc involvement	39	68
Epidural abscess	42	74
Paraspinal abscess	43	76
Spinal cord involvement	7	12
Skip lesions	7	12
Posterior elements involved in No. of vertebra (n=129)	23	18
Psoas abscess	5	8

Table 2. MRI Findings

DISCUSSION

MRI of 57 cases of spinal tuberculosis were evaluated. Of the 57 cases, 28 were males and 29 females. These patients were aged between 3-82 years. These demographic features are in agreement with those reported by Sharif et al and Boxer et al.^{7, 8} Contiguous vertebral involvement was seen in 94% of cases in our study and skip lesions were seen in

6%. Usually two continuous vertebrae are involved but several vertebrae may be affected, skip lesions, and solitary vertebral involvement may also be seen. The average number of vertebrae affected per patients was 2-3 noted by Kim et al and Al-Mulhim et al in their studies.^{9,10} In majority (94%) of our cases multiple vertebral involvement was seen. Single vertebral involvement was noted in 6%. Xing et al noted single vertebral involvement in 23% of their cases slightly higher than our study.¹¹ A central vertebral body lesion is another atypical spinal TB form in which vertebral collapse can occur producing a vertebra plana appearance.¹²

Disc space reduction was observed in 43 patients (76%) of our study, of which 34 showed features of discitis (hypo intense on T₁WI and hyper intense on (T₂WI). In those cases, where contrast was given, 72% of the involved discs showed enhancement. Desai et al found features of discitis (hypo intense on T₁ WI and hyper intense on T₂ WI) with disc space reduction in 50% of his cases.¹³ All the affected discs showed loss of internuclear cleft. Similar features were noted by Sharif et al.⁷ Moore et al state that with tuberculous spondylodiscitis, the discs show signal characteristics similar to pyogenic discitis in about three-fourths of cases.¹⁴ Disc space preservation, normal signal intensity and lack of enhancement were seen in 25% of the cases. Sashikumar et al noted intervertebral disc involvement in 85% of the cases. Our findings are in agreement with the above.¹⁵

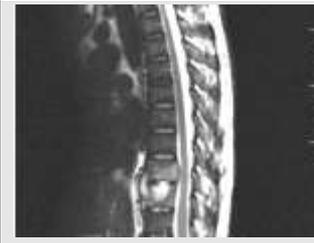
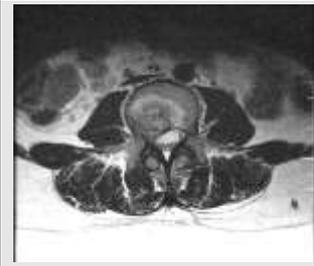
Contrast enhanced studies were done in 50 of our cases (88%). In 10 cases diffuse/ inhomogeneous contrast enhancement was noted. Peripheral enhancement was seen in 12 cases (24%) and mixed pattern was observed in 28 cases (56%). Rim enhancement with central non-enhancing areas on post contrast T₁ weighted images was considered highly specific for spinal tuberculosis by Sharif et al.⁷ Para spinal abscesses were noted in 43 cases (76%) in our study. Kim et al give the incidence of paraspinal mass at 55%-96%.¹⁰ Desai noted paraspinal abscesses in 90% of the cases in his study.¹³ Subligamentous spread of abscess to three or more vertebral levels is frequent in tubercular spondylitis.¹⁶ The subligamentous spread of a paraspinal abscess and the involvement of multiple contiguous bones and intramedullary spinal changes can be very well demonstrated by MRI.¹⁷

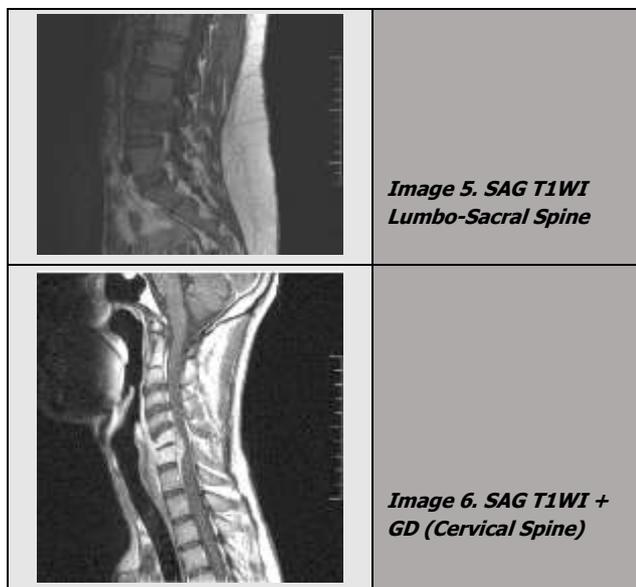
Psoas abscess was seen in 8% of our cases whereas Owolabi et al reported it in only 3% of the cases.¹⁸ Epidural abscess was noted in 74% of our cases. Al Mulhim et al found epidural abscess in 61% of the cases.⁹ In those cases, with para spinal extension, Al Mulhim et al noted that 85% had an associated epidural component.⁹ Shashikumar MR et al noted epidural abscess in 77% of their cases. Our findings are in agreement with their observations.¹⁵ Even though neurological deficit and epidural abscesses were noted in a considerable number of our patients, cord signal intensity changes on T₂ weighted images were observed in only 7 cases (12%). Kuker et al found focal hyper intensity in the spinal cord on T₂ weighted images in only 1 out of 8 cases (12%) of epidural abscess.¹⁹ Rohini Avantsa et al noted cord oedema in 12% of their cases.²⁰ Hlavin et al state that lack of abnormal signal with good recovery post treatment

indicates functional compromise of the cord. In this study, cord oedema/compression was found in 12% of the cases.²¹

Out of the 129 vertebrae evaluated on MRI, posterior element involvement was seen in 23 vertebrae (18%). Extension of the disease process to involve the adjacent rib on MR was seen in 7 (6%) vertebrae. This contrasts with the plain radiograph findings, which demonstrated posterior element and rib involvement in 5.7% and 2.8% respectively. This observation highlights the increased sensitivity of MR in detection of posterior element involvement in 10% of their cases. Desai et al observed posterior element involvement on MRI in 2 out of 17 vertebral bodies (12%).¹³ Sinan et al reported 10% of their spinal TB cases having isolated posterior arch involvement.²²

Deformity/ dislocation was noted in 8 (14%) of our cases. These include gibbus formation (7 cases-12%) and scoliosis (1 case 2%). These are common sequelae of spinal TB as stated by, Hsu et al and Shanley et al.^{23,24} Gibbus deformity (kyphotic deformity) is noted in 25% of their cases in Antonio Rivas et al and 31% of their cases in Rohini Avantsa et al.^{5,20} Gibbus deformity is considered specific to spinal tuberculosis and occurs due to anterior wedge compression of contiguous vertebrae, as noted by de Roos et al.²⁵ Figures 1 & 2 showing altered signal intensities in D9-D10 vertebra with minimal pre and para vertebral and anterior epidural collections.

	<p>Image 1. SAG T1WI Thoracic Spine</p>
	<p>Image 2. SAG T2WI Thoracic Spine</p>
	<p>Image 3. Axial T2WI Lumbar Spine</p>
	<p>Image 4. SAG T2WI Lumbo-Sacral Spine</p>



CONCLUSIONS

MRI with its high spatial resolution, multiplanar imaging capability, tissue characterization, is the imaging modality of choice for evaluating suspected cases of spinal tuberculosis. MRI is more sensitive in detecting involvement of posterior elements especially when plain films are normal.

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