CLINICAL REPORT

Spinal Cord Stimulator Relieves Neuropathic Pain in a Patient With Radiation-Induced Transverse Myelitis

Basem Hamid, MD*; Naeem Haider, MD†

*Department of Anesthesia and Pain Medicine, UTMD Anderson Cancer Center, Houston, Texas; †Department of Anesthesiology, University of Michigan, Ann Arbor, Michigan, U.S.A.

■ **Abstract:** We present a patient with intractable neuropathic pain because of radiation-induced transverse myelitis unresponsive to medical treatment. After a successful trial of spinal cord stimulation, a permanent stimulator was implanted. Improvement was noted in verbal pain score, medication usage and function. Spinal cord stimulation may offer a therapeutic option for patients with neuropathic pain resulting from transverse myelitis and should be considered when other treatments fail. ■

Key Words: Transverse Myelitis, Neuropathic Pain, Spinal Cord Stimulation

CASE REPORT

A 54-year-old right-handed man with a 30 pack-year history of smoking was diagnosed with right lower lobe nonsmall cell lung carcinoma, which was treated with chemotherapy (paclitaxel and carboplatin) followed by resection and radiation. He received a total of 5040 cGy in 28 fractions. Two months following the completion of radiation therapy, he developed gradual onset of severe dysesthesia in the left leg, evolving into a circumferential pattern, extending from the hip and buttock down to the toes. He developed burning, pins and needle sensation, accompanied by severe tactile hypersensitivity. The pain increased with physical activity, impacting his ability to ambulate. It worsened during the night and prevented adequate sleep. The only alleviating factor was immobilization of the legs in an elevated position. Mild weakness of the legs and mild bladder dysfunction were also noted. The reported verbal pain score at the first interview was 10/10.

On examination, a sensory level was detected at T5. Decreased sensation to pin prick on the left leg and decreased vibration on the right leg were identified. Nerve conduction studies of the lower extremities remained unremarkable. Magnetic resonance imaging of the spinal cord revealed increased signal intensity on T2-weighted images extending from the second thoracic vertebral level through the fourth thoracic vertebral level, consistent with transverse myelitis with diffuse homogeneous increased signal intensity within the vertebrae.

The patient's employment as a real estate agent was jeopardized. He met diagnostic criteria for major depression. Initial treatment consisted of gabapentin, which was escalated to 900 mg three times a day. Nortriptyline was added and titrated up to 100 mg at

Address correspondence and reprint requests to: Basem Hamid, MD, UTMD Anderson Cancer CenterDepartment of Anesthesia and Pain Medicine, 1515 Holcombe Blvd Unit 409, Houston, TX 77030, U.S.A. Tel: 713-745-7246; Fax: 713-745-0177; E-mail: bhamid@mdanderson.org.

Submitted: March 7, 2007; Revision accepted: June 26, 2007
DOI. 10.1111/j.1533-2500.2007.00148.x

bedtime. Pain scores did not improve on this regimen. Transdermal fentanyl was instituted at a dose of 25 μg/hour every 72 hours and increased gradually to 75 μg/hours every 72 hours. Morphine IR 15 mg every 4 hours PRN was provided for breakthrough pain. Acetaminophen 500 mg and ibuprofen 400 mg every 6 hours was continued. The patient reported minimal relief of pain, accompanied by fatigue, drowsiness, and dizziness. At a later time, topiramate 100 mg a day was started. For depression, he was prescribed paroxetine 40 mg a day. He continued of complain of pain rated at 9–10/10; depression, function, and quality of life deteriorated.

Transdermal fentanyl was changed to methadone and the dose increased gradually to 40 mg per day. Despite this regimen, there was minimal relief. After 8 months of conservative treatment, a spinal cord stimulator trial was carried out. A single quad electrode array (Medtronic Inc., Minneapolis, MN, U.S.A.) was placed, with the uppermost electrode positioned at the top of the T10 vertebral body as viewed on AP Fluoroscopy. Corresponding paresthesias were achieved in both legs with "electrode 0 off," "electrode 1–," "electrode 2+," "electrode 3 off." The trial continued for 5 days, during which the patient had almost complete resolution of pain and was able to discontinue the use of breakthrough medication. Three weeks after the initial trial, the patient underwent permanent implantation. Placement of a flat electrode (Specify lead, Medtronic) at the level of T10 was performed through a thoracic laminotomy.

The patient experienced dramatic pain relief. Methadone and paroxetine were decreased and all other medications were discontinued. He has been followed for 18 months after permanent implantation and continues to rate his pain at 0–1/10 with the stimulator on. When the stimulator is off, pain intensity increases to 5–6/10 but remains tolerable with the use of methadone 15 mg per day. His depression has improved significantly and he returned to work.

DISCUSSION

Transverse myelitis is a rare inflammatory disease of the spinal cord, which has an incidence of 0.46 per 100 000 in the United States.[1] Two-thirds of acute transverse myelitis episodes are idiopathic. Viral infections appear to trigger one-third of the cases in adults and at least half the cases in children.[2] Radiation-induced transverse myelitis occurs more rarely.[3] Yamada et al. surveyed 409 patients whose spinal cords were irradiated with more than 30 Gy to study the relationship between the dose of spinal irradiation and the incidence of radiation myelitis.[3] Radiation myelitis was observed in 26 cases including 3 patients who developed transverse myelitis.[3] The calculated 5-year incidence of transverse myelitis was approximately 0% at 40 Gy, 5% at 50 Gy, 10% at 60 Gy and 20% at 70 Gy.[3] Current data indicate that given in once-daily fractions of less than 200 cGy, the risk of delayed radiation myelopathy is less than 0.5% for a total dose of 4500 cGy and 5% for total doses of 5700 cGy to 6100 cGy.[4]

Pain or dysesthesia is usually the most debilitating sequela of transverse myelitis, occurring in as many as 40% of patients with this disorder.[5] Treatment can consist of antiepileptic medication along with antidepressants. Opioids have little to offer patients with transverse myelitis, as was evident in this case, especially in the presence of side effects like constipation and urinary retention.[5] Overuse of opioid medication in the absence of identifiable improvement in pain relief and/or function should be avoided. When traditional means of treating neuropathic pain fail to offer tangible benefit, interventional modalities may need to be considered.[6] It is unknown if the pain in patients with transverse myelitis is sympathetically maintained. No literature is available regarding the role of sympathetic blocks in this entity. Although this was not tried in this patient, it is not unreasonable to attempt this minimally invasive option before proceeding to spinal cord stimulation.

Spinal stimulation was first described by Shealy after work completed in the 1960s with electrodes placed epidurally over the dorsal columns of the spinal cord.[7] Further refinement of the device led to the use of totally implantable generator and electrode systems, allowing for adjustment of stimulation parameters and optimization of pain relief. Over the last three decades, multiple studies have demonstrated the safety and efficacy of spinal stimulation for the treatment of chronic pain.[6] Spinal stimulation has been used with varying degrees of success in the treatment of neuropathic pain syndromes including radiculopathy, peripheral nerve injury, postherpetic neuralgia, diabetic neuropathy, and chemotherapy-induced neuropathy.[6] Spinal stimulation has also been utilized for failed back surgery syndrome, complex regional pain syndrome, peripheral vascular disease, and angina pectoris.[6]

Despite the neuropathic nature of pain occurring in patients with transverse myelitis, a review of the literature provides limited information on the use of spinal cord stimulation in this condition.[8–10] Dooley et al. and Tani et al. documented a variable degree of success with

the use of spinal stimulation for patients with transverse myelitis.[9,10] Laffey et al. described one case involving a patient with idiopathic transverse myelitis in which spinal cord stimulation provided marked improvement in quality of life with a 70% reduction in pain 12 months post implant.[8]

Selection of patients for permanent spinal cord implantation can be challenging. Clinical predictors of outcome are still under study and additional data are needed to allow for more accurate prediction of outcome.[11–13] Decisions regarding patient selection, choice of lead (percutaneous vs. surgical), and generator (single use vs. rechargeable) need to be considered carefully. Surgical leads have demonstrated longer survival time in some series and "Specify leads" (Medtronic) have been reported to provide better axial coverage than percutaneous leads.[11,14] Somatosensory evoked potentials have been studied to assist in predicting outcome from spinal stimulation.[15] Pain because of lesions located proximal to the dorsal root ganglion should demonstrate normal central conduction time if spinal cord stimulation is being considered. As an alternative, when trial stimulation is possible with a percutaneous lead, as in our case, Sindou et al. conclude that use of a percutaneous trial can serve as a first step before definitive implantation is performed.[15]

Although spinal cord stimulation in central neuropathic pain syndromes has shown inconsistent results, our case demonstrates the potential beneficial effect of spinal cord stimulation in the treatment of neuropathic pain resistant to conventional treatment resulting from radiation-induced transverse myelitis.[8] Further study is required to delineate subsets of central pain that may respond to this treatment modality.

ACKNOWLEDGMENT

The case is credited to the University of Iowa Department of Anesthesia, Pain Clinic, Iowa City, Iowa.

REFERENCES

1. Jeffery DR, Mandler RN, Davis LE. Transverse myelitis. Retrospective analysis of 33 cases, with differentiation of cases associated with multiple sclerosis and parainfectious events. *Arch Neurol.* 1993;50:532–535.

2. Berman M, Feldman S, Alter M, Zilber N, Kahana E. Acute transverse myelitis: incidence and etiologic considerations. *Neurology.* 1981;31:966–971.

3. Yamada S, Hoshi A, Takai Y, et al. [Radiation tolerance dose of the spinal cord following conventionally fractionated irradiation]. *Gan No Rinsho.*, 1987;33:1189–1192.

4. Schultheiss TE, Kun LE, Ang KK, Stephens LC Radiation response of the central nervous system. *Int J Radiat Oncol Biol Phys.* 1995;31:1093–1112.

5. Johnson RT, Griffin JW, McArthur JC, eds. *Current Therapy in Neurologic Disease*, 6th edn. St. Louis, Mo; London: Mosby; 2002.

6. Cameron T. Safety and efficacy of spinal cord stimulation for the treatment of chronic pain: a 20-year literature review. *J Neurosurg.* 2004;100(suppl 3 spine), pp. 254–267.

7. Shealy CN. Dorsal column stimulation. *Surg Neurol.* 1977;7:192.

8. Laffey JG, Murphy D, Regan J, O'Keeffe D. Efficacy of spinal cord stimulation for neuropathic pain following idiopathic acute transverse myelitis: a case report. *Clin Neurol Neurosurg.* 1999;101:125–127.

9. Dooley DM, Sharkey J, Keller W, Kasprak M. Treatment of demyelinating and degenerative diseases by electro stimulation of the spinal cord. *Med Prog Technol.* 1978;6:1–14.

10. Tani S, Shimizu H, Ishijima B, Hanakago R. [Our experiences of PISCES (percutaneously inserted spinal cord electrical stimulation) in SMON and other neurologic disorders]. *No Shinkei.* 1984;36:383–388.

11. Kumar K, Hunter G, Demeria D. Spinal cord stimulation in treatment of chronic benign pain. challenges in treatment planning and present status, a 22-year experience. *Neurosurgery.* 2006;58:481–496; discussion 481–496.

12. Doleys DM. Psychological factors in spinal cord stimulation therapy: brief review and discussion. *Neurosurg Focus.* 2006;21:E1.

13. Van Buyten JP, Van Zundert J, Vueghs P, Vanduffel L. Efficacy of spinal cord stimulation: 10 years of experience in a pain centre in Belgium. *Eur J Pain.* 2001;5:299–307.

14. North RB, Kidd DH, Olin JC, Sieracki JM Spinal cord stimulation electrode design: prospective, randomized, controlled trial comparing percutaneous and laminectomy electrodes-part I. technical outcomes. *Neurosurgery.* 2002;51:381–389;discussion 389–390.

15. Sindou MP, Mertens P, Bendavid U, Garcia-Larrea L, Mauguiere F. Predictive value of somatosensory evoked potentials for long-lasting pain relief after spinal cord stimulation: practical use for patient selection. *Neurosurgery.* 2003;52:1374–1383; discussion 1383–1384.