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Case Report

Concomitant epidural and subdural spinal abscess: a case report

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Abstract

BACKGROUND CONTEXT: Spinal subdural abscess (SSA) is a rare occurrence for which the management typically involves open surgical removal and washout.
PURPOSE: This case report aims to review the literature and discuss the management of patients with SSA.
STUDY DESIGN: We present a case of a 33-year-old female who presented with a spinal epidural abscess and concurrent SSA. She presented in the context of intravenous (IV) drug use, back pain, and generalized lower extremity weakness.
METHODS: The literature was reviewed with a focus on modern treatment options for SSA. Our patient was managed with IV antibiotics, and separate laminectomies and washouts for both lesions.
RESULTS: The patient recovered well with return of neurologic function and normalization of infection markers. The review of the literature resulted in a management flowchart that will help direct treatment of SSA.
CONCLUSIONS: The literature suggests that in a patient with a definitive diagnosis of SSA, limited surgical management and IV antibiotics are the mainstay of treatment in a patient with a decline in neurologic function. There may be a role for expectant management in the absence of diagnostic imaging or the neurologically stable patient.

Keywords: Intravenous drug use; MRI; Spinal epidural abscess; Spinal infection; Spinal subdural abscess; Surgical management

Introduction

Spinal infections can present as spine surgery emergencies because of the risk of sudden irreversible neurologic deficit. The most common spine infections include osteodiscitis and associated spinal epidural abscess (SEA). Spinal epidural abscess is easily recognized on magnetic resonance imaging (MRI), and the management of such infections has been discussed widely in the literature [1–4]. However, spinal subdural abscess (SSA) is a less common, but no less serious threat to neurologic function. Here we report a case of a patient who presented with a lumbar SEA and was found to have a concomitant SSA. A review of the relevant literature and discussion of treatment options is presented.

Search methods

A US National Library of Medicine–National Institutes of Health (PubMed) search was conducted. Search terms included "subdural abscess spine (al)" and "subdural infection spine (al)." These mapped to, and included, the medical subject heading terms of "subdural space," "empyema, subdural," and "infection." A total of 219 records were identified, of which the title and abstract were reviewed for relevance. After non-English-language articles were excluded, a total of 45 articles were identified, including 3 comprehensive reviews that spanned the historical nature of SSA in the pediatric and adult literature [5–7]. Because the focus of our review was to identify diagnostic and treatment options in adult patients within the modern imaging and antibiotic era, relevant clinical articles from 2005 to the present were critically reviewed. Only case reports and case series were available in the literature;

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therefore, a formal systematic review or meta-analysis was not pursued.

Case report

A 33-year-old female with a history of intravenous drug use (IVDU) and hepatitis C presented to an outside hospital with a 1-month history of low back pain. Computed tomography scan was concerning for left psoas muscle and paravertebral muscle abscess; therefore, the patient was transferred to our institution for further care. On admission, the patient had diffuse bilateral lower extremity weakness (4 of 5 motor strength) and intermittent decreased sensation in bilateral lower extremities. She denied bowel or bladder incontinence, did not have saddle anesthesia, and had intact rectal tone. Admission laboratory work revealed an Erythrocyte sedimentation rate (ESR) of 108 mm/hour (normal lab value [nl] <20), C-Reactive Protein (CRP) of 361 mg/L (nl <10), White Blood Cell (WBC) count of 15.9 K/μL (nl range: 4.5–11.0), and negative blood cultures. Magnetic resonance imaging revealed an L2–L4 epidural abscess without evidence of osteodiscitis (Fig. 1). In addition, imaging suggested a possible thoracic subdural abscess. However, thoracic spine imaging was limited by motion artifact and a definitive diagnosis of SSA was not made initially.

Because of the patient's weakness on exam and systemic markers suggesting she was at risk of medical management failure, she was taken to the operating room for a lumbar laminectomy and drainage of epidural abscess. Because of her lack of meningitic signs, subdural exploration was avoided and there was no durotomy. While the patient remained intubated and sedated, a postoperative MRI of the entire neuraxis was done to further evaluate the presence and extent of SSA. Cultures sent from the operating room grew methicillin-sensitive *Staphylococcus aureus*. The patient subsequently underwent computed tomography-guided drainage of the psoas abscess, which grew the same organism. Postoperative MRI revealed a cervicothoracolumbar subdural collection (Fig. 2). Despite response to intravenous (IV) nafcillin, the patient did not show any improvement in her neurologic exam; therefore, she was taken back to the operating room 1 week later for exploration of the subdural collection. A T7 laminectomy with partial T6 and T8 laminectomies was performed and dura was opened. Thick phlegmonous material was seen and collected for culture (Fig. 3). The area was copiously irrigated. Cultures and pathology from the subdural collection revealed necrotic debris and tissue with necropurulent inflammation, and no organisms were seen.

The patient continued to do well with treatment with IV antibiotics and was discharged with long-term antibiotic therapy. At 1-month follow-up, the patient had improved to full strength, with intact sensation, and inflammatory markers were improved with an ESR of 55 mm/hour, CRP of 10 mg/L, and WBC of 5.5 K/μL.

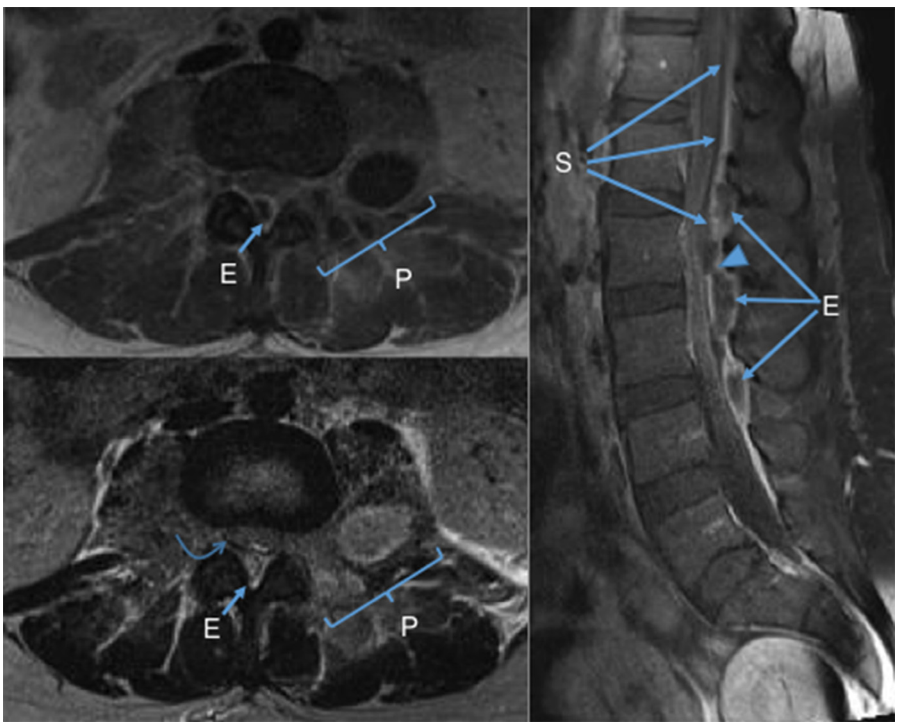

Fig. 1. Preoperative magnetic resonance imaging (MRI) of the lumbar spine. (Top left) T1-weighted contrast enhanced axial imaging demonstrates the ring-enhancing epidural abscess (E) in the lumbar spine. (Bottom left) T2 axial shows a fluid collection noted external to the dura (curved arrow). (Right) Sagittal T1 with gadolinium imaging redemonstrates the epidural abscess and also the subdural abscess (S), which was confirmed on repeat imaging. The transition between epidural and subdural collections is depicted at the L2–L3 levels (arrowhead). A paraspinal abscess (P) was also present involving the left paraspinal musculature and left psoas muscle.

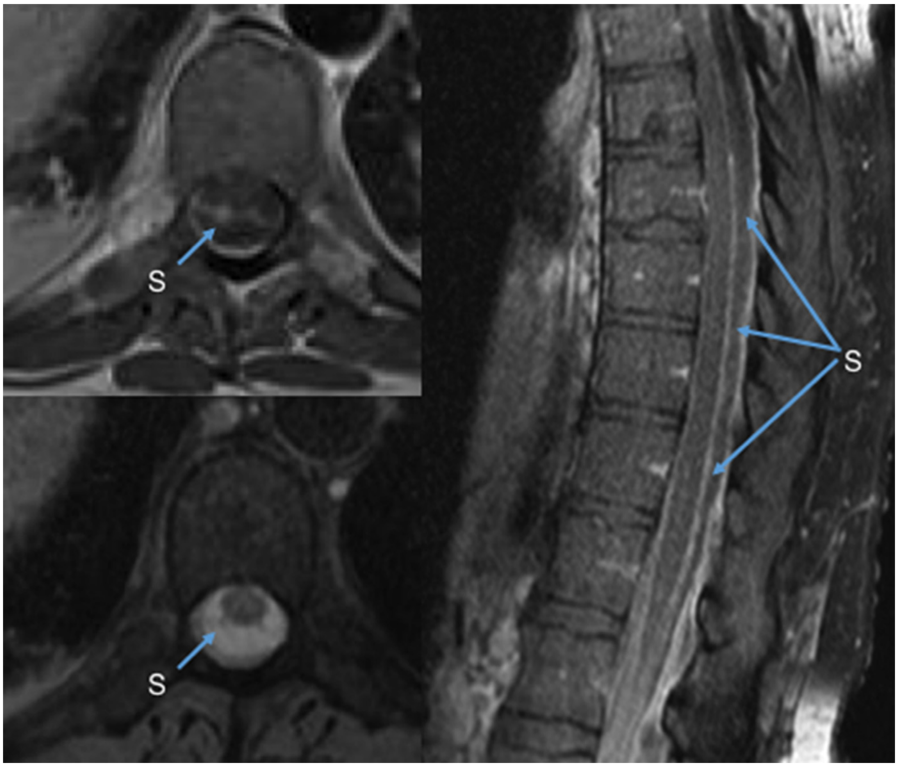

Fig. 2. Subdural abscess (S) in the thoracic spine. T1-weighted post-contrast images reveal a peripherally enhancing subdural collection that mildly displaces the cord anteriorly, seen in axial (Top left) and sagittal (Right) views. There is curvilinear enhancement along the pial surface of the cord and along the posterior nerve roots. T2 axial imaging (Bottom left) also demonstrates that the fluid collection is subdural.

Search results

A total of 15 cases (including this one) of SSA in adults have been reported in the literature since 2005 and are indexed in the Table. The organism most frequently found was *S. aureus*. However, a postpartum case had *Mycoplasma hominis* as the source [18], and cases associated with decubitus ulcers had a variety of organisms [13,17]. Although not presented in the Table, there have also been two recent cases of spinal subdural infections and granulomas associated with tuberculosis, which may represent a distinct entity [20,21]. All of these recent cases used MRI for diagnosis, with many using multiple interval MRIs [14,16,18]. Lim and colleagues [16] used 3Tesla MRI to obtain better quality imaging to help distinguish abscess from intradural extramedullary tumor before the surgical intervention. All case reports of SSA within the past 10 years are in agreement that quality MRI is necessary to identify spinal infection and localize the infection to the subdural space.

Additionally, all of the recent cases proceeded with surgical intervention, except for one case of a patient who declined treatment [17]. All 15 cases involved a limited surgical approach that consisted of laminectomies of less than three levels, drainage of purulent material, and copious irrigation during surgery. However, the timing of surgery varied among reports, and was most consistently related to the patient's

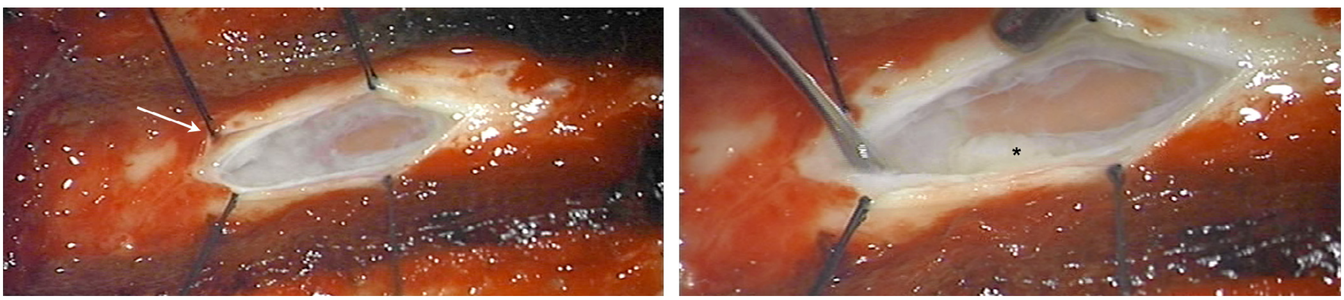

Fig. 3. (Left) Intraoperative image illustrates the small dural opening at T7. The dural edges are held up with retention sutures (arrow). White purulent material is seen, which was swabbed for culture. (Right) Closer image of the white material shows that it is thick and phlegmonous in nature (asterisk). It was adherent to both the dura and the underlying spinal cord.

Table
Summary of published cases of spinal subdural abscess since 2005

Authors	Year	Infectious source, cause	Organism	Clinical presentation	Outcome	Recommendations and conclusions
Collis and Harries [8]	2005	Spinal anesthesia	*S. aureus*	Back pain, draining superficial tract	Recovery with improved pain	Early MRI is necessary for diagnosis and treatment
Volk et al. [9]	2005	Spinal anesthesia	Unknown	Fever, back pain, dysphasia	Improved with mild concentration deficit	MRI for diagnosis; central deficits precluded conservative approach
Vural et al. [5]	2005	Suspected meningitis	Methicillin-resistant *S. aureus*	Sudden onset paraplegia after 6-d medical treatment	Improved from paraplegia to 4/5 BUE, 2/5 BLE	Early MRI for diagnosis and treatment important for good outcome
Ko et al. [10]	2007	Osteodiscitis from prior spine surgery	*S. aureus*	Back pain, papilledema	Improved papilledema	SSA can present with papilledema
Sorar et al. [11]	2008	Primary	*S. aureus*	1-mo back pain, 2/5 paraparesis	Improved from paraparesis 2/5 to 4/5	Need high index of suspicion, urgent MRI, and prompt surgical drainage
Chern et al. [12]	2009	IVDU, retropharyngeal abscess	Methicillin-resistant *S. aureus*	Acute quadriplegia and urinary retention	Stable quadriplegia	MRI necessary for diagnosis
Velissaris et al. [6]	2009	Diabetes mellitus, meningitis	*S. aureus*	Leg pain and meningismus with progression to respiratory failure and quadriplegia	Surgery 8 d after admission; death 6 wk later	MRI with contrast for diagnosis; progression of symptoms can be unpredictable so recommend urgent surgery
Nadkarni et al. [13]	2010	Diabetes mellitus, foot ulcer	*S. aureus* and *E. coli*	Quadriparesis, urinary retention	Death	Early suspicion and rapid intervention
Coumans and Walcott [14]	2011	Epidural steroid and joint injections	*S. aureus*	Back pain, developed confusion	Improved confusion	Radiographic findings can lag behind clinical symptoms, recommend interval MRI if needed for diagnosis and urgent surgery
Khalil et al. [15]	2013	Primary	*S. aureus*	Urinary retention, BLE weakness, meningismus	Improved to intact	Careful examination of MRI to localize infection; limited surgical treatment can achieve good outcome
Lim et al. [16]	2013	Possibly epidural steroid injection	*S. aureus*	Back pain, leg pain, urinary retention	Slight improvement in cauda equina symptoms	Chronic SSA can present atypically, need high-resolution MRI to diagnose
Usoltseva et al. [17]	2014	Decubitus ulcer	Coagulase negative *Staphylococcus*, Bacteroides fragilis, *Enterobacter cloacae*	Baseline paraplegia with new onset BUE paresis	Patient declined all treatments; death within 4 d	MRI is the imaging modality of choice; SSA should be treated surgically once diagnosis is established
Hos et al. [18]	2015	Spinal anesthesia and blood patch	*Mycoplasma hominis*	Persistent fever and lack of diagnostic organism	Resolution of symptoms	Interval MRI to aid in treatment plan
Kraeutler et al. [19]	2015	Epidural steroid injection	*S. aureus*	Urinary retention, BLE paraparesis	Improved symptoms	MRI with contrast for diagnosis; treatment should be immediate to prevent progression of neurologic deficits
Ngwenya et al.	2015	IVDU, psoas abscess	*S. aureus*	BLE 4/5	Improved to neuro intact	In patient with minor deficits and identified organism, can wait until definitive imaging to determine surgical intervention

MRI, magnetic resonance imaging; SSA, spinal subdural abscess; IVDU, intravenous drug use. BUE, bilateral upper extremities; BLE, bilateral lower extremities.

neurologic status at presentation. Patients who presented with significant neurologic deficit and signs of cord compression were universally imaged urgently and taken immediately to the operating room. Patients presenting with only minor symptoms were observed for a period of time (such as in our case), and were taken for surgery when there were signs of abscess progression or failure of treatment. Hos and colleagues [18] described a case of SSA in which the patient received surgery 3 weeks after presentation. The patient was neurologically intact, and the SSA had been followed for 2 weeks; however, persistent fever, progression of abscess on repeat imaging, and lack of definitive organism prompted surgical intervention. Similarly, Coumans and Walcott [14] reported a patient with back pain and positive blood cultures. Initial MRI was negative; however, repeat imaging 62 hours later demonstrated an SSA. The patient developed confusion and therefore was taken to the operating room, in which purulent material was drained, although cultures never grew any organisms [14]. The major cause of poor outcome in the reviewed cases was when MRI, and hence diagnosis, was delayed in patients presenting with neurologic deficits. Vural and colleagues [5] presented a case of a patient presenting with 2 weeks of back pain and 2 days of fever with lower extremity weakness. The patient was treated for presumed meningitis, and it was not until the patient became paraplegic that MRI and the diagnosis of SSA were obtained. The patient underwent urgent surgery; however, the patient recovered only to 2 of 5 motor strength in bilateral lower extremities. Hence, prompt diagnosis and treatment are crucial in patients with SSA and neurologic deficit.

Discussion

Spinal epidural abscess is fairly common, and over 1,000 cases have been reported in the literature. Spinal subdural abscess, however, is a rare occurrence of which only 138 cases have been reported in the literature (including this case) [5,6,8,13–16,18,19,20,22–24], 75 of which are pediatric cases [7,25,26]. The risk factors for SSA are similar to those for SEA, and include IVDU, immunosuppressed states, and diabetes [5,6]. In the pediatric population, 53% of cases of SSA were in patients who harbored a spinal dysraphism [7]. Hematogenous spread is the most common route of subdural infection; however, concurrent meningitis, superimposed infection of a subdural hematoma, and iatrogenic seeding of the subdural space are also sources of infection [5,6,16,19]. The threshold for diagnosis of SSA should, therefore, be heightened in patients presenting with back pain and these risk factors.

Before modern imaging techniques, diagnosis of SSA involved a heightened suspicion, elevated infection markers, and a positive lumbar puncture or myelographic block in a patient with paraplegia. Prognosis was poor, and delay of diagnosis and subsequent treatment led to poor neurologic outcomes, and occasionally death [22,27,28]. The clinical course of SSA can be described in three stages: (1) fever with or without pain, (2) motor deficit, sensory loss, or sphincter dysfunction, and (3) paralysis and complete sensory loss [22]. In the absence of prompt diagnosis and treatment, patients with SSA progress through these stages, sometimes rapidly and irreversibly. Therefore, prompt diagnosis of SSA is crucial, especially in patients with neurologic decline.

Magnetic resonance imaging with and without gadolinium is the modern imaging modality of choice to diagnose spinal abscess. Some authors advocate the evaluation of the entire spinal axis in the setting of suspected spinal abscess to determine the full extent [29]. The imaging appearance of spinal infections depends on the stage of the infection. Both phlegmon and abscesses may demonstrate fluid signal characteristics on pre-contrast images. Enhancement pattern following IV administration of gadolinium allows differentiation between these possibilities. Phlegmon typically demonstrates complete enhancement, whereas abscesses show only peripheral contrast enhancement given central necrotic or purulent material. These distinctions can be useful in planning operative interventions. The use of diffusion-weighted imaging (DWI) has been recently suggested as an important adjunct in the diagnosis of spinal infections. Diffusion-weighted images can demonstrate restricted diffusion in highly viscous purulent material present in spinal abscesses. However, the degree of restricted diffusion and corresponding apparent diffusion coefficient signal hypointensity can be less pronounced when compared with intracranial abscesses [30]. In addition, many artifacts that affect the evaluation of diffusion-weighted imaging in the spine need to be recognized [31]. Other imaging adjuncts, such as positron emission tomography, have proven useful for distinguishing spine infections from other entities [32]. However, there are currently no recommendations for routinely using DWI or positron emission tomography in the setting of spinal infection.

A high-quality MRI with contrast and without motion degradation or artifact can differentiate between subdural and epidural collections. Subdural abscesses typically present as an intradural extramedullary ring-enhancing fluid collection between the dura and the arachnoid. Contrast enhancing dura is typically identified between normal epidural fat and the fluid collection. Intrathecally, contrast enhancement is typically identified along the pia on subdural empyemas. Subdural collections in the spine also tend to have a more semicircular or crescent appearance, whereas epidural collections tend to be biconvex [15,33]. Epidural collections, on the other hand, may infiltrate the epidural fat or extend into the nerve root canals. This imaging distinction between SEA and SSA that is possible with MRI allows for proper patient management and surgical treatment.

Because of the historically precarious clinical course of patients with SSA, the mainstay of treatment is urgent surgical washout followed by 4 to 8 weeks of IV antibiotics. The historical surgical treatment of SSA often involved multilevel laminectomies and extensive washout of the subdural abscess. Recently, others have advocated minimal surgery with single-level laminectomy or skip laminectomies with washout and prompt IV antibiotic treatment [5,15].

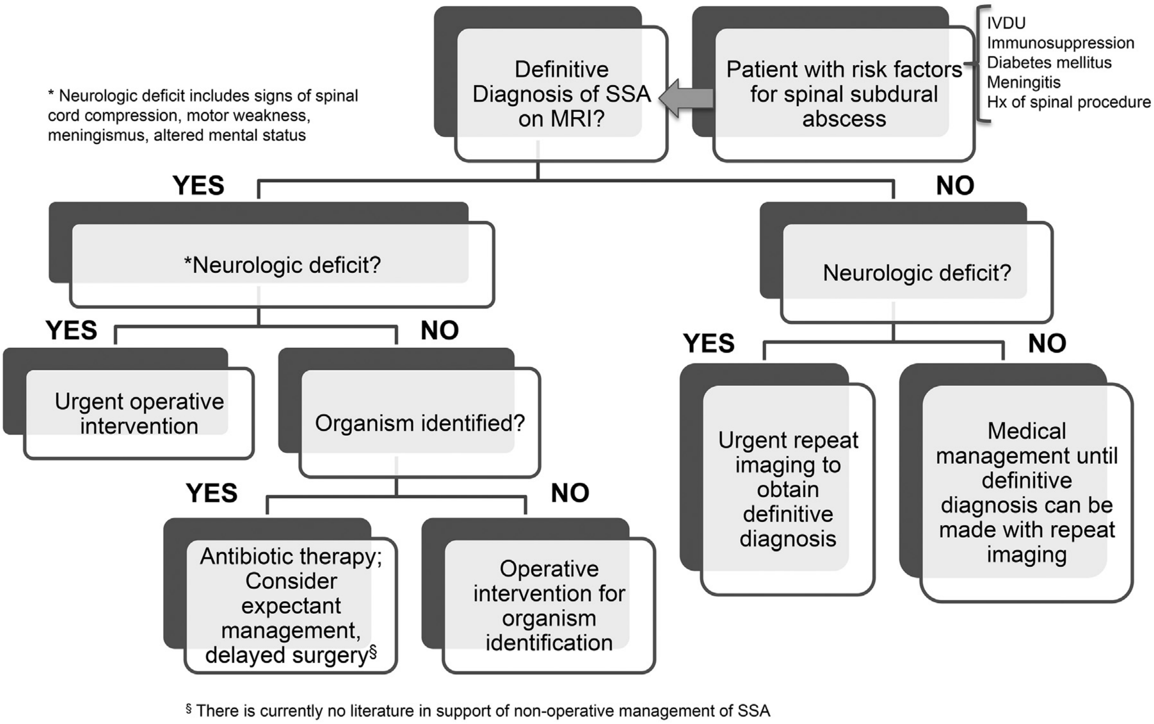

Fig. 4. Flowchart demonstrating suggested triage plan for patients with suspected spinal subdural abscess. Definitive magnetic resonance imaging (MRI) is crucial to the decision tree. Presence or lack of neurologic deficit determines the urgency of surgical intervention. There is currently no literature that advocates a non-operative approach.

In contrast to SSA, in which, to date, patients universally undergo surgery, for patients with SEA there has been much debate as to whether surgical or medical management is best. In a meta-analysis of 915 patients with SEA, 11% underwent medical management only [4]. It has been advocated that conservative management only be entertained in patients without severe neurologic deficits that have early identification of the infectious organism and can be followed closely both clinically and with repeat imaging [4,34–36]. A recent analysis of risk factors has shown that in patients managed medically, 41% failed, requiring delayed surgery, and those patients had less improvement in neurologic function compared with those who underwent immediate surgical decompression and washout [1]. Patel et al. [1] identified four risk factors as predictors of failure of medical management: diabetes mellitus, CRP >115, WBC >12.5, and positive blood cultures. Patients with one of these risk factors had a 35% risk of failure, two risk factors had 40% risk, and three or more risk factors suggested a 77% risk of failure of medical management. Based on these risk factors for failure of medical management and reviews of the literature, algorithms for the treatment of SEA have been proposed [37,38].

Our review of cases of SSA from the past 10 years suggests that MRI is necessary for diagnosis and localization. A limited surgical approach including focused laminectomy is preferred, and requires high-quality MRI for diagnosis and localization. In patients with neurologic deficit, surgery should be done in an urgent fashion. In patients with minimal symptoms, surgery can be delayed, and there may be a role for expectant management. An authoritative treatment algorithm, such as for SEA, cannot be proposed for SSA because of the paucity of available literature. However, we suggest a management flowchart for triaging the treatment of patients with suspected SSA (Fig. 4).

Our case was unique in the presentation of SEA and concomitant SSA. We ultimately chose limited surgical treatment for both lesions. The patient presented with back pain and only mild neurologic deficit (4 of 5 motor exam). However, her laboratory values revealed that she had two of four risk factors for failure of medical management of SEA. In addition, the patient did not have an isolated organism to direct antibiotic treatment. Therefore, based on recent literature and proposed algorithms for SEA, it was reasonable to take the patient to the operating room for washout of her epidural abscess. The diagnosis of SSA was made in a delayed fashion after repeat MRI imaging. Spinal subdural abscess was present in the patient's initial MRI, and the lack of durotomy during the first procedure precluded seeding during her lumbar SEA surgery as a source. The patient was being treated with appropriate IV antibiotics, continued to have a stable neurologic exam with 4 of 5 strength, and was not medically ill-appearing. However, because of the lack of significant improvement in the patient's strength, and the lack of literature advocating non-operative management, she was taken to the operating room for exploration of her SSA. Our delayed minimal laminectomy and washout were sufficient for treatment of this patient. The patient had a good outcome, and in the face of negative cultures from her surgery it questions whether an equally good outcome could have been obtained with continued observation and medical management.

Conclusions

Spinal subdural abscess is a rare entity that is associated with immunocompromised state, diabetes mellitus, IVDU, recent spinal injection or anesthesia, and spinal dysraphism. A heightened suspicion and prompt diagnosis via MRI are necessary. The literature supports urgent limited surgical management and IV antibiotic therapy. Delay of diagnosis and treatment are the main detriments to neurologic recovery. In the subset of patients who present with minimal symptoms, diagnosis via MRI followed by IV antibiotic treatment and expectant management can be considered.

Acknowledgments

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