Ochsner Journal 18:63–65, 2018

Pulsed Radiofrequency for Treating Trigeminal Neuralgia

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Background: Trigeminal neuralgia is the most common cause of facial pain but can be challenging to treat. Some patients fail on medications, and while surgical procedures achieve short-term efficacy, they can be associated with numerous complications. We present a case series suggesting the efficacy and safety of using pulsed radiofrequency (PRF) through the transcoronoid approach to treat trigeminal neuralgia.

Methods: This retrospective analysis included 8 cases with data collected from the electronic medical record. Outcomes were pain scores before and after the procedure as well as the percent improvement after the procedure (improvement in severity, frequency, and duration).

Results: Patients had an average age of 56.4 $\pm$ 13 years. All patients reported improvement after the procedure, and 3 patients reported that their improvement was ongoing at the time of follow-up. No complications were reported by any of our patients.

Conclusion: PRF through the transcoronoid approach may be a safe and effective approach for treating trigeminal neuralgia in patients resistant to conservative management.

Keywords: *Facial pain, pulsed radiofrequency, trigeminal neuralgia*

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INTRODUCTION

Trigeminal neuralgia is the most common cause of facial pain. Its estimated prevalence is 4.3 per 100,000, and the condition occurs more commonly in women than men. Trigeminal neuralgia usually affects patients >50 years but can affect younger patients, especially those with multiple sclerosis.[1]

The International Headache Society has specified the diagnostic criteria for trigeminal neuralgia.[2,3] Diagnosis is confirmed if the patient has had at least 3 attacks of unilateral facial pain with the following characteristics:

- Meeting at least 1 of the following 4 criteria: (1) paroxysmal and lasting from a fraction of a second to 2 minutes; (2) severe; (3) electric shock–like, shooting, stabbing, or sharp; (4) precipitated by nonpainful stimuli
- Occurring in at least 1 division of the trigeminal nerve with no radiation beyond its distribution
- Lacking neurologic deficits and any other identifiable causes

Treatment of trigeminal neuralgia is challenging. Medical options include carbamazepine and oxcarbazepine as primary agents, although practitioners prescribe other neuropathic agents such as neuroleptics and anticonvulsants with variable degrees of success.[4] Carbamazepine has been used since 1960 for its efficacy in approximately 60%-80% of patients; however, its side effects and possible loss of efficacy have encouraged the search for other drugs.[5] Only an estimated 25% of patients will achieve total long-term pain control using medications,[4] indicating that the majority of patients will require an intervention at some point to treat their pain.

Surgical options include neurovascular decompression, balloon compression, glycerol gangliolysis, and radiofrequency ablation (RFA).[6] Surgeries, although reported to be successful, can have significant risks and complications.

The goal of vascular decompression is trigeminal nerve decompression from compressing vessels. Trigeminal nerve decompression was successful for 1-2 years with a decline in efficacy after 10 years.[7] In addition, this surgical procedure has the risk of complications.

Balloon compression is performed under general anesthesia. A Fogarty balloon is inserted into the Meckel cave and inflated with a dye. The appropriate duration for compression remains controversial.[8] This procedure provides short-term pain relief, but long-term relief is variable. Balloon compression includes risks associated with the procedure, as well as the additional complications of general anesthesia.[9]

Glycerol gangliolysis requires an injection of glycerol through the foramen ovale. Although the procedure is initially successful in relieving pain, efficacy at 12 months is variable, and recurrence rates at 12 months can reach 53%.[10] An important problem with this procedure is the spread of glycerol beyond the ganglion and the lack of selectivity that can cause damage to motor and autonomic fibers.

Table 1. Patient Demographics and Outcomes

Patient	Sex	Age, Years	Pain Score Before PRF[a]	Pain Score After PRF[a]	Percent Improvement in Pain After PRF[b]	Duration of Improvement at Time of Follow-Up, Days
1	Female	83	4	3	60	462 (and ongoing after follow-up)
2	Female	51	7	3	50	183
3	Female	45	5	2	70	315 (and ongoing after follow-up)
4	Female	62	4	3	50	91
5	Female	64	8	5	100	227
6	Female	51	8	1	85	188 (and ongoing after follow-up)
7	Male	43	8	1	70	131
8	Male	52	10	NA	100 (V1 and V2); no improvement in V3	151

NA, not available; PRF, pulsed radiofrequency.
[a]Pain was scored on a scale of 0-10, with 0 corresponding to no pain and 10 corresponding to the worst pain imaginable.
[b]Percent improvement reflects improvement in severity, frequency, and duration of pain and was scored from 0%-100%.

The role of RFA in treating trigeminal neuralgia has been described but has not been well studied. The traditional technique is to place the RFA needle through the mouth until it is in proximity to the foramen ovale (close to the gasserian ganglion) and then to perform RFA, but this technique is associated with pain and soft tissue trauma.[11]

Several other procedures have been described for treating trigeminal neuralgia: stereotactic radiosurgery, alcohol injection, cryotherapy, local light amplification by stimulated emission of radiation, and electroacupuncture.[12] None of these procedures provides long-term efficacy, some require general anesthesia, and they all have complications. Complications may be surgical or result from the lack of selectivity that damages nerve fibers, ultimately leading to the loss of motor and autonomic functions.

We present a case series in which patients with trigeminal neuralgia resistant to conservative therapy that included antidepressants, anticonvulsants, and opioids (for some patients) were effectively treated with pulsed radiofrequency (PRF)—applying energy intermittently rather than continuously as in RFA—using a transcoronoid approach rather than the traditional approach through the mouth.

METHODS

We retrospectively studied patients who received PRF to treat trigeminal neuralgia from January 1, 2015 through June 1, 2016. After obtaining an institutional review board exemption, we collected the following data from our electronic medical record: patient demographics, pain scores before and after the procedure (scored on a scale of 0-10, with 0 corresponding to no pain and 10 corresponding to the worst pain imaginable), percent improvement after the procedure (improvement in severity, frequency, and duration scored at 0% to 100%), and duration of improvement.

Statistical Analysis

Data were entered in an Excel spreadsheet and then into SPSS v.22 (IBM). Analysis included descriptive statistics (mean and standard deviation for continuous variables and numbers for categorical variables). Pain scores before and after PRF were compared using paired *t* test, and a *P* value <0.05 was considered significant.

Procedure Technique

Each patient received 2 nerve blocks using 0.25% bupivacaine with or without steroids that resulted in >50% improvement in pain. Patients then underwent PRF. During PRF, patients were in the lateral position with the operable side up. The site was cleaned with sterile solution and sterile drapes were applied. The coronoid notch was identified under fluoroscopic guidance. A 21-gauge 50-mm radiofrequency needle with a 4-mm active tip was inserted through the coronoid notch in an upward direction under fluoroscopic guidance until the needle was touching the lateral pterygoid plate. A similar needle was placed in a downward direction. The goal of placing the needles in those directions was to capture the nerve branches as they exit the skull. The PRF was performed at 40°C or 60°C and for 180 seconds.

RESULTS

Our study included 8 patients, 6 females and 2 males, with an average age of 56.4 ± 13 years (Table 1). One patient reported the development of the trigeminal neuralgia after getting herpes zoster, 3 patients after a motor vehicle accident, and 1 patient after left posterior fossa decompression. The remaining patients did not report a triggering event.

One patient reported improvement in the distribution of V1 and V2 branches but no improvement in the distribution of V3 branch, so we excluded this patient from the comparison of preprocedure and postprocedure pain scores. Seven patients reported a statistically significant decrease in their pain scores. All patients also reported improvement of their neuralgia episodes (Table 2).

Duration of improvement ranged from 91-462 days at the time of follow-up, and 3 patients reported ongoing relief at 60, 70, and 85 days after the follow-up period. None of the patients reported any complications after the procedure.

DISCUSSION

Our case series presents a novel method of performing PRF for patients with trigeminal neuralgia that is resistant to medical management. The procedure results in excellent pain relief, and the lack of side effects reported in our series suggests that PRF is also a safe procedure.

RFA and PRF have previously been described as modalities for treating trigeminal neuralgia by using an approach through

Table 2. Pain Scores and Percent Improvement Before and After Pulsed Radiofrequency (PRF)

Variable	Before PRF	After PRF	*P* Value
Pain scores[a]	6.3 ± 1.9	2.6 ± 1.4	0.008
Percent improvement[b]	NA	73.1 ± 20.2 (range, 50-100)	NA

NA, not applicable.
[a]Pain was scored on a scale of 0-10, with 0 corresponding to no pain and 10 corresponding to the worst pain imaginable (n=7).
[b]Percent improvement reflects improvement in severity, frequency, and duration of pain and was scored from 0%-100% (n=8).

the mouth. RFA, while effective, may cause nonselective damage to the nerve that can lead to the loss of motor and autonomic function. In a large study that included 1,600 patients who received RFA for treating trigeminal neuralgia, the authors reported the following complications: diminished corneal reflex, masseter weakness and paralysis, dysesthesia, anesthesia dolorosa, keratitis, transient paralysis of cranial nerves III and VI, cerebrospinal fluid leakage, carotid-cavernous fistula, and aseptic meningitis.[13]

PRF does not produce thermal lesions, but evidence suggests that microscopic damage to axonal microfilaments and microtubules can occur, with greater changes seen in C fibers than A-beta or A-delta fibers, the fibers principally responsible for pain transmission.[14] Studies of PRF used to treat trigeminal neuralgia have been variable. Erdine et al compared RFA vs PRF and found that PRF was not effective in treating trigeminal neuralgia,[15] while another series showed that long-term efficacy was obtained.[16] However, these studies used the classic approach to target the gasserian ganglion through the foramen ovale.

Our study suggests the efficacy of PRF treatment for trigeminal neuralgia. This efficacy might be attributed to the different technique we used to target the branches as they exit the gasserian ganglion rather than targeting the ganglion itself. Our patients did not report any side effects or complications with our approach, suggesting the safety of the transcoronoid approach.

Limitations of our study are that our case series involved a limited number of patients, and we lacked a control group. In addition, the analysis was retrospective, and the outcomes were pain scores and percent improvement; our records did not contain data on functional improvement. Although retrospective data collection has limitations, the percent improvement after procedure and the pain scores were well reported in our electronic medical record. Further, all cases were performed by one provider, eliminating any interperformer variability.

CONCLUSION

Our study suggests that PRF through the transcoronoid approach may be a safe and effective approach for treating trigeminal neuralgia in patients resistant to conservative management.

ACKNOWLEDGMENTS

Dr Abd-Elsayed is a consultant for Medtronic, Halyard, SpineLoop, Innocol, Axsome, and Ultimaxx Health. The other authors have no financial or proprietary interest in the subject matter of this article.

REFERENCES

1. Katusic S, Beard CM, Bergstralh E, Kurland LT. Incidence and clinical features of trigeminal neuralgia, Rochester, Minnesota, 1945-1984. *Ann Neurol*. 1990 Jan;27(1):89-95.
2. Headache Classification Committee of the International Headache Society (IHS). The international classification of headache disorders, 3rd edition (beta version). *Cephalalgia*. 2013 Jul;33(9):629-808. doi: 10.1177/0333102413485658.
3. Eller JL, Raslan AM, Burchiel KJ. Trigeminal neuralgia: definition and classification. *Neurosurg Focus*. 2005 May 15;18(5):E3.
4. Maestri JM, Holzer F. Pathophysiology of trigeminal neuralgia [in Spanish]. *Revista Chilena de Neuro-Psiquiatria*. 1993;31(3): 317-321.
5. Kitt CA, Gruber K, Davis M, Woolf CJ, Levine JD. Trigeminal neuralgia: opportunities for research and treatment. *Pain*. 2000 Mar;85(1-2):3-7.
6. Quesada G, Baptista CE, Daiana SP, Douglas LF. Trigeminal neuralgia – from diagnosis to treatment [in Spanish]. *Revista Dentística*. 2005;11.
7. Kondo A. Follow-up results of microvascular decompression in trigeminal neuralgia and hemifacial spasm. *Neurosurgery*. 1997 Jan;40(1):46-51; discussion 51-52.
8. Nurmikko TJ, Eldridge PR. Trigeminal neuralgia—pathophysiology, diagnosis and current treatment. *Br J Anaesth*. 2001 Jul;87(1):117-132.
9. Kouzounias K, Schechtmann G, Lind G, Winter J, Linderoth B. Factors that influence outcome of percutaneous balloon compression in the treatment of trigeminal neuralgia. *Neurosurgery*. 2010 Oct;67(4):925-934; discussion 934. doi: 10.1227/NEU.0b013e3181eb5230.
10. Håkanson S. Trigeminal neuralgia treated by the injection of glycerol into the trigeminal cistern. *Neurosurgery*. 1981 Dec; 9(6):638-646.
11. Raj PP, Lou L, Erdine S, Staats PS, Waldman SD. *Radiographic Imaging for Regional Anesthesia and Pain Management*. Philadelphia, PA: Churchill Livingstone; 2003.
12. Punyani SR, Jasuja VR. Trigeminal neuralgia: an insight into the current treatment modalities. *J Oral Biol Craniofac Res*. 2012 Sep-Dec;2(3):188-197. doi: 10.1016/j.jobcr.2012.10.002.
13. Kanpolat Y, Savas A, Bekar A, Berk C. Percutaneous controlled radiofrequency trigeminal rhizotomy for the treatment of idiopathic trigeminal neuralgia: 25-year experience with 1,600 patients. *Neurosurgery*. 2001 Mar;48(3):524-532; discussion 532-534.
14. Bogduk N. Pulsed radiofrequency. *Pain Med*. 2006 Sep-Oct;7(5): 396-407.
15. Erdine S, Ozyalcin NS, Cimen A, Celik M, Talu GK, Disci R. Comparison of pulsed radiofrequency with conventional radiofrequency in the treatment of idiopathic trigeminal neuralgia. *Eur J Pain*. 2007 Apr;11(3):309-313.
16. Van Zundert J, Brabant S, Van de Kelft E, Vercruyssen A, Van Buyten JP. Pulsed radiofrequency treatment of the gasserian ganglion in patients with idiopathic trigeminal neuralgia. *Pain*. 2003 Aug;104(3):449-452.

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