Case Report

Significant Improvement in Sensory Nerve Function with Electroacupuncture in Diabetic Peripheral Neuropathy: A Case Report

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ABSTRACT

Diabetic Peripheral Neuropathy (DPN) affects up to 50% of diabetics, resulting in severe complications and significantly impacting quality of life. Current treatments often provide incomplete relief and fail to address underlying nerve dysfunction. This case report evaluates the efficacy of electroacupuncture as a complementary therapy for improving sensory function in DPN. A 56-year-old male with a 6-year history of type 2 diabetes presented with worsening numbness in both feet, impacting his daily activities. Clinical examination revealed significantly altered sensations, including diminished protective sensation, impaired vibration perception, and abnormal thermal thresholds. The patient underwent a 12-day electroacupuncture intervention consisting of 20-minute sessions on alternate days that targeted specific acupuncture points related to nerve function and circulation in the lower extremities. Post-intervention assessments showed notable improvements across multiple sensory modalities. There was a 29.86% improvement in protective sensation, a 40.97% decrease in vibration perception threshold, and a 14.37% improvement in hot perception threshold. Cold perception showed a minimal improvement of 3.50%. These outcomes align with recent literature suggesting electroacupuncture's potential to enhance nerve function through improved microcirculation, neuropeptide modulation, and anti-inflammatory effects. While individual responses may vary, this case study, supported by emerging research, suggests that electroacupuncture could be an effective complementary approach to managing sensory deficits associated with DPN. Further large-scale clinical trials are required to establish its efficacy and optimise treatment protocols.

Key words: Diabetic Peripheral Neuropathy (DPN), Electroacupuncture (EA), Sensory Dysfunction, Type 2 Diabetes Mellitus, Pain Management.

Diabetes comprises a range of metabolic disorders characterised by high blood glucose levels caused by issues with insulin production, insulin effectiveness, or both. Diabetes mellitus, characterised by persistent high blood sugar can cause long-term damage, dysfunction, and organ failure, most notably affecting the eyes, kidneys, nerves, heart, and blood vessels [1, 2]. Symptoms of severe hyperglycaemia include frequent urination, excessive thirst, weight loss, increased hunger, and blurred vision. Chronic hyperglycemia can impair growth and increase the risk of infection. Uncontrolled diabetes can lead to acute complications such as ketoacidosis and nonketotic hyperosmolar syndrome [2]. Diabetic peripheral neuropathy (DPN) affects up to 50% of diabetics, causing severe complications. Current treatments have significant limitations: glycaemic control alone is often insufficient, and no effective disease-modifying medications exist.

Therapies primarily focus on symptom management rather than addressing underlying nerve dysfunction. FDA-approved drugs offer only partial relief and often have significant side effects. There is few effective treatments for sensory deficits such as hypesthesia, and an incomplete understanding of DPN mechanisms hinders targeted therapy development. These gaps highlight a clear need for alternative approaches addressing multiple aspects of DPN, including pain relief and potential nerve regeneration. Electroacupuncture (EA) has emerged as a promising complementary therapy that combines

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traditional acupuncture and electrical stimulation. It has the potential to treat DPN by stimulating the somatosensory system, potentially improving circulation, reducing inflammation, and modulating pain perception. This approach provides a rationale for exploring EA as an alternative therapy for DPN management [3-7].

Diabetes and its complications have a substantial impact on both the economic burden as well as the quality of life for those affected individuals [5]. DPN is primarily caused by hyperglycaemia-induced oxidative stress, inflammation, and vascular changes [4]. Chronic high blood glucose leads to mitochondrial dysfunction, advanced glycation end-product accumulation, and impaired insulin signalling [5]. These factors lead to progressive nerve fibre damage, reduced nerve blood flow, and neurotrophic factor deficiency [6]. The primary approach to managing painful diabetic peripheral neuropathy (DPN) involves controlling hyperglycemia and other modifiable risk factors. However, these measures alone may not be sufficient to prevent or treat the disease. Since there are no effective disease-modifying medications for DPN, the focus shifts to pain management.

Treatments for neuropathic pain in painful DPN include gabapentinoids, serotonin-norepinephrine reuptake inhibitors, tricyclic antidepressants, alpha-lipoic acid, sodium channel blockers, and topical capsaicin [6]. The FDA has approved pregabalin, duloxetine, tapentadol, and the 8% capsaicin patch to treat painful DPN. The FDA recently approved spinal cord stimulation using electrical stimulation for this condition [6]. Pharmacological treatments for hypesthesia are limited because current symptomatic therapies only target additional symptoms like pain or tingling. Anticonvulsant and antidepressant medications are commonly used in this setting [7].

Neuropathic pain results from changes in the somatosensory system, which includes several neural pathways that transmit sensory information from the skin, muscles, tendons, and internal organs to the central nervous system and, ultimately, to conscious perception [8]. The somatosensory system mediates the sensation of de qi during acupuncture and is crucial to its pain-relieving effects. Aβ, Aδ, and C fibres are key in transmitting acupuncture signals. Additionally, acupuncture influences the brain and spinal cord to relieve pain. Acupuncture, as a non-invasive nerve stimulation method, is an effective and safe treatment for neuropathic pain with minimal adverse effects [8]. In electroacupuncture (EA), an electrical stimulator delivers current to acupoints via needles. The therapeutic effects of EA depend on the stimulation's frequency, current amplitude, and pulse width.

Electroacupuncture (EA) provides more consistent stimulation and may be significantly effective than manual acupuncture (MA) in providing continuous stimulation and response times reduction [8]. Endogenous pain inhibition systems are activated by stimulating Aβ, Aδ, and C fibres [8]. Reduces both local and systemic inflammation [7].

Neuropeptide modulation affects pain perception and nerve function [9]. Potential nerve regeneration may promote nerve repair, but more research is required [2]. Conventional treatments for DPN, such as medications and glycaemic control, frequently fails to address complex pain and sensory issues. Drugs like gabapentinoids and serotonin-norepinephrine reuptake inhibitors may provide some relief but they do not change the course of the disease and have limited efficacy or adverse effects. EA offer a broader, more holistic approach to DPN management. Its ability to address pain, nerve function, inflammation, and circulation makes it a valuable complementary therapy that could enhance the efficacy of existing treatments while reducing the side effects of conventional pharmacotherapy. Combining EA with traditional treatments may have a synergistic effect, potentially improving patient outcomes beyond what current medications cannot achieve alone. This case report aims to evaluate the efficacy of electroacupuncture as a complementary therapy for improving sensory function in a patient with DPN, with a focus on changes in protective sensation, vibration perception, and hot/cold perception thresholds.

CASE PRESENTATION

On June 23, 2024, a 56-year-old male electrician of south asian ethnicity presented to the outpatient department of the International Institute of Yoga and Naturopathy Medical Sciences, Chengalpattu, with worsening numbness in the soles of both feet, affecting his daily activities and quality of life. He had a 6-year history of type 2 diabetes mellitus, with an HbA1C of 8.5%, fasting blood sugar of 189 mg/dL, and postprandial blood sugar of 258 mg/dL, which is managed with a pioglitazone 15 mg tablet twice daily. Additionally, he had a 5-year history of hypertension, for which he was taking atenolol 50mg daily. The patient had not received any specific treatment for diabetic peripheral neuropathy prior to this visit.

DIAGNOSIS

Following a clinical examination and screening for sensory nerve functions, the patient was found to have significantly altered sensations in several areas of the sole. The protective sensation test using 10 gm, 25 gm, and 50 gm monofilaments revealed a failure to detect pressure with the 10 gm and 25 gm filaments, with the sensation only detected at 50 gm, the mean value with standard deviation was 12.833 ± 2.5, indicating diminished protective sensation. The vibration perception threshold (VPT) was recorded at 30 volts using a biothesiometer, which was significantly higher than the normal range of ≤15 volts, the mean value with standard

deviation was 24.00 ± 303, indicating impaired vibration perception. The Neuro Touch Biothesiometer showed a heat threshold of 45°C and a cold threshold of 15°C, both outside normal ranges (≤40°C for heat and ≥20°C for cold). The mean value with the standard deviation of hot was 42.333 ± 2.774, and for cold was 23.833 ± 3.433, confirming impaired thermal perception. These results confirmed the diagnosis of Diabetic Peripheral Neuropathy (DPN) with significant sensory deficits– (Figure 1) (Table 1).

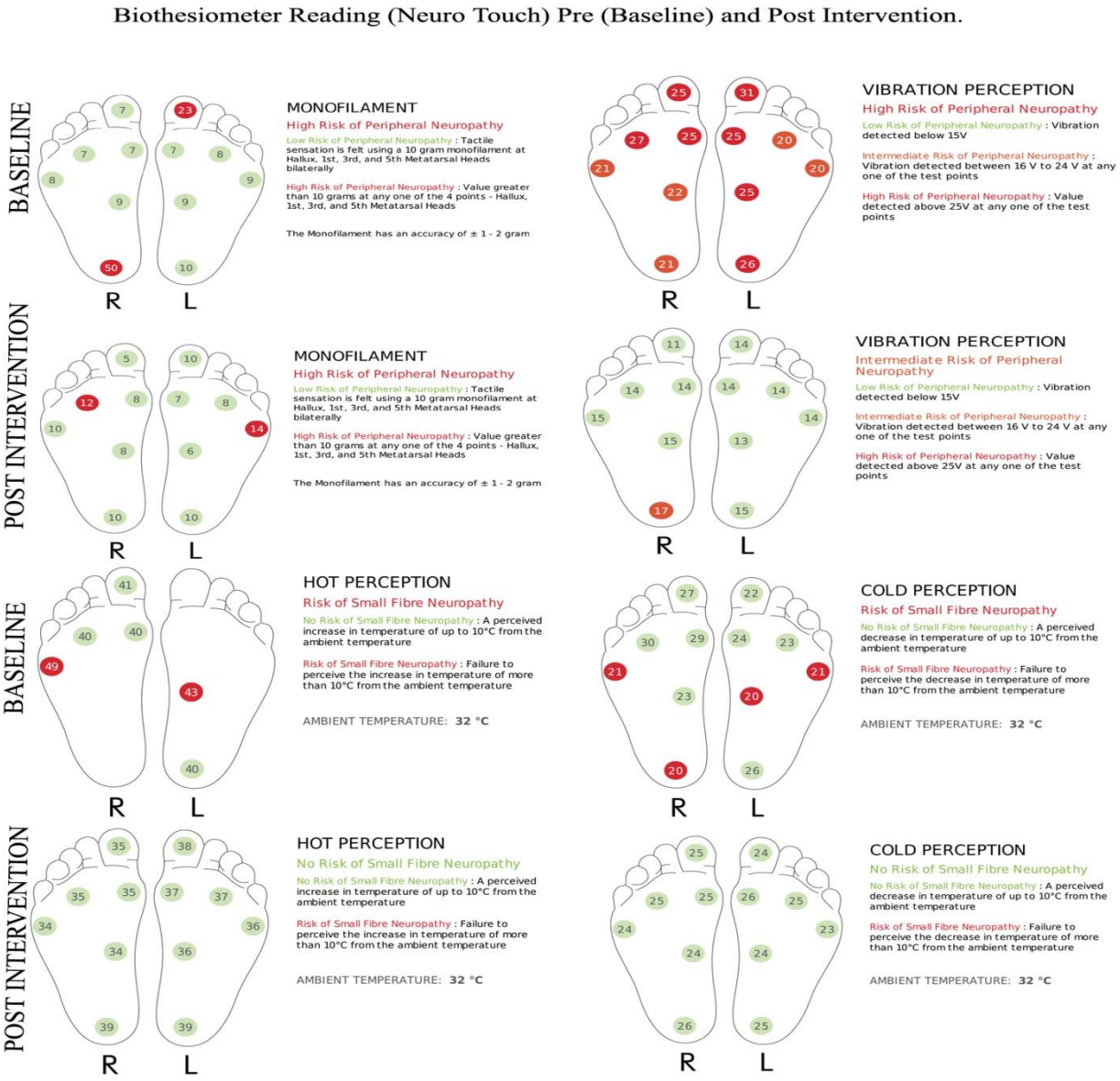

Figure. 1: Shows the details of Pre and Post Assessment of Sensory Nerve Parameters.

Table. 1. Pre and Post Intervention Mean Value of Sensory Nerve Functions.

Sl. No.	Sensory Components	Baseline (Pre)	Post – Intervention
1	Protective Sensation (Monofilament test)	12.833 ± 2.5	9.00 ± 2.523
2	Vibration Perception Threshold (VPT)	24.00 ± 303	14.167 ± 1.403
3	Hot Perception Threshold (HPT)	42.333 ± 2.774	36.250 ± 1.765
4	Cold Perception Threshold (CPT)	23.833 ± 3.433	24.667 ± 0.888

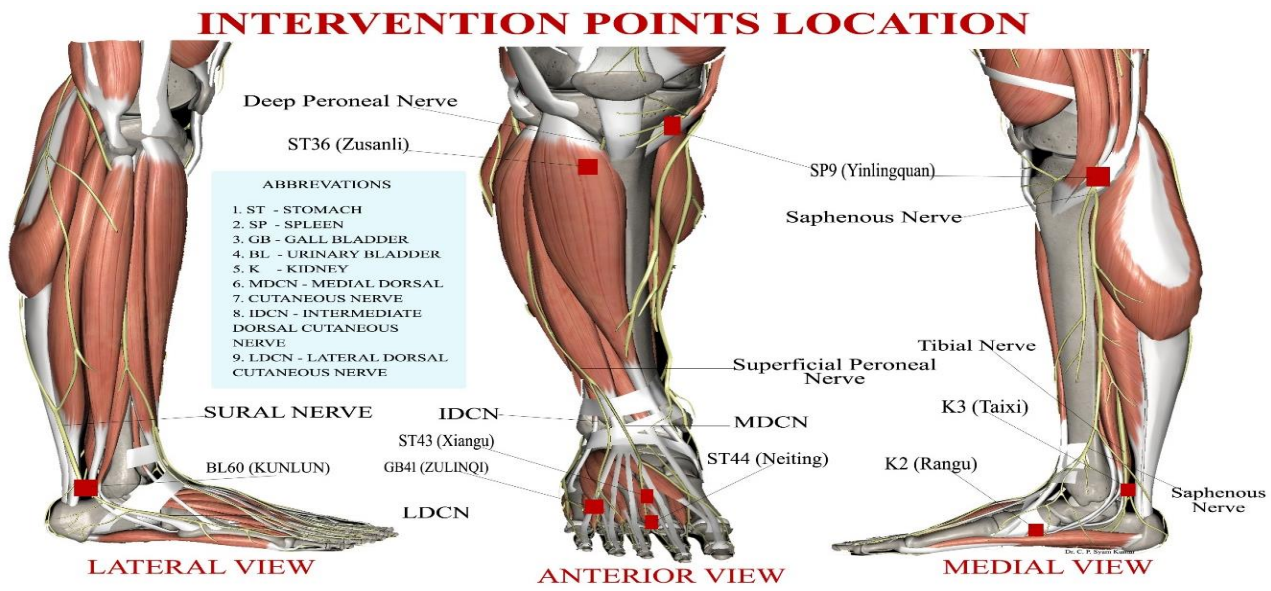

Figure.2 Details of intervention point location.

INTERVENTION

The patient was treated with electroacupuncture for 12 days, with sessions conducted on alternate days. Each session lasted for 20 minutes. The acupuncture points selected for treatment were St44 (Yingxiang), GB41 (Foot Governor of Tears), UB60 (Kunlun), St36 (Zusanli), K2 (Rangu), K3 (Taixi), Sp6 (Sanyinjiao), and Sp9 (Yinlingquan). These points were chosen because of their traditional association with improved nerve function, circulation, and overall health in the lower extremities.

RESULTS

The sensory function outcomes before and after the 12-day electroacupuncture intervention. The protective sensation, vibration perception, and hot perception thresholds all improved significantly after the intervention, while the cold perception threshold showed only minor changes.—the degree of improvement for each sensory component after the intervention showed notable changes. For protective sensation (Monofilament test), there was an improvement of 3.833 gms, representing a 29.86% enhancement. The vibration perception threshold (VPT) improved by 9.833 volts, resulting in a 40.97% improvement. Hot perception threshold (HPT) improved by 6.083 degrees Celsius, representing a 14.37% increase. However, the cold perception threshold (CPT) increased slightly, by 0.834 degrees Celsius, resulting in a 3.50% improvement. Overall, the intervention significantly improved most sensory functions except for a slight decrease in cold perception. (Figure. 1), (Table 1).

DISCUSSION

The improvement in sensory function observed in this patient aligns with recent literature on electroacupuncture for Diabetic Peripheral Neuropathy (DPN). A meta-analysis by Dimitrova et al. (2017) reported significant improvements in nerve conduction velocity and symptoms in DPN patients treated with acupuncture [12]. Electroacupuncture resulted in increased skin blood flow in diabetic patients. Neuropeptide modulation revealed upregulation of nerve growth factor in DPN rat models after electroacupuncture. Anti-inflammatory effects were observed in DPN patients post-electroacupuncture, which reduced pro-inflammatory cytokines. Metabolic Control reported that using electroacupuncture as an adjunct therapy improved glycaemic control. Neuroplasticity noted changes in brain connectivity patterns associated with improved sensory function [13-17].

The positive outcome in our patient's case is encouraging, but it is important to note that individual responses to electroacupuncture can vary. While our case report and the supporting literature provide promising evidence for the use of electroacupuncture in DPN management, larger, well-designed clinical trials are still required to determine its efficacy and optimal treatment protocols. Future research should also focus on elucidating the precise neurobiological mechanisms underlying the observed clinical benefits.

CONCLUSION

In conclusion, this case study, supported by recent research, indicates that electroacupuncture could be an effective complementary therapy for treating sensory deficits in diabetic peripheral neuropathy (DPN). It is a potentially effective treatment option for patients who have not responded well to traditional therapies because of its capacity to enhance nerve function through several physiological mechanisms. As our knowledge of the mechanisms and best practices for applying electroacupuncture in DPN evolves, it has the potential to play

a more significant role in the holistic management of this complex diabetic complication.

Conflict of Interest Statement: The authors declare no conflicts of interest and have received no financial support for this research.

Patient Consent: The patient provided written informed consent for participation in this study and the publication of their case details.

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REFERENCES

1. What is diabetes [Internet]. Belgium: International Diabetes Federation; 2024 Aug. Available from: https://idf.org/about-diabetes/what-is-diabetes/
2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014; 37(Suppl 1).
3. Jugal KS, *et al*. Article 2. RJMS. 2021; 11(2):85-91.
4. Cho E, Kim W. Effect of acupuncture on diabetic neuropathy: A narrative review. Int J Mol Sci. 2021; 22(4):1-11.
5. Mathiyalagen P, Kanagasabapathy S, Kadar Z, *et al*. Prevalence and determinants of peripheral neuropathy among adult Type II diabetes mellitus patients attending a non-communicable disease clinic in rural South India. Cureus. 2021; 13(6).
6. Jang HN, Oh TJ. Pharmacological and nonpharmacological treatments for painful diabetic peripheral neuropathy. Diabetes Metab J. 2023; 47(5):743-56.
7. Hoerder S, Habermann IV, Hahn K, *et al*. Acupuncture in diabetic peripheral neuropathy—neurological outcomes of the randomized acupuncture in diabetic peripheral neuropathy trial. World J Diabetes. 2023; 14(12):1813-23.
8. Ma X, Chen W, Yang NN, *et al*. Potential mechanisms of acupuncture for neuropathic pain based on somatosensory system. Front Neurosci. 2022; 16:875532.
9. Medakkel AA, Sheela P. Vibration perception threshold values and clinical symptoms of diabetic peripheral neuropathy. J Clin Diagn Res. 2018; 12(5).
10. Riddhi D, Jebasingh F, Thomas N, *et al*. NEURO TOUCH: A novel digital device for assessment and screening of peripheral neuropathy. Foot. 2022; 51:101765.
11. Col M. Review article. Delta Med Col J. 2019; 7(2):1-6.
12. Dimitrova A, Murchison C, Oken B, *et al*. Acupuncture for the treatment of peripheral neuropathy: A systematic review and meta-analysis. J Altern Complement Med. 2017; 23(3):164-79.
13. Hsieh YL, Lin YW, Peng CH, *et al*. Electroacupuncture at different frequencies (5Hz and 25Hz) ameliorates cerebral ischemia-reperfusion injury in rats: possible involvement of p38 MAPK-mediated anti-apoptotic signaling pathways. BMC Complement Altern Med. 2016; 16(198):1-9.
14. Liang Y, Zhou Q, Sun F, *et al*. Electroacupuncture improves neurovascular unit reconstruction by promoting collateral circulation and angiogenesis. Neural Regen Res. 2019; 14(10):1765-74.
15. Zhang X, Chen X, Wang Y, *et al*. Effect of electroacupuncture on inflammatory factors and oxidative stress in patients with diabetic peripheral neuropathy: A randomized controlled trial. J Diabetes Complications. 2022; 36(4):108145.
16. Liu Z, Zhao Y, Xu J, *et al*. Effect of electroacupuncture on glycemic control in patients with type 2 diabetes: A randomized controlled trial. Complement Ther Med. 2021; 56:102616.
17. Xue T, Shi Z, Zhao Q, *et al*. Electroacupuncture for mild cognitive impairment: A systematic review and meta-analysis of randomized controlled trials. Evid Based Complement Alternat Med. 2020; 2020:8836685.

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