e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(7); 729-734

Original Research Article

Effect of Gurmar (*Gymnema sylvestre*) on Sensory Nerve Conduction Velocity in the Upper Limbs of Patients with Type 2 Diabetes Mellitus

Poornima Vyas[1*], Bijendra Kumar Binawara[2], Pooja Shrama[3]

[1]Ph.D Scholar, Department of Physiology, S.P. Medical College, Bikaner, Rajasthan, India.
[2]Senior Professor and Head, Department of Physiology, S.P. Medical College, Bikaner, Rajasthan, India.
[3]Ph.D Scholar, Department of Physiology, S.P. Medical College, Bikaner, Rajasthan, India.

Received: 25-04-2024 / Revised: 23-05-2024 / Accepted: 25-06-2024
Corresponding Author: Poornima Vyas
Conflict of interest: Nil

Abstract:

Introduction: Diabetic neuropathy, a common and troublesome complication of diabetes, causes significant morbidity and burdens diabetes care. Early detection and intervention can slow its progression. Nerve conduction studies are sensitive indicators of neuropathy severity, aiding in lesion localization and assessment of the pathophysiologic process, including clinically unrecognized alterations. Due to the chronic nature of diabetes and its impact on quality of life, many people are turning to complementary therapies. *Gymnema sylvestre*, a medicinal herb used in traditional Indian Ayurvedic medicine, has gained attention for its potential benefits in managing type 2 diabetes and its complications, such as diabetic neuropathy.

Aim and Objectives: This research aimed to assess the effect of *Gymnema sylvestre* on diabetic neuropathy.

Materials and Methods: Two hundred patients with type 2 DM were randomly divided into two groups. Group I (n = 100) received a placebo powder, while Group II (n = 100) was supplemented with 6 g/day of gurmar leaf powder. The patients continued taking their anti-diabetic medications as before, and patients were blinded to their treatment allocation. Latency, amplitude and sensory nerve conduction velocity (SNCV) of median and ulnar nerves of both left and right upper limbs were recorded at baseline and after 3 months of gurmar intervention.

Results: All parameters of the sensory nerve conduction study for the medial and ulnar nerves showed no statistically significant differences when compared between baseline and after 3 months.

Conclusion: *Gymnema sylvestre* therapy for three months did not demonstrate effectiveness in treating diabetic neuropathy.

Keywords: Diabetic neuropathy, *Gymnema sylvestre*, sensory nerve conduction study, latency, amplitude, SNCV, median and ulnar nerves.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Diabetes mellitus (DM) is a persistent metabolic condition marked by hyperglycemia resulting from inadequate insulin production, ineffective insulin utilization, or a combination of both. [1] This medical condition, although common, has become increasingly prevalent and poses a major public health challenge. [2] The number of persons affected by it worldwide is estimated to be above 500 million, and by 2025, it may exceed 700 million. [3] Chronic hyperglycemia, seen in type 1 and type 2 DM, may produce significant consequences. Stroke, cardiovascular disease, peripheral vascular disease, nephropathy, neuropathy, and retinopathy are among these consequences. [4]

Diabetes neuropathy (DN) is a prevalent condition that is growing in incidence. There are various forms of DN, however the most widespread and investigated is distal symmetrical polyneuropathy (DSPN). DSPN generally appears as a bilateral, symmetrical polyneuropathy which shows with a "stocking and glove" distribution, wherein the hands and lower limbs are often afflicted. [5] Sensory complaints usually begin in the foot and develop proximally, ranging from numbness to dysesthesia, pain, and allodynia. Moreover, there may be impairments to motor function, hampering everyday tasks with weakness, atrophy, gait abnormalities, and lack of coordination. Furthermore, DN is a significant risk factor for both Charcot foot, and diabetic foot ulceration. These conditions are separate risk factors for lower limb amputation and death. [6] The two biggest risk factors for DPN are the duration of diabetes and glycemic control. Smoking, dyslipidemia, obesity, and hypertension are additional risk factors. [7-9]

Gymnema sylvestre (GS), belonging to the Asclepiadaceae family, has been utilized as a traditional herbal remedy in southern India, tropical Africa, and Australia for nearly 2,000 years. [10-11] The leaves of GS possess anti-diabetic, anti-hyperlipidemic, anti-obesity, anti-sweetener, anti-inflammatory, and antioxidant properties due to the presence of numerous phytochemical compounds such as alkaloids, flavonoids, saponins, gymnemic acids, acidic glycosides, anthraquinones, flavones, hentriacontane, pentatriacontane, phytin, resins, tartaric acid, formic acid, butyric acid, lupeol, and β-amyrin [12-14] Previous research has shown that an extract from GS leaves displayed antioxidant properties and the ability to inhibit lipid peroxidation in an experimental model involving gastric ulcers and colitis. [15,16] The cause of diabetic neuropathy (DN) is characterized by high levels of reactive oxygen species (ROS) and a related inflammatory response. Therefore, we suggested that the antioxidant effects of GS may serve as a treatment for inflammation, helping to reduce damage to nerve tissue. Therefore, in the present study, effect of GS on onset latency, amplitude and sensory nerve conduction velocity (SNCV) of Upper Limbs in Type 2 DM individuals was evaluated.

Materials and Methods

The current randomised control trial was carried out at Sardar Patel Medical College in Bikaner, in the department of physiology. 200 diabetic patients between the ages of 36 and 55 made up the overall study population, which was divided into two groups. Patients in the control group (Group I) were undergoing conventional treatment, while the study group (Group II) received *Gymnema sylvestre* (GURMAR) leaf powder in addition to conventional treatment.

Patients with chronic diseases such as liver disease, arthritis, pulmonary tuberculosis, asthma, a history of coronary heart disease, acute myocardial infarction, valvular heart diseases, renal failure, cerebrovascular, malabsorption, alcoholism, neuropathy from other causes, neuromuscular disorders, or those taking drugs that could affect the normal course of neuropathy were excluded from the study. Additionally, smokers, pregnant women with diabetes, and uncooperative patients were also excluded.

After receiving approval from the institutional ethical committee, participants were enrolled in the research. Before enrollment, all participants were given a detailed explanation of the study's procedure, nature, and purpose, and informed consent was obtained.

Dried Gurmar (*Gymnema sylvestre*) leaf powder was purchased from a reputable company in Bikaner. Participants in the study group were administered 3 grams of Gurmar leaf powder twice daily before meals, and a placebo powder with no hypoglycemia or dyslipidemic effect was given to participants in the control group, maintaining their regular diet and exercise routines for a continuous period of three months. Anti‑diabetic medications were continued as same.

A detailed clinical history was recorded, and a clinical examination was conducted according to a predesigned proforma. Median and ulnar nerves of both left and right upper limbs were checked for sensory conduction and the following parameters were recorded before and after intervention of gurmar powder -

1. Onset latency time in milli-second (ms)
2. Amplitude in micro-volt (μV)
3. Conduction velocity in meter per second (m/s)

Statistical Analysis: Microsoft Excel was used to input the data, while SPSS software was used to analyze it. By student's paired and unpaired "t-test," comparison between two groups is achieved. For significance, the probability level was chosen at $p < 0.05$. It is considered non-significant if $p > 0.05$.

Results

Table 1 shows the anthropometric parameters of control and study group participants at the baseline. The mean age, weight, height and BMI of Control Group subjects were 46.23 ± 4.70 years, 74.27 ± 9.93 Kg, 1.67 ± 0.09 m and 26.65 ± 3.65 Kg/m^2 whereas of Study Group subjects were 46.41 ± 5.52 years, 74.45 ± 9.79 Kg, 1.67 ± 0.08 m and 26.66 ± 3.80 Kg/m^2. Thus, none of the anthropometric parameters showed a statistically significant difference ($p > 0.05$), making the groups comparable for studying the effect of gurmar.

Table – 2 shows the comparison of the Sensory Nerve Conduction Study of the upper limbs of control and study group participants at baseline. All the values were statistically insignificant t baseline, making the groups comparable for studying the effect of gurmar. ($p > 0.05$)

Table – 3 shows the comparison of the Sensory Nerve Conduction Study of the upper limbs of control and study group participants after three months. The differences were statistically non-significant. ($p > 0.05$)

In table 4, latency, amplitude and SNCV of left & right medal and ulnar nerves in control group participants before and after intervention were compared; no statistically significant change was noted. ($p > 0.05$)

In table 5, latency, amplitude and SNCV of left & right medal and ulnar nerves in study group participants before and after gurmar intervention

were compared; all the values were statistically insignificant. (p> 0.05)

Table 1: Comparison of Anthropometric parameters of control and study groups at the baseline

Parameters	Control Group (Mean±SD)	Study Group (Mean±SD)	p
Age (in years)	46.23±4.70	46.41±5.52	0.804
Weight (in Kg)	74.27±9.93	74.45±9.79	0.897
Height (in m)	1.67±0.09	1.67±0.08	1.000
BMI (in Kg/m^2)	26.65±3.65	26.66±3.80	0.985

Table 2: Comparison of Sensory Nerve Conduction Study of upper limb of control and study group participants at the baseline

Medial Nerve						
Parameters	Right Limb			Left Limb		
	Control Group (Mean±SD)	Study Group (Mean±SD)	p	Control Group (Mean±SD)	Study Group (Mean±SD)	p
Onset Latency (ms)	2.66±0.50	2.59±0.50	0.323	2.53±0.51	2.48±0.50	0.485
Amplitude (μV)	26.31±13.04	26.87±11.60	0.749	25.98±13.63	25.80±13.90	0.926
Velocity (m/s)	56.51±10.82	56.18±10.85	0.830	59.07±10.35	59.44±12.74	0.822
Ulnar Nerve						
Onset Latency (ms)	2.65±0.85	2.72±1.08	0.611	2.64±0.94	2.48±0.49	0.133
Amplitude (μV)	25.21±12.57	28.27±14.61	0.114	26.37±14.52	26.43±14.06	0.976
Velocity (m/s)	56.96±12.34	54.15±10.90	0.089	57.75±12.07	57.14±9.43	0.691

Table 3: Comparison of Sensory Nerve Conduction Study of upper limb of control and study group participants after 3 months

Medial Nerve						
Parameters	Right Limb			Left Limb		
	Control Group (Mean±SD)	Study Group (Mean±SD)	p	Control Group (Mean±SD)	Study Group (Mean±SD)	p
Onset Latency (ms)	2.63±0.52	2.54±0.49	0.209	2.51±0.51	2.44±0.47	0.314
Amplitude (μV)	26.46±13.20	27.13±11.46	0.702	26.05±13.58	25.92±13.52	0.946
Velocity (m/s)	57.08±10.49	56.91±10.96	0.911	59.58±10.83	60.07±12.42	0.767
Ulnar Nerve						
Onset Latency (ms)	2.63±0.88	2.66±0.97	0.819	2.61±0.91	2.42±0.45	0.063
Amplitude (μV)	25.30±12.72	28.43±14.58	0.107	26.49±14.56	26.65±14.01	0.937
Velocity (m/s)	57.55±12.56	54.83±10.66	0.100	58.35±12.09	57.89±8.87	0.759

Table 4: Comparison of Sensory Nerve Conduction Study of medial nerve in control group participants.

Medial Nerve						
Parameters	Right Limb			Left Limb		
	Before inter-vention (Mean±SD)	After inter-vention (Mean±SD)	p	Before intervention (Mean±SD)	After inter-vention (Mean±SD)	p
Onset Latency (ms)	2.66±0.50	2.63±0.52	0.678	2.53±0.51	2.51±0.51	0.782
Amplitude (μV)	26.31±13.04	26.46±13.20	0.936	25.98±13.63	26.05±13.58	0.971
Velocity (m/s)	56.51±10.82	57.08±10.49	0.706	59.07±10.35	59.58±10.83	0.734
Ulnar Nerve						
Onset Latency (ms)	2.65±0.85	2.63±0.88	0.870	2.64±0.94	2.61±0.91	0.819
Amplitude (μV)	25.21±12.57	25.30±12.72	0.960	26.37±14.52	26.49±14.56	0.954
Velocity (m/s)	56.96±12.57	57.55±12.56	0.738	57.75±12.07	58.35±12.09	0.726

Table 5: Comparison of Sensory Nerve Conduction Study of upper limbs in study group participants before and after the intervention.

Medial Nerve						
Parameters	**Right Limb**			**Left Limb**		
	Before intervention (Mean±SD)	**After intervention (Mean±SD)**	**p**	**Before intervention (Mean±SD)**	**After intervention (Mean±SD)**	**p**
Onset Latency (ms)	2.59±0.50	2.54±0.49	0.476	2.48±0.50	2.44±0.47	0.561
Amplitude (μV)	26.87±11.60	27.13±11.46	0.873	25.80±13.90	25.92±13.52	0.951
Velocity (m/s)	56.18±10.85	56.91±10.96	0.636	59.44±12.74	60.07±12.42	0.724
Ulnar Nerve						
Onset Latency (ms)	2.72±1.08	2.66±0.97	0.680	2.48±0.49	2.42±0.45	0.368
Amplitude (μV)	28.27±14.61	28.43±14.58	0.938	26.43±14.06	26.65±14.01	0.912
Velocity (m/s)	54.15±10.90	54.83±10.66	0.656	57.14±9.43	57.89±8.87	0.563

Discussion

Diabetes appears to cause diabetic neuropathy more frequently than any other long-term consequence, with significant rates of morbidity and mortality. The peripheral nervous system involves neurological complications associated with diabetes. Several distinctive clinical symptoms and signs of peripheral nerve dysfunction in diabetics include diabetic neuropathies after exclusion of other factors. Electrodiagnostic testing (NCV determination) is one diagnostic approach for diabetic neuropathy. Besides being the most accurate test for identifying diabetic neuropathy, the determination of nerve conduction velocity (NCV) provides other benefits, such as consistency in results. [17]

Diabetic neuropathy has a complicated pathophysiology characterized by peripheral nerve fiber and micro-vessel dysfunction. The primary factors contributing to this issue include inflammation, abnormal lipid levels, high blood sugar, generation of reactive oxygen species (ROS), and suppression of anti-oxidant defenses, all of which result in a range of subsequent harmful pathways. Finding novel substances that not only have anti-diabetic properties but also lessen the consequences of diabetes is thus critically needed. Reducing oxidative stress and hyperglycemia may slow the development of these problems. [18]

Previous studies have shown that a variety of plants with a broad spectrum of naturally occurring antioxidants, including saponins, tannins, alkaloids, phenolic acids, flavonoids, and polyphenols, may increase the levels of antioxidant enzymes and improve their ability to scavenge free radicals. These characteristics could be beneficial in managing the complications associated with diabetes.

In experimentally produced diabetic rats, Fatani AJ et al. [19] showed that GS extract administration reduced the negative consequences of diabetic neuropathy. The capacity of the GS leaf extract to prevent STZ-induced hyperglycemia and decrease oxidative and inflammatory destruction of the peripheral nervous system was thought to be the cause of this relief. GS has been shown by Lingumpelly R et al. [20] to decrease hyperalgesia in experimental diabetic neuropathy. This action is most likely caused by the herb's antioxidant and aldose reductase inhibitory properties, rather than by its anti-hyperglycemic properties.

According to Senthilkumar M [21] and Laha and Paul [22], *G. sylvestre's* antioxidant activity is influenced by bioactive substances such as flavonoids, phenols, several gymnemic acids, gymnemarerin, saponins that tannins, and triterpenoids.

In their investigation, Rachh et al. [23] found that the GS extract exhibits reducing power, DPPH inhibition, superoxide and hydrogen peroxide scavenging, and antioxidant characteristics that may be related to flavonoids, phenols, tannins, and triterpenoids.

Behera SK [24] discovered that due to the presence of phytochemicals such as alkaloids, steroids, proteins, terpenoids, and glycosides, the methanolic GS extract showed high antioxidant activity by hydroxyl radical and superoxide scavenging.

Anti-hyperglycemic and anti-oxidative qualities of GS have been shown, suggesting that it might be a useful adjuvant treatment for diabetic neuropathies. Our findings, however, were not consistent with those of earlier research.

In the present research, sensory nerve conduction studies of the left and right median and ulnar nerves were studied. Latency, amplitude, and SNCV were recorded for each nerve. Both the groups were comparable at the baseline and remained comparable even at the end of 3 months. After three months, in both the study group and the

control group, we found a minor increase in the amplitude and conduction velocities of the sensory nerves, as well as a slight reduction in sensory latency for the bilateral medal and ulnar nerves. But across all factors, the statistical significance bar was untouched.

Conclusion: These findings indicate that *Gymnema sylvestre* therapy for three months did not demonstrate effectiveness in treating diabetic neuropathy.

Financial support and sponsorship: None.

Acknowledgement: We acknowledge the support from the Departments of Sardar Patel Medical College and the Associated Group of Hospitals in Bikaner (Rajasthan), India, for their assistance with technical and administrative matters. We are grateful to the participants, as well as the clinical and non-clinical staff of the college and hospital. Our thanks extend to everyone who contributed to this research in any way.

References –

1. WHO. Classification of diabetes mellitus. Geneva: World Health Organization; 2019
2. Zimmet P., Alberti K.G.M.M. & Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001; 414:782–787.
3. International Diabetes Federation. IDF Diabetes Atlas, 10th ed. Brussels, Belgium: International Diabetes Federation; 2021.
4. Fowler M.J. Microvascular and macrovascular complications of diabetes. Clin. Diabetes 2008; 26:77–82.
5. Valerie M. Donaghue, John M. Giurini, Barry I. Rosenblum, Peter N Weissman and Aristidis Veves. Variability in function me asurements of three sensory foot nerves in neuropathic diabetic patients. Diabetes research and clinical practice. 1995; 29:37–42.
6. Pop-Busui R., Boulton A.J.M., Feldman E.L., Bril V., Freeman R., Malik R.A., et al. Diabetic Neuropathy: A Position Statement by the American Diabetes Association. Diabetes Care 2017; 40:136–154.
7. Abbott CA, Malik RA, van Ross ERE, Kulkarni J, Boulton AJM. Prevalence and Characteristics of Painful Diabetic Neuropathy in a Large Community-Based Diabetic Population in the U.K. Diabetes Care. 2011 Aug 18; 34 (10):2220–4.
8. Callaghan BC, Gao L, Li Y, Zhou X, Reynolds E, Banerjee M, et al. Diabetes and obesity are the main metabolic drivers of peripheral neuropathy. Annals of Clinical and Translational Neurology. 2018 Feb 14; 5(4):397–405.
9. Andersen ST, Witte DR, Dalsgaard EM, Andersen H, Nawroth P, Fleming T, et al. Risk Factors for Incident Diabetic Polyneuropathy in a Cohort with Screen-Detected Type 2 Diabetes Followed for 13 Years: ADDITION-Denmark. Diabetes Care. 2018 May 1;41(5):1068–75.
10. Yeh GY, Eisenberg DM, Kaptchuk TJ and Phillips RS: Systematic review of herbs and dietary supplements for glycemic control in diabetes. Diabetes Care 2003; 26:1277-94.
11. Kanetkar P, Singhal R and Kamat M: Gymnema sylvestre: A Memoir. J Clin Biochem Nutr 2007; 41:77-81.
12. Khan F, Sarker MMR, Ming LC, Mohamed IN, Zhao C, Sheikh BY, Tsong HF, Rashid MA. Comprehensive review on phytochemicals, pharmacological and clinical potentials of Gymnema sylvestre. Front Pharmacol 2019; 10: 1223.
13. Tiwari P, Mishra BN, Sangwan NS. Phytochemical and pharmacological properties of Gymnema sylvestre: An important medicinal plant. BioMed Res Int. 2014; 2014:830285.
14. Pagadala JC, Madduru D, Tadepalli A.S. A review on Gymnema sylvestre a major antidiabetic asclepiadaceae herb. World J Pharm Res 2015;4(8):2724–32.
15. Al-Rejaie SS, Abuohashish HM, Ahmed MM, Aleisa AM and Alkhamees O: Possible biochemical effects following inhibition of ethanol-induced gastric mucosa damage by Gymnemasylvestre in male Wistar albino rats. Pharm Biol 2012; 50:1542-50.
16. Aleisa AM, Al-Rejaie SS, Abuohashish HM, Ola MS, Parmar MY and Ahmed MM: Pretreatment of Gymnema sylvestre revealed the protection against acetic acid-induced ulcerative colitis in rats. BMC Complement Altern Med 2014; 14:49.
17. Dyck PJ. Evaluative procedures to detect, characterize, and assess the severity of diabetic neuropathy. Diabetic Med 1991;8: S2
18. Boulton AJM, Vinik AI, Arezzo JC, Bril V, Feldman EL, Freeman R, et al. Diabetic Neuropathies: A statement by the American Diabetes Association. Diabetes Care. 2005 Mar 25; 28(4):956–62.
19. Fatani AJ., Al-Rejaie SS., Abuohashish HM., Al-Assaf A., Parmar MY., Ola MS., et al. Neuroprotective effects of Gymnema sylvestre on streptozotocin-induced diabetic neuropathy in rats. Exp. Ther. Med. 2015;9(5):1670–8.
20. Lingumpelly R, Jytothirmaye P, Kumar GN, Kumar MR. Anti-Diabetic Neuropathy and Pharmacological Evaluation of the Indian Traditional Herb Gymnema sylvestre. International Journal of Toxicological and Pharmacological Research 2015;7(1);60–4.
21. Senthilkumar M. Phytochemical Screening and Antibacterial Activity of Gymnema sylvestre

R.Br. Ex Schult. Int J Pharm Sci Res.2015;6 (6):2496–503.
22. Laha S, Paul S. Gymnema sylvestre (Gurmar): A Potent Herb with Anti-Diabetic and Antioxidant Potential. Pharmacog J. 2019;11(2):201–6.
23. Rachh PR, Patel SR, Hirpara HV, Rupareliya MT, Rachh MR, Bhargava AS, et al. In vitro evaluation of antioxidant activity of Gymnema sylvestre r. br. leaf extract. Rom. J. Biol. Plant Biol. 2009;54(2):141–8.
24. Behera SK. Phytochemical Analysis and Antioxidant Activities of Gymnema sylvestre R. Br. Leaf Extracts. Free Radicals and Antioxidants. 2019;9(1):12-5.