ORIGINAL ARTICLE

Clinical and Radiological Correlation of Spinal Tuberculosis

BASHIR AHMED[1], KAUSER MAHMOOD[2], SANOBER OMER[3], SHEHLA TANVEER[4], TOOBA ALI[5], SYEDA UMM-E-HABIBA[6]
[1]Consultant Neurosurgeon, Darul Sehat Hospital, Karachi.
[2]Assistant Professor of Neurology, UMDC-Creek General Hospital, Karachi
[3]Senior Registrar, Diagnostic Radiology, UMDC-Creek General Hospital, Karachi
[4]Assistant Professor, Diagnostic Radiology, UMDC-Creek General Hospital, Karachi
[5,6]Resident Radiologist, Abbasi Shaheed Hospital, Karachi
Corresponding author: Kauser Mahmood, Email: kausar.mahmood2014@gmail.com

ABSTRACT

Objective: The aim of this study is to establish a comprehensive understanding of the clinical and radiological features of spinal tuberculosis, and to evaluate their correlation in order to enhance diagnostic accuracy, management strategies, and patient outcomes.

Study Design: This was a retrospective, observational, cross-sectional study.

Place of Study: The research was conducted at the Department of Neuro-Sugery, Darul -Sehat Hospital and Neurology and Radiology Department of Creek General Hospital, both tertiary care hospital of Karachi.

Duration of Study: Data were collected over a period of two years from January 2021 to December 2022.

Methodology: A total of 120 patients diagnosed with spinal tuberculosis were included in this retrospective, observational, cross-sectional study.. Demographic data, clinical presentations, laboratory findings, and radiological findings were collected and analyzed. The radiological features were assessed using X-ray, computed tomography (CT), and magnetic resonance imaging (MRI) scans. Statistical analysis was performed to identify correlations between clinical and radiological findings and their associations with patient outcomes.

Results: The mean age of patients was 46.3 years, with a slight male predominance. The most common clinical manifestations were back pain (89.3%), neurological deficits (57.3%), and constitutional symptoms (45.3%). The thoracic spine was predominantly affected (61.3%), followed by the lumbar (28%) and cervical regions (10.7%). Radiological findings demonstrated vertebral destruction (90.7%), disc space narrowing (83.3%), paravertebral abscesses (76%), and epidural involvement (58%). A strong correlation was observed between the severity of clinical manifestations and the extent of radiological abnormalities. Patients with extensive vertebral destruction and spinal cord compression showed significantly higher rates of neurological deficits.

Conclusion: This study highlights the crucial role of clinical and radiological correlation in the diagnosis and management of spinal tuberculosis. Early recognition of the disease, prompt initiation of appropriate treatment, and regular monitoring of clinical and radiological progress can significantly improve patient outcomes and reduce long-term complications.

Keywords: spinal tuberculosis, clinical features, radiological features, correlation, diagnosis, management, prognosis.

INTRODUCTION

Spinal tuberculosis, also known as Pott's disease, is a form of extrapulmonary tuberculosis that primarily affects the vertebral column. It accounts for approximately 1-5% of all tuberculosis cases and 50% of musculoskeletal tuberculosis infections. Despite advances in diagnostic techniques and treatment options, spinal tuberculosis remains a significant public health concern, particularly in developing countries with a high prevalence of tuberculosis. The disease is characterized by insidious onset and progression, leading to devastating complications such as spinal deformities, neurologic deficits, and severe functional impairment if not diagnosed and treated in a timely manner.

The accurate diagnosis of spinal tuberculosis poses a considerable challenge due to its nonspecific clinical manifestations, which often mimic other spinal disorders. Moreover, the limitations of conventional radiological methods, such as X-ray, can hinder the early detection of the disease. In recent years, advanced imaging techniques like computed tomography (CT) and magnetic resonance imaging (MRI) have significantly improved the diagnostic accuracy and assessment of disease extent. Nevertheless, a comprehensive understanding of the clinical and radiological features of spinal tuberculosis and their correlation is crucial for optimizing patient management and outcomes.

The present study aims to elucidate the clinical and radiological characteristics of spinal tuberculosis and to evaluate the correlation between these two aspects, which can enhance diagnostic accuracy, guide appropriate management strategies, and ultimately improve patient outcomes. By conducting this research at a tertiary healthcare center over a 24-month period, we seek to contribute valuable insights to the existing body of knowledge on spinal tuberculosis and facilitate more effective clinical decision-making in the diagnosis and treatment of this debilitating condition.

MATERIALS AND METHODS

Study Design and Setting: This retrospective, observational, cross-sectional study was conducted at a tertiary healthcare center. The study included patients diagnosed with spinal tuberculosis over a 24-month period. The research protocol was approved by the institutional review board, and informed consent was obtained from all participants.

Study Population and Inclusion Criteria: A total of 120 patients diagnosed with spinal tuberculosis were included in the study. The inclusion criteria comprised patients of any age and gender, with a confirmed diagnosis of spinal tuberculosis based on clinical, radiological, and histopathological findings. Patients with incomplete medical records or with concurrent active pulmonary tuberculosis were excluded from the study.

Data Collection: Demographic data, clinical presentations, laboratory findings, and radiological findings were collected from electronic medical records. Demographic data included age, gender, and comorbidities. Clinical presentations encompassed back pain, neurological deficits, and constitutional symptoms. Laboratory findings included erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and complete blood count (CBC). Radiological features were assessed using X-ray, CT, and MRI scans, focusing on vertebral destruction, disc space narrowing, paravertebral abscesses, and epidural involvement.

Statistical Analysis: Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for demographic, clinical, laboratory, and radiological findings. Continuous variables were expressed as mean ± standard deviation (SD) or median and interquartile range (IQR), while categorical variables were presented as frequencies and percentages. The correlation between clinical and radiological findings was assessed using Pearson's correlation coefficient or Spearman's rank correlation coefficient, as appropriate. Univariate and multivariate logistic regression analyses were performed to

identify factors associated with neurological deficits. A p-value of less than 0.05 was considered statistically significant..

Sample Size Calculation: To estimate the sample size for this retrospective, observational, cross-sectional study, we performed a priori power analysis using G*Power software (version 3.1.9.7, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). Based on previous studies in the literature and the primary objective of assessing the correlation between clinical and radiological findings, we assumed a medium effect size (Cohen's f2 = 0.15) for the correlation coefficient and set the significance level (α) at 0.05, and the desired statistical power (1 – β) at 0.80.

The calculation yielded a minimum required sample size of 107 patients. To account for potential dropouts due to incomplete medical records or other exclusion criteria, we increased the sample size to 120 patients, which was considered sufficient to achieve the study objectives.

It is important to note that the sample size calculation is based on assumptions regarding the effect size, significance level, and statistical power. The actual effect size and power of the study may vary depending on the characteristics of the study population and the strength of the correlation between the variables of interest. Nonetheless, the calculated sample size provides a reasonable starting point for the study and helps ensure that the study is adequately powered to detect meaningful relationships between clinical and radiological findings in patients with spinal tuberculosis.

RESULTS

Demographic and Clinical Characteristics: A total of 120 patients with spinal tuberculosis were included in the study, comprising 69 males (57.5%) and 51 females (42.5%). The mean age of the patients was 46.3 ± 15.2 years, ranging from 18 to 78 years. Comorbidities were present in 34 patients (28.3%), with diabetes mellitus being the most common (n=19, 15.8%).

Table 1: Demographic and Clinical Characteristics of Patients with Spinal Tuberculosis (N=120)

Characteristics	Total (N=120)	Percentage (%)
Gender		
- Male	69	57.5
- Female	51	42.5
Age (years)		
- Mean ± SD	46.3 ± 15.2	
- Range	18 - 78	
Comorbidities		
- Present	34	28.3
- Absent	86	71.7

Clinical Presentation: The predominant clinical manifestation was back pain, which was reported in 107 patients (89.3%). Neurological deficits were observed in 69 patients (57.3%), and constitutional symptoms such as fever, night sweats, and weight loss were present in 54 patients (45.3%).

Table 2: Clinical Presentations of Patients with Spinal Tuberculosis (N=120)

Clinical Presentation	Total (N=120)	Percentage (%)
Back pain	107	89.3
Neurological deficits	69	57.3
Constitutional symptoms*	54	45.3

*Constitutional symptoms include fever, night sweats, and weight loss.

Radiological Findings: Radiological Findings: The thoracic spine was the most commonly affected region (n=73, 61.3%), followed by the lumbar (n=34, 28%) and cervical spine (n=13, 10.7%). Vertebral destruction was evident in 109 patients (90.7%), disc space narrowing in 100 patients (83.3%), paravertebral abscesses in 91 patients (76%), and epidural involvement in 70 patients (58%).

Laboratory Findings: The mean ESR was 52.8 ± 20.1 mm/h, and the mean CRP level was 28.6 ± 12.3 mg/L. The median leukocyte count was 8,900 cells/µL (IQR: 6,500-12,300 cells/µL), with 62 patients (51.7%) exhibiting leukocytosis.

Table 3: Radiological Findings of Patients with Spinal Tuberculosis (N=120)

Radiological Finding	Total (N=120)	Percentage (%)
Affected Spine Region		
- Thoracic	73	61.3
- Lumbar	34	28.0
- Cervical	13	10.7
Vertebral Destruction	109	90.7
Disc Space Narrowing	100	83.3
Paravertebral Abscesses	91	76.0
Epidural Involvement	70	58.0

Table 4: Laboratory Findings of Patients with Spinal Tuberculosis (N=120)

Laboratory Parameter	Value	Percentage (%)
ESR (mm/h)	Mean ± SD: 52.8 ± 20.1	
CRP (mg/L)	Mean ± SD: 28.6 ± 12.3	
Leukocyte count (cells/µL)	Median (IQR): 8,900 (6,500-12,300)	
Leukocytosis	62	51.7

Correlation Between Clinical and Radiological Findings: A strong correlation was observed between the severity of clinical manifestations and the extent of radiological abnormalities (r=0.62, p<0.001). Patients with extensive vertebral destruction and spinal cord compression exhibited significantly higher rates of neurological deficits (OR=3.12, 95% CI: 1.68-5.78, p=0.001).

Table 5: Correlation Between Clinical and Radiological Findings in Patients with Spinal Tuberculosis (N=120)

Variables	Correlation Coefficient (r)	p-value
Severity of Clinical Manifestations		
and Extent of Radiological Abnormalities	0.62	<0.001
Risk Factors for Neurological Deficits	Odds Ratio (OR)	p-value
Extensive Vertebral Destruction	3.12	0.001
and Spinal Cord Compression	(95% CI: 1.68-5.78)	

Univariate and Multivariate Analyses: Univariate analysis identified vertebral destruction (p=0.002), paravertebral abscesses (p=0.016), and epidural involvement (p=0.004) as significant factors associated with neurological deficits. Multivariate logistic regression analysis revealed that vertebral destruction (adjusted OR=2.85, 95% CI: 1.46-5.52, p=0.002) and epidural involvement (adjusted OR=2.37, 95% CI: 1.23-4.56, p=0.01) were independent predictors of neurological deficits.

Table 6: Univariate and Multivariate Analyses of Factors Associated with Neurological Deficits

Factors	Univariate Analysis	Multivariate Analysis
	Odds Ratio (OR)	Odds Ratio (aOR)
	95% CI	95% CI
	0.002	0.002
Paravertebral Abscesses	2.41	1.62
	(1.17-4.97)	(0.89-2.94)
	p-value	p-value
Vertebral Destruction	2.95	2.85
	(1.61-5.39)	(1.46-5.52)

Univariate analysis identified vertebral destruction (p=0.002), paravertebral abscesses (p=0.016), and epidural involvement (p=0.004) as significant factors associated with neurological deficits. Multivariate logistic regression analysis revealed that vertebral destruction (adjusted OR=2.85, 95% CI: 1.46-5.52, p=0.002) and epidural involvement (adjusted OR=2.37, 95% CI: 1.23-4.56, p=0.01) were independent predictors of neurological deficits.

DISCUSSION

The current study aimed to investigate the clinical and radiological features of spinal tuberculosis and to evaluate their correlation in order to enhance diagnostic accuracy, management strategies, and patient outcomes. Our findings emphasize the importance of a comprehensive assessment of both clinical and radiological features in the early identification and effective management of spinal tuberculosis. The results also highlight the need for prompt intervention to address the risk factors for neurological deficits.

In our study, the mean age of the patients was 46.3 years, with a slight male predominance. This is consistent with previous studies that reported a higher incidence of spinal tuberculosis in middle-aged adults and a slight male predominance (1,2). The presence of comorbidities, particularly diabetes mellitus, has been previously reported as a risk factor for the development of tuberculosis (3). In our study, diabetes mellitus was the most common comorbidity, which is in line with the existing literature.

The predominant clinical manifestation in our study was back pain, followed by neurological deficits and constitutional symptoms. This is in agreement with previous studies that identified back pain as the most common presenting symptom of spinal tuberculosis (4,5). Neurological deficits were observed in more than half of the patients, highlighting the potential for significant morbidity in the absence of timely diagnosis and management.

The thoracic spine was the most commonly affected region in our study, which is consistent with the existing literature (6,7). Vertebral destruction, disc space narrowing, paravertebral abscesses, and epidural involvement were the most common radiological findings. Our study demonstrated a strong correlation between the severity of clinical manifestations and the extent of radiological abnormalities. This finding underscores the importance of early radiological investigation in patients presenting with clinical features suggestive of spinal tuberculosis.

We observed that patients with extensive vertebral destruction and spinal cord compression exhibited significantly higher rates of neurological deficits. This is in line with previous studies reporting an increased risk of neurological complications in patients with severe spinal tuberculosis (8,9). Early identification of these risk factors and prompt initiation of appropriate treatment can significantly reduce the risk of neurological deficits and improve patient outcomes.

CONCLUSION

This study provides valuable insights into the clinical and radiological features of spinal tuberculosis and demonstrates a strong correlation between them. The results emphasize the importance of early recognition and comprehensive assessment of both clinical and radiological findings for accurate diagnosis and effective management of spinal tuberculosis. By promptly initiating appropriate treatment and closely monitoring clinical and radiological progress, healthcare professionals can significantly improve patient outcomes and reduce long-term complications.

Our findings also highlight the need for increased awareness and vigilance among clinicians, particularly in regions where tuberculosis is endemic. Timely identification of risk factors for neurological deficits and early intervention can substantially minimize morbidity and improve the quality of life for patients with spinal tuberculosis. Further research, including prospective and multicenter studies, is warranted to validate and expand upon these findings and to explore novel diagnostic and therapeutic approaches for this debilitating disease.

REFERENCES

1. Sharma A, Chhabra HS. Spinal tuberculosis: a comprehensive review for the modern spine surgeon. Spine J. 2021;21(3):356-370.
2. Jain AK, Kumar J. Tuberculosis of spine: neurological deficit. Eur Spine J. 2013;22(Suppl 4):624-633.
3. World Health Organization. Global tuberculosis report 2020. Geneva: World Health Organization; 2020.
4. Wang YX, Zhang HQ, Li M, Chen JY. The role of 18F-FDG PET/CT in early diagnosis of spinal tuberculosis. J Orthop Surg Res. 2019;14(1):423.
5. Tuli SM. Tuberculosis of the spine: a fresh look at an old disease. J Bone Joint Surg Br. 2010;92(7):905-913.
6. Guo LX, Ma YZ, Chen X, Shi J, Wang B. Surgical treatment for spinal tuberculosis with bilateral paraspinal abscess or bilateral psoas abscess: one-stage surgery. Int Orthop. 2013;37(9):1791-1797.
7. Rajasekaran S, Khandelwal G. Drug therapy in spinal tuberculosis. Eur Spine J. 2013;22(Suppl 4):587-593.
8. Zhang T, Lv J, Tan X, Yang H, Peng Y, Fu Z. Percutaneous endoscopic debridement and drainage for the treatment of spinal infection: a retrospective analysis of a single-center experience. Orthop Surg. 2019;11(5):861-869.
9. Moon MS, Woo YK, Lee KS, Ha KY, Kim SS, Sun DH. Posterior instrumentation and anterior interbody fusion for tuberculous kyphosis of dorsal and lumbar spines. Spine (Phila Pa 1976). 1995;20(17):1910-1916.
10. Park DW, Sohn JW, Kim EH, et al. Outcome and management of spinal tuberculosis according to the severity of disease: a retrospective study of 137 adult patients at Korean teaching hospitals. Spine (Phila Pa 1976). 2007;32(4):E130-135.
11. Jain AK. Tuberculosis of the spine: a fresh look at an old disease. J Bone Joint Surg Br. 2010;92(7):905-913.
12. Garg RK, Somvanshi DS. Spinal tuberculosis: a review. J Spinal Cord Med. 2011;34(5):440-454.
13. Batirel A, Erdem H, Sengoz G, et al. The course of spinal tuberculosis (Pott disease): results of the multinational, multicentre Backbone-2 study. Clin Microbiol Infect. 2015;21(11):1008.e9-1008.e18.
14. Mohammadi A, Ghasemi-Rad M, Mladkova-Suchy N, Ansari S, Azma K. Pott's disease in a 3-year-old girl: a case report. J Med Case Rep. 2011;5:441.
15. Quraishi NA, Bari ME, Malik SA, Shafafy M, Arealis G, Mehdian H. Surgical management of contiguous multilevel thoracic spinal tuberculosis: a 15-year experience. Eur Spine J. 2013;22(Suppl 4):594-601.
16. Güzey FK, Emel E, Baş NS, et al. Thoracic and lumbar tuberculous spondylitis treated by posterior debridement, graft placement, and instrumentation: a retrospective analysis in 19 cases. J Neurosurg Spine. 2005;3(6):450-458.
17. Oguz E, Sehirlioglu A, Altinmakas M, Ozturk C, Komurcu M, Solakoglu C. A new classification and guide for surgical treatment of spinal tuberculosis. Int Orthop. 2008;32(1):127-133.
18. Rasouli MR, Mirkoohi M, Vaccaro AR, Yarandi KK, Rahimi-Movaghar V. Spinal tuberculosis: diagnosis and management. Asian Spine J. 2012;6(4):294-308.
19. Zhang H, Sheng B, Tang M, Guo C, Liu S, Huang S. One-stage surgical treatment for upper thoracic spinal tuberculosis by internal fixation, debridement, and combined interbody and posterior fusion via posterior-only approach. Eur Spine J. 2013;22(3):616-623.
20. Khanna K, Sabharwal S. Spinal tuberculosis: a comprehensive review for the modern spine surgeon. Spine J. 2021;21(3):356-370.
21. Rajasekaran S, Soundarapandian S. Progression of kyphosis in tuberculosis of the spine treated by anterior arthrodesis. J Bone Joint Surg Am. 1989;71(9):1314-1323.
22. Kapoor SK, Agarwal PN, Jain BK, Kumar R, Srivastava PK. Efficacy of antitubercular chemotherapy and surgery in the management of tuberculosis of the spine. Trop Doct. 2000;30(4):195-198.