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Fluoroscopy-Guided Radiofrequency Ablation of the Supraorbital Nerve for Refractory Painful Post Herpetic Trigeminal Neuralgia: A Case Report

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Background: Post-herpetic Neuralgia (PHN) is the most common complication of Herpes Zoster (HZ) and is characteristically difficult to treat with limited pharmacologic and interventional options. We present a case of PHN of the supraorbital branch of the trigeminal nerve successfully treated with thermal radiofrequency ablation.

Case Report: An 82 year-old woman with a 7 year history of supraorbital branch neuralgia following HZ, presented to clinic with pain refractory to a multimodal oral pain regimen. Her pain resolved for 3 days after a supraorbital nerve block, and she had durable relief following right supraorbital thermal radiofrequency nerve ablation (RFA) which produced a > 75% decrease in her pain and lasting for months. She currently continues to receive this treatment every 6 to 10 months.

Conclusion: When medications fail, RFA is a potential treatment option for V1. Additionally, the risk of post-RFA neuritis and anesthesia dolorosa should be considered.

Key words: Herpes zoster, post-herpetic neuralgia, trigeminal neuralgia, supraorbital nerve, radiofrequency ablation

BACKGROUND

Herpes zoster (HZ) is characterized by painful, unilateral vesicular skin lesions arising usually in a single dermatome (1,2). The most common complication of HZ is post-herpetic neuralgia (PHN) which presents as pain persisting greater than 3 months beyond the rash duration (2). The mechanism of PHN is thought to include complex changes in pain signaling pathways that result in an increased pain response through nociceptors sensitization, sensitivity from local inflammatory mediators, altered pain pathways excitability, and reduced inhibitory control involving the peripheral and central nervous systems by varicella-zoster virus induced nerve injury (3,4). Fifteen to 20 percent of HZ cases affect the trigeminal nerve, with the majority of those affecting the ophthalmic division (5).

The first line treatment for PHN includes gabapentin, pregabalin, or 5% lidocaine patches (6). The second line treatments include opioids, 8% capsaicin, and duloxetine (6). For refractory cases of PHN, treatment options are limited, making interventional approaches an important consideration. Nerve blocks often have a short duration of relief given the rapid metabolism of local anesthetics (2). Spinal cord stimulation has been used for treatment of chronic neuropathic pain, however this modality is not typically used for the treatment of trigeminal nerve disorders. Alternatively, peripheral nerve stimulation has shown some promise in the treatment of supraorbital neuralgia and HZ related trigeminal neuralgia, but is an invasive procedure with a risk for infection, lead migration, lead fracture, and skin erosion (2,7-9). Percutaneous radiofrequency thermoco-

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agulation of the Gasserian ganglion has demonstrated durable for pain relief in trigeminal neuralgia, but its intracranial target results in a greater risk compared to other options (10,11).

Although radiofrequency ablation (RFA) of the supraorbital nerve has been described in the treatment of nonherpetic cranial neuralgias, such as for idiopathic trigeminal neuralgia, hemicrania continua, as well as for trigeminal nerve branches with ultrasound and computed tomography (CT) guidance. However, its use for PHN involving the terminal branches of the ophthalmic division (V1) of the trigeminal nerve remains limited in the literature (2,11-13). Although these findings support the use of supraorbital RFA in select conditions, there remains limited published data on fluoroscopy-guided RFA for PHN specifically affecting the supraorbital nerve. Herein we present a case report of a patient who received thermal conventional RFA for the treatment of refractory supraorbital PHN highlighting the utility of this treatment modality for refractory supraorbital PHN.

CASE PRESENTATION

An 82-year-old woman presented with a 7-year history of pain over the right forehead that started after a HZ rash. The pain was severe, with paroxysmal 10-90 second sharp, stabbing attacks superimposed over a background moderate constant discomfort. The distribution extended from her right eyebrow across her right forehead to the crown of the head, corresponding to the supraorbital branch of the right trigeminal nerve. She had previously failed treatment with gabapentin, pregabalin, nonsteroidal anti-inflammatory drugs, topical anesthetics, attempted acupuncture, and a transcutaneous electrical nerve unit without any significant improvement. Tricyclic antidepressants, serotonin-norepinephrine reuptake inhibitors, and other antiepileptics were avoided due to the patient's preference and concern for potential adverse reactions. Her medical history was notable for arrhythmia requiring a cardiac pacemaker and defibrillator, as well as chronic kidney disease.

She was initially treated with a supraorbital nerve block using 2 mL of 0.2% ropivacaine (1.5 mL) and dexamethasone 4mg/mL (0.5 mL), which provided 100% pain relief for 3 days, with gradual recurrence over the course of approximately one week. In hopes of obtaining longer lasting relief, she then underwent right-sided RFA of the supraorbital nerve.

Procedure

The patient was placed in the supine position and posterior-anterior fluoroscopic images of the region surrounding the right eye were obtained. The skin was prepped with 70% isopropyl alcohol and the skin at the needle entry site was anesthetized with a 1% lidocaine. A 22G, 10 cm RFA needle (Abbott Medical) with a 10 mm active tip was placed subcutaneously and advanced from lateral to medial in the plane under the dermis and above the frontalis muscles and guided to the region immediately superior to the supraorbital notch, in the area of the supraorbital nerve as it passes through the supraorbital notch and travels cephalad (Fig. 1). While positioning the needle, care was taken to avoid advancing the needle into and below the frontalis muscle, as well as avoiding being too superficial, within the dermis. The proximity of the needle to the supraorbital nerve was verified via sensory stimulation testing at 0.3 mV at 50 Hz and the patient confirmed sensation in the area of her usual neuralgiform pain. A 2 mL mixture of 2% lidocaine and 0.2% ropivacaine was injected in the area after a negative aspiration. Then, neurotomy was carried out using pulsed RF at 42°C for 120 seconds followed by conventional RFA at 65°C for 90 seconds. The patient reported 50% reduction in her pain lasting at least 3 weeks. A second conventional RFA was performed in a similar manner, however this time the nerve was treated with 80°C for 90 seconds. At her 2-week post procedure follow-up, she reported 75-80% reduction in her constant background pain as well as a 75-80% reduction in both the frequency and intensity of her paroxysmal neuralgiform pains. She had continued relief with pain slowly returning over several months. At the time of preparation of this case report, the patient has had this procedure repeated 6 times as her pain is returning and she loses > 50% of the pain reduction she achieved with the RFA. The average time between repeated procedures has been 8 months, ranging from 6 months to 12.25 months. The patient has not had any complications or adverse reactions.

Regarding the procedure technique, if based on skull anatomy, a lateral to medial approach as described above will not allow for smooth advancement of the needle due to the curve of a patients skull, a medial to lateral approach from the contralateral side can be utilized (Fig. 2). This approach would involve advancing past the ipsilateral supratrochlear artery and supratrochlear/frontal vein in the forehead, and may increase bleeding and bruising risk.

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

DISCUSSION

Treating the supraorbital nerve with RFA gave this patient with painful post-herpetic trigeminal neuralgia significant and long lasting pain relief. RFA involves the application of energy adjacent to the peripheral nerves. This application of thermal energy above 42°C creates an area of tissue destruction that interrupts pain impulses stemming from the targeted nerve (14,15). During conventional RFA, tissue temperature is maintained at a predetermined set point, usually avoiding raising the temperature above 90°C, at which point tissue gas formation occurs. During pulsed RFA, structural changes to the nerve still take place, such as an increase in concentration of vacuoles and disruption of myelin (16,17).

Multiple trigeminal targets have been utilized for radiofrequency treatment of facial pain syndromes. The supraorbital nerve and the Gasserian (trigeminal) ganglion have been targeted for the treatment of neuralgia (2,3,11). However, the intracranial location of the Gasserian ganglion makes this approach higher risk, with potential for corneal damage causing a decreased corneal reflex, keratitis, ptosis, and decreased mastication muscle strength (10). A small prospective randomized trial of trigeminal ganglion versus distal trigeminal branch RFA for the treatment of idiopathic trigeminal neuralgia has shown no difference for pain reduction at 3 months post treatment (11). Treating the supraorbital nerve at or just above the supraorbital notch provides a safer location for the treatment of supraorbital neuralgia. At this location, the nerve has already separated from the ophthalmic division's deeper branches, including those supplying the cornea, theoretically minimizing the risk of corneal anesthesia or keratitis (18). The supraorbital nerve emerges from the supraorbital notch and travels within the subcutaneous tissue of the forehead, becoming superficial approximately 0.3–1 cm beneath the skin (19).

RFA is generally regarded as a safe procedure with a low risk of morbidity, but it is not without potential side effects (20). The most common side effect is postneurotomy neuritis, a neuropathic pain often described as a burning sensation (21). The incidence of postneurotomy neuritis ranges from 0.5-9.2% (20). A rare but serious complication is anesthesia dolorosa, a pain syndrome in which numbness is paradoxically accompanied by persistent neuropathic pain. The incidence is about 4% with trigeminal ablative procedures (22).

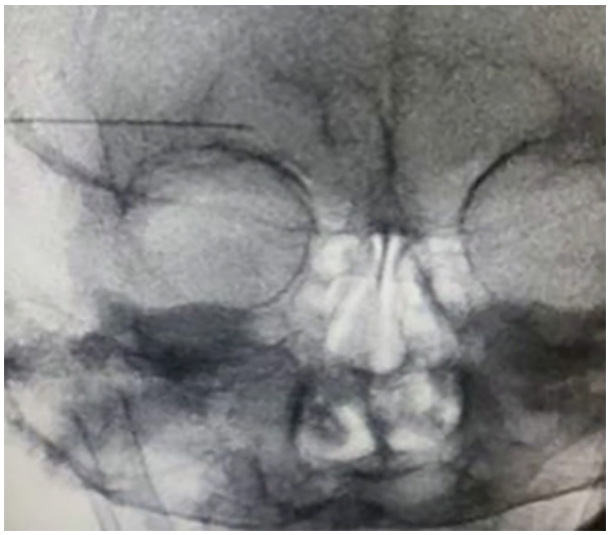

Fig. 1. An anterior-posterior (AP) fluoroscopy image of needle placement prior to ablation. The needle is guided to the region immediately superior to the supraorbital notch and location is verified via sensory stimulation.

Fig. 2. Fluoroscopic imaging depicting medial to lateral needle approach for targeting the supraorbital nerve.

In our case, the patient did not experience post-radiofrequency neuritis or any cutaneous complications; however, this remains a potential complication. In a retrospective analysis of 91 patients undergoing ultrasound-guided craniofacial RFA for PHN, new onset

neuralgia was reported in 7.8% of cases, along with transient sensory deficits and local edema as the most frequent minor adverse events (23).

Although specific clinical correlations between lesion temperature and post-RFA neuritis are limited, pre-clinical data by Dong et al. (24) demonstrated a temperature dependent relationship between heat exposure and neural injury, with overt neuronal destruction at 67°C. These findings reinforce the rationale for using moderate temperature to achieve effective thermocoagulation while minimizing excessive collateral injury that could predispose to neuritis.

Additionally, nerve size may affect lesion size and injury extent but has not been directly linked to neuritis risk (25). Skin thermal injury is another concern with RFA. A study reported only transient upper eyelid ecchymosis in 23% of 22 patients undergoing ultrasound-guided pulsed RFA for idiopathic supraorbital neuralgia, with no cases of skin necrosis or ulceration (26). Likewise, Zhang and colleagues achieved effective analgesia in patients with ophthalmic PHN using CT guided conventional RFA without eyelid, corneal, or cutaneous complications (2). These findings suggest that when the appropriate needle depth and temperature parameters are used, skin injury in supraorbital RFA is minimal.

Initially, we treated our patient with pulsed RFA as well as conventional RFA at 65°C to mitigate the risk of post RF neuritis and potential skin injury. Retrospective studies of trigeminal ganglion stereotactic thermal rhizotomies has demonstrated success with treating the nerve at 65°C (26,27). However, that treatment unfortunately did not yield long lasting results. This may have been due to the size and surrounding tissue structure of the supraorbital nerve compared to other nerves studied. For the initial treatment, we used a combination of pulsed and thermal RFA given the different mechanism by which these modalities work, in hopes of yielding a higher chance of success.

A retrospective review studied 53 patients with supraorbital neuralgia who underwent ultrasound-guided RFA of the supraorbital nerve at the supraorbital notch (26). This study included patients diagnosed with supraorbital neuralgia that primarily encompasses idiopathic or traumatic etiologies. Their cohort did not include patients with PHN, making our case distinct in etiology. RFA was performed under ultrasound guidance using a stepwise temperature protocol of 60°C, 65°C, 70°C, 75°C, and 80°C, each maintained for 75 seconds. This gradual escalation allowed for controlled lesion formation and minimization of thermal injury to the surrounding tissues. The final lesioning temperature was 80°C. Unlike their ultrasound guided approach, our case utilized fluoroscopic guidance to localize the supraorbital notch and a single conventional lesion at 80°C for 90 seconds, providing comparable efficacy while demonstrating an alternative imaging and procedural technique.

Similarly, Zhang et al (2) demonstrated a statistically significant reduction in numeric rating scores from a median of 6.0 pre-procedure to 2.0 post-procedure, durable at 360 days post-procedure, following CT-guided supraorbital nerve RFA for patients with ophthalmic herpetic neuralgia. Of note, Zhang carried about conventional RFA at a temperature of 95°C, which was higher than our treatment temperature, but did not have any reported complications beyond forehead or apex numbness.

The authors selected CT guidance to directly visualize the supraorbital foramen and confirm needle tip placement with millimeter level accuracy. While CT provides exceptional precision, it also increases cost, setup time, and increased radiation exposure - making it less practical for routine pain procedures. In contrast, our fluoroscopy guided approach utilizes bony landmarks and sensory testing to achieve accurate localization of the supraorbital notch with lower radiation exposure and greater clinical accessibility. Our case also demonstrates comparable analgesic efficacy at a lower temperature without adverse effects. To our knowledge, is the first report of fluoroscopy guided conventional RFA of the supraorbital nerve for PHN.

CONCLUSIONS

We highlight the potential role of fluoroscopy-guided conventional RFA of the supraorbital nerve in patients with refractory painful post-herpetic trigeminal neuralgia as a safe, effective, and minimally invasive treatment option. Further studies with larger sample sizes and longer follow-up are warranted to validate these findings, optimize procedural parameters, and establish standardized guidelines for supraorbital RFA in patients with trigeminal PHN.

Author Contributions

Authors JH, VM, and TK all participated in the planning, writing, and revisions of the manuscript. TK performed the clinical care of the patient.

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