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CASE REPORT
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Long-term Effectiveness of Spinal Cord Stimulation for Intractable Neuropathic Pain in a Traumatic Paraplegic Patient : Case Report

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Spinal cord stimulation (SCS) has been used to treat chronic neuropathic pain for decades; Spinal cord injury (SCI) frequently results in intractable neuropathic pain. Unfortunately, the majority of literature regarding the use of SCS for central neuropathic pain in post-traumatic paraplegia after SCI is not promising and such papers did not have long-term follow-up greater than 10 years. We describe the case of a post-traumatic paraplegic sailor who presented with intractable neuropathic pain as constant burning and frequent electric-like shooting pain along a few patchy areas of sensation on the Rt. L1−2−3 dermatomes. He underwent a surgical lead implantation on the epidural space at the T10 level in 2002 and obtained good pain relief during the follow-up period of 15 years. Even chronic neuropathic pain in complete loss of motor function with sensory patchy area after SCI may obtain the benefits of SCS.

KEY WORDS: Neuropathic pain · Spinal cord injury · Paraplegia · Spinal cord stimulation.

INTRODUCTION

Spinal cord stimulation (SCS) for the clinical control of pain was introduced in 1967 by Shealy, et al.[1] in response to the publication of the gate control theory of pain by Melzack and Wall[2] in 1965 ; SCS has been used to treat intractable pain syndrome ever since the publication of these first clinical reports on SCS for intractable pain in humans. Persistent neuropathic pain is a common and serious consequence of spinal cord injury (SCI) that is refractory to both pharmacological and non-pharmacological treatments. SCS has been used to treat chronic neuropathic pain for decades and SCI frequently results in intractable neuropathic pain.[3] Unfortunately, the majority of the literature regarding the use of SCS for central neuropathic pain in patients with significant motor or sensory loss after SCI is not promising and in such papers that report success, the patient did not have long-term follow-up greater than 10 years.[4-6] Therefore, the authors report a post-traumatic paraplegic patient who obtained adequate pain control for 15 years following the implantation of SCS.

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CASE REPORT

A 43-year-old sailor fell from a height of about eight meters and developed backache and paraplegia on Sep. 15, 2001. A CT scan of the L-spine (Sep. 16, 2001) revealed fractures of the right transverse process and lower endplate of the T12 vertebra, burst fractures of L1, L2, and L3 bodies with fractures of both pedicles, right lamina and both transverse process with the displaced fragment causing compression of the thecal sac and central spinal stenosis, particularly at the L2 and L3 levels. He underwent emergency Harrington's rod fixation from T11 to L5 under a diagnosis of SCI associated with multiple spinal fractures at the thoraco-lumbar junction at Saint Louis Hospital, Bangkok, the kingdom of Thailand on Sep. 16, 2001. Following the injury, he began experiencing severe pain in his right leg and he was transferred to Korea on Nov. 1, 2001. He had flaccid paraplegia, loss of urination and defecation control, and severe sensory deficits including anesthesia below the right L4 and left L1 dermatomes and severe hypesthesia and dysesthesia along the right L1−2−3 dermatomes. He complained of intractable pain of constant burning and frequent electric-like shooting pain along a few patchy areas of sensation on the Rt. L1−2−3 dermatomes. Evoked pain (allodynia and hyperpathia) was not noted. Conservative treatments were attempted but failed. He took various medications including gabapentin 1,800 mg and etravil 40 mg daily. The severity of pain was 8−9 out of 10 in visual analogue scale

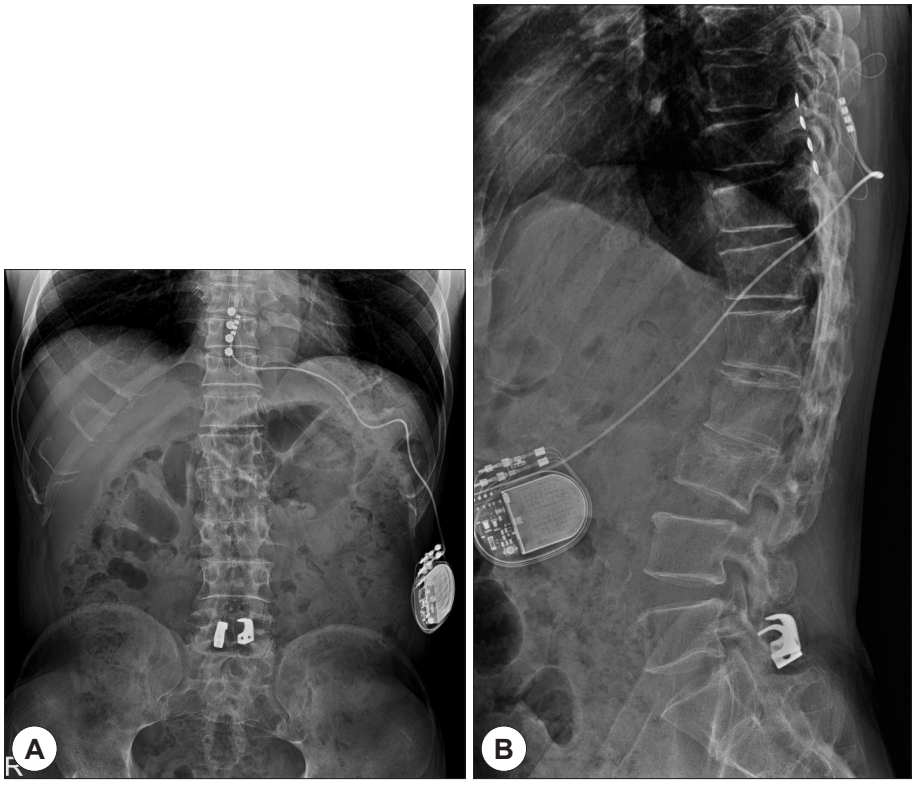

Fig. 1. Anterior-posterior (A) and lateral (B) radiographs of the lumbar spine showing a surgical lead implanted slightly off the midline at the T10 level and two distal hooks of Harrinton's rod fixation in the lower lamina of L5.

pain score. An electrophysiologic study on Feb. 11, 2002 showed bilateral lumbosacral polyradiculopathy of a very severe degree with abnormal somatosensory evoked potential study in lower limbs.

On Mar. 20, 2002, we performed a surgical lead (Medtronic Resume type) implantation on the epidural space at T10 after a laminectomy. Trial stimulation for four days provided approximately 60% pain relief. A permanent stimulator (Medtronic Itrel III, Minnesota, USA) was inserted on Mar. 25, 2002 (Fig. 1), which he operated about 4−6 times for about 2−5min each day. The right leg pain subsided and became tolerable via the paresthesia-coverage of the painful area on stimulation. The optimal parameters of the stimulators included 0.7−0.8 volts/210μs/40Hz with bipolar simulation at the middle two contacts (1−2+). The pain relief degree had not notably changed and the parameters of the stimulator also showed little change. He took only gabapentin 1,200mg (400mg three times) daily as pain medication.

After the complete consumption of the power of the stimulator, the pain was at a worse to intolerable state. The SCS system has worked well for 15 years until the battery power lasts. Presently, at 15 years' follow-up, the patient rates his pain as 2−3/10 after the exchange of a multi-program neurostimulator (Medtronic PrimeAdvanced, Minnesota, USA) on May 12, 2017.

DISCUSSION

Chronic pain is common in spinal cord injury (SCI) patients ; it impacts about 70% of patients, a third of whom experience severely intense pain that impacts mood, functionality, and quality of life.[7] The pain can be nociceptive, neuropathic, or visceral. Neuropathic pain following SCI is thought to occur due to a combination of abnormal inputs from the injured spinal cord and the aberrant reorganization of spinal-cortical circuits.

Chronic neuropathic pain following SCI could have different forms of expression ; there are several classifications of paraplegic pain based either on its topography (as segmental/at level pain, end-zone pain, diffuse/below level pain), quality (burning, shooting, or electrical) or its proposed different neurogenic mechanisms (steady, intermittent, or evoked).[8] SCI-related neuropathic pain is a very difficult problem with which neurosurgeons must frequently deal. A large portion of patients' SCI pain is refractory to pharmacological treatment and thus surgical interventions are being explored. Two commonly considered neurosurgi-

cal methods are : 1) modulative, using neurostimulation and 2) ablative, making selective lesions in well-defined and identified targets (especially dorsal root entry zone (DREZ) lesions).[9] Tasker, et al.[10] reported the different response of steady and intermittent pain to destructive surgery based on the experience of treating 127 patients with paraplegic pain. Spinal-based destructive surgeries (DREZ, cordotomy) were effective at treating intermittent pain but not steady pain. Spontaneous constant pain in a region of profound sensory deficit without allodynia did not respond well to DREZtomy surgery. In cases such as ours, SCS was the preferred means of treatment.

Contemporary stimulator lead types consisted of either percutaneous, wire-shaped electrodes or flat, paddle-shaped electrodes that require open surgery. The percutaneous type can provide broad access to multiple levels of the spinal cord in a minimally invasive manner and have become popular due to their ease of placement and permission of broad access to multiple levels of the spinal cord in a minimally invasive manner.[11] The paddle-shaped leads allow for the more focused dispersion of current but require a more invasive implantation procedure[12] which might explain why this case with the stimulation with a lower voltage at 0.5−0.7V has been successful at achieving pain relief. Battery longerity varies, depending on configuration and the parameters for stimulator device use, and model of neurostimulator. In our experience, intermittent stimulation of SCS in pain relief offers prolongation of battery life.

Although the mechanism of action of SCS remains an open question, the effect is clearly related to the modulation of signals mediated by dorsally located fibers within the spinal cord.[13] Neurohumoral changes in the spinal cord may be secondary to such activity modulation.[14] Although there has been success in using the SCS system for failed back syndrome, its use for central neuropathic pain has not been very encouraging.[15][16] In particular, chronic neuropathic pain in patients with significant motor or sensory loss after SCI has little to no effectiveness on SCS.[5][17] Cioni, et al.[5] reported the ability of a percutaneous SCS to control paraplegic pain due to a spinal cord lesion in twenty-five patients. At the end of a test stimulation period, Ten patients (40%) with incomplete lesions of the spinal cord reported satisfactory pain relief. At 37.2 months' follow-up time, the success rate had decreased to 18%. All seven patient with complete lesions with paraplegia reported no pain relief. Some patients with mild or incomplete SCI have experienced more success than those with severe or complete SCI at achieving pain relief using SCS. The probability of having integrity of the lemniscal fibers is higher in patients with incomplete lesions. The patient presented in this paper had complete motor loss with profound sensory deficit but did have small patchy areas that had some sensation. Therefore, it is possible that he had some preservation of the lemniscal fibers ; this indicates that even patients with complete motor loss and only patchy areas of sensation may benefit from SCS.

CONCLUSION

Achieving proper pain control in patients with medically intractable neuropathic pain requires assessing the characteristics of the patient's pain and sensory capabilities prior to the implantation of a spinal cord stimulator. SCI frequently results in neuropathic pain, which has different forms of clinical expression. Chronic medically intractable neuropathic pain in most patients with post-traumatic paraplegia is unsuccessful for the management of SCS. However, chronic neuropathic pain in traumatic paraplegia with some sensory patchy areas at painful sites may benefit from SCS.

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