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Case Report

# Novel Use of Intraoperative Dexmedetomidine Infusion for Sedation During Spinal Cord Stimulator Lead Placement via Surgical Laminectomy

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**Background:** Spinal cord stimulators are most often placed through a percutaneous approach using minimal sedation and local anesthesia to facilitate intraoperative testing. However, when leads need to be placed using a laminectomy incision additional anesthesia is required which can complicate intraoperative testing. There is no consensus as to the best anesthetic choice when laminectomy-placed leads are required.

**Objective:** We present 2 cases where spinal cord stimulator leads were implanted through a surgical laminectomy under sedation using dexmedetomidine infusion and local anesthesia to provide a cooperative patient for intraoperative testing.

**Case Report:** Patient #1: A 40-year-old female with Complex Regional Pain Syndrome secondary to an automobile accident who had good pain control with a spinal cord stimulator until a lead fracture resulted in loss of stimulation. She required a laminectomy-placed lead which was implanted under dexmedetomidine infusion and local anesthesia.

Patient #2: A 54-year-old female with Failed Back Syndrome who had good pain control until a lead fracture resulted in loss of stimulation. She underwent a laminectomy-placed lead, new battery pocket, and removal of the old system under a dexmedetomidine infusion and local anesthesia.

**Limitations:** Report of only 2 cases.

**Conclusions:** The anesthetic management from a laminectomy-placed spinal cord stimulator can present a difficult choice. A general anesthetic or even deep sedation can provide good operative conditions but limits intraoperative testing or in the case of deep sedation risks losing the airway in the prone position. On the other hand, minimal sedation, which facilitates intraoperative testing, can make the surgical procedure extremely uncomfortable or even unbearable. Dexmedetomidine infusion and local anesthesia provide sedation for the operative portions while rendering the patient alert and cooperative during intraoperative testing.

**Key words:** Spinal Cord Stimulator, dexmedetomidine, percutaneous, laminectomy, intraoperative, sedation

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Spinal Cord Stimulator (SCS) lead placement is often performed via the percutaneous approach to the epidural space while the patient enjoys light sedation (1-5). Patient feedback during placement of the leads is critical to achieving the correct level and pain pattern coverage for maximal pain relief. However, sometimes leads must be placed via a traditional laminectomy approach, requiring more intense sedation or even general anesthesia (6). This can make the intraoperative testing very

difficult or impossible. We present 2 cases where dexmedetomidine infusion, without invasive airway support, was used as the major anesthetic drug during the dissection and closure phases of surgery, while also rendering the patient awake and cooperative for intraoperative testing.

## Case Descriptions

### Patient #1

This patient was a 40-year-old, 70-kilogram (kg) female who presented with a failed SCS originally placed for Complex Regional Pain Syndrome (CRPS) of the left lower extremity after suffering an ankle fracture secondary to an automobile accident. She had good coverage until a lead fracture resulted in loss of stimulation. After a failed percutaneous revision, the patient was scheduled for SCS lead placement via lumbar laminectomy.

On the day of surgery, her preoperative evaluation included a standard anesthetic assessment with particular attention to her airway and her ability to maintain spontaneous ventilation during prone sedation. Two peripheral intravenous catheters (PIV) were placed and one milligram (mg) of midazolam was then administered. Initial vital signs were blood pressure 103/57mmHg, heart rate 72, respiratory rate 20, and oxygen saturation on room air 99%. She was taken to the operating room where she was able to position herself on the operating table in the prone position. Non-invasive hemodynamic monitors were attached, including electrocardiography, blood pressure, pulse oximetry, and end-tidal carbon dioxide (ETCO2) monitoring (via a nasal cannula with sidestream monitoring). Dexmedetomidine infusion was then instituted through a dedicated PIV, with an initial bolus of 1 mcg/kg over 10 minutes. Oxygen saturation, heart rate, blood pressure, and respiratory rate were monitored continuously and recorded every 5 minutes. Of note, a slight but expected drop in heart rate and blood pressure to 60 bpm and 90/50 mmHg respectively occurred; neither required intervention. No changes in oxygen saturation occurred during the anesthetic. Following completion of the bolus, a maintenance infusion of dexmedetomidine was begun at 0.7mcq/kg/hour. Once the patient was deeply sedated, as judged by voluntary responsiveness only to physical stimulation, surgery was allowed to proceed.

The surgeons began by injecting 0.5% lidocaine with epinephrine 1:200,000 (cumulative dose of 365 mg of lidocaine) at the planned incision site. The surgeons carried out a formal laminectomy in a standard fashion. On occasion, the patient demonstrated evidence of pain as judged by verbal confirmation or small movements. Additional local anesthetic was administered, and the patient quickly returned to a sedated state.

Prior to the period of stimulation testing, the dexmedetomidine infusion was stopped. Twenty minutes later, the patient was conversant and cooperating with testing. Two SCS leads were placed at the L1 laminectomy, and the patient reported good stimulation and complete coverage of her pain. The dexmedetomidine infusion was resumed at the rate of 0.7mcq/kg/hour (without bolus), and an additional one mg of midazolam was administered. The incision was then closed, and the dexmedetomidine infusion was discontinued after 195 minutes of surgery. She had an uneventful postoperative course, and was discharged home on postoperative day one reporting a favorable experience.

### Patient #2

This patient was a 54-year-old, 78 kg female with a long-standing history of back pain. Patient had a SCS placed 5 years prior for failed back syndrome. She enjoyed good pain control until a lead fracture resulted in loss of stimulation. Given her history of multiple back surgeries and the need to replace both battery and leads, a neurosurgical consult was obtained. The patient's SCS revision was planned with a formal thoracic laminectomy approach with intraoperative testing.

Preoperatively, in addition to a complete anesthetic evaluation, special attention was focused on the patient's ability to maintain spontaneous ventilation in the prone position. Initial vital signs were blood pressure 144/64 mmHg, heart rate 82, respiratory rate 20, and 95% oxygen saturation on room air. Two PIVs were placed, and after one mg of midazolam, the patient was taken to the operating room where she placed herself in the prone position. Non-invasive hemodynamic monitors, including electrocardiography, blood pressure, pulse oximetry, and end-tidal carbon dioxide (ETCO2) monitoring (via a nasal cannula with sidestream monitoring) were attached. Oxygen saturation, heart rate, blood pressure, and respiratory rate were monitored continuously and recorded every 5 minutes. The dexmedetomidine loading dose was instituted at one mcq/kg over 10 minutes through the dedicated intravenous line, followed by a maintenance infusion at a rate of 0.5 mcq/kg/hour.

Once the patient was appropriately sedated, as judged by responsiveness to verbal and physical stim-

ulus, the surgery was allowed to proceed. The surgeons began by injecting 0.5% lidocaine with 5 mcq/cc epinephrine (total dose 375 mg lidocaine). Because the patient woke during the initial injection, the dexmedetomidine infusion was increased to 0.7mcq/kg/hour and maintained at that rate. Corresponding to this patient arousal, blood pressure increased to 160/60 mmHg; however, this returned to her baseline blood pressure with the increased dexmedetomidine infusion rate and 25mcq of fentanyl. Her heart rate did slow during the procedure to 60 beats per minute, but no change in oxygen saturation occurred. After the laminectomy, 2 leads were placed into the epidural space. The infusion was discontinued 10 minutes prior to testing, and the patient was easily awakened and fully cooperative with testing. After satisfactory stimulation, the dexmedetomidine infusion was resumed at 0.7 mcq/Kg/hour with an additional one mg of midazolam. Once the patient was again sedated, a new battery pocket was created. The removal of the old system and closure of the laminectomy concluded the procedure. Infusion was discontinued after 150 minutes of surgery. The patient was discharged later that day without complaints and very happy with her experience.

## Discussion

In these 2 case reports, we describe the novel use of dexmedetomidine for sedation during SCS lead placement via traditional laminectomy. This technique provided adequate anesthesia during intense surgical stimulation yet, with brief interruption of the infusion, also allowed the patient to follow commands and answer questions appropriately.

Dexmedetomidine is a selective alpha-2 agonist that produces sedation and analgesia with minimal respiratory depression. It has an extremely short redistribution half-life (6 – 9 minutes), making it ideally suited as an easily titratable infusion (4). Currently, the use of dexmedetomidine has been described in a variety of clinical situations: short and long-term sedation in the intensive care unit; sedation during awake craniotomy in the operating room; and pediatric sedation in the MRI suite (7-10). We have expanded the clinical role for dexmedetomidine to include deep sedation of patients without invasive airway support in the prone position. This technique might also offer better sedation for patients during SCS trials or for hyperalgesic patients who require deep sedation for other interventional pain procedures. Caution must be exercised since dexmedetomidine, like other sedative agents, may produce deep sedation. This deep sedation could result in a patient who is unable to provide feedback, potentially leading to unrecognized over-advancement of the procedure needle (11).

Previous anesthetic techniques for laminectomy-placed leads have described the use of local and neuraxial techniques. Local anesthesia involves directly anesthetizing the skin, soft tissue, and other structures directly in the operative path, with minimal or no sedation (12,13). This means that patients may experience significant discomfort and pain during these procedures. Interestingly, in a randomized study comparing percutaneous versus laminectomy-placed leads, the authors do not comment on satisfaction with intraoperative pain control for those patients receiving laminectomy-placed leads with local anesthesia alone (14). In a study of epidural anesthesia for SCS lead placement, 31 out of 24 patients were successfully anesthetized for lead placement via laminectomy (15). The 7 remaining patients were excluded due to difficulty accessing the epidural space and converted to general anesthesia. This represents a 22.5% failure rate, indicating that this is an inconsistent technique for laminectomy-placed leads. Moreover, when the epidural technique does fail, this requires a change in the anesthetic plan in an already-prone patient, as well as the loss of the ability to perform intraoperative testing.

Finally, a very common anesthetic technique for a multitude of minimally invasive procedures includes some combination of propofol, midazolam, or fentanyl, commonly referred to as monitored anesthesia care (MAC) ( 16). While these drugs provide excellent sedation, their analgesic and amnestic properties prevent valid intraoperative testing. Moreover, these drugs, when used alone and especially in combination, result in respiratory depression, complicating airway management in the prone position.

Because dexmedetomidine is not a general anesthetic, it does require local anesthetic infiltration at the site of surgery to control intraoperative pain. Additionally, since one of the benefits of dexmedetomidine is its ability to allow the patient to become alert and responsive, there is a chance that this intraoperative awareness may be distressing to the patient. Therefore, small supplemental doses of an anxiolytic such as midazolam may decrease such a risk, without sacrificing the important tool of patient cooperation during the testing phase of this operation.

In conclusion, this is the first report of dexmedetomidine infusion for the placement of SCS leads via laminectomy. The use of dexmedetomidine provides consistent, reliable sedation during laminectomy, yet also allows for an awake and cooperative patient during stimulation testing. Our limited case series suggests dexmedetomidine is possibly the method of choice for laminectomy-placed leads. However, significant concerns regarding loss of airway or maintenance of spontaneous ventilation may limit its usefulness in a subset of patients.

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