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Surgical management of an extensive spinal epidural abscess: illustrative cases

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BACKGROUND Extensive spinal epidural abscesses (SEAs) occupying three or more spinal regions are rare. This study aimed to address the key dilemma of surgical treatment for holospinal epidural abscesses, i.e., to determine the required scope of surgery and minimize surgical trauma with adequate purulent drainage.

OBSERVATIONS Two patients with extensive SEAs were treated at the Neurosurgery Department of the Central Hospital of Ministry of Internal Affairs of Ukraine from 2018 to 2020. Both patients had a neurological deficit and general inflammatory response syndrome. Spinal magnetic resonance examinations were performed, showing that the first and second patients had extensive SEAs at T11/S1 and C2/L1, respectively. Both underwent minimally invasive abscess drainage via intra- and translaminar access at the most caudal point using an epidural silicone catheter in the cranial direction along the entire length of the abscess.

LESSONS To achieve the key goal of extensive SEA treatment, i.e., to prevent the development of a persistent neurological deficit, immediate effective spinal canal decompression should be performed. Access method and scope should meet the requirements of spinal canal decompression and purulent content aspiration to the greatest possible extent while inducing minimal trauma.

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KEYWORDS extensive spinal abscess; holospinal abscess; epidural abscess; epidural drainage

Spinal epidural abscess (SEA) is defined as the accumulation of purulent contents in the epidural space of the spinal canal, causing spinal medullary and root ischemia via compression, resulting in persistent neurological disorders and generalized inflammation.[1] The incidence of SEA is estimated at 0.2–2 per 10,000 hospitalized patients.[2] More than 1,000 clinically recorded patients with treated SEA over the past 50 years have been reported.[3] This information is sufficient to determine the etiology, pathogenesis, clinical presentation, and effective diagnostic methods. However, the standard optimal treatment techniques and methods remain to be established—in the early 1900s, SEA was a fatal disease, and by the end of the century, mortality caused by SEA was reduced to 15%–20%.[3] More than half of the patients continue to have neurological deficits after treatment.[3–5] Successful conservative antibacterial SEA treatment has already been reported; however, neurological deficits, coexisting chronic diseases, and methicillin-resistant *Staphylococcus aureus* (MRSA) infection are negative prognostic criteria that require surgical intervention.[6,7] Over the past 50 years, the incidence of epidural abscesses has doubled[2,3] because of the increased number of invasive methods for the treatment of spinal diseases, the increased number of chronic diseases in older age groups, the spread of intravenous drug use, and the development of more effective diagnostic methods (e.g., computed tomography [CT] and magnetic resonance imaging [MRI]).[2,7–9]

According to statistics, more than 70% of SEA cases arise from localized or systemic inflammatory diseases (e.g., regional abscesses and spondylodiscitis) or immunodeficiency diseases (e.g., human immunodeficiency virus), and approximately 22% occur postoperatively.[4] Approximately 70% of cases are caused by methicillin-susceptible *Staphylococcus aureus* (MSSA) and MRSA, which develop more frequently among patients with spinal or cardiovascular implants.

The following pathogens have also been found: *Staphylococcus epidermidis*, *Escherichia coli*, and *Pseudomonas aeruginosa*, among others.[4]

ABBREVIATIONS CBC = complete blood count; CT = computed tomography; ESR = erythrocyte sedimentation rate; MRI = magnetic resonance imaging; MRSA = methicillin-resistant *Staphylococcus aureus*; MSSA = methicillin-susceptible *Staphylococcus aureus*; SEA = spinal epidural abscess; VAS = visual analog scale.

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SEAs have been classified into two groups depending on their extension: local, covering up to two spinal regions, and extensive (holospinal or multiregional), covering three or more regions.[10]

The latter is rare, comprising <25 holospinal abscess cases over the past 25 years.[11] Only 1% of >900 patients with an SEA in a large meta-analysis had a holospinal abscess that covered the cervical-thoracic-lumbar region.[4] SEA may also predominantly extend along the front surface of the epidural space, pushing the medulla to the posterior ventral abscess and vice versa, and can be located behind the dural sac, i.e., the dorsal SEA. In the scientific literature, most authors prefer active surgical techniques for the treatment of extensive abscess. The methods applied include mono- and multilevel laminectomy, followed by epidural drainage installation or percutaneous drainage injection under CT control with further purulent content aspiration and lavage.[1,2,11] The key dilemma of surgical holospinal SEA treatment is to determine the required scope of surgery and minimize surgical trauma with adequate suppurative drainage.

Extensive multilevel laminectomies may be impossible for several reasons: serious or critical patient condition, risks of mechanical spinal instability, increased surgical duration, and major blood loss, among others.

In this report, we present the treatment methods used for two patients with extensive SEA indicated for surgical drainage due to the increased rate of clinical symptoms and extensive process.

We have detailed the method used, reviewed its advantages, and compared it with other methods used in similar clinical conditions.

The SEA was accessed from its most caudal point. An interlaminectomy or laminectomy was performed at the distal pole of the abscess, followed by epidural drain installation (Fig. 1).

Intraoperatively, a 3-mm-diameter perforated silicone drainage catheter was used and introduced in the cranial direction along the entire SEA length.

The cranial drainage catheter was restricted to the abscess wall or to when it reached an obstacle while attempting to advance it.

A syringe was attached to the distal end of the catheter, and the abscess contents were aspirated as the catheter progressed, with part of the abscess evacuated through aspiration for further microbiological testing.

After sanitation and irrigation using an antiseptic solution of 0.2 mg/ml decamethoxin (Yuria-Pharm, Kiev, Ukraine) and saline in a ratio of 1:2, the drainage catheter was mandatorily extracted through a counter-opening of at least 5 cm, lateral to the right or left of the cut, and stitched to the skin.

If spondylodiscitis was the cause of an extensive SEA, an extended interlaminectomy was performed in addition to the drainage at this level, and the primary focus (spondylodiscitis) was sanitized.

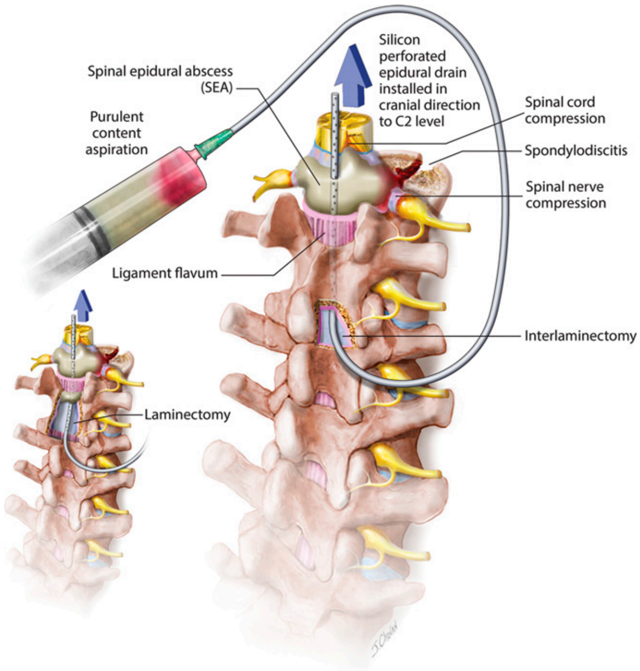

FIG. 1. Schematic view of epidural space drainage.

Illustrative Cases

Case 1

In November 2018, a 49-year-old man was hospitalized due to intense pain in the lumbar spine that radiated to both lower limbs, on the posterior lateral surface of the thighs and tibia, with a visual analog scale (VAS) score of 8,[12] progressive lower limb weakness, a temperature of up to 39°C, and general weakness. During the preceding month, the patient had experienced a low-grade fever of an unknown cause. One week prior to treatment, the patient had experienced lumbodynia with progressing intensity that limited the range of motion in the lumbar spine, radiating pain to the lower extremities, and causing weakness.

Thoracolumbalis, hypesthesia in the lower extremities at L5, bilateral dermatome, and paraparesis at L4/5 were found during the examination. The patient also had incontinence-related pelvic organ dysfunction. His blood test results were as follows: complete blood count (CBC) showed leukocytosis, 19×10^9, and an increased erythrocyte sedimentation rate (ESR), 54 mm/hr. Thoracic and lumbar spine MRI identified an SEA at T11/S1, discitis at L5/S1, and signs of retrolisthesis at L5 (Fig. 2). The caudal pole of the abscess at L5/S1 was applied. The drainage catheter was inserted into the epidural space in the cranial direction along the entire SEA length.

Active content aspiration was performed with a syringe, followed by passive drainage.

Bilateral interlaminar decompression at L4/5 and posterior spondylosyndesis using the transpedicular fixation system at L4/L5/S1 were also performed to decompress the spinal canal, fully sanitize the site, and stabilize the provoked spinal motor segment (Fig. 3A and B).

No causative pathogen was found in a blood culture test, and MSSA was identified by testing contents isolated from the epidural space. For 10 postoperative days, 1 g of ceftriaxone and 1 g of meropenem was intravenously administered twice a day. Subsequent antibacterial therapy with 400 mg of oral moxifloxacin once a day was administered for 2 months. On the second postoperative day, the pain syndrome improved (VAS score = 3) and his body temperature decreased to subfebrile. The drainage catheter was removed on day 3. On day 12, general inflammatory and focal symptoms regressed.

MRI (Fig. 3C) and follow-up examination at 6 months showed that the patient's state was satisfactory; his tendon and periosteal reflexes of the lower limbs were active and symmetrical, and he had no motor deficit or sensitivity disorder.

Case 2

The second case was that of a 58-year-old man who had complained of acute spinal pain, primarily thoracic and cervical, radiating to

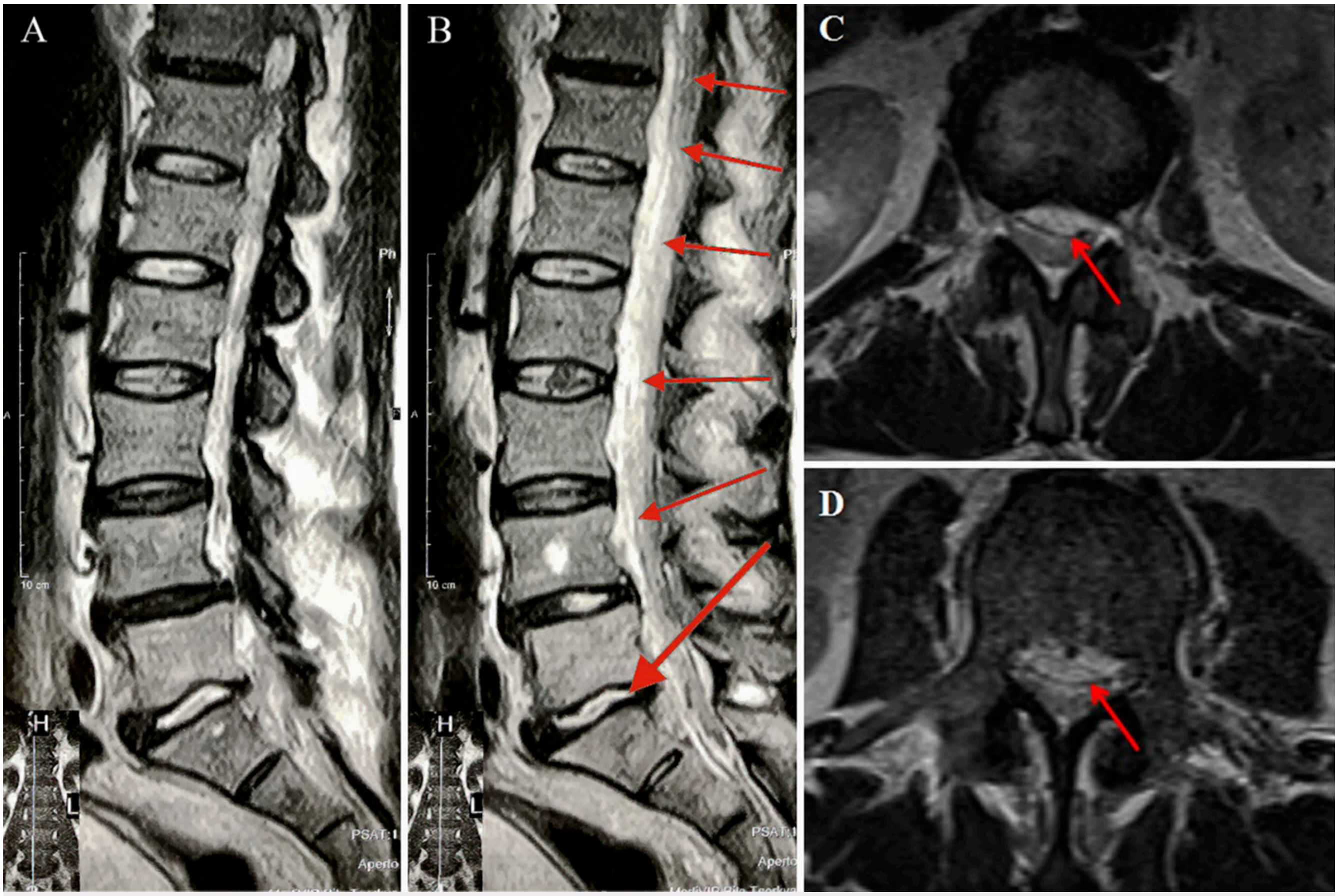

FIG. 2. Preoperative MRI in case 1. **A:** Sagittal plane, retrolisthesis at the L5 vertebra on the background of L5/S1 discitis. **B:** Sagittal plane, anterior extensive SEA (*small arrows*) at T11/S1 on the background of L5/S1 discitis (*large arrow*). **C:** Axial plane, ventral compression of SEA dural sac at T12/L1. **D:** Axial plane, ventral compression of SEA dural sac at L3 vertebra.

the upper limbs (VAS score = 6), accompanied by limb weakness and a febrile temperature (up to 38.5°C) in January 2020. Symptoms acutely developed 2 days before presentation. The examination revealed weakened tendon and periosteal reflexes of the upper and lower extremities, lower extremity strength of 3.5/5, upper extremity strength of 4/5, hypesthesia from C3, dermatome, and cervicothoracic syndrome.

His blood test results were as follows: CBC showed leukocytosis, 26×10^9, and increased ESR, 72 mm/hr.

MRI confirmed an extensive SEA at C2/L1 on the spondylodiscitis background at the L1/2 segment (Fig. 4). The patient had type 2 diabetes mellitus. An extended laminectomy of the L1 vertebra was performed for adequate access. The drainage catheter was inserted in the cranial direction up to C2 along the entire length of the abscess, which was successfully drained. MRSA was cultured from the blood and aspirate. A follow-up CT of the drainage location in the epidural space was performed (Fig. 5). Combination antibiotic therapy was administered as follows: 1 g of ceftriaxone and 1 g of vancomycin were intravenously administered twice a day and once a day, respectively. Moxifloxacin (400 mg) was administered once a day orally for the subsequent 2 months. Symptoms of cervicothoracic syndrome and generalized inflammation fully regressed on day 11. The drainage catheter was removed on day 5. The patient's condition at the 1-month

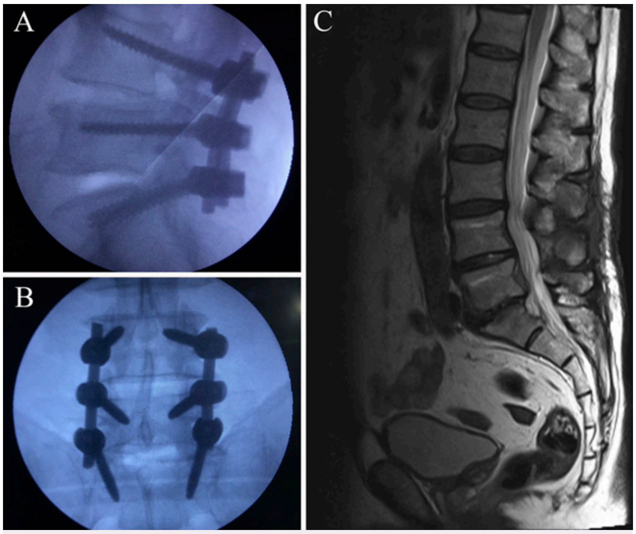

FIG. 3. Case 1. **A, B:** Follow-up radiography, lateral and anteroposterior views of L4/L5/S1 segment stabilization. **C:** MRI at 6 postoperative months.

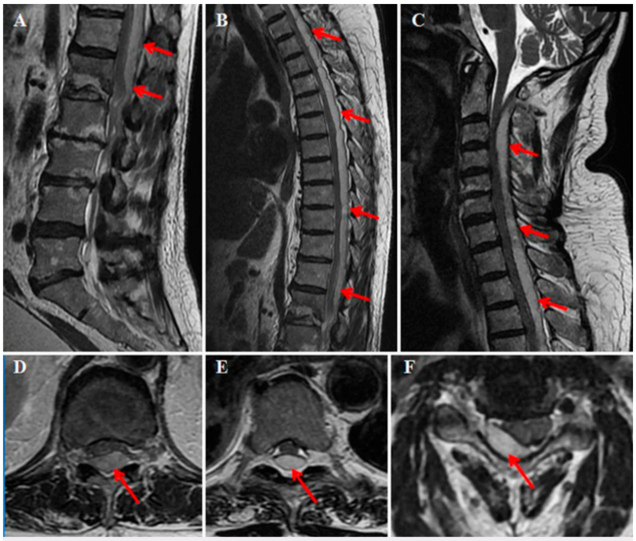

FIG. 4. Preoperative MRI in case 2. Sagittal plane, cervical (**A**), thoracic (**B**), and lumbosacral (**C**) spinal regions; the *arrows* indicate SEA spread on the background of L1/2 spondylodiscitis. Axial plane, dorsal compression of the SEA dural sac at L1/2 (**D**), T7 (**F**), and C3/4 (**E**).

follow-up examination was satisfactory. He fully recovered from weakness in his extremities.

Discussion

Observations

The standard treatment for patients with an extensive SEA remains controversial. A successful case of conservative antibacterial treatment of holospinal SEA has been reported,[10] and various percutaneous aspiration methods[13,14] have been successfully used. However, the standard surgical approaches have not yet been established. Some authors suggest that selective laminectomies at the rostral and caudal poles of the abscess with subsequent drainage should be performed,[15] whereas others have performed the so-called apical laminectomy on the natural spinal elevations, at the midcervical C3/5 level, the midthoracic T6/9 level, and the midlumbar L2/3 spinal segments.[2] Laminectomy on the overlying T2/3 segments combined with hemilaminectomy on the underlying L1/2 segments of the extensive SEA has also been reported.[16]

In addition, a thoracic spine laminoplasty[17] and even a transoral dens extraction with partial C2 vertebral corpectomy and anterior arc removal of the C1 vertebra were performed to adequately drain the ventral holospinal SEA.[18] Due to varying surgical scope, various epidural space drainage catheter types have been used. A Fogarty catheter,[15] a 5-Fr[2] pediatric feeding tube, and soft silicone catheters for drainage have been used.[16,19]

Multilevel laminectomy may expose patients who often experience aggravating SEA-related somatic diseases due to various complications, such as mechanical instability, long surgical duration, or blood loss. However, medullar decompression and infection focus drainage should be performed.

In the case of progressive neurological deficit, most authors agree on surgical treatment for SEA.[2,18,19] Instrumental fixation is rarely performed in an extensive SEA because the risk of implant

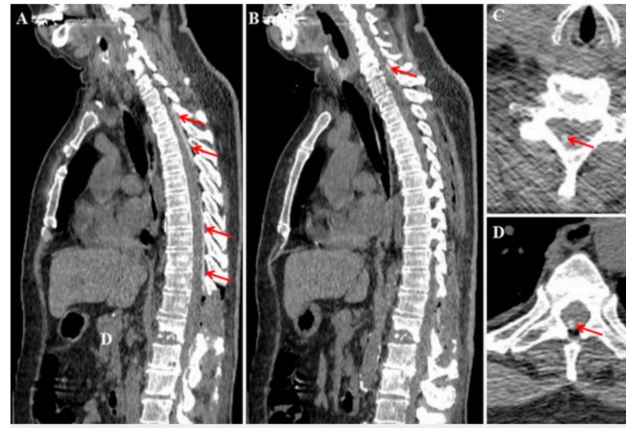

FIG. 5. Case 2. Postoperative CT, sagittal plane, epidural drainage imaging along the entire length of the thoracic spine (**A**), and epidural drainage at C7 (**B**). Axial plane, epidural drainage imaging at the C7 vertebra (**C**) and T7 vertebra (**D**).

contamination is not excluded. However, the positive role of fixation of the affected segment in spondylodiscitis has been increasingly discussed in the literature because focus drainage combined with immobilization facilitates early elimination of infection, early verticalization, and early patient activation with a significantly reduced risk of mechanical spinal instability.[20–22] In both cases, holospinal epidural abscesses developed in patients with a history of spondylodiscitis. With regard to the extension, the first SEA was ventral and the other was dorsal. The affected segment, i.e., a retrolisthesis at the L5 vertebra in the first case, was unstable. Corresponding neurological and general inflammatory symptoms rapidly developed in both patients, which indicated a high risk of complications, including neurological deficits.

Therefore, when choosing treatment methods, conservative management was not performed because of the strong literature evidence of the need for urgent medullary and root decompression in an extensive SEA.[2,6,7]

A Fogarty catheter can be used to perform compression on the medulla,[15] whereas 5-Fr feeding tubes are, in our opinion, too thin and flexible, which can be a problem when placed in the epidural space, especially when granulation commissures or intersections are present or in the case of highly viscous purulence. We preferred the silicone-perforated epidural drainage catheter, which was rigid enough to run it along the entire abscess length. Perforations along the catheter increased the contact area with purulent content. Due to such drainage catheter installation, multilevel accesses were performed, depending on the requirements of spinal canal drainage and decompression. Consequently, this reduced surgical time and blood loss.

Lessons

It is difficult to establish the exact criteria for drainage method selection in an extensive SEA due to greatly varied SEA locations and the presence of coexisting diseases.

To achieve the key goal of treatment for extensive SEA, i.e., to prevent the development of persistent neurological deficits, immediate effective spinal canal decompression should be performed. Therefore, we recommend avoiding conservative treatment of extensive epidural abscesses.

The access method and scope should meet the criteria of spinal canal decompression and purulent content aspiration to the greatest possible extent while inducing minimal trauma.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: all authors. Acquisition of data: Romanukha. Analysis and interpretation of data: Romanukha, Voitsekhovskyi. Drafting the article: Romanukha. Critically revising the article: Eroshkin, Voitsekhovskyi. Statistical analysis: Voitsekhovskyi. Administrative, technical, and material support: Eroshkin. Study supervision: Eroshkin.

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