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THE USE OF PULSED RADIOFREQUENCY FOR SCIATIC PERIPHERAL NEUROPATHY IN DIABETIC PATIENTS IN SETTING OF PAIN AND PARESTHESIA

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Abstract

Background: Pulsed radiofrequency is an interventional pain management technique that has been successful in treating radicular pain brought on by nerve damage, trigeminal neuralgia, and thoracic postherpetic neuralgia.

Aim of the study: To examine both the therapeutic benefits and potential risks of pulse radiofrequency in the management of pain and paresthesia in patients with diabetes mellitus.

Patients and method: A clinical therapeutic trial study was done in Baghdad, Iraq between April 1 and October 1, 2024. A convenient sample of 80 patients who had diabetic neuropathy were enrolled. The intervention included pulse radiofrequency for two sessions at three months intervals.

Results: The proportion of patients with severe paresthesia significantly decreased after the first session (P-value=0.006). Then, it significantly decreased after the second session compared to the first session (P-value=0.029). There was an improvement in the pain as estimated by the VAS score after the first session and after the second session compared to the first session (P-value= were 0.003 and 0.004, respectively).

Conclusion: In the current study, about 50–70% of the patients had pain reduction with improved mobility and reduced medication dependence. It is recommended to repeat pulsed radiofrequency if pain returns every 3–6 months if needed; consider mentioning possible side effects or safety considerations if relevant.

Keywords: Keywords: Pulsed radiofrequency, paresthesia, pain, diabetic neuropathy

Introduction

Diabetes mellitus is a metabolic disorder that causes chronic hyperglycemia, a pathologic condition that may include problems in insulin secretion and/or action, as well as disturbances in carbohydrate, lipid, and protein metabolism.[1, 2]

According to the most recent 2021 estimates, 536.6 million people worldwide have diabetes (10.5% prevalence).[3, 4)] Diabetes affects about 1.4 million people in Iraq. The stated prevalence of diabetes mellitus in Iraq varies between 8.5 and 13.9%. [5]

Diabetic neuropathy is a prevalent long-term consequence of diabetes mellitus, the incidence varies in association with the duration and severity of hyperglycemia. Roughly, 50% of diabetic patients may eventually develop neuropathy. [6] Neuropathy symptoms are caused by injury to peripheral sensory nerves, which is followed by a steady decline in epidermal nerve fiber density, greater sensory loss, and increased reactivity to painful stimuli. Prolonged hyperglycemia, abnormal lipid profile, and altered insulin signalling pathways are implicated in the onset of painful neuropathy.[7, 8] Diabetic neuropathy comprises a range of clinical manifestations including peripheral and autonomic dysfunction, including urogenital, gastrointestinal, and cardiovascular complications.[9] It results in burning sensations, deep aching, sharp "electric shock"-like or stabbing pains. There is sensitivity to touch (allodynia). Walking can be painful, often described as feeling like stepping on marbles, hot sand, or shards of glass. People may also experience abnormal sensations of heat or cold in their feet, a constant dull ache, and cramp-like feelings in their

legs.[10] Management focuses on slowing the progression of neuropathy, relieving symptoms, and addressing complications related to loss of sensation. The recommended guidelines include various strategies to prevent symptom onset, slow disease advancement, and manage existing symptoms. However, there are few treatment options that directly target the underlying nerve damage.[11]

Currently, pulsed radiofrequency is an interventional pain management technique used to treat numerous pain syndromes throughout the body.[12]. It is a percutaneous micro-destructive and micro-invasive neuromodulation technology that utilizes a radiofrequency current that delivers alternating cycles of short-duration electrical stimulation followed by rest periods.[13] A 300–500 kHz current is delivered along with intermittent pulsed radiofrequency bursts lasting 480 milliseconds, allowing adequate time for heat to dissipate. This prevents the tissue temperature from exceeding 42°C, thereby maintaining the structural and functional integrity of the nerve fibers.[14] Ultrasound-guided radiofrequency offers several advantages compared to other imaging techniques, including portability, real-time visualization and dynamic assessment, minimal tissue trauma, and the elimination of radiation exposure for both the patient and physician.[15] The side effects include local swelling, formation of haematoma, neural trauma, injection into vessels, and infectious complications.[16] However, it is rarely associated with complications like numbness and damage to the motor nerve.[14]

Aim of the study: To examine both the therapeutic benefits and potential risks of pulse radiofrequency in the management of pain and paresthesia in patients with diabetes mellitus.

Patients and method

Study design and setting: A clinical therapeutic trial study was done in

Baghdad, Iraq between April 1 and October 1, 2024.

Sampling method: The current study enrolled a convenient sample of 80 patients diagnosed with diabetic neuropathy.

Inclusion criteria:

1. Aged ≥18 years.
2. Chronic sciatic neuropathic pain (burning, tingling, shooting pain).
3. Pain refractory to medications (e.g., gabapentinoids, TCAs, opioids).
4. Diabetes-related sciatic nerve dysfunction.

Exclusion criteria:

1. HbA1c > 8% (increases infection risk).
2. Local or systemic infection.
3. Bleeding disorders or anticoagulation therapy (adjust as per guidelines).

Intervention and data collection

Non-invasive monitoring including blood pressure cuff, pulse oximeter, temperature probe, and electrocardiogram was conducted on the patients with continuous monitoring of them during procedures. The collected data included age, gender, and duration of diabetes mellitus. The visual analogue scale (VAS) was employed to determine the severity of the pain. It is a validated and subjective tool for assessing pain. Scores are recorded by making a handwritten mark on a 10-cm line that indicates a continuum from "no pain" to "worst pain."[17]. According to the paraesthesia rating scale, grade 3 = intolerable paresthesias, grade 2 = severe paresthesias, grade 1 = mild paresthesias, and grade 0 = no symptoms of neuropathy[18]. All interventions were performed with standard monitoring and sedation as required. The patients were put in a lateral decubitus position, with the affected leg uppermost, faintly flexed at the hip and knee using a low-frequency curvilinear probe (2–5 MHz). The sciatic nerve was visualized in the mid-thigh region using short-axis (transverse) view for better nerve delineation with Doppler

mode to identify and avoid nearby vascular. In the mid-thigh, the sciatic nerve appears as a hyperechoic (bright) oval or flattened structure and lies deep to the hamstring muscles. The position was confirmed by tilting the probe to improve nerve visibility. The intervention was done using a 22-gauge, 10 cm insulated pulsed radiofrequency needle with a curved tip. The needle progressed in-plane lateral to medial slowly under ultrasound guidance. The tip approached about 2–5 mm from the sciatic nerve (without intraneural penetration). This proximity was confirmed using nerve stimulation. The sensory stimulation (50 Hz) elicited tingling or paresthesia in the affected area at ≤0.3 mA and motor stimulation (2 Hz) confirmed muscle twitching in the hamstrings or calf at ≤0.5 mA. If stimulation was achieved at <0.2 mA, the needle was repositioned slightly away to avoid nerve trauma. The pulsed radiofrequency was adjusted according to the following settings (voltage adjusted to achieve 42°C, pulse duration of 20 ms per pulse, frequency of 2 Hz, and total duration of 120–240 seconds). Another assessment of the pain and paresthesia was done for the patients after the first session and after the second session.

The study received approval from the Scientific Council of Anaesthesia and Intensive Care under the Arabic Board of Medical Specializations. Informed written permission was acquired from all patients prior to their enrollment.

Microsoft Excel software was used to analyze the gathered data. The chi-square test and t-test were used to test the statistical significance between the two groups. A statistically significant result was defined as a p-value below 0.05.

Results

The current study incorporated 80 patients in total, with males making up the greatest percentage of the sample (57%), and nearly half of the patients (51%) were equal or over 50 years. As shown in table I.

Table I: Age and sex of the patients

Age and gender		N (%)
Age	18-29 years	7 (8.8)
	30-39 years	11 (13.8)
	40-49 years	21 (26.3)
	≥50 years	41 (51.0)
Sex	Male	46 (57.0)
	Female	34 (42.5)

As shown in table II, the proportion of patients with severe paresthesia significantly decreased after the first session (P-value=0.006). Then, it significantly decreased after the second session compared to the first session (P-value=0.029).

Table II: Improvement of the paresthesia after the intervention

Paresthesia	**Before intervention N (%)**	**After first session N (%)**	**P-value**
Mild paresthesia	0 (0.0)	31 (38.8)	**<0.001**
Moderate paresthesia	37 (46.3)	23 (28.8)	**0.022**
Severe paresthesia	43 (53.8)	26 (32.5)	**0.006**
	After first session N (%)	**After second session N (%)**	
Mild paresthesia	31 (38.8)	46 (57.5)	**0.018**
Moderate paresthesia	23 (28.8)	20 (25.0)	0.589
Severe paresthesia	26 (32.5)	14 (17.5)	**0.029**

There was an improvement in the pain as assessed by the VAS score after the first session (P-value= 0.003) and after the second session compared to the first session (P-value= 0.004, respectively) as shown in table III and figure 1.

Table III: Severity of pain before and after intervention according to the VAS score

	Before intervention	**After first session**	**P-value**
	Mean ±SD	Mean ±SD	
VAS score	6.8 ±1.2	4.1 ±1.5	0.003
	After first session	**After second session**	
	Mean ±SD)	Mean ±SD)	
VAS score	4.1 ±1.5	2.9 (±1.2)	0.004

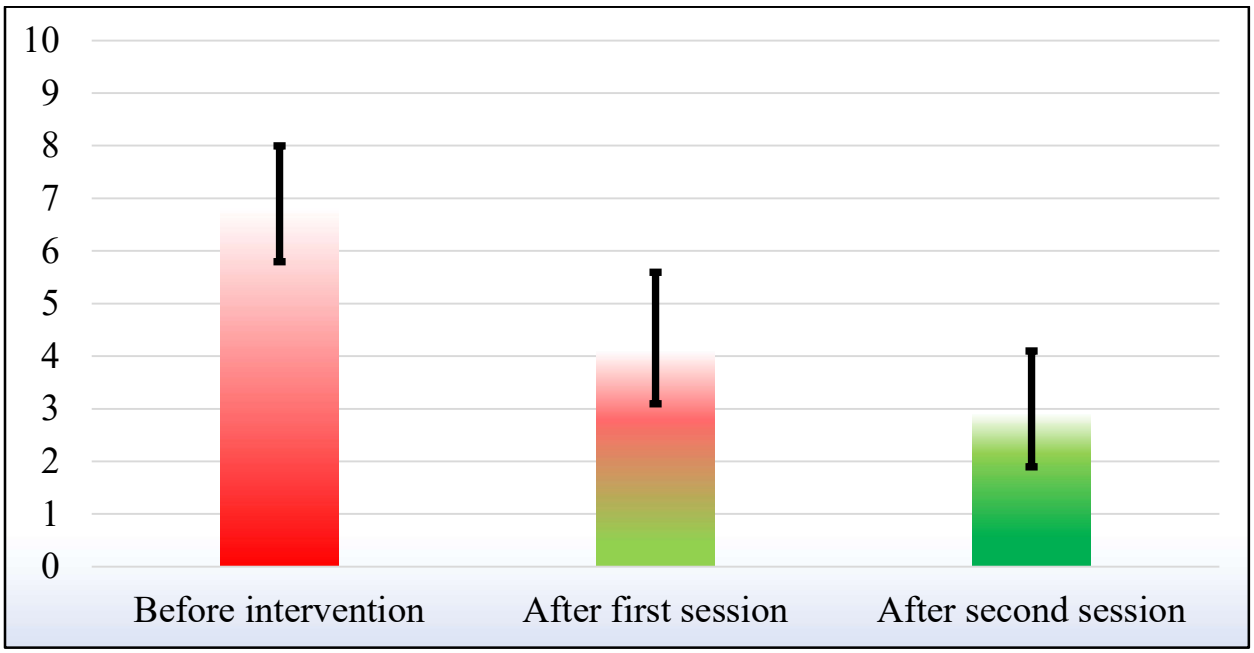

Figure 1: Pain improvement according to VAS score

Discussion:

While pulsed radiofrequency shows promise, its application under ultrasound guidance specifically for diabetic peripheral neuropathy remains under-investigated.[19] his study aimed

to assess the therapeutic outcomes of pulsed radiofrequency in Iraqi patients with diabetic neuropathy.

In the current study, there were significant improvements in the paresthesia after the first and after the second sessions. These findings are consistent with those of the study that was done by Natalie H. Strand and Adam R. Burkey who concluded that a greater percentage of patients experienced treatment success, relief from paresthesia, and signs of enhanced neurological function.[20] In the same line, demonstrated that pulsed radiofrequency targeting the femoral cutaneous nerve offers a low-risk, effective alternative for patients unresponsive to medical therapy.[21] Furthermore. Yu-Hsin et al. concluded that pulsed radiofrequency is capable of reducing diabetes-induced hyperalgesia and allodynia, potentially through the inhibition of spinal glutamatergic transmission[22].

The current study revealed that the patients had a significant recovery in pain sensation after the first and second sessions. These results were endorsed in a Jiying et al. study which included 56 patients with diabetic neuropathic peripheral pain.[19]This agreed with the findings of other studies that were conducted by Mayank et al.,[23] Huiyan et al.[(24)], and Erica et al..[25)] In the same line, Ren et al. pulse radiofrequency temporarily attenuates neuropathic and inflammatory pain.[26] Rahul et al. concluded that neuromodulation enhances quality of life and boosts functional ability in diabetic patients complicated with neuropathy.[27] Consistent with Ren et al.[(26)] and Rahul et al.,[27] our findings suggest that pulsed radiofrequency offers temporary relief and improves quality of life.

In conclusion: In the current study, bout 50–70% of the patients in this study had pain reduction with improved mobility and reduced medication dependence. It is recommended to repeat pulsed radiofrequency if pain returns every 3–

6 months if needed; consider mentioning possible side effects or safety considerations if relevant.

Limitation: The gathered data focused on one nerve among the other nerves that could be affected by diabetes mellitus

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Data collection and analysis 2,
Responsibility for statistical analysis 2
Writing the article 1,2
Critical review, 1, 2
Final approval of the article 1,2

Each author believes that the manuscript represents honest work and certifies that the article is original, is not under consideration by any other journal, and has not been previously published.
Availability of Data and Material: The corresponding author is prompt to supply datasets generated during and/or analyzed during the current study on wise request.

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