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Cervical spinal cord stimulator trial complicated by epidural abscess

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ABSTRACT

Back ground: Spinal cord stimulation (SCS) is a growing interventional treatment modality in patients experiencing intractable pain refractory to conservative treatments. Many patients with chronic low back and leg pain that persists after surgery have found pain relief, and more evidence is suggesting that chronic upper limb and neck pain may respond just as well to this therapy. However, the placement of foreign body, for instance SCS leads, in the epidural space can become the source for deep intra-spinal infection.

Case report: We present a 49-year-old robust male who underwent a temporary cervical SCS trial and was diagnosed with epidural abscess on the day 9 when the leads were pulled. The trial phase was complicated by immediate and prolonged post procedure pain. The diagnosis of epidural abscess was made soon after clinical presentation with no neurological deficits or escalation in pain but new onset fever. He made a complete recovery after extensive laminectomy and antibiotic treatment.

Conclusion: The decision to extend the SCS trial length poses a question of risk versus benefit in regards to potential infectious complications versus pain relief. Continuing antibiotic therapy during a SCS trial phase is a possible strategy but of uncertain benefit.

Categories: Anesthesiology, Pain Management.

1. Background

Intractable neck pain and cervical radiculopathy after cervical spine surgeries can be extremely debilitating for patients in their daily lives. Spinal cord stimulation (SCS) has been trialed and implanted in patients experiencing intractable pain due to failed neck surgery syndrome (FNSS) with great responses to a decrease in overall pain scores and increased mobility and daily function [1]. The number of reported SCS complications are overall low with surgical site infections (SSI) and epidural abscess occurring less frequently than lead migration [2]. Epidural abscess formation incidence overall is 0.2 to 2 cases per 10,000 hospital admissions [2,3]. In a multicenter retrospective analysis of 2,737 SCS implant patients; it was found that the occurrence of epidural abscess was 0.1% (3/2737) which supports the overall rare incidence of epidural abscess among hospital admissions [4]. Surgical site infections are the most common complication for spinal cord stimulation. In the United States, the SSI rate for SCS implants ranged from 2 to 5% with most infections happening at the battery site. SSI and deep infections of SCS leads during temporary SCS trials have uncommonly been reported [4]. An increase in infection rate during spinal cord stimulator trials can be associated with extended duration of the trial, difficulty encountered placing the leads during the procedure, or a prolonged procedure time due to complexity [5,6]. There are very few cases of epidural abscess infections following SCS percutaneous trials, we present the first case of a cervical epidural abscess following a temporary percutaneous trial [2,7].

2. Case presentation

The patient was a 49-year old athletic male with medical history of severe axial neck pain after an anterior cervical fusion of C5–C6 with an interbody fusion device related to a work related injury. He also complained of ongoing intermittent sharp neck pain that radiated posteriorly and laterally down both arms to his 3rd, 4th, and 5th digits, associated with numbness and weakness bilaterally that persisted 2 years after his surgery. His past medical history was also significant for polycystic kidney disease (cr = 1.2), hypertension, and a 4.7 cm abdominal aortic aneurysm but no past SSI infections or drug abuse. The magnetic resonance imaging (MRI) of his cervical spine after his surgery showed no significant foraminal or central canal stenosis. The patient had undergone and failed conservative treatments including medication

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management, (taking as needed skeletal muscle relaxants), physical therapy, cervical medial branch blocks and cervical epidural steroid injections. Prior to the SCS trial, the patient was negative for methicillin-resistant or sensitive *Staphylococcus aureus* by nasal swab.

In preparation for the trial procedure, he performed chlorhexidine washes the night before and morning of the procedure. Following informed consent, he received 2 g of prophylactic intravenous cefazolin and was prepped with chlorhexidine/alcohol with sterile prep and drape sealed with ioban in the operating room. The patient received minimal sedation anesthesia for the entirety of the procedure. Under fluoroscopic guidance, using a 14-gauge coude epidural needle, the T1-T2 and C7-T1 interspaces were engaged using loss of resistance technique as well as multi-planar fluoroscopic imaging. Each lead was placed at a different level, one at T1-T2 and another at C7-T1. Due to small inter-laminar openings, access to the epidural space was moderately challenging, and because of this the angle of the epidural needle needed to be adjusted to access the space at the C7-T1 level. Initially, the T2-T3 level was attempted, but not successful, also due to small inter-laminar openings. Confirmation of appropriate depth into the epidural space was confirmed in the contralateral oblique view. The SCS leads were passed easily to the level of C2 vertebra (Fig. 1) with no painful paresthesias. The patient was awake at all points of the procedure, including needle access into the epidural space as well as lead insertion, and had no complaints of pain consistent with an epidural hematoma. No intraoperative mapping was performed because the plan was for 10 kHz stimulation thereby further minimizing lead manipulation. The epidural leads were secured with a Stayfix and Tegaderm dressing.

In the post anesthesia care unit, the patient reported worsening left cervical radicular symptoms with paraspinal and trapezius muscle spasms that required trigger point injections, hydromorphone, and tizanidine while in the recovery room. Although trigger point injections are not routine in our practice, they were performed anatomically in the trapezius muscles far from the lead insertion sites due to the patient complaining of muscle like spasms in this anatomical location. He did have a minimal reduction in pain with the trigger point injections. He was observed in the recovery room for 2 hours, and was stable on neurological exam, and had enough of a decrement in pain to go home. However, due to the significant pain that followed, not intraoperatively, but in the recovery period, the patient was prescribed a 4-day supply of oral hydromorphone upon discharge from the hospital. The patient did not have a history of taking any opioid medications and was opioid naïve. Although opioid medications are not routinely prescribed in this practice after SCS trial placement, this trial was unusual with the patient's presenting amount of pain. Opioid medications can interfere when trying to assess any beneficial results from a SCS trial, however given the amount of pain experienced by the patient, the decision was made to prescribe a short course of oral hydromorphone. The trial phase was characterized by significant post-procedure pain for the next few days and the patient did not call or present to the clinic for further refill of the oral hydromorphone. Over this same time frame, the patient could not be reached either to optimize SCS programming. On the fifth day, because of persistent cervical radicular symptoms, and no progress with improvement from SCS, the patient contacted the clinic to return for assessment and SCS reprogramming. Also, the procedural site dressings were changed and re-secured using Tegaderm on post-operative day 5. He was afebrile with no evidence of a superficial infection. The fluoroscopic exam demonstrated no lead migration so the trial was extended until the morning of day 8 in order to complete program testing. At the time after reprogramming, the patient's radicular symptoms improved from his baseline, whereby he could focus on the device and the reprogramming and notice a difference in a reduction in his pain. The patient could not return on day 8 but presented the morning of post procedure day 9. In clinic, his temperature was 99.9° Fahrenheit, and he reported feeling subjectively feverish the previous night. He had no other symptoms and his clinical lung and neurological exam, as well as the lead insertion site were normal. After lead removal, he was immediately sent to the emergency room for further evaluation and work up for potential infectious process. A cervical MRI was performed and showed an epidural abscess located at C2 to T3 (Fig. 2).

He was hospitalized for antibiotic (vancomycin, metronidazole, cefepime) treatment as well as a posterior cervical laminectomy decompression from C3 to C7, posterior thoracic laminecotomy decompression via T1-T4, and an irrigation with debridement of the posterior

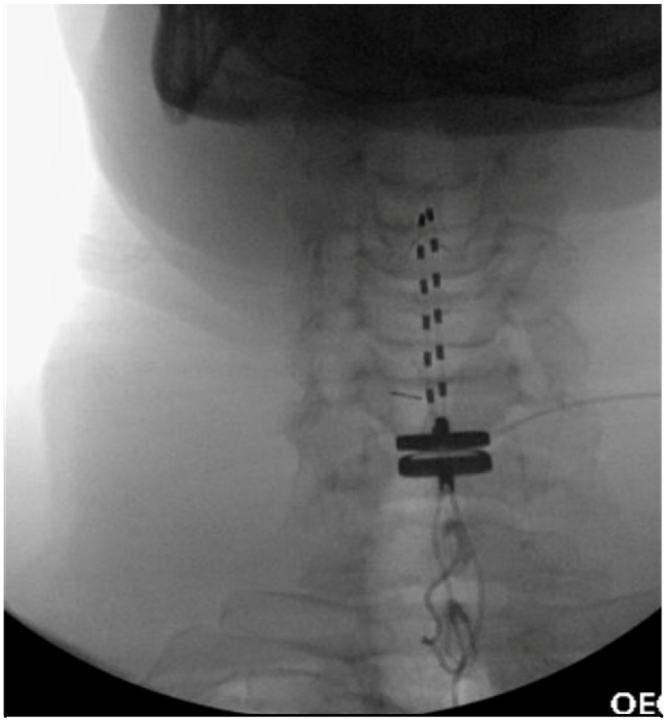

Fig. 1. Anterior-posterior view of the spinal cord stimulator lead placement in the epidural space at the level of the C2 vertebrae.
This image is an anterior-posterior view of the cervical spine with fluoroscopy. Under fluoroscopic guidance, the leads were placed one at a time within the epidural space and guided toward the C2 vertebrae level. Entry point was made at the C7-T1 and T1/2 interspaces.

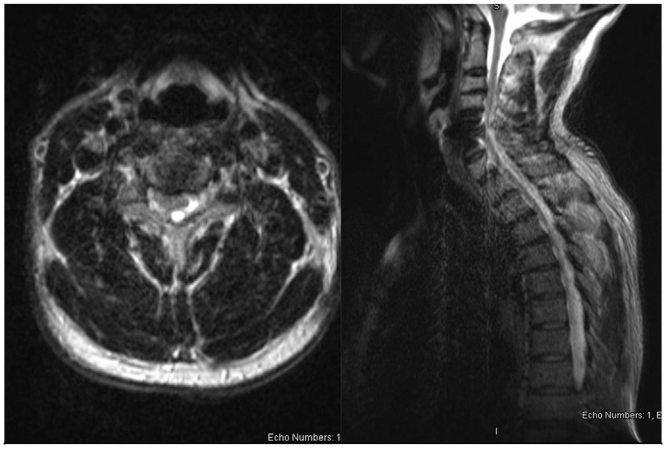

Fig. 2. T2-weighted axial and sagittal magnetic resonance image of cervical and thoracic spine epidural abscess.
This figure shows both an axial (left) and sagittal (right) T2-weighted magnetic resonance image view of the cervical spine highlighting the epidural abscess. The axial view highlights circular appearing epidural abscess within cervical spine. The sagittal view highlights the epidural abscess extending from the C2 vertebra to T3.

cervical epidural abscess. The cultures revealed methicillin sensitive *Staphylococcus aureus,* and the patient was treated for six weeks with intravenous cefazolin. The patient never developed neurological deficits and his radicular symptoms resolved following surgery. He recovered with no neurological deficits but developed more intense cervical and thoracic axial pain 3 months after surgery that persists 3 years post-operatively. There was never a recurrence of the infection. He continues on a combination of cyclobenzaprine, oxycodone, topical diclofenac and transcutaneous nerve stimulation with modest relief and no success from any other therapy.

3. Discussion

Epidural abscess is associated with high level of morbidity and up to 23% mortality but is a rare complication of SCS percutaneous temporary trials. Known risk factors for SSI including smoking, diabetes mellitus, obesity, and immunocompromised disease states can potentially increase the risk of such a complication [8]. Immunosuppression can also be the result of multiple issues including alcoholism, cirrhosis, trauma to the spine, and chronic opioid or steroid therapy administered just a few months prior to a surgical procedure [9]. None of these risk factors were present in the current case and necessary perioperative infection mitigation strategies included proper surgical patient selection, *Staphylococcus aureus* screening, antiseptic bathing, intraoperative aseptic techniques and postoperative wound dressings were performed [10,11].

The key susceptibility the present patient had to infection was likely trial duration. The question of extending antibiotics or limiting the trial duration are further discussed. Neurostimulation Appropriateness Consensus Committee (NACC) has established guidelines that can be utilized to reduce the infectious risk. Given *Staphylococcus aureus* is the most common pathogen, NACC recommends preoperative screening for methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *Staphylococcus aureus* (MRSA). For those patients who are testing positive, decolonization protocol should take place through the application of mupirocin nasal ointment and chlorohexidine baths [11]. About 25–30% of the general population is colonized with *S. aureus*, therefore decolonization is important [12]. Utilization of preoperative antibiotics for neuromodulation SCS trial procedures poses as level I evidence in helping prevent infections. NACC has advocated that a single preoperative dose of antibiotics is sufficient in preventing post procedural infection. The antibiotic should be tailored to hospital, community and resistance patterns of organisms, nasal swab testing, and weight-based dosing [11]. In clinical studies, antibiotic prophylaxis can result in about 50% reduction in the incidence of wound infections [13]. NACC also recommends discontinuation of antibiotics within 24 hours. Although antibiotics are considered safe, prolonged antibiotic usage can increase the risk of *Clostridium* difficile colitis and environmental resistance [7].

This brings up the issue of whether continuing antibiotics throughout an SCS trial or adding antibiotics during the trial if it becomes prolonged is appropriate to reduce the risk of infection.

Prolonged antibiotic use after orthopedic or cardiac surgeries has not been shown to improve infectious outcomes, yet according to Medicare data, only 40.7% of surgical patients had antimicrobial prophylaxis discontinued within 24 hours of surgery [14,15]. Using prophylactic antibiotics throughout the course of the SCS trial lasting longer than 5 days could be considered to reduce the risk of infection, especially in patients with comorbid diseases [16]. NACC consensus on prolonged post-operative antibiotics states that it can be considered in high-risk patients [11]. According to a survey analysis of practice patterns by Sarrafpour et al., about 35% of physicians surveyed continued prophylactic antibiotics throughout the SCS trial and about 39% continued the prophylactic antibiotics for at least 3 days after implantation [17]. This survey analysis demonstrates that many physicians are administering antibiotics longer than the recommendation by the NACC guidelines based on clinical judgment. The decision to use antibiotics throughout the trial phase should be tailored to each patient based on their potential risk for post-procedural infection as determined by the treating physician. However, there is also no evidence for the preventive effectiveness of prolonged antibiotic administration in SCS trials.

The decision to extend an SCS trial poses the balance to the risk of infection versus the benefit of potential pain relief in an individual who has reached a last resort therapy. There were issues with procedure related pain and communication that complicated and extended the trial duration of the case at hand. In addition, the current literature describes no set guidelines on specific duration of SCS trial length particularly with newer waveforms such as 10 kHz at the time of this case. A SCS trial duration usually varies between 3 and 15 days. According to a prospective analysis by Chincholkar et al., the average trial duration was 5.97 days with 75% of their 40 patients having decided on final treatment with SCS by day 9 [18]. In another study by North et al., they reviewed a 20-year experience with SCS at their institution and reported 78% successful SCS trials with the decision made after 3 days into the trial to proceed with the full implant [19]. Previous case reports detailing temporary SCS trials leading to low thoracic epidural abscess demonstrated symptom onset between 3 and 7 days [2,7,9] but the only cervical case developed symptoms 3 weeks after permanent lead insertion [20]. Shortening of trial duration in order reduce this rare incidence of epidural abscess must be weighed against the time it takes to adequately test the multiple stimulation parameters of today's devices in order not to exclude patients who may benefit from SCS therapy. While optimal temporary trial duration is debatable, it is easily agreed that it should be minimized when feasible, and the patient develops clear improvement in pain and function at least over more than one consecutive day to minimize the placebo response.

Rapid diagnosis of this infection by MRI is imperative, as the late phase of the infection results in irreversible neurologic injury such as paralysis. Post et al. stated that MRI imaging should be used in all patients with suspicion for spinal infection. By evaluating patients with spinal infection, it was determined that gadolinium-enhanced MRI images were superior in identifying anatomic delineation of epidural abscesses [21]. Our patient presented initially to the Emergency Department where the MRI spine without contrast imaging was obtained. If the MRI spine imaging showed no initial spinal infection, then an MRI with gadolinium enhancement would have been obtained for higher sensitivity and specificity of detecting spinal infection.

Besides emergent imaging, there are laboratory markers that can be measured post-operatively to help aid in diagnosing infection. Initial diagnostic evaluation of suspected SCS infection should include white blood cell (WBC) count, blood cultures, C-Reactive Protein (CRP), and Erythrocyte Sedimentation Rate (ESR). If the patient presents with systemic signs of infection, then blood cultures will be helpful in recognizing possible epidural abscess or osteomyelitis. Yusuf et al. reported that in patients with SCS infections, 94.7% of them had an elevated CRP, and many of the patients had leukocytosis following the procedure [22,23]. CRP levels rise 4–6 hours after an acute tissue injury, such as in the post operative period. CRP levels begin to normalize around 14–21 days, and therefore failure of the CRP levels to normalize is a highly sensitive predictor of an infection. ESR can also be measured, however those levels rise slower than CRP and are not as predictable [11]. For this case specifically, given the unusual amount of post operative pain experienced by the patient, and the lack of presenting neurological deficits, ordering a CRP level as well as WBC during the beginning days of the trial could have helped aid in recognition of an infectious process and prompt ordering of imaging. Our patient did not show signs of infection until post operative day 9, with a presenting fever, and therefore a justification for ordering blood cultures could have been more difficult during the initial stages of the trial period. It would also have been difficult to initiate an infectious work up in the first 5 days of the trial for this specific patient due to the problems encountered trying to reach the patient for any type of communication about his SCS trial management.

The early signs and symptoms of an epidural abscess include fever,

pain, and neurological deficits [24]. Gait ataxia was the presenting symptom in the aforementioned published SCS case with cervical epidural abscess but only fever in the current case [20]. Darouiche et al. identified failed back surgery syndrome as being a reason for delayed diagnosis of infection in patients after spinal cord stimulation trials, because these patients already have intractable neck or back pain prior to the procedure with high levels of post procedure related pain [24]. Increased back pain was a common complaint in previous reported cases of epidural abscess following SCS trial [2,7,9]. In the case of our patient, it was difficult to assess whether his pain after the procedure and during the trial was an exacerbation of his baseline radicular pain due to a recent procedure, versus an exacerbation of pain due to a new cause. It is imperative to try and distinguish the origin of the new or worsening symptoms after a procedure in order to help diagnose a potential complication, such as an epidural hematoma or abscess. In agreement with previous authors, the prompt diagnosis and treatment with antibiotics and decompression can result in a favorable outcome [2,7,9].

4. Conclusion

Epidural abscess is a rare complication of SCS trials with only a few reported cases in the literature. This case is the first cervical spine epidural abscess infections following a SCS phase 1 trial. Optimizing SCS trial length to offer patients a chance for pain relief and mitigating the risk of infectious complications remains under clinical judgment. Even in relatively healthy individuals who have received most infectious risk reduction strategies can still develop epidural abscess. Vigilant monitoring to establish the diagnosis promptly with rapid treatment is necessary to avoid neurological complications.

Disclosures

Human subject: Consent was obtained by the participant in this case report.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Thomas Simopoulos reports a relationship with Nevro Corp that includes: consulting or advisory.

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