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Successful Treatment of Refractory Neuropathic Pain Following Axillary Dissection and Lipoma Resection Using Cervical and Thoracic Dorsal Root Ganglion Stimulation

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Background: Neuropathy is a pain condition that is caused by an insult to the somatosensory system. Provid-ing adequate management of neuropathic pain (NP) conditions can be challenging as the dis-ease may become progressively nonresponsive to conventional therapies. If conventional treatment options prove ineffective, cervical dorsal root ganglion (DRG) stimulation is a relatively effective, off-label-use therapy for NP, which requires expert cervical placement to be completed safely and effectively. The Neuromodulation Appropriateness Consensus Committee guidelines highlight safety features and general indications for DRG stimulation, which includes current on-label usage up to T10. Although this committee's expert opinions stated that DRG is safe up to the C5 level, there is limited published efficacy and safety data at levels higher than T10.

Case Report: A 36-year-old woman with a significant medical history of anxiety developed intractable right upper extremity NP following an axillary dissection for a lipoma excision. De-spite conservative management, she presented with debilitating NP and severe right upper ex-tremity functional restrictions following the procedure. The patient underwent a C8-T1 DRG stimulation trial, which decreased her pain levels over 50%, and significantly increased her functional abilities. Right-sided C8-T1 permanent DRG leads were placed, which resulted in improved sleep, increased ability to use her right upper extremity, a 95% to 97% reduction in pain, and elimination of regularly scheduled analgesic medications.

Conclusions: Cervical and high thoracic DRG was safe and successful in the treatment of right upper extremity NP in the upper dermatomal levels secondary to axillary dissection and lipoma resection.

Key words: Cervical and high thoracic DRG, neuropathic pain, axillary dissection, lipoma re-section, neuromodulation, case report

BACKGROUND

The United States Food and Drug Administration approval for on label DRG stimulation is limited to T10 and below. According to the Neuromodulation Appropriateness Consensus Committee on Best Practices for DRG stimulation, it is safe up to the C5 level, but there is limited published efficacy and safety data at levels higher than T10 (1, 2). Breast masses are common, with over 25% of women affected by some form of breast disease in their lifetime (3). They are associated with a wide spectrum of diseases, from benign physiological processes to aggressive malignancies (3,4). Therefore,

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evaluation and prompt diagnosis are necessary to rule out malignancy. Breast cancer is the second most common cancer among women in the United States (US) with an incidence rate of diagnosis increasing 0.5% per year (5). With more cases being diagnosed, patients are undergoing more breast procedures in the US; subsequently the risk of neuropathic pain (NP) due to neural trauma is increasing (5-7). NP is defined by the International Association for Study of Pain as "pain caused by a lesion or disease of the somatosensory nervous system" (8). The prevalence of NP in the general population may be as high as up to 8%, accounting for up to 25% of those afflicted with chronic pain (9). NP is diagnosed by history, physical exam, and characteristic symptoms, such as allodynia, paresthesias, burning-shooting pain, pressure, or numbness (8-10). Various tests, such as electromyography (EMG), nerve biopsies, and imaging, may also assist in identifying and characterizing the neurologic lesion (9).

Treatment options for NP include physical therapy, nonsteroidal anti-inflammatory drugs, serotonin-noradrenaline reuptake inhibitors, tricyclic antidepressants, anticonvulsants, N-methyl-D-aspartate antagonists (ketamine), opioids, topical capsaicin, botulinum toxin A, and lidocaine cream (8,11-13). More invasive treatment options exist, such as intrathecal injections, further surgical intervention, or neurosurgical stimulation (11). However, there are limited effective treatment options for refractory cases of NP. Dorsal root ganglion (DRG) stimulation is used for the treatment of NP conditions, such as failed back surgery syndrome, complex regional pain syndrome, and peripheral neuropathy (1). While DRG stimulation therapy has been more successfully described in the lumbar spine, and is US Food and Drug Administration approved for chronic pain of the lower extremities of adults, there are only a few reports of its off-label use in the high thoracic or cervical spine (1,2,14).

We present a case of a 36-year-old woman who developed refractory NP in her right upper extremity following a right-sided axillary dissection for a lipoma excision. The patient's pain began immediately following the procedure and ultimately prohibited her ability to perform activities of daily living (ADLs). After failing conservative management, she was successfully treated with C8-T1 DRG stimulation. This therapy provided approximately 95% to 98% improvement in her pain with a regain in ADLs and titration off regularly scheduled medications. This case report aims to highlight the novel, off-label use of cervical DRG stimulation as a potentially effective treatment for refractory neuropathy following axillary dissection.

CASE REPORT

A 36-year-old woman with a history of endometriosis and anxiety underwent a right-sided axillary dissection of a lipoma. She presented to the pain clinic several months later after failed conservative management for progressively worsening right-sided axillary and upper back pain that presented immediately after undergoing her surgery. Her pain radiated down to her medial right upper arm and right fingers (C8 and T1 dermatomes). Her pain at the time of her visit was rated as a constant 8/10, and described as "shooting, stabbing, sharp, cramping and gnawing." She also endorsed numbness in her right extremity. Symptoms worsened with persistent use of her right arm, such as with driving or writing, and the application of prolonged pressure, such as during sleep. Sensations were minimally improved with rest and with the application of a heat pad. She reported her symptoms were very distressing, preventing her from completing basic ADLs like opening bottles or writing. On physical exam, she exhibited increased pain and piloerection to her right arm with deep palpation. No sudomotor, vasomotor, or trophic changes were exhibited. A cervical and thoracic magnetic resonance imaging (MRI) of the spine did not show any significant findings that could have explained her symptoms. An EMG study confirmed abnormal conduction and weakness of her right-sided C8 and T1 dermatomes. Her prior pain management included physical therapy, occupational therapy, acupuncture, chiropractor treatments, magnet therapy, over-the-counter nonsteroidal inflammatory mediators, acetaminophen, tizanidine, gabapentin, pregabalin, and lidocaine cream. She also had tried quetiapine and alprazolam for worsening anxiety postoperatively.

A DRG trial with tunneled leads was pursued to target the multiple affected nerves. Prior to surgery, her MRI scan was reviewed to rule out potential clinically significant spinal canal stenosis or foraminal stenosis at the treatment levels. Leads were placed to her right-sided C8 and T1 DRGs, which corresponded to the dermatomal levels of her symptoms (Fig. 1). She followed up in the clinic a week postoperatively and described an immediate relief in pain and improved use of her right upper extremity. Due to her success during the tunneled trial, the decision was made to pursue permanent DRG implantation, which occurred

several days later (Fig. 2). On multiple follow-ups, the patient reported a 95% to 98% pain improvement in her right upper extremity and axillary back pain and regained her ability to use her right upper extremity for prolonged periods of time (> 1 hour without pain). Soon after undergoing DRG implantation, she titrated her pregabalin from 3 times a day to an as-needed basis, taking it only a few times a month, and no longer used tizanidine or daily lidocaine cream. During her follow-up appointments, she continues to endorse improved pain control (consistently rated 1/10) with improved range of motion in her right upper extremity. She is now able to perform basic ADLs without pain for over an hour. She reports to being very relieved with the results of her DRG stimulation in allowing her to live independently without regular medication usage.

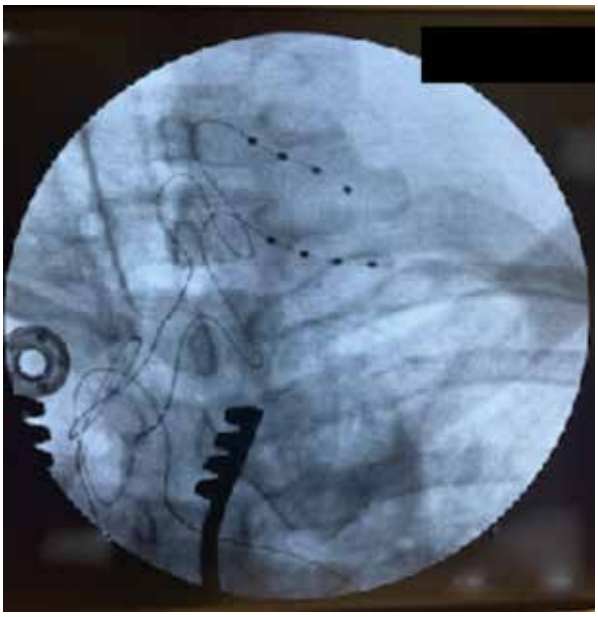

Fig. 1. Posterior cervical-thoracic x-ray with right sided DRG tunneled leads (C8 and T1). DRG trial with external IPG.

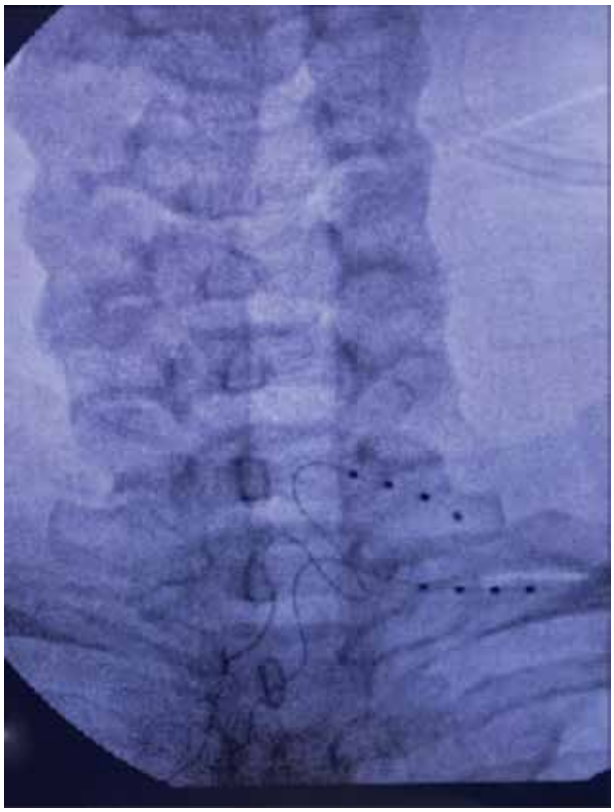

Fig. 2. Posterior cervical x-ray with right sided DRG tunneled leads (C8 and T1). Confirmed lead placements during permanent IPG implantation.

DISCUSSION

NP secondary to mechanical neural trauma is associated with prolonged hypersensitivity and loss of function even after the initial insult (15). The prevalence of acute postoperative NP secondary to operative trauma is estimated to be around 10% to 50% of patients, with severe chronic NP developing in around 2% to 10% of patients (16). The primary etiology of postsurgical NP is suspected to be the result of direct surgical injury to peripheral nerves, such as the intercostobrachial nerves, in the axilla during surgical interventions as in our case (13,15,16). Chapell et al (17) also suggest that indirect nerve injury can occur during surgery or postoperatively through stretch and compression of peripheral nerves. Although direct injury to nerves, such as in axillary dissection, was found to be a strong predictor, psychological factors, genetic predispositions, and even younger aged women (18-39 years old) were found to be at higher risk in developing pain syndromes (13,18). In our patient, she didn't undergo a complete mastectomy, but rather an axillary dissection that likely resulted in iatrogenic neural trauma with symptoms manifesting to her right C8 and T1 dermatomal regions. Other predisposed risk factors our patient exhibited included being younger aged and having predisposed anxiety.

Poorly controlled perioperative pain also increases risk of developing neuropathies; therefore, treatment recommendations are to pursue an early multifaceted approach (17). The primary aim is to reduce nerve damage by limiting direct trauma, compression, scarring, and inflammation through minimally invasive approaches (13,17). As aforementioned, current postoperative

conservative treatment recommendations may include physical therapy, pain medications, anti-depressants, anticonvulsants, steroids, and topical creams (8,11-13). In our case, although the patient underwent early multifaceted treatment, such as multimodal pharmaceuticals and therapies, her symptoms progressed to a debilitating state where she no longer attained the functional use of her right upper extremity. In cases of axillary and upper extremity NP resistant to treatment, there are patterns of a lack of further management options, such as the use of cervical neuromodulation. Here, cervical and high thoracic DRG stimulation (C8-T1) was pursued to the dermatomal areas of her symptoms with significant results. DRG stimulation was pursued over peripheral nerve stimulation due to multiple nerves being afflicted vs neuromodulation to one specific nerve. Furthermore, DRG stimulation was initially pursued over spinal cord stimulation (SCS) as it is recommended by the 2022 Neuromodulation Appropriateness Consensus Committee (NACC), due to a more precise dermatomal targeting of the patient's symptoms in her C8-T1 region (14). This also limits potential paresthesias in areas of neuromodulation with DRG stimulation in comparison to SCS (19).

Furthermore, the leads were placed using a "tunneled trial," where the leads were fed to their intended permanent locations during the initial trial (Fig. 1). Extension wiring was used to connect to an externalized implant pulse generator (IPG). Once it was determined the patient was satisfied with neuromodulation, the permanent implantation included an IPG exchange with the original C8-T1 leads already in place (Fig. 2). With the leads initially placed in their proper locations and eliminating the lead exchange, this subsequently reduced the potential for neurotrauma or misplaced leads that may occur with a second lead placement attempt. Another benefit in utilizing a tunneled trial is that the patient received the same neuromodulation relief as they experienced during the initial implantation.

Challenges associated with cervical DRG implantation incur a risk of neurotrauma since the leads are placed directly adjacent to the spinal cord, and then through the neural foramina at the levels of the spinal cord associated with the dermatomes affected by pain. This requires significant experience and comfort with DRG placement. Lead migration is another potential complication in spinal neuromodulation due to the mobility of the spine, with more concern in the cervical vs lumbar spine. However, after Silastic anchors and nonabsorbable sutures were utilized in practice lead migrations, instances have significantly decreased. Furthermore, as indicated by the NACC guidelines, once the cervical or high thoracic leads are placed and anchored, the narrower spatial anatomy in the cervical/high thoracic spine vs the lumbar or lower thoracic spine may also contribute to limiting lead movement (20). Overall, the rate of adverse events following DRG lead implantation in the cervical and upper thoracic region is similar to the lower thoracic and lumbar regions (21). Furthermore, cervical and upper thoracic DRG stimulation is becoming a more established therapy, while still offering similar pain relief when compared to DRG stimulation for groin and lower limb pain (22,23).

CONCLUSIONS

This case highlights the novel, off-label use of cervical and high thoracic DRG stimulation in treating a refractory postoperative NP following an axillary dissection and excision of a lipoma. Here, our patient experienced a debilitating constant pain in her right upper extremity, axilla, and back following an axillary dissection and excision that prohibited ADLs, such as opening bottles, writing, driving, and even sleeping. Multifaceted conservative management proved unsuccessful. However, following the off-label use of cervical and high thoracic DRG stimulation, the patient exhibited significant pain improvement (95% to 98%) immediately after implantation.

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