

DIFFICULT SINGLE-LEAD SPINAL CORD STIMULATOR TRIAL FOR FAILED BACK SURGERY SYNDROME SALVAGES TREATMENT

Christopher L. Robinson, MD, PhD¹, Anh Phung, MD¹, Moises Dominguez, MD², Sravya Madabushi, MD¹,
Tony El-Hayek, DO¹, Omar Viswanath, MD³⁻⁵, Jamal Hasoon, MD⁶, and Cyrus Yazdi, MD¹

Background: Spinal cord stimulation (SCS) is a minimally invasive neuromodulation treatment modality primarily used for failed back surgery syndrome (FBSS), complex regional pain syndrome, and diabetic neuropathy. Specifically, when utilized for the treatment of FBSS, placement can be complicated by the excessive scarring, adhesions, and altered anatomy limiting the access to the epidural space and advancement of the leads.

Case Report: Our patient is a 58-year-old woman with a history of scoliosis and severe lumbar spinal stenosis who presented for trial of an SCS for FBSS. Given the refractory nature to medical and minimally invasive management, an SCS trial was performed. Unfortunately, due to the extensive fibrosis and adhesions in her epidural space, only a single lead could be placed but experienced pain relief. During the permanent SCS, 2 leads were successfully placed with the patient ultimately receiving > 50% pain relief.

Conclusions: Here, we present a case of FBSS refractory to medical and minimally invasive management where a single SCS lead was placed during the trial, due to scarring and adhesions, and 2 leads during the permanent SCS procedure. Our case report suggests considering even the trial of a single-lead placement during an SCS trial in patients with an otherwise difficult anatomy, as the placement of the permanent lead offers greater access to the epidural space potentially allowing for the placement of a second lead and potentially salvaging the entire therapy.

Key words: Spinal cord stimulator, spinal stenosis, single lead, failed back surgery syndrome

BACKGROUND

Spinal cord stimulation (SCS) is a minimally invasive neuromodulation treatment modality primarily used for failed back surgery syndrome (FBSS), complex regional pain syndrome, and diabetic neuropathy (1-3). An impulse generator delivers pulses of varying frequencies through electrodes placed in the epidural space to interfere with the transmission of pain signals

in the dorsal column (2-5). This proposed mechanism originated from the gate control theory, wherein the activation of A-beta fibers, located in the dorsal columns or dorsal roots, serve to augment the nonnoxious large-fiber input into the spinal pain-gating circuitry (6). The patient will first undergo a trial with temporary leads and an external impulse generator; if there is improvement of pain with the trial, longer-term, permanent

From: ¹Beth Israel Deaconess Medical Center, Department of Anesthesia, Critical Care, and Pain Medicine, Harvard Medical School, Boston, MA; ²Department of Neurology, Weill Cornell Medical College, New York Presbyterian Hospital, New York, NY; ³Valley Anesthesiology and Pain Consultants, Phoenix, AZ; ⁴Creighton University School of Medicine, Department of Anesthesiology, Omaha, NE; ⁵Louisiana State University Health Sciences Center School of Medicine, Department of Anesthesiology, Shreveport, LA; ⁶UTHealth McGovern Medical School, Department of Anesthesiology, Critical Care and Pain Medicine, Houston, TX

Corresponding Author: Cyrus Yazdi, MD, E-mail: cyazdi@bidmc.harvard.edu

Disclaimer: C Robinson and A Phung contributed equally to this work. There was no external funding in the preparation of this manuscript.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Patient consent for publication: Consent obtained directly from patient(s).

Authors adhere to the CARE Guidelines for writing case reports and have provided the CARE Checklist to the journal editor.

Accepted: 2023-11-14, Published: 2023-12-31

leads with a subcutaneous impulse generator will be implanted (3-5). The SCS leads will often thread with ease into the posterior epidural space, but can occasionally be difficult due to anatomy, body habitus, or scarring from prior procedures or conditions. If difficult access is encountered during trials but a positive result is later achieved, continuation to a permanent placement may be beneficial as the manual dissection during the permanent placement provides better access to the epidural space.

Specifically, when utilized for the treatment of FBSS, placement can be complicated by the excessive scarring and adhesions limiting access to the epidural space and advancement of the leads (7,8). Despite difficult access, evidence suggests that the use of SCS provides a superior level of pain relief as compared to repeat surgery or medical management (9). Currently, the data are limited on factors that may make SCS lead placement in an otherwise difficult patient population with less than straightforward anatomy (7). Here, we present a case of a difficult SCS placement such that only a single lead was able to be advanced during the trial. Despite the use of a single lead, the patient experienced significant improvement of her pain and proceeded with placement of a permanent lead. Given the manual dissection, 2 permanent leads were placed offering this patient a final avenue for pain relief.

CASE

Our patient is a 58-year-old woman with a history of scoliosis and severe lumbar (L3-L4) spinal stenosis who presented for a trial of an SCS for FBSS. Her surgical history is notable for a lumbar decompression with L2-L5 laminectomy, bilateral foraminotomies, and T4-T10 fusion, which resulted in severe FBSS. After her lumbar decompression and fusion, the patient continued to have severe lower back pain with radiculopathy and thoracic paraspinal pain.

The patient then was trialed on opioids (hydromorphone and tramadol), antiepileptic drugs (gabapentin and pregabalin), and nonsteroidal anti-inflammatory drugs (ibuprofen), with the most effective, yet temporary in nature, being her oral hydromorphone and ibuprofen. Furthermore, lumbar epidural steroid injections (LESI) and lumbar and thoracic medial branch blocks (MBB) were performed with minimal improvement of her pain. Given the refractory nature, an SCS trial was performed.

The SCS trial, including further procedures, was done

under standard sterile operating conditions for percutaneous SCS lead placement. The patient was positioned prone, sterile drapes placed, and the site of incision and insertion was anesthetized with local anesthetic. The epidural space was localized under intermittent fluoroscopic guidance using the loss-of-resistance technique. Due to the extensive scar tissue and adhesions in her epidural space, only a single lead could be passed under fluoroscopy at the available space of T12-L1 on the left with no further advancement past the bottom of T10 (Fig. 1). Despite a single lead and minimal advancement, she received > 50% of pain relief of her lower back pain and radiculopathy. Since the lead could not be advanced further than T10, she was referred to neurosurgery for the placement of a permanent paddle lead but declined. She was then scheduled for a placement of a permanent lead by the chronic pain specialist.

During placement of the permanent SCS, 2 leads were successfully passed into the epidural space at the L1-L2 space, given the manual dissection, and better access to the space than at the trial (Fig. 2). The left lead was advanced to the bottom of T10 and the right to the top of T11 (Fig. 2). During follow-up, the patient expressed > 50% pain relief with the permanent SCS.

DISCUSSION

The use of SCS for the alleviation of FBSS can be rather complicated in a patient population with an already difficult anatomy partially resulting from the very back surgeries intended to provide relief. Prior to performing any SCS procedure on this FBSS population, all relevant imaging should be reviewed thoroughly, and a detailed relevant clinical history and physical examination should be obtained. Despite a proper assessment, the likelihood of encountering further difficulty with this patient population remains unknown as there remains a scarcity of data on factors affecting lead placement in this patient population. Some known factors that may present difficulty, in general, include facet hypertrophy, narrowed interlaminar spaces, osteophytes, and disruption of the ligamentum flavum (7). With this information at hand, the patient should be informed of the possible difficulty with placement and increased risk of complications.

Though there is increased difficulty with placement in these patients, numerous case reports have demonstrated success, including using alternative methods for approaching the epidural space or in patients who would otherwise be a difficult candidate (7,10-12). One

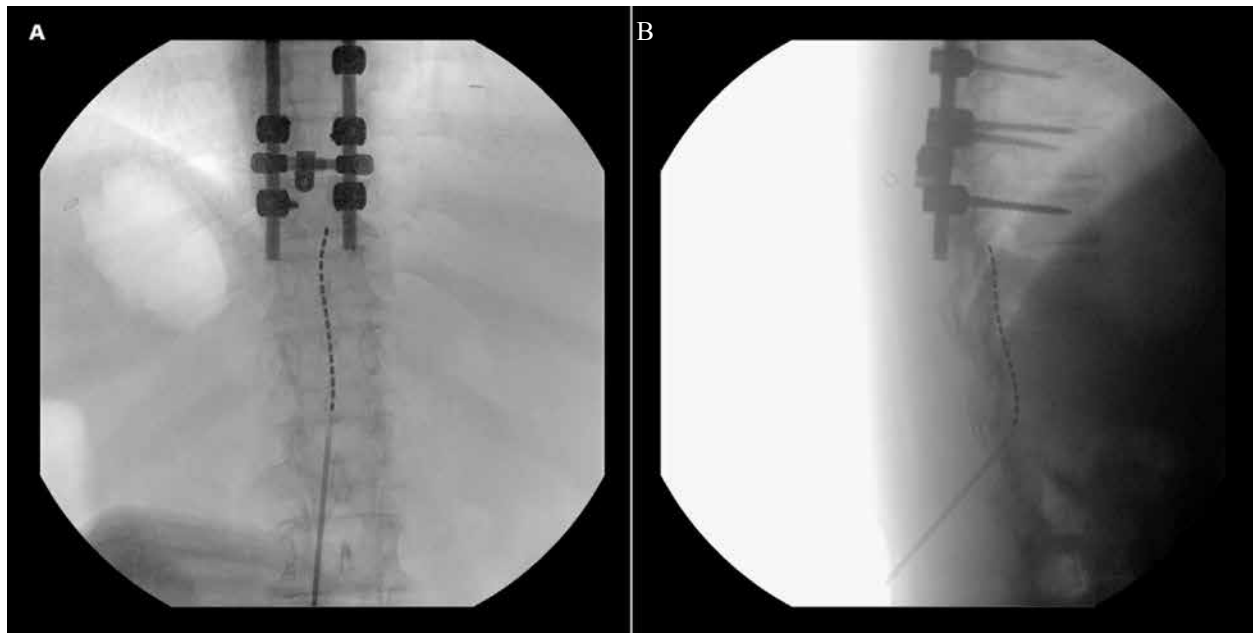


Fig. 1. Fluoroscopic images of the SCS trial with the single lead shown in the anteroposterior (A) and lateral (B) views. SCS, spinal cord stimulation.

report utilized the transforaminal space with success after 3 previous attempts lead to dural punctures in a patient with prior fusion (anterior L3-S1 and posterior T9-S1) and laminectomies (T12-L5) (7,10). In our case, manual dissection offered better access to the epidural space that would have otherwise been inaccessible.

CONCLUSIONS

SCS for FBSS frequently employs dual parallel leads to superimpose electric fields for optimal paresthesia coverage. As this is challenging to accomplish with a single epidural lead, it has become a conventional practice to implant dual trial and permanent leads for FBSS to maximize pain relief. However, the placement of dual trial leads can be complicated, or even impossible in some cases, due to the excessive scarring and adhesions limiting access to the epidural space and advancement of the leads in patients with FBSS. These limitations can be overcome during the permanent lead placements, as manual dissection facilitates a more straightforward entry to the epidural space. Here, we present a case of FBSS refractory to medical management, including minimally invasive options, such as LESI and MBBs, such that only a single SCS lead can be placed during the trial. This case report demonstrates that a positive single-lead trial serves as a viable approach to FBSS patients with

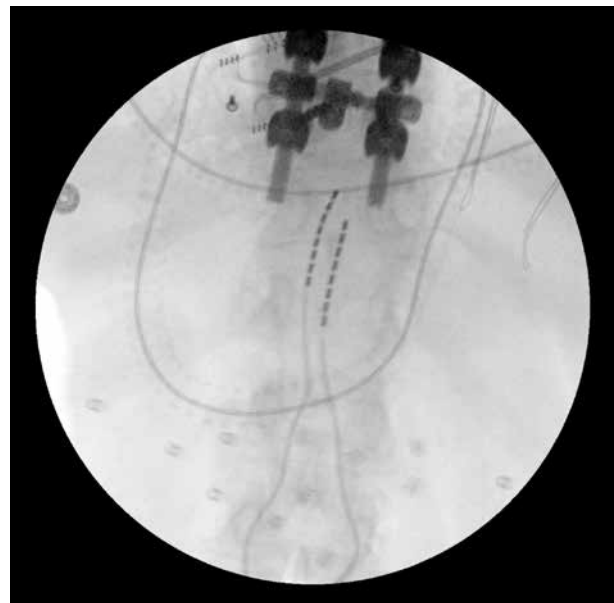


Fig. 2. Fluoroscopic image demonstrating the 2 SCS permanent leads during placement in the anteroposterior view. SCS, spinal cord stimulation.

difficult access, as there is a strong probability that dual permanent leads can be positioned to emulate and enhance paresthesia coverage, offering patients an eventual avenue for pain relief.

REFERENCES

1. Petersen EA, Stauss TG, Scowcroft JA, et al. Effect of high-frequency (10-kHz) spinal cord stimulation in patients with painful diabetic neuropathy: A randomized clinical trial. *JAMA Neurol* 2021; 78:687-698.
2. Verrills P, Sinclair C, Barnard A. A review of spinal cord stimulation systems for chronic pain. *J Pain Res* 2016; 9:481.
3. Eckermann JM, Pilitsis JG, Vannaboutathong C, Wagner BJ, Province-Azalde R, Bendel MA. Systematic literature review of spinal cord stimulation in patients with chronic back pain without prior spine surgery. *Neuromodulation* 2022; 25:648-656.
4. Li SL, Li J, Xu HC, Liu YC, Yang TT, Yuan H. Progress in the efficacy and mechanism of spinal cord stimulation in neuropathological pain. *Ibrain* 2022; 8:23-36.
5. Sdrulla AD, Guan Y, Raja SN. Spinal cord stimulation: Clinical efficacy and potential mechanisms. *Pain Pract* 2018; 18:1048.
6. Caylor J, Reddy R, Yin S, et al. Spinal cord stimulation in chronic pain: Evidence and theory for mechanisms of action. *Bioelectron Med* 2019; 5:12.
7. Baranello RJ, Walker JT, Sobey CM. A retrospective case series of difficult percutaneous dorsal column stimulator epidural lead placement for failed back surgery syndrome pain medicine case reports. *Pain Med Case Rep* 2021; 5:325-331.
8. Robertson JT. Role of peridural fibrosis in the failed back: A review. *Eur Spine J* 1996; 5(suppl 1): S2-S6.
9. Palmer N, Guan Z, Chai NC. Spinal cord stimulation for failed back surgery syndrome -- patient selection considerations. *Transl Perioper Pain Med* 2019; 6:81.
10. Choi HR, Fuller B, Bottros MM. Successful transforaminal epidural blood patch in a patient with multilevel spinal fusion. *Reg Anesth Pain Med* 2020; 45:746-749.
11. Ghaly RF, Lissounov A, Tverdohle T, Kohanchi D, Candido KD, Knezevic NN. Spinal neuromodulation as a novel surgical option for failed back surgery syndrome following rhBMP exuberant bony growth in instrumented lumbar fusion: A case report and literature review. *Surg Neurol Int* 2016; 7:S668-S674.
12. Okpareke I, Young AC, Amin S. Spinal cord stimulator placement in a patient with complex regional pain syndrome and ankylosing spondylitis: A novel approach with dual benefits. *A A Case Rep* 2014; 2:117-120.