



Case Report

Mixed pyogenic and tuberculous spinal epidural abscesses perforating the dura and extending into the subdural space: A case report and review of the literature

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Received: 23 June 2023

Accepted: 21 August 2023

Published: 08 September 2023

DOI

10.25259/SNI_536_2023

Quick Response Code:



ABSTRACT

Background: Spinal infections are associated with a wide variety of clinical conditions, including osteomyelitis, spondylitis, diskitis, septic facet joints, and abscesses. Based on its anatomical relationship with the dura mater, the abscess can be epidural (extradural) or subdural (intrathecal). Subdural intramedullary abscesses of the lumbar spinal canal are more common than subdural extramedullary abscesses. Here, we present a rare case of a patient with a mixed pyogenic and tuberculous epidural abscess in the lumbar spine, which perforated the dura and extended to the subdural space.

Case Description: A 29-year-old male presented with progressively worsening back pain and lower-limb weakness over a period of 3 months, with an associated inability to walk, intermittent radicular pain primarily on the left side, intermittent incontinence, and a history of low-grade fever and night sweats. The patient had a history of intravenous (IV) drug abuse and reported practicing unprotected sexual intercourse. Furthermore, the patient had recently come into contact with a person diagnosed with tuberculosis (TB). The patient was administered empirical broad-spectrum antibiotics and underwent emergent L4–L5 laminectomy and spinal abscess decompression. IV antibiotics were selected based on culture results, and anti-TB medications were started. Postoperatively, the patient demonstrated a remarkable lower-limb power improvement and radicular pain alleviation.

Conclusion: Spinal epidural abscess perforation of the dura and extension into the subdural space is extremely rare. Distinguishing between epidural and subdural abscesses radiologically is challenging. Multiple risk factors, such as unprotected sexual contact and IV drug misuse, may be associated with the development of polymicrobial abscesses in the lumbar spine. Careful anticipation, identification, and isolation of the causative micro-organisms can ensure effective antibacterial treatment. Early diagnosis, expeditious surgical decompression, and antibiotic treatment are associated with promising outcomes.

Keywords: Epidural abscess, Pyogenic spinal infection, Spinal infection, Spinal tuberculosis, Subdural abscess

INTRODUCTION

Spinal infections are rare and are associated with several clinical manifestations, including, but not limited to, osteomyelitis, spondylitis, diskitis, septic facet joints, and abscesses. These may be caused by hematogenous seeding, dissemination from infected contagious tissue, or direct inoculation during surgery or trauma.^[15] Risk factors for spinal epidural abscess (SEA) include an immunosuppressed state (as in diabetes mellitus, alcoholism, cirrhosis, end-stage renal disease, and HIV infection), intravenous (IV) drug abuse, direct intervention with or without instrumentation (i.e., acupuncture, paraspinal or epidural injection, lumbar puncture, and central nervous system (CNS) surgery), and bacteremia. Diabetes mellitus is the most common risk factor of SEAs.^[2] However, IV drug use and epidural catheter placement are becoming increasingly important risk factors for the development of this disease.^[5,6]

Spinal canal abscess is a well-described sequela of spondylitis and spondylodiscitis^[1] and may present with a wide range of symptoms, including back pain, weakness, radicular pain, loss of sensation, and sphincter dysfunction.^[7] Systemic symptoms, such as fever, night sweats, and weight loss, can also occur.^[1] The classical triad of fever, back pain, and neurological deficits is present in only 2% of patients with tubercular spinal abscesses.^[13] Magnetic resonance imaging (MRI) is the modality of choice for diagnosis of spinal abscesses.^[12] Based on its anatomical relationship with the dura mater, an abscess can be epidural (extradural) or subdural (intrathecal).^[12] A spinal subdural abscess is a rare condition with unknown incidence.^[16] Furthermore, subdural abscesses are infrequent compared to epidural abscesses, with intramedullary abscesses being more common than intradural extramedullary abscesses of the lumbar spinal canal.^[12]

Staphylococcus aureus is the most frequent cause of spinal infections, accounting for more than 50% of cases. In contrast, *Mycobacterium tuberculosis* accounted for <25% of the cases. Almost half of skeletal tuberculosis (TB) cases occur in the spine. The thoracolumbar junction is the most affected area in the spine, followed by the lumbar and cervical spine.^[7]

Here, we present the rare case of a 29-year-old male with a mixed pyogenic and tuberculous lumbar epidural abscess that perforated the dura into the subdural space.

CASE DESCRIPTION

A 29-year-old male presented with progressive lower back pain, left lower-limb radicular pain, lower-limb weakness, and inability to walk associated with intermittent incontinence over a period of 3 months. The patient reported a history of low-grade fever and nighttime sweats. There was a history

of IV drug abuse and recent unprotected sexual intercourse. Furthermore, the patient had a recent contact with a person diagnosed with TB. Clinical examination was remarkable for moderate to severe back pain associated with lower-limb weakness (2–3/5 power): right > left, pinprick sensation was decreased on the left side from L2 to S1, joint position sensation was intact, reflexes were decreased (+1), and rectal tone was normal. White blood cell count was normal but inflammatory marker levels were elevated (erythrocyte sedimentation rate [ESR], 120). Blood culture results were negative. Preoperative computed tomography (CT) and MRI revealed sternoclavicular joint arthritis, left fourth anterior rib infection with a pathological fracture, and multilevel early disc dehydration. Moreover, at the L4/L5 level, there was a 4.5 × 1.2 × 0.8 cm intradural, extramedullary bright T2 and bright T1 signal intensity lesion with low internal T2 signals, which was compressing the filum terminale anteriorly. There was associated underlying bone scalloping. At the same level, there was a partially imaged tubular branching, abnormal bright T2/fluid signal with an epicenter at the neural foramina encircling the L4 and L5 vertebral bodies anteriorly [Figure 1].

Empirical broad-spectrum antibiotics were initiated, and the patient underwent emergency L4–L5 decompression. The infiltrated bone was weak and brittle, with some sclerotic areas. The ligamentum flavum was thickened and infected. The epidural collection was multilayered and lobulated. Nonpurulent phlegmon was noted. In other areas, there was a white-yellow purulent fluid discharge within a thin encapsulated membrane. Phlegmon/abscess in the epidural space was observed. The abscess perforated the dura and was dissecting intradurally (within the subdural space). The dura was thick and inflamed. In addition, a paraspinal muscle abscess extension noted [Figure 2].

The abscess was grossly removed. Notably, the arachnoid layer was thick, inflamed, and intact. Hemostasis was achieved after adequate decompression and sampling. The dura was sealed using gel foam, along with TachoSil and TISSEL. A drain was inserted. The fascia was closed watertight using 2.0 Vicryl. The subcutaneous layer was closed using 2.0 Vicryl while the skin was sealed with staples. The patient was shifted to the recovery unit and had no complications.

The tissue cultures were positive for *Enterobacter cloacae*, *Citrobacter koseri*, and *Staphylococcus epidermidis*. The result of the QuantiFERON-TB test was positive. The final surgical pathology revealed a well-formed necrotizing (caseating) granuloma with central necrosis surrounded by epithelioid histiocytes and lymphocytes. Acid-fast bacilli (AFB) were negative for *Mycobacterium* [Figure 3].

IV antibiotics were selected based on the culture report, and anti-TB medications were initiated. Postoperatively,

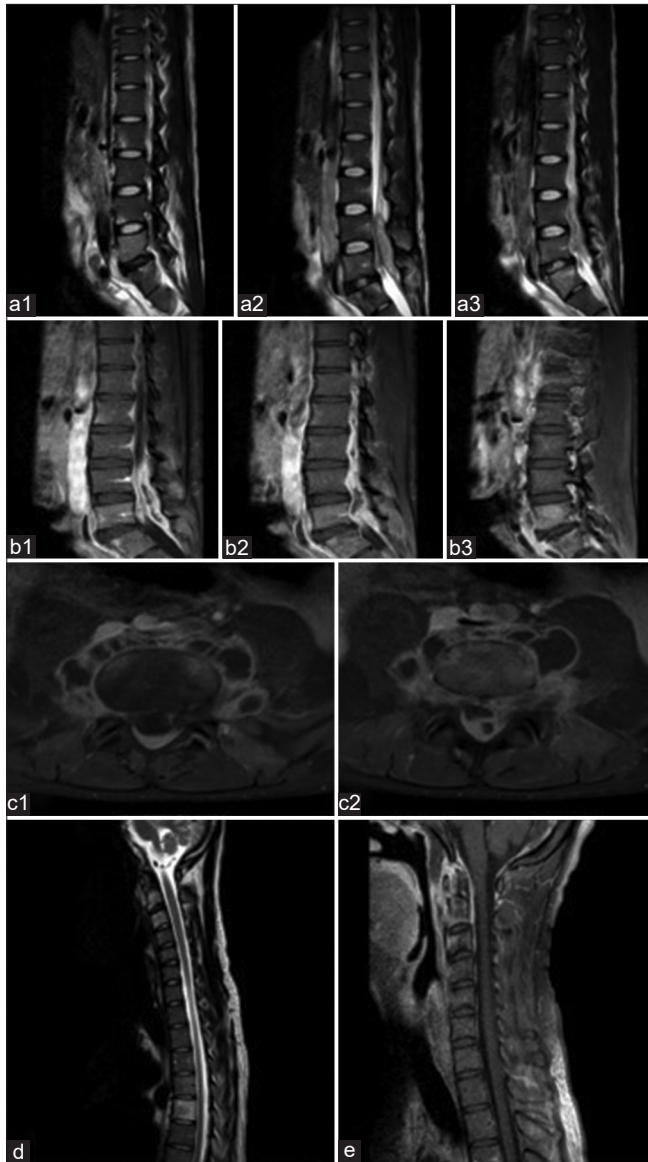


Figure 1: Radiology: Spondylodiscitis with epidural and paraspinous abscess. (a1-a3) Sagittal T2WI of the lumbar spine shows multiple abnormal marrow signals involving the vertebral body and endplates of L2, L4, L5, and S1 with disc degeneration at L5/S1. There is an associated abnormal large ventral and dorsal epidural and paraspinous components compressing the thecal sac and cauda equina nerve roots. Sagittal (b1-b3) and axial (c1 and c2) WI show abnormal post contrast enhancement of the vertebral bodies and end-plates and marginal enhancement of the large epidural and paraspinous abscesses with extension against the neural foramen. (d) Sagittal T2WI of the cervical spine shows abnormal signal intensity of the upper cervical spine C2/3 and T5 suggesting noncontiguous infection. (e) A sagittal post contrast study shows abnormal vertebral with associated mild prevertebral and ventral epidural enhancement suggesting an infective process.

the patient demonstrated a remarkable lower-limb power improvement and back/radicular pain alleviation.

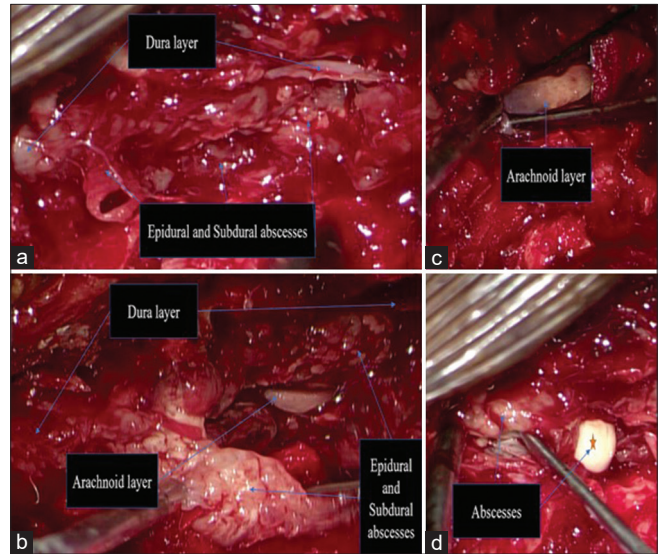


Figure 2: (a and b) Epidural and subdural multi-layered inflamed nonpurulent soft-tissue/phlegmon perforating the dura and extending into the subdural space. (b and c) A thick, inflamed, and intact arachnoid layer. (d) White-yellow liquor puris purulent fluid pus discharge contained within a thin encapsulated membrane.

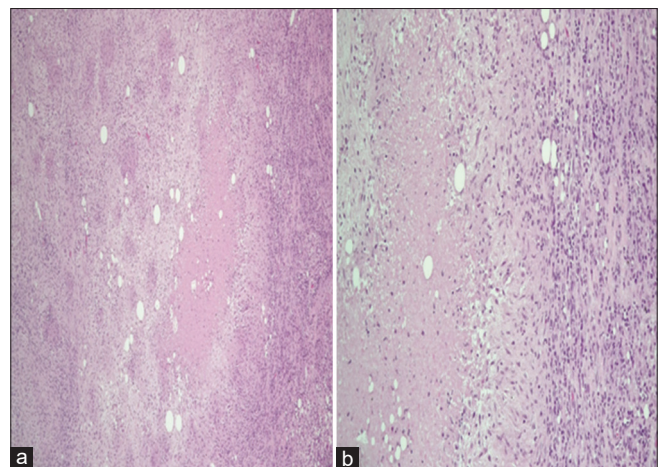


Figure 3: Pathology: low power $\times 4$ (a) and high power $\times 20$ (b), shows a well-formed necrotizing (caseating) granuloma with central necrosis, surrounded by epithelioid histiocyte and lymphocyte. Special stains (not shown here) for *Mycobacterium* [Ziehl-Neelsen stain (ZN)] and fungal infection [Grocott methenamine silver (GMS) stain] are negative (these studies are for screening purposes. Negativity for these stains does not rule out the possibility of such infection).

DISCUSSION

Intradural extension of a SEA is a rare phenomenon with unknown incidence.^[16] Radiologically, the intradural lesion appears isointense with the cord on T1-weighted images.^[10] However, the abscess of the intradural space appears hyperintense and well-demarcated in T2-weighted images, which can also be seen in epidural abscesses, making

it challenging to distinguish the two entities by imaging.^[10] In contrast, spinal tuberculoma often adheres to the dura and the cord, making it difficult to determine whether the tumor originates extramedullary or intramedullary.^[14]

Vertebral infections are frequently hematogenous. In pyogenic spinal infections, the vertebral endplate is first infected and subsequently, associated with early disc involvement and destruction. However, TB infection results from venous spread through Batson's paravertebral venous plexus. In spinal TB, the initial destruction involves the anterior inferior aspect of the vertebra. Subsequently, subligamentous spread to the adjacent vertebra by skipping the disc at the early stages of infection.^[9] Spinal TB infection is usually associated with para/intraspinal abscess, thin and smooth wall abscess, well-defined margins post contrast administration, multiple vertebral body involvement, mild to moderate disc destruction, and severe vertebral bony destruction.^[14]

Classically, spinal TB is a granulomatous inflammation resulting from the aggregation of lymphocytes in the affected tissue leading to the formation of a caseating granuloma, also known as a cold abscess. Granulomas are formed by aggregates of histiocytes or macrophages mixed with variable numbers of inflammatory cells, with or without giant cells. It can have infectious or noninfectious etiologies, the identification of which is key to treatment and prognosis. Underlying etiologies include infections, sarcoidosis, hematologic and nonhematologic malignancies, drug reactions, autoimmune diseases, and other disorders. Two common histological findings are caseating or noncaseating granulomas. Histopathological features are not reliable for differentiating between causes, and it is necessary to combine morphology with microbiological, serological, molecular, and clinical findings for accurate interpretation. Histopathologically, a caseating/necrotizing granuloma containing a central area of necrosis (caseation) surrounded by epithelioid histiocytes and lymphocytes is observed, and immunohistochemistry results are positive for cluster of differentiation (CD)68 and CD163, thereby highlighting the cluster of histiocytes. AFB is positive for mycobacterial infections while Grocott's methenamine silver is positive for fungal infections.^[4] However, in the case of a negative special stain for AFB, positive mycobacterial cultures were identified based on the colony morphology and selected biochemical reactions.^[11] Molecular methods must be used for definitive identification of most mycobacterial isolates from tissue cultures.^[11] Unlike traditional biochemical tests, including AFB special staining, molecular methods allow for rapid species identification.^[11] Several molecular technologies, including nucleic acid hybridization probes, line-probe hybridization assays, matrix-assisted laser desorption ionization time-of-flight mass spectrometry, and DNA sequencing, are currently used to identify and isolate bacteria from cultures.^[11]

This case illustrates a rare finding of an aggressive, mixed pyogenic, and tuberculous epidural abscess in the lumbar spine that perforated the dura into the subdural space. To the best of our knowledge, this phenomenon has been described in only a few cases in the literature.^[12] Rosinsky et al.^[12] reported an intrathecal pyogenic epidural abscess caused by *S. aureus* that extended intradurally through multiple perforations in the inflamed dura and affected the arachnoid layer as well.^[15] In our case, the arachnoid was intact, and we isolated four organisms: *E. cloacae*, *C. koseri*, *S. epidermidis*, and *M. tuberculosis*. The presence of more than one type of organism may be related to a history of IV drug abuse, unprotected sexual intercourse, and recent contact with a patient with TB. Polymicrobial infection is probably associated with increased cumulative acquisition of pathogenicity, which shapes the virulence potential and, hence, contributes to dura perforation.^[8] One study revealed that polymicrobial infections were associated with large areas of infection, high ESR, and increased vertebral instability compared to those associated with monomicrobial infections.^[8] Polymicrobial infections also have a higher mortality rate than monomicrobial infections. The mortality rate was 19.2% in polymicrobial infections compared to 9.4% in monomicrobial infections.^[8]

Conservative management, including bed brace, analgesics, appropriate antibiotic coverage, and spinal immobilizing brace, resulted in 90% of infection eradication and pain control.^[15] Surgical intervention is indicated in cases of failed medical management, sepsis, progressive spinal deformity, neurological compromise, or SEA.^[15] Moreover, surgical intervention has been advocated in many studies as it is associated with lower failure rates, morbidity, and mortality than medical management alone.^[3] In our case, the patient presented with progressive neurological compromise, deficits, and sphincter dysfunction, necessitating early surgical intervention.

CONCLUSION

Spinal epidural perforation of the dura and extension into the subdural space is an extremely rare phenomena. Distinguishing between epidural and subdural abscesses radiologically is challenging. Multiple risk factors, such as unprotected sexual contact and IV drug misuse, may be associated with the development of polymicrobial abscesses in the lumbar spine. Careful anticipation, identification, and isolation of the causative micro-organisms can ensure effective antibacterial treatment. Early diagnosis, expeditious surgical decompression, and antibiotic treatment are associated with promising outcomes.

Ethics

In conducting and reporting this case study, we have adhered to ethical standards, ensuring that the welfare of the patient

and their privacy has been prioritized throughout the process. All efforts have been made to ensure the anonymity and confidentiality of the patient involved in this case report and any potentially identifying information has been removed.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of artificial intelligence (AI)-assisted technology to assist in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Almotairi FS, Alsaleh AA, Basalamah AA, Mallat MM, Babateen EM, Abdu A, *et al.* Mixed pyogenic and tuberculous spinal epidural abscesses perforating the dura and extending into the subdural space: A case report and review of the literature. *Surg Neurol Int* 2023;14:315.

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