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Effective Management of Recurrent Trauma-Induced Neck Pain With Radiofrequency Neurotomy Using the Nimbus Electrosurgical Radiofrequency Multitined Expandable Electrode: A Case Report

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Background: Radiofrequency neurotomy (RFN) can be an effective treatment for patients with chronic neck pain and cervicogenic headaches resistant to conservative care. However, the degree and duration of pain relief after RFN is dependent upon the thoroughness of target nerve coagulation.

Case Report: This is a case of a 37-year-old patient with debilitating neck pain and headaches following a motor vehicle accident. Successful local anesthetic block of the third occipital nerve (TON) confirmed pain of C2-C3 facet joint origin. An initial RFN treatment of the TON, using standard 18G electrodes in bipolar mode, resulted in complete symptom amelioration for 8 months. Repeat RFN, using the same electrode configuration, was unsuccessful in alleviating the severe neck pain and headaches, and produced no demonstrable sensory loss in the distribution of the TON. RFN was then performed using the Nimbus® electrosurgical RF multitined expandable electrode, which provides a larger zone of coagulation in volume than standard RFN electrodes even when used in bipolar configuration.

Conclusions: The Nimbus procedure resulted in successful coagulation of the TON with sensory loss in the TON distribution and reinstatement of palliative relief.

Key words: Cervical pain, radiofrequency neurotomy, third occipital nerve, Nimbus, case report

BACKGROUND

Percutaneous radiofrequency thermocoagulation neurotomy (RFN) has been shown to offer effective symptom amelioration in patients suffering from chronic neck pain and cervicogenic headaches resistant to conservative care (1-5). The C2-C3 cervical facet (zygapophysial or "Z") joints, innervated by the third occipital nerve (TON) (6), is often the primary pain generator in this condition (7-9). RFN is used to coagulate the TON thereby blocking nociceptive transmission and conduction. While patients experience substantial and clinically significant pain diminution following the procedure (10,11), relief of symptoms is temporary as the TON cell bodies remain intact and eventually regenerate sensory nerve fibers and reinnervate the painful joint, at which point pain recurs.

The duration of pain relief after RFN is directly associated with the thoroughness of target nerve coagulation both in terms of the length and full thickness of neural tissue affected during the procedure (1). This procedural outcome is particularly important for the TON, which traverses the dorsolateral surface of the C2-C3 facet joint (6,12), and is anatomically variable in size and course with an average diameter 2 to 3 times that of other medial branch occipital nerves (12). Consequently, there

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is a higher likelihood of failing to achieve full-thickness coagulation along a satisfactory length of the TON to impart sustained pain relief, particularly with standard small-diameter RFN electrodes (13).

We present a case of a patient with recurrent, debilitating neck pain and cervicogenic headaches who experienced complete symptom amelioration following RFN using standard 18G canulae in bipolar configuration, then failed repeat TON RFN when symptoms recurred using the same canulae and configuration with virtually identical fluoroscopic placement. Ultimately, successful TON coagulation was achieved after a third treatment with the Nimbus® electrosurgical RF multitined expandable electrode, which produces a larger volume of tissue coagulation than standard RFN electrodes even when used in bipolar configuration (Fig. 1).

CASE REPORT

This case represents a 37-year-old woman who sustained a motor vehicle accident, in 2019, that resulted in persistent left upper cervical pain and headaches. Pain was of sufficient severity and chronicity to cause functional limitations and reduced quality of life. Symptoms failed to respond to conservative treatment measures, including opioid analgesics. A local anesthetic block (x 2) of the left TON eliminated the pain and was diagnostic for a C2-C3 facetogenic pain source (Fig. 2).

After providing informed consent, RFN was undertaken under fluoroscopic guidance, utilizing standard 18G electrodes (10-cm length, 10-mm active tip) in a bipolar configuration at 85°C for 90 seconds, to coagulate the TON at 2 locations (Fig. 3). Distance between electrodes was maintained at approximately one needle width to prevent gaps in the coagulation zone. The patient experienced sensory loss in the TON distribution and relief of symptoms.

Eight months after the initial RFN, the patient reported symptom recurrence, which is consistent with TON regeneration and reinnervation of the C2-C3 facet joint. RFN was repeated at 3 locations along the TON utilizing the same 18G electrode bipolar configuration and temperature/duration protocol (Fig. 4). This procedure failed to provide sufficient coagulation of the TON and the patient did not experience sensory loss or dysesthesia in the TON distribution. Severe neck pain and headaches persisted postprocedure.

With lack of efficacy with the standard RFN electrodes, a third RFN treatment was undertaken with the Nimbus electrosurgical RF multitined expandable electrode (Nimbus, Stratus Medical, Magnolia, TX) in monopolar

Fig. 1. The Nimbus electrosurgical RF multitined expandable electrode (Stratus Medical, Magnolia,TX). RF = radiofrequency.

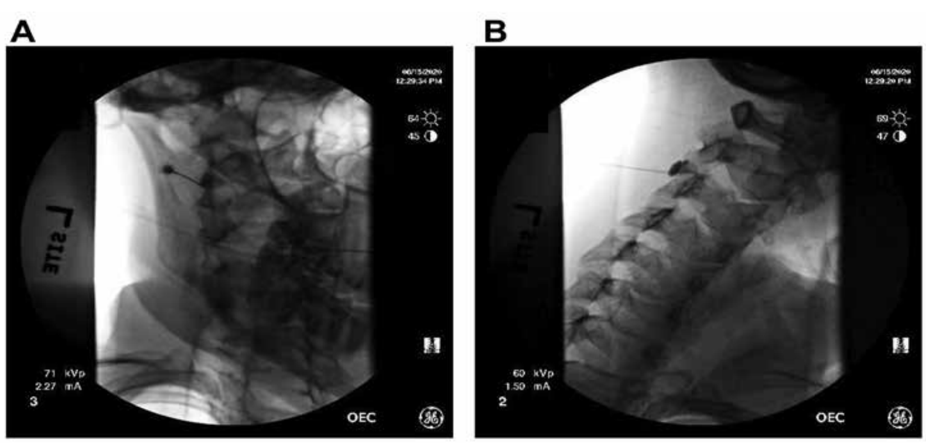

Fig. 2. Local anesthetic block of the left TON shown in AP (A) and oblique ipsilateral foraminal (B) views. TON = third occipital nerve; AP = anteroposterior.

mode at 85°C for 90 seconds, at 2 locations along the TON (Fig. 5). Due to the larger volume of coagulated tissue created by the Nimbus electrode, the TON was successfully captured, nociceptive pain conduction interrupted, and complete sensory loss in the TON distribution achieved. The patient experienced symptom amelioration and palliative relief.

DISCUSSION

In cases of chronic neck pain with a confirmed facetogenic source via local anesthetic blocks of the target joint(s) innervation (i.e., medial branches or TON), palliative relief can be achieved by RFN. Relief of symptoms is temporary as regeneration of the sensory nerve fibers and subsequent reinnervation of the painful joint(s) will occur. Repeat RFN of the target nerve(s) typically results in a similar degree and duration of pain relief as the initial RFN treatment (14-16). However, as the sole innervation of the C2-C3 facet joint, the TON is the largest sensory medial branch in the cervical spine with a mean diameter of 1.5 +/- 0.4 mm, which is 2 to 3 times larger than the other medial branches (6). The TON can also take on a more circuitous anatomical course as it crosses the joint and may be located anywhere from opposite the apex of the C3 superior articular process to opposite the bottom of the C2-C3 intervertebral foramen (12).

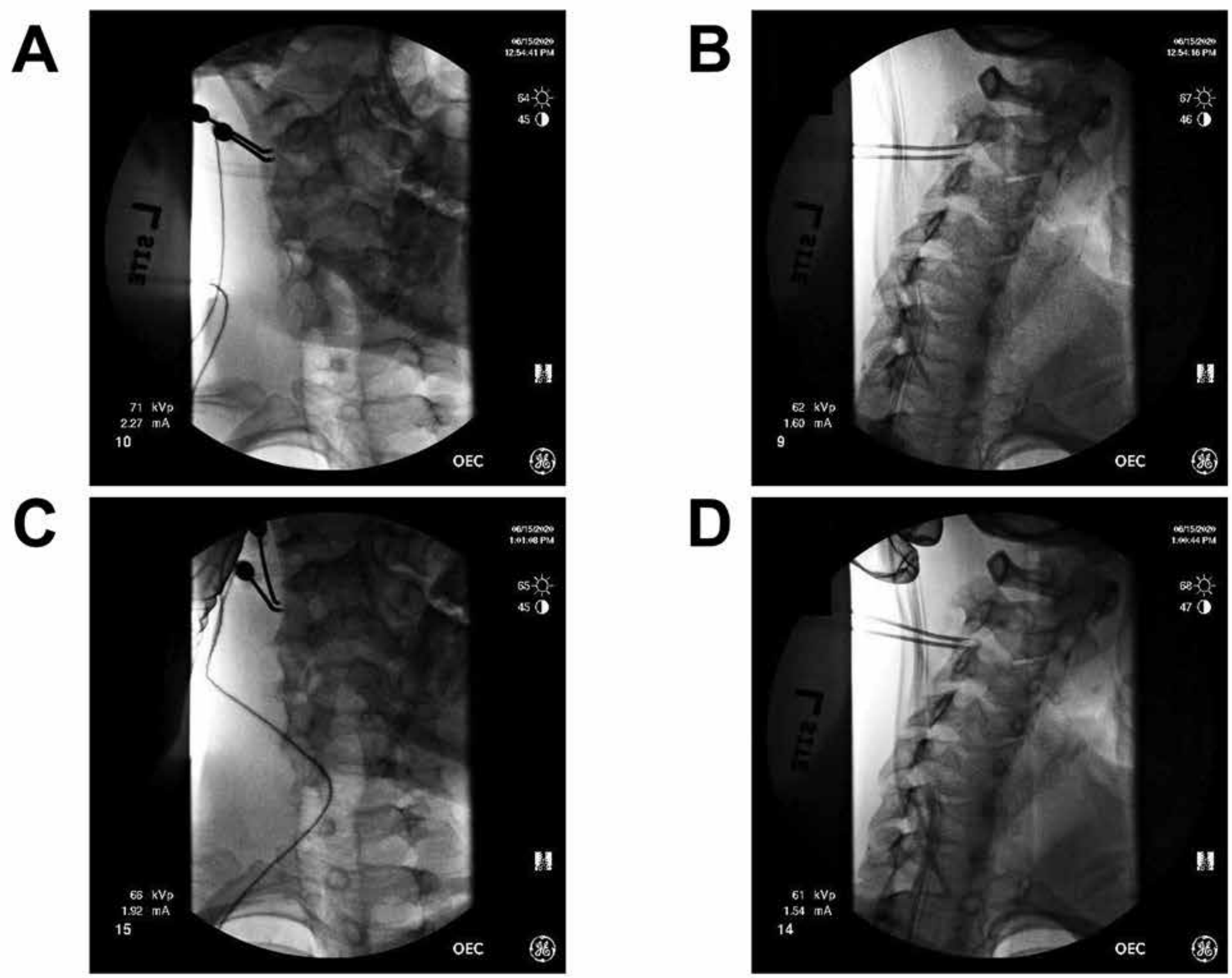

Fig. 3. Initial successful RFN procedure using standard 18G electrodes in bipolar configuration shown in AP view of superior and middle TON pass (A), oblique ipsilateral foraminal view of superior and middle TON pass (B), AP view of middle and inferior TON pass (C), and oblique ipsilateral foraminal view of middle and inferior TON pass (D). Electrode placement is slightly displaced from the periosteum. RFN = radiofrequency neurotomy; AP = anteroposterior; TON = third occipital nerve.

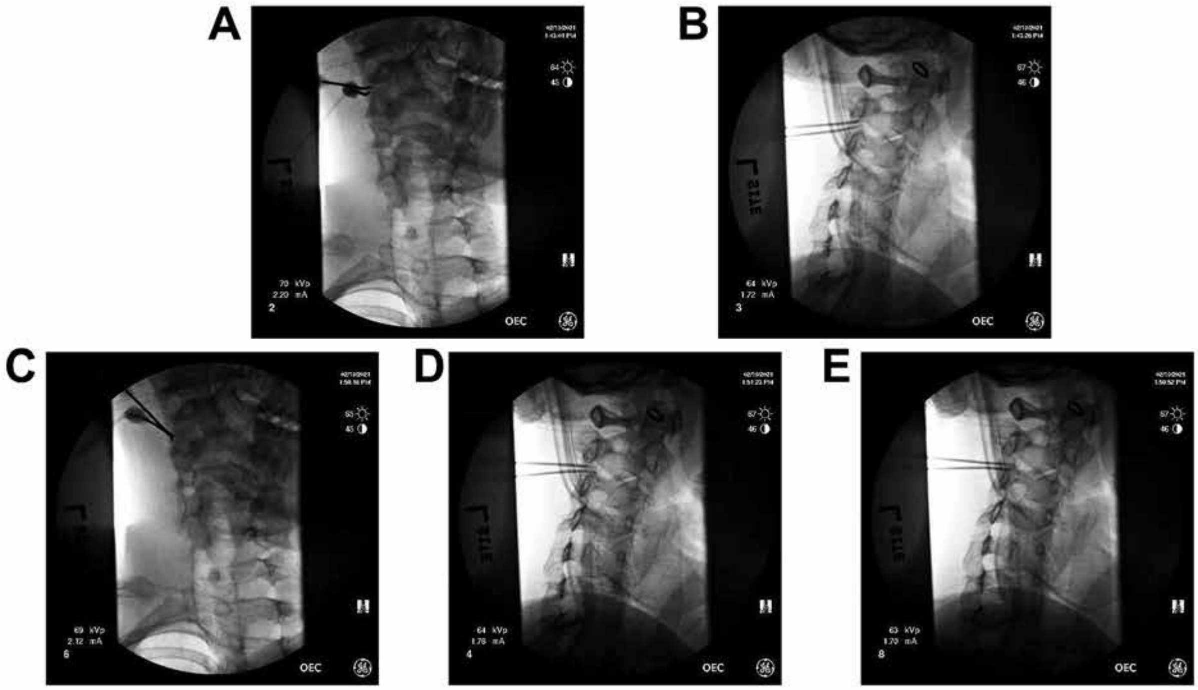

Fig. 4. Repeat RFN procedure failed to successfully capture and coagulate the TON shown in AP view of superior and middle TON pass (A), oblique ipsilateral foraminal view of superior and middle TON pass (B), AP view of middle and inferior TON pass (C), oblique ipsilateral foraminal view of middle and inferior TON pass (D), and oblique ipsilateral foraminal view of additional inferior TON pass (E). Electrode placement approximates the periosteum more closely than initial RFN procedure. RFN = radiofrequency neurotomy; TON = third occipital nerve; AP = anteroposterior.

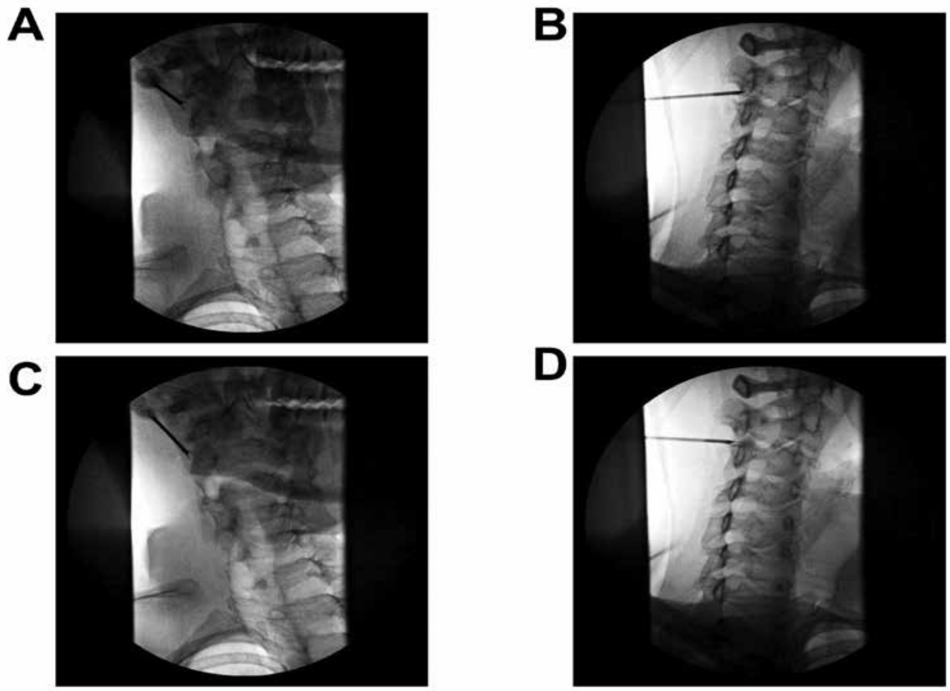

Fig. 5. Final RFN procedure utilizing the Nimbus electrode (shown in AP view of superior and middle TON pass [A], oblique ipsilateral foraminal view of superior and middle TON pass [B], AP view of middle and inferior TON pass [C)], and oblique ipsilateral foraminal view of middle and inferior TON pass [D]). Electrode placement closely approximates the periosteum. RFN = radiofrequency neurotomy; AP = anteroposterior; TON = third occipital nerve.

Additionally, the nerve may be found directly adjacent to the bone, within 0.2 mm, or as far away as 2.2 mm. Thus, traditional needle electrodes, even with perfect cephalocaudal needle placement and multiple lesion locations may be unsuccessful in capturing the TON as the lesion volume away from the bone may be inadequate, necessitating more lesions at less precise locations away from contact with the bone. Moreover, conducting RFN in a bipolar configuration, which requires 2 needle punctures and electrodes in close proximity, can be a technically challenging procedure to master. When comparing images of the initial, successful, RFN coagulation (Fig. 3) to the second, failed, RFN coagulation (Fig. 4), the needle placement angles are slightly displaced from the bone in the former vs the latter. This suggests that the patient's TON is significantly displaced from the bone.

In contrast, the Nimbus electrode, which requires only a single-needle puncture, coagulates a much larger tissue volume of approximately 23% than traditional 18G electrodes in bipolar configuration (Fig. 6). Nimbus creates a large, optimally shaped prolate (ellipsoid) spheroid lesion (17). This allows for Nimbus electrode placement to remain in contact with the periosteum to capture the TON when close to the bone, but also has a much higher likelihood of capturing the TON when significantly displaced, with fewer lesion locations.

CONCLUSIONS

In summary, the Nimbus procedure resulted in successful coagulation of the TON with sensory loss in the TON distribution and reinstatement of palliative relief when traditional needle electrodes, even with perfect cephalocaudal needle placement and multiple lesion locations were unsuccessful.

Author Contributions

BDV and JEB made significant contributions to manuscript development, including conception, study design, execution, acquisition of data, analysis, and interpretation, as well as drafting, revising, and critically reviewing the article.

Fig. 6. Experimental bench-top comparison demonstrating an approximate 23% larger ellipsoidal volume in tissue samples for the Nimbus electrode in monopolar mode (A) vs standard 18G electrodes in bipolar mode (B). Both procedures were conducted at 85°C for 90 seconds.

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