

Diagnosis and treatment of isolated tuberculosis of the posterior spinal elements: A retrospective study of 15 cases

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Abstract

Background

Isolated tuberculosis (TB) of the posterior spinal elements is rare and often difficult to diagnose. We present the clinical features, diagnosis, treatment, and long-term outcomes of 15 patients with isolated posterior element TB.

Methods

We retrospectively reviewed 15 consecutive patients treated between October 2013 and January 2021. The patients' baseline clinical, laboratory, and imaging findings were analyzed. The following outcomes were assessed: erythrocyte-sedimentation rate (ESR), C-reactive protein (CRP), visual analogue scale (VAS) pain score, American Spinal Injury Association (ASIA) grade, Kirkaldy-Willis functional grade, recurrence, and complications.

Results

The cohort included 7 male and 8 female patients, with a mean age of 32.9 ± 13.8 years. The diagnosis was supported by CT and MRI findings (all patients), positive T-SPOT results (13 patients), positive culture (8 patients), and histopathological confirmation (4 patients). Twelve patients required surgery, and 3 received conservative anti-TB therapy alone. The mean follow-up was 66.4 ± 4.4 months. ESR, CRP, and VAS scores decreased significantly after treatment. Among 9 patients with baseline neurological impairment, 8 improved by at least one ASIA grade; no patient deteriorated neurologically. No recurrence, vertebral body involvement, progressive kyphosis, implant failure, or deep infection was observed. Kirkaldy-Willis outcomes were excellent in 11 patients, good in 3, and fair in 1.

Conclusion

Isolated posterior element TB may be missed on plain radiographs. CT and MRI are essential for diagnosis. Anti-TB chemotherapy is fundamental, and surgery may be appropriate for selected patients with neurological deterioration, epidural abscess, sequestrum, large dorsal muscle abscess, or spinal instability.

Introduction

Tuberculosis (TB) is endemic to many parts of the developing world, and is increasingly seen in the developed world due to migration [1]. A total of 1.3 million people die annually from the disease [2]. Moreover, with the rising incidence of immunocompromised patients, multidrug-resistant TB is resurging as a public health threat [3]. Spinal TB is the most common musculoskeletal manifestation of TB,

accounting for approximately 1% to 2% of all TB cases [4, 5]. Spinal TB has a high incidence in individuals of low socioeconomic status [6]. Spinal TB is typically characterized by the destruction of contiguous vertebral bodies and narrowing of the intervertebral disc space. The infection spreads to adjacent vertebral bodies by extending beneath the anterior longitudinal ligament and to the adjacent paraspinal soft tissues, resulting in a paravertebral abscess [5].

Isolated TB of the posterior spinal elements is extremely rare, occurring in 0.2% to 2% of patients with spinal TB [7]. The posterior spinal elements include the spinous process, transverse process, facet joints, lamina, and pedicles; isolated TB of the posterior spinal elements may involve one or more of these structures, resulting in an epidural abscess and/or pyomyositis of the dorsal muscles [8]. Isolated TB of the posterior spinal elements has no typical clinical manifestations. Early symptoms are limited to back pain without visible or palpable spinal deformity. Early manifestations cannot be seen on plain radiographs, and spinal cord compression can occur if the diagnosis is delayed [9]. Isolated TB of the posterior spinal elements should be suspected in patients with destruction of the pedicles and transverse processes on anteroposterior X-ray and destruction of the spinous processes on lateral X-ray. Computed tomography (CT) and magnetic resonance imaging (MRI) have the most clinical utility for the diagnosis of this rare infection [10, 11].

While significant progress has been made in the early diagnosis and effective management of spinal TB in recent years [12], isolated TB of the posterior spinal elements is difficult to diagnose and differentiate from spinal tumors. Early diagnosis and treatment are of great clinical importance, as these measures can effectively prevent and reduce the neurological damage caused by this condition [13]. The published literature on isolated TB of the posterior spinal elements, thus far, is sparse and mostly consists of case reports [14–16]. Therefore, the aim of this retrospective study was to report the diagnosis, treatment, and long-term outcomes of 15 patients with isolated TB of the posterior spinal elements over a 5-year follow-up period.

Methods

Study design and setting

We conducted a retrospective consecutive case-series study at the Department of Orthopaedic Surgery, Xiangya Hospital. All patients treated for isolated TB of the posterior spinal elements between October 2013 and January 2021 were screened for eligibility.

Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) diagnosis of spinal TB confirmed by pathology and/or microbiology; (2) involvement limited to the posterior spinal elements (spinous process, transverse process, facet joints, lamina, and/or pedicles), with no evidence of vertebral body or intervertebral disc

involvement on CT or MRI; (3) availability of complete clinical, laboratory, and imaging data; and (4) a minimum follow-up of 60 months.

The exclusion criteria were as follows: (1) involvement of the vertebral bodies or intervertebral discs on initial imaging; (2) concomitant spinal tumors, pyogenic spondylodiscitis, or other infections; (3) previous spinal surgery or anti-TB therapy prior to admission; and (4) loss to follow-up.

Case definition and diagnostic work-up

Isolated TB of the posterior spinal elements was defined as tuberculous infection confined to one or more posterior spinal structures, including the spinous process, transverse process, facet joint, lamina, or pedicle, with intact vertebral bodies and preserved intervertebral disc spaces on baseline CT and MRI.

The diagnosis was classified as confirmed TB when *Mycobacterium tuberculosis* was identified by culture or when histopathological examination showed caseating granulomas or granulomatous inflammation compatible with TB. The diagnosis was classified as probable TB when the typical CT and MRI findings were present; immunological testing was positive; alternative diagnoses such as spinal tumor and pyogenic infection were excluded; and a sustained clinical, laboratory, and radiological response to anti-TB therapy was observed.

The baseline diagnostic evaluations included plain radiography, CT, and MRI of the spine; erythrocyte-sedimentation rate (ESR); C-reactive protein (CRP); T-SPOT testing; sputum acid-fast bacillus smear; human immunodeficiency virus (HIV) testing; and chest CT. CT-guided biopsy or intraoperative tissue sampling was performed when the diagnosis was uncertain or when surgery was indicated. Culture-based drug-susceptibility testing was performed in culture-positive cases.

Treatment strategy

All patients received a standardized, first-line anti-TB chemotherapy regimen for 12–18 months, consisting of isoniazid (5 mg/kg/day, max $\leq$ 300 mg/day), rifampicin (10 mg/kg/day, max $\leq$ 1200 mg/day), ethambutol (15 mg/kg/day, max $\leq$ 2500 mg/day), and pyrazinamide (30 mg/kg/day, max $\leq$ 2000 mg/day). Routine hematological monitoring and hepatorenal toxicity screening were executed throughout the medication phase. Additionally, all patients received comprehensive nutritional support to correct any baseline anemia and hypoalbuminemia.

Surgical interventions were indicated in patients presenting with any of the following: (a) progressive neurological decline (American Spinal Injury Association [ASIA] grades B–D) driven by epidural abscess or direct mechanical cord compression; (b) an epidural abscess accompanied by sequestrum formation; (c) massive paraspinal or dorsal muscle abscesses with an imminent risk of sinus tract formation; (d) failure of conservative management after 3–4 weeks of anti-TB therapy; or (e) acute, sudden-onset paralysis during ongoing chemotherapy (mandating emergency decompression).

Surgically treated patients underwent either decompressive laminectomy paired with inter-laminar bone grafting and rigid internal fixation (n = 9, owing to neurological deficits or epidural abscess with sequestrum) or isolated abscess debridement (n = 3, owing to isolated dorsal muscle pyomyositis). Postoperatively, patients maintained strict bed rest for 2 weeks before initiating progressive ambulation while wearing a customized plastic orthosis.

Conservative management was reserved for patients who met all of the following criteria: (1) completely preserved neurological function (ASIA grade E); (2) absence of epidural abscesses or spinal cord compression on MRI; (3) structural spinal stability; and (4) excellent compliance with the oral chemotherapy regimen.

Follow-up protocol and outcome measures

Follow-up protocol and outcome measures

Patients were followed up every 3 months during the first year after treatment and every 6 months thereafter. At each visit, clinical symptoms, neurological status, adverse drug reactions, ESR, CRP, and functional recovery were assessed. CT and MRI were used to evaluate abscess resolution, recurrence, anterior column involvement, kyphosis progression, instrumentation integrity, and bone-graft fusion when applicable.

The primary outcomes were neurological recovery and absence of TB recurrence at the final follow-up. Secondary outcomes included changes in visual analog scale (VAS) pain score, ESR, CRP, ASIA grade, Kirkaldy-Willis functional grade, radiological resolution of the abscess, bone-graft fusion in instrumented patients, kyphosis progression, complications, and adverse reactions to anti-TB therapy.

Recurrence was defined as renewed clinical symptoms with compatible laboratory and imaging evidence after initial clinical and radiological healing. Solid fusion was defined as continuous trabecular bone bridging across the grafted area on CT, with no implant loosening or breakage. Kyphosis progression was defined as an increase of 5° in the segmental kyphotic angle during follow-up.

Statistical analysis

Statistical analysis was performed using IBM SPSS v26.0. Data with a normal distribution were expressed as mean $\pm$ SD, and compared using the Student *t*-test. Data with a non-normal distribution were compared using the rank-sum test. *P* < 0.05 was considered statistically significant.

Results

Baseline characteristics

Between October 2013 and January 2021, 15 consecutive patients with isolated TB of the posterior spinal elements were found to meet the eligibility criteria and were included in this analysis. The study

cohort included 7 male and 8 female patients, with a mean age of 32.9 ± 13.8 years. The patients' demographic characteristics, clinical manifestations, abscess type, diagnostic evidence, and treatment modalities are summarized in Table 1.

Table 1
Baseline characteristics and diagnostic evidence in 15 patients with isolated TB of the posterior spinal elements

Variable	Value
Demographic characteristics	
Number of patients	15
Age	32.9 ± 13.8 years
Sex	
Male	7/15 (46.7%)
Female	8/15 (53.3%)
Clinical manifestations	
Back pain	15/15 (100.0%)
Fever	9/15 (60.0%)
Weakness	15/15 (100.0%)
Weight loss	15/15 (100.0%)
Radicular pain	8/15 (53.3%)
Lower motor neuron paralysis	2/15 (13.3%)
Upper motor neuron paralysis	7/15 (46.7%)
Palpable posterior soft-tissue mass	5/15 (33.3%)
Paraspinal muscle spasm	12/15 (80.0%)
ASIA grade, n/N (%)	
B	2/9 (22.2%)
C	4/9 (44.4%)
D	3/9 (33.4%)
Laboratory and diagnostic evidence	
ESR	53.5 ± 22.5 mm/h
CRP	32.9 ± 13.6 mg/L
T-SPOT positive	13/15 (86.7%)
Values are presented as n/N (%), mean ± SD, or number of patients. ASIA = American Spinal Injury Association; ESR = erythrocyte-sedimentation rate; CRP = C-reactive protein; TB = tuberculosis; CT = computed tomography.	

Variable	Value
Demographic characteristics	
Culture positive	8/15 (53.3%)
Histopathology positive	4/15 (26.7%)
Pulmonary TB on chest CT	6/15 (40.0%)
Treatment allocation	
Surgical treatment	12/15 (80.0%)
Conservative treatment	3/15 (20.0%)
Values are presented as n/N (%), mean $\pm$ SD, or number of patients. ASIA = American Spinal Injury Association; ESR = erythrocyte-sedimentation rate; CRP = C-reactive protein; TB = tuberculosis; CT = computed tomography.	

Back pain and weight loss were the most common presenting symptoms and were observed in all patients. Constitutional symptoms included fever (9 patients). Radicular pain, palpable posterior soft-tissue mass, and dorsal muscle pyomyositis were present in 8, 5, and 3 patients, respectively. Varying degrees of neurological impairment were present in 9 patients at the time of presentation: 2 patients, ASIA grade B; 4 patients, ASIA grade C; and 3 patients, ASIA grade D.

ESR and CRP were elevated in all patients before treatment, with mean values of 53.5 ± 22.5 mm/h and 32.9 ± 13.6 mg/L, respectively. T-SPOT testing was positive in 13 of the 15 patients. Sputum acid-fast bacillus smear and HIV antibody testing were negative in all patients. Chest CT showed pulmonary TB lesions in 6 patients.

Imaging findings and diagnostic confirmation

Plain radiographs were unremarkable in most patients, and osteolytic changes of the posterior elements were detected in only 5 patients. CT demonstrated posterior element destruction in 13 patients, typically presenting as patchy low-density “flea-bitten” osteolytic lesions with blurred margins and surrounding sclerosis. Sequestra were identified on CT scans in 10 patients. No patient showed vertebral body destruction or intervertebral disc space narrowing on baseline CT or MRI.

MRI showed soft-tissue swelling, posterior element destruction, or cold abscess formation in 14 patients. Lesions were typically hypointense on T1-weighted images and hyperintense or of mixed intensity on T2-weighted images. Contrast-enhanced MRI showed rim enhancement of abscesses. Epidural abscess with spinal cord or cauda equina compression was present in 9 patients, and dorsal muscle pyomyositis was observed in 3 patients. The imaging and diagnostic findings are summarized in Table 2.

Table 2
Imaging findings and diagnostic evidence of isolated posterior spinal element TB

Category	Finding	Number of patients
Plain radiography	Osteolytic changes in posterior spinal elements	5/15 (33.3%)
	Unremarkable anteroposterior and lateral radiographs	10/15 (66.7%)
CT findings	Posterior element destruction	13/15 (86.7%)
	Patchy low-density “flea-bitten” osteolytic lesions with sclerotic margins	13/15 (86.7%)
	Sequestra	10/15 (66.7%)
	No vertebral body destruction	15/15 (100.0%)
	No intervertebral disc space narrowing	15/15 (100.0%)
MRI findings	Cold abscess or soft-tissue swelling with bone destruction	14/15 (93.3%)
	Hypointense signal on T1WI and hyperintense or mixed signals on T2WI	14/15 (93.3%)
	Rim enhancement on contrast-enhanced MRI	14/15 (93.3%)
	Epidural abscess with spinal cord or cauda equina compression	9/15 (60.0%)
	Pyomyositis of the dorsal muscles	3/15 (20.0%)
	No anterior column involvement	15/15 (100.0%)
Diagnostic evidence	Positive T-SPOT test	13/15 (86.7%)
	CT-guided percutaneous biopsy performed	4/15 (26.7%)
	Histopathological evidence of tuberculous granuloma or caseous necrosis	4/15 (26.7%)
	Positive culture for <i>Mycobacterium tuberculosis</i>	8/15 (53.3%)
	Drug-susceptibility testing performed	8/15 (53.3%)
	Susceptible to all first-line anti-tuberculosis drugs among culture-positive isolates	8/8 (100.0%)
	Xpert MTB/RIF performed	0/15 (0%)
	Other molecular testing performed	0/15 (0%)
Values are presented as n/N (%). CT = computed tomography; MRI = magnetic resonance imaging; T1WI = T1-weighted imaging; T2WI = T2-weighted imaging; TB = tuberculosis. Culture samples included biopsy tissue, intraoperative tissue, abscess fluid, or another source.		

Diagnostic evidence included positive T-SPOT testing in 13 patients, positive culture for *Mycobacterium tuberculosis* in 8 patients, and histopathological evidence of tuberculous granuloma or caseous necrosis in 4 patients. All culture-positive isolates were susceptible to first-line anti-TB drugs. Xpert MTB/RIF and other molecular diagnostic tests were not routinely available during the study period and were not performed. A representative biopsy-confirmed case is shown in Fig. 1.

The mean interval from the first medical visit to a definite diagnosis was 4.9 ± 3.4 days. Among patients with neurological impairment, the mean interval from symptom onset to neurological deterioration was 16.2 ± 11.2 days.

Treatment allocation and follow-up

Twelve patients underwent surgical treatment, and three patients were treated conservatively with anti-TB chemotherapy alone. Among the surgically treated patients, 9 patients underwent decompressive laminectomy, interlaminar bone grafting, and internal fixation because of neurological impairment, epidural abscess, sequestrum, or neural compression. Three patients with dorsal muscle pyomyositis underwent abscess debridement or drainage. One patient underwent emergency surgery because of acute paralysis during anti-TB therapy. The treatment allocation and radiological outcomes are summarized in Table 3. The mean follow-up duration was 66.4 ± 4.4 months (range: 60 to 75 months).

Table 3
Treatment allocation, complications, and radiological outcomes

Variable	Value
Treatment allocation	
Surgical treatment	12/15 (80.0%)
Conservative treatment	3/15 (20.0%)
Decompressive laminectomy, interlaminar bone grafting, and internal fixation	9/15 (60.0%)
Abscess debridement or drainage for dorsal muscle pyomyositis	3/15 (20.0%)
Emergency surgery for acute paralysis during anti-tuberculosis therapy	1/15 (6.7%)*
Follow-up	
Follow-up duration, months	66.4 ± 4.4†
Radiological outcomes	
Tuberculosis recurrence	0/15 (0%)
New vertebral body involvement	0/15 (0%)
Progressive kyphosis	0/15 (0%)
Solid fusion among patients who underwent bone grafting and internal fixation	9/9 (100.0%)
Screw loosening or implant breakage	0/9 (0%)
Postoperative complications	
Superficial wound infection	1/12 (8.3%)
Transient postoperative radiculopathy	1/12 (8.3%)
Deep surgical-site infection	0/12 (0%)
Cerebrospinal fluid leakage	0/12 (0%)
Instrument failure	0/9 (0%)
Adverse drug reactions	
Mild hepatotoxicity	2/15 (13.3%)
Discontinuation of anti-tuberculosis therapy	0/15 (0%)
Values are presented as n/N (%) or mean ± SD. *The patient who underwent emergency surgery is included among the 9 patients treated with decompressive laminectomy, bone grafting, and internal fixation. †The range, median, and interquartile range of follow-up duration are provided in the supplementary material.	

Clinical outcomes

Among the 9 patients with baseline neurological impairment, neurological function improved in 8 patients and remained stable in 1 patient, with no neurological deterioration observed during follow-up. Both patients with baseline ASIA grade B improved to grade D. Among the 4 patients with baseline ASIA grade C, 3 recovered to grade E, and 1 improved to grade D. Among the 3 patients with baseline ASIA grade D, 2 recovered to grade E, and 1 remained at grade D.

Longitudinal monitoring revealed that both serum inflammatory markers (ESR and CRP) and subjective pain intensity (VAS score) decreased substantially from the baseline to the 3-month post-treatment evaluation and the final follow-up ($P < 0.05$; Table 4).

Table 4
Serial changes in inflammatory markers and pain scores across treatment phases (N = 15)

Parameter	Pre-therapy	3 Months Post-treatment	Final Follow-up	P-value
ESR (mm/h)	53.5 ± 22.5	16.5 ± 5.4	8.2 ± 3.3	< 0.05
CRP (mg/L)	32.9 ± 13.6	6.3 ± 1.7	3.1 ± 1.0	< 0.05
VAS pain score	6.9 ± 0.6	—	0.5 ± 0.5	< 0.05
Data are expressed as mean ± standard deviation. ESR, erythrocyte-sedimentation rate; CRP, C-reactive protein; VAS, visual analogue scale. — indicates data not recorded at this specific time point.				

According to the Kirkaldy-Willis criteria at the final follow-up, functional outcomes were excellent in 11 patients, good in 3, fair in 1, and poor in none. No patient experienced TB recurrence, new vertebral body involvement, recurrent abscess, or progressive kyphosis. Among the 12 surgically treated patients, 1 developed a superficial wound infection, which resolved after debridement and antibiotics, and 1 developed transient postoperative radiculopathy, which resolved within 3 weeks. No deep surgical-site infection, cerebrospinal fluid leakage, implant failure, or recurrent abscess was observed. Two patients developed mild hepatotoxicity, defined as transaminase elevation less than 3 times the upper limit of normal, which resolved after dose adjustment and hepatoprotective treatment, and no patient required discontinuation of anti-TB therapy. Among the 9 patients who underwent decompressive laminectomy with interlaminar bone grafting and internal fixation, CT at the final follow-up demonstrated solid fusion in all patients, with no screw loosening, implant breakage, or progressive kyphosis (Table 3; Figs. 2, 3 and 4)

Discussion

Isolated TB of the posterior spinal elements can involve a single site or multiple sites. The posterior elements may be involved by the hematogenous dissemination of *Mycobacterium tuberculosis* through the posterior external vertebral plexus, located behind the lamina and surrounding the spinous process, articular process, and transverse process [17]. The causes of neurological impairment in this type of

infection are probably multifactorial and may include epidural abscess-related compression, inflammatory edema, and vascular compromise caused by radicular arterial thrombosis [18]. The thoracic spinal cord may be particularly vulnerable because of the relatively narrow canal and less robust blood supply, especially in the mid-thoracic region [19]. Spinal cord tissue is also sensitive to ischemia and hypoxia, which may aggravate neurological dysfunction when compression or vascular compromise occurs [20]. Consequently, even a relatively small abscess in this confined space can produce disproportionate neurological deficits, emphasizing the need for urgent decompression when acute paralysis develops.

The clinical diagnosis of isolated TB of the posterior spinal elements is mainly based on clinical symptoms, signs, CT and MRI findings, and the results of puncture biopsy, pathology, and culture. This type of atypical spinal TB should be differentiated from metastatic tumors, myeloma, and related disorders [21]. The tuberculin skin test (PPD) is positive in 62%–100% of patients with spinal TB [22]. The onset of spinal TB is relatively slow, progressing over 4 to 11 months [23]. Pain is the most common symptom of spinal TB, and can be aggravated by activity, cough, and weight-bearing. The incidence of nervous system involvement ranges from 23% to 76%, and the incidence of nonspecific symptoms ranges from 20% to 30% [24]. A key diagnostic challenge is distinguishing isolated posterior element TB from classical spinal TB and spinal tumors. Classical spinal TB typically involves the vertebral body and intervertebral disc, whereas isolated posterior element TB may initially spare the anterior column and disc space, making plain radiographs insensitive for the diagnosis of this condition [25]. In our series, CT was particularly useful for identifying posterior element destruction, sequestra, sclerotic margins, and characteristic “flea-bitten” osteolytic lesions. MRI can show changes in the spine earlier than X-ray and CT, and can show the extent of soft-tissue involvement and nerve compression [26]. MRI can reveal epidural abscesses, which appear hypointense on T1-weighted imaging and hyperintense on T2-weighted and fat-suppressed imaging, and may have septations and rim-like enhancement.

In the present study, we classified cases as either confirmed or probable TB according to the prespecified diagnostic criteria. Of the 15 patients, 8 were confirmed to have TB via a positive culture for *Mycobacterium tuberculosis*, and 4 were confirmed to have TB owing to histopathological evidence of caseating granulomas or granulomatous inflammation. The remaining patients met the criteria for probable TB based on characteristic imaging findings, positive immunological testing, exclusion of alternative diagnoses, and a favorable response to anti-TB therapy. This distinction is clinically meaningful. Isolated posterior element TB often presents with paucibacillary lesions and limited accessibility for biopsy, making microbiological confirmation challenging in routine practice. In our cohort, all culture-positive isolates were susceptible to first-line drugs, and both confirmed and probable TB patients demonstrated comparable clinical and radiological improvement during follow-up. These findings suggest that when strict clinical, imaging, and laboratory criteria are applied, the diagnostic category of probable TB is a practical and reliable basis for initiating treatment in this rare condition, particularly in settings where molecular testing is not readily available. However, we acknowledge that a probable diagnosis relies on a composite of indirect evidence; therefore, we recommend that all patients

without microbiological confirmation be carefully monitored for treatment response and considered for repeat biopsy if the response is suboptimal.

The treatment of isolated TB of the posterior spinal elements is based on the recommendations for spinal TB, with no consensus on whether this is an appropriate approach. Tuli [27] considered lesions affecting the posterior spinal elements to be an indication for surgery due to the risk of developing a superficial abscess or secondary infection of the sinus tracts and meninges. In the present cohort, surgery was used for patients with neurological impairment, epidural abscess, sequestrum, dorsal muscle abscess, acute paralysis, or potential instability, whereas conservative treatment was reserved for patients without neurological deficit or neural compression. Surgery may provide neural decompression, abscess drainage, sequestrum removal, diagnostic tissue, and restoration or preservation of spinal stability [28, 29]. Nevertheless, because this was a retrospective case series without random treatment allocation, our data cannot establish the superiority of surgery over conservative treatment. Careful handling of the posterior elements, dura, and neural structures during surgery is essential because traction or additional ischemic injury may worsen neurological function. Conservative treatment is recommended for patients with spinal TB and intact neurological function. However, published evidence suggests that surgery may reduce the risk of kyphosis in some patients [30]. Severe kyphosis can lead to neurological deficits and late complications that may be difficult to treat, and early surgical intervention may prevent this progression [31]. In our cohort, no patient developed recurrence, new vertebral body involvement, progressive kyphosis, or implant failure during follow-up. Compared with the series by Arora et al., in which residual neurological deficits were reported in some patients, our outcomes appear encouraging [17]. However, comparisons across small retrospective series should be made cautiously because of differences in case selection, diagnostic criteria, disease severity, treatment indications, and follow-up duration.

Isolated TB of the posterior spinal elements is rare and often occult in imaging. It should be considered in patients hailing from areas endemic for TB and presenting with vertebral arch lesions on CT and MRI. Early diagnosis and a reasonable treatment plan will improve prognosis. The degree of spinal destruction, condition of the adjacent soft tissues, grade of neurological impairment, and degree of spinal instability should be evaluated. Tissue biopsy should be performed, and empirical anti-TB therapy should be initiated [32]. Almost all anti-TB drugs can penetrate TB foci well [33]. For patients whose imaging findings are highly suspicious but cannot be diagnosed as TB of the posterior spinal elements, empirical anti-TB therapy is helpful for further evaluation. For patients with spinal TB without neurological symptoms or potential changes in vertebral stability, anti-TB therapy can be given first. If the symptoms are relieved and inflammation reduced, conservative treatment can be continued.

This study has several inherent limitations. First, it is a retrospective case series with a small sample size of 15 patients, which is a consequence of the extreme rarity of isolated TB of the posterior spinal elements. The limited sample size restricts the statistical analysis to basic paired comparisons and precludes the use of more advanced techniques, such as multivariate logistic regression, to identify independent predictors of neurological recovery. Second, the single-center design may limit the

generalizability of our findings; our cohort may represent a subgroup of patients with relatively favorable prognosis due to early referral and surgical access. Third, the lack of a control group treated with anti-TB therapy alone limits our ability to quantify the independent contribution of surgery versus medical management. Fourth, the pathophysiological mechanisms of rapid neurological worsening and recovery discussed herein are based on clinical reasoning and literature review, and not on direct histopathological or hemodynamic evidence. Larger, multicenter, prospective studies are needed to validate these findings and to establish evidence-based treatment guidelines for this rare but potentially devastating condition.

Conclusion

Isolated TB of the posterior spinal elements is rare and often missed on plain radiographs; CT and MRI are essential for diagnosis. Anti-TB chemotherapy is the cornerstone of treatment, while surgery is reserved for selected patients with neurological deterioration, epidural abscess, sequestrum, large dorsal muscle abscess, or spinal instability. In this series of 15 patients, individualized treatment yielded favorable neurological, functional, and radiological outcomes with no recurrence or major complications, although larger prospective studies are needed to confirm these findings.

Declarations

Author contributions

Z.C.X: Conceptualization, Experiment, Data curation, Formal analysis, Writing - original draft. D.Y.J and Y.L.Z: Investigation, Writing - editing. Z.L and X.Y.W: Funding acquisition, Supervising, and Writing - review. All authors discussed the results and commented on the manuscript.

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Data availability

The datasets and materials generated or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was reviewed and approved by the Ethics Committee of Hunan Children's Hospital (No. HCHLL-2026-338; approval date: March 2026). All procedures were performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained from all patients for participation. Informed consent to participate was obtained from all adult patients and from the parents or legal guardians of all participants under the age of 16.

Consent for publication

Written informed consent for publication of clinical details and/or clinical images was obtained from all adult patients and from the parents or legal guardians of all participants under the age of 18.

Competing interests

The authors declare no competing interests.

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Figures

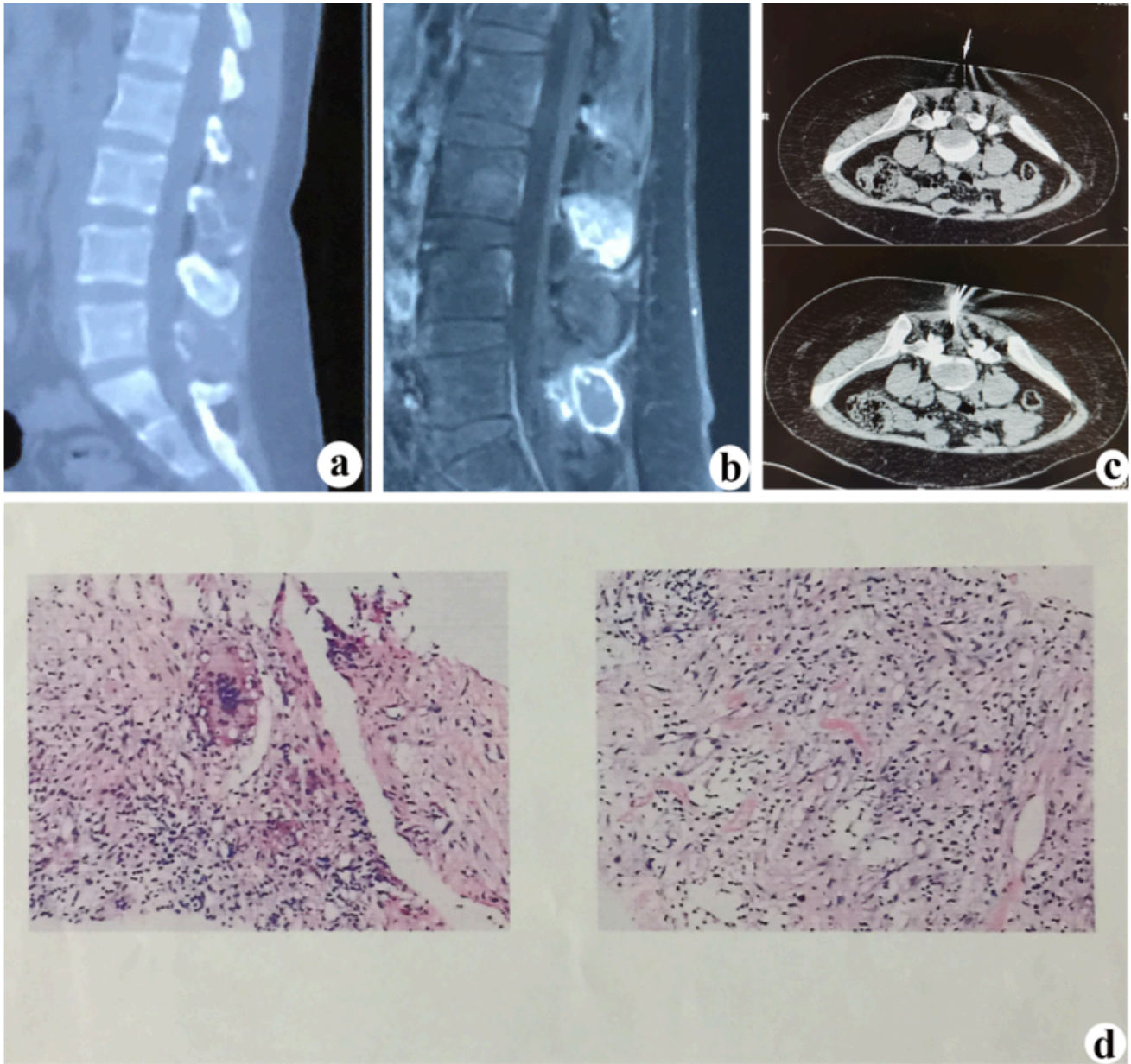


Figure 1

A 28-year-old man presented with bone destruction in the lumbar spine. The diagnosis was TB of the lumbar spinous process. The patient was treated conservatively. **(a, b)** CT and MRI show destruction of the spinous processes at L2-3 and L5, with abscess formation. **(c)** Percutaneous puncture biopsy is performed under CT guidance. **(d)** Pathological examination reveals chronic granulomatous inflammation, confirming TB.

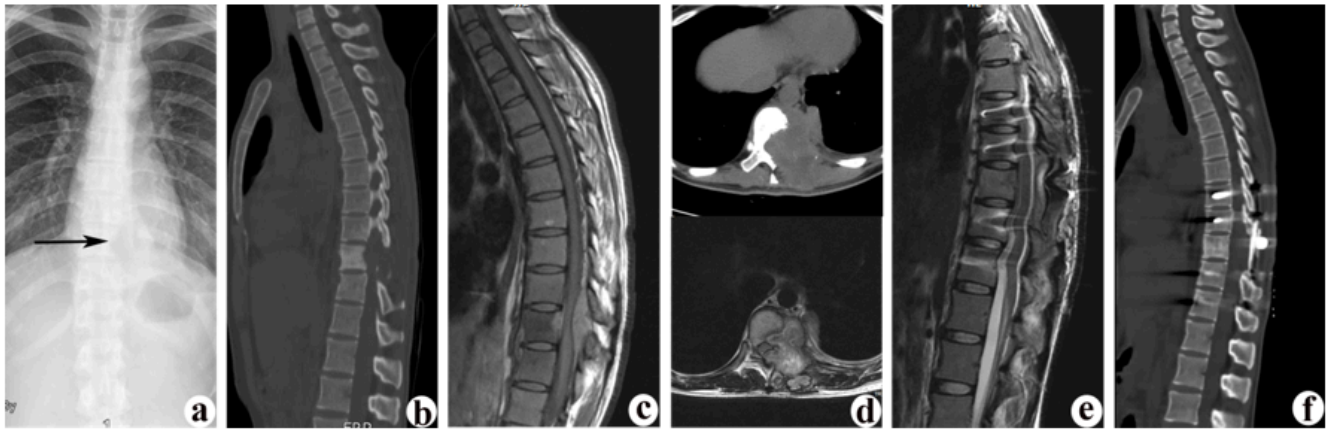


Figure 2

A 28-year-old woman presented with bone destruction at T10 and spinal cord compression. She was diagnosed with T10 posterior element TB, and was treated with anti-TB therapy, debridement, bone grafting, and internal fixation. **(a)** X-ray shows osteolytic changes (arrow) on the left side of T10. **(b–d)** Sagittal and cross-sectional CT and MRI images show bone destruction in the posterior column of T10, with abscess formation causing spinal cord compression at the corresponding segments. **(e)** Postoperative MRI shows that the lesion has been eliminated, and the spinal canal is unobstructed. **(f)** CT at the final follow-up shows no recurrence of TB and solid fusion of the bone graft.

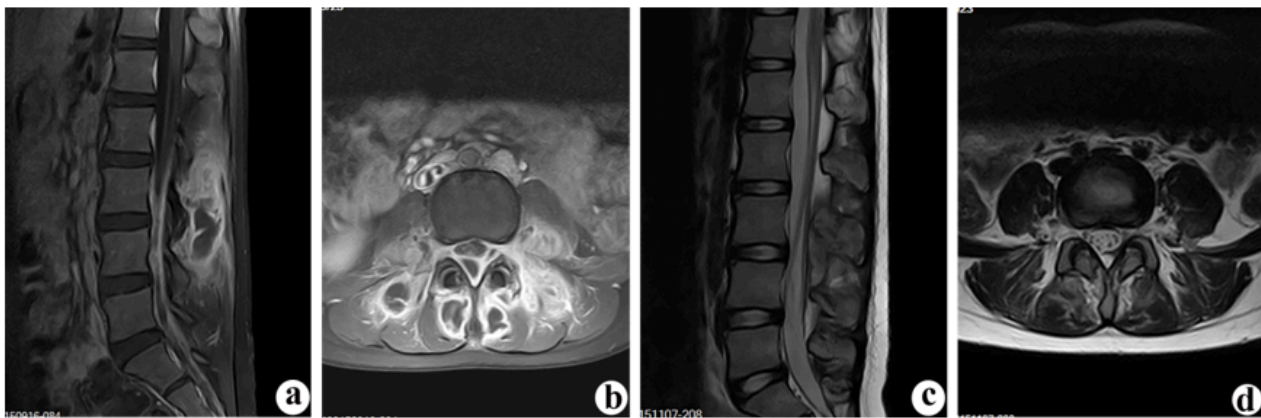


Figure 3

A 13-year-old girl presented with an intraspinal abscess at L3–5 and pyomyositis of the corresponding dorsal muscles. She was diagnosed with TB, and was treated with anti-TB therapy and abscess removal. **(a, b)** Sagittal and cross-sectional MRI scans show an intraspinal abscess, cauda equina compression, and multiple abscesses in the dorsal muscles. **(c, d)** MRI at the last follow-up shows that the compression has been relieved, and no residual abscess is present.

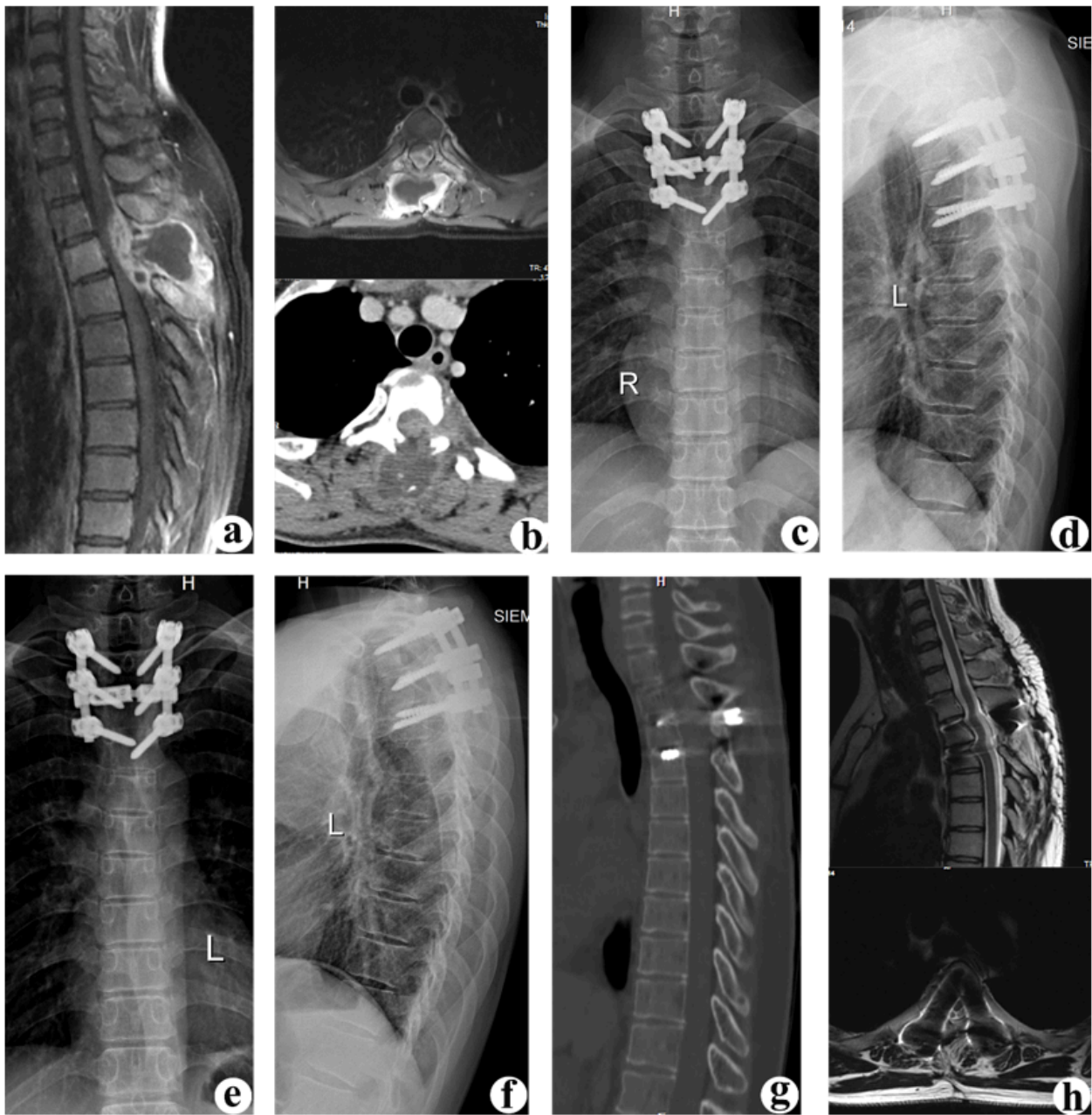


Figure 4

A 23-year-old man was diagnosed with spinal tuberculosis involving T3–T5, characterized by posterior element destruction, abscess formation, and spinal cord compression at the corresponding levels. He was treated with anti-tuberculous chemotherapy and surgical management comprising debridement, bone grafting, and internal fixation. **(a, b)** MRI and CT demonstrated destruction of the posterior elements at T3–T5 and a large cold abscess causing spinal cord compression at the corresponding levels. **(c, d)** Postoperative follow-up radiographs demonstrated satisfactory placement of the instrumentation. **(e–h)** At the final follow-up, radiographs demonstrated well-positioned instrumentation without loosening, CT demonstrated solid fusion of the bone graft, and MRI demonstrated resolution of the lesion, a patent spinal canal, and no evidence of tuberculosis recurrence.

