Sp6: Can MRI reliably differentiate pyogenic and spinal tuberculosis and is a contrast MRI important in all patients with evidence of spinal tuberculosis?

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Response/Recommendation: There is no single MRI imaging parameter to confidently distinguish tubercular from pyogenic spondylodiscitis and comparing multiple imaging findings increases the sensitivity and specificity to distinguish the two pathologies. Developing the scoring systems, namograms, radiomics may help in standardizing image analysis in day-to-day practice to increase the predictability of tuberculosis. Contrast is not mandatory for distinction however, it helps in a clear depiction of the findings.

Level of Evidence: Moderate

Delegate Vote:

Rationale: A systematic review was conducted to evaluate the reliability of MRI to differentiate pyogenic and spinal tuberculosis and if the contrast MRI is important in all patients with evidence of spinal tuberculosis. PubMed, Web of Science, Clinicaltrials.org, and Scopus were searched for original articles from inception until January 01, 2025. We excluded articles published in a non-English language, case reports, review articles, registry-based studies, and studies Initial database screening resulted in 4055 articles of which were excluded 3888 articles which after duplicate removal resulted in 30 articles that were subjected to tile and abstract screening. We shortlisted 14 articles for full-text screening in the review that met the inclusion criteria. All the studies were retrospective and provided level IV evidence.

MRI is the most common imaging modality used for diagnosis and treatment plans in cases of infective spondylodiscitis. The differentiation of tuberculosis and pyogenic infections based on MRI is crucial when clinical and laboratory data are inconclusive. Since there are no single differentiating MRI findings, various studies have analyzed multiple MRI features to increase the accuracy in differentiating tubercular from pyogenic spondylodiscitis. Studies have included, the level of the spinal column, the pattern of vertebral body involvement, disc destruction, paravertebral and epidural collections, end plate changes, posterior element involvement, signal of involved bone with contrast enhancement pattern, skip lesions, the pattern of subligamentous spread of infection to differentiate the two. A summary of 25 variables compared from 13 selected publications is included in this manuscript (1-13).
The most commonly included parameters (more than 50% of articles) are level of spine involved, number of vertebral bodies involved, signal and contrast enhancement of the involved vertebra, intraosseous abscess, extent of vertebral body destruction, disc sparing and enhancement pattern, paravertebral and epidural collection along with subligamentous spread are considered.
The paravertebral collections with thin and regular walls are seen in 80-97% of tuberculosis as compared to 3-25% in pyogenic. The involvement of more than 3 contiguous vertebrae is common in tuberculosis ranging from 30-100% versus 0-37% in pyogenic. The epidural abscess is a feature of tuberculosis in 45-80% whereas 4-43% pyogenic can have epidural abscess. Vertebral body destruction for more than 50% and intraosseous abscess indicated tuberculosis in 60-80% and 65-80% respectively in most of the studies. T2 and STIR

heterogeneity with heterogeneous enhancement is shown to be more common in tuberculosis ranging from 70-100% with 12-13% in pyogenic. Disc sparing is a common feature of tuberculosis seen in about 75% as compared to 30% in pyogenic. Subligamentous spread is a feature of tuberculosis in 70-90% versus 30-40% of pyogenic infections. Skip lesion is not extensively reported but are common to tuberculosis with only one study quoting about 11% of pyogenic to have skip lesions. The involvement of the thoracic and thoracolumbar spine is common in tuberculosis but not exclusive.
Four studies proposed MRI scoring system (2,7,10,13), MRI nomogram (1) and radiomics which increased the sensitivity and specificity up to 97% and 92% respectively in predicting tuberculosis.

Contrast was used in almost all the studies. Study by Galhotra et (12) all showed that Contrast-enhanced MRI features were able to identify tubercular infection with a sensitivity of 75% and specificity of 90% Pyogenic infection was identified with a sensitivity of 90% and specificity of 83.3%. Thus, contrast-enhanced MRI improved the sensitivity and specificity for differentiating spinal infections. Non-contrast MRI features were able to identify tubercular infection with a sensitivity and specificity of 75%. However, pyogenic infection was identified with a sensitivity of 37.5% and specificity of 75%. The study by Hiroshi Miyamato et al (4) did not find any significantly different findings between the diseases in plain and Gd-enhanced MRIs. Ring enhancement of the soft-tissue mass was shown in 65%, Subligamentous enhancement in 35%, and bone enhancement in 100% of cases with tuberculosis.(14) The utility of dynamic contrast study was also evaluated by Hiroshi Miyamato et al (4) which indicated that a longer maximum contrast index, higher likelihood of diffusion pattern from the disc, and higher likelihood of enhanced disc are more specific to PS than TB. This less invasive imaging technique is useful for a more accurate diagnosis of PS and TB.

Brucellosis, although a bacterial infection, shows distinctive imaging and histopathological changes from pyogenic and tubercular spondylodiscitis (15). Brucella shows facet joint predominance and vertebral osteophyte formation with no or mild vertebral body deformation. Due to slow progression speeds in BSD, there is mild destruction of disc, focal end plate destruction, and partial, fan-shaped hyperintense signals in the infected vertebrae as opposed to severe disc destruction, extensive end plate destruction, and diffuse vertebral signal changes in the pyogenic spondylodiscitis (16,17). A retrospective observational study showed diffuse vertebral involvement with normal vertebral height and homogeneous high signal intensity on FS T2WI inclined the diagnosis towards brucella as compared to Tuberculosis which showed predominant end plate involvement with a significant decrease in vertebral height and heterogeneous high signal (18).

Conclusion:

From the available data, it is evident that there is no single MRI imaging parameter to distinguish tubercular from pyogenic spondylodiscitis. Comparing multiple imaging findings increases the sensitivity and specificity to distinguish the two. Developing the scoring systems, namograms and radiomics may help in standardizing image analysis in day-to-day practice to increase the predictability of tuberculosis. All studies included in this manuscript have used gadolinium in their studies, although only a few studies stated the utility of contrast as compared to non-contrast studies. MRI can differentiate brucellosis from pyogenic and tubercular infections although there is no extensive literature.

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