CORRELATION BETWEEN CLINICAL, RADIOLOGICAL AND OPERATIVE FINDINGS IN MANAGEMENT OF TUBERCULOUS AND PYOGENIC SPONDYLITIS.

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ABSTRACT

Background: *spinal infection is a major category of spinal diseases that is difficult to differentiate clinically from degenerative diseases or spinal neoplasm. Evaluation of the vertebral osteomyelitis and tuberculous spondylitis need an accurate and specific imaging modality to guide the invasive procedures for a definitive microbiological diagnosis and to spare patients with other disorders that might mimic these entities as aggressive neoplastic lesions of the spine.*

Aim of the work: *The aim of this study was to determine the accuracy of MRI for discrimination between different types of spinal infections mainly between tuberculous spondylitis and pyogenic spondylitis.*

Material and methods: *We did a retrospective study of MRI images of 30 patients who had confirmed spondylitis either tuberculous or pyogenic in their MRI of the spine. Then we correlate the clinical and operative findings with the preoperative radiology of the patients. Statistical analysis was performed with the Fisher exact test and Monte Carlo test.*

Results: *The incidence of the following MRI findings was significantly higher in patients with tuberculous spondylitis than in those with pyogenic spondylitis a well-defined paraspinal abnormal signal was present in 14 patients 88% in tuberculous spondylitis vs 4 patients 28% in pyogenic spondylitis, a thin and smooth abscess wall was present in 14 patients 88% in TB vs 2 patients 14% in pyogenic spondylitis , presence of paraspinal or intraosseous abscess (15 patients 93% in TB vs 6 patients 42% in pyogenic infection, subligamentous spread or more than two vertebral levels was detected in 12 patients 75% in TB vs 5 patients 35% in pyogenic spondylitis. thick and irregular abscess wall was present in 5 patients 35% in pyogenic spondylitis vs 0% in TB, a horizontal bandlike sparing of the body was present in 4 patients 28% in pyogenic spondylitis vs 0% in TB. Hyperintense signal on T2-weighted images was more commonly observed in tuberculous spondylitis 15 patients 93% in tuberculous vs 8 patients 57% in pyogenic. The accuracy and specificity of preoperative MRI diagnosis correlated to the postoperative pathological findings was 100% of both types of spondylitis*

Conclusion: *MRI is an accurate and sensitive modality in diagnosis of spinal infection. It also has a high specificity in differentiation of tuberculous spondylitis and pyogenic spondylitis.*

Key Words: *Tuberculous Spondylitis, Pyogenic Osteomyelities, MRI Spine.*

INTRODUCTION

Spinal infection is a major category of spinal diseases that is difficult to differentiate clinically from degenerative disease, non infective inflammatory lesions, and spinal neoplasm. Infectious spondylitis is defined as an infection by a specific organism of one or more components of the spine.[1] It can affect the vertebrae, intervertebral discs, paraspinal soft tissues, the epidural space, the meninges, and or the spinal cord. Specific causative organisms include bacteria (pyogenic, granulomatous), fungi, parasites (Echinococcus, Schistosoma), and viruses.[2]

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.[3-4] However, it is sometimes difficult to differentiate these two types clinically and radiologically.[1,3]

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Imaging plays an important role in the overall evaluation of these lesions, and an ideal technique is expected to provide information that will help to characterize and delineate the disease process, guide the method of treatment either medical or surgical, and finally to assess the response to therapy in the follow up study.[5,6]

Magnetic Resonance imaging, (MRI) has become an established imaging technique.[7-10] MRI has shown to be very sensitive in detecting infections of the vertebrae[5,7,9] using the high contrast resolution, and direct multiplanar imaging, with the help of routine and fat suppression sequences, which is very useful in detecting marrow infiltration, and the location of the lesion either extradural, intradural extramedullary, and intramedullary. The MR technique using contrast enhancement should be modified to obtain adequate visualization and delineation of the extent of the pathological process.[10,11]

The appearance of vertebral osteomyelitis on MR images has been characterized as confluently decreased signal intensity of the vertebral bodies and associated interspace with poor distinction between

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these on short TR/short TE images; abnormal increased signal of the disc on long Time of repetition (TR)/long Time of echo (TE) images with an abnormal configuration and increased signal of the vertebral endplates at the abnormal disc level on long TR/long TE images.(12) However, variations from this original description have been reported.(7,13)

In tuberculous spondylitis, the cortical definition of affected vertebrae is invariably lost, in contradistinction to pyogenic spondylitis. T1 - weighed images usually show decreased signal from the affected vertebral marrow, reduced disk height, morphologic alteration of paraspinal soft tissues, and epidural extension. On T2-weighted images, an indiscriminate increase in signal intensity is noted from the vertebrae, discs, and soft tissues. Enhanced MR studies are particularly useful for characterizing tuberculous spondylitis. Rim enhancement around intraosseous and paraspinal soft-tissue abscess had not been demonstrated in other spinal infections. Epidural extension and meningeal involvement are seen to be better advantage on enhanced examinations.(10,14) Recent technical advances have made diffusion-weighted imaging of the spine substantially more practical for routine clinical use.(15-16)

Aim of the work:

The aim of this study was to determine the accuracy of MRI for discrimination between different types of spinal infections mainly between tuberculous spondylitis and pyogenic spondylitis.

METHODS

Thirty patients presented with infectious spondylitis with positive MRI findings referred to Main University Hospital of Alexandria University over a 5 years period. Those patients were studied by a neuroradiologist and neurosurgeon with a provisional diagnosis of either tuberculous or pyogenic spondylitis depending on the clinical history and the MRI findings, and then we operate the patients and correlate the postoperative pathological results with the preoperative provisional diagnosis.

The clinical data of the patients ranged from mild symptoms as low or high grade fever, anorexia, weight loss, mild low back pain or severe manifestation as neurological deficit or myelopathy, severe back pain and sciatica with marked disability.

Preoperative diagnosis of tuberculous spondylitis was present in 16 patients (10 men and 6 women) and 14 cases of pyogenic spondylitis (8 men and 6 women). The mean ages of patients with tuberculous spondylitis and pyogenic spondylitis were 46 years (ranged from 32-68 years) and 39 years (ranged from 28–61 years) respectively. The mean interval from presentation to MRI was 24 weeks (range, 2 weeks–16 months) in patients with tuberculous spondylitis and 3 weeks (range, 5 days–3 months) in patients with pyogenic spondylitis.

MRI was performed in Axial, sagittal and sometimes coronal T1-weighted MR images (TR range/TE range, 350–650/11–30) before and after contrast administration. T2-weighted images (3,000–4,000/76–108) were obtained. In addition, axial and sagittal fat-suppressed T1-weighted images (350–800/11–30) were obtained after IV infusion of 0.1 mmol/kg of gadopentetate dimeglumine.

Typical MR parameters were as follows: field of view, 15–20 cm for axial plane and 30–35 cm for sagittal plane; number of excitations, 2; matrix size, 256 x 192; slice thickness, 4 mm; intersection gap, 1 mm; and echo-train length, 8–16.

We evaluated the MR images and comment upon the following items including : para-vertebral items as (the location and extension of the lesion, the appearance of the margin of paraspinal abnormal signal, the appearance of the abscess walls, the extent of subligamentous spread) , the vertebral body items as (horizontal bandlike sparing of the body, morphological changes of the vertebral bodies and its appendages , the involvement of the thoracic spine, entire body involvement, and the signal intensity of involved vertebral bodies were evaluated.), intervertebral disc items as (disc space) ,Spinal canal items as (meningeal and spinal cord involvement), The post contrast evaluation including the degree and pattern of the enhancement of the lesion , and finally we did over all assessment of the type of spondylitis.

Statistical analysis:

Data were analyzed using SPSS software package version 15.0 (SPSS, Chicago, IL, USA), Fisher exact test was applied to compare between different groups.

RESULTS

The present study included 30 patients with infectious spondylitis referred to Main University Hospital of Alexandria University over a 5 years period. MRI was done in all patients and preoperative diagnosis studied by a neuroradiologist and neurosurgeon was done and then correlation of this finding with the clinical history and operative pathological results was done.

Preoperative diagnosis of tuberculous spondylitis was present in 16 patients (10 men and 6 women) and 14 cases of pyogenic spondylitis (8 men and 6 women). The mean ages of patients with tuberculous spondylitis and pyogenic spondylitis were 46 years (ranged from 32-68 years) and 39 years (ranged from 28–61 years) respectively. The mean interval from presentation to MRI was 24 weeks (range, 2 weeks–16 months) in patients with tuberculous spondylitis and 3 weeks (range, 5 days–3 months) in patients

with pyogenic spondylitis. (Table I)

The most common presenting symptoms of tuberculous spondylitis were low back pain or neck pain, Low grade fever, anorexia and weight loss. In lately diagnosed tuberculous patients presented with slowly progressive neurological deficit as myelopathy followed by paraplegia in 5 cases (31.3%), whereas in pyogenic spondylitis the patients presented with fever, severe back pain, and severe radiculopathy with rapid progressive cord compression in 3 cases (21.4%). (Table II)

Thoracic spine was the most common site of spinal TB involvement followed by lumbar and cervical. Sacrum was not involved in any spinal TB cases but in pyogenic spondylitis lumbar spine was the most common site affected followed by the cervical spine then dorsal spine then finally the sacrum. In tuberculous spondylitis, thoracic involvement was observed in 7 patients 43% of cases and lumbar involvement in 5 patients 32% of cases and the least affected was the cervical spine 4 patients 25%, whereas in pyogenic spondylitis, thoracic involvement was observed in 2 patients 14% of cases, lumbar involvement was observed in 9 patients 64% of cases, cervical spine involvement was observed in 2 patients 14% of cases, and sacral involvement was observed in 1 patient 8% of cases. (table III)

In cases of preoperative diagnosis of tuberculous spondylitis, we found the incidence of the following MRI findings was significantly higher than in those with pyogenic spondylitis ($p < 0.05$) a well-defined paraspinal abnormal signal was present in 14 patients 87.5% in tuberculous spondylitis vs. 4 patients 28.6% in pyogenic, a thin and smooth abscess wall was present in 14 patients 87.5% in TB vs 2 patients 14.3% in pyogenic spondylitis , combination of both findings (88% vs 14%), presence of paraspinal or intraosseous abscess (15 patients 93.8% in TB vs 6 patients 42.9% in pyogenic infection, subligamentous spread or more than two vertebral levels was detected in 12 patients 75% in TB vs 5 patients 35.7% in pyogenic spondylitis (Fig1,2,3). (Table IV)

The incidence of the following MRI findings was significantly higher in patients with pyogenic spondylitis than in those with tuberculous spondylitis ($p < 0.05$). An ill-defined paraspinal abnormal signal 9 patients 64.3% in pyogenic vs one patient 6.3% in tuberculous (Fig. 4, 5) thick and irregular abscess wall 5 patients 35.7% in pyogenic spondylitis vs 0% in TB, a horizontal bandlike sparing of the body 4 patients 28.6% in pyogenic spondylitis vs 0% in TB (Fig 6). (Table V)

All patients with spondylitis showed a hypointense to isointense signal on T1-weighted images. No significant difference in heterogeneous signal was seen on T1-weighted images Hyperintense signal on T2-weighted images was more commonly observed in tuberculous spondylitis 15 patients 93.8% in tuberculous vs 8 patients 57.1% in pyogenic, whereas isointense signal on T2-weighted images was more commonly observed in pyogenic spondylitis 6 patients 42.9% in pyogenic vs one patient 6.3% in tuberculous. No hypointense signal was seen on T2-weighted images or heterogenous signal on T2-weighted images. Contrast enhancement pattern showed no significant difference in both 16 patients 100% in tuberculous vs 12 patients 85% in pyogenic.

The involvement of the posterior element was present in 14 patients 87.5% in tuberculous vs 9 patients 64.3% in pyogenic. The epidural extension was present in 16 patients 100% in TB vs 13 patients 92.9% in pyogenic spondylitis which was not significantly different in tuberculous and pyogenic spondylitis, also, No difference was present in the involvement of intervertebral disk (13 patients 81.3% in tuberculous vs 13 patients 92.9% in pyogenic, and disk space narrowing (9 patients 56.3% in tuberculous vs 7 patients 50% in pyogenic). (table VI)

Table I: age and sex distribution in both groups

	T.B. spondylitits (n=16)		Pyogenic spondylitis(n=14)	
	No.	%	No.	%
Sex				
Male	10	62.5	8	57.1
Female	6	37.5	6	42.9
Age				
Range	32 – 68		28 – 61	
Median	46		39	

Table II: clinical presentation of the patients

	T.B. (n=16)		Pyogenic (n=14)	
	No.	%	No.	%
Back pain and Fever without neurological deficit	11	68.8	11	78.6
With Neurological deficit	5	31.3	3	21.4

Table III: The distribution of the lesion in patients.

	T.B. (n=16)		Pyogenic (n=14)	
	No.	%	No.	%
Cervical	4	25.0	2	14.3
Thoracic	7	43.8	2	14.3
Lumbar	5	31.3	9	64.3
Sacrum	0	0.0	1	7.1

Table IV: MRI findings significantly higher in T.B. spondylitis

	T.B. (n=16)		Pyogenic (n=14)		FE(P)
	No.	%	No.	%	
Well defined paraspinal abnormal signal	14	87.5	4	28.6	0.002*
Thin and smooth abscess wall	14	87.5	2	14.3	<0.001*
Paraspinal and intraosseous abscess	15	93.8	6	42.9	0.004*
Subligamentous spread or >2 vertebral levels	12	75.0	5	35.7	0.063
Hyperintense signal on T2 -weighted images	15	93.8	8	57.1	0.031*

FEp: p value for Fisher Exact test
*: Statistically significant at $p \leq 0.05$

Table V: MRI findings significantly higher in pyogenic spondylitits

	T.B. (n=16)		Pyogenic (n=14)		FE(P)
	No.	%	No.	%	
Ill defined paraspinal abnormal signal	1	6.3	9	64.3	0.001*
Thick and irregular abscess wall	0	0.0	5	35.7	0.014*
Horizontal band-like spring of the body	0	0.0	4	28.6	0.037*
Isointense signal on T2 weighted images	1	6.3	6	42.9	0.031*

FEp: p value for Fisher Exact test
*: Statistically significant at $p \leq 0.05$

Table VI: MRI findings in both T.B. and pyogenic spondylitits

	T.B. (n=16)		Pyogenic (n=14)		FE(P)
	No.	%	No.	%	
Epidural extension	16	100.0	13	92.9	0.467
Intervertebral disk involvement	13	81.3	13	92.9	0.602
Disk space narrowing	9	56.3	7	50.0	1.000
Involvement of the posterior element	14	87.5	9	64.3	0.204

FEP: p value for Fisher Exact test

Operative findings were matched with the preoperative diagnosis of both tuberculous spondylitis and pyogenic spondylitis in all patients with 100% accuracy and specificity.

Fig 1: Sagittal T2, Sagittal, coronal and axial T1 post contrast images: TB spondylodiscitis showing partial dorsal vertebral collapse,prevertebral and intraspinal epidural abscess extending over three v/ertebral levels, showing regular wall enhancing margis, fusiform shape with total marrow involvement of related vertebral bodies

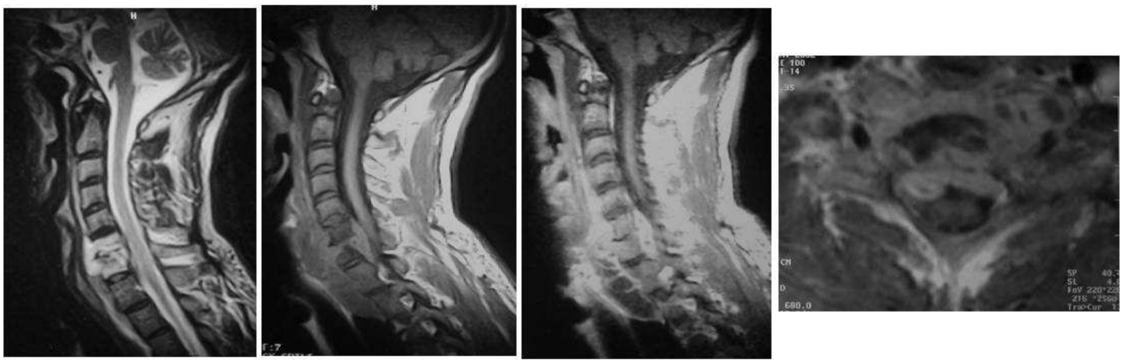

Fig 2: Typical tuberculous spondylitis in 37 years-old woman. Sagittal T2,T1-weighted (pre and post contrast) and axial T1 post contrast images of cervical spines show heterogeneously T2 hyperintense signal and T1 enhancing signals involving C6-C7 vertebral bodies and intervening disc with epidural mass and anterior prevertebral subligamentous spread from D1 to D3 vertebrae.

Fig 3: Sagittal T2 and sagittal T1, fat suppression and axial T1 post contrast MRI lumbar spines show extramedullary extradural abscess formation with localized marrow edema of posterior L2 and L3 vertebral bodies. Left lateral extension through exit foramen with involved swollen left psoas muscle noted in the axial image. Intact intervening intervertebral disc ….typical tuberculous spondilitis.

Fig 4: Pyogenic lower dorsal spondylitis. Sagittal T1, T2 and fat suppression images showing intraosseous D9 abscess and epidural irregular thick wall abscess opposite D9 and D10 posterior vertebral bodies. Partially collapsed D9 vertebral body with almost no subligamentous prevertebral extension.

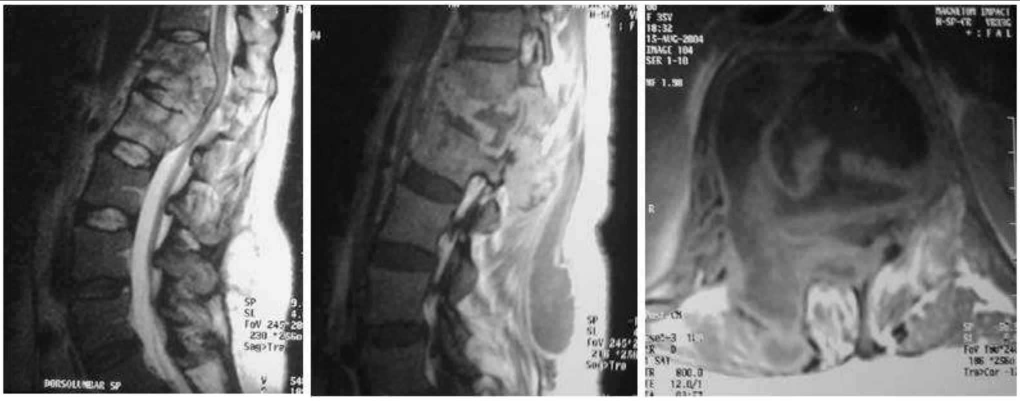

Fig 5: Sagittal T2, post contrast sagittal T1, and axial T1 post contrast images. Showing pyogenic dorsolumbar spondylitis with sizable irregular thick wall posterior and paraspinal abscess showing caudal extension through posterior soft tissue till level of lower lumbar vertebrae.

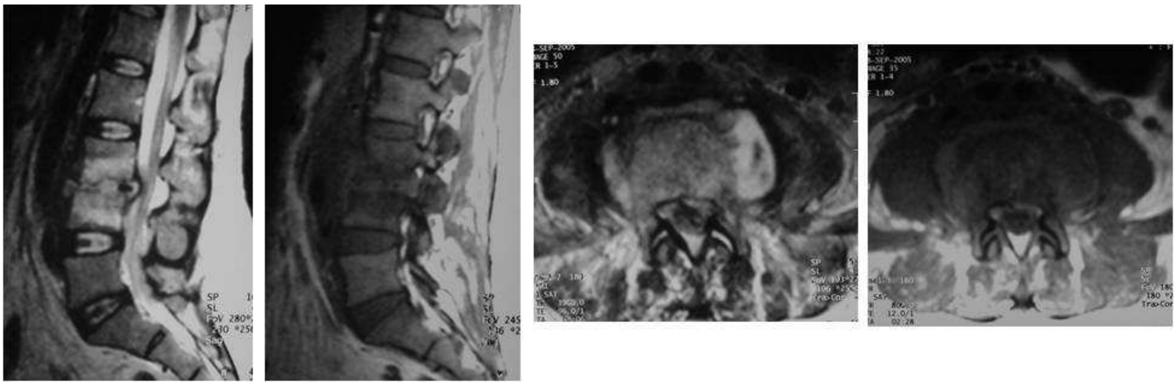

Fig 6: Typical features of pyogenic lumbar spondylitis involving L3 and L4 vertebral bodies and intervening disc. Irregular thick wall prevertebral involvement involving only two vertebral levels with small posterior epidural extension .Horizontal band-like sparing the infected bodies diagnostic of pyogenic rather than T.B spondylitis.

DISCUSSION

The symptoms and clinical findings in patients with spinal infection are often non-specific and may vary widely, depending on the site, extent, and severity of the pathological process.[16-18] Especially, tuberculosis infection is more indolent with a gradual onset of symptoms over months to years. Cases with spinal and radicular pain without fever often are diagnosed erroneously as disc protrusions. The incidence of typical acute vertebral osteomyelitis has decreased because of the more wide-spread use of antibiotics. However, tuberculous spondylitis is still a frequent cause of infectious spondylitis in endemic regions and is increasing in prevalence because of the resurgence of tuberculosis during the past decade, especially in patients who are immunocompromised.[4,19]

Tuberculosis of the spine accounts for more than 50% of musculoskeletal tuberculosis. The importance of early diagnosis and prompt treatment of infectious spondylitis based on a specific diagnosis cannot be overemphasized in minimizing the residual spinal deformity or permanent neurologic deficit.[3,20]

Differentiation between tuberculous and pyogenic spondylitis is difficult clinically and radiographically. MRI has been reported to be useful in the early detection of spondylitis.[3,21]

Rim enhancement of abscess on MRI is reportedly suggestive of tuberculous spondylitis.[16,22] However, rim enhancement was observed in both tuberculous and pyogenic spondylitis in this study. The two most reliable MRI findings suggesting tuberculous spondylitis in the current study were thin and smooth enhancement of the abscess wall and well-defined paraspinal abnormal signal, whereas thick and irregular enhancement of abscess wall and ill-defined paraspinal abnormal signal were suggestive of pyogenic spondylitis. Thus, contrast-enhanced MRI was essential in the differentiation of these two types of spondylitis. Hong et al.[23] Reported that in tuberculous arthritis the margins of extraarticular lesions were smoother and the abscess walls were thinner and smoother than in pyogenic arthritis. Regarding the margin of the soft-tissue abnormal signal and the appearance of the abscess wall, tuberculous and pyogenic spondylitis presented MRI findings similar to those of tuberculous and pyogenic arthritis, respectively. This might be attributed to the relative late phase and chronic course of tuberculous spondylitis contributed to the smoother margin of the paraspinal abnormal signal and a thinner and smoother abscess wall. The minimal inflammation of tuberculous abscess may also contribute to the thin and smooth appearance of abscess wall.

It was recently reported that signal intensity was of limited value in differentiating tuberculous arthritis from pyogenic arthritis.[23] In contrast, in this study hyperintense signal on T2-weighted images were more common in tuberculous spondylitis than in pyogenic spondylitis. This discrepancy between the studies could be due to the use of various MRI units in the previous study.

A lack of proteolytic enzymes in the Mycobacterium as compared with pyogenic infection has been proposed as the cause of relative preservation of the intervertebral disks.[3,24,25] However, in this study, disk space narrowing was observed in 9 patients 56% in tuberculous which was similar to 7 patients 50% in pyogenic this assumed that a longer interval existed from presentation to MRI in tuberculous spondylitis than pyogenic spondylitis in the current study in contrary to Liu et al.[26] who reported that the disk space narrowing was prominent in 72% (21/29) of patients with tuberculous spondylitis in his study.

Subligamentous spread to three or more vertebral levels was frequent in tuberculous spondylitis in this study, which is consistent with previous reports as in Thrush and Enzmann[16] and Griffith.[27] The involvement of the thoracic spine and multiple vertebral bodies was significantly higher in patients encountered in this study with tuberculous spondylitis than in patients with pyogenic spondylitis, which is also consistent with previous reports as in Alothman et al[20] study and Moorthy.[28] Horizontal bandlike sparing of the body was exclusively observed in 28% of cases of pyogenic spondylitis, although it was observed in a minority of the patients with pyogenic spondylitis. In agreement with previous reports as in Alothman et al[20] and Akman et al[22] studies. Thoracic involvement was more common than lumbar and cervical involvement in patients with tuberculous spondylitis encountered in this study. In the current study, abnormal signal of the posterior element was observed in 87% of patients with tuberculous spondylitis and in 64% of patients with pyogenic spondylitis, but this difference was not significant this findings is matched with other studies as in Arizono et al, Shanley and Smith et al studies[3,19,29] but in a recent studies, Narlawar et al[30] reported that posterior element tuberculosis was reported in only 24% and not as previously reported In the current study, it was considered that the more common abnormal signals of the posterior element in this study could be related to the use of fat-suppressed contrast-enhanced T1-weighted images with 1.5-T MR scanners.

Conclusion

MRI was accurate for differentiation of tuberculous spondylitis from pyogenic spondylitis. A well-defined paraspinal abnormal signal, a thin and smooth abscess wall, subligamentous spread to three or more vertebral levels, and multiple vertebral or entire body involvement were more suggestive of tuberculous spondylitis than pyogenic spondylitis.

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