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Systemic Allergic Reaction to a Spinal Cord Stimulator Trial: A Case Report

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Background: Spinal cord stimulation (SCS) is commonly used for the management of chronic pain conditions, such as intractable axial and radicular back pain, complex regional pain syndrome, and painful peripheral vascular disease. Patients have had adverse complications with SCS trials and permanent implants. Cases of contact dermatitis from SCS devices have been reported, but a systemic allergic reaction to an SCS trial has not yet been published to date.

Case Report: A 52-year-old woman with complex regional pain syndrome type II and a history of a presumed infectious reaction to a previous SCS trial 8 years prior presented with chronic right L5, S1 radicular pain. Having failed conservative measures, she underwent a repeat SCS trial. The lead was placed at the T8 vertebral body, migrated several days later to the T9 vertebral body, and was subsequently adjusted back to T8 under fluoroscopic guidance. The patient reported improvement in her back and leg pain. Three days later, she presented to the emergency department with subjective fever, headache, rigors, chills, diaphoresis, nausea, vomiting, and diarrhea. The lead was removed, and the patient's acute symptoms resolved within 48 hours.

Conclusions: Systemic allergic reactions to SCS can be significant and lead to device removal despite improvement in pain symptoms. Further case reports and studies are needed to elucidate the risks associated with SCS placement, such as allergic reaction, infection, and neurologic injury.

Key words: Case report, spinal cord stimulator, chronic pain, allergic reaction

BACKGROUND

Spinal cord stimulation (SCS) as a therapeutic modality for chronic pain was first reported in 1967 by Shealy et al (1), and today, SCS is considered a well-established treatment for patients with chronic pain conditions that have failed conservative approaches. SCS generates electric fields between metal contacts residing in the epidural space. The subsequent change in electrical potentials across membranes based on tissues near the electrode, such as cerebrospinal fluid and white matter, triggers action potentials in nearby dorsal column axons. This activation of the dorsal columns generates segmental and supraspinal effects via orthodromic and antidromic transmission. The mechanism of neuromodulation is based on the "gate theory for pain transmission." Large myelinated nerve fibers in the dorsal column inhibit the transmission of signals to small unmyelinated fibers in the spinal cord, which leads to pain inhibition (2).

The most common complications of SCS are equipment failure without neurologic injury, and other minor complications, such as implant infection, foreign body reaction, and lead migration. Contact allergy and

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cutaneous complications to the SCS devices have been reported in the literature (3-7), but an allergic reaction to an SCS trial with systemic symptoms, including subjective fever, headache, rigors, chills, diaphoresis, nausea, vomiting, and diarrhea, has not yet been reported to date. We present a case that highlights the concern for a systemic allergic reaction to the biomaterials utilized in SCS devices, which could create barriers to successful SCS implantation for patients with chronic back pain.

CASE PRESENTATION

A 52-year-old woman presented to the outpatient clinic with right L5, S1 radicular pain. The pain was rated 6/10, and described as constant burning, with a sharp, tingling sensation radiating from her back down into her right leg. She had decreased range of motion in the cervical and lumbar spine. Strength testing revealed 5/5 right knee extension, 4+/5 left knee extension, and 5/5 bilateral knee flexion. Magnetic resonance imaging of the lumbar spine showed loss of lordosis, deformed/hypoplastic left facet joint, and right facet joint hypertrophy at L5-S1 with resulting compression and displacement of the traversing right S1 nerve root.

She had a history of complex regional pain syndrome type II of the right ankle secondary to fracture, and a presumed infectious reaction from a previous SCS trial followed by treatment with a course of doxycycline 8 years prior. Her allergies were to codeine (hives), iodine solution (hives, edema), and lobster (itching). She was not a surgical candidate and had failed conservative measures, including physical therapy and a right L5-S1 transforaminal, right L5-S1 interlaminar, and caudal epidural steroid injections. She had tried several pain medications, including nonsteroidal anti-inflammatory drugs, muscle relaxants, and opiates, and her pain remained uncontrolled with a daily regimen of hydromorphone 8 mg 3 times daily, gabapentin 800 mg 3 times daily, and methocarbamol 750 mg 3 times daily. Therefore, the patient decided to try another SCS trial.

Before the procedure, the patient was given cefazolin 2G intravenously (IV) for infection prevention and midazolam 1mg/mL IV for anxiety. Local anesthetic was injected down to just short of the ligamentum flavum. A 14-G Tuohy needle was then advanced to contact the right L1 lamina, and it was walked off in a superior medial direction until it entered the epidural space using the loss-of-resistance technique. The SCS lead, composed of epoxy, fluoropolymer, platinum-iridium, polyurethane, and tantalum, was advanced through the Tuohy needle, and directed to rest the tip at the right T8 superior vertebral body. Once the lead was assured to be in the correct position and coverage of the stimulation was sufficient for the patient, the needle was withdrawn leaving the lead in place. The lead was then secured to the patient's skin using StayFIX (Merit Medical Systems, Inc, South Jordan, UT) and Tegaderm (3M Health Care, St. Paul, MN). The guide wires, needles, and stylets used during the procedure were composed of stainless steel. The procedure was completed without complications, and the patient was discharged in stable condition.

Four days later, the patient reported improvement in her back and leg pain, but mentioned that she was starting to feel unwell with "flu-like" symptoms. Static anteroposterior fluoroscopic pictures were taken and showed that the SCS lead had migrated to the top of the T9 vertebral body. The SCS lead was repositioned to the top of T8, the device was interrogated, and the patient reported good bilateral coverage. Keflex 500 mg 3 times daily for 3 days was prescribed to prevent infection. The plan was to remove the lead in 6 days.

Three days later, the patient presented to the emergency room with acute onset of subjective fever, headache, rigors, chills, diaphoresis, nausea, vomiting, and diarrhea. She reported constant aching and burning in her back, with a pain level of 6/10. Her temperature was 98.7°F, heart rate was 105, blood pressure was 149/92, respiratory rate was 16, and oxygen saturation was 100% on room air. The SCS lead insertion site was erythematous and tender to palpation. The lead was removed and within 48 hours, the patient's acute symptoms had fully resolved. Follow-up complete blood count with differential, erythrocyte sedimentation rate, and C-reactive protein laboratory results were unremarkable.

DISCUSSION

In the United States, the most common indication for SCS placement is chronic pain from failed back surgery syndrome (8), and based on meta-analysis data (9), SCS significantly increased the odds of reducing intractable spine pain by 50%. Indications for SCS include chronic pain that has failed conservative approaches, including axial back pain, radicular pain, complex regional pain syndrome, painful peripheral vascular disease, intractable angina, and painful diabetic neuropathy (10). The primary etiology of our patient's chronic back pain was discogenic in nature with associated lumbar radiculitis. Since the patient had persistent and worsening back pain after failing multiple conservative measures, SCS

was the most appropriate next step in terms of therapeutic intervention.

SCSs are composed of an implantable pulse generator (battery), leads, and electrode contacts on the ends of the leads. The battery is covered by a metallic casing, usually titanium, and the leads are insulated cables that are usually composed of silver, stainless steel, or nickel alloy and coated with silicone or polyurethane insulation. The electrode contacts at the site of stimulation are made of a variety of metals, including stainless steel, gold, and platinum-iridium (11). The lead, guide wire, needles, and stylets utilized in our patient's SCS trial were composed of epoxy, fluoropolymer, platinum-iridium, polyurethane, tantalum, a cobalt-nickel-chromium-molybdenum alloy (MP35N), and stainless steel.

Hypersensitivity reactions initiated by immunologic mechanisms can occur iatrogenically whenever a foreign substance is introduced to the body. Several published papers (11-14) have reported cases of type IV hypersensitivity, or delayed hypersensitivity reactions, to SCS implant materials. Pruritic erythematous rashes overlying the SCS generator site, due to a suspected nickel allergy, have led to eventual device removal despite the SCS providing significant improvement in pain symptoms (3). Similar cases (6,7) where patients experienced improvement in pain, but ultimately had SCS devices removed due to nickel and other metal-induced contact dermatitis have been reported. Histopathological examination of such rashes has demonstrated foreign-body granuloma formation (4). Epidural electrode encapsulations have also been documented in several published reports (15-17), due to the activation of fibroblasts by the local toxicity of metal particles generated by corrosion of electrodes, leading to spinal cord compression and neurologic deficits. Identification of the antigen with epicutaneous patch testing has allowed successful reimplantation of SCS devices with components of which had be found to be unreactive on skin testing (5).

Systemic adverse reactions to epidural injections, including facial flushing, diarrhea, nausea, vomiting, night sweats, headache, chills, and dizziness have been published (18). However, a case of such systemic symptoms to an SCS trial involving fever, headache, rigors, chills, diaphoresis, and gastrointestinal symptoms has not yet been reported to date. The differential of our patient's adverse reaction includes hypersensitivity to implant biomaterials, infection, psychomotor reaction, or sympathetic hyperreflexia.

Erythema was visible at the incision site with no purulent discharge or edematous skin changes, which could indicate a hypersensitivity reaction, such as contact dermatitis (4). An infectious etiology is less likely since the patient's acute symptoms started after a 3-day course of oral Keflex and fully resolved within 48 hours of SCS lead removal. A systemic infection would likely have persisted after SCS lead removal and warranted IV antibiotic treatment. Anxiety-related symptoms, including tachycardia and nausea, could possibly explain the patient's reaction, particularly in the setting of the patient's previous diagnosis of generalized anxiety disorder, but the timing of symptom onset 7 days after initial lead placement and 3 days after lead location adjustment does not fit a typical psychomotor reaction due to anxiety regarding the procedure. The timing of symptoms within a week and migration of the lead to the T9 vertebral body and readjustment to the T8 vertebral body without injury above the T6 level make autonomic dysreflexia less likely. However, the patient's tachycardia, hypertension, diaphoresis, nausea, and vomiting could be considered characteristic of the sympathetic surge associated with a lack of compensatory descending parasympathetic stimulation that can oftentimes be seen after an injury to the spinal cord above the level of T6. There are few reports of autonomic dysreflexia occurring after lesions below T6, but due to the maintenance of some degree of control over splanchnic sympathetic outflow, the magnitude of the changes in heart rate and blood pressure tends to be milder (19).

The symptoms that the patient experienced to this SCS trial were reported to be similar to the adverse reaction that she experienced to the previous SCS trial 8 years prior, which supports an allergic etiology. The contact, insulation, and conductor materials of the first SCS device were similar to the second SCS device, including platinum[-]iridium, polyurethane, and MP35N, along with stainless steel needles. The patient also mentioned that her father could not have a pacemaker placed because he too had an adverse reaction to it. Both cardiac and neurostimulators are composed of plastics, resins, and metal alloys, all of which have been shown to cause sensitization. Pacemaker hypersensitivity reactions can involve fever, chills, nausea, vomiting, and painful localized cutaneous erythema and edema (20). The best explanation for our patient's symptoms is a combination of a cutaneous and systemic hypersensitivity reaction to SCS biomaterials due to the abrupt onset and resolution of symptoms after lead placement and removal.

CONCLUSIONS

Systemic allergic reactions should be discussed as potential risks related to SCS trials during the preprocedural informed consent process with the patient. A high degree of vigilance should be maintained when considering SCS trials, and further studies are needed to better understand the possible adverse outcomes associated with SCS trials and permanent implantation.

Disclosure

The retrospective analysis of a single patient's experience with standard treatments is a medical/educational activity and does not meet the Federal Policy for the Protection of Human Subjects definition of "research." Therefore, our case report does not require review or exemption by the Institutional Review Board. The patient has provided consent for this case to be published in accordance with the Health Insurance Portability and Accountability Act privacy regulations, and all personal identifiers were removed from this case report.

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