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CASE-BASED UPDATE

Pediatric cervical epidural abscess in a 4-year-old patient: a case-based update

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Abstract

Purpose The purpose of this study was to review a case comprised of a cervical spinal epidural abscess, cervical and thoracic paraspinous edema, and widening of the right thoracic neural foramen secondary to a phlegmon.

Methods We reviewed the case of a spinal epidural abscess managed medically in a 4-year-old male and performed a review of the literature with 15 other cases that have previously been reported.

Results The current mainstay of treatment is largely variant but generally falls into a laminectomy-based surgical approach or longstanding antibiotics. Our review of the literature concluded that there are currently no clear guidelines established to recommend treatment, and current practice is largely based on the discretion of the pediatric neurosurgeon.

Conclusions Based on the literature review, and our personal case illustration, we conclude that an antibiotic-based treatment is a valid approach for therapy if initiated promptly in a pediatric patient with no neurological deficit.

Keywords Spinal epidural abscess · Phlegmon · Epidural laminectomy · Epidural space

Introduction

Epidemiology

Cervical spinal epidural abscess (SEA) is exceedingly rare in pediatric populations. In adults, the incidence of SEA is higher particularly in diabetic patients and IV drug abusers. Often, there is an association with discitis and osteomyelitis. Epidemiologically, the incidence of a SEA is 2–15 patients per 100,000 admissions making this condition rare [1].

Anatomy

The presentation of a SEA can be a surgical emergency given the anatomy of the cervical region. The odontoid ligament is prone to degradation leading to instability in the upper cervical spine. The dura is joined to the foramen magnum and sacrococcygeal membrane, superiorly and inferiorly, respectively. Most spinal epidural abscesses occur posteriorly since the anterior dura is in proximity with the posterior longitudinal ligament and the periosteum [1]. The case discussed is particularly unique because no discitis or osteomyelitis could be appreciated and the SEA was located anteriorly.

Pathogenesis and pathology

The most common route of infection for SEA is usually hematogenous in nature from the ear, nose, and throat [1].*Staphylococcus aureus* is the most common pathogen involved. It is not common to isolate *Staphylococcus aureus* from the cerebrospinal fluid of a patient who has not undergone recent neurological surgery especially in pediatric populations [2].

Diagnosis and clinical presentation

The optimal imaging modality for diagnosis is MRI examination with Gd-DTPA enhancement. The lesion may be hypointense on T1-weighted imaging and hyperintense on T2-weighted imaging. While the classic "triad" is composed of localized back pain, neurological deficit, and fever, this does not occur in a majority of patients. Studies show that

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up to 29% of patients can present with no neurological deficit [3]. This was the case for the patient reviewed in our case and highlights the possibility of an antibiotic-based treatment in this population of patients. Differential diagnosis includes Grisel's syndrome, which classically involves the atlanto-axial joint, and presents with restricted head movement following an upper respiratory infection. Grisel's syndrome comprises instability in the atlanto-axial joint without any concurrent trauma or bone disease. Grisel's syndrome has been identified as an element of tonsillitis, pharyngitis, and also cervical abscesses. The condition is thought to be caused by septic seeding through the venous and lymphatic channels that communicate with the cervical venous plexus. Grisel's is a condition almost exclusively found in children, though a few rare cases have been noted in adults [4].

Management

The two primary treatment modalities for SEA include non-operative antibiotic-based management or surgical decompression. While the basis for treatment is primarily based on the presentation of the patient, key indicators for surgery would include the development of neurological signs or a worsening in inflammatory markers. There is a lack of evidence in the literature defining an optimum guideline for effective treatment, and variability in treatment selection is high [5]. The cervical region is particularly more complex because of diaphragmatic innervation from C3, C4, and C5 nerve roots in addition to the spinal cord. Thus, treatment, in this case, is important to prevent quadriplegia and ventilator dependence. Surgical treatment consists of spinal cord decompression and drainage of the SEA supplemented with antibiotics. In general, patients who present with a cervical SEA are prone to more aggressive treatment modalities [2]. In our case, management was based off the absence of neurological deficits and remained more conservative in nature.

Review of the Literature on Management of Spinal Epidural Abscess in Children (Table 1)

Results from literature review

The patient's age ranged from 10 days old to 18 years of age. Most patients were under the age of 15. The male to female ratio was 5:3. Most patients presented with a chief complaint of fever, pain, and irritability. Of the patient's studied, six did not have a concurrent neurological sign, including our patient. A surgical treatment was performed on over 62% of the patients included in the study. Medication-based treatment was given to over 93% of patients studied (medical treatment was not listed for one patient). This was largely antibiotic based. There was a large variance in antibiotic selection. Completely normal function was regained in 13 patients.

Presentation

The presentation of a spinal epidural abscess can be difficult to diagnose given that very few patients present with the classic triad of symptoms. However, fever was the most common presenting sign. Fever was noted in 75% of the patients examined. Neck/back pain could be localized in over 37% of patients proving to be another useful diagnostic sign. Of the 11 patients who presented with a neurological sign, upper extremity involvement was seen in four patients.

Radiographic findings

The most common diagnostic tool employed was an MRI. This was done in over 93% of the cases studied, with the remaining representation comprised of spiral CT scans. An epidural abscess involving the cervical region was noted in 13 of the 16 patients. Thus, MRI tends to be the diagnostic gold standard and localization of the cervical region can be expected in a majority of cases.

Treatment

Treatment via a surgical approach was done in 10 of the 16 patients. Of these patients, 10 received a laminectomy. A medication-based treatment was also given to every individual who underwent surgery (except for one patient with unspecific medications given). Of this population of patients who received surgery + medication, one patient recovered with some residual weakness, one patient developed a benign dermoid cyst, one patient developed near-normal power in the extremities, one patient had minimal back pain, and the rest of the patients recovered normally.

While *Staphylococcus aureus* was found in 10 of the 16 patients, an emphasis should still be placed on isolating the causative organism. From our review of the literature and patient illustration, this can be done through pus aspiration, urine culture, or blood culture. If the patient is from outside of the USA, emphasis should be placed on checking for *Mycobacterium tuberculosis* infection. This would allow targeted therapy in the result of resistant organisms or pathogens not covered for in initial treatment.

Medical treatment only was given to five patients. The primary method of medication delivery was via IV. Medications commonly included clindamycin, nafcillin, daptomycin, and ceftriaxone. Of this class of patients, all obtained a normal neurological development with no post-treatment

Table 1 Summary of clinical and radiographic findings in children presenting with epidural abscess

Authors	Patient no.	Age (years)	Gender	Chief compliant	Neurologic complications	Radiographic findings	Surgical treatment	Medical treatment	Outcome	Organism isolated
Rafferty et al. [6]	1	5	Male	Increasing fevers and left upper back pain	Torticollis, left arm adduction	(MRI) Spread of infection from the left longus coli muscle through C7/T1 neuroforamen, epidural phlegmon C7-T2	None	250 mg ciprofloxacin IV 2× daily, 300 mg rifampin daily for 6 weeks.	Remained afebrile and asymptomatic without any neck or back pain	*Bartonella henselae*
Henton et al. [7]	1	12	Female	Neck pain, stiffness, restricted range of movement	Tenderness over spinous processes C3-T1	(MRI) Epidural abscess C4/C5, elevation of the posterior aspect of the C4–5 intervertebral disc	None	IV antibiotics, clindamycin for 3 months	6 months after diagnosis the patient had recovered with full range of movement and no neurological deficit	None isolated from blood culture
Bair-Merritt et al. [8]	1	3	Female	Fever and hip pain	None	(MRI) SEA location not disclosed	None	IV and oral antibiotics	Child doing well several months later with no signs of neurologic deficit	*Staphylococcus aureus*
Paro-Panjan et al. [9]	1	3 (weeks)	Male	Decreasing movement in upper limbs	Paresis and areflexia of both arms	(MRI) of the cervical spine revealed discitis at level C4/C5 and anterior epidural and prevertebral abscesses	Particles of the intervertebral disc C4/C5 were removed and the intervertebral space was enlarged by a bone spreader and irrigated with antibiotics	Systemic antibiotic therapy with ampicillin, clindamycin and gentamicin was started before surgery and continued for 3 weeks.	The boy recovered without any complications. No abnormalities were found on clinical or neurological examination 2 months after surgery	None isolated from blood, urine, or CSF
Anand et al. [10]	2	11	Male	Fever and low back pain	None listed	A contrast-enhanced spiral CT scan was performed, which showed posterior epidural collection extending from LI to L5	A laminectomy was performed and pus was evacuated	Antibiotic (none specified)	Patient recovered fully	*Staphylococcus aureus*
Anand et al. continued		18	Male	Complete flaccid paraplegia below T4	Bladder and bowel involvement	(MRI) epidural collection from C7 to T5.	Laminectomy was performed and pus was removed	None specified	Partial neurological recovery with some residual weakness	*Staphylococcus aureus*
Liu et al. [11]	1	5 (weeks)	Male	Fever, irritability, and grunting for 1 day	None listed	(MRI) large epidural collection extending from C3 to the sacrum compressing the thecal sac anteriorly	posterior laminectomy	4 weeks of antibiotic therapy with vancomycin and meropenem	Development of a benign dermoid cyst	*Staphylococcus aureus, Bacteroides fragilis, Peptococcus magnus*
Hazelton et al. [2]	1	16 (days)	Male		None listed	(MRI) extensive epidural abscess extending from	Drained via thoracic laminectomies			*Staphylococcus aureus*

Table 1 (continued)

Authors	Patient no.	Age (years)	Gender	Chief compliant	Neurologic complications	Radiographic findings	Surgical treatment	Medical treatment	Outcome	Organism isolated
				Fever and irritability		C1/2 to the lumbosacral level, right-sided paraspinal abscess extending from C3 to T4		1 week of intravenous dexamethasone	Discharged at 10 weeks with normal motor development	
Horner et al. [12]	1	34 (days)	Male	Fever, fussiness, and decreased oral intake	None listed	(MRI) anterior epidural abscess and C4 shows pathologic contrast enhancement	None	IV nafcillin	Normal neurodevelopment	*Staphylococcus aureus*
Gudinchet et al. [13]	1	10 (days)	Female	Fever	Paresis of both upper arms, difficulty swallowing	(MRI) spinal epidural abscess C4-C5	C5 bone sequestrum was removed, resection of inflammatory tissue	Intravenous antibiotic therapy with amoxicillin clavulanic acid and tobramycin	Normal and complete resolution of the upper arm paresis	*Staphylococcus aureus*
Lee et al. [14]	1	6 (weeks)	Female	Fever and irritability	Progressive quadriparesis	(MRI) revealed anterior epidural mass and destruction of the C3, C4, and C5 vertebral bodies, with posterior displacement and compression of the spinal cord by an epidural mass	Right anterolateral approach, debridement of granulation tissue and pus, irrigation with vancomycin	Cefaclor for 3 months	Improvement in neurological function was immediate, near normal power of both extremities restored	N/A
Sekhar et al. [15]	1	7 (months)	Female	Fever, irritability, tachypnea	Decreased movement of right lower limb	(MRI) epidural abscess from C7 to L5	None	IV antibiotics for 6 weeks	No neurological deficit	*Staphylococcus aureus*
Sinatra et al. [16]	1	15	Male	Fever and right cervical neck pain; nausea and vomiting	Positive straight leg tests, Hoffman and Babinski reflexes present, and 3 beats of clonus bilaterally.	(MRI) loculated epidural abscess from T3 to L3 with compression of the spinal cord	decompression and left-sided hemilaminectomies from T3 to L3	Meropenem, 1 g every 8 h for 6 weeks	Normal neurological exam; at 1-year follow-up patient had minimal back pain	*Fusobacterium necrophorum*
Strober et al. [17]	1	15	Male	Fever, bilateral back pain	Right leg numbness	(MRI) epidural collection beginning at C3 to the lower cervical spine	C4-C5 hemilaminectomy with removal of granulation tissue and necrotic epidural fat	6-week course of intravenous Cefazolin	Normal follow-up examination	*Staphylococcus aureus*
	1		Female							

Table 1 (continued)

Authors	Patient no.	Age (years)	Gender	Chief compliant	Neurologic complications	Radiographic findings	Surgical treatment	Medical treatment	Outcome	Organism isolated
Zipkin et al. [18]	3	(months)		Transfer to PICU from PCP	Decreased upper extremity movement	(MRI) epidural abscess extended from C2 to T2 with associated cord compression	Incision and drainage of the retropharyngeal abscess	Broad-spectrum antibiotics, as well as systemic corticosteroids	Regained movement in both arms and had no immediate complications	*Escherichia coli* and *Enterobacter cloacae*

complications. This indicates that a rapid diagnosis via MRI with subsequent treatment with antibiotics can be an effective modality of treatment.

While there is currently no clear indication on how treatment should be guided, it is certain that prompt imaging does improve patient outcomes [17]. Strober et al. maintained that after a diagnosis of SEA is established, the gold standard for treatment should include surgical decompression and debridement combined with IV antibiotics. Medication should be given IV/oral for a total of 6 to 8 weeks. Initially, broad spectrum antibiotic coverage is necessary, and should be continued in cases of an unknown pathogen. In cases where an organism is isolated, duration of therapy should continue for 6 weeks. However, a targeted antibiotic approach can be suitable for treatment based on microbial sensitivity levels. Without rapid intervention, mortality can be seen in up to 5% of the pediatric population, and a complete recovery in only 40% of patients [16]. Our refinement of this recommendation is based off the lack of neurological deficits present in the child.

This recommendation has been made by other authors, including Dr. Horner, who indicate that "standard therapy for epidural abscesses is antibiotics and surgical drainage, but conservative nonoperative management with antibiotics alone may be considered in patients without neurologic deficit, with extensive abscesses, or with high surgical risks [11]." There is paucity in the literature on the length of ICU admission and criteria for discharge. In our case illustration, complete resolution occurred within 9 days of admission, so inpatient treatment until complete resolution is a definite approach. Hence, children with SEA should remain in the ICU for hourly neurologic assignment, and surgical management should be arranged upon any change. Thus, it is important to make an early diagnosis in a child presenting without neurological symptoms.

Exemplary case illustration

History and physical examination

This patient is a 4-year-old boy with a past medical history of asthma who was admitted for workup of fever, neck, and back pain. In the past, the patient's mother reports he had a history of right ear pain and was found to have a mastoid effusion. He was also diagnosed with pneumonia and was treated with amoxicillin for 10 days. After no relief of his neck and back pain and cough, the patient presented back to his primary care physician where he was then sent to an outside hospital emergency department for further workup for presumed worsening of his pneumonia. He was treated with IV vancomycin and had an allergic reaction comprised of hives and lip swelling. He was subsequently transferred to Nemours Children's Hospital for further

workup and treatment. During the workup, the radiology team found an epidural abscess/phlegmon, and pediatric neurosurgery was notified immediately of the finding. The patient's mother denied that he had any constipation, accidents with urination, decreased frequency of urination, or emesis. He has no history of congenital heart disease, strep throat, dental caries, skin abscesses, or other recurrent infections. On examination, the patient did not have any neurological deficits. The patient was tearful and not very cooperative. This is likely due to his distress from the MRI and having the IV taped again. The patient was in a Miami J collar and was guarding his neck. The patient's pupils were brisk, equal, and reactive. The patient was able to push and kick without any apparent deficit. The patient was able to grip on command and also give a thumbs up on both sides. The patient had intact, 2+, deep tendon reflexes with no clonus or Hoffmann's sign. The patient was not cooperating enough for a sensory or proprioceptive exam. The ICU team was notified that the patient should have blood cultures taken, an echocardiogram performed, and further workup and treatment for suspected bacteremia with secondary seeding of the epidural space. The patient had hourly neurological check while in the ICU.

Medication/management

Given this patient's lack of neurological deficits, a medication-based treatment regimen was started. The patient was initially treated with daptomycin (240 mg in 0.9% sodium chloride 24 mL IV intermittent) and ceftriaxone (0.9% sodium chloride 2000 mg IV syringe) until his cultures showed that he had methicillin-sensitive *S. aureus* rather than MRSA. The patient was then switched to nafcillin IV. At discharge, the patient was sent home on ceftriaxone IV via PICC for 3 weeks with plans for 4–6 weeks of oral Cephalexin if his inflammatory markers responded appropriately, which was true for this patient.

Radiographic comparison (Figs. 1, 2, and 3)

Patient outcome

The patient was able to regain normal baseline status without any neurological complications. He is still completing his oral cephalexin, but is full of energy with no neurologic deficit or residual pain. Follow-up MRI performed 6 weeks after

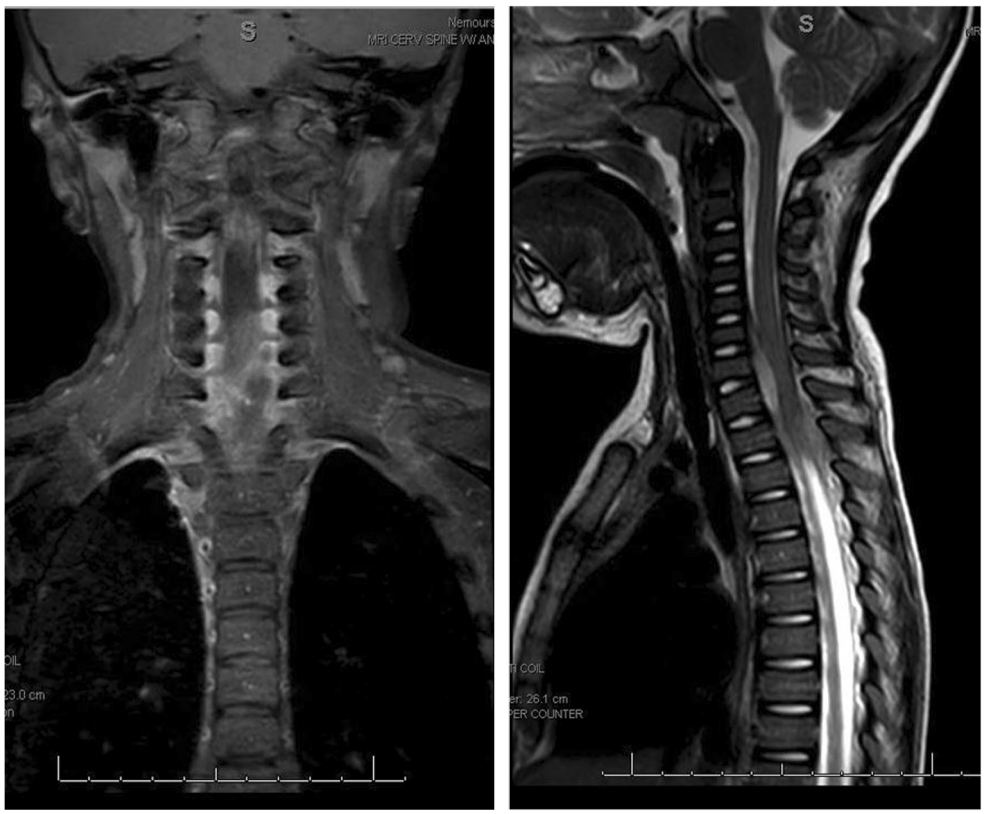

Fig. 1 and 2 MRI of cervical spine. Interpretation: Extensive paraspinous edema involving the cervical and upper thoracic spine with the epicenter in the region of the transverse process/facet joint and pedicle of T2 on the right. There is some slight widening of the right neural foramen from T1 to T3 related to phlegmon and there is a rim-enhancing fluid collection, likely abscess, from C3 to C5 producing effacement of the spinal cord as described. Normal signal within the cord is preserved

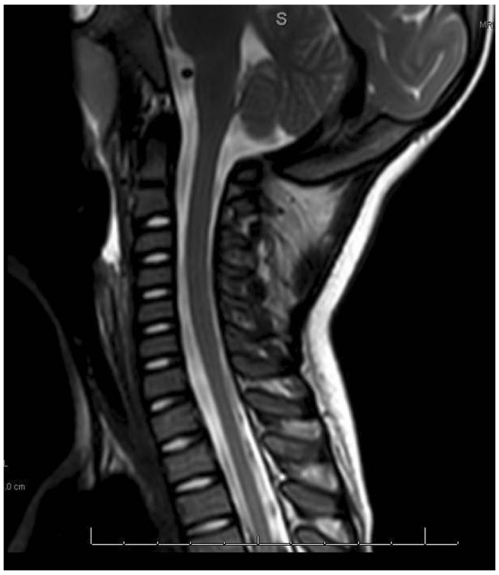

Fig. 3 MRI of the cervical spine. Interpretation: The brain appears normal. There is some thick dural enhancement that extends up to the skull base from the spine related to meningitis

initiation of antibiotic therapy shows "continued improvement in inflammatory/infectious changes involving the spine since the prior studies. There is some persistent edema and enhancement involving the upper thoracic spine as described above. There is persistent signal abnormality and enhancement involving posterior elements of T2 and to a lesser degree T3 and the surrounding soft tissues in keeping with history of osteomyelitis. No residual fluid collection is seen."

Laboratory comparison: The patient's white blood cell count (WBC) on admission was 14,500 WBCs per microliter with primarily neutrophils. The patient's WBC reduced to 7300 white blood cells per microliter in 10 days. In terms of the patient's C-reactive protein (CRP), a value of 28 mg/L was obtained on admission and was reduced to 2.3 mg/L on the day of discharge. At a 6 weeks checkup, the CRP was noted to be 0.6 mg/L.

Conclusion

From our experience and review of literature comprised of similar experiences, we recommend that pediatric patients presenting with a spinal epidural abscess without neurological symptoms should be treated with a non-surgical antibiotic-based approach. This has been recommended throughout the literature; however, future studies are warranted to refine this treatment method. Studies examining treatment administration from time of diagnosis vs. patient outcomes could prove useful. Additionally, a consensus on antibacterial efficacy and selection should also be further studied. The mainstay treatment of laminectomy-based debridement plus antibiotics should be reserved for patients presenting with neurological symptoms.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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