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Surgical Management of Spontaneous Thoracic and Lumbar Spondylodiscitis via Posterior Debridement and Long-Segment Fixation: A Retrospective Case Series

Dr. Mounty Raj Chilukoti[1], Dr. K. V. V. Satyanarayana Murthy[2], Dr. V Jagadeesh Reddy[3]

[1]MS M.Ch Neurosurgery resident, Guntur Medical College, Guntur (Corresponding Author)

[2]MS M.Ch., Professor & Head, Department of Neurosurgery, GMC, Guntur

[3]MS M.Ch., Assistant Professor, Department of Neurosurgery, GMC, Guntur

Abstract: ***Introduction: Spontaneous thoracic and lumbar spondylodiscitis (STLS) is an increasing clinical challenge. While conservative treatment is the mainstay, surgical intervention is required for instability or neurological deficits. The optimal approach- posterior-only versus combined- remains a subject of debate. Objective: To evaluate the clinical, neurological, and microbiological outcomes of a surgical strategy centered on posterior transpedicular debridement and long-segment instrumented fixation. Methods: We retrospectively analyzed 20 consecutive patients with STLS treated between 2018 and 2023. All patients underwent posterior-only decompression, aggressive debridement, and long-segment stabilization (typically 2 levels above and below). Outcomes were measured via the Visual Analog Scale (VAS), modified MacNab criteria, and the American Spinal Injury Association (ASIA) Impairment Scale. Results: The mean age was 58.7 years. The lumbar spine was the most common site (70%). Staphylococcus aureus was the primary pathogen (25%), while 25% of cases were culture-negative. Post-operatively, the mean VAS score improved to 3.1, and 70% of patients achieved a satisfactory functional outcome (Excellent/Good) per MacNab criteria. Of the 16 patients presenting with pre-operative neurological deficits, 50% (n=8) showed an improvement of at least one ASIA grade. The overall major complication rate was 25%, including two cases of recurrent infection. Conclusion: Posterior debridement and long-segment fixation provide a reliable means of achieving mechanical stability and neurological recovery in STLS. This approach effectively eradicates the infectious focus while minimizing the morbidity associated with anterior surgery.***

Keywords: Spondylodiscitis, Posterior Fixation, Transpedicular Debridement, Spinal Infection, ASIA Scale.

1. Introduction

Spondylodiscitis, an infectious process involving the vertebral body and intervertebral disc space, represents a severe and potentially devastating form of spinal infection. Although the overall annual incidence is relatively low, typically cited between 0.2 and 2.4 cases per 100,000 population, the prevalence is increasing, particularly in elderly and immunocompromised patients [1, 2]. The thoracic and lumbar regions are the most commonly affected sites, often leading to rapid structural damage due to the rich vascular supply of the vertebral endplates.

Conservative management, consisting of prolonged rest and targeted, long-term antimicrobial therapy, remains the initial standard of care for uncomplicated cases. However, surgical intervention becomes mandatory when the infectious process leads to neurological deficit, epidural abscess formation, severe mechanical spinal instability, or progressive kyphotic deformity [3]. A delay in surgical decompression and stabilization in these complicated scenarios carries a high risk of permanent neurological impairment and profound spinal collapse.

The therapeutic objective of surgery for spontaneous thoracic and lumbar spondylodiscitis (STLS) is twofold: eradication of the infectious focus through radical debridement and restoration of spinal biomechanical integrity [4]. The debate centers on the optimal surgical strategy, typically choosing between a posterior-only approach (offering simultaneous decompression and posterior fixation) and a combined anterior-posterior approach (allowing direct access to the anterior column for thorough debridement and fusion). Given the complexity and high morbidity associated with these procedures, a continuous evaluation of outcomes is critical to refine surgical protocols.

This study aims to retrospectively evaluate the efficacy and safety of a surgical strategy centered on fixation and debridement for spontaneous thoracic and lumbar spondylodiscitis. We analyze a cohort of 20 patients to assess the clinical (Visual Analog Scale scores and MacNab criteria), neurological (American Spinal Injury Association—ASIA grade), and microbiological outcomes associated with this aggressive surgical management approach.

2. Materials and Methods

Study Design and Patient Selection

This study was conducted as a retrospective case series of 20 consecutive patients who underwent surgical management for spontaneous thoracic or lumbar spondylodiscitis (STLS) at a single institution between January 2018 and December 2023. Institutional Review Board (IRB) approval was obtained, and the need for individual informed consent was waived due to the retrospective nature of the study.

Inclusion criteria were:

1) Diagnosis of spontaneous pyogenic spondylodiscitis (excluding post-operative, post-traumatic, or non-pyogenic causes).
2) Lesion located in the thoracic or lumbar spine (T1–S1).
3) Indication for surgical intervention, defined as the presence of neurological deficit, spinal instability (osseous destruction, impending kyphosis), or persistent infection/pain refractory to a minimum of four weeks of conservative antibiotic therapy.

3. Data Collection and Variables

All demographic, clinical, surgical, and outcome data were extracted from the patients' electronic medical records and summarized in a master chart. The following variables were recorded:

- Demographics: Age (years) and sex.
- Clinical: Vertebral level of involvement (e.g., L4-L5), pre-operative neurological status assessed using the American Spinal Injury Association (ASIA) Impairment Scale.
- Microbiology: Causative organism identified via intraoperative tissue culture.
- Surgical Data: Surgical approach (Posterior-only or Combined Anterior-Posterior), and the total number of segments stabilized by fixation.
- Post-operative Management: Total duration of antibiotic therapy (intravenous and oral combined, in weeks).

4. Surgical Technique

The surgical decision-making process was individualized based on the disease pattern and patient co-morbidities.

1) **Posterior Approach (N=20):** This was the predominant strategy. It involved a midline incision, exposure of the posterior elements, neural decompression (laminectomy/facetectomy) as needed, and aggressive curettage of the infected disc material and endplates via the transpedicular route. Long-segment pedicle screw fixation was applied, typically extending two levels above and two levels below the infected segment, followed by posterolateral fusion.
2) **Post-operative Management and Antibiotics**: All patients received post-operative intravenous antibiotic therapy, which was initiated empirically and subsequently tailored according to the intraoperative culture and sensitivity results. The mean duration of antibiotic therapy (IV followed by oral) was recorded in weeks, with the goal of complete inflammatory resolution.
3) **Outcome Assessment**: Patients were followed up clinically and radiographically at 3, 6, 12, and 24 months post-surgery. Final outcomes were assessed at the last available follow-up (mean 12.9 months).
   - Pain Relief: Assessed using the Visual Analog Scale (VAS) score, ranging from 0 (no pain) to 10 (worst imaginable pain).
   - Functional Status: Evaluated using the modified MacNab Criteria (Excellent, Good, Fair, Poor).
   - Neurological Recovery: Assessed by comparing the final ASIA grade to the pre-operative ASIA grade, noting any improvement.
   - Complications: Any major surgical or medical complications, including wound dehiscence, deep vein thrombosis (DVT), non-union, or recurrent infection, were recorded.
4) **Statistical Analysis:** Descriptive statistics were used to report all variables, including means and ranges for continuous data (e.g., age, VAS, antibiotic duration) and frequencies and percentages for categorical data (e.g., sex, ASIA grade, MacNab outcome). Due to the small, descriptive nature of this case series (N=20), comparative or inferential statistics were not performed.

5. Summary of Results (N=20)

1) Patient Demographics and Clinical Presentation

a) Age and Sex: The mean age of the cohort was 58.7 years (range: 32–80 years). There was a slight male predominance, with 11 males (55%) and 9 females (45%).

b) Disease Location: The spondylodiscitis involved the lumbar spine in the majority of cases (14 patients, 70%) and the thoracic spine in 6 patients (30%). The most common single level affected was L4-L5 (3 patients).

c) Neurological Status (Pre-operative):
   - ASIA Grade E (Normal): 4 patients (20%)
   - ASIA Grade D (Motor/Sensory Deficit): 10 patients (50%)
   - ASIA Grade C (Non-functional Motor): 5 patients (25%)
   - ASIA Grade B (Sensory Only): 1 patient (5%)

Parameter	Value
Age (years)	58.7 (Range:32–80)
Sex	
- Male	11 (55%)
- Female	9 (45%)
Infection Location	
- Lumbar Spine	14 (70%)
- Thoracic Spine	6 (30%)
- Most Common Level	L4-L5 (n=3)
Pre-operative ASIA Grade	
- Grade E (Normal)	4 (20%)
- Grade D (Incomplete)	10 (50%)
- Grade C (Incomplete)	5 (25%)
- Grade B (Sensory Only)	1 (5%)

2) Microbiology and Antibiotic Therapy

a) **Causative Organism:** The most common organism isolated was Staphylococcus aureus (including MRSA), found in 5 patients (25%).
   - *S. aureus* (MSSA): 3 patients
   - MRSA: 2 patients
   - *E. coli*: 2 patients
   - *P. aeruginosa*: 2 patients
   - *S. epidermidis*: 2 patients
   - Tuberculosis (*Mycobacterium TB*): 3 patient
   - *Candida albicans*: 1 patient
   - Negative Culture: A significant number, 5 patients (25%), had negative intraoperative cultures.

b) **Antibiotic Duration:** The mean duration of post-operative targeted antibiotic therapy was 10.2 weeks (range: 6–24 weeks, with the TB patients receiving the longest course).

Organism Type	Isolated Pathogen	n (%)
Gram-Positive	*Staphylococcus aureus* (inc. MRSA)	5 (25%)
	Staphylococcus epidermidis	2 (10%)
Gram-Negative	*Escherichia coli*	2 (10%)
	Pseudomonas aeruginosa	2 (10%)
Atypical/ Other	*Mycobacterium tuberculosis*	3 (15%)
	Candida albicans	1 (5%)
No Growth	Culture Negative	5 (25%)

3) Operative Details

- Surgical Approach: The posterior approach (posterior debridement, decompression, and fixation) was the surgical strategy (20 patients, 100%).
- Fixation Length: The fixation typically spanned two levels above and two levels below the affected disc space.

4) Outcomes and Complications

a) Follow-up: The average follow-up period was 12.9 months (range: 3–24 months).

b) Pain Reduction (VAS): The final mean Visual Analog Scale (VAS) pain score was 3.1 (range: 0–7).

c) Functional Outcome (MacNab Criteria):
- Excellent: 10 patients (50%)
- Good: 4 patients (20%)
- Fair: 4 patients (20%)
- Poor: 2 patients (10%)
- Overall, 70% of patients achieved a satisfactory outcome (Excellent or Good).

d) Neurological Recovery: 8 out of 16 patients who presented with a pre-operative neurological deficit (ASIA Grade B, C, or D) showed improvement of at least one ASIA grade at final follow-up. 5 patients recovered fully to ASIA Grade E.

Metric	Pre-operative	Final Follow-up
Mean VAS Score	8.4 +/- 1.2	3.1 +/- 1.5
Functional Outcome (MacNab)		
- Satisfactory (Excellent/Good)	—	14(70%)
- Fair	—	4(20%)
- Poor	—	2(10%)
Neurological Recovery		
ASIA Grade Improve	—	8/16 patients (50%)
Full Recovery (to Grade E)	—	5/16 patients (31.3%)

Complications: 5 patients (25%) experienced major complications:

- Recurrent/Persistent infection: 2 patients (Pt 5, Pt 12)
- Non-union requiring revision: 1 patient (Pt 7)
- New-onset DVT: 1 patient (Pt 14)
- Persistent neurological deficit: 1 patient (Pt 18)

Complication	n (%)	Management/Outcome
Recurrent Infection	2(10%)	Long-term targeted IV antibiotics
Non-union	1(5%)	Revision surgery and re-fixation
New-onset DVT	1(5%)	Anticoagulation therapy
Persistent Deficit	1(5%)	Continued physical rehabilitation

6. Discussion

The surgical management of spontaneous thoracic and lumbar spondylodiscitis aims to achieve three primary goals: aggressive debridement of infected tissue, neurological decompression, and definitive spinal stabilization with instrumentation. The retrospective analysis of our 20-patient cohort demonstrates that this approach yields satisfactory clinical and functional outcomes, consistent with modern spine surgery literature, though several areas warrant comparative discussion.

Microbiological and Pathogen Profile

Our microbiological analysis identified a causative pathogen in 75% (n=15) of the cohort. *Staphylococcus aureus* remained the most prevalent organism, isolated in 25% (n=5) of cases (including two MRSA isolates). This is highly concordant with established literature, which identifies *Staphylococcus* species as the primary driver of pyogenic spondylodiscitis globally [1].

A notable finding in our series was the 25% culture-negative rate (n=5). While this is higher than the 14% reported by Elnaggar and Habib [2], it sits within the broader reported range for spinal infections, which can reach up to 30–40% in some series. This high rate of negative yield is likely attributable to the administration of empiric antibiotics prior to referral or the presence of fastidious, slow-growing organisms. This finding underscores a critical clinical reality: in a quarter of cases, surgeons must rely on clinical, radiological, and inflammatory markers (CRP/ESR) to guide therapy rather than specific sensitivities.

Our study also highlights the importance of regional and opportunistic pathogens. We identified three cases (15%) of *Mycobacterium tuberculosis* and one case of *Candida albicans*. These patients required significantly longer antibiotic courses (up to 24 weeks) compared to those with pyogenic infections. Conversely, while some global studies, such as the 2023 study by Fazlul Haque et al. in Bangladesh, have reported a shift toward Gram-negative dominance (38% vs. 16% *S. aureus*) [3], our cohort maintained a traditional Gram-positive predominance.

Ultimately, the diversity of isolates in our small cohort-ranging from common pyogenic bacteria to fungal and tubercular pathogens- validates the necessity of radical debridement for tissue sampling and emphasizes the role of broad-spectrum empirical coverage followed by rigorous, tailored antimicrobial stewardship.

Surgical Approach and Functional Outcomes

Our cohort utilized the posterior approach for debridement and transpedicular fixation. This is increasingly favored by spine surgeons as it allows for simultaneous decompression and stabilization, avoiding the morbidity associated with staged anterior-posterior procedures, especially in elderly or comorbid patients [4].

The efficacy of this strategy is confirmed by our functional outcomes. Seventy percent (70%) of our patients achieved a satisfactory MacNab outcome (Excellent or Good), and the mean final Visual Analog Scale (VAS) score improved to 3.1.

While highly positive, this outcome is slightly lower than the 93% Excellent/Good rate reported by Elnaggar and Habib [2] and significantly lower than the 100% satisfactory rate achieved in a series utilizing a minimally invasive extreme lateral interbody fusion (XLIF) approach combined with posterior fixation, as reported by Wang et al. [5]. The marginally lower satisfactory rate in our cohort may be attributable to the higher complication rate, and the presence of complex pathogens like Tuberculosis and *Candida albicans*, which generally require longer recovery times and more aggressive regimens.

Neurological Recovery and Complications

Neurological compromise is a key indication for surgical intervention. In our study, 50% of patients with pre-operative deficits (8/16) demonstrated an improvement of at least one ASIA grade, and five patients achieved full recovery (ASIA Grade E). This significant recovery is consistent with the literature, which attributes neurological improvement to the radical decompression of the neural elements achieved during the surgical debridement phase [4].

However, the 25% overall complication rate (including non-union, DVT, and recurrent infection) highlights the inherent risks in treating this high-risk population. While the complication rate in contemporary spine literature varies widely based on patient selection and definition, the zero recurrence/complication rate reported by Elnaggar and Habib [2] suggests that meticulous surgical technique, particularly long-segment fixation spanning two levels above and below, and tailored antibiotic therapy are critical to minimizing hardware-related issues and re-infection. The need for subsequent revision or fusion surgery, as was necessary in our patient with non-union, has been reported in other series, emphasizing the necessity of rigid initial stabilization [1].

7. Conclusion

Surgical debridement combined with instrumented fixation remains a highly effective method for managing complicated spontaneous thoracic and lumbar spondylodiscitis, providing reliable pain control and a strong potential for neurological recovery. While our outcomes are broadly comparable to current literature, future efforts should focus on optimizing pathogen isolation techniques, exploring minimally invasive approaches to reduce morbidity, and rigorously standardizing post-operative antibiotic protocols to further reduce the risk of recurrent infection and improve functional results.

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