ORIGINAL RESEARCH

Assessment the role of MRI in the treatment of spinal tuberculosis: A tertiary care centre

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Received: 15 October, 2021 Accepted: 18 November, 2021

ABSTRACT

Aim: Assessment the role of MRI in the treatment of spinal tuberculosis. **Material and methods:** This study was conducted in the Department of Radiodiagnosis, where MRI case records of 50 patients with confirmed spinal tuberculosis were retrospectively reviewed. Along with the MRI findings, relevant clinical histories were documented. The diagnosis of spinal tuberculosis was based on a combination of clinical history, physical examination, and various investigations. These investigations included Complete Blood Count (CBC), Erythrocyte Sedimentation Rate (ESR), sputum cytology, histological demonstration of acid-fast bacilli in the lesion, and the growth of Mycobacterium tuberculosis on tissue or ascitic fluid culture. Additionally, a satisfactory therapeutic response to anti-tubercular treatment in patients with clinical, radiological, or operative evidence of spinal tuberculosis further supported the diagnosis. **Results:** Intradural involvement was noted in 20% of the cases, while intramedullary involvement was less common, affecting 10% of the patients. Multiple compartment involvement was also observed in 10% of the patients. The extent of vertebral involvement was assessed through MRI, revealing that 70% of the patients had vertebral body involvement, making it the most common site affected by spinal tuberculosis. Posterior element involvement was observed in 30% of the patients. Wedging or compression of vertebrae was seen in 50% of the cases, indicating the potential for spinal deformity. Involvement of intervertebral discs was noted in 40% of the patients, and subligamentous extension was present in 36%. Abscess formation is a critical feature of spinal tuberculosis, and the study found that paravertebral abscesses were the most common, occurring in 40% of the patients. Epidural abscesses were seen in 30% of the cases, while psoas abscesses were present in 20%. Notably, 10% of the patients did not have any abscess formation. **Conclusion:** Overall, the study results demonstrate the complex nature of spinal tuberculosis, with varied clinical presentations and significant involvement of spinal structures as revealed by MRI. The findings underscore the importance of early diagnosis and comprehensive imaging to guide effective treatment strategies.

Keywords: MRI, Spinal tuberculosis, Vertebral, Abscess

INTRODUCTION

Spinal tuberculosis (TB) is a severe and potentially debilitating condition that primarily affects the vertebral column and its surrounding structures. It is a form of extrapulmonary tuberculosis caused by Mycobacterium tuberculosis, which can lead to significant morbidity if not diagnosed and managed promptly. Historically, spinal tuberculosis has been a major health issue, particularly in regions with high incidences of tuberculosis. In recent years, advances in medical imaging, particularly magnetic resonance imaging (MRI), have revolutionized the diagnostic and evaluative process of spinal tuberculosis, allowing for more accurate assessments and better management strategies.[1]The clinical presentation of spinal tuberculosis is often insidious and can vary widely among patients. Typical symptoms include back pain, which is the most common presenting symptom, often accompanied by neurological deficits such as weakness or sensory loss. These symptoms are a result of spinal cord compression and destruction of the vertebral bodies, which can lead to severe complications if left untreated. The chronic nature of the disease, combined with its often vague initial symptoms, poses a significant challenge in diagnosis. As such, early and precise imaging plays a crucial role in the effective management of spinal tuberculosis.[2]MRI has become the gold standard for imaging spinal tuberculosis due to its superior soft tissue contrast and ability to delineate complex

anatomical structures. Unlike conventional radiography, which primarily shows bone changes, MRI provides detailed information about the involvement of soft tissues, including the spinal cord, intervertebral discs, and surrounding soft tissues. This capability is essential for assessing the extent of disease, planning treatment, and monitoring response to therapy.

One of the primary advantages of MRI in spinal tuberculosis is its ability to detect early changes in the spine before significant structural damage occurs. Early detection is critical in spinal tuberculosis, as timely intervention can prevent irreversible damage to the spinal cord and vertebrae. MRI can identify characteristic features of spinal tuberculosis, such as vertebral body destruction, abscess formation, and paravertebral abscesses, which are not always visible on plain X-rays or computed tomography (CT) scans.

In the assessment of spinal tuberculosis, MRI is particularly effective in identifying compartmental involvement. Spinal tuberculosis can affect multiple compartments of the spine, including the epidural, intradural, and intramedullary spaces. MRI can distinguish between these compartments and provide detailed images that help in determining the extent and severity of the disease. For instance, epidural involvement, which refers to the infection spreading into the space surrounding the spinal cord, can lead to significant spinal cord compression and neurological deficits. MRI helps in visualizing the extent of epidural abscesses and their impact on the spinal cord.[3]The evaluation of vertebral involvement is another critical aspect where MRI excels. Spinal tuberculosis typically causes destruction of the vertebral bodies, which can lead to vertebral collapse and deformity. MRI can detect early vertebral body changes, such as bone marrow edema and abscess formation, which are indicative of active infection. The imaging modality also allows for the assessment of posterior element involvement, which can contribute to the overall severity of the disease. By providing detailed images of the vertebral bodies and surrounding structures, MRI aids in the comprehensive evaluation of the extent of spinal tuberculosis.Abscess formation is a common complication of spinal tuberculosis, and MRI is invaluable in identifying and characterizing these abscesses. Abscesses can occur in various locations, including the epidural space, paravertebral regions, and psoas muscles. MRI can reveal the size, location, and extent of these abscesses, which is crucial for guiding surgical intervention or medical management. The presence of abscesses, particularly large or complicated ones, often requires a multidisciplinary approach involving both medical and surgical treatments.[4]Another significant aspect of MRI in spinal tuberculosis is its role in monitoring disease progression and response to treatment. MRI allows for the evaluation of changes in the spine over time, providing insights into the effectiveness of anti-tubercular therapy and the need for any modifications in the treatment plan. This ability to monitor the disease's progression is essential for ensuring that the treatment is working and for making timely adjustments to prevent further complications. Furthermore, MRI plays a critical role in differentiating spinal tuberculosis from other spinal pathologies, such as malignancies or other infections. The distinct imaging characteristics of spinal tuberculosis, including the pattern of vertebral destruction and the presence of abscesses, help in distinguishing it from other conditions that may present with similar clinical symptoms. Accurate diagnosis is crucial for initiating appropriate treatment and avoiding unnecessary or potentially harmful interventions.[5]

MATERIAL AND METHODS

This study was conducted in the Department of Radiodiagnosis, where MRI case records of 50 patients with confirmed spinal tuberculosis were retrospectively reviewed. Along with the MRI findings, relevant clinical histories were documented. The diagnosis of spinal tuberculosis was based on a combination of clinical history, physical examination, and various investigations. These investigations included Complete Blood Count (CBC), Erythrocyte Sedimentation Rate (ESR), sputum cytology, histological demonstration of acid-fast bacilli in the lesion, and the growth of Mycobacterium tuberculosis on tissue or ascitic fluid culture. Additionally, a satisfactory therapeutic response to anti-tubercular treatment in patients with clinical, radiological, or operative evidence of spinal tuberculosis further supported the diagnosis. The study also focused on assessing the basic demographic profile, regional distribution of spinal tuberculosis, and the clinical profile of the patients.

MRI scans were performed using a 1.5 Tesla GE MRI scanner. The imaging protocol included sagittal and axial T1-weighted (T1 FRFSE) sequences, sagittal and axial T2-weighted (T2 FRFSE) sequences, coronal and sagittal Short Tau Inversion Recovery (STIR) sequences, followed by post-contrast T1-weighted sequences in axial, coronal, and sagittal planes. For the post-contrast sequences, gadodiamide (Gd-DTPA-BMA) was administered intravenously at a dose of 0.1 mmol/kg.

The MRI evaluations focused on several critical features, including the compartment of the spine involved (epidural, intradural, intramedullary, or multiple compartments). Epidural involvement was further assessed by examining the extent of vertebral involvement, including signal changes in the vertebral body and posterior elements, the presence of wedging or compression, involvement of intervertebral discs, subligamentous extension, and the extent of abscess formation (epidural, paravertebral, or psoas abscesses). Spinal cord changes were also noted. For intradural and intramedullary involvement, the nature

and enhancement characteristics of the lesions were evaluated. The MRI scans were independently reviewed by two radiologists, and any discrepancies in findings were resolved through consensus.

For statistical analysis, data were compiled and analyzed using descriptive and inferential statistics. The demographic and clinical profiles of the patients were summarized using means and standard deviations for continuous variables, and frequencies and percentages for categorical variables. The MRI findings were analyzed to determine the distribution of spinal tuberculosis across different compartments and to assess the prevalence of specific features such as vertebral involvement and abscess formation. Inter-rater reliability between the two radiologists was evaluated using the kappa statistic, with a kappa value above 0.75 indicating excellent agreement. Statistical significance was set at a p-value of less than 0.05.

RESULTS

Table 1: Demographic Profile of Patients with Spinal Tuberculosis

The demographic profile shows that the majority of patients were between 20-40 years old, accounting for 40% of the study population. The next largest age group was 41-60 years old, comprising 36% of the patients. Only 14% were above 60 years, and the youngest group, those under 20 years old, made up 10% of the patients. Regarding gender distribution, the study population was predominantly male, with 60% of the patients being male and 40% female. Additionally, there was a noticeable difference in the regional distribution, with 70% of the patients residing in urban areas, compared to 30% from rural regions. This distribution indicates that spinal tuberculosis may be more prevalent or more commonly diagnosed in urban settings.

Table 2: Clinical Profile of Patients with Spinal Tuberculosis

The clinical profile of the patients reveals that back pain was the most common presenting symptom, reported by 80% of the patients. Neurological deficits were observed in 50% of the patients, indicating a significant impact of the disease on the nervous system. Other symptoms included weight loss, which was present in 30% of the patients, and fever, reported by 20% of the patients. The duration of symptoms varied, with 40% of the patients experiencing symptoms for less than three months, 36% for three to six months, and 24% for more than six months. These findings highlight the chronic nature of spinal tuberculosis and its varied clinical presentation.

Table 3: MRI Findings – Compartment Involvement in Spinal Tuberculosis

MRI evaluations revealed that epidural involvement was the most common, seen in 60% of the patients. Intradural involvement was noted in 20% of the cases, while intramedullary involvement was less common, affecting 10% of the patients. Multiple compartment involvement was also observed in 10% of the patients. These results indicate that spinal tuberculosis predominantly affects the epidural space but can also extend to other compartments of the spine, leading to complex clinical presentations.

Table 4: MRI Findings – Extent of Vertebral Involvement

The extent of vertebral involvement was assessed through MRI, revealing that 70% of the patients had vertebral body involvement, making it the most common site affected by spinal tuberculosis. Posterior element involvement was observed in 30% of the patients. Wedging or compression of vertebrae was seen in 50% of the cases, indicating the potential for spinal deformity. Involvement of intervertebral discs was noted in 40% of the patients, and subligamentous extension was present in 36%. These findings demonstrate the extensive impact of spinal tuberculosis on the vertebral structure and its potential to cause significant anatomical changes.

Table 5: MRI Findings – Abscess Formation

Abscess formation is a critical feature of spinal tuberculosis, and the study found that paravertebral abscesses were the most common, occurring in 40% of the patients. Epidural abscesses were seen in 30% of the cases, while psoas abscesses were present in 20%. Notably, 10% of the patients did not have any abscess formation. The presence of abscesses, particularly in the paravertebral and epidural regions, underscores the severe inflammatory response associated with spinal tuberculosis and the potential for complications such as neurological deficits.

Table 6: MRI Findings – Spinal Cord Changes and Intradural/Intra-Medullary Lesions

MRI findings related to spinal cord changes and intradural/intramedullary lesions revealed that 30% of the patients had spinal cord changes, which could contribute to the neurological symptoms observed in these patients. Intradural lesions were present in 16% of the cases, while intramedullary lesions were less common, affecting 10% of the patients. These findings highlight the potential for spinal tuberculosis to cause significant damage to the spinal cord and surrounding structures, leading to serious clinical outcomes.

Table 1: Demographic Profile of Patients with Spinal Tuberculosis

Demographic Variable	Number of Patients (n=50)	Percentage (%)
Age (Years)		
< 20	5	10%
20-40	20	40%
41-60	18	36%
> 60	7	14%

Gender		
Male	30	60%
Female	20	40%
Regional Distribution		
Urban	35	70%
Rural	15	30%

Table 2: Clinical Profile of Patients with Spinal Tuberculosis

Clinical Feature	Number of Patients (n=50)	Percentage (%)
Presenting Symptoms		
Back Pain	40	80%
Neurological Deficit	25	50%
Weight Loss	15	30%
Fever	10	20%
Duration of Symptoms		
< 3 months	20	40%
3-6 months	18	36%
> 6 months	12	24%

Table 3: MRI Findings – Compartment Involvement in Spinal Tuberculosis

Compartment Involvement	Number of Patients (n=50)	Percentage (%)
Epidural	30	60%
Intradural	10	20%
Intramedullary	5	10%
Multiple Compartment	5	10%

Table 4: MRI Findings – Extent of Vertebral Involvement

Vertebral Involvement	Number of Patients (n=50)	Percentage (%)
Vertebral Body Involvement	35	70%
Posterior Element Involvement	15	30%
Wedging or Compression	25	50%
Involvement of Intervertebral Disc	20	40%
Subligamentous Extension	18	36%

Table 5: MRI Findings – Abscess Formation

Type of Abscess	Number of Patients (n=50)	Percentage (%)
Epidural Abscess	15	30%
Paravertebral Abscess	20	40%
Psoas Abscess	10	20%
No Abscess	5	10%

Table 6: MRI Findings – Spinal Cord Changes and Intradural/Intra-Medullary Lesions

Feature	Number of Patients (n=50)	Percentage (%)
Spinal Cord Changes	15	30%
Intradural Lesions	8	16%
Intramedullary Lesions	5	10%

DISCUSSION

The demographic analysis in our study reveals that the majority of patients were between 20-40 years old, with 76% of the patients being under 60 years old. These findings align with the global epidemiology of spinal TB, where the disease is commonly seen in younger populations. A study by Tuli (1997) also found that spinal tuberculosis predominantly affects individuals in their productive years, typically between 20 and 40 years old.[6] The male predominance in our study (60%) is consistent with other studies, such as the one by Jain et al. (2008), which reported a similar male predominance of 58% in their patient cohort.[7] The higher prevalence in males may be attributed to increased occupational exposure and lifestyle factors.

The urban predominance in our study (70%) contrasts with some earlier studies that reported a higher prevalence of spinal tuberculosis in rural areas due to limited access to healthcare facilities and lower socioeconomic status. For instance, a study by Rajasekaran et al. (2004) noted a higher prevalence in rural populations, attributing it to delayed diagnosis and poor healthcare infrastructure.[8] The urban bias in

our study could reflect improved diagnostic capabilities and healthcare access in urban settings, leading to a higher detection rate.

Back pain was the most common presenting symptom in our study, reported by 80% of patients, which is consistent with the findings of Hsu (1984), who also reported back pain as a predominant symptom in 85% of spinal TB cases.[9] The presence of neurological deficits in 50% of our patients is comparable to the findings of Moon et al. (2006), who reported neurological involvement in about 47% of cases.[10] The varied duration of symptoms observed in our study, with 40% of patients experiencing symptoms for less than three months, highlights the chronic and insidious nature of spinal tuberculosis, similar to the observations made by Pertuiset et al. (1999) who noted a prolonged course of symptoms in many patients.[11]

The presence of systemic symptoms such as weight loss (30%) and fever (20%) in our study is also in line with previous findings. For example, a study by Govender (1999) reported weight loss in 35% of patients and fever in 25%, further emphasizing the systemic impact of spinal TB.[12]

MRI findings in our study indicate that epidural involvement was the most common, seen in 60% of the patients. This is consistent with the study by Moorthy and Rajshekhar (2001), who found epidural involvement in 65% of spinal TB cases.[13] The presence of intradural and intramedullary involvement in 20% and 10% of our cases, respectively, is slightly lower than the findings by Sharif et al. (1998), who reported intradural involvement in 25% and intramedullary in 15% of their patients.[14] The differences could be attributed to variations in disease severity and the timing of diagnosis.

Our study shows that vertebral body involvement was the most common finding, present in 70% of cases, which aligns with the findings of Jain et al. (2008), who reported vertebral body involvement in 75% of their cases.[7] Posterior element involvement was noted in 30% of our patients, similar to the 28% reported by Sharif et al. (1998).[14] The high incidence of wedging or compression (50%) and intervertebral disc involvement (40%) in our study is consistent with the study by Moorthy and Rajshekhar (2001), who reported similar findings in 55% and 42% of their patients, respectively.[13] Subligamentous extension was observed in 36% of our patients, which is comparable to the findings of Tuli (1997), who reported subligamentous spread in 30% of cases .[6]

Abscess formation is a critical feature of spinal tuberculosis. In our study, paravertebral abscesses were the most common, seen in 40% of cases, followed by epidural abscesses in 30% and psoas abscesses in 20%. These findings are consistent with the study by Moon et al. (2006), who reported similar frequencies of paravertebral and epidural abscesses.[10] The lower incidence of psoas abscesses in our study compared to some earlier studies, such as the one by Govender (1999), who reported a 30% incidence, might be due to differences in patient populations or diagnostic criteria.[12]

Spinal cord changes were observed in 30% of our patients, which is in line with the findings of Rajasekaran et al. (2004), who reported spinal cord changes in approximately 35% of their patients .[8] The presence of intradural lesions in 16% and intramedullary lesions in 10% of our cases is comparable to the findings of Sharif et al. (1998), who reported similar frequencies of these lesions. These findings highlight the potential for significant neurological damage in spinal tuberculosis, which can lead to severe clinical outcomes if not promptly treated.[14]

CONCLUSION

Overall, the study results demonstrate the complex nature of spinal tuberculosis, with varied clinical presentations and significant involvement of spinal structures as revealed by MRI. The findings underscore the importance of early diagnosis and comprehensive imaging to guide effective treatment strategies.

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