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MR evaluation of spinal tuberculosis

Sajid Ansari[1]*, Raj Kumar Rauniyar[1], Kanchan Dhungel[1], Panna Lal Sah[1], Pashupati Chaudhary[2], Kaleem Ahmad[1] and Md. Farid Amanullah[2]

[1]Department of Radiodiagnosis, B.P. Koirala Institute of Health Sciences, Dharan, Nepal and [2]Department of Orthopedics, B.P. Koirala Institute of Health Sciences, Dharan, Nepal

Abstract: *Objectives:* The purpose of the study is to describe the radiological features of spinal tuberculosis on MRI (magnetic resonance imaging) and plain radiograph and the role of MRI in assessing the extent of disease, to assess the degree of cord/ thecal sac compression and to correlate with neurological deficit. *Methods:* This study was done on prospective basis in 30 patients with clinical suspicion of Pott's spine. Plain radiograph of the spine and chest was done followed by MRI of spine were done in all the patients. Various MRI features were observed on non-contrast T1W, T2W and STIR sequences followed by post-contrast T1W sequences and degree of cord compression was correlated with neurological deficit. The characteristic radiological features on plain radiograph and MRI along with response to treatment were considered diagnostic. *Results:* Back pain and low grade fever were most common clinical complaints followed by paraparesis and sensory deficit. Neurological symptoms were found in patients with degree of spinal canal compression exceeding 20%. Dorsal vertebrae were most commonly involved followed by lumbar and sacral vertebrae. Vertebral body wedge collapse, compression fracture and combination of both were evaluated. Prevertebral and paravertebral abscesses and epidural phlegmon were seen more on MRI. *Conclusions:* MRI is the best diagnostic modality for spinal TB and is more sensitive than plain radiography. It provides the diagnosis of spinal TB earlier than conventional methods, offering the benefits of earlier detection and treatment.

Keywords: Spinal tuberculosis, Pott's spine, Magnetic resonance imaging, Plain radiograph, Spinal cord compression.

Introduction

Percival Pott presented the classic description of spinal tuberculosis (TB) in 1779. Hence, spinal TB was called 'Pott's Disease'. TB is caused by Mycobacterium tuberculosis and it spreads usually by haematogenous route. Haematogenous seeding may arise from a primary focus in the lung or other extra osseous foci such as lymph nodes, gastrointestinal or any other viscera which may be active or quiescent [1]. Spinal TB accounts for 2% of all cases of TB, 15% of the cases of extrapulmonary TB and 50% of the cases of skeletal TB [2].

Lower thoracic and lumbar vertebrae are the most common sites of spinal TB followed by middle thoracic and cervical vertebrae. As tubercular infection is characterized by an insidious onset, delay in diagnosis resulting in serious neurological complications is not uncommon [3]. There are mainly four sites of infections in vertebra paradiscal, central, anterior subligamentous and appendiceal. Despite the Pott's disease being a common problem in this part of Nepal, there is no study to describe the pattern and the magnitude of the problem. Therefore, study was designed to describe radiological features of Pott's spine on plain radiograph and magnetic resonance imaging (MRI), to assess degree of cord compression and to correlate these findings with clinical neurological deficit.

Material and Methods

The study was carried out on prospective basis in the Department of Radiodiagnosis and Imaging, B. P. Koirala Institute of Health Sciences, over the period of one and half years between January 2010 to July 2011. Patient with clinical suspicion of Pott's spine or with cold abscess referred from orthopedics outpatient department were included in the study. Patients contraindicated to MRI were excluded in our study. After taking informed consent the detailed clinical history was taken and general and systemic examination were

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done. Neurological deficit and level of cord compression was recorded after complete clinical neurological evaluation.

Plain radiograph of spine and chest was first done in all cases followed by evaluation on 0.35 Tesla Siemens Magnetom MR Scanner. Initially non-contrast T1 weighted (T1W), T2 weighted (T2W) and short tau inversion recovery (STIR) sequences in axial, sagittal and coronal planes were taken. Then post-contrast sequences T1W were obtained by using intravenous administration of gadodiamide (GdDTPA-BMA) of 0.2 mmol/kg doses, in axial, coronal and sagittal planes.

The characteristic radiological features on plain radiograph and MRI along with response to treatment were considered diagnostic of Pott's spine; however wherever possible cytopathological or histopathological findings (specimen of decompression surgery or percutaneous aspiration/biopsy) were considered diagnostic of the condition. Degree of cord compression was assessed on the basis of percentage of narrowing of spinal canal calculated in relation to diameter of spinal canal just one vertebra level above/below the lesion and was correlated with neurological deficit. Several parameters that were noted on MRI are described in Table-1.

Table-1: Showing several parameters observed on MRI

Parameters observed on MRI	Findings
Level of spine involvement	Cervical, dorsal, lumbar and sacral
Number of vertebrae involved	Single or multiple levels
Alignment of vertebrae	Normal / kyphosis / scoliosis
Types of vertebral lesions	Paradiscal/central/anterior subligamentous/posterior element TB
Vertebral body height	Normal / Reduced
Vertebral body edema	Present / Absent
Severity of bone disease	Wedge collapse/Compression fracture
Signal characteristics – isointense, hypointense or hyperintense	On T1W, T2W, STIR, post-contrast T1W sequences
Enhancement pattern	Homogeneous/Heterogeneous/Peripheral
Intervertebral disc	Normal/Involved. If intervertebral disc involved, disc edema/reduced disc height – Present / Absent
Paravertebral soft tissue swelling / abscess / disc sequestration	Present / Absent. If present – level, extent and size of abscess
Spinal cord compression	Present / Absent. If present – degree of spinal cord compression

MRI characteristics in spinal TB are as follows:

- Vertebral body endplate involvements appear as heterogeneously enhancing endplate irregularity on post-contrast sequences.
- Vertebral lesions appear hypointense on T1W images, hyperintense on T2W images and shows heterogeneous enhancement on post-contrast T1W images.
- Marrow edema appears as hyperintense areas on T2W and STIR images.
- Intervertebral disc involvement appears hypointense on T1W and hyperintense on T2W images and shows heterogeneous enhancement on post-contrast T1W images.
- Prevertebral, paravertebral and psoas abscesses appear as heterogeneous lesion with peripheral enhancement and central non-enhancing hypointense areas on post-contrast T1W images. The level, extent and size of abscess can be well delineated on MRI.

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- Granulation tissue appears heterogeneously enhancing soft tissue on post-contrast T1W images. The granulation tissues and epidural abscess can cause narrowing of thecal sac or compression of spinal cord causing neurological complications.

Results

Out of 30 patients, spinal TB ranged from 15 to 75 years, 11 patients were males and 19 were females. Various clinical features like back pain, low grade fever, paraparesis, bowel-bladder involvement, history of contact with TB and antitubercular therapy (ATT), kyphotic deformity and scoliotic deformity were found in our patients. Number of patients and percentage of these clinical features are described in Table 2. In 2 (6.6 %) patients pulmonary TB seen and in rest of the 28 cases chest x-ray were normal. Hence Pott's spine was secondary to pulmonary TB was only in 6.6 % in our study.

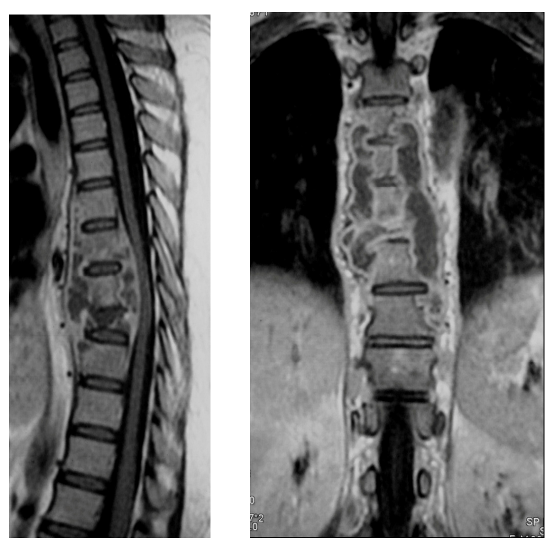
Table-2: Showing clinical features in spinal TB

Clinical features	Number of patients (n=30)	Percentage (%)
Back pain	19	63.3
Low grade fever	26	86.7
Paraparesis	12	40
Bowel bladder involvement	14	46.6
Kyphotic deformity	17	56.7
Scoliotic deformity	8	26.7
History of ATT	16	53.3
History of contact with TB patients	16	53.3

Dorsal vertebrae were involved in 50%, lumbar vertebrae in 43.3% and sacral vertebrae in 6.7% patients. Cervical vertebrae involvement was not found in our study. Among dorsal vertebrae D11-D12 level were commonly involved followed by D10-D11 level, while among lumbar vertebrae L3-L4 level were commonly involved. Paradiscal type of involvement was most common followed by central type. Posterior element involvement was found in 8 cases. Least common was anterior subligamentous type of involvement. Severe levels of vertebral body destruction were seen in 19 patients. Vertebral body wedge collapse was seen in 40%, compression fracture in 10% and both combination in 13.3% patients (Figures 2a, 2b, 3, 4). In 22 patients more extensive level of involvement were noted as compared with involvement noted on plain radiographs. Prevertebral & paravertebral abscesses seen in 26.7% patients on plain radiograph (Figure 1) and 80% on MRI (Figures 2a, 2b, 3, 4, 5).

Figure-1: Plain radiograph of dorso-lumbar spine (AP view) showing collapse of D9 vertebral body along with soft tissue opacity in the bilateral paravertebral regions - suggestive of abscesses.

Figure-2a and 2b: Post-contrast T1W sagittal MR image (figure 2a) and coronal MR image (figure 2b) of dorso-lumbar spine, showing collapse of D9 vertebral body along with altered signal intensity of D7, D8, D9 and D10 vertebral bodies, enhancing prevertebral and bilateral paravertebral abscesses with compression of spinal canal by epidural extension of abscesses.



2(a) 2(b)

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Figure-3: T2W sagittal MR image of dorsal spine showing collapse of D8 and D9 vertebral bodies with endplate irregularities of D7 and D10 vertebral bodies and severe kyphotic deformity and compression of spinal canal.

Figure-4: T2W coronal MR image of lumbosacral spine showing large left psoas abscess and destruction of L4 and L5 vertebral bodies.

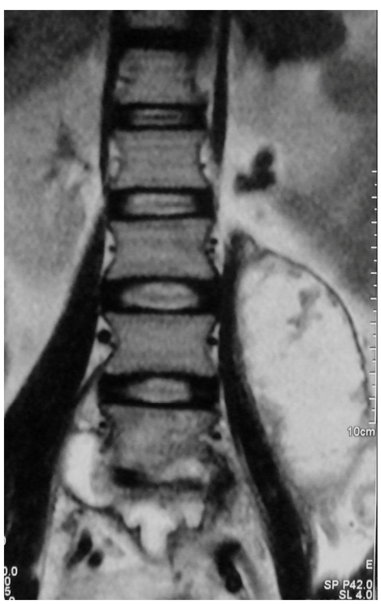

Figure 5: Post-contrast T1W sagittal MR image of lumbosacral spine showing altered signal intensity of L4 and L5 vertebral bodies with destruction & enhancement of intervening disc along with prevertebral and epidural abscesses and spinal canal stenosis.

On MRI, vertebral body edema seen in 18 (60%), disc involvement in 25 (83.3%), reduced disc height in 22 (73.3%) and epidural phlegmon in 17 (56.7%) patients (Figure 3, 5). Maximum kyphotic degree was between 11^0 to 20^0 in 26.7% of patients. Kyphotic degree between 30^0-40^0 was found in 13.2% patients. 20% of patients had scoliotic degree less than 5^0 and 6.7% cases had scoliotic degree between 5^0-10^0. Bone density evaluation and calcification were better evaluated on plain radiographs.

Degree of spinal canal compression ranges between 17 to 67%. Neurological deficit was seen in 26 patients. Neurological symptoms were found in patients with degree of spinal canal compression exceeding 20%. Fine needle aspiration cytology (FNAC)/ histopathological examinations were done in 12 cases out of which 8 patients were positive for acid fast bacilli (AFB). In rest of the patients FNAC/ Histopathological examinations were not done. 26 patients were managed conservatively showing good response to antitubercular therapy (ATT) on follow-up scan. Only four patient undergone decompressive surgeries. The comparison between plain radiograph and MRI findings in our study are summarized in Table 3.

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Table-3: The comparison between plain radiographs and MRI finding in our study			
		Plain radiographs (No. of patients)	**MRI (No. of patients)**
Type of lesions	Paradiscal	25	25
	Central	21	21
	Anterior subligamentous	-	1
	Posterior element	4	8
Level of involvement	Cervical	0	0
	Dorsal	11	15
	Lumbar	10	13
	Sacral	1	2
Severity of bone destruction	Wedge collapse	12	12
	Compression fracture	3	3
	Both	4	4
I.V. disc space/disc involvement		22	25
Abscess		8	24
Calcification		8	-
Scalloping of anterior vertebral surface		16	16
Kyphosis		17	17
Scoliosis		8	8
Bone density		19	-
Vertebral body height reduction		19	19
Phlegmon		-	17
Spinal canal stenosis		-	26

Discussion

In our study back pain was found in 19 (63.3%), low grade fever in 26 (86.7%), paraparesis in 12 (40%) and bowel-bladder involvement in 14 (46.7%) patients. Similar study has been reported by Rajeswari R et al, Jain AK et al, Nussbaum ES et al and Alothman A et al [3-6]. Age of patients with spinal TB ranged from 15 to 75 years in our study. Females are more commonly affected this disease [7]. In our study the diagnosis was made by comparing the plain radiograph and MRI, response to treatment and also histopathological correlation (wherever needed). Contrast enhanced MRI was very helpful in diagnosing paraspinal abscesses, granulation tissues and determining the level of vertebrae involved along with its signal intensities [7-10].

In present study, vertebral body edema was seen in 18 (60%), disc involvement in 25 (83.3%), reduced disc height in 22 (73.3%) and epidural phlegmon formation in 17 (56.7%) patients. These findings were also supported by Smith AS et al [11]. Lower thoracic and thoraco-lumbar spines were the most commonly involved regions [12-16]. Shanley DJ evaluated radiographic manifestations of tubercular spondylitis like intraosseous and paraspinal abscess formation, subligamentous spread of infection, vertebral body destruction and collapse, and extension into the spinal epidural space [17]. Significant instability and deformity of the spine can result, mandating prompt diagnosis and treatment to prevent permanent neurologic damage.

He demonstrated the value of MRI in determining the extent of disease. Similar studies have also been reported by J Pursey et al, Zaidi H et al and Andronikou S et al, and our study is consistent with these observers

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[18-20]. Anterior subligamantous involvement was seen in only 3.3% patients, it may be due to small sample size of the study.

MRI is extremely useful in evaluating the extent of involvement and response to therapy of isolated TB of posterior elements [21]. Involvement of posterior elements due to TB is not so uncommon. 8 (26.7%) patients had posterior element involvement in present study. Similar observations were also been reported by Yusof MI et al, Ehara S et al and Cotton A et al [22-24]. In our study, 26 patients showed neurological deficit and 4 patients were normal. We found that neurological symptoms were present in patients with degree of spinal canal compression exceeding 20%. Both medical and surgical treatment was beneficial in our study. Decompressive surgery plus anti-TB chemotherapy remains the best mode of therapy for Pott's disease. Omari B et al reported similar observation and concluded that combined surgical and medical treatment gave excellent results [25].

Computed tomography (CT) scanning provides much better bony detail of irregular lytic lesions, sclerosis, disc collapse and disruption of bone circumference than plain radiograph. CT is more effective for defining the shape and calcification of soft tissue abscesses. However, CT is less accurate in defining the epidural extension of the disease and its effect on neural structures. The pattern of bone destruction (fragmentary, osteolytic, sclerotic and subperiosteal) can be seen well on CT. It is ideal for guiding a percutaneous diagnostic needle in potentially hazardous or relatively inaccessible sites. The presence of calcification within the abscess is virtually diagnostic of spinal TB [2]. MR Spectroscopy will further help in diagnosis by characterizing tissue consistent of the lesion aiding in confirming the tuberculosis.

Recently, diffusion-weighted magnetic resonance imaging (DW-MRI) and apparent diffusion coefficient values (ADC) are being used in Pott’s spine which may help in the differentiation of spinal tuberculosis from other lesions of similar appearance [26].

Conclusion

MRI is the best diagnostic modality for spinal TB and is more sensitive than plain radiography. MRI provides the diagnosis of spinal TB earlier than conventional methods, offering the benefits of earlier detection and treatment. It allows for the rapid determination of the mechanism for neurologic compression and can distinguish between bone and soft tissue lesion. MRI is the gold standard for evaluating disc space infection and is most effective for demonstrating the extension of disease into soft tissues and also serial MRI can be used to assess the response to treatment and regression of the disease.

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*All correspondences to: Dr. Sajid Ansari, Assistant Professor, Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Sciences, H-2733, BPKIHS, Dharan, Nepal. E-mail: drsajidansari@yahoo.co.in

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