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Is Pulsed Radiofrequency of C2 Dorsal Root Ganglion an Option for Tinnitus Treatment?

C2 Dorsal Kök Gangliyonuna Pulse Radyofrekansı Tinnitus Tedavisinde Bir Seçenek Midir?

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Is Pulsed Radiofrequency of C2 Dorsal Root Ganglion an Option for Tinnitus Treatment?

ABSTRACT

Objective: Tinnitus is a chronic problem with low treatment success. Pulsed radiofrequency application (PRF) to the second cervical dorsal root ganglion (C2 DRG) has been suggested as a possible treatment for tinnitus. This study aimed to evaluate the effectiveness of C2 DRG PRF for tinnitus.

Material and Method: Patients who underwent C2 DRG PRF treatment due to chronic tinnitus were included in this retrospective study. PRF was performed using a 5 cm length with a 5 mm active tip RF electrode for 4 minutes under a C-arm fluoroscopic view. The Tinnitus Handicap Inventory (THI) was applied before and one month after the procedure. Significant symptom relief was regarded as a 50% decrease in THI scores at a one-month check-up visit.

Results: A total of 22 patients were included in the study. Mean THI scores before, and one month after the procedure were 42.36±25.43 and 37.31±25.04, respectively (*p=0.28*). Only one patient (4.5%) had significant symptom relief (*p=0.31*).

Conclusion: Based on the results of this study, we suggest that PRF of C2 DRG is not an effective and reliable method for chronic tinnitus treatment. Further studies using different interventional techniques and large patient groups may be helpful in the treatment of this persistent complaint.

Keywords: Dorsal root ganglion, hearing loss, radiofrequency, tinnitus.

ÖZET

Amaç: Tinnitus, düşük tedavi başarı oranına sahip, kronik bir hastalıktır. İkinci servikal dorsal kök gangliyonuna (C2 DRG) uygulanan pulse radyofrekansın (PRF) muhtemel bir tedavi yöntemi olduğu öne sürülmüştür. Bu çalışmanın amacı, C2 DRG PRF'in tinnitus tedavisinde olan etkinliğini değerlendirmektir.

Gereç ve Yöntem: Bu retrospektif çalışmaya kronik tinnitus nedeniyle C2 DRG PRF uygulanmış olan hastalar dahil edildi. PRF, 5 cm uzunluğunda, 5 mm aktif uçlu RF elektroduyla C-kollu skopi görüntülemesiyle 4 dakika süreyle uygulandı. Hastaların işlemden önce ve işlemden bir ay sonraki kontrollerinde uygulanan Tinnitus Handikap Envanteri (THE) skorları değerlendirildi. Birinci ay kontrollerinde THE'de %50 ve fazlası azalma, belirgin semptom azalması kabul edildi.

Bulgular: Toplam 22 hasta çalışmaya dahil edildi. İşlemden önceki ve bir ay sonraki THE skorları sırasıyla 42,36±25,43 ve 37,31±25,04 idi (*p=0.28*). Sadece bir hastada belirgin semptom azalması oldu (*p=0.31*).

Sonuç: Çalışmalarımızın sonuçlarına göre, C2 DRG PRF işleminin tinnitus için etkin ve mâkul bir yöntem değildir. Bu inatçı hastalığın tedavisi için başka girişimsel işlemleri içeren daha fazla hasta sayılarına sahip çalışmalar yardımcı olabilir.

Anahtar Sözcükler: Dorsal kök gangliyonu, işitme kaybı, radyofrekans, tinnitus.

Introduction

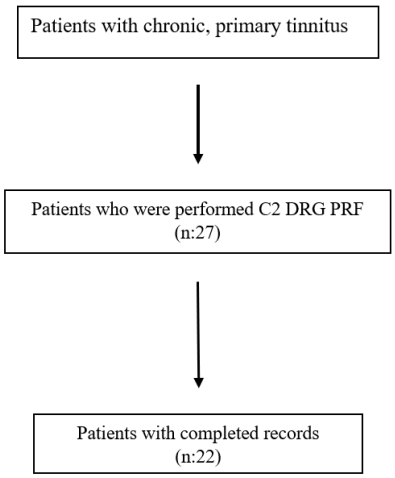
Tinnitus is an auditory symptom characterized by abnormal sounds. It is a common complaint, and the estimated rate of tinnitus is 22% (1). The frequency increases with age and is higher in people older than 65 years (2). Despite almost a quarter of society experiencing tinnitus, only 3-5% of people require treatment (2). The main risk factors for tinnitus are noise exposure, hearing loss, and mental stressors. In subjective tinnitus -which is the frequent form- only the patient hears the abnormal sound in the auditory system, while another person can hear the sound in objective tinnitus. Tinnitus is named 'primary tinnitus' when there is no specific underlying cause and called 'secondary tinnitus' if there is a pre-existing specific etiology (3). Common causes of secondary tinnitus are noise-induced hearing loss, presbycusis, otosclerosis, otitis, impacted cerumen, Meniere's disease, sudden deafness, head or cervical injury, multiple sclerosis, acoustic neuroma, cerebellopontine angle tumors, otitis media, Lyme disease, meningitis, or side effects of some drugs (4). However, in many cases, the cause of tinnitus remains unidentified (5). When the duration of tinnitus is shorter than six months, it is called 'acute tinnitus', and if it is longer than six months, it is called 'chronic tinnitus' (3).

In the literature, there is no strongly effective treatment for tinnitus. Ginkgo biloba extracts, antidepressants, benzodiazepines, zinc, melatonin, cannabis, oxytocin, steroids, and gabapentin are not effective for tinnitus treatment (2). Pulsed radiofrequency (PRF) of the second cervical dorsal root ganglion (C2 DRG) under C-arm fluoroscopy is an interventional pain medicine procedure, and it was shown to be effective for the treatment of headache in several studies (6,7). Furthermore, Koning and Haasnoot suggested that C2 DRG PRF has beneficial effects for tinnitus treatment (8,9). In their study with 61 patients, Koning et al. reported symptom relief in 25% of patients, and they also reported that symptom relief was maintained in half of these patients 13 months later (8). The primary aim of this retrospective study was to assess the efficacy of PRF treatment of C2 DRG under C-arm fluoroscopic imaging in patients with chronic tinnitus. The secondary aim was to observe possible complications or side effects developed due to the intervention.

Material and Methods

This retrospective study was conducted in Ondokuz Mayıs University Faculty of Medicine, Anesthesiology and Reanimation Department, Pain Clinic. Ethical approval was obtained from the institutional ethics committee (Decision number: OMUKAEK 2024/12). Patients who underwent C2 DRG PRF due to chronic primary tinnitus complaints between January 2021 and November 2023 were included in the study. Patients with tinnitus due to a diagnosed disease, e.g., otitis, Meniere's disease, head or cervical injury, and patients who applied an interventional treatment for tinnitus in the last three months were not included in the study. Patients with cervical facet joint and temporomandibular joint tenderness detected in the physical examination were also not included. Written informed consent was obtained from the patients before the procedures. The Tinnitus Handicap Inventory (THI) was used as the assessment tool. Age, accompanying hearing loss (determined by audiometry test), the affected side(s), and the current medical treatment for tinnitus were recorded. THI scores were recorded before and one month after the intervention. Effective results were determined as 50% reduction in the THI scores.

Table I. Flowchart of patient selection for the study



The C2 DRG PRF procedures in our clinic are performed with the following routine:

The procedures are performed in the operating room of the pain clinic. Cardiac and respiratory

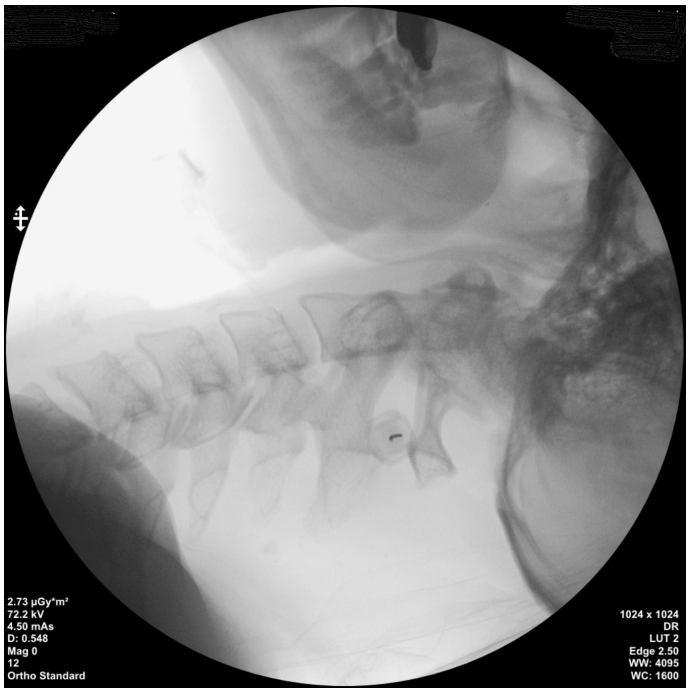
monitorization was performed in all perioperative periods. An intravenous cannula is inserted, and light sedation (1 mg midazolam) is administered in all patients. Patients are placed on the operation table in the supine position, and the area of needle entry is cleaned with povidone-iodine solution. The area is covered with sterile cloths. In a lateral fluoroscopic view, a radiofrequency needle with a 5 cm length and 5 mm active tip (Apro Korea®, Rep. of Korea) is inserted at the six o-clock point of the imaginary circle between the spinous processes of C1 and C2 vertebrae (Figure I). The needle is advanced using the tunnel vision technique. After a few centimeters, the C-arm is positioned in the anteroposterior plane, and the needle is advanced until the lateral border of the facet column (Figure II). Then, sensorial stimulation with 50 Hz is applied by the RF needle, and patients are asked about paresthesia of the neck and posterior part of the head at 0.4 mV, or lower stimulation level. When it is concluded that the needle tip is at the correct location, 4 minutes of PRF (2 Hz) is applied. The voltage of the PRF is dynamically adjusted as long as the patient does not feel disturbance and the temperature does not exceed 42 °C.

Table II. Characteristics of the study population

	n:22
Mean Age	53.22 ± 13.05 years
Female / Male	9 /13 (40.9% vs 59.1%)
Mean duration of complaint	45.59 ± 65.59 months
Right ear affected	5 (22.7%)
Left ear affected	14 (63.6%)
Both ears affected	3 (13.6%)
Accompanying hearing loss	7 (31.8%)

Statistical Package for the Social Sciences version 22 (SPSS 22, IBM Software®, New York, USA) was used for statistical analysis. Nominal data are described by means and standard deviations, while ordinal data are described by numbers and percentages. The Wilcoxon signed-rank test was used to compare the pre-interventional and post-interventional THI scores, and chi-square was used to assess the number of patients with symptom relief following the procedure. P values smaller than 0.05 were regarded as 'statistically significant'.

Figure I. Lateral view of the radiofrequency needle



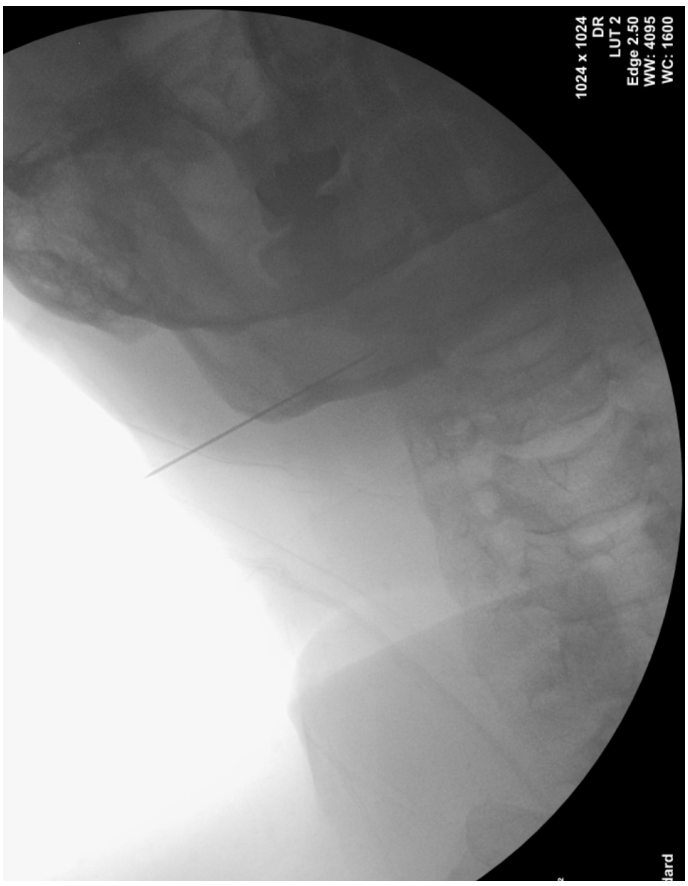
Results

There were 27 patients who underwent C2 DRG pulsed radiofrequency treatment for tinnitus treatment during the related time interval (Table I). Five of them were not included in the study due to the lack of check-up results. A total of 22 patients were included in this study. While 9 (40.9%) of them were female, 13 (59.1%) were male. The mean age of the study population was 53.22 ± 13.05 years. The mean duration of the tinnitus complaint was 45.59 ± 65.59 months (Table II). The right ear was affected in 5 (22.7%), the left was affected in 14 (63.6%), and both ears were affected in 3 (13.6%) patients. Hearing loss was found in 7 (31.8%) patients, and hearing loss was not observed in 15 (68.2%) patients (Table II). Patients with hearing loss had a sensorineural type.

Table III. Results of THI score and rate of patients with significant symptom relief

	Before the Intervention	One month after the intervention	*p value*
Tinnitus Handicap Inventory Score	42.36 ± 25.43	37.31± 50.79	*0.28*
Rate of patients with significant symptom relief	-	1/22	*0.31*

Figure II. A-P view of the radiofrequency needle



Seventeen (77.2%) of the patients were actively using betahistine for tinnitus treatment, and 5 (22.7%) had stopped using any kind of drug for tinnitus treatment due to lack of effectiveness. The mean THI score before the intervention was 42.36 ± 25.43, and it was 37.31± 50.79 one month after the intervention (Table III). There was no statistically significant difference in terms of THI score before and one month after the intervention (*p=0.28*) (Table III). Only one female received significant relief after the intervention. Her preintervention THI score was 96, and she reported that her complaints were totally gone (THI score was zero). There was no statistically significant difference in terms of the number of patients who had significant relief of complaints (*p=0.31*) (Table III). No remarkable side effects were observed due to the intervention.

Discussion

Chronic tinnitus is a complex issue, and treatment options do not provide satisfactory results. Unfortunately, the results of our retrospective study were unsatisfactory. We observed that only one among twenty-two patients had experienced significant symptom relief after the PRF procedure, and there was no significant reduction in mean THI scores. However, our study included only chronic tinnitus patients; therefore, we have no data for the tinnitus patients in the acute period.

There are many studies showing the effective results of C2 DRG RF for headache. It was mainly shown to be effective for cervicogenic headache (6,7).

The clinical application of C2 DRG radiofrequency for the treatment of tinnitus was proposed by a Dutch team. In 2012, Haasnoot et al. presented a case report of someone who suffered from tinnitus for sixteen years and it was almost totally resolved following C2 DRG PRF at 42 °C for 120 seconds (9). Seven years later, Koning, who was one of the authors of the case report above, published an original research paper showing some promising effects on tinnitus treatment (8). They observed that 25% of their 61 patients experienced a decrease in tinnitus intensity in the acute period, and half of these patients still encountered an advantage 13.5 months later.

An interesting point that is different between Koning's study and our study is the clinical characteristics of the study groups. In Koning's study, 67% of the patients had accompanying cervical pain complaints. Koning et al. also found that 87% of the patients who experienced symptom relief with C2 DRG PRF had previous cervical pain complaints. In this retrospective research, none of our patients reported cervical pain either in the examination by the ear-throat-nose department or in pain clinic examination. Based on the combination of the results from Koning's study and this study, it is possible that cervicogenic pain is a positive factor for tinnitus symptom relief with C2 DRG PRF.

Cervical dorsal root ganglion injections, or radiofrequency applications, are complex and advanced interventional pain procedures. Spinal nerve damage, spinal cord damage, intravascular injection, local anesthetic toxicity, hematoma, local infection or meningitis, increased pain, hypoesthesia, allodynia, and loss of strength of the upper extremity are among the possible complications of cervical DRG interventions. Therefore, these interventions must be performed by physicians who have sufficient experience in the interventional pain medicine field.

There are limited numbers of studies suggesting stellate ganglion block or greater occipital nerve block may have beneficial effects on tinnitus (10-12). Due to the retrospective design, this study has some limitations. First of all, this study involved 22 patients. Nevertheless, considering only one patient got symptom relief among 22, it can help to extrapolate some clinical opinions. Secondly, no hearing test results were available one month following the procedure. Therefore, we didn't have the opportunity to investigate the effects of C2 DRG PRF on hearing ability, but the main aim of our study was to assess tinnitus rather than hearing loss. Another limitation was the short duration of follow-up because patients were called for the check-up visit one month after the intervention, and we did not have enough data to project for longer durations.

PRF duration was 4 minutes in this study, and this was based on the personal clinical experience of the pain physicians for the treatment of neck pain or headache. There is no certain consensus on the PRF time for cervical DRG for pain treatment. While some authors use 2 minutes, some authors prefer 4 minutes (13-15). Koning et al. used 2 2-minute duration in the original research on C2 DRG PRF for tinnitus.

In conclusion, chronic tinnitus remains a challenging symptom. Unfortunately, considering the possible complications, the results of this study show that C2 DRG PRF is not an effective and reliable treatment option for chronic tinnitus. Prospective studies, including higher numbers of participants and radiofrequency applications with different parameters, may be helpful for tinnitus treatment.

References

1. Oiticica J, Moreira Bittar RS. Tinnitus prevalence in the city of São Paulo. Braz J Otorhinolaryngol 2015;81(2):167-176.

2. Mazurek B, Hesse G, Dobel C, Kratzsch V, Lahmann C, Sattel H. Chronic tinnitus diagnosis and treatment. Dtsch Arztebl Int 2022;119(13):219-225.

3. Esmaili AA, Renton J. A review of tinnitus. Aust J Gen Pract 2018;47(4):205-208.

4. Han BI, Lee HW, Kim TY, Lim JS, Shin KS. Tinnitus: characteristics, causes, mechanisms, and treatments. J Clin Neurol 2009;5(1):11-19.

5. Lockwood AH, Salvi RJ, Burkard RF. Tinnitus. N Engl J Med 2002;347:904-910.

6. Lee HJ, Cho HH, Nahm FS, Lee PB, Eunjoo Choi. Pulsed radiofrequency ablation of the C2 dorsal root ganglion using a posterior approach for treating cervicogenic headache: a retrospective chart review. Headache 2020;60(10):2463-2472.

7. Li SJ, Feng D. Pulsed radiofrequency of the C2 dorsal root ganglion and epidural steroid injections for cervicogenic headache Neurol Sci 2019;40(6):1173-1181.

8. Koning HM, Ter Meulen BC. Pulsed radiofrequency of C2 dorsal root ganglion in patients with tinnitus Int Tinnitus J 2019;23(2):91-96.

9. Haasnoot PJ, Koning HM, van Rheenen TA. A different approach to treatment-resistant tinnitus: pulsed radiofrequency to the ganglion C2 Int Tinnitus J 2012;17(1):94-96.

10. Matsushima JI, Sakai N, Uemi N, Ifukube T. Effects of greater occipital nerve block on tinnitus and dizziness. Int Tinnitus J 1999;5(1):40-46.

11. Skinner C, Kumar S. Ultrasound-Guided Occipital Nerve Blocks to Reduce Tinnitus-Associated Otalgia: A Case Series. A A Pract 2022;16(1):e01552.

12. Adlington P, Warrick J. Stellate ganglion block in the management of tinnitus. J Laryngol Otol 1971;85(2):159-168.

13. O'Gara A, Leahy A, McCrory C, Das B. Dorsal root ganglion pulsed radiofrequency treatment for chronic cervical radicular pain: a retrospective review of outcomes in fifty-nine cases Ir J Med Sci 2020;189(1):299-303.

14. Kinci A, Sari S, Ertilav E, Aydin ON. Efficacy of combined dorsal root ganglion pulsed radiofrequency and cervical epidural steroid injection on radicular neck pain. Turk Neurosurg 2023;33(1):58-62.

15. Yıldız G, Can E. Comparison of the Efficacy of Dorsal Root Ganglion Pulsed Radiofrequency for 2 Minutes versus 4 Minutes in the Treatment of Chronic Lumbosacral Radicular Pain. Hitit Medical Journal 2024;6(3):313-320.