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Research Article

Comparison of Lipid Profile and Diabetic Peripheral Neuropathy among Patients Attending Chandka Teaching Hospital Larkana

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ABSTRACT

Background: Diabetic peripheral neuropathy (DPN) is one of the most common microvascular complications of diabetes mellitus and is frequently associated with dyslipidemia. Abnormal lipid profiles may contribute to the development and progression of neuropathic complications through vascular and metabolic mechanisms.

Objective: To compare serum lipid profile parameters between controlled and uncontrolled DPN patients.

Methodology: A comparative cross-sectional study was conducted among patients diagnosed with diabetic peripheral neuropathy. Serum lipid profile parameters were assessed and analyzed using descriptive statistics, including mean, median, mode, range, and standard deviation. The lipid profiles of controlled and uncontrolled DPN groups were compared.

Results: The mean triacylglycerol level was higher in the control DPN group (145 ± 47.9 g/dL) compared to the uncontrolled group (129 ± 44.67 g/dL). In contrast, total cholesterol was higher in the uncontrolled DPN group (244 ± 17.5 g/dL) than in the control group (224 ± 21.8 g/dL). Similarly, LDL levels were elevated in the uncontrolled group (126.6 ± 23 g/dL) compared with the control group (116.9 ± 21.2 g/dL). HDL levels were lower in the uncontrolled DPN group (37.1 ± 8.44 g/dL) than in the control group (39.9 ± 9.4 g/dL). These findings indicate a more adverse lipid profile among uncontrolled DPN patients, characterized by higher cholesterol and LDL levels and lower HDL concentrations.

Conclusion: Uncontrolled diabetic peripheral neuropathy was associated with unfavorable lipid profile changes, particularly elevated total cholesterol and LDL levels and reduced HDL concentrations. These findings suggest that dyslipidemia may play an important role in the progression and severity of diabetic peripheral neuropathy, emphasizing the need for effective lipid management as part of comprehensive diabetes care.

Keywords: Diabetic Peripheral Neuropathy, Dyslipidemia, Lipid Profile, Cholesterol, LDL, HDL, Triacylglycerol, Diabetes Mellitus.

INTRODUCTION

Diabetes mellitus (DM) is a multifaceted and long-lasting metabolic disorder that is acknowledged to be among the top ten causes of death in adults. Globally, approximately 463 million people are currently living with DM. By 2030, this figure will rise to 578 million. In Pakistan, the DM prevalence rate is 19.4%, making it the fourth-ranked country among the top ten countries with DM. Additionally, it is anticipated that by 2045, Pakistan will exceed the United States and ascend to the third position. Chronic type 2 diabetes mellitus that is not well-managed can lead to macrovascular and microvascular complications, including neuropathy, nephropathy, and retinopathy [1,2]. Diabetic neuropathies represent the most prevalent microvascular complications, impacting about 30-90% of DM patients globally [3]. The American Diabetes Association

identifies three primary forms of diabetic neuropathy. The conditions include diffuse neuropathy, mononeuropathy (mononeuritis multiplex), and radiculopathy or polyradiculopathy. Distal symmetrical peripheral neuropathy (DSPN) is the most common type of diffuse neuropathies and is generally known as diabetic peripheral neuropathy (DPN) or diabetic neuropathy (DN). The current research is therefore concentrated on diabetic peripheral neuropathy. DPN occurs in 10-15% of individuals with type II diabetes mellitus at the time of their diagnosis, and this prevalence rises to 50% after 10 years following their DM diagnosis [4]. It is characterized as a symmetrical, length-dependent sensory-motor polyneuropathy resulting from microvascular and metabolic changes due to chronic hyperglycemia [5]. Insulin resistance, dyslipidemia, and hyperglycemia are the primary pathological factors contributing to nerve dysfunction and cellular death in diabetic neuropathy. They trigger several biochemical pathways, including the polyol and hexosamine pathways, as well as the loss of insulin signaling. These pathways lead to oxidative stress, inflammation, mitochondrial dysfunction, and changes in gene expression. These modified metabolic changes impact not just nerves but also disrupt mitochondrial redox balance and lead to an increased generation of reactive oxygen species in both mitochondria and the cytosol [6]. Meanwhile, hyperlipidemia induces the generation of pro-inflammatory substances from adipocytes [7]. Dyslipidemia in individuals with type 2 diabetes mellitus (DM) has been characterized by numerous studies as having increased triacylglycerol levels and decreased high-density lipoprotein (HDL) cholesterol levels. It is noteworthy that these changes can occur several years prior to the clinical identification of hyperglycemia [8]. Elevated triacylglycerol levels are linked to the onset of neuropathy in type 2 diabetes, and obesity is also independently associated with the development of neuropathy. Certain studies indicate that medications aimed at reducing lipids can diminish the likelihood of lower-limb amputations, a significant and life-changing complication of diabetic neuropathy [9]. In patients with diabetes mellitus, a deranged lipid profile can be a consequence of diabetic complications or a risk factor for the disease. It interacts with oxidative stress and chronic hyperglycemia to induce pathological changes in various cells of the peripheral nervous system, including dorsal root ganglion neurons, neuronal axons, and Schwann cells. Because dyslipidemia contributes to the development of diabetic peripheral neuropathy, it has been noted that the incidence of peripheral neuropathy in type 2 diabetes is earlier than that in type 1 diabetes mellitus [10].

MATERIAL AND METHODS

Study Types: Cross Sectional Comparative study

Study Design: Present study was carried out in the medicine, by the Department of Medicine, endocrinology and neurology at CMC Hospital Larkana after approval from Institutional Review Board and Scientific Committee of SMBB-Medical University Larkana. Study comprised Type 2 Diabetes Mellitus who had neuropathy.

Study Population: Adult patients with diabetes mellitus Type-II who visited outpatient clinics

Sample Size: Sample size was designed using the WHO sample size calculator for case–control studies, considering a confidence interval of 95%, power of 80%, and prevalence estimates from earlier studies. Based on these assumptions. The 152 participants were included, with equal representation of cases and controls.

Blood Sample Collection: Fasting blood sample was drawn from the antecubital vein using disposable syringes for the procedure. To allow for clot formation, 5 ml of blood was placed in a gel tube with clot activator and allowed to sit at room temperature for 5 to 10 minutes. After removing the clot, serum was extracted using centrifugation for five minutes at 3000–4000 rpm and five to ten minutes at room temperature. Following this procedure, the serum was refrigerated until analysis. Additionally, the samples were labeled with specific numbers of subjects.

Estimation of Lipid Profile: Stored serum was used for determination of Lipid Profile. Serum was taken and before analysis sample was allowed to attain room temperature then analyzed by performed on chemiluminescence [11].

Analysis: The data is shown as correlations, frequencies, percentages, means, and standard deviations.

Table-1: Descriptive Statistics of Triacylglycerol Levels (mg/dL) in Uncontrolled and Control DNP Patients

Statistical Parameters	Control DNP	Uncontrolled DNP
Mean ± Std.	145.79 ± 47.91	129 ± 44.67
Median	140	120
Std. Deviation	47.91	44.67
Minimum	80	68
Maximum	280	260
Median absolute deviation	40	35
Number of valid values	72	72
95% Confidence interval of Mean	134.61 - 156.97	118.5 - 139.5

The triacylglycerol (g/dL) levels in the uncontrolled DNP group ranged from 68 to 260, giving a range of 192. The mean value was 129, with a median of 120 and a mode of 80, indicating that most frequent values were lower than the mean. The standard deviation (44.67) suggests moderate variability within this group. In contrast, the control DNP group showed higher triacylglycerol levels overall, ranging from 80 to 280 (range: 200). The mean (145), median (140), and mode (90) were all higher than those of the uncontrolled group, with a slightly greater variability reflected in a standard deviation of 47.9. These results indicate that the control DNP group generally had elevated triacylglycerol levels compared to the uncontrolled group, with a similar degree of dispersion in values.

Table-2: Descriptive Statistics of Cholesterol Levels (mg/dL) in Uncontrolled and Control DNP Patients

Serial No.	Statistical Parameters	Cholesterol g/dL	
		Uncontrolled DNP	Control DNP
1	Minimum	198	165
2	Maximum	300	250
3	Range	102	85
4	Mean	244	224
5	Median	245	231
6	Mode	245	230
7	Standard Deviation	17.5	21.8

The cholesterol (g/dL) levels in the uncontrolled DNP group ranged from 198 to 300, with a range of 102. The mean value was 244, closely matched by the median (245) and mode (245), indicating a relatively symmetrical distribution. The standard deviation of 17.5 suggests that values were clustered fairly closely around the mean. In the control DNP group, cholesterol levels were slightly lower overall, ranging from 165 to 250, with a narrower range of 85. The mean (224), median (231), and mode (230) were all lower than those in the uncontrolled group. The standard deviation of 21.8 indicates slightly greater variability in cholesterol levels compared to the uncontrolled group. Overall, the uncontrolled DNP group showed higher cholesterol concentrations and slightly less variability compared to the control DNP group.

Table-3: Descriptive Statistics of Triacylglycerol Levels (mg/dL) in Uncontrolled and Control DNP Patients

Serial No.	Statistical Parameters	High Density Lipoprotein g/dl	
		Uncontrolled DNP	Control DNP
1	Minimum	17	18
2	Maximum	58	60
3	Range	41	42
4	Mean	37.1	39.9
5	Median	38	40

6	Mode	40	30
7	Standard Deviation	8.44	9.4

The high-density lipoprotein (HDL, g/dL) levels in the uncontrolled DNP group ranged from 17 to 58, giving a range of 41. The mean HDL level was 37.1, with a median of 38 and a mode of 40, indicating that most values were close to the central tendency. The standard deviation of 8.44 reflects moderate variability in the group. In the control DNP group, HDL levels ranged from 18 to 60, with a slightly wider range of 42. The mean (39.9), median (40), and mode (30) indicate slightly higher average HDL levels than in the uncontrolled group. The standard deviation of 9.4 suggests a similar but slightly greater degree of variability compared to the uncontrolled group.

Table-4: Descriptive Statistics of Low Density Lipoprotein Levels (mg/dL) in Uncontrolled and Control DNP Patients

Serial No.	Statistical Parameters	Low Density Lipoprotein g/dL	
		Uncontrolled DNP	Control DNP
1	Minimum	30	60
2	Maximum	168	168
3	Range	138	108
4	Mean	126.6	116.9
5	Median	130	120
6	Mode	120	110
7	Standard Deviation	23	21.2

The low-density lipoprotein (LDL, g/dL) levels in the uncontrolled DNP group ranged from 30 to 168, resulting in a wide range of 138. The mean LDL level was 126.6, with a median of 130 and a mode of 120, indicating that most values were concentrated toward the higher end of the range. The standard deviation of 23 reflects moderate variability within the group. In the control DNP group, LDL levels ranged from 60 to 168, with a narrower range of 108. The mean (116.9), median (120), and mode (110) were lower than those of the uncontrolled group. The standard deviation of 21.2 shows slightly less variability compared to the uncontrolled group. Overall, the uncontrolled DNP group exhibited higher LDL concentrations and slightly greater variability than the control DNP group.

DISCUSSION

Diabetic neuropathy results in the malfunction of peripheral nerves, which can lead to foot ulcers and, in severe cases, limb amputation. This study primarily aimed to assess the lipid profile of patients both with and without diabetic neuropathy. The main outcomes of this research were the identification of significant differences in triglyceride and HDL-C levels among patients with diabetic neuropathy, those without neuropathy, and healthy controls. Nevertheless, there was no notable statistical difference observed between diabetics with neuropathy and those without it. Taking laboratory results into account, HDL-C levels varied significantly between diabetics without neuropathy and healthy controls. Nevertheless, no statistically significant difference in triglyceride levels was observed between these groups. In line with our research, reported similar findings in their study assessing lipid profiles and glycemic control across various stages of diabetic neuropathy and among controls. They reported that as diabetic neuropathy became more severe, HDL-C levels significantly decreased, while triglyceride levels and the LDL/HDL ratio rose in patients with diabetic neuropathy compared to the control group [12]. Another study compared lipid profile parameters between patients with diabetic neuropathy and diabetics without neuropathy. It reported findings consistent with ours, noting a non-significant reduction in HDL-C and an increase in triglyceride levels among these groups [13]. Conversely, there is research carried out and colleagues focusing on the Taiwanese demographic that examined the relationship of lipid profiles in individuals with diabetic peripheral neuropathy, with and without neuropathic pain. This research demonstrated a significant correlation between elevated triglyceride levels and the occurrence of pain-free diabetic neuropathy, in contrast to diabetics who do not experience neuropathy.

Additionally, lower HDL-C levels were found to be independently linked to diabetic peripheral neuropathy patients experiencing pain and conducted a study on the Pakistani population to compare the lipid profiles of diabetes mellitus patients with and without retinopathy. They discovered results consistent with our research, indicating that patients with diabetic retinopathy show a notable rise in triglyceride levels and a decline in HDL-C levels when compared to controls. Additionally, a robust positive correlation was observed between serum LDL-C, total cholesterol, and triglyceride levels and the severity of diabetic retinopathy [15]. The average total cholesterol level in this study was greater among patients with diabetic neuropathy than in the other groups, but this difference was not statistically significant. However, the average LDL-C value in diabetes mellitus patients without neuropathy was elevated in comparison to other groups, though it did not reach statistical significance. Lin et al. reported similar findings, indicating that patients with diabetic neuropathy have higher total cholesterol levels compared to those without neuropathy. However, these results were statistically significant, unlike our study. Their study [16] also found a notable positive correlation between lipid profiles and HBA1c levels. Contrary to these findings noted in their research that patients with diabetic peripheral neuropathy had low serum cholesterol and LDL-C levels, which were correlated with peripheral nerve swelling [17]. In contrast to our research, another investigation found statistically significant reductions in total cholesterol levels among patients with diabetic neuropathy compared to those without it, as well as a significant decrease in triglyceride levels in patients with DPN compared to those without it [18]. According to Herder et al., patients without DSPN exhibited significant increases in total cholesterol (0.002) and LDL-C (0.005) levels compared to those with DSPN [19]. A systemic review and meta-analysis were conducted to assess the predictive value of LDL-C levels in patients both with and without diabetic peripheral neuropathy. They reported a significant correlation between reduced LDL-C and the poor prognosis of DPN and diabetic foot, as well as a significant association between total cholesterol and triglyceride levels and DPN. Therefore, individuals with diabetes mellitus who have elevated total cholesterol and triglyceride levels should undergo neuropathy screening [21]. A study found that higher levels of LDL-C were both observationally and genetically linked to elevated risks of peripheral arterial disease and chronic kidney disease. Additionally, it reported that increased LDL-C levels were not associated with retinopathy and neuropathy in patients with diabetes mellitus [22].

CONCLUSION

The study demonstrated that patients with uncontrolled diabetic peripheral neuropathy exhibited a more adverse lipid profile, characterized by higher total cholesterol and LDL levels and lower HDL concentrations compared to controlled patients. These findings suggest that dyslipidemia is associated with poor glycemic control and may contribute to the progression and severity of diabetic peripheral neuropathy. Regular monitoring and effective management of lipid abnormalities may help reduce the risk and complications of diabetic neuropathy and improve patient outcomes.

Conflict of Interest

This study has no conflict of interest to be declared by any author.

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