MR IMAGING IN INFECTIOUS SPONDYLITIS

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ABSTRACT

BACKGROUND
Spondylodiscitis is characterized by infection involving the intervertebral disc and adjacent vertebrae. MRI is the imaging modality of choice due to its very high sensitivity and specificity. It is also useful in differentiating between pyogenic, tubercular, brucellar and other types of spondylitis. Hence this study was undertaken to evaluate MRI findings in infectious spondylitis.

MATERIALS AND METHODS
Totally, 40 patients referred for MRI scans with the clinical diagnosis of spinal infections were included in our study. The patients were classified as tubercular, pyogenic, and brucellar spondylodiscitis on the basis of imaging findings and were correlated with the final diagnosis made by histopathology/cytology/culture/biochemistry or with successful therapeutic outcome and were subsequently analysed for sensitivity, specificity and accuracy based on the imaging findings.

RESULTS
Statistical analysis was done using the Chi square test and Z test. The sensitivity, specificity, accuracy and p value of the MRI findings in tubercular, pyogenic and brucellar spondylitis was calculated and the inference and conclusion were made based on the above findings.

CONCLUSION
MRI was accurate for differentiation of tuberculous spondylitis from pyogenic and brucellar spondylitis.

KEYWORDS
Tubercular, Pyogenic, Brucellar, Spondylitis.

HOW TO CITE THIS ARTICLE: Singh PP, Sai S, Gowda S, et al. MR imaging in infectious spondylitis. J. Evid. Based Med. Healthc. 2018; 5(41), 2895-2900. DOI: 10.18410/jebmh/2018/592

BACKGROUND

Pyogenic, tuberculous and brucella spondylitis are common causes of spinal infection. Tuberculous spondylitis is much more common than pyogenic spondylitis due to use of antibiotics and good hygiene.[1,2] Brucella spondylitis is an uncommon infection of the spine.[3] The vertebral spondylitis presents as destruction of two or more contiguous vertebrae, intervertebral disc infection and paraspinal mass/collection. Three forms of dissemination are described as follows: hematogenous spread from a distant septic focus, direct inoculation, contiguity with an adjacent septic focus. The infection typically commences at the anterior vertebral body at discovertebral junction because of its rich arterial supply and spreads through the medullary spaces with subligamentous extension and penetration of the subchondral plate. Large paraspinal abscesses / collections are much more common in tubercular spondylitis than pyogenic and brucellar spondylitis. On MRI spondylodiscitis presents with altered signal intensity of the involved vertebrae appearing hypointense on T1 and hyperintense on T2 with altered signal in the involved intervertebral disc.[4,5] The ability to imaging in different planes and high tissue contrast shows MRI to be the modality of choice to evaluate patients with infectious spondylitis and is the modality of choice for differentiation between tubercular, pyogenic and brucellar spondylitis.[6,7] MRI is considered as one of the most sensitive diagnostic method for differentiation between different types of spondylitis.[8,9]

Financial or Other, Competing Interest: None.
Submission 14-09-2018, Peer Review 18-09-2018,
Acceptance 02-10-2018, Published 04-10-2018.
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DOI: 10.18410/jebmh/2018/592

Aims and Objectives

The purpose of this study was to determine the accuracy of MRI for discrimination between tuberculous spondylitis, pyogenic spondylitis and brucellosis spondylitis.

MATERIALS AND METHODS
The study is a prospective study conducted in MVJ Medical college and Research hospital over a period of 2 years from June 2016 to May 2018. MRI scan was performed using MAGNETOM ESSENZA, 16 Channel, 1.5 Tesla, MRI Machine, SIEMENS, in the Department of Radiodiagnosis, MVJMC & RH, Bangalore.

Inclusion Criteria
A total of 40 patients with the clinical diagnosis of spinal infections are included in this study.

Exclusion Criteria
Patients with previous spinal abnormalities such as congenital abnormalities, traumatic fractures, tumors, severe scoliosis which can obscure the MRI results.

Patients with inadequate follow up and those without histological diagnosis.

Magnetic resonance protocol
The MRI protocol consisted of sagittal T1-weighted MR images, axial and sagittal T2-weighted MR images, fat-suppressed T2-weighted images, sagittal and axial 3D turbo spin echo SPACE sequences, in addition with sagittal and coronal fat-suppressed STIR images were also obtained.

The overall assessment of the type of spondylitis was done. The Criteria used to differentiate tubercular, pyogenic and brucellosis infections were as follows: vertebral body destruction, end plate erosion, destruction of intervertebral disk space, large paraspinal/ epidural collections, skip lesions and presence of intradiscal gas. The MRI diagnosis was subsequently correlated with histopathology / cytology / culture / biochemistry.

Figure 1(a) Figure 1(b) Figure 1(c)

Figure 1(a) - T2W sagittal image shows vertebral end plate erosion with destruction of intervertebral disc space and marrow signal change appearing hyperintense involving L4 and L5 vertebral bodies.
Figure 1(b) - T1W sagittal image shows marrow signal change appearing hyperintense and intervertebral disc destruction involving L4/L5 disc level.
Figure 1(c) - STIR coronal shows contiguous involvement of L4 and L5 vertebral bodies with intervertebral disc destruction suggestive of pyogenic spondylitis.

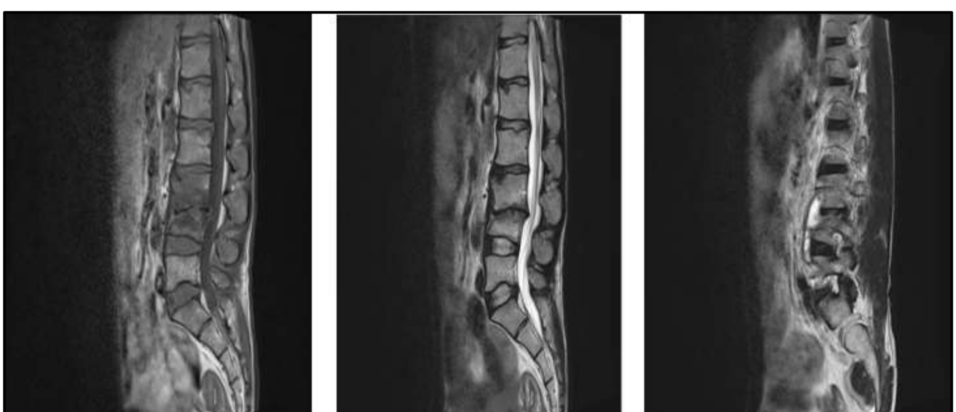

Figure 2(a) Figure 2(b) Figure 2(c)

Figure 2(a) - T1W sagittal and
Figure 2(b) - T2W sagittal images show vertebral end plate erosion with marrow signal change appearing hypointense on T1W and hyperintense on T2W involving L3 and L4 vertebral bodies with a prevertebral collection at L3 and L4 vertebral bodies.

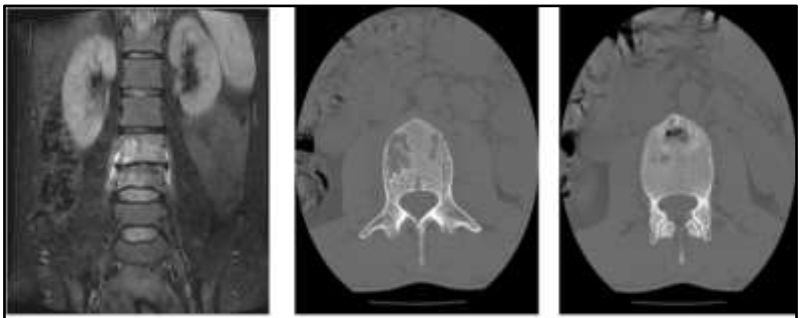

Figure 2(d) Figure 2(e) Figure 2(f)

Figure 2(d) - STIR coronal image shows end plate erosion involving L3 and L4 vertebral bodies with marrow signal change appearing hyperintense with bilateral paraspinal collections.
Figure 2(e) and (f) - NCCT scan shows lytic lesions involving the L4 vertebral body with presence of intradiscal gas in Figure 2(f).

Above findings are suggestive of brucellar spondylitis.

Figure 3(a) Figure 3(b) Figure 3(c)

Figure 3(a) and 3(b) – T2W sagittal image shows end plate erosion of L2 vertebral body with hyperintense signal involving L1/L2 intervertebral disc level with a small anterior subligamentous collection.
Figure 3(c) - STIR coronal image shows hyperintense collection within the left psoas muscle suggestive of psoas muscle abscess.

Above findings are suggestive of tubercular spondylodiscitis with psoas muscle abscess.

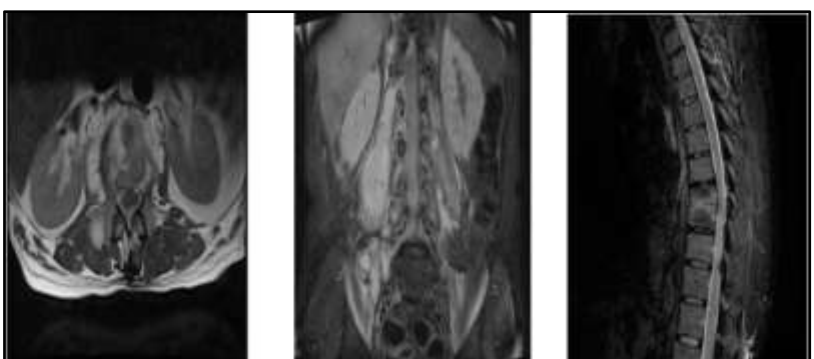

Figure 3(d) Figure 3(e) Figure 3(f)

Figure 3(d) - T2W transverse image shows prevertebral and bilateral paraspinal collections appearing hyperintense with vertebral body destruction and collections in the right paraspinal muscles.
Figure 3(e) - STIR coronal image shows a well-defined right psoas muscle collection/abscess with bilateral iliopsoas muscle abscesses.
Figure 3(f) - STIR sagittal image shows irregular end plate erosion of D8 and D9 vertebral bodies displaying hyperintense signal with complete destruction of the intervertebral disc space at D8/D9 disc level. Above findings are suggestive of tubercular spondylodiscitis.

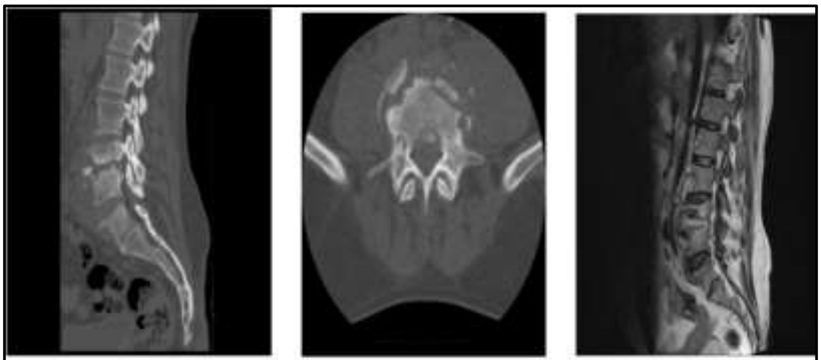
Figure 4(a) Figure 4(b) Figure 4(c)

Figure 4(a) and 4(b) - NCCT scan shows destruction/ collapse of L4 vertebral body with lytic lesions involving L4 vertebral body and calcifications noted within paraspinal abscesses.
Figure 4(c) - Shows prevertebral collection extending from L3 to S1 vertebral levels.
Figure 4(a), (b) and (c) are suggestive of tubercular spondylodiscitis.

RESULTS
Out of the total 40 patients, 26 patients were categorized as having tuberculous spondylitis, 12 patients with pyogenic spondylitis and 2 patients as brucella spondylitis based on MR imaging findings of vertebral body destruction, destruction of intervertebral disc space, end plate erosion, skip lesions, presence of paraspinal and epidural collection and presence of intradiscal gas and subsequently correlated with histopathology, cytology and cell culture.

Age Distribution	Tubercular Spondylitis	Pyogenic Spondylitis	Brucellar Spondylitis
20 – 30 yrs.	2	0	0
30 – 40 yrs.	7	5	1
40 – 50 yrs.	10	6	1
50 – 60 yrs.	7	1	0
Total	**26**	**12**	**2**

Table 1

Sex Distribution	Tubercular Spondylitis	Pyogenic Spondylitis	Brucellar Spondylitis
Male	22	7	2
Female	4	5	0
Total	**26**	**12**	**2**

Table 2

Histopathological diagnosis and cytological analysis were performed for the total 40 patients who underwent MRI scans which confirmed 26 patients with tubercular spondylitis, 12 patients with pyogenic spondylitis and 2 patients with brucellar spondylitis.

Findings	Tuberculous Spondylitis No. of Patients (26/40)	Pyogenic Spondylitis No. of Patients (12 /40)	Brucellar Spondylitis No. of Patients (2 /40)	P Value
Vertebral body destruction	14/26	2/12	0/2	0.002
Destruction of intervertebral disc space	11/26	9/12	2/2	0.001
End plate erosion	12/26	11/12	2/2	0.001
Large paraspinal and epidural collections/abscess	20/26	6/12	1/2	0.002
Skip lesions	5/26	1/12	0/2	0.15
Presence of intradiscal gas	0/26	2/12	2/2	0.02

Table 3

P value < 0.05 was taken as statistically significant.

Above findings and considering the p value, the sensitivity, specificity and accuracy of vertebral body collapse/ destruction is 100%, 80% and 90% for tuberculous spondylitis.

The sensitivity, specificity and accuracy of end plate erosion is 90%, 100% and 90% for pyogenic spondylitis and 70%, 80% and 80% for brucellar spondylitis respectively.

The sensitivity, specificity and accuracy of destruction of intervertebral disc space is 90%, 100% and 100% for pyogenic spondylitis and 100%, 90% and 90% for brucellar spondylitis respectively.

The sensitivity, specificity and accuracy for large paraspinal and epidural collections is 70%, 80% and 70% in tuberculous spondylitis. Skip lesions are more common in tuberculous spondylitis with sensitivity, specificity and accuracy of 100%, 90% and 100% respectively. Presence of intradiscal gas has 100% sensitivity, 100% specificity and 90% accuracy in brucellar spondylitis.

Statistical significance was drawn using Chi square and Z test for analysis and Statistical passage for social sciences (SPSS).

DISCUSSION

Tuberculous Spondylitis

Spinal tuberculosis most commonly involves the thoracic spine than lumbar spine. In tuberculous spondylitis there is relative preservation of the intervertebral disc with variable destruction and occurs late as compared to the bone destruction, there may be complete destruction/ collapse of the vertebral body and subligamentous spread of infection with large paraspinal abscesses.[10,11] In tuberculous spondylitis there is involvement of three or more vertebral levels with vertebral body collapse and destruction, gibbus deformity, large paraspinal soft tissue masses/abscesses, most commonly iliopsoas abscesses. Spondylodiscitis is more common in tuberculosis of the spine with vertebral body end plate erosion/ destruction and altered signal of the involved intervertebral disc space. Posterior elements may be involved in tuberculous spondylitis. The abscess wall is thin and smooth in tuberculous spondylitis. The presence of skip lesions, large paraspinal cold abscess and paraspinal calcifications within abscesses are also suggestive of tuberculous spondylitis.[12,13,14]

Pyogenic Spondylitis

Pyogenic spondylitis most commonly involves the lumbar spine. Most frequently Staphylococcus aureus is the etiological agent. Other relevant agents include Streptococcus, Pneumococcus, Enterococcus, Pseudomonas aeruginosa and Klebsiella. There is two contiguous vertebral body involvement with involvement of the intervening disk. MRI shows low signal intensity on T1-weighted images and high signal intensity on T2-weighted images of the involved vertebral bodies with a loss of definition of the vertebral endplate and fat suppressed STIR images also show hyperintensity of the involved vertebral bodies.[4] Vertebral endplate destruction is more common in pyogenic spondylitis. In pyogenic spondylitis abscess wall appears thick and irregular unlike thin and smooth in tuberculous spondylitis. There is moderate to complete disc destruction in pyogenic spondylitis.[15] Small paravertebral and epidural extension/ abscess is seen in pyogenic spondylitis as compared to large paraspinal collections in tuberculous spondylitis which usually appears hypointense relative to the cord on T1-weighted images and hyperintense on T2-weighted images.[16]

Brucellar Spondylitis

Brucellosis is a global zoonotic infection caused by gram-negative coccobacilli which are mostly spread animal to human via unpasteurized dairy products.[17,18] Brucellosis may affect any body part and may be focal or systemic, but it has an affinity for the musculoskeletal system particularly the spine. MR imaging features of brucellar spondylitis include a predilection for the lower lumbar spine, preservation of the vertebral body height, early destruction of the intervertebral disc space and facet joint involvement.[19] In brucellar spondylitis, paraspinal abscesses are smaller than those in tuberculous spondylitis, anterior parrot beak osteophytes, intradiscal gas, facet joint involvement with relative sparing of the posterior elements are also seen.[20,21] Intervertebral disc destruction appears as hyperintense signal on T2 weighted MRI images. Spinal deformities are less common in brucellar spondylitis. Bone sclerosis is more common in pyogenic and brucellar spondylitis.[22]

Features	Tubercular	Pyogenic	Brucellar
Site of predilection	Dorsolumbar	Lower lumbar	Lower lumbar
Vertebral body height	Destroyed	Destroyed	Preserved
Posterior elements	May be involved	Spared	Spared
Subligamentous spread	Common	May be seen	No
Disk destruction	Late	Early	Early
Intradiscal gas	Infrequent	May be seen	Frequently
Paraspinal and epidural extension	Common	Common	Uncommon
Paraspinal mass	Large	Small	Small
Calcification in paraspinal mass	Yes	No	No
Gibbus Deformity	Common	Uncommon	Uncommon
Multilevel involvement	Common	Uncommon	Rare

Paraspinal involvement	Large abscess, with often thin, smooth rim enhancement; may calcify(healing)	If present; small abscess with often thick, irregular rim enhancement	Relatively mild
Bone sclerosis	No	Yes	Yes

Table 4. Features Differentiating between Tubercular, Pyogenic and Brucellar Spondylitis

CONCLUSION
Endplate erosion with changes in bone marrow on both sides of the disk is a typical finding in infectious spondylitis. MRI is very sensitive in diagnosing infectious spondylitis and is the modality of choice. Vertebral collapse/destruction with endplate erosion, skip lesions and paraspinal and epidural collections are more common in tuberculous spondylitis. End plate erosion, destruction of intervertebral disc space with small prevertebral and paraspinal abscesses are more common in pyogenic spondylitis. Destruction of intervertebral disc space with intradiscal gas, facetal arthropathy and anterior marginal/parrot beak osteophytes are more common in brucellar spondylitis. With these points in mind, MR imaging can be very beneficial to patients with spinal infection.

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