J Anesth (2012) 26:286–288
DOI 10.1007/s00540-011-1311-4

CLINICAL REPORT

Percutaneous electrode placement for spinal cord stimulation in a patient with spinal fusion: a technical report

Sung-Chun Park · Kyung-Hoon Kim

Received: 2 May 2011 / Accepted: 9 December 2011 / Published online: 4 January 2012

Abstract A spinal cord stimulation (SCS) trial was attempted to alleviate left knee pain in a patient with spinal fusion from T12 to L4. Good paresthesia coverage for the knee pain was attained with SCS. However, while removing the needle used for electrode placement, the needle became fixed in the bony supplementary tissue. Moreover, while attempting to remove the needle using Kelly forceps, the hub of the needle became blocked. Without the hub, we had no choice but to use a pneumatic drill for removing the needle. Accordingly, the supplementary bone tissue was drilled under real-time imaging, using a pneumatic drill with a 3.2-mm drill bit, and another epidural needle was inserted through the hole. We consider that, in patients with spinal fusion, making a borehole with a pneumatic drill for introducing the epidural needle for percutaneous SCS electrode placement may be advisable in order to avoid the above-mentioned difficulties.

Keywords Electrical analgesia · Electric stimulation · Failed back surgery syndrome · Spinal cord injury · Spinal fusion

S.-C. Park · K.-H. Kim
Department of Anesthesia and Pain Medicine, School of Medicine, Pusan National University, Pusan, Korea

K.-H. Kim (✉)
Pain Clinic, Pusan National University Yangsan Hospital, Bumeuri, Mulgeumup, Yangsan, Kyungsangnamdo 626-770, Korea
e-mail: pain@pusan.ac.kr

Introduction

Spinal cord stimulation (SCS) is most commonly used for treating failed back surgery syndrome (FBSS) in the United States and for treating peripheral ischemic pain in Europe. A systematic review evaluating the effectiveness of SCS in relieving the chronic intractable pain of FBSS has indicated a level of evidence of II-1 or II-2 with 1B or 1C, i.e., a strong recommendation for clinical use on a long-term basis [1].

While inserting the epidural needle for SCS after back surgery, three different kinds of difficulties may be expected; difficulties with the introduction of the epidural needle owing to posterior instrumentation, difficulties with penetration of the needle through the supplementary bone tissue, and difficulties with advancing the electrodes to the desired level owing to postoperative epidural adhesions (Fig. 1).

Currently, although there are more than 19,000 articles in PubMed concerning the action mechanisms, indications, contraindications, clinical effectiveness, outcome, cost effectiveness, and complications of SCS, few reports describe the technical difficulties of or failure encountered during the insertion of SCS electrodes, particularly in patients with prior back surgery.

We describe our experience of percutaneous SCS electrode insertion in a patient with a spinal cord injury who had previously undergone spinal fusion.

Case report

A 72-year-old man, who had suffered a spinal cord injury below the T12 level and had subsequently undergone posterior spinal fusion from T12 to L4, presented with

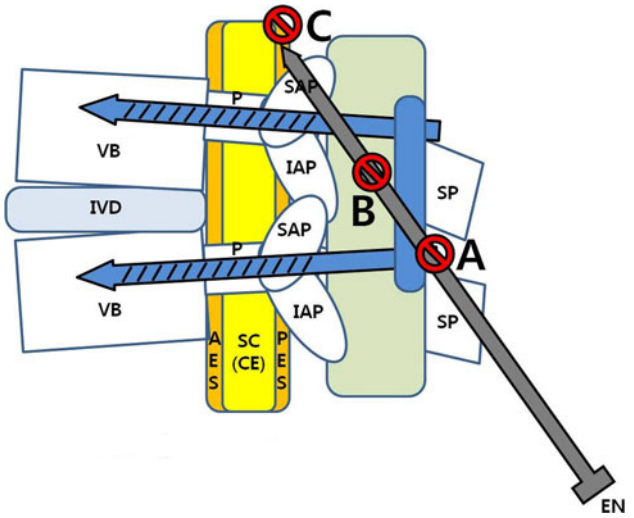

Fig. 1 Three difficulties are expected in advancing an epidural needle in a patient with spinal fusion with posterior instrumentation. (*A*) Difficulties in introducing the epidural needle owing to posterior instrumentation, (*B*) difficulties with the needle penetrating through the supplementary bone tissue, and (*C*) difficulties in advancing the electrodes to the desired level because of the presence of postoperative epidural adhesions. *AES* Anterior epidural space, *CE* cauda equina, *EN* epidural needle, *IAP* inferior articular process, *IVD* intervertebral disc, *P* pedicle, *PES* posterior epidural space, *SAP* superior articular process, *SC* spinal cord, *SP* spinous process, *VB* vertebral body

complaints of burning sensations, stabbing pain, and cold allodynia in the medial, lateral, and anterior aspects of the left knee that had lasted for 20 years. The pain had become exacerbated during the past 3 years despite lumbar sympathetic nerve ablation and the administration of various neuropathic medications. His visual analogue scale (VAS) score was 9/10.

We decided to perform an SCS trial for the intractable left knee pain. Informed consent was obtained from the patient after explanation of the potential operative complications, including dural puncture, nerve injury, bleeding, and wound infection.

The patient was placed in the prone position on a radiolucent table with an inflatable adjustable pillow. The procedure was performed under conscious sedation with basic monitoring such as electrocardiography, pulse oximetry, and noninvasive blood pressure.

After aseptic draping, the skin and muscle for the left L5–S1 level were anesthetized with 10 mL of 1% lidocaine; intravenous analgesia was given with 30 mg of ketorolac. Under fluoroscopic guidance, a 14-gauge, 10-cm-long introducer needle was inserted into the anesthetized skin, aiming for the posterior epidural space at a shallow angle of less than 30° to the skin.

Unfortunately, the needle could not advance under real-time fluoroscopy without hammering, owing to the presence of posterolateral bony tissue between the L3–L4 interlaminar spaces. After identification of the epidural space by loss-of-resistance and after confirming the absence of regurgitation of cerebrospinal fluid (CSF) or blood, a guidewire was inserted through the introducer needle into the posterior epidural space. However, the guidewire could not reach above the L1–L2 level. Therefore, the electrodes were placed at the L1–L2 level with no further advance being possible owing to the presence of epidural adhesions.

Fortunately, good paresthesia coverage of the knee pain was attained by the SCS. However, while removing the needle used for electrode placement, we encountered another difficulty, i.e., the non-movable rigid needle had become fixed in the supplementary bone tissue. Moreover, while we were attempting to remove the needle using Kelly forceps, the hub of the needle had become blocked and the electrodes were removed. Without the hub, we had no choice but to use a pneumatic drill to remove the needle.

The supplementary bone tissue was drilled using a pneumatic drill with a 3.2-mm slow spiral drill bit under real-time imaging for preventing dural puncture and cauda equina injury. After the drill bit was removed, another introducer needle was inserted into the hole, and the electrodes were replaced in the posterior epidural space at the L1–L2 level, where good paresthesia coverage had been previously attained.

A subcutaneous tunnel was created for an extension cable that was connected to the SCS electrodes. Skin closure was then performed. Postoperative 3-dimensional computed tomography showed the percutaneous SCS electrodes embedded in the hardened and thickened supplementary bone tissue between the transverse processes and the spinous processes.

The postoperative VAS score was 2/10 and the score was maintained during the 7-day trial period with the same medications as those used preoperatively. A permanent SCS device was then implanted on the left abdomen after removing the extension cable. The patient was satisfied with the sustained pain relief in the 6-week follow-up period, and the concomitant pain medications were subsequently reduced without any side effects.

Discussion

Three 3 challenging events may occur during percutaneous SCS electrode insertion in a patient with spinal cord injury with prior back surgery: first, difficulty in introducing the epidural needle owing to spinal fusion; second, difficulty in placing the electrodes owing to posterior epidural adhesions; and third, difficulty in removing the needle while leaving the electrodes behind.

Preoperative examinations for predicting difficulties in percutaneous SCS electrode insertion in patients with

previous back surgery may include radiography, epidurography, epiduroscopy, or computed tomography/magnetic resonance imaging (CT/MRI). Preoperative radiography or CT/MRI reveals the type of surgery performed previously, but not the density of the bone graft or substitute. If the density of the bone graft or substitute is not revealed, a surgical lead implantation would seem to be safer than a percutaneous lead implantation. However, most patients with previous back surgery tend to refuse additional surgical procedures. Further, although preoperative epidurography is useful, suspending an SCS trial based on the presence of posterior epidural adhesions above the predicted insertion level of electrodes noted on such epidurography would be difficult when we consider the intractable pain of the patient. In addition, preoperative epiduroscopy is possibly unwarranted for exploring such epidural adhesions; reaching the targeted level from the sacrococcygeal area with an epiduroscope is a difficult procedure, and performing adhesiolysis for permitting electrodes to pass the epidural adhesions is even more difficult.

A guidewire is sometimes useful for the intraoperative assessment of potential difficulties in the advancing of percutaneous SCS electrodes. However, not only does the use of a guidewire increase the risk of perforating the dura and causing neurologic injury, but also it creates a pathway in the epidural fat that sometimes prevents any steering of the lead off the guidewire track [2]. We consider it preferable to check that the guidewire is inserted into the posterior epidural space less than 1 level from the entry point, and then to insert the electrodes under real-time lateral fluoroscopy.

For the treatment of chronic low back/lower extremity pain, the SCS electrode leads are generally placed in the thoracic epidural space, with the lead tip located at the T8–T10 level [3]. Our patient suffered L2–L4 dermatomal knee pain, and good paresthesia coverage was attained with SCS. Despite the difficulties encountered during the procedure, we could not suspend the replacement of the electrodes because of the near complete relief of pain that the patient experienced during the trial electric stimulation and the patient's subsequent expectations of relief from the intractable pain of the past 3 years.

We used a pneumatic drill with pistol grips rather than a manual drill in order to control the precise depth and accurate direction of the drill bit. In circumstances such as those in our patient, pneumatic drilling to make an appropriate-sized hole through the supplementary bony tissue into the posterior epidural space at the level of the spinal fusion without causing spinal cord damage would be crucial before placing an epidural needle for percutaneous SCS electrode placement. When great accuracy is required, the holes are first drilled slightly undersized and then reamed to size. Drill bits with variable sizes from 1 to 80 gauge and different shapes are the cutting tools used to create cylindrical holes. Careful consideration when selecting the drill bits may reduce the risk of dural puncture and spinal cord injury [4, 5].

Our patient did not have FBSS, but rather, he represented a case of spinal cord injury treated by back surgery. However, the difficulties we encountered were similar to those noted after FBSS. FBSS is a nonspecific term that implies that the final surgical outcome did not meet the preoperative expectations of either the patient or the surgeon [6]. FBSS is the most frequent indication for SCS in the United States, with the neuropathic leg pain component showing a good response [7].

Fortunately, in our patient, there was no electrode migration or lead breakage during a 2-year follow-up. During a long-term follow-up, there are increasing possibilities of lead breakage or migration at the site of the anchor being caused by friction between the bony tissues and the lead [8].

Therefore, considering the frequency of SCS electrode implantation after back surgery, it is essential to develop a novel introducer epidural needle or new instruments for piercing supplementary bony tissue in patients with spinal fusion; as well, it is essential to resolve the difficulties associated with posterior epidural adhesions arising from prior back surgery. It is also necessary to evaluate the patient's anatomy and the instrumentation preoperatively when performing back surgery.

In conclusion, for a patient with spinal fusion who is a good responder to percutaneous SCS and who does not want to have another back surgery for surgical lead insertion, making a borehole with a pneumatic drill before inserting the epidural needle for percutaneous SCS electrode placement may be a favorable option.

Conflict of interest This work entails no conflict of interest.

References

1. Frey ME, Manchikanti L, Benyamin RM, Schultz DM, Smith HS, Cohen SP. Spinal cord stimulation for patients with failed back surgery syndrome: a systematic review. Pain Phys. 2009;12:379–97.
2. Mironer YE. Neurostimulation techniques. In: Tollison CD, Satterthwaite JR, Tollison JW, editors. Practical pain management. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2002. p. 160.
3. Stojanovic MP, Abdi S. Spinal cord stimulation. Pain Phys. 2002;5:156–66.
4. Schofferman J, Reynolds J, Herzog R, Covington E, Dreyfuss P, O'Neill C. Failed back surgery: etiology and diagnostic evaluation. Spine J. 2003;3:400–3.
5. Karmani S, Lam F. The design and function of surgical drills and K-wires. Curr Orthop. 2004;18:484–90.
6. Fincham BM, Jaeblon T. The effect of drill bit, pin, and wire tip design on drilling. J Am Acad Orthop Surg. 2011;19:574–9.
7. Van Buyten JP. Neurostimulation for chronic neuropathic back pain in failed back surgery syndrome. J Pain Symptom Manage. 2006;31:S25–9.
8. Cameron T. Safety and efficacy of spinal cord stimulation for the treatment of chronic pain: a 20-year literature review. J Neurosurg. 2004;100:254–67.