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Treatment of Refractory Radial Neuropathy with Implantation of Radial Nerve Stimulator

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Background: With the high rate of complications of spine surgery and the current opioid epidemic, peripheral nerve stimulation has become more popular in recent years. This procedure is usually indicated for patients who have failed conservative measures for pain relief.

Case Report: A 56-year-old man with a past medical history of right-hand pain after trauma who failed a trial of opioids and nerve blocks underwent a radial nerve stimulator procedure, which successfully resolved his neuropathic pain state.

Conclusion: Radial nerve stimulators should be offered as an alternative to pain management in patients who have failed conservative treatment options and who continue to have peripheral nerve pain.

Key words: Hand pain, neuropathic pain, peripheral nerve stimulation, postsurgical pain, radial nerve

BACKGROUND

The roots of neurostimulation can be traced as far back as 1811, when Bell (1) was able to elicit muscle contractions of the back via experimental induction of the anterior sacral roots. This opened the door to multiple developments in the field of neuromodulation. The theory of "gate control" developed by Wall and Melzack (2) in 1965 significantly innovated the field of pain management. This theory suggested that pain relief can be accomplished by stimulating the sizable, fast, conducting nerves. This theory was an important contribution that paved the way for the development and clinical use of spinal cord stimulators. The clinical usage of this theory rapidly expanded, with approximately 50,000 spinal cord neurostimulator implantations performed annually to this day (3).

With the high rate of complications of spine surgery and the opioid epidemic, interventional pain procedures such as neurostimulators have been utilized in additional roles in recent years. The function of neurostimulators in pain relief is to disrupt signals sent via the spinal cord and peripheral nerve through an external source. This procedure is usually indicated for patients who have failed conservative measures for pain relief, such as physical therapy, pharmacotherapy, nerve blocks, and surgical attempts. A randomized control trial in 2014 showed that spinal cord stimulation provided greater therapeutic benefit than medical management and reoperation for failed back surgery syndrome (4). Neurostimulation is usually divided into 2 parts: a trial procedure and then permanent implant if the trial procedure is deemed successful. During the trial procedure, leads are placed in the correct position guided by fluoroscopy. The leads are then attached

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to an external pulse generator. If the trial procedure demonstrates effectiveness of pain relief, the patient would then undergo a second procedure to implant a pulse generator subcutaneously in a pocket connected to permanent leads (5).

Neurostimulation of peripheral nerves has been gaining popularity recently, demonstrating benefit in the treatment of headache syndromes (6), cranial nerve pain (6), postnerve trauma (7), fibromyalgia (10), and complex regional pain syndrome (8). When deciding whether peripheral nerve stimulation is warranted, there are certain criteria that must be met. These include pain that correlates with the path of the peripheral nerve indicated for the procedure; nerve entrapment pathologies have been eliminated via differential diagnosis; the patient does not have current psychiatric illness; the patient has a history of previous positive peripheral nerve block of the affected nerve; and symptoms are unresponsive to conventional treatments (9).

Neurostimulation of peripheral nerves offers many advantages for neuropathic pain. The procedure is generally safe, with low morbidity and rapid recovery rates. The procedure is performed with conscious sedation or monitored anesthetic care. Procedure times are typically 30 to 60 minutes. The trial procedure also gives a clear advantage in forecasting the long-term outlook of the neurostimulation implant. Long-term evidence of the therapeutic benefit of peripheral neurostimulation remains unclear, largely due to the limited cases researched in this field. A retrospective study of 38 patients with peripheral nerve injuries reported that 60% of them had improvement in pain and lifestyle after a mean follow-up time of 31 months (11). A prospective observational study of 100 patients who received peripheral nerve stimulation for the management of chronic retractable pain demonstrated a 4.2 +/- 2.5-point decrease in pain (on a 10-point numeric pain scale). The mean follow-up time was 8.1 months (12).

The purpose of the present investigation, therefore, is to describe the role of peripheral nerve stimulation in a patient post surgery. Because there is limited research on the outcome of the insertion of a neurostimulator of peripheral nerves in patients, we describe in this case report technical aspects, safety, and efficacy of a neurostimulator implant of a radial nerve in a patient.

CASE

A 56-year-old man with a past medical history of right-hand pain due to an accident in which he amputated his right index finger with a knife several years back presented with worsening "shooting/sharp" hand pain rated 8 of 10, which caused him difficulty with fine motor tasks such as using a computer mouse. Physical exam demonstrated right posterior forearm tenderness, strength rated 5 of 5, and no sensory deficits or deformities. He had multiple previous radial nerve and stellate ganglion blocks that provided minimal temporary relief. He was taking meloxicam, gabapentin, and hydrocodone to control his pain symptoms.

After reviewing the patient's history, conducting a complete physical examination, and obtaining consent, insertion of a neurostimulator to the right radial nerve was indicated given multiple previous unsuccessful attempts at adequate pain relief via procedures and medication. The trial provided a significant improvement in the patient's right-hand pain, providing a positive outlook for the future insertion of a permanent stimulator implant.

With fluoroscopic guidance, the location of the desired site for placement of the percutaneous leads was identified, and local anesthetic consisting of 1% lidocaine and 1:200000 epinephrine was injected subcutaneously over the area. A one-cm stab incision was made along the midlateral forearm; under ultrasound guidance using a linear probe, the radial nerve was identified deep to the brachioradialis muscle. Then using an in-plane approach, a Tuohy needle (bevel up) was advanced at a shallow angle to lay parallel to the nerve. Then the 8-contact electrode was advanced through the needle using a gentle push-pull technique; the lead was advanced and the needle retracted. The anchor was then secured around the lead. Then attention was directed to creating a pocket on the lateral forearm to accommodate the internal programmable generator. The Touhy needle was fed from the implantable pulse generator (IPG) incision to the stab incision to facilitate tunneling. The proximal tip of the lead was then passed into the needle and externalized into the IPG site; this was followed by connecting the lead and the IPG, followed by closing the wounds.

Simple (3 or fewer) electronic stimulator analysis was performed. The impedance value was abnormally high. The connection between the lead and extension was then rechecked. Analysis/ programming was performed intraoperatively for 5 minutes and postoperatively for 5 minutes.

The patient was followed up in our pain clinic one week after the procedure and his pain had improved

significantly with regard to reduction in severity and duration, with mild tenderness in the incision site but no erythema or drainage. At his 2-month follow-up, the patient no longer had pain in his right hand or index finger, did not require pain medication, and was able to perform activities of daily living without difficulty.

DISCUSSION

When weighing whether to continue peripheral nerve blocks vs perform a peripheral nerve stimulator implant, certain factors must be considered. If a patient is still having to take medication such as opioids for pain relief after peripheral nerve blocks, a peripheral nerve stimulator may provide longer-lasting pain relief without the unfavorable side effects of pain medication. Motor weakness is a common side effect of peripheral nerve blocks. However, peripheral stimulation has been shown to evade this significant adverse complication (14).

Although peripheral nerve neurostimulation implantation is generally considered safe, the most common complication is the lead migrating from the desired location. Other complications can include infection, hematoma, wrong placement of the lead during the procedure, allergic dermatitis, hardware malfunction, and inability to endure stimulation (13). Hence, these potential complications must be discussed during the informed consent process.

Peripheral nerve stimulators can be utilized for various aspects of patient care. There have been studies demonstrating the effectiveness of controlling postoperative surgical pain via peripheral nerve stimulation. Two studies showed substantial decrease in pain following knee surgeries with a negligible amount of opioid use (14,15). In another study, a patient suffering with complex regional pain syndrome was successfully treated with a Stimwave (Simwave, Pompano Beach, FL) wirelessly controlled radial nerve stimulator after failed treatment with conservative management (16).

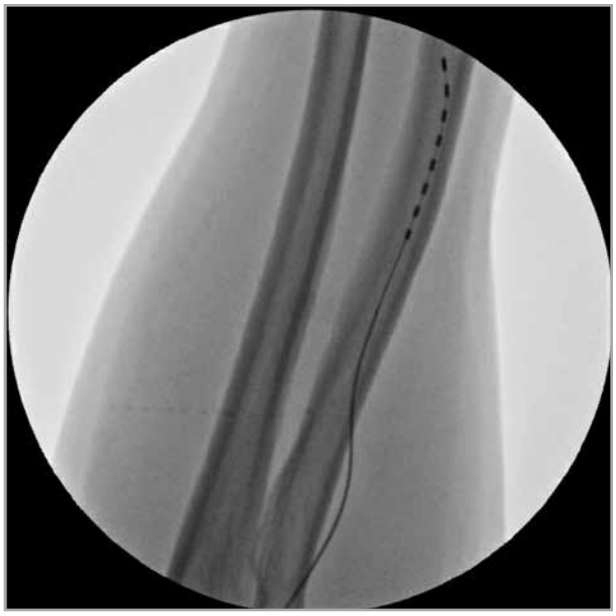

Fig. 1. Lead placement of radial nerve stimulator.

The Medtronic (Medtronic, Minneapolis, MN) that was used in this patient has an autosensing feature that can block the pain signal when sensed. The settings can be changed wirelessly if needed by the provider by contacting the device wirelessly. Peripheral nerve stimulator interventions have shown a promising outlook as providers look to eliminate opioids out of their treatment regimen because of their dangerously high addictiveness and undesirable side effects.

CONCLUSION

This case report describes a successful alternative to minimally invasive pain management in an understudied area of research. Radial nerve stimulators should be offered as an alternative to pain management in patients who have failed conservative treatment options and continue to have peripheral nerve pain.

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