ORIGINAL ARTICLE

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Diagnostic Accuracy of Magnetic Resonance Imaging in Diagnosis of Spinal Tuberculosis

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ABSTRACT

Objective: To determine diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis, taking histopathology findings as gold standard. **Study Design:** Descriptive, Cross-sectional Validation study. **Settings:** Department of Radiology, Allied Hospital, Faisalabad-Pakistan. **Duration:** 6 months. **Methodology:** A total of 147 patients with suspected spinal tuberculosis of age 25-65 years of either gender were included. Patients with h/o of anti-tuberculous therapy, h/o trauma to spine and contraindication of MRI were excluded. All the patients were then underwent magnetic resonance imaging of spine and were looked for presence or absence of 0073pinal tuberculosis. MRI findings were compared with histopathology. **Results:** Mean age was 49.82 ± 11.00 years. Out of these 147 patients, 95 (66.67%) were male and 52 (33.33%) were females with ratio of 1.8:1. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis, taking histopathology findings as gold standard was 92.13%, 84.48%, 90.11%, 87.50% and 89.12% respectively. **Conclusion:** This study concluded that magnetic resonance imaging is the non-invasive modality of choice with high diagnostic accuracy in diagnosing spinal tuberculosis.

Keywords: Spinal tuberculosis, imaging, magnetic resonance imaging, sensitivity.

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INTRODUCTION

Spinal tuberculosis is an antiquated ailment and the causative operator, Mycobacterium Tuberculosis is as yet distinguishable during the bones of Egyptian mummies.[1] The main portrayal of spinal tuberculosis was given by Sir Percival Pott in 1779.[2] Today Spinal tuberculosis establishes half of skeletal tuberculosis, 50-60% of extra Pulmonary tuberculosis and 1-5% of all tuberculosis cases. It keeps on being a deadly ailment in developing countries.[1,3]

The contamination arrives at the spine by means of respiratory tract or digestive system by circulatory system. The disease starts from the front piece of vertebral body, spreads to the circle and causes bone decimation and development of ulcer, which could prompt untreatable neurologic deficiency and obliterating circumstance on account of finding delays. Undoubtedly, for maintaining a strategic distance from the seriousness of the related intricacies, the early finding is the fundamental need for the recognization of spinal tuberculosis. On the off chance that instances of spinal TB are analyzed early, hostile to tubercular chemotherapy alongside immobilization can be effective.[4] It has been contended that if patients don't react to preservationist treatment or show dynamic neurological manifestations, spinal deformation or flimsiness, careful intercession ought to be the pillar of treatment.[3]

Ordinary tissue-based demonstrative tests like histopathology, bacteriology and cytology; are tedious, obtrusive and eyewitness subordinate. Now and then, it may not be conceivable to acquire an example for testing, because of the profound situated area of the lesion.[4] Conventional radiological imaging is noninvasive yet it takes about three to four months for spinal TB sore to be obvious on plain radiographs.[5]

Plain radiography is normally performed at first in patients suspected to have STB. Magnetic reverberation imaging (MRI) is the methodology of decision for imaging of STB. STB can be recommended over pyogenic spondylodiscitis based on a few trademark MRI highlights. Normal MRI variations from the norm incorporate spinal injuries that begin from the vertebral endplate, include the foremost vertebral body corner, show proof of subligamentous spread, display numerous vertebral bodies however safeguarded circles, and show broad paraspinal sore development, calcification, and vertebral body collapse.[7] The mean paces of anomalous discoveries in various imaging modalities are 15% in plain spinal radiography, 100% in MRI, and 100% in CT.[8]

In a study, Jain AK et al[9] has demonstrated affectability and explicitness of attractive reverberation imaging in diagnosing spinal tuberculosis as 100.0% and 88.0% individually while another investigation has indicated 95.2% and 75.0% respectively.[10] One more investigation has indicated the affectability and particularity of 100% and 88.2% separately for the conclusion of spinal TB.[11] As the accessible writing on the affectability and explicitness of MRI in diagnosing spinal tuberculosis has demonstrated variable outcomes and furthermore I have discovered no nearby examination in this

viewpoint, so I had wanted to lead this investigation to diagnose spinal tuberculosis, taking histopathology discoveries as highest quality level. My examination won't just give the neighborhood details yet will likewise be a helpful expansion in the current writing. This non-intrusive imaging modality can be utilized routinely in our general practice for diagnosing spinal tuberculosis precisely and to choose a superior treatment plan pre-operatively for these specific patients so as to lessen their grimness. The objective was "To determine diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis, taking histopathology findings as gold standard."

METHODOLOGY

Study Design: Descriptive, Cross-sectional Validation study.
Settings: Department of Radiology, Allied Hospital, Faisalabad-Pakistan.
Duration: 6 months.
Sample Technique: Non-probability convenience sampling.
Sample Size: 147 cases.
Inclusion Criteria: A total of 147 patients (Sample size of 147 cases has been calculated with 95% confidence level, taking expected percentage of spinal tuberculosis as 50.0%[7] and desired precision of 5% for sensitivity of 95.0%[10] and 10% for specificity of 75.0%[10] of MRI for diagnosing spinal tuberculosis) with suspected spinal tuberculosis of age 25-65 years of either gender were included.
Exclusion Criteria: Patients with history of anti-tuberculous therapy, h/o trauma to spine and contraindication of MRI were excluded.
Methods: Suspected spinal tuberculosis was considered as presence of all these i.e. backache (>6 months), loss of weight (>10% of the total weight in last one month) and appetite, ESR >10 mm/hr and positive sputum culture for AFB was taken as positive. Spinal tuberculosis on MRI was considered as presence of all these i.e. increase signal intensity on T2 weighted images in vertebral discs but decrease in vertebral bodies and decrease in signal intensity on T1 weighted images in both vertebral discs and bodies was deemed as positive. Spinal tuberculosis on Histopathology was taken as presence of acid-fast bacilli on pathological specimen and the presence of epithelioid cells on biopsy was deemed as positive. All the patients were then underwent magnetic resonance imaging of spine and were looked for presence or absence of Pinal tuberculosis. MRI findings were compared with histopathology.
After approval from the ethical review committee, total 147 patients who were referred to Radiology department of Allied Hospital, Faisalabad, fulfilling the inclusion criteria was selected. Informed written consent was taken from each patient. After this, magnetic resonance imaging (MRI) of spine was performed in every patient by using 1.5 Tesla MR system equipped with magnetic quantum gradients with circularly polarized spine array coils. All magnetic resonance imaging findings were interpreted by a consultant radiologist (with at least 5 years post-fellowship experience) in the presence of researcher and were looked for presence or absence of spinal tuberculosis (as per-operational definition). All patients were undergone biopsy in the concerning ward and specimen was sent for histopathology in the institutional laboratory where histopathology report was interpreted by consultant pathologist (with at least 3 years of post-fellowship experience). MRI findings were compared with histopathology report. All this data was recorded on a specially designed proforma.
Collected data was analyzed through computer software SPSS 20.0. Age, duration of disease and BMI were presented as mean and standard deviation. Gender, site of tuberculosis (cervical/thoracic/lumbar/sacral), place of living (rural/urban), spinal tuberculosis on MRI and histopathology (present/absent) were presented as frequency and percentage. 2×2 contingency table was used to calculate the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI in diagnosing spinal tuberculosis, taking histopathology as gold standard.
Effect modifiers like age, gender, BMI, site of tuberculosis (cervical/thoracic/lumbar/sacral), place of living (rural/urban) and duration of disease were controlled through stratifications and post-stratification diagnostic accuracy was also calculated. P-value ≤ 0.05 was considered as significant. ROC curve and likelihood ratio was also calculated.

RESULTS

Age range in this study was from 25-65 years with mean age of 49.82 ± 11.00 years. Majority of the patients 110 (74.84%) were between 46 to 65 years of age as shown in Table I.
Out of these 147 patients, 95 (66.67%) were male and 52 (33.33%) were females with ratio of 1.8:1 (Figure IV).
Mean duration of disease was 10.90 ± 2.64 months as shown in Table II. Mean BMI was 29.29 ± 3.17 kg/m2 (Table III). Percentage of patients according to place of living and site of tuberculosis is shown in Figure V & VI respectively.
All the patients were subjected to magnetic resonance imaging (MRI) of spinal cord. MRI supported the diagnosis of spinal tuberculosis in 91 (61.90%) patients. Histopathology findings confirmed spinal tuberculosis in 89 (60.54%) cases. In MRI positive patients, 82 were True Positive and 09 were False Positive. Among 40, MRI negative patients, 07 were False Negative whereas 49 were True Negative (p=0.0001) as shown in Table IV. ROC curve is shown in Figure VII.
Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis, taking histopathology findings as gold standard was 92.13%, 84.48%, 90.11%, 87.50% and 89.12% respectively.

Table 1: Diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis, taking histopathology findings as gold standard

	Positive result on Histopathology	Negative result on Histopathology	K-value
Positive on MRI	82 **(TP)***	09 **(FP)*****	**0.0001**
Negative on MRI	07 **(FN)****	49 **(TN)******	

Sensitivity: 92.13%
Specificity: 84.48%
Positive Predictive Value (PPV): 90.11%
Negative Predictive Value (NPV): 87.50%
Positive likelihood ratio: 5.94
Negative likelihood ratio: 0.09
Diagnostic Accuracy: 89.12%

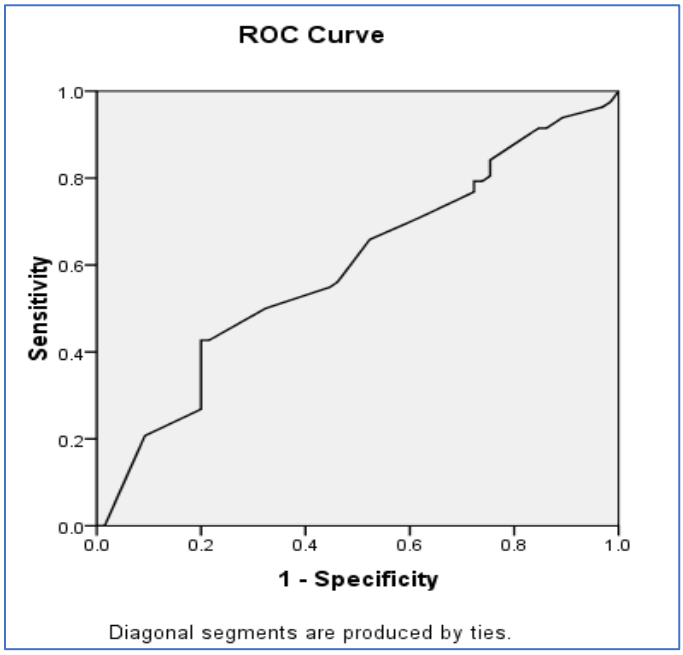

Figure VII: ROC curve

Table 2: Stratification of diagnostic accuracy with respect to duration of disease ≤12 months (n=100)

	Positive result on Histopathology	Negative result on Histopathology	P-Value
Positive on MRI	51 **(TP)**	06 **(FP)**	**0.001**
Negative on MRI	05 **(FN)**	38 **(TN)**	

Sensitivity: 91.07%
Specificity: 86.36%
Positive Predictive Value (PPV): 89.47%
Negative Predictive Value (NPV): 86.36%
Positive likelihood ratio: 6.68
Negative likelihood ratio: 0.10
Diagnostic Accuracy: 89.0%

Table 3: Stratification of diagnostic accuracy with respect to duration of disease >12 months (n=47)

	Positive result on Histopathology	Negative result on Histopathology	P-Value
Positive on MRI	31 **(TP)**	03 **(FP)**	**0.001**
Negative on MRI	02 **(FN)**	11 **(TN)**	

Sensitivity: 93.94%
Specificity: 78.57%
Positive Predictive Value (PPV): 91.12%
Negative Predictive Value (NPV): 84.62%
Positive likelihood ratio: 4.38
Negative likelihood ratio: 0.08
Diagnostic Accuracy: 89.36%

DISCUSSION

MRI spine is the best imaging innovation to survey anatomical anomalies of the spine and encompassing structures, decide the degree of spinal harm, and follow-up an ailment. MRI give us a superior opportunity to see a change in medullary bones. MRI likewise expected to show early circle variations from the norm and changes in bone marrow (a part of fat and water) on account of infection.[12,13]

Diseases of the spine (spondylitis) is characterized as a contamination by a particular living being which includes at least one segments of the spine, including vertebrae, intervertebral plates, paraspinal delicate tissue, and epidural cavity.

As indicated by Colmenero et al and Moore and Rafii, the most continuous spinal disease is tuberculous and pyogenic spondylitis.[14,15] The main early side effect of spondylitis is vague back agony, which makes it hard to analyze early. Radiological assessment has a significant job in the early conclusion, particularly utilizing plain radiography and MRI.[16] A past report expresses that a 1.5 Tesla MRI had an affectability of 96% and an explicitness of 94% in the finding of spondylitis.[17]

Tuberculous spondylitis is regular in under developed nations. It is noticed that tuberculous spondylitis happens in 1% of all tuberculous contamination patients, and 25%–60% of bone and joint contaminations are brought about by tuberculosis.[17-20] Research directed by Lee expressed that pyogenic spondylitis is an uncommon illness with a pervasiveness of ~0.15%–3% in osteomyelitis cases.[20] Tuberculous spondylitis requires totally unique treatment from with non-tuberculous spondylitis, so it is imperative to recognize the two kinds of spondylitis. The correct administration of spondylitis can decrease inability and harm to organ work, yet it is frequently hard to separate these variations from the norm, both clinically and radiologically. Highest quality level assessment for separating tuberculous and pyogenic spondylitis is histology, which is intrusive.

I have led this examination to decide analytic precision of attractive reverberation imaging in diagnosing spinal tuberculosis, taking histopathology discoveries as best quality level. Age extend in this examination was from 25-65 years with mean period of 49.82 ± 11.00 years. Larger part of the patients 110 (74.84%) were between 46 to 65 years old. Out of these 147 patients, 95 (66.67%) were male and 52 (33.33%) were females with proportion of 1.8:1. XRAYs bolstered the analysis of spinal tuberculosis in 91 (61.90%) patients. Histopathology discoveries affirmed spinal tuberculosis in 89 (60.54%) cases. In MRI positive patients, 82 were True Positive and 09 were False Positive. Among 40, MRI negative patients, 07 were False Negative while 49 were True Negative (p=0.0001). In general affectability, particularity, positive predictive value, negative

predictive value and indicative precision of attractive reverberation imaging in diagnosing spinal tuberculosis, taking histopathology discoveries as best quality level was 92.13%, 84.48%, 90.11%, 87.50% and 89.12% respectively. In an examination, Jain AK et al[9] has demonstrated affectability and particularity of attractive reverberation imaging in diagnosing spinal tuberculosis as 100.0% and 88.0% individually while another investigation has indicated 95.2% and 75.0% respectively.[10]

MRI has a detailed affectability and particularity of 100% and 88.2% individually for the finding of spinal TB. The significant favorable circumstances of MRI are the prior location of spinal TB as proposed by an expanded force of the bone marrow and taking into account review of the entire vertebral segment to analyze non-adjacent lesions.[21] Three significant discoveries of spinal TB on MRI are endplate disturbance, paravertebral delicate tissue boil and the nearness of expanded sign power of intervertebral plate on T2W. Also, MRI will distinguish different abscesses including involvement into the psoas muscle and epidural space, back component inclusion and spinal line compression.[21]

In a study,[11] three most helpful MR imaging highlights with high affectability and explicitness (> 80%) were endplate interruption (100%, 81.4%), paravertebral delicate tissue (96.8%, 85.3%), and high sign power of intervertebral plate on T2W (80.6%, 82.4%). High affectability however low explicitness signs in MRI included bone marrow edema (90.3%, 76.5%), bone marrow improvement (100%, 42.5%), back component contribution (93.5%, 76.5%), waterway stenosis (87.1%, 26.5%), and spinal rope or nerve root pressure (80.6%, 38.2%). Low affectability however high explicitness includes in MRI were intervertebral circle improvement (63.3%, 84.2%), vertebral collpase (58.1%, 85.3%), and kyphosis disfigurement (67.7%, 82.4%). Generally speaking, the affectability and explicitness of MRI for spinal tuberculosis were 100% and 88.2% respectively.[11]

The coming of attractive reverberation imaging (MRI), with announced affectability and particularity of 100% and 88.2% separately, for Caries spine has changed the conclusion of the condition.[22] It can recognize the neurotic injuries in the beginning times of the illness, effectively show the degree of the malady inclusion and can screen the reaction to treatment. Be that as it may, the helpfulness of MRI in determination relies upon exact translations of the discoveries seen. Despite the fact that the writing laid out the wide range highlights of MRI in spinal TB,[23] however what precisely characterized the tubercular sore on a spinal MRI is still not commonly agreed.[23]

Attractive reverberation imaging is valuable in the location of the reactivation of old TB spondylitis. The nearness of dynamic illness is shown as vertebral body pulverization, particularly with attendant paraspinal delicate tissue or potentially intra-bony abscesses. It has been accounted for that thick edge improvement in these abscesses is emphatically reminiscent of tuberculous contamination and isn't seen in non-granulomatous spondylitis.[24] The difference in signal force from low sign in mended TB to high flag on T2 weighted pictures recommends dynamic illness. Vertebral body and circle upgrade might be seen after intravenous difference.

MRI ought to be viewed as the imaging methodology of decision for patients with suspected TB spondylitis, as a result of its high particularity, affectability and exactness as it gives important data to the specialist for appropriate administration by giving vertebral intra-rigid sore, vertebral circle breakdown, skip injuries, dural and intradural maladies and association of back components more precisely.[10]

CONCLUSION

This study concluded that diagnostic accuracy of magnetic resonance imaging in diagnosing spinal tuberculosis is quite high. Magnetic resonance imaging is the non-invasive modality of choice and has not only dramatically improved our ability of diagnosing spinal tuberculosis but also help the clinicians for timely and proper management in order to reduce the untreatable neurologic complications.

LIMITATIONS

Limitation of study are as MRI is used for the confirmation of spinal tuberculosis, traumatic, neoplastic and previous TB lesions could not be included in this study.

SUGGESTIONS / RECOMMENDATIONS

We recommend that this non-invasive imaging modality can be used routinely in our general practice for diagnosing spinal tuberculosis accurately and to select a better treatment plan pre-operatively for these particular patients in order to reduce their morbidity.

CONFLICT OF INTEREST / DISCLOSURE

No conflict of Interest is involved.

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Acknowledgement criteria includes to help the qualitative diagnosis of spinal TB with the use of non-invasive technique and to give a better treatment plan and to avoid the further disabilities.

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Asim Shaukat	Supervision
Sehrish Israr	Comparison of Results