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Compressive Myelopathy, Spinal Shock, and a Complicated Neurological Exam

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Abstract

The neurological examination, developed and tested since the 1800s has provided physicians with a vital tool to rapidly assess and provide clues to many of the pathological processes lurking inside the brain and spinal cord. With the advent of magnetic resonance imaging, physicians are able to visualize the precise location of the abscess before surgical intervention. In this case report, we present a 51-year-old male with an epidural abscess with multifocal compressive myelopathy, resulting in a complicated neurological examination, making localization a diagnostic challenge. With this case, we would like to stress that complicated multifocal lesions of the cord may present with a large variation in examination findings. This patient's neurological exam was complicated secondary to a ventrally as well as dorsally located epidural abscess with superimposed spinal shock sequelae. We would like to highlight the importance of a thorough history and the neurological examination but also mention some of its limitations. It is crucial to use clinical judgement to navigate the patient's history, presentation, and examination to accurately diagnose and treat, particularly so in cases involving compressive myelopathies of the spinal cord.

Keywords

Compressive Myelopathy, Spine, Spinal Epidural Abscess, Spinal Imaging, Neurological Examination, Neurology, Neurosurgery, Abscess, Neuroimaging

1. Introduction

Modern day medicine uses a variety of tools to aid in both the diagnosis and treatment of a multitude of disease processes. A key foundation in the assessment of any patient is an adequate and detailed clinical examination. One spe-

cialty that relies heavily on the clinical examination in conjunction with modern day imaging is the field of neurology. From the time of Jean-Martin Charcot, credited as the father of neurology, localization has been a key feature in the clinical examination. The neurological examination, as we know today, was developed and tested due to the likes of Wilhelm Erb, Joseph Babinski and William Gowers since the 1800s [1]. It now allows for rapid assessment and aids practitioners by providing clues to the many pathological processes lurking both inside the brain and spinal cord.

One such disease process is a spinal epidural abscess (SEA), an infection of the spinal epidural space, considered a neurosurgical emergency. Classically, there are three routes of pathogen spread: hematogenous, direct external inoculation, and spread from contiguous tissues [2]. Spinal epidural abscesses are often initially misdiagnosed, particularly in neurologically intact patients or patients with complex neurological findings. Practitioners can usually pinpoint the location of an abscess by the neurological exam alone as pain, upper and lower motor signs and sensory levels reveal vital clues in aiding with the diagnosis. Abscesses are most commonly located in the lumbar spine (48%), followed by the thoracic spine (31%) and the cervical spine (24%) [3]. The symptoms of SEA are characterized by fever, back pain, and neurological symptoms, which are traditionally described as a classical triad of symptoms for this type of infection; however, it is worth noting that this collection of symptoms is seen in only about 10% of cases [4]. Of the causative agents that are most frequently isolated, Methicillin-sensitive *Staphylococcus aureus* (MSSA) is the most common pathogen of SEA, accounting for about two-thirds of cases, followed by other gram-positives [4]. However, recently the number of methicillin-resistant *Staphylococcus aureus* (MRSA) has significantly increased. Some known risk factors for SEA are the following: diabetes mellitus, intravenous drug use, long-term systemic corticosteroid therapy, spinal abnormalities such as recent trauma or surgery, epidural anesthesia, treatment around the spinal cord, and systemic bacterial infection from a local infection and injection [4]. Spinal epidural abscesses also often result in elevated WBC levels, classically elevated levels of ESR and CRP, and positive blood cultures. Further, Procalcitonin levels (normal 0.05 ng/mL) may be elevated to >2 ng/mL or >10 ng/mL indicating respectively infection, and severe sepsis [5]. Gadolinium-enhanced MRI is the most sensitive, specific, and considered to be the most beneficial imaging modality for establishing a diagnosis of SEA. This allows the surgical team to accurately visualize the precise location of the abscess before the patient is taken to the surgical suite.

The treatment for epidural abscess is dependent on various factors, however, surgical intervention has remained the mainstay of treatment. Recent studies show that patients that have a known causative organism may be candidates for treatment with conservative medical management such as antibiotic therapy. However, it is estimated that about 30% - 40% of patients will fail conservative

therapy alone without surgery [3]. Ultimately, decompression combined with systemic antibiotics has been established as gold standard in the last decades, especially in patients with progressive infection and late diagnosis. It is also worth noting that recent studies now show that computed tomography (CT) guided percutaneous needle aspiration may be a safe and minimally invasive procedure that can be regarded as a rational alternative to surgical intervention for the management of SEA in patients without neurological deficits or those in poor medical condition [4].

In this case report, we present a patient with an epidural abscess with multifocal compressive myelopathy of the spinal cord, resulting in a complicated neurological examination and making precise localization a diagnostic challenge for all teams involved in the case, including neurology, neurosurgery, infectious disease, and internal medicine.

2. Case Presentation

A 51-year-old male with a past medical history of type I diabetes mellitus presented to the hospital for a nonproductive cough, fever, chills, uncontrolled blood glucose, urinary retention as well as three days' worth of bilateral lower extremity weakness. He was admitted for management of diabetic ketoacidosis and workup began to evaluate his lower extremity weakness and urinary retention. History was positive for a recent COVID infection although testing in the hospital did not reveal an active infection. His vitals revealed a temperature of 100.5 Fahrenheit and heart rate in the 120s. Lab work was positive for a white blood cell count of 25,000 mm^3, glucose of 436 mg/dL, hemoglobin A1c of 10%, lactate of 2.1 mmol/L. The patient's presentation was concerning for diabetic ketoacidosis and the differential was clouded by the positive COVID history. Viral and bacterial inflammatory processes were considered after correction of the ketoacidosis did not significantly alleviate his symptoms. Subsequently, blood cultures were drawn and grew methicillin resistant *Staphylococcus aureus* in 2 of 2 blood vials. Infectious Disease was consulted, and the patient was started on vancomycin and ceftriaxone. The patient also underwent both a transthoracic and transesophageal echocardiogram to rule out infective endocarditis, with results showing no evidence of vegetations. Further questioning did not reveal any recent trauma, loss of consciousness, acute bleeds, or drug abuse. Physical examination revealed a diaphoretic and tachycardic male in no acute distress. There was no increased respiratory effort or signs of ventilatory decline. His neurological examination showed no alteration in mental status, visual or cranial nerve deficits. His lower extremities had 4/5 strength in the iliopsoas and quadriceps: 2/5 plantar flexors, dorsiflexors, and extensor hallucis longus bilaterally. Knee and ankle reflexes were 0+ bilaterally with mute plantar reflexes. Fine touch and vibratory senses were diminished in the lower extremities up to the mid shins bilaterally (the patient stated that this was an acute finding as he had never noticed these deficits before). Upper extremity strength was

5/5 in the deltoids and biceps, 2/5 in triceps and 4/5 grip strength bilaterally. Biceps and brachioradialis reflexes were 2+ bilaterally with no Hoffman's sign notable on either upper extremity. Sensation, vibration, and coordination were preserved in the upper extremities. The patient's deficits were hyperacute and progressed rapidly. He endorsed riding his mountain bike down a trail a few days ago with no issues in coordination or sensation. The neurological examination did not match well with an isolated upper motor neuron (UMN) lesion as he had symptoms concerning for compressive myelopathy in the posterior grey column as well as the anterior grey column with the addition of lower motor neuron (LMN) components, such as loss of bilateral knee and ankle reflexes. Unfortunately, due to the patient's body habitus and acute status, anal wink and the Osinski reflex were deferred. An MRI of brain and spine was ordered, but it was not able to be acquired until the following day. During the interim, the patient's sensory deficits had ascended to the mid thighs and his motor exam had declined with a 0/5 in the lower extremities, 4/5 deltoids and biceps, 2/5 in the triceps and 1/5 grip strength bilaterally. Ventilatory function continued to be preserved with no increase in respiratory effort and normal saturation on room air. The running diagnosis due to his complicated neurological exam prior to imaging confirmation was acute inflammatory demyelinating polyradiculoneuropathy vs compressive myelopathy. At this time, the patient was started on IVIG (400 mg/kg daily) in addition to the ongoing antibiotics as a precautionary measure.

MRI of cervical, thoracic, and lumbar spine were eventually acquired revealing a 7.9 × 3.1 × 1.3 cm ventral epidural marginally enhancing abscess extending from C1 to C7 level with significant compression of the thecal sac from the level of the C4 to T1 (Figures 1-3). Additionally, there was a dorsal epidural abscess

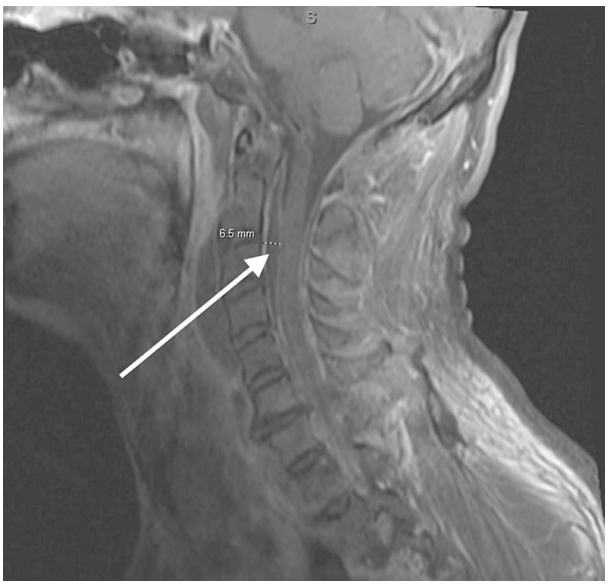

Figure 1. Ventral epidural abscess on T1 magnetic resonance imaging of cervical spine (Sagittal View).

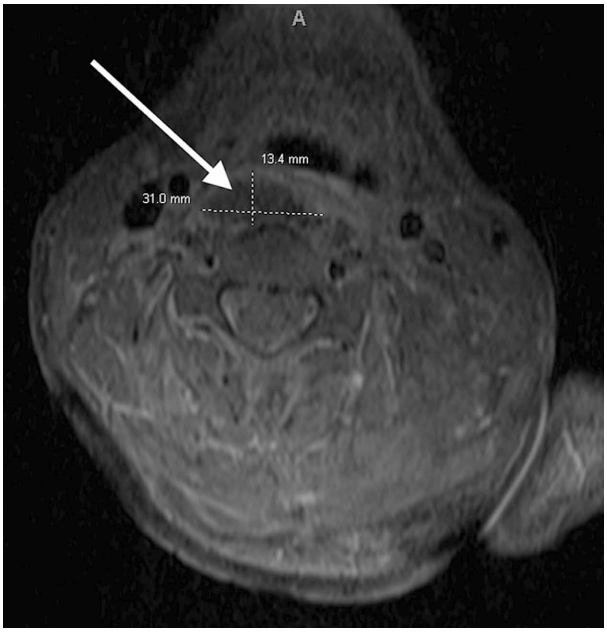

Figure 2. Ventral epidural abscess on T1 magnetic resonance imaging of cervical spine (Axial View).

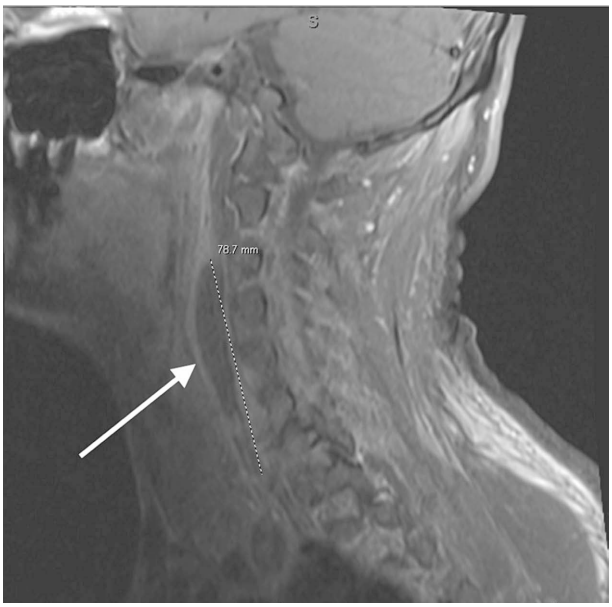

Figure 3. Prevertebral abscess on T1 post-contrast magnetic resonance imaging (Sagittal View).

seen extending from the C4 to T4 level (**Figure 4**). The thoracic and lumbar spine MRIs did not reveal any infectious processes, compressions or spinal stenosis that would explain the LMN signs noted on the patient's neurological examination (**Figure 5** and **Figure 6**). The patient's treatment with IVIG was discontinued and the findings were emergently relayed to the neurosurgery team and the patient was taken to the operating room for C2 - T2 laminectomy with removal of an epidural phlegmon.

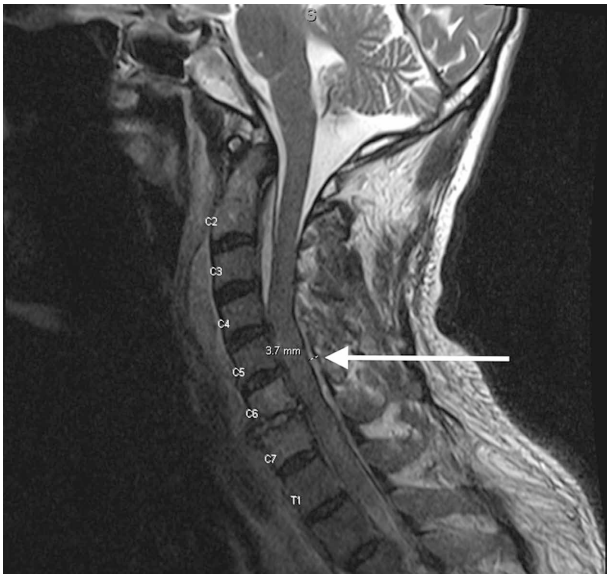

Figure 4. Dorsal epidural abscess on T2 magnetic resonance imaging (Sagittal View).

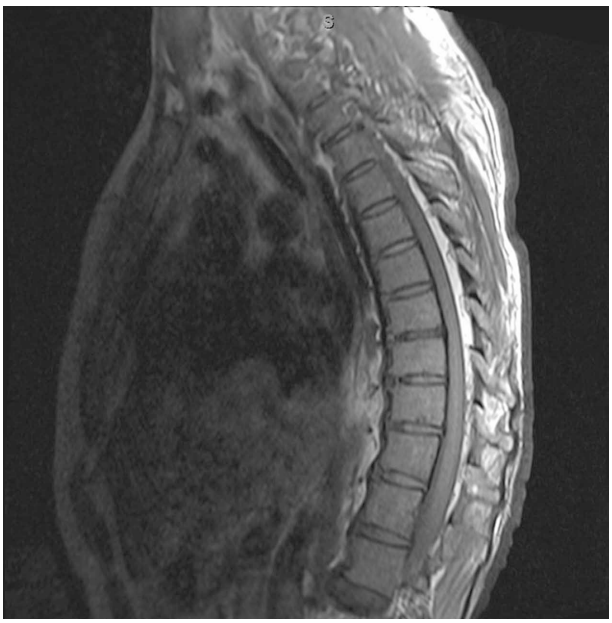

Figure 5. T1 magnetic resonance imaging of thoracic spine (Sagittal View).

Below, **Figures 1-4** are magnetic resonance imaging the cervical spine taken with and without contrast, in which we can see the abscess demarcated in each figure. **Figure 5** and **Figure 6** are magnetic resonance imaging of the thoracic and lumbar spine respectively, which revealed no acute abnormalities.

Our patient had a complicated hospital course and was taken back to the operating room a month after the initial surgery for an anterior C6 and C7 corpectomy. A week after her had a C2 - T2 posterior instrumentation with decompression. Two days after, he was taken for another C6 - C7 corpectomy and an

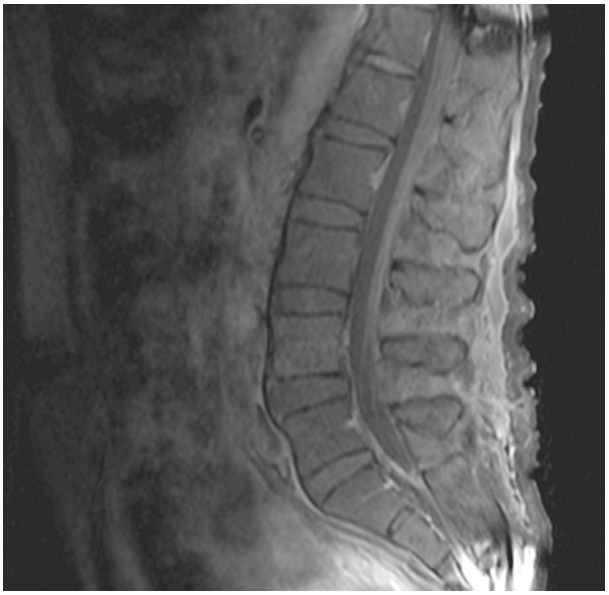

Figure 6. T1 magnetic resonance imaging of lumbar spine (Sagittal View).

arthrodesis of C5 - T1 spine. The last MRI acquired prior to discharge revealed improvement of the epidural abscess and prevertebral soft tissue collections. Regarding his antibiotic coverage, the ceftriaxone that was initially started was discontinued after a short 5 day course. The vancomycin was continued for a total of 6 weeks for optimum coverage. He was also started on IV Daptomycin (8 mg/kg) with which he completed an 8 week course. Due to a lack of IV drug use and high-risk behaviors, it was thought that recycled needles during self-injection of insulin were the source of his underlying MRSA infection. The most recent physical exam on discharge revealed a patient with upper extremity strength of 4+/5 in the bilateral biceps and deltoids, 1/5 strength in right triceps, 3/5 strength in left triceps, intrinsic muscle 2/5 strength and grip 3+/5 strength. The patient exhibited slight movement of the legs on examination. The patient continued to work with physical medicine, rehabilitation, and physical therapy with discharge to an inpatient rehabilitation center.

3. Discussion

This unfortunate case of a complicated epidural abscess resulting in compressive myelopathy and spinal shock yields multiple talking points regarding spinal pathology and the neurological exam. The spinal cord's organization, divisions, openings, reflex arcs and tracts produce characteristic findings giving clues to underlying pathology on the physical exam. That said, it is important to understand the limitations of such an exam. Complicated lesions affecting multiple areas of the cord will not always manifest in the same manner. Patients may present with multiple lesions and pathological processes skewing examination findings. In our case, the patient's neurological exam was complicated secondary to ventrally and dorsally located epidural abscesses with superimposed spinal

shock sequalae. Similarly documented cases report anterior column symptoms with epidural abscesses located in the ventral cord. In a similar case, Yang-Wei Pi describes a 70-year old diabetic male with an extensive ventral spinal epidural abscess presenting with 3/5 motors in the left lower extremity but preservation of sensory and vibratory senses [6]. Another case by Vit Kotheeranurak documented a patient with acute motor weakness in the bilateral upper and lower extremities which diminished from 3/5 to 0/5 within a short twelve-hour period [7]. No deficits in sensory or vibratory senses were clearly documented and anterior column localization seemed clear in many of these cases where the spinal epidural abscess affected the ventral cord. Alternatively, in a case report by Daniel Robinson, a patient with posteriorly located T8-T12 epidural abscess was documented as having predominantly sensory loss below the right knee and diminished sensation to light tough up to the thighs bilaterally [8]. Although particular spinal cord injuries have known syndromic presentations, the neurological exam can vary greatly depending on degree of compression of the lesion. Additionally, the exam can be further clouded if multiple locations are affected, such as in our case. In retrospect, it is easy to correlate findings with the imaging results, but during acute presentation, localization and prompt diagnosis can pose to be a challenging endeavor.

4. Conclusion

With this case, we would like to highlight the importance of a thorough history and the neurological examination but also mention some of its limitations. The neurological examination is an essential tool in guiding us toward the right diagnosis. As physicians we must thoroughly examine our patients to explore a full set of differential diagnosis. However, we must consider the limitations of the neurological examination in pathologies where there may be multilevel alteration. It is crucial to use clinical judgement to navigate the patient's history, presentation, and examination to accurately diagnose and treat, particularly in cases involving compressive myelopathies of the spinal cord. We may and should use auxiliary tools to further assist or confirm our suspect diagnosis. The immediate use and availability of MRI is essential in the diagnosis of patients presenting with epidural spinal abscess particularly in multiple levels. Using modern day imaging and tools to further evaluate the patient has become essential, such as in this case report, where a neurological examination was not sufficient on its own to localize and initially diagnose the epidural abscess. Working together with all specialties involved and approaching each case with a multidisciplinary approach is quintessential in the prompt diagnosis of patients with such complicated presentations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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