Surgical Management of Spondylodiscitis: A Single-Center Retrospective Analysis of 126 Cases

Pavel Trávníček[1,2,*], Lenka Ryšková[3], Tomáš Hosszú[1,2], Roman Kostyšyn[1,2], Pavel Ryška[4], Jan Trlica[5,6], Tomáš Česák[1,2], Miroslav Cihlo[1,2]

ABSTRACT

Background: Pyogenic spondylodiscitis is a severe spinal infection. Surgery can provide source control, neural decompression, and stability when indicated, but practice varies. We assessed outcomes of surgically treated cases at a tertiary neurosurgical center (2015–2024).
Methods: Retrospective cohort of consecutive adults admitted with pyogenic spondylodiscitis to a tertiary neurosurgical center (2015–2024). Surgical and non-surgical cases were recorded; analyses focus on surgically managed patients with whole-cohort descriptors where indicated.
Methods: We retrospectively analysed consecutive patients indicated for surgery. Variables included procedure type (decompression alone vs. instrumentation), presence of epidural abscess, reoperation for relapse or new-onset instability, microbiology, length of hospital stay (LOS), early outcomes, and admission clinical status.
Results: We included 126 patients (87 men, 69%); mean age 65 years (range 13–91). Surgery was performed in 108 (85.7%): decompression alone in 76/108 (70.4%), instrumented decompression in 21/108 (19.4%), standalone instrumentation in 4/108 (3.7%), and multistage combined procedures in 7/108 (6.5%). Epidural abscess was present at the index operation in 98/108 (90.7%). Relapse, either confirmed intraoperatively or on preoperative MRI occurred in 29/126 (23.0%); reoperation for progressive instability in 17/108 (15.7%). Among patients with confirmed etiology (121/126, 96.0%), the most frequent pathogens were Staphylococcus aureus 69/121 (57.0%), Enterobacterales 18/121 (14.9%), and streptococci 16/121 (13.2%). Mean LOS was 35.3 days (median 27). Multiorgan failure developed in 44/126 (35.0%); in-hospital mortality was 7/126 (5.6%). No implant-related complications were observed.
Conclusions: Early surgical source control with decompression without instrumentation was sufficient in most operated cases. When radiographic or intraoperative instability was present, instrumentation appeared safe despite active infection, provided meticulous debridement and pathogen-directed antibiotics were employed. Blood cultures and tissue samples should be taken timely and repeated if needed, as they both provide high diagnostic yield.

KEYWORDS

spondylodiscitis; spondylitis; epidural abscess; magnetic resonance imaging; antibiotic therapy; instrumentation; spine; intervertebral disc

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AUTHOR AFFILIATIONS
[1] Department of Neurosurgery, Charles University, Faculty of Medicine in Hradec Králové, Hradec Králové, Czech Republic
[2] Department of Neurosurgery, University Hospital Hradec Králové, Hradec Králové, Czech Republic
[3] Department of Clinical Microbiology, University Hospital Hradec Králové, Hradec Králové, Czech Republic
[4] Department of Radiology, University Hospital Hradec Králové, Hradec Králové, Czech Republic
[5] Department of Surgery, University Hospital Hradec Králové, Hradec Králové, Czech Republic
[6] Department of Surgery, Charles University, Faculty of Medicine in Hradec Králové, Hradec Králové, Czech Republic
* Corresponding author: Department of Neurosurgery, Charles University, Faculty of Medicine in Hradec Králové, Hradec Králové, Czech Republic; Department of Neurosurgery, University Hospital Hradec Králové, Hradec Králové, Czech Republic; pavel.travnicek@fnhk.cz

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INTRODUCTION

Infectious spondylodiscitis is a serious spinal infection involving the intervertebral disc and/or the adjacent vertebral bodies. It is an inherently multidisciplinary condition that engages multiple medical and surgical specialties. The incidence has been rising in recent decades, driven by population aging, a higher burden of comorbidities, and improved detection owing to broad availability of sensitive imaging modalities – particularly magnetic resonance imaging (MRI) with gadolinium-based contrast (1–3). Randomized controlled trials of antimicrobial therapy are lacking, and there is currently no national consensus guideline for diagnosis and treatment in the Czech Republic (1).

The source of infection is usually in another body system and the infection is spread via the hematogenous route. In adults, infection typically begins in the subchondral regions of the vertebral bodies with secondary spread to the intervertebral disc; in children it may more rarely start in the disc due to different vascularization (2, 3). Infection can extend into the paravertebral compartments and the epidural space with abscess formation; less commonly it involves the subdural space or the central nervous system (CNS) (meningitis, myelitis) (4). Microbiologically, Staphylococcus aureus predominates (up to ~60%), followed by Enterobacterales, streptococci; mycobacterial (e.g. *Mycobacterium tuberculosis*), fungal, and parasitic etiologies are less frequent but clinically important (3–5). In epidural abscesses, S. aureus and streptococci prevail (6). The most common location is the lumbar spine (≈58%), followed by thoracic (≈30%) and cervical (≈11%); multisegmental involvement is uncommon and more often associated with atypical pathogens (6, 7).

Risk factors for spondylitis development include diabetes mellitus, intravenous drug use, catheter-related infections, recent spinal surgery, infective endocarditis, urinary tract infection, chronic alcoholism, and conditions associated with immunosuppression (8). In complicated courses (e.g., subdural abscess), liver cirrhosis and chronic renal failure have also been reported (5). The disease shows two age peaks: a pediatric form (especially between 2–8 years) and an adult form peaking in the 5th–7th decades; males are more frequently affected (ratio ~1.5–2:1) (1, 2).

Clinical manifestations of spondylitis are nonspecific. Localized back or neck pain – often nocturnal and at rest – predominates; radicular radiation is common and may lead to misdiagnosis. Fever is absent in a substantial proportion of patients, it is found in only half of the cases (9–15). Neurological deficit is present in approximately one third of cases and more commonly accompanies delayed diagnosis, epidural abscess, cervical involvement, or tuberculous etiology; the spectrum ranges from sensorimotor deficits and radiculopathy to paraplegia or conus/cauda syndromes with sphincter dysfunction (3, 5).

Diagnosis relies on contrast-enhanced MRI and laboratory testing including repeated blood cultures and inflammatory markers. Early, high-quality microbiological sampling with culture and PCR diagnosis is crucial for targeted therapy; prematurely initiated empirical antibiotic therapy markedly reduces culture yield and increases the risk of relapse (3, 7). In uncomplicated cases, the standard approach is conservative management with immobilization and at least six weeks of antimicrobial therapy; percutaneous abscess drainage may be appropriate for early collections (1). Surgical treatment is indicated in case of instability, progressive or impending neurological deficit, failure of conservative therapy, extensive epidural/paravertebral abscess, or diagnostic uncertainty. The goals are eradication of the infectious focus, decompression of neural elements, and restoration of spinal stability (1–4).

The role of surgery, alongside antibiotics, is to obtain source control (decompression and debridement), eradicate devitalized tissue, drain abscess collections, protect neural elements, and restore spinal stability when instability is present. However, consensus varies regarding indications, timing, and the safety of instrumentation in the setting of active infection. This single-center retrospective study summarizes our surgical strategies, microbiological yield, and short-term outcomes over a 10-year period, with attention to relapse and reoperation for progressive instability.

The aim of this single-centre retrospective study is to describe the indication criteria, the range of surgical procedures, and early outcomes – including complications – in spondylodiscitis management at the authors' institution.

MATERIALS AND METHODS

STUDY DESIGN AND SETTING

Single-center retrospective observational study at a tertiary neurosurgical department (2015–2024). Consecutive hospitalized adults with pyogenic spondylodiscitis were screened.

INCLUSION/EXCLUSION CRITERIA

Included: MRI-confirmed pyogenic spondylodiscitis requiring surgery at our center during the index admission. Excluded: non-pyogenic etiologies (e.g., tuberculosis, fungal), purely conservative cases that never underwent a surgical procedure during the index episode, and pediatric-specific entities. (We report conservative cases descriptively where relevant.)

DIAGNOSTIC WORK-UP AND IMAGING

Diagnosis was based on clinical presentation and contrast-enhanced MRI of the affected segment; plain radiography was added as needed. Single-centre retrospective observational study conducted at the authors' institution in 2015–2024. Consecutive hospitalized patients with spondylodiscitis who were indicated for conservative or surgical management at our centre were included. The diagnosis was based on the clinical manifestation (localized back/neck pain, fever, neurological deficit, signs of sepsis) and contrast-enhanced MRI of the affected spinal segment (16); plain radiography was added as needed. Data were systematically extracted from the medical record. The following were recorded:

- demographics, comorbidities, and body-mass index (BMI) (with emphasis on diabetes mellitus and long-term corticosteroid therapy);
- clinical presentation at admission (pain, fever, neurological deficit, sepsis) and the Medical Research Council (MRC) muscle strength score (0–5);
- inflammatory and organ-function laboratory indices (complete blood count, C-reactive protein (CRP); as indicated, urea, creatinine, estimated glomerular filtration rate);
- microbiology (see below); imaging findings (contrast-enhanced MRI; plain radiography);
- treatment strategy (conservative vs. surgical), timing, and surgical approach/procedure type;
- hospitalization metrics and discharge status (pain at discharge categorized as none/improved/unchanged/worsened) and the need for reoperation.

  MRI was obtained in all potentially operable patients.

MICROBIOLOGY

Blood cultures were drawn at admission whenever feasible prior to antibiotics. Tissue sampling from the spinal focus was performed in all patients (intraoperatively in operated cases; CT-guided biopsy otherwise). Culture was the in non-operated /deferred cases. The primary modality, in culture-negative cases with concomitantly negative blood cultures, PCR was added. Organism proportions are reported on the subset with confirmed etiology (n = 121/126, 96.0%) and explicitly labeled as such throughout. The presence of an epidural abscess was recorded. Conservative therapy comprised immobilization with an orthosis and targeted antibiotic therapy based on blood cultures or CT-guided biopsy results; empiric antibiotics were initiated only in case of sepsis, according to local recommendations.

SURGICAL STRATEGIES

Procedures were categorized as: (i) debridement + decompression without instrumentation; (ii) instrumented decompression; (iii) instrumentation alone; (iv) staged/combined procedures. Approach (anterior/posterior/combined) and the presence of epidural abscess were recorded. Timing categories (primary/early; delayed after antibiotics; after failure of conservative therapy) are mutually exclusive and refer to the index operation.

Outcome definitions:

- Relapse (primary endpoint, added): recurrent clinical signs compatible with spondylodiscitis within 90 days of index hospitalization plus ≥1 of: (a) microbiological confirmation concordant with the index episode; (b) MRI evidence of progression/recurrence (new/enlarging abscess or destructive changes); (c) sustained inflammatory response (CRP/ESR) with renewed focal pain or neurologic worsening requiring escalation (antimicrobials and/or reoperation). Events >90 days are reported descriptively but not counted toward the primary relapse rate. Reoperation for progressive

Primary outcomes:

- Presence of a drainable (pus-containing) epidural abscess, defined by intraoperative proof/finding of suppuration or preoperative MRI features of a fluid collection with rim enhancement and diffusion restriction.
- Reoperation for relapse/residual infection.
- Development or progression of spinal instability: any unplanned surgery prompted by radiographic/clinical worsening of stability after the index procedure.
- Spinal instability: increase in segmental kyphosisof the kyphotic angle ≥10° or >50% vertebral body height loss, or clear intraoperative instability prompting fixation, as per institutional practice.
- Microbiological yield: any positive culture from blood and/or tissue and/or positive PCR result (pooled as "confirmed etiology"). The denominator for pathogen percentages is n = 121.

STATISTICAL

Secondary outcomes:

- length of hospital stay and in-hospital mortality;
- pain status at the time of discharge (none/improved/unchanged/worsened);
- diagnostic yield of microbiology (blood cultures, tissue cultures, PCR results).

A DESCRIPTIVE ANALYSIS

Descriptive analysis only: categorical variables are presented as counts/numbers/sum and percentages; continuous variables as mean (SD) or median (IQR) depending on distribution. Missing data were left as missing; denominators are explicitly stated by variable (e.g., microbiology n = 121). Analyses were done instandard deviation (SD)) and/or median (interquartile range (IQR)) according to distribution). Statistical processing was performed using

NCSS (NCSS, LLC, East Kaysville, Utah, USA; version NCSS 2025, www.ncss.com).

RESULTS

We identified 126 patients (87 men, 69%); mean age 65 years (median 67, range 13–91). Surgery was performed in 108/126 (85.7%). An epidural abscess at the index operation was present in 98/108 (90.7%). Baseline characteristics are summarized in Table 1.

Tab. 1 Baseline cohort characteristics and laboratory indices.

Variable	Value
Number of patients, n	126
Age, mean (range), years	65 (13–91)
Sex, n (%)	Men **87** (69%) Women **39** (31%)
BMI[1], mean (min–max)	**29.15** (17.60–52.20)
Clinical presentation at admission, n (%)	Isolated pain **55** (43.6%); Isolated neurological deficit **16** (12.7%); Sepsis **16** (12.7%); Combination of symptoms **39** (31%)
Fever at admission, n (%)	**22** (17.5%)
MRC[2] score at admission–distribution, n (%)	5: **60** (47.6%); 4: **18** (14.3%); 3: **22** (17.5%); 2: **11** (8.7%); 1: **5** (4%); 0: **10** (7.9%)
MRC score - summary	Mean 3.69; median 4
Comorbidities / risk factors, n (%)	Type 2 diabetes mellitus **53** (42.1%); long-term corticosteroid therapy **41** (32.5%); tobacco use **24** (19%); chronic alcohol misuse **10** (7.9%); intravenous drug use **3** (2.4%)
Length of hospital stay, mean (days)	**35.3 (median 27, range...)**

[1] BMI = body-mass index; [2] MRC = Medical Research Council muscle strength score

LOCALIZATION

Spinal involvement was categorized as cervical, thoracic, lumbar, or multilevel disease. Proportions were cervical 12.0%, thoracic 20.6%, lumbar 46.0%, and multilevel 21.4%. These categories were treated as mutually exclusive for reporting; "multilevel" denotes contiguous or noncontiguous involvement spanning more than one region and is not summed with single-region categories.

SURGICAL MANAGEMENT

Among surgically treated patients (n = 108): decompression alone in 76/108 (70.4%); decompression with instrumentation in 21/108 (19.4%); standalone instrumentation in 4/108 (3.7%); multistage combined procedures in 7/108 (6.5%).

Early surgical intervention and a single-stage strategy predominated. Debridement with decompression without instrumentation was the most common procedure; instrumented procedures represented a minority. The cohort consisted predominantly of older patients (mean age 65 years) with a substantial comorbidity burden (type 2 diabetes 42.1%, long-term corticosteroid therapy 32.5%). Clinically, back/neck pain prevailed; fever was present in only 17.5%, underscoring the nonspecific presentation. The MRC distribution indicates that 52.4% of patients had a motor deficit, reflecting marked functional impairment at the time of admission.

MRI was performed in all patients. Distribution by spinal segment: cervical 12%, thoracic 20.6%, lumbar 46%; multilevel disease 21.4%. A pre-existing extra-spinal infectious focus was identified in 68 patients, while isolated spinal involvement without another primary focus was present in 58 patients.

Admission blood cultures were obtained in 103/126 patients; 89/103 (86.4%) were positive, corresponding to 89/126 (70.6%) of the entire cohort. Material from the spinal focus was obtained in all patients (intraoperatively in those undergoing surgery, CT-guided biopsy in non-operated /deferred cases). Tissue cultures were positive in 114/126, negative in 11/126, and contaminated/indeterminate in 1/126; PCR was performed in 10 culture-negative samples. The total number of patients with any microbiological confirmation (blood and/or tissue culture and/or PCR) was 121/126 (96.0%). The most frequently identified pathogen was *Staphylococcus aureus* (69/121, 57,0%), followed by Enterobacterales (18/121, 14.9%; most commonly *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella Enteritidis*) and Streptococci (16/121, 13.2%), see Figure 1.

Primary conservative therapy (combination of antibiotics and orthosis) was applied in 18/126 patients; it was successful in 14/18. Owing to failure of conservative management, 4 of these patients subsequently underwent surgery; an additional 17 patients were referred for surgery after failure of conservative treatment at referring hospitals (total 21 were operated after failed conservative care).

Early surgery (without previous conservative treatment) was indicated in 74/126 patients: a delayed procedure after antibiotics in 17/126. The posterior approach was dominant; a pure lateral approach was not used. The high prevalence of epidural abscesses at presentation reflects the severity of cases treated at a tertiary center and explains the predominance of decompressive procedures.

MICROBIOLOGY

Confirmed etiology was established in 121/126 (96.0%), see Figure 1. The most frequent pathogen was Staphylococcus aureus 69/121 (57,0%) (MSSA/MRSA distribution to be specified if available), followed by Enterobacterales 18/121 (14.9%) and Streptococci 16/121 (13.2%). Polymicrobial growth and contaminants were recorded according to institutional microbiology standards.

EARLY OUTCOMES, RELAPSE, AND REOPERATIONS

Relapse occurred in 29/126 (23.0%) by the primary 90-day definition. Reoperation for progressive instability occurred in 17/108 (15.7%). Mean LOS was 35.3 days (me-

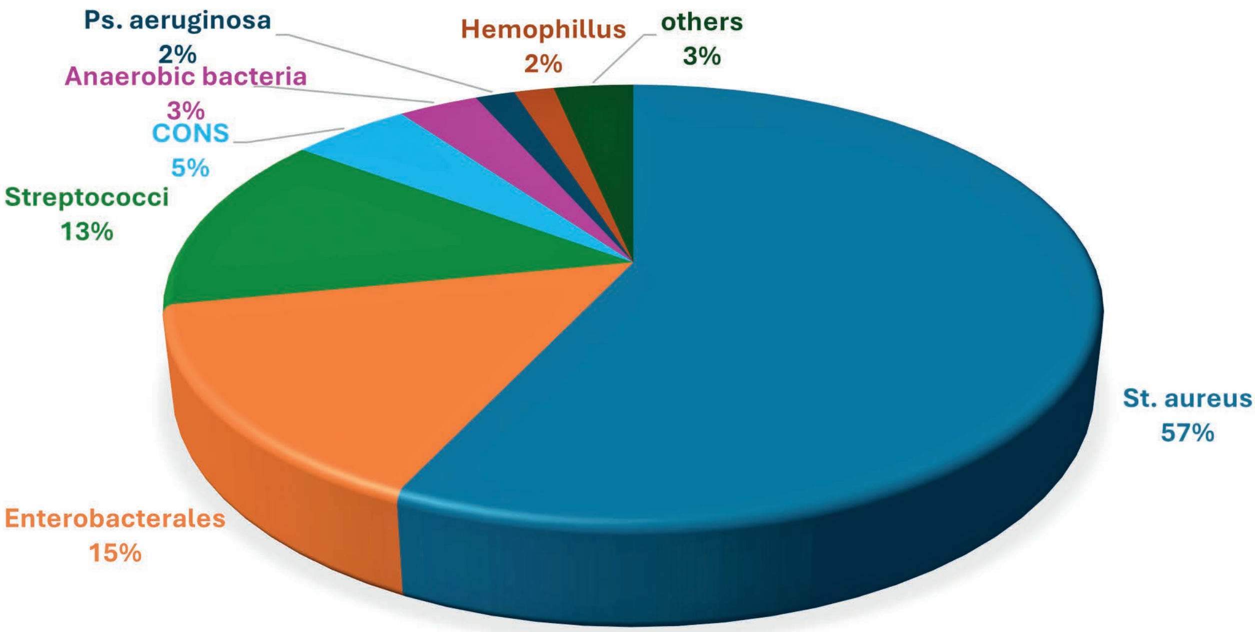

Fig. 1 Pathogen distribution among culture/PCR-confirmed cases (n = 121).
Pie chart shows counts and proportions of the etiologic groups.
CONS = Coagulase-Negative Staphylococci.

dian 27). Multiorgan failure developed in 44/126 (35.0%); in-hospital mortality was 7/126 (5.6%). No implant-related complications were observed within the recorded follow-up window.

Surgical management is summarized in Table 2.

Tab. 2 Surgical management of spondylodiscitis (N = 108).
Values are n (% of operated patients). Timing categories are mutually exclusive and refer to the index operation.

		n	%
Timing of surgery	Primary (early) procedure	74	58.7
	Delayed procedure after antibiotics	17	13.5
	After failure of conservative therapy*	17	15.7
Number of stages	Single-stage procedure	85	78.7
	Multistage procedure	23	21.3
Type of surgical procedure	Debridement + decompression without instrumentation	76	70.4
	Instrumented decompression	21	19.4
	Instrumentation alone (no decompression)	4	3.7
	Combined multistage procedures	7	6.5
Surgical approach	Posterior	90	83.3
	Anterior	12	11.1
	Combined (anterior+posterior / lateral+posterior)	6	5.6
	Lateral alone	0	0.0

* Note: Patients did not respond to conservative therapy at regional hospitals.

Early surgical intervention and a single-stage strategy prevailed. Debridement with decompression without instrumentation was the most common procedure with lesser number of instrumented procedures our tertiary centre and explains the predominance of decompressive procedures.

Targeted antibiotic therapy was guided by culture results; when the pathogen was unknown, empiric therapy was used in severe septic presentations according to local microbiological treatment standards. The duration of antibiotic treatment could not be reliably retrieved in many cases and is therefore not reported.

Treatment course and outcomes are summarized in Table 3.

During hospitalization, multiorgan failure occurred in 35% and in-hospital mortality was 5.6%. Most patients were discharged to subsequent inpatient/rehabilitation care (73.8%), with 7.9% transferred directly to a rehabilitation institute. Relapse was documented in nearly one quarter of the cohort. Pain relief at discharge was achieved in the vast majority (80.9% with no pain or improved pain), and we observed no complications related to spinal instrumentation.

DISCUSSION

In this single-centre retrospective cohort of 126 consecutive patients with pyogenic spondylodiscitis managed at a tertiary neurosurgical center, surgery was indicated in 108/126 (85.7%). Early surgical source control with decompression alone sufficed in most operated cases (76/108; 70.4%). When radiographic or intraoperative instability was present, instrumented fusion appeared safe despite active infection (32/108; 29.6%), and no implant-related mechanical failures were observed. The cohort was char-

Tab. 3 Treatment outcomes in our spondylodiscitis cohort.
Cohort N = 126; survivors at discharge n = 119.

Domain	Outcome	n	%
In-hospital course	Multiorgan failure	44	35.0
	In-hospital mortality	7	5.6
Discharge disposition (of all 126)	Home	26	20.6
	Further inpatient/rehabilitation care	93	73.8
	Died in hospital	7	5.6
– of which (subset of "Further care")	Direct transfer to a rehabilitation institute[1]	10	7.9
Relapse (of all 126)	Disease relapse after treatment	29	23.0
Pain at discharge (of survivors, n = 119)[2]	None	12	9.5
	Improved	90	71.4
	Unchanged	17	13.5
	Worsened	0	0.0
Implant-related complications[3]	Complications related to spinal instrumentation	0	0.0

[1] Subset of the "Further inpatient/rehabilitation care" group.
[2] Pain assessed among survivors only (n = 119).
[3] Assessed among instrumented cases (denominator detailed in Table 2); no implant-related complications were observed.

acterized by a high prevalence of epidural abscess (98/108; 90.7%), a relapse rate of 23.0% (29/126), substantial systemic morbidity (multiorgan failure 44/126; 35.0%), and low in-hospital mortality (7/126; 5.6%). Microbiological confirmation was achieved in 96.0% of cases, with Staphylococcus aureus as the predominant pathogen.

SURGICAL STRATEGY AND THE ROLE OF INSTRUMENTATION

The predominance of decompression-only procedures reflects a pragmatic approach prioritizing source control and neural decompression while avoiding hardware when structural stability can be preserved. This contrasts with reports from centers employing instrumentation in >90% of surgically treated cases (17), likely reflecting differences in case mix, referral patterns, and stability assessment (18, 19). The absence of implant failures in our instrumented subgroup aligns with contemporary evidence that instrumentation, when combined with meticulous debridement and appropriate antibiotics, does not inherently increase reinfection risk (20–22).

Our broad definition of relapse (including clinical, radiographic, and microbiological recurrence at any time during follow-up) may capture events that other series classify differently. Some studies distinguish between early treatment failure (within 3 months) and late recurrence, or between same-site relapse and new-level disease (23, 24). Our relapse rate (23.0%) and reoperation for progressive instability (15.7%) exceed figures in many series (~8–14%) (18, 23, 25). This likely reflects (i) a more severe case mix with an exceptionally high burden of epidural abscess (26, 27); (ii) pathogen factors, including a high proportion of S. aureus with potential MRSA contribution (28, 29); (iii) limits on debridement scope imposed by neurological or anatomical considerations (24); and (iv) nuances of antimicrobial timing, penetration, and duration. Clinically, more liberal instrumentation at the index procedure may be considered in patients with substantial vertebral body destruction, three-column involvement, or clear intraoperative instability – balanced against operative risk in fragile hosts (30, 31).

The predominance of S. aureus (~57%) lies at the middle of published ranges, consistent with its central role in hematogenous vertebral infections (28, 29). Enterobacterales and streptococci comprised relevant minorities, often with identifiable bacteremic sources (32). These patterns support empiric anti-staphylococcal coverage with agents achieving therapeutic bone/disk levels and prompt de-escalation once susceptibilities are known.

In-hospital mortality (5.6%) falls within contemporary surgical series and reflects the severity of sepsis among patients referred for neurosurgical intervention (30, 32). The 35.0% rate of multiorgan failure underscores the need for multidisciplinary care (infectious diseases, critical care, rehabilitation). Hospital length of stay was prolonged (mean 35.3 days; median 27 days), consistent with requirements for intravenous therapy, stabilization of sepsis, wound healing, and mobilization. Pathways that enable early switch to high-bioavailability oral regimens, use of outpatient parenteral antimicrobial therapy (OPAT), and structured rehabilitation may shorten hospitalization without compromising outcomes (33).

A 96.0% microbiological confirmation rate exceeds many reports and likely reflects systematic practices: obtaining blood cultures before antibiotics, collecting multiple intraoperative tissue specimens, and close laboratory coordination. Blood and tissue sampling are complementary and should both be pursued; molecular diagnostics (e.g., 16S rRNA PCR) may aid culture-negative cases with strong clinical suspicion (34, 35).

This study has some limitations. The retrospective, single-center design with tertiary referral bias (high rates of epidural abscess and organ failure) limits generalizability. Absence of a nonoperative comparator precludes inference on relative effectiveness versus medical therapy alone. Incomplete detail on antibiotic regimens and long-term functional outcomes constrains analysis of relapse determinants. Standardized definitions for relapse and instability would facilitate cross-study comparisons (36).

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

Management should be individualized based on neurological status, biomechanical stability (imaging and intraoperative assessment), extent of osseous destruction, pathogen virulence/susceptibility, comorbidity burden, and response to initial therapy. We favor early source control, decompression when stability is preserved, and instrumentation when instability is documented. Priorities for future research include prospective, multicenter comparisons of surgical strategies and timing, validated risk models for relapse/instability, and optimization of perioperative antimicrobial pathways.

Limitations of our study are as follows: (i) retrospective design without a control group and without inferential analyses, limiting causal inference and exposing the data to selection and information bias; (ii) single-centre setting, which may limit generalizability; (iii) incomplete capture of the entire conservatively treated population across specialties, as spondylodiscitis is multidisciplinary and many patients are treated outside neurosurgery; (iv) imperfect post-discharge follow-up across multiple post-acute facilities, limiting precise ascertainment of antibiotic start/stop dates (intravenous and oral) and late complications/relapses; (v) absence of standardized cross-disciplinary protocols for follow-up imaging, potentially introducing heterogeneity in indications for re-intervention; (vi) antibiotic duration (IV and oral) was not analysed due to incomplete documentation and inter-facility variation in prescription, precluding adjustment for antimicrobial exposure in outcome comparisons.

Our findings support a pragmatic algorithm: early microbiological sampling; early decompression and debridement in case of epidural abscess or neurological deficit; and instrumentation when instability is confirmed, without an observed increase in implant-related complications in our series. Prospective multicentre studies should aim to: (i) standardize surgical indication criteria; (ii) optimize IV/PO antibiotic duration and the role of early switch to oral therapy; (iii) define follow-up MRI protocols, particularly in the post-operative and post-antibiotic periods; and (iv) validate predictors of relapse.

CONCLUSIONS

Conservative therapy remains the standard for uncomplicated spondylodiscitis, with targeted – often prolonged – antimicrobial treatment as a cornerstone. Staphylococcus aureus predominates microbiologically; early blood cultures and sampling from the spinal focus are therefore essential, with repeated sampling advisable when initial results are negative or inconclusive. Surgical indications include, in particular, diagnostic tissue sampling, neurological deficit or its progression, failure of conservative therapy, epidural abscess, and instability or extensive disease. In our cohort, early surgical source control with decompression without instrumentation sufficed in most cases; instrumentation was effective and safe when instability was demonstrated, and we observed no implant-related complications. Meticulous debridement and subsequent targeted antimicrobial therapy are crucial steps to success. CT-guided sampling proved a useful adjunct to establish etiology and guide therapy in unclear or non-surgical cases.

AUTHOR CONTRIBUTIONS

Conceptualization, P.T. and L.R.; methodology, P.T., L.R.; software, M.C.; validation, L.R.; formal analysis, L.R., T.H., T.Č.; investigation, P.T., R.K., T.H., P.R. L.R., J.T.; resources, P.T.; data curation – M.C.; writing – original draft preparation, P.T.; writing – review and editing, M.C., T.Č., L.R.; supervision, T.Č., T.H., L.R.; project administration, P.T., M.C.; funding acquisition, P.T. All authors have read and agreed to the published version of the manuscript. All authors participated in critical revision of the manuscript, contributed comments, and approved the final version.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Ethical Committee of the University Hospital Hradec Kralove, Hradec Kralove, Czech Republic (Chairperson Jiri Vortel, MD) determined that this retrospective chart review was exempt from full review, and that written informed consent was not required due to the use of de-identified data. The study adhered to the Declaration of Helsinki and applicable data-protection regulations. All data were de-identified prior to analysis; no direct patient identifiers were collected (GDPR-compliant).

CONSENT FOR PUBLICATION

Not applicable (no individual person's data are included).

DATA AVAILABILITY

The study protocol and de-identified dataset supporting the findings are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

The authors declare no competing interests.

CONFLICTS OF INTEREST

The authors certify that there are no conflicts of interest with any financial organization regarding the materials discussed in this manuscript.

REFERENCES

1. Lee KY. Comparison of pyogenic spondylitis and tuberculous spondylitis. Asian Spine J. 2014; 8(2): 216–23.
2. Lang S, Walter N, Heidemanns S. [18F] FDG PET/CT imaging is associated with lower in-hospital mortality in patients with pyogenic spondylodiscitis: a registry-based analysis of 29,362 cases. Antibiotics (Basel). 2024; 13(9): 860.
3. Baryeh K, Anazor F, Iyer S, Rajagopal TS. Spondylodiscitis in adults: diagnosis and management. Br J Hosp Med (Lond). 2022; 83(1): 1–9.
4. Grammatico L, Baron S, Rusch E, et al. Epidemiology of vertebral osteomyelitis in France: analysis of hospital-discharge data 2002–2003. Epidemiol Infect. 2008; 136(5): 653–60.
5. Stangenberg M, Mende KC, Mohme M, et al. Influence of microbiological diagnosis on the clinical course of spondylodiscitis. Infection. 2021; 49(4): 723–32.
6. Lima D, Lopes N, Rodrigues D. Diagnosis and treatment of spondylodiscitis: insights from a five-year single-center study. Cureus. 2024; 16(1): e74192.
7. Pojskić M, Carl B, Schmöckel V, Völlger B, Nimsky C, Saß B. Neurosurgical management and outcome parameters in 237 patients with spondylodiscitis. Brain Sci. 2021; 11(8): 1019.
8. Piccolo CL, Villanacci A, Di Stefano F. Spondylodiscitis and its mimickers: a pictorial review. Biomedicines. 2024; 12(1): 2566.
9. Bernard L, Dinh A, Ghout I, et al. Antibiotic treatment for 6 weeks versus 12 weeks in patients with pyogenic vertebral osteomyelitis: an open-label, non-inferiority, randomised, controlled trial. Lancet. 2015; 385(9971): 875–82.
10. Courjon J, Lemaignen A, Ghout I, Therby A, Belmatoug N, Dinh A. Pyogenic vertebral osteomyelitis of the elderly: characteristics and outcomes. PLoS One. 2017; 12(12): e0188470.
11. Kehrer M, Pedersen C, Jensen TG, Lassen AT. Increasing incidence of pyogenic spondylodiscitis: a 14-year population-based study. J Infect. 2014; 68(4): 313–20.
12. Kim UJ, Bae JY, Kim SE, Kim CJ, Kang SJ, Jang HC. Comparison of pyogenic postoperative and native vertebral osteomyelitis. Spine J. 2019; 19(5): 880–7.
13. Lemaignen A, Ghout I, Dinh A, Gras G, Fantin B, Zarrouk V. Characteristics of and risk factors for severe neurological deficit in patients with pyogenic vertebral osteomyelitis: a case-control study. Medicine (Baltimore). 2017; 96(21): e6387.
14. Park KH, Cho OH, Lee JH, Park JS, Ryu KN, Park SY. Optimal duration of antibiotic therapy in patients with hematogenous vertebral osteomyelitis at low risk and high risk of recurrence. Clin Infect Dis. 2016; 62(10): 1262–9.
15. Pola E, Autore G, Formica VM, Pambianco V, Colangelo D, Cauda R. New classification for the treatment of pyogenic spondylodiscitis: validation study on a population of 250 patients with a follow-up of 2 years. Eur Spine J. 2017; 26(Suppl 4): 479–88.
16. Singer M, Deutschman CS, Seymour CW, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). JAMA. 2016; 315(8): 801–10.
17. Lenga P, Gülec G, Bajwa AA, Issa MA, Oskouian RJ, Chapman JR. Decompression only versus fusion in octogenarians with spinal epidural abscesses: early complications, clinical and radiological outcome with 2-year follow-up. Neurosurg Rev. 2022; 45(4): 2765–74.
18. Lim JS, Kim TH. Recurrence rates and associated factors after early spinal instrumentation for pyogenic spondylodiscitis: a nationwide cohort study of 2148 patients. J Clin Med. 2022; 11(12): 3356.
19. Hasan GA, Raheem HQ, Qutub A, Salman L, Alnemari A, Alkhani A. Management of pyogenic spondylodiscitis following nonspinal surgeries: a tertiary care center experience. Int J Spine Surg. 2021; 15(3): 527–36.
20. Poutoglidou F, Metaxiotis D, Saloupis P, Pazarlis K, Igoumenou VG. Operative treatment of adult pyogenic spondylodiscitis: a retrospective study of 32 cases. Cureus. 2021; 13(5): e14820.
21. Lee JJ, Sadrameli SS, Sulhan S, De la Garza Ramos R, Yassari R. The role of instrumentation in the surgical treatment of spondylodiscitis and spinal epidural abscess: a single-center retrospective cohort study. Int J Spine Surg. 2022; 16(1): 68–76.
22. Kim JH, Lee SY, Jung JS, Jang SH, Seo JY, Chung SK. Outcome following spinal instrumentation in haemodialyzed patients with pyogenic spondylodiscitis. J Bone Joint Surg Br. 2019; 101-B(1): 11–8.
23. Taylor DG, Buchholz AL, Sure DR, Buell TJ, Nguyen JH, Chen CJ. Presentation and outcomes after medical versus surgical treatment of spontaneous infectious spondylodiscitis: a systematic review and meta-analysis. Global Spine J. 2019; 9(3): 291–308.
24. Lai PJ, Wang SF, Tsai TT, Li YD, Chiu PY. Percutaneous endoscopic interbody debridement and fusion for pyogenic lumbar spondylodiscitis: comparison with percutaneous endoscopic drainage and debridement. Neurospine. 2021; 18(4): 780–9.
25. Hopkinson N, Patel K, Rossiter N. The role of diskectomy in reducing infectious complications after surgery for lumbar spondylodiscitis. J Neurol Surg A Cent Eur Neurosurg. 2022; 83(6): 522–8.
26. Schatlo B, Shiban E. Pyogenic spinal infection. J Neurol Surg A Cent Eur Neurosurg. 2022; 83(3): 261–74.
27. Keller LJ, Alentado VJ, Tanenbaum JE, Lee BS, Steinmetz MP, Krishnaney AA. Assessment of postoperative outcomes in spinal epidural abscess following surgical decompression. Spine J. 2019; 19(5): 827–33.
28. Berreta RS, Zhang HJ, Alsoof D, Goodwin CR, Sciubba DM, De la Garza Ramos R. Beta-lactam-resistant *Staphylococcus aureus* in spinal osteomyelitis and spondylodiscitis: current landscape in antibiotic resistance, treatment, and complications. J Neurosurg Spine. 2023; 39(1): 82–92.
29. Ebot J, Freeman WD, Wharen RE, Hocker S. MRSA spinal epidural abscess as a neurosurgical and infectious disease emergency with unresolved antimicrobial solution. Case Rep Infect Dis. 2019; 2019: 7413089.
30. Pola E, Taccari F, Autore G, Giovannenze F, Pambianco V, Cauda R. Multidisciplinary management of pyogenic spondylodiscitis: epidemiological and clinical features, prognostic factors and long-term outcomes in 207 patients. Eur Spine J. 2018; 27(Suppl 2): 229–36.
31. Ammanuel S, Page PS, Greeneway GP, Brooks NP. Primary spinal infections: a retrospective review of instrumentation use and graft selection. Surg Neurol Int. 2022; 13: 446.
32. Widdrington J, Emmerson I, Cullinan M, Narayanan M, Klejnow E, Narayanan N. Pyogenic spondylodiscitis: risk factors for adverse clinical outcome. Med Sci (Basel). 2018; 6(4): 96.
33. Norris AH, Shrestha NK, Allison GM, Keller SC, Bhavan KP, Zurlo JJ. 2018 Infectious Diseases Society of America clinical practice guideline for the management of outpatient parenteral antimicrobial therapy. Clin Infect Dis. 2019; 68(1): e1–e35.
34. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America clinical practice guidelines for the diagnosis and treatment of native vertebral osteomyelitis in adults. Clin Infect Dis. 2015; 61(6): e26–e46.
35. Fuursted K, Arpi M, Lindblad BE, Pedersen LN, Christensen JJ, Andersen CO. Broad-range PCR as a supplement to culture for detection of bacterial pathogens in patients with clinically diagnosed spinal infection. Scand J Infect Dis. 2008; 40(10): 772–7.
36. McNamara AL, Dickerson EC, Gomez-Hassan DM, Cinti SK, Srinivasan A. Yield of image-guided needle biopsy for infectious discitis: a systematic review and meta-analysis. AJNR Am J Neuroradiol. 2017; 38(10): 2021–7.