

Spondylodiscitis: Understanding pathophysiology, surgical strategies, and postoperative management – A single-center study

ABSTRACT

Background: Spondylodiscitis (SD) is an inflammatory condition affecting the intervertebral discs and adjacent structures, often leading to serious complications, including epidural abscesses. This study aimed to differentiate postoperative SD from spontaneous cases caused by osteoporotic defects and associated pathologies, evaluating the frequency of SD in spinal diseases at a single center.

Materials and Methods: A retrospective observational study involving 25 patients was conducted, analyzing variations between postoperative revisions in SD patients and spontaneous SD due to concurrent pathology and osteoporotic defects. The effects of postoperative wound healing following transforaminal lumbar interbody fusion and decompressive hemilaminectomy with pedicle screws were also investigated. Ethical guidelines were strictly followed during the study, conducted from January 2023 to September 2023 at Moscow City Clinical Hospital No. 68, Demikhova V.P.

Results: Among the 25 patients with spontaneous SD, 15 females and 10 males were included, with only two undergoing surgical revision. Predominant purulent inflammatory foci were observed at specific spinal levels, and demographics revealed prevalent comorbidities such as arterial hypertension (80%) and type 2 diabetes mellitus (60%). Postoperative complications included paravertebral abscesses and wound-related issues. Structural observations indicated vertebral destruction, joint gaps, and localized spinal canal narrowing, revealing complexities in SD cases.

Conclusion: Surgical intervention remains crucial for addressing SD-related vertebral complications, while antimicrobial therapy tailored to specific pathogens is pivotal. Concurrent conditions necessitate comprehensive management, often involving cardiological interventions. Postoperatively, a combined approach of conservative therapy and calcium phosphate adjuncts is recommended, especially considering the observed low bone density, aiming to optimize patient recovery and spinal stability.

Keywords: Conservative therapy, pathophysiology, postoperative care, spinal infection, spondylodiscitis, surgical intervention

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Submitted: 22-Nov-23


Accepted: 23-Feb-24

Published: 24-May-24

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How to cite this article: Encarnación-Santos D, Valerievich KA, Scalia G, Shestov E, Pachev M, Wellington J, *et al.* Spondylodiscitis: Understanding pathophysiology, surgical strategies, and postoperative management – A single-center study. *J Craniovert Jun Spine* 2024;15:185-9.

Access this article online	
Website: www.jcvjs.com	Quick Response Code 
DOI: 10.4103/jcvjs.jcvjs_164_23	

INTRODUCTION

Spondylodicitis (SD) is characterized by inflammation at the intervertebral disc level, often associated with concurrent inflammation in nearby vertebral bodies or occasionally linked to deep tissue infections. This condition can lead to the formation of uncomplicated epidural abscesses within the spinal column.^[1] Between 1995 and 2008, the incidence of SD varied between 2.2 and 6 cases/100,000 individuals annually. In Germany, the age-standardized incidence was estimated at 30 cases per 250,000 individuals per year, based on the data from the Federal Statistics Office's official database in 2015. A 2016 study reported a prevalence of 1–2.5 cases/100,000 individuals in Russia.^[2] *Staphylococcus aureus* was identified as the most common pathogen associated with SD.^[2] The first documented case of pyogenic vertebral osteomyelitis dates back to 1879, recorded by a French physician named Lannelongue.^[3] During that era, Kulowski published several articles focusing on pyogenic vertebral diseases in 1936.^[4]

Hematogenous transmission is another possible cause of SD. However, the incidence of postoperative cases is significantly lower compared to cases resulting from hematogenous spread. For instance, lumbar spinal involvement accounts for 60% of cases, followed by thoracic (30%) and cervical levels (10%).^[5] It is worth noting that the pathogenesis of postoperative cases is often related to pathogens present during the postsoft-tissue infection phase. The typical syndrome includes fever, myalgia, weight loss, and general malaise.^[6]

This article aims to distinguish postoperative SD resulting from wound healing after procedures such as transforaminal lumbar interbody fusion (TLIF) and decompressive hemilaminectomy with pedicle screws from spontaneous SD caused by osteoporotic defects and associated pathologies, along with postoperative revisions in patients with SD. It seeks to elucidate a single-center experience regarding the frequency of SD in the pathophysiology of spinal diseases.

MATERIALS AND METHODS

A retrospective observational study was conducted involving 25 patients, comprising 10 males and 15 females, to discern the variations between postoperative revisions in patients with SD and spontaneous SD resulting from concurrent pathology and osteoporotic defects. In addition, the study aimed to investigate the effects of postoperative wound healing following the application of TLIF and decompressive hemilaminectomy with pedicle screws. Ethical guidelines outlined in the Helsinki Declaration of the World Medical Association were strictly followed, ensuring that each patient

provided informed consent before participating in the research. The study spanned from January 2023 to September 2023 and was exclusively conducted at Moscow City Clinical Hospital No. 68, Demikhova V.P.

Study participants underwent surgical marking using an image intensifier before being positioned prone, enabling exposure of the L1–L3 spinal vertebrae along the midline. A 6-cm incision was made in the skin, accompanied by concurrent subperiosteal tissue dissection, allowing access to the right spinous processes and arches of L1–L3. Upon opening the anterior epidural space, a dense fibrous capsule fused to the dura mater was observed. A creamy pus-like discharge was extracted, and samples were collected for microscopy, culture, and sensitivity analysis.

A hemilaminectomy of the T12–L1–L5–S1 vertebrae's left aspect was performed using TLIF at the lumbar level and a decompressive microdiscectomy. Antiseptic solutions were used to sanitize the epidural space, establishing a decompressed dural sac. A 5-mm silicone drain was placed paravertebrally in the epidural region. Subsequently, a counter-opening technique was employed to remove the drains, followed by suturing to close the wound shown in [Table 1, Figures 1-4].

Subjects were monitored for 3–6 months, during which fusion rates, Visual Analog Scale ratings, and Oswestry Disability Index scores were assessed.

RESULTS

Among the study cohort of 25 patients with spontaneous SD, there were 15 females and 10 males, with only two undergoing surgical revision for SD. Notably, significant purulent inflammatory foci were observed predominantly at spinal levels T12–L1, L2–L3, L4, and L5, representing 60% of SD cases ($n = 15$) [Figures 1-2]. Conversely, pathological SD was seen in the remaining 10% of cases at vertebral levels T3–10. Demographic analysis revealed that 80% of patients had Stages II–III arterial hypertension and 60% had type 2 diabetes mellitus. Evaluation for thromboembolic risk using the scale for persistent atrial flutter indicated 2 points on the HAS-BLED scale and 4 points on the CHA2DS2VASc scale. In addition, chronic renal disease was observed in Stage 3 and Stage 3a, respectively. Cardiac congestive failure was noted with New York Heart Association lists functional class II and chronic heart failure 2B, predominantly characterized by hypertensive disease and heart failure due to congestion.

Concerning additional health risks, three patients (12%) experienced cerebral infarction or ictus, necessitating a

2-year recovery period. Previous studies in 2011 reported an average adult population of 500,000 cases of spontaneous SD annually, equating to 4 cases/100,000 individuals. However, in our patient group, the age range varied from 30 to 85 years, with an average age of 50.9 years among those undergoing surgery. Notably, 90% of the data suggest that osteoporotic changes in patients contribute to the instability of the vertebral column, increasing the risk of vertebral slippage or fractures (spondylolisthesis).

Postoperative complications included a paravertebral abscess at level T10–L1 and an epidural leak at level T10–11 in four individuals (16%), along with wound site-related SD in 10% of cases [Figure 3]. Preexisting physical health conditions within the study population included one case of an ongoing anterior abdominal free wall hernia excluding incarceration and strangulation, and another case of postmyocardial ischemic cardiosclerosis in 2004, which had undergone cardiac bypass surgery in 2005.

In terms of specific structural observations, the destruction of the intervertebral disc and bone structure, particularly at the T7 vertebra, dictated the destruction of adjacent end plates at the T7–8 level. A lenticular-shaped leak, measuring 34 mm in craniocaudal dimensions and protruding 5 mm into the spinal canal cavity along the posterior contours of the T7–8 vertebral bodies, was observed, with its sagittal size reducing to 6 mm. In addition, one patient presented with a paravertebral lesion in the right pleural cavity, characterized by a modest quantity of cystic effusion (approximately 10 ml in volume), tiny calcifications, and air bubbles, constituting a 2.5% minor bilateral hydrothorax. Furthermore, seven patients (28%) exhibited a left psoas abscess. Table 1 lists the symptoms and complications.

DISCUSSION

Based on our radiological findings, 91% of the patient's clinical symptoms were consistent with spontaneous SD, while only 10% required surgical revision due to complications.

There were no significant alterations in the vertical axis, but the physiological lordosis in the lumbar region appeared straightened. The median follow-up period from admission to after surgery was 6 months, during which positive cultures were obtained in 85% of cases, and only two re-interventions were performed within an average period of 182.2 days.^[7]

The surgical procedure involved antiseptic treatment and subsequent extubating of the patient, with no other neurological deficits noted. Our results indicated the presence of SD and epiduritis at the affected vertebrae levels, potentially contributing to spinal canal stenosis. The choice of surgical approach depends on the surgeon's experience and preference. The techniques such as TLIF, posterior lumbar interbody fusion, anterior lumbar interbody fusion (ALIF), or ALIF may be utilized in managing patients with SD, as indicated in a small cohort study from a single institution.^[8]

Observations postsurgery revealed a suture region devoid of inflammatory alterations. Drainage removed approximately 10 ml of hemorrhagic discharge, followed by cleaning with a dioxidine solution. Preservation of facet joints and vertebral congruence was noted. However, distortion was observed in the sacrococcygeal junction, alongside the backward movement of the coccyx. The authors reported successful outcomes using a combination of external stabilization and antibiotic therapy, avoiding further surgical intervention, suggesting conservative treatment's efficacy in eradicating SD.^[9] Prolonged antibiotic treatment, although effective, can result in residual deformities affecting spinal biomechanics and potentially causing foraminal stenosis with segmental kyphosis.

Structural analysis revealed typical lumbosacral connections with possible joint gaps in the facet sections. Anterior fusion between the vertebrae and partial absence of the intervertebral disc between T10 and L1 bodies were noted. In addition, coracoid osteophytes and tiny wedges along the vertebral bodies' margins caused deformities in 16% of cases. Other findings included compacted articular surfaces in facet joints, multiple lesions,

Table 1: Cause of spondylodicitis by levels [Figure 4]

Patient	Age	Clinical competition	TLIF	Agents	Localization	CPR	TX	Glucose
Female	66 years	HTA type II/DM type 2, cáncer <i>De ovario</i> T3cNOM0	L4–S1	<i>Escherichia coli</i> , <i>Candida albicans</i>	Psoas bilateral abscess	6.0 mg/L	Vancomycin fl. 1g	6.5 mmol/L
Female	71	HTA II/DMII/encephalopathy thy post ictus	Th12–L1/L5–S1 HERN IA	<i>Staphylococcus</i>	Th12 - L1	7.3 mg/L 0.00–5.00	Vancomycin fl. 1 g	7.5 mmol/L
Male	63	DM II	L2–L3	<i>Staphylococcus</i>	Left psoas abscess	77.0 mg/L 0.00–5.00	Vancomycin fl. 1g	7 mmol
Female	73	-	Th12–L4	<i>Staphylococcus</i>	-	81.31 mg/L 0–5		5.3 mmol
Male	63	HTA III	Th12–L2	<i>Staphylococcus</i>	-	2.57 mg/L 0–5	Vancomycin	-
Male	54	HTA II	L3–L4	<i>Staphylococcus</i>		0.7 mg	Cefalexin/ vancomycin	-

DM - Diabetes mellitus; TLIF - Transforaminal lumbar interbody fusion; CPR - c-reactive protein; HTA - Arterial hypertension; TX - Treatment; HERN2 Epidermal growth factor receptor 2, vancomycin fl=vancomycin lyophilizate



Figure 1: Illustration of a male patient with epiduritis at the level of the concerned vertebrae L5–S1 spondylodiscitis preoperative images revealed L4/5 pyogenic spondylodiscitis with endplate destruction. A minimally invasive transpedicular lumbar interbody fusion transforaminal lumbar interbody fusion

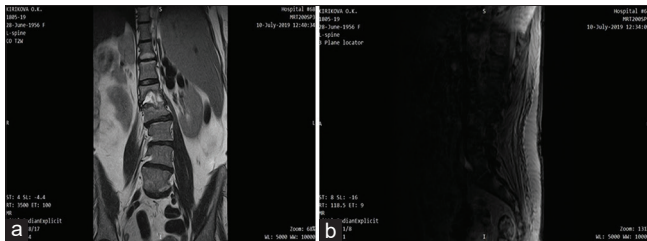


Figure 3: Illustration of A 59-year-old female patient with spontaneous spondylodiscitis (a and b) note the intraspinal abscess with compression of the spinal cord. After postoperative intensive care unit with active antibiotic therapy was discharge for beginning complete rehabilitation

partial lysis of bone tissue, and tissue thickening at the L1–L3 level in the posterior longitudinal ligament region. Moreover, localized spinal canal narrowing at the L2/3 level and disc protrusions at L4–S1 was observed [Figure 4].

Postspinal fusion evaluations indicated uncertainty regarding the exact nature of structural changes after T12–L4 spinal fusion. Notably, the L4–5 vertebral projection revealed a cage present on the left aspect of the L2 vertebral body, displaying a substantial 56% splinter fracture [Figure 3]. The dural sac was compressed sufficiently to displace bone fragments posteriorly and laterally. Heterogeneous fluid clusters were observed at the base of the artifact, reaching lengths of 7.0 cm and densities of + 7, +24, and + 40 HU. The evaluation of the spinal canal at the L2–L3 level was hindered due to the cage artifact postspinal fusion. In addition, a metal cage insertion in the left L2 vertebra indicated a left paravertebral abscess at the L5–S1 level (52%) [Figures 1 and 2].

For postoperative SD without internal fixation, surgical treatment is recommended since conservative approaches show no improvement. Subsequent debridement with fusion or instrumentation, with or without internal fixation, is suggested for spontaneous infectious SD.^[10]

CONCLUSION

Surgical intervention stands as the primary approach for

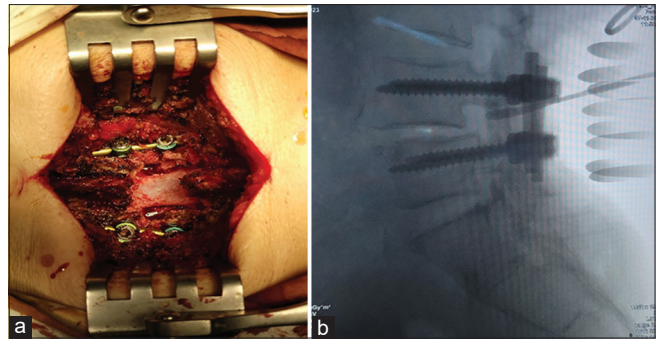


Figure 2: (a) Transforaminal lumbar interbody fusion open bilateral decompressive hemilaminectomy note the dural sac, (b) Fluoroscope note the pedicle screws at the level of the L4–L5 vertebrae

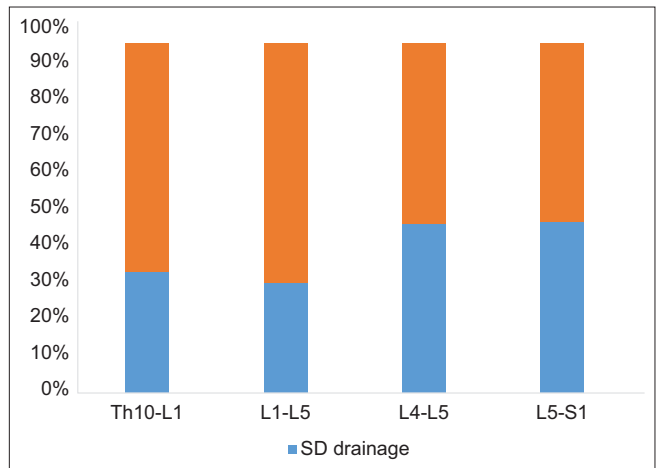


Figure 4: The most frequently rate of spondylodiscitis (SD) surgery at the vertebral levels in a simulative comparison of drainage use. SD more frequently localization. SD - Spondylodiscitis

addressing SD associated with vertebral body complications, whether resulting from bony fractures or issues related to spinal drainage. This method allows for direct rectification and stabilization of the affected vertebral structures, ensuring better resolution and potential prevention of further complications related to spinal infection.

The administration of antimicrobial chemotherapy is a crucial component in SD management, warranting a minimum 2-week treatment duration, tailored to the specific infectious agent detected. The choice of antimicrobial agents should be based on culture and sensitivity reports, ensuring targeted therapy to effectively combat the identified pathogens causing the infection.

When managing cases involving spinal abscesses, the administration of gentamicin and predominantly vancomycin for most individuals has been the preferred therapeutic approach. A 4-week duration of vancomycin treatment was commonly employed, indicating its efficacy in tackling SD-associated infections.

Patients concurrently presenting with conditions such as diabetes mellitus and hypertension require a comprehensive and staged management approach. In many instances, this involves coordination with cardiological interventions tailored to the specific stage and severity of their respective conditions, thereby optimizing overall patient care.

Postoperative care for patients necessitates a multifaceted strategy. Alongside surgical interventions, a combined regimen of conservative therapy and the adjunctive use of calcium phosphate are recommended. This approach is especially pertinent given the observed low bone density in bone densitometry scans, aiming to enhance bone stability and aid in the recovery process postsurgery.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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