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Case report
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Paraspinal Abscess Secondary to Spondylodiscitis: A Rare Presentation with Progressive Neurological Deficits and Systemic Infection

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ABSTRACT

Background: Spondylodiscitis is a rare but serious spinal infection that may result in neurological and systemic complications, especially when associated with paraspinal abscess formation. This case highlights its clinical severity and the importance of early intervention. This study aims to highlight the clinical importance and potential severity of spondylodiscitis, particularly when complicated by paraspinal abscess formation.

Case Presentation: A patient presented with progressive lower back pain, bilateral lower limb weakness, and systemic symptoms including fever and night sweats. Laboratory tests revealed hypoalbuminemia, leukocytosis, and anemia. MRI imaging identified a paraspinal abscess at the L3–L5 levels, resulting in lumbar canal stenosis and worsening neurological deficits. Emergency surgical intervention was undertaken, consisting of abscess drainage, laminectomy for neural decompression, and posterior spinal stabilization. Intraoperative findings included a substantial purulent collection, necessitating extensive debridement. Postoperatively, the patient demonstrated clinical improvement with ongoing antibiotic therapy, nutritional support, and rehabilitation.

Discussion: Spondylodiscitis with paraspinal abscess is a diagnostic challenge due to its insidious onset and non-specific presentation. Delayed recognition increases the risk of severe neurological impairment and systemic sepsis. MRI is the gold standard for early detection, while microbiological confirmation is crucial for targeted treatment. A multidisciplinary approach is essential. Surgical intervention is indicated for progressive neurological deficits, extensive abscess formation, or spinal instability, with timely antibiotic therapy playing a critical role in infection control.

Conclusion: This case illustrates the importance of early diagnosis and timely surgical management in spondylodiscitis with paraspinal abscess. Multimodal treatment improves outcomes and helps prevent long-term disability.

Keywords: Spondylodiscitis, paraspinal abscess, neurological deficit, spinal stabilization

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BACKGROUND

Spondylodiscitis is a serious infection affecting the intervertebral disc and adjacent vertebral bodies, posing significant clinical concern due to its risk of neurological impairment and systemic complica-

tions (Al-Afif et al., 2023). Although relatively rare, it accounts for approximately 2–7% of all osteomyelitis cases. Its incidence has risen in recent decades, attributed to an aging population, increased prevalence of immunosuppression, and advances in diagnostic capabilities (Howard et al., 2024).

The infection is primarily caused by hematogenous dissemination from distant infectious sources, with Staphylococcus aureus being the predominant causative pathogen. However, polymicrobial infections, gram-negative bacteria, fungi, and Mycobacterium tuberculosis should also be considered, particularly in immunocompromised individuals or endemic regions (Madhavan et al., 2019). The lumbar spine is the most frequently affected area due to its rich vascular supply, which makes it susceptible to bacterial seeding (Kamal et al., 2020).

A major complication of spondylodiscitis is the formation of a paraspinal abscess, a purulent collection within the paravertebral soft tissues, which can exert mass effect on adjacent neural structures and lead to progressive neurological deterioration (Chae et al., 2021). When the abscess extends into the spinal canal, it can cause spinal cord compression, radiculopathy, and even cauda equina syndrome, leading to significant morbidity (Nasto et al., 2021).

Additionally, uncontrolled infection can trigger a systemic inflammatory response, resulting in sepsis and multiple organ dysfunction, further complicating management and increasing mortality risk (Plancha da Silva et al., 2020).

Diagnosing spondylodiscitis with a paraspinal abscess is often challenging due to its insidious onset and nonspecific symptoms (Fan et al., 2020). The initial presentation commonly includes persistent back pain, fever, malaise, night sweats, and weight loss, which overlap with other conditions such as degenerative spine disorders, malignancies, and autoimmune diseases (da Silva et al., 2020). Laboratory findings typically demonstrate leukocytosis, anemia, and elevated inflammatory markers, while MRI with contrast enhancement remains the gold standard imaging modality for detecting vertebral infections, abscess formation, and spinal cord involvement (Crombé et al., 2024).

Despite its critical role in early diagnosis, MRI findings alone may not distinguish between infectious, inflammatory, or neoplastic etiologies, necessitating further microbiological confirmation through blood cultures or CT-guided biopsy (Bonello et al., 2020).

Management of paraspinal abscess secondary to spondylodiscitis requires a multidisciplinary approach, incorporating long-term antimicrobial therapy, supportive care, and surgical intervention when indicated (Anamaria-Alexandra et al., 2021). While conservative treatment with intravenous antibiotics remains the cornerstone for uncomplicated cases, patients with extensive abscess formation, progressive neurological deficits, or spinal instability require urgent surgical decompression, abscess drainage, and spinal stabilization to prevent irreversible damage (Mariniello et al., 2023). This case report describes a patient with a paraspinal abscess complicating lumbar spondylodiscitis, presenting with pro-gressive lower extremity weakness and systemic infection, emphasizing the challenges in diagnosis and the importance of timely intervention in preventing long-term neurological sequelae.

CASE PRESENTATION

A patient presented with progressive lower back pain over the past few weeks, accompanied by movement limitations. The

pain was described as dull, non-radiating, and rated 3–4 out of 10 on the Visual Analog Scale (VAS). Over time, the patient experienced worsening weakness in both lower extremities, initially mild but progressively deteriorating to the point where ambulation required assistance. Additionally, the patient reported persistent fever reaching 38.4°C, night sweats, and an excoriated wound in the sacral region that had failed to heal over the past few days. There was no history of preceding trauma, and the patient also reported unintentional weight loss over the past few months despite preserved appetite.

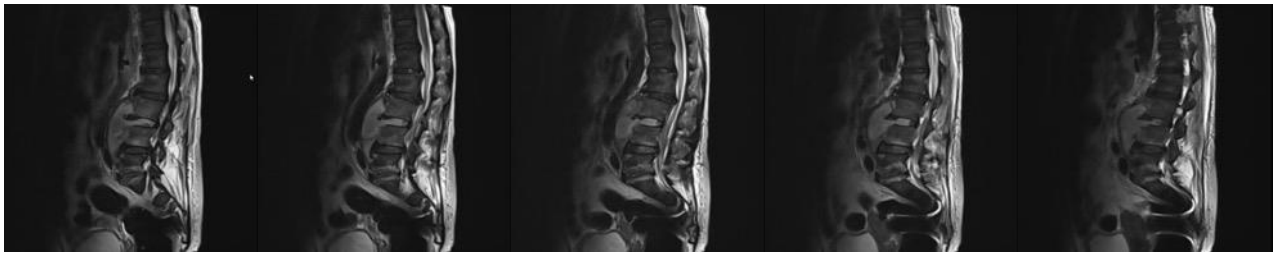

Figure 1. Lumbosacral MRI Sagittal T2W View

The patient's past medical history was unremarkable for systemic illnesses such as hypertension, diabetes mellitus, or tuberculosis. There was no prior history of chronic infections, long-term medication use, or previous surgical interventions. Family history was negative for similar neurological or infectious conditions, malignancies, or autoimmune diseases. On physical examination, the patient was alert and hemodynamically stable. Vital signs included blood pressure of 110/70 mmHg, heart rate of 88 beats per minute, respiratory rate of 20 breaths per minute, body temperature of 38.4°C, and oxygen saturation of 99% on room air. The general condition appeared fair, with no signs of acute distress. Local examination of the lumbar spine revealed no significant swelling, deformity, or ecchymosis, though an excoriated wound was noted in the sacral region. Neurological assessment demonstrated no midline tenderness or step-off deformities. Sensory examination showed no hypoesthesia or anesthesia below the L1 level.

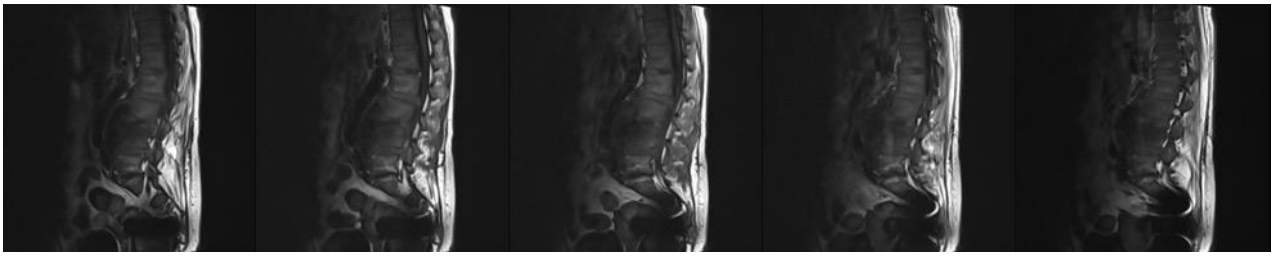

Figure 2. Lumbosacral MRI Sagittal T1W View

Motor strength in the upper extremities was preserved at 5/5 bilaterally. However, lower extremity strength was reduced, particularly on the left side, where it ranged between 3 and 4 out of 5. Deep tendon reflexes were normal, and no

pathological reflexes, such as Babinski or Hoffmann's sign, were observed. Sacral reflexes, including the bulbocavernosus and superficial anal reflexes, were absent. Provocative tests, including the Straight Leg Raise (SLR), Patrick's test, and Contra-Patrick's test, were negative, ruling out significant radiculopathy or hip joint pathology. These findings were suggestive of a combination of mechanical, infectious, and potentially inflammatory processes affecting the lumbar spine.

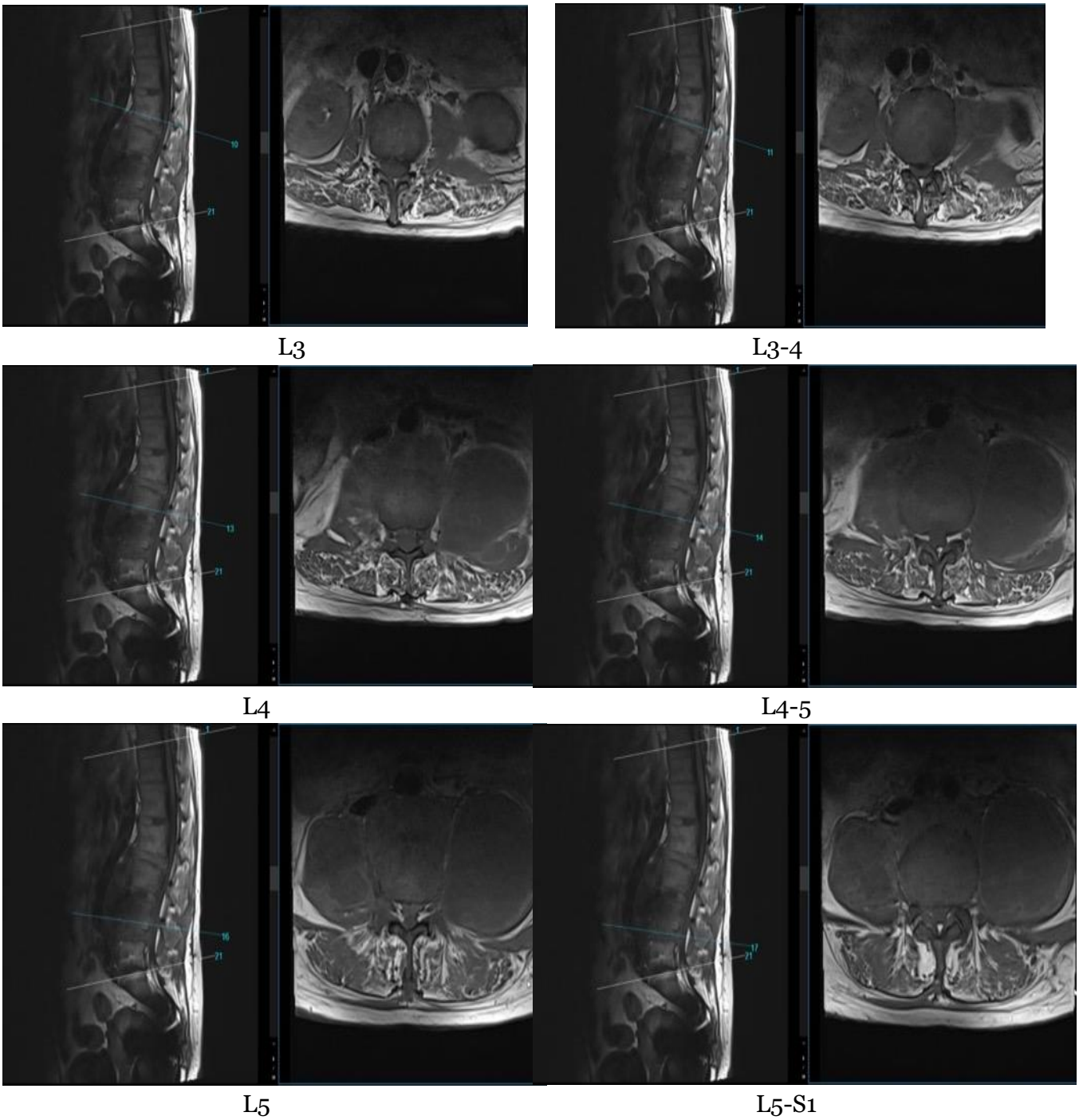

Figure. 3. Lumbosacral MRI Axial T1W View

Initial laboratory workup revealed significant leukocytosis (WBC: 25,900 /uL), indicating an active infectious or inflammatory process. Anemia was present, with a hemoglobin level of 9 g/dL and hematocrit of 27%, suggestive of anemia of chronic disease or systemic inflammation. Additionally, hypoalbuminemia (2.20 g/dL) was noted, indicating a chronic inflammatory state or malnutrition secondary to infection. Renal function assessment showed an estimated glomerular filtration rate (eGFR) of 54.47 mL/min, suggestive of mild renal impairment. Serum electrolyte analysis demonstrated hypokalemia (K:3.34 mmol/L), necessitating correction to prevent further neuromuscular complications. Liver function tests were within normal limits, with SGOT at 37 U/L and SGPT at 23 U/L. Blood glucose levels were stable at 83 mg/dL, reducing the likelihood of uncontrolled diabetes mellitus as a contributing factor. Radiological imaging, including MRI Lumbosacral was used to clinical investigation.

Based on the clinical presentation and laboratory findings, the patient was diagnosed with a paraspinal abscess at the L3-5 level, suspected to be secondary to spondylodiscitis with a pyogenic infection. The presence of fever, progressive back pain, night sweats, leukocytosis, and hypoalbuminemia strongly supports an infectious etiology, with imaging expected to further confirm the diagnosis. Additionally, the patient was found to have lumbar canal stenosis due to herniated nucleus pulposus (HNP) at L2-3 and L4-5, contributing to progressive lower limb weakness.

Given the absence of radicular pain but the presence of bilateral neurological deficits, the degree of stenosis is suspected to be severe, leading to compressive myelopathy. The patient also exhibited clinical features consistent with myofascial pain syndrome, contributing to chronic musculoskeletal discomfort.

The infectious component was further complicated by suspected community-acquired pneumonia (CAP), classified as PSI Class IV, with a risk of multidrug-resistant (MDR) infection, and sepsis, as indicated by a qSOFA score of 2. Fever, leukocytosis, and systemic inflammatory markers supported this diagnosis. Additionally, the patient exhibited transient hyperglycemia during hospitalization, raising concerns for stress-induced hyperglycemia versus undiagnosed Type 2 Diabetes Mellitus (T2DM), necessitating further monitoring. Renal impairment in this patient was suspected to be due to acute-on-chronic kidney disease (ACKD), likely prerenal in origin, possibly secondary to pneumonia or nephrotic syndrome. The presence of chronic venous insufficiency in the left lower extremity, supported by a history of edema and vascular dysfunction, was also noted.

A multidisciplinary treatment was initiated to address the patient's complex clinical presentation. Blood transfusion with packed red blood cells (PRC) was planned to correct anemia, with a target hemoglobin level of >10 g/dL. Given the neurological deficits and evidence of spinal compression, surgical decompression, spinal stabilization, and fusion were recommended. If feasible, microbiological cultures and biopsy would be performed to identify the infectious pathogen and guide targeted antimicrobial therapy. Empirical broad-spectrum intravenous antibiotic therapy was initiated to cover potential pyogenic pathogens, considering the high likelihood of MDR infection.

Supportive therapy, including electrolyte correction and potassium supplementation, was administered to address hypokalemia. Pain management strategies, including multimodal analgesia, were

implemented to improve mobility and overall patient comfort. Close renal function monitoring and fluid optimization were conducted to prevent further deterioration of kidney function.

RESULTS

The patient was positioned in a prone position under general anesthesia to facilitate optimal surgical access and ensure spinal stability. A midline incision was made extending from L1 to L5, followed by careful soft tissue dissection to expose the affected vertebral levels. Upon accessing the infected site, a significant paraspinal abscess was encountered, necessitating immediate debridement and drainage, which yielded approximately 1000 cc of purulent fluid from the transpedicular region. Given the suspicion of an infectious etiology, samples were collected for bacterial culture and histopathological biopsy to determine the underlying cause, includeing differentiation between pyogenic spondylodiscitis and tuberculous spondylitis.

Following adequate abscess evacuation, spinal stabilization was performed to restore structural integrity and prevent further vertebral collapse. Pedicle screw fixation was applied at multiple levels, including polyaxial screws (6.5 × 45 mm) bilaterally at L1 and L2, and long-arm screws (6.5 × 45 mm) at L4 and (6.5 × 40 mm) at L5. Two 140 mm rods were placed and secured with eight locking nuts to reinforce spinal alignment and stability. To ensure proper neural decompression, a laminectomy was performed at L2-L3, effectively alleviating pressure within the spinal canal and mitigating the risk of further neurological deficits.

Figure 4. Durante Operation

Intraoperatively, hemostasis was meticulously maintained, and the surgical site was thoroughly irrigated with copious saline lavage to reduce the risk of residual infection. A surgical drain was placed to facilitate postoperative fluid evacuation, and the incision was closed in multiple layers to optimize wound healing. The total intraoperative blood loss was approximately 1200 cc, necessitating fluid resuscitation and perioperative transfusion support to maintain hemodynamic stability. \

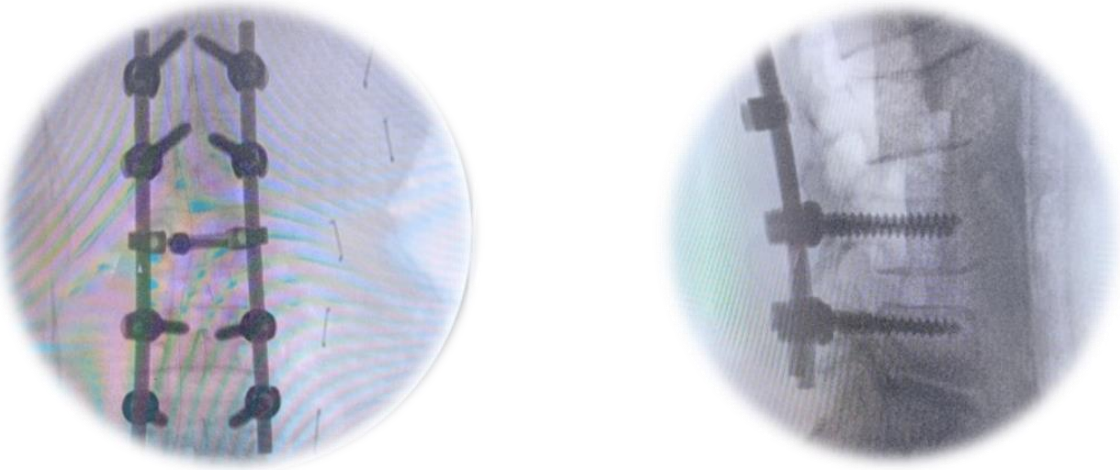

Figure 5. C-Arm Durante Operation

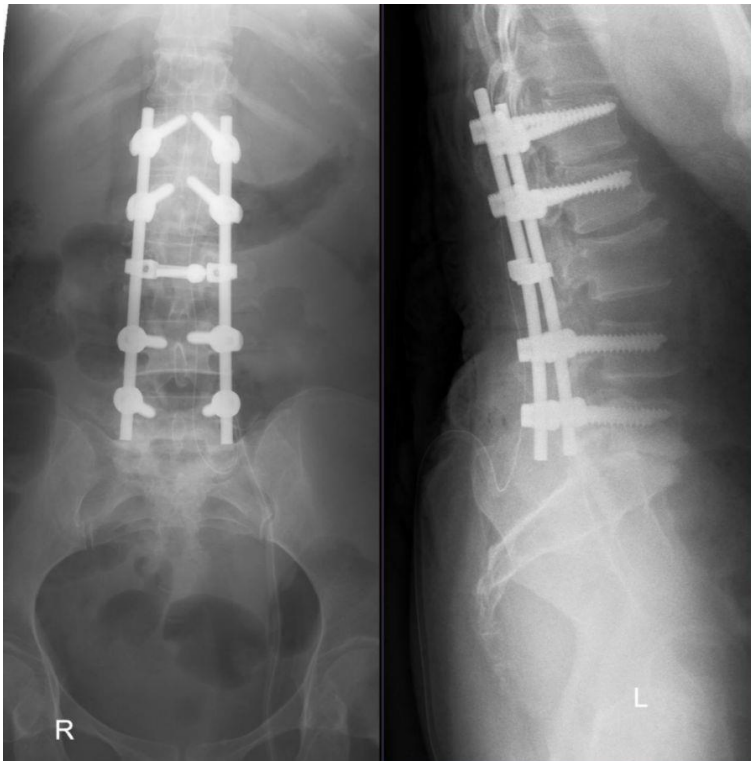

Figure 6. Lumbosacral X-Ray AP/Lateral View Post Operation

The patient tolerated the procedure well and was subsequently transferred to the intensive care unit (ICU) for close post-operative monitoring. Following surgical intervention, the patient was diagnosed with paraspinal abscess at L3-5 secondary to spondylodiscitis, suspected to be of pyogenic origin, with a differential diagnosis of tuberculous spondylitis. Additionally, lumbar canal stenosis secondary to herniated nucleus pulposus (HNP) at L2-3 and L4-5 was identified as a contributing factor to the patient's progressive neurological deficits. The patient was also found to have myofascial pain syndrome, which further exacerbated the chronic musculoskeletal pain symptoms.

The patient was placed on intensive

monitoring, including serial neurological assessments and infection surveillance. Empirical broad-spectrum intravenous antibiotics were initiated while awaiting culture results. Nutritional optimization and albumin supplementation were recommended to address persistent hypoalbuminemia. Further renal function evaluation and glycemic control assessments were planned to determine the need for long-term intervention. The patient was scheduled for ongoing multidisciplinary follow-up, including infectious disease consultation, nephrology evaluation, and physical rehabilitation to optimize post-operative recovery and prevent recurrence.

DISCUSSION

Spondylodiscitis with paraspinal abscess is a severe infectious pathology that necessitates early diagnosis and prompt intervention to prevent irreversible neurological sequelae and systemic complications (Ratiu et al., 2024). The condition arises from bacterial invasion of the intervertebral disc and adjacent vertebral endplates, leading to a progressive inflammatory cascade, vertebral destruction, and potential abscess formation within the paraspinal musculature (Marathe et al., 2022a). The anatomical structure of the vertebral venous plexus, which lacks valves, predisposes the lumbar spine to hematogenous dissemination of pathogens, making it the most frequently affected region (Marciano et al., 2023).

In this case, the patient exhibited a classic triad of spondylodiscitis, including worsening lower back pain, fever, and progressive neurological deficits (Yokota & Tali, 2023). These symptoms are often delayed in onset, contributing to diagnostic challenges and increasing the likelihood of complications such as vertebral collapse and spinal cord compression (Miksić et al., 2019). The presence of a paraspinal abscess further exacerbates the disease burden by exerting direct mechanical pressure on neural structures, thereby accelerating motor and sensory deterioration. The patient's evolving lower extremity weakness and gait impairment indicated cauda equina involvement, warranting urgent surgical decompression.

Several risk factors have been identified in the pathogenesis of spondylodiscitis, including diabetes mellitus, chronic kidney disease, immunosuppression, and recent spinal procedures (Zacharia & Valiyaparambil, 2022). In this case, anemia and hypoalbuminemia suggested a chronic inflammatory state, likely predisposing the patient to a severe infectious burden. Leukocytosis and elevated inflammatory markers reflected a systemic inflammatory response, indicating significant bacterial dissemination and a heightened risk of secondary complications such as infective endocarditis, septic embolization, and multi-organ dysfunction (Gregori et al., 2019).

The diagnostic approach to spondylodiscitis relies heavily on imaging modalities, with MRI being the gold standard due to its superior sensitivity in detecting early vertebral edema, abscess formation, and neural compression (Park et al., 2023). The MRI findings in this case revealed an extensive paraspinal abscess spanning L3 to L5, with concurrent lumbar canal stenosis and herniated nucleus pulposus at L2-3 and L4-5 (Marathe et al., 2022b). These radiological findings correlated with the patient's progressive neurological symptoms, highlighting the need for immediate intervention (Mazzella et al., 2024). Although blood cultures and percutaneous biopsies play a crucial role in identifying the causative pathogen, prior antibiotic use may yield negative cultures, necessitating empirical

broad-spectrum antimicrobial therapy until definitive microbiological results become available (Camino-Willhuber et al., 2022).

The management of spondylodiscitis with paraspinal abscess is dictated by the severity of neurological impairment and the extent of infectious involvement (Babic & Simpfendorfer, 2021). In cases without significant neurological deficits, prolonged intravenous antibiotic therapy (6–12 weeks) may suffice (Onuminya, 2021). However, the presence of progressive motor weakness, spinal instability, and abscess formation necessitates surgical intervention (Algrmi et al., 2021). The primary objectives of surgery include decompression of neural structures, drainage of purulent collections, debridement of infected tissues, and spinal stabilization to prevent further vertebral collapse. Various surgical approaches exist, with posterior decompression and stabilization being favored for multilevel involvement and significant abscess formation (Farrokhi & Mousavi, 2021).

In this case, the surgical approach was justified by the presence of neurological deterioration and radiological evidence of significant abscess formation. Intraoperatively, 1000 cc of pus was evacuated, signifying an extensive infectious burden (Gonzalez et al., 2023a). Posterior spinal stabilization was performed using pedicle screw fixation at multiple levels (L1, L2, L4, and L5) to restore mechanical stability, while laminectomy at L2-L3 facilitated neural decompression (Lashkarbolouk et al., 2023). Given the substantial intraoperative blood loss (1200 cc), appropriate resuscitative measures, including fluid replacement and transfusion support, were undertaken to optimize hemodynamic stability (Gonzalez et al., 2023b). Postoperatively, the patient faced systemic challenges, including persistent infection, hypoalbuminemia, and renal impairment, necessitating a multidisciplinary approach with targeted antibiotic therapy, nutritional optimization, and renal function monitoring (Tsantes et al., 2020).

This case underscores the necessity of early surgical intervention in severe spondylodiscitis with paraspinal abscess formation. While antibiotic therapy remains the cornerstone of management, it is often insufficient in cases with extensive abscesses or progressive neurological deficits. The concurrent presence of lumbar canal stenosis due to herniated nucleus pulposus further complicated the clinical course, making decompression essential for functional recovery. Additionally, the coexistence of systemic infections, chronic venous insufficiency, and renal dysfunction highlights the importance of a comprehensive, multidisciplinary treatment strategy. Long-term follow-up, including serial inflammatory markers, radiological surveillance, and rehabilitation, remains crucial in optimizing patient outcomes and minimizing recurrence risks.

This case highlights the complexities of diagnosing and managing spondylodiscitis complicated by a paraspinal abscess, emphasizing the need for early recognition and timely surgical intervention. A high index of suspicion is crucial for patients presenting with persistent back pain, fever, and progressive neurological deficits. Prompt surgical decompression and abscess drainage are essential to prevent permanent neurological damage. Additionally, comprehensive postoperative care including prolonged antimicrobial therapy, rehabilitation, and nutritional support plays a vital role in ensuring optimal recovery and minimizing long-term complications.

Early diagnosis and proactive intervention are critical in preventing irrever-

sible damage, as delayed treatment may lead to permanent neurological deficits and systemic complications. This case reinforces the importance of maintaining clinical vigilance for spinal infections to ensure timely management and improved patient outcomes.

AUTHORS CONTRIBUTION

All authors contributed equally to the conception, design, data acquisition, analysis, and drafting of this case report. All authors have read and approved the final manuscript.

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CONFLICT OF INTEREST

None.

REFERENCE

Al-Afif S, Atallah O, Scheinichen D, Palmaers T, Cinibulak Z, Rollnik JD, Krauss JK (2023). Surgical treatment of spondylodiscitis in critically ill septic patients. Acta Neurochir. 165(12): 3601–3612. https://doi.org/-10.1007/s00701-023-05748-7.

Algrmi SEA, Taha M, Fattah IMA, Youssef EME (2021). Management of patients with spondylodiscitis: an overview. Eur J Mol Clin Med. 8(3): 3023–3034.

Anamaria-Alexandra A, Gabriel I, Ciurea AV (2021). Postoperative lumbar spondylodiscitis. a systematic review. Romanian Neurosurgery. 35(4): 434-443. https://doi.org/10.33962/roneuro-2021-074.

Babic M, Simpfendorfer C (2021). Bacterial infections of the spine. Curr Clin Neurol. 273–292. https://doi.org/-10.1007/978-3-030-56084-3_13.

Bondy SC, Wu M (2022). Pyogenic spondylodiscitis. Immune Funct Depressed Aging Inflamm. 153. https://escholarship.org/uc/item/8kk420pv.

Bonello EC, Vassallo C, Cassar PJ (2020). Lumbosacral spondylodiscitis complicated by sepsis, osteomyelitis, epidural abscess formation and deep vein thrombosis. BMJ Case Rep CP. 13(12): e238522. https://doi.org/10.-1136/bcr-2020-238522.

Camino-Willhuber G, Beyer RS, Hatter MJ, Franklin AJ, Brown NJ, Hashmi S, Oh M, et al. (2022). Pyogenic spinal infections in patients with chronic liver disease: illustrative case and systematic review. J Neurosurg Case Lessons. 4(4). https://doi.org/10.31-71/CASE22222.

Chae H, Kim J, Kim C (2021). Clinical characteristics of spinal epidural abscess accompanied by bacteremia. J Korean Neurosurg Soc. 64(1): 88–99. https://doi.org/10.3340/jkns.2020.0278.

Crombé A, Fadli D, Clinca R, Reverchon G, Cevolani L, Girolami M, et al. (2024). Imaging of spondylodiscitis: a comprehensive updated review—multimodality imaging findings, differential diagnosis, and specific microorganisms detection. Microorganisms. 12(5): 893. https://doi.org/10.3390/-

microorganisms12050893.

da Silva TP, Silva MA, Boaventura SS, Martins MC, Duro ST, Carvalho F (2020). Spinal cord disorder due to spinal epidural abscess secondary to thoracic facet joint septic arthritis—a rare case with a surprising evolution. Spinal Cord Ser Cases. 6: 102. https://doi.org/10.1038/s41394-020-003-53-7

Fan Z, Yang Y, Li D, Fei Q (2020). A rare lumbar pyogenic spondylodiscitis caused by staphylococcus caprae with initial misdiagnosis: case report and literature review. BMC Surg. 20: 1–9. https://doi.org/10.1186/s12893-020-00860-2.

Farrokhi MR, Mousavi SR (2021). Spinal brucellosis with large circumscribed paraspinal and epidural abscess formation: a case report. Br J Neurosurg. 35(6): 714–718. https://doi.org/10.1080/02688697.2020.1789557.

Gonzalez GA, Porto G, Tecce E, Oghli YS, Miao J, O'Leary M, Chadid DP, Vo M, Harrop J (2023a). Advances in diagnosis and management of atypical spinal infections: a comprehensive review. N Am Spine Soc J. 16: 100282. https://doi.org/10.1016/j.xnsj.2023.100282.

Gonzalez GA, Porto G, Tecce E, Oghli YS, Miao J, O'Leary M, Chadid DP, Vo M, Harrop J (2023b). Advances in diagnosis and management of atypical spinal infections: a comprehensive review. N Am Spine Soc J. 16: 100282. https://doi.org/10.1016/j.xnsj.2023.100282

Gregori F, Grasso G, Iaiani G, Marotta N, Torregrossa F, Landi A (2019). Treatment algorithm for spontaneous spinal infections: a review of the literature. J Craniovert Junct Spine. 10(1): 3–9. https://doi.org/10.4103/jcvjs.JCVJS_115_18.

Howard R, Benjamin L, De Saram S, Houlihan C, Manji H (2024). Infection in the nervous system. Neurol Queen Square Textb. 369–432. https://doi.org/10.1002/9781118486160.ch9.

Kamal AM, El-Sharkawi MM, El-Sabrout M, Hassan MG (2020). Spondylodiscitis: experience of surgical management of complicated cases after failed antibiotic treatment. SICOT J. 6: 5. https://doi.org/10.1051/sicotj/2020002.

Lashkarbolouk N, Mazandarani M, Ilharreborde B, Nabian MH (2023). Understanding the management of pediatric spondylodiscitis based on existing literature; a systematic review. BMC Pediatr. 23(1): 578. https://doi.org/10.1186/s12887-023-04395-2.

Madhavan K, Chieng LO, Armstrong VL, Wang MY (2019). Spondylodiscitis in end-stage renal disease: a systematic review. J Neurosurg Spine. 30(5): 674–682. https://doi.org/10.3171/2018.9.SPINE18824.

Marathe NA, Tedesco G, Chiesa AM, Mallepally AR, Di Carlo M, Ghermandi R, Evangelisti G, et al. (2022a). Pyogenic and non-pyogenic spinal infections: diagnosis and treatment. Curr Med Imaging Rev. 18(2): 231–241. https://doi.org/10.2174/1573405617666211117143203.

Marathe NA, Tedesco G, Chiesa AM, Mallepally AR, Di Carlo M, Ghermandi R, Evangelisti G, Girolami M, Pipola V, Gasbarrini A (2022b). Pyogenic and non-pyogenic spinal infections: diagnosis and treatment. Curr Med Imaging Rev. 18(2): 231–241. https://doi.org/10.2174/1573405617666211117143203.

Marciano ND, Beyer RS, Nguyen A, Paladugu A, Hatter MH, Franklin A,

Brown NJ, et al. (2023). Primary spinal infections in patients with hematologic immunocompromising conditions: a systematic literature review. JAAOS Glob Res Rev. 7(5): e22. https://doi.org/10.5435/JAAOS-Global-D-22-00178.

Mariniello G, Corvino S, Corazzelli G, Maiuri F (2023). Cervical epidural abscess complicated by a pharyngo-esophageal perforation after anterior cervical spine surgery for subaxial spondylodiscitis. Surg Neurol Int. 14: 102. https://doi.org/10.25259/SNI_1-14_2023.

Mazzella GG, Velluto C, Caredda M, Messina F, Perna A, Meluzio MC, Proietti L (2024). Parvimonas micra-related spondylodiscitis: a case report and systematic literature review. J Neurosci Rural Pract. 15(3): 415–424. https://doi.org/10.25259/JNRP_72_2024.

Miksić NG, Kljaić Dujić M, Rejc Marko J, Voršič M, But I (2019). Bacteroides fragilis sacral spondylodiscitis and epidural abscess after sacrocolpopexy: a case report and literature review. J Int Med Res. 47(9): 4568–4574. https://doi.org/10.25259/JNRP_72_2024.

Nasto LA, Fantoni M, Cipolloni V, Piccone L, Pola E, Schiavone Panni A (2021). A detailed analysis of clinical features and outcomes of patients with pyogenic spondylodiscitis presenting without axial back pain. Trop Med Infect Dis. 6(2): 54. https://doi.org/10.3390/tropicalmed6020054.

Onuminya JE (2021). Current concepts in the management of pyogenic spondylodiscitis: a narrative review. EC Emerg Med Crit Care. 5(8): 12–21.

Park J, Han S, Jeon Y, Hong JY (2023). Spinal epidural abscess as predicting factor for the necessity of early surgical intervention in patients with pyogenic spondylitis. BMC Musculoskelet Disord. 24(1): 586. https://doi.org/10.1186/s12891-023-06703-4.

Plancha da Silva T, Amaral Silva M, Santos Boaventura S, Castro Martins M, Teixeira Duro S, Carvalho F (2020). Spinal cord disorder due to spinal epidural abscess secondary to thoracic facet joint septic arthritis—a rare case with a surprising evolution. Spinal Cord Ser Cases. 6(1): 102. https://doi.org/10.1038/s41394-020-00353-7

Ratiu IA, Moisa CF, Țiburcă L, Hagi-Islai E, Ratiu A, Bako GC, Ratiu CA, et al. (2024). Antimicrobial treatment challenges in the management of infective spondylodiscitis associated with hemodialysis: a comprehensive review of literature and case series analysis. Antibiotics (Basel). 13(3): 284. https://doi.org/10.3390/antibiotics13030284.

Tsantes AG, Papadopoulos DV, Vrioni G, Sioutis S, Sapkas G, Benzakour A, Benzakour T, Angelini A, Ruggieri P, Mavrogenis AF (2020). Spinal infections: an update. Microorganisms. 8(4): 476. https://doi.org/10.3390/microorganisms8040476.

Yokota H, Tali ET (2023). Spinal infections. Neuroimaging Clin N Am. 33(1): 167–183. https://doi.org/10.1016/j.nic.2022.07.015.