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# **MANAGEMENT OF PULMONARY EMBOLI DURING A SPINAL CORD STIMULATOR TRIAL: A CASE REPORT**

Varun Rimmalapudi, MD  
Kacey Montgomery, MD  
David Fairleigh, MD

**Background:** Neuromodulation has been used in the management of chronic pain for well over 30 years and is becoming increasingly relevant in the face of the ongoing opioid epidemic. Although this therapy continues to provide pain relief and improvement in function to patients with a wide variety of pathologies, several complications have been described ranging from lead migration to development of a granuloma causing cord compression. Although not described in the literature, a pulmonary embolism can be one of the rare complications of a spinal cord stimulation procedure, and when it happens during the trial period of spinal cord stimulation, it involves significant challenges in the clinical management of anticoagulation in the patient.

**Case Report:** We present a case in which a patient developed bilateral pulmonary emboli (PE) during the trial phase of spinal cord stimulation. The patient did have a prior history of PE, had an inferior vena cava filter in place, and was on anticoagulation, which was held as per the current American Society of Regional Anesthesia guidelines prior to the spinal cord stimulator (SCS) trial.

**Conclusion:** A pulmonary embolus is a possible complication from an SCS trial, especially in patients with preexisting thromboembolic risk factors. Management must involve multidisciplinary care focused on balancing the risks of thrombosis with those from a potential epidural hematoma at the time of lead removal.

**Key words:** Spinal cord stimulation, pulmonary embolus, spinal cord stimulator complications, neuromodulation, venous thromboembolism, SCS trial, VTE, PE

From: Clearway Pain Solutions Institute, Pensacola, FL

Corresponding Author: Varun Rimmalapudi, MD, Clearway Pain Solutions Institute, 4901 Marketplace Rd, Pensacola, FL 32504

E-mail: abcdvarun@gmail.com

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## BACKGROUND

Spinal cord stimulation is a technique that is being used with increasing frequency to provide long-term pain relief and improvement in quality of life for patients suffering from chronic low back pain, lumbar radiculopathy, complex regional pain syndrome, and postlaminectomy syndrome. Although the overall risk of complications remains low (1,2), a wide range of complications have been described ranging from pain at the surgical site, lead migration and cerebrospinal fluid leakage to epidural abscess (3), lead fracture (4) and cord compression from epidural fibrosis (5), or granuloma formation (6). Anticoagulant therapy does increase the risk of procedural complications but holding anticoagulant therapy could also potentially lead to systemic complications. A shared decision-making approach between the proceduralist and the prescribing physician has been advocated in the current safety guidelines (7). Although thromboembolic events including pulmonary emboli (PE) are understood to occur with increased frequency in the postoperative or postprocedural state, to our knowledge, occurrence of this particular complication has not been reported in the literature after the performance of a spinal cord stimulator (SCS) trial. The management of a pulmonary embolus poses a unique challenge in a patient with in situ SCS trial leads, as the benefit of anticoagulant therapy for PE must be balanced with the risk of epidural hematoma formation.

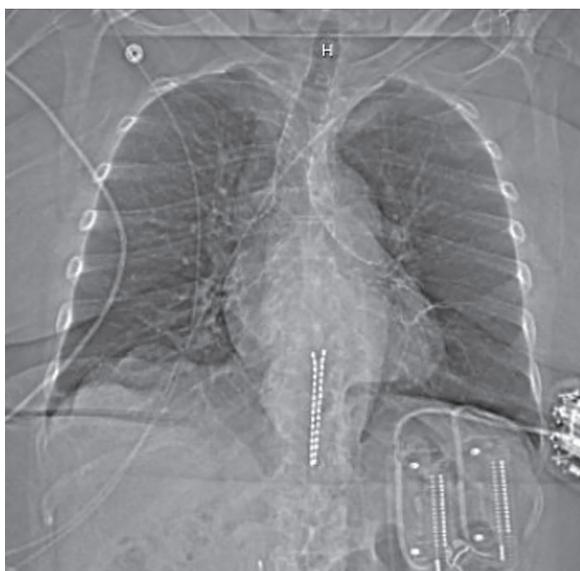


Fig. 1. Scout x-ray image showing SCS leads in place.

## CASE REPORT

A 77-year-old woman with a past medical history significant for a pulmonary embolus and a prior inferior vena cava (IVC) filter placement on anticoagulation therapy with warfarin presented to our practice for management of chronic low back pain. A multimodal treatment plan was initiated, including conservative care and medication management. After failure of other interventions, including lumbar facet interventions and epidural steroid injections, the patient was offered a trial of spinal cord stimulation. Medical clearance was obtained for warfarin to be held for 5 days prior to the procedure and for the duration of the trial, which was planned for 5 days. The SCS trial procedure was completed uneventfully, and the patient was discharged home with the percutaneous SCS leads and the temporary SCS system (Fig.1). About 8 hours into the SCS trial, the patient experienced an episode of shortness of breath, lightheadedness, and fainting. She was admitted to the hospital and workup, including a duplex ultrasound of bilateral lower extremities and a computed tomography (CT) angiogram of the chest, was completed. A CT scan of the abdomen was also performed and revealed appropriate positioning of the existing IVC filter (Fig.2.). The ultrasound revealed no evidence of deep vein thrombosis (DVT) in the lower extremities, but the CT angiogram revealed bilateral PE (Fig.3). She was started on therapeutic anticoagulation with Lovenox (Sanofi-Aventis, Bridgewater, NJ). After a multidisciplinary discussion between the specialties of pain medicine, internal medicine, hematology, and critical care regarding the concomitant management of the PE and the ongoing SCS trial, the decision was made to maintain therapeutic anticoagulation for at least 72 hours, and to convert the anticoagulation to a heparin drip to allow for shorter period of "anticoagulation hold" at the time of lead removal. In the interim, the SCS leads were left in place, and the SCS trial was continued with the patient reporting over 90% pain relief from her usual back and lower extremity pain. After continued multidisciplinary discussions, the decision was made to hold the heparin drip for 4 hours prior to removal of the leads. The lead removal was performed in a monitored setting on day 5 of hospitalization. The hospital's neurosurgical and anesthesiology teams were alerted, and an operating room kept on hold considering the possibility of an epidural hematoma requiring surgical intervention. The patient was made NPO (nothing by mouth) for 6 hours prior to the planned lead removal in preparation for the same.

After the lead removal, the patient remained in an intensive care unit setting with neurologic checks every 30 minutes. The heparin drip was restarted 6 hours after the lead removal. There were no changes noted on the patient’s neurologic examination, and she was subsequently discharged home uneventfully. Written informed consent was obtained from the patient to publish the clinical details including diagnostic images.

**DISCUSSION**

Venous thromboemboli (VTE) and PE are 2 of the most common causes of cardiovascular morbidity and have been collectively identified as the third most common cause of cardiovascular death after myocardial infarction and cerebrovascular accidents (8). One in 4 deaths worldwide have been attributed to thromboembolic conditions (9). The “Virchow’s triad” of hypercoagulability, venous stasis, and vessel wall injury are said to play a role in the pathophysiology of emboli formation. Risk factors include immobilization, surgery, recent trauma, cerebrovascular accident, advanced age, a prior history of VTE/PE, malignancy, smoking, obesity, and pregnancy. Symptoms can include dyspnea, pleuritic pain, and cough. Tachypnea and tachycardia are often noted. A high index of suspicion is essential in making an early diagnosis of PE, especially while managing patients with risk factors. CT angiography can permit direct visualization of the embolus. Early initiation of anticoagulation is paramount along with supportive care of hypoxemia and hemodynamic instability (10). IVC filter placement can be considered in patients with recurrent episodes or with contraindications to anticoagulation, although

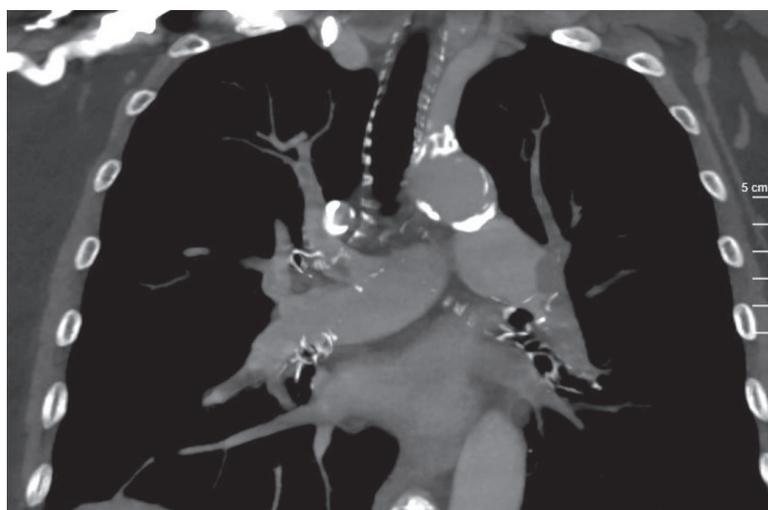


Fig. 3. CT scan of the abdomen showing patient’s IVC filter in place.

breakthrough PE has been reported to occur in up to 6.2% of cases despite implantation of a permanent IVC filter (11,12). In light of our patient’s ultrasound of the lower extremities revealing no signs of DVT, and with an IVC filter that was in place preprocedurally, it is likely that the origin of the thrombus was upstream from the IVC filter.

An SCS trial is an invasive procedure that can promote the “vessel wall injury” component of “Virchow’s

Fig. 3. CT angiogram noted large PE in the left main pulmonary artery extending into the left upper and lower lobes, and suggestion of right upper and lower lobe PE.



Triad” owing to the procedural trauma. Although an improvement in functional status by the end of the trial phase is often used as one of the measures of success of the SCS trial, patients can report a reduction in their mobility, especially during days 0 through 2 of the SCS trial. This reduction may be attributable to procedural sedation, procedural pain, and discomfort. We believe this played a role in our patient, as she exhibited the symptoms of PE within a few hours of initiation of the SCS trial. Although a PE is among the complications that could be associated with an SCS trial, to our knowledge, such an event has yet to be reported in the literature. We searched PubMed and Embase databases and were unable to find a case similar to the one presented. The presented case reemphasizes the value of weighing the risk of thromboembolic complications in patients with preexisting risk factors prior to offering them the option of neuromodulation for pain control. This also illustrates the significant challenges involved in the management of a pulmonary embolus during an SCS trial. The current American Society of Regional Anesthesia guidelines (13) were followed preprocedurally in terms of holding the patients warfarin prior to the procedure. The guidelines do recommend a shorter trial for patients at higher risk of thromboembolic complications. The use of anticoagulation, prophylactic or therapeutic, in patients with in situ temporary epidural catheters or SCS leads is controversial and is a decision made based on the clinical scenario.

The recommendation for discontinuing intravenous heparin is a duration hold of at least 6 hours before and 24 hours after lead removal, but the presence of an active PE limited the application of this recommendation to our patient. The pharmacokinetics of unfractionated heparin differ significantly in patients with active thrombosis owing to changes in the circulating levels of heparin binding proteins, and these patients exhibit

“heparin resistance” requiring higher doses of heparin to achieve a therapeutic response (14,15). In addition to these pharmacokinetic considerations, the decisions to stop the heparin drip 4 hours prior to removal of the SCS trial leads and to restart the drip 6 hours after the removal were made after a multidisciplinary discussion, carefully weighing the risk of epidural hematoma with that of undertreatment of the existing pulmonary thrombus. Finally, it is of paramount importance to be prepared to handle untoward consequences, such as an epidural hematoma, and prepare for surgical evacuation by having the patient and surgical teams ready in case such a scenario arises.

## **CONCLUSIONS**

To our knowledge, this is the first report of a pulmonary embolus occurring during a spinal cord stimulation trial. Careful consideration must be given to thromboembolic complications prior to considering invasive spinal procedures in patients with preexisting risk factors. When such complications do occur, management must be guided by a multidisciplinary team approach, weighing the risks of worsening thromboemboli with bleeding-related complications. Adequate preparation must always be made to handle the possible scenario of an epidural hematoma requiring surgical evacuation.

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