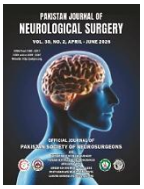

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Original Research

Peripheral Neuropathy in Hypothyroid Patients: Clinical and Biochemical Correlation

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ABSTRACT

Objective: The purpose of the study was to find the prevalence of peripheral neuropathy in hypothyroid patients and to identify the relationship between the level of thyroid hormone and the neurological symptoms.

Materials & Methods: The proposed observational study was carried out at Lady Reading Hospital, Peshawar. Consecutive sampling was used to select a total of 160 patients aged 18 to 70 years who were confirmed to have hypothyroidism. Neuropathic symptoms were clinically assessed by conducting a detailed neurological examination. All patients were measured in regard to serum thyroid-stimulating hormone, free thyroxine, and triiodothyronine. The conduction studies of nerves were conducted in individuals who presented with possible symptoms of peripheral neuropathy. Pearson correlation analysis was used to determine the correlation between the level of neuropathy and thyroid hormones.

Results: A significant number of patients had their peripheral symptoms of neuropathy. Paresthesia was the most common, and then burning sensation and muscle weakness. Conduction studies on nerves indicated that 42.5 percent of patients had neuropathy. There existed a marked positive relationship between high levels of TSH and the severity of neuropathy, and neuropathy had a negative relationship with free T4 and T3 levels.

Conclusion: Peripheral neuropathy is a prevalent neurological complication in patients with hypothyroidism and has a great association with biochemical thyroid dysfunction. Management of hypothyroidism early can help in the prevention of complications of neuropathy and a better neurological outcome.

Keywords: Hypothyroidism, Peripheral Neuropathy, Thyroid Stimulating Hormone, Nerve Conduction Study, Neurological Manifestations, Thyroid Hormones.

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INTRODUCTION

Hypothyroidism is a prevalent endocrine disease that may have an impact on various body systems, including the peripheral nervous system. Thyroid hormones are significant in the metabolism of neurons, in the axonal transport, and in the myelin maintenance. Lack of these hormones can result in the dysfunction of peripheral nerves and neuropathic dysfunction.[1] Hypothyroid patients have a high likelihood of peripheral neuropathy, and in many cases, it is underdiagnosed because, in the early stages of the disease, the manifestations are mild or indistinct. The clinical and biochemical relationship between neuropathy and hypothyroidism needs to be comprehended to diagnose and manage it on time.[2]

Hypothyroidism is a common endocrine disorder characterized by reduced production of thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3). These hormones are essential for maintaining metabolic homeostasis and play a critical role in the normal functioning of the nervous system.[3] The nervous system, particularly peripheral nerves, is highly sensitive to changes in thyroid hormone levels, as these hormones are involved in neuronal metabolism, myelination, and axonal transport.[4]

Peripheral neuropathy is a recognized but often underdiagnosed complication of hypothyroidism. It commonly presents with symptoms such as numbness, tingling, burning sensations, and muscle weakness.[5] Several studies have reported an association between hypothyroidism and peripheral nerve dysfunction; however, the reported prevalence varies considerably across different studies. This variation may be attributed to differences in study design, patient selection, and diagnostic approaches.[6]

The pathophysiology of hypothyroid-related neuropathy is complex and multifactorial. Reduced thyroid hormone levels may impair mitochondrial function and decrease energy production in neurons, leading to disruption of axonal transport and nerve conduction.[7] In addition, accumulation of glycosaminoglycans and mucopolysaccharides in peripheral tissues may result in nerve compression and edema, further contributing to neuropathic manifestations. Despite these proposed mechanisms, the relationship between biochemical thyroid dysfunction and the severity of peripheral neuropathy remains incompletely understood.[8]

Although several international studies have explored the association between hypothyroidism and peripheral neuropathy, there is limited data from developing countries, particularly Pakistan[9]. Regional differences in nutritional status, iodine intake, healthcare access, and diagnostic practices may influence both the prevalence and clinical presentation of hypothyroid neuropathy. Furthermore, few studies have evaluated both clinical manifestations and biochemical parameters together in this population.[10]

Therefore, the present study was conducted to determine the prevalence of peripheral neuropathy among patients with hypothyroidism and to assess its correlation with thyroid hormone levels. By addressing this gap, the study aims to provide region-specific evidence that may contribute to improved early diagnosis and management of neurological complications associated with hypothyroidism.

MATERIALS AND METHODS

Study Design & Setting

The research was a prospective observational study conducted in the Department of Medicine and Neurology at Lady Reading Hospital, a major tertiary care teaching hospital. The study was carried out from 5 February 2025 to 5 December 2025. The hospital serves as a referral center for endocrine and neurological disorders across Khyber Pakhtunkhwa, allowing recruitment of a sufficient number of patients during the study period.

Sampling

Non-probability consecutive sampling was used to select a total of 160 patients diagnosed with hypothyroidism. Adult patients presenting to outpatient and inpatient departments were included. All patients underwent detailed clinical assessment, including demographic information, medical history, and standardized neurological examination.

Inclusion Criteria

The study included patients aged 18 to 70 years with laboratory-confirmed hypothyroidism. Both newly diagnosed and previously known cases were eligible.

Exclusion Criteria

Patients with conditions known to cause peripheral neuropathy, including diabetes mellitus, chronic kidney disease, chronic liver disease, alcoholism, vitamin B12 deficiency, or other metabolic disorders, were excluded. Patients receiving medications known to cause neuropathy, such as chemotherapy, and those with traumatic or hereditary neuropathies were also excluded.

Clinical Management and Data Collection

All patients underwent a standardized neurological examination, including assessment of muscle strength, deep tendon reflexes, vibration sense, pinprick sensation, and proprioception. Symptoms suggestive of peripheral neuropathy, such as numbness, tingling, burning sensation, weakness, and loss of sensation in extremities, were carefully documented.

Biochemical analysis was performed to evaluate thyroid function. Blood samples were collected according to standard laboratory procedures and analyzed for thyroid-stimulating hormone (TSH), free thyroxine (FT4), and triiodothyronine (T3) using automated immunoassay techniques.

Patients with clinical suspicion of peripheral neuropathy were further evaluated using electrophysiological testing with nerve conduction studies (NCS). Due to resource and feasibility constraints, nerve conduction studies were performed only in patients with clinical suspicion of peripheral neuropathy. Motor and sensory nerve conduction parameters, including conduction velocity, distal latency, and amplitude, were measured in major peripheral nerves of the upper and lower limbs using standard electrophysiological equipment.

Standard electrophysiological criteria were used to interpret nerve conduction abnormalities based on established reference values.

Peripheral neuropathy was defined as the presence of suggestive clinical symptoms along with abnormal nerve conduction study findings, including reduced conduction velocity, prolonged distal latency, or decreased amplitude. Neuropathy was further classified into sensory, motor, or sensorimotor types based on electrophysiological findings.

Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Pearson correlation analysis was used to determine the relationship between thyroid hormone levels and neurological manifestations. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Review Board of Lady Reading Hospital (REF: NO. 362/LRH/MTI). Written informed consent was obtained from all participants before enrollment. Patient confidentiality and anonymity were

maintained throughout the study, and all procedures were conducted in accordance with ethical guidelines and the Declaration of Helsinki.

RESULTS

This study was carried included 160 patients with confirmed hypothyroidism. Each participant was assessed using clinical neurological examination, biochemical thyroid function tests, and nerve conduction studies where clinically indicated**.** The demographic data, clinical features of peripheral neuropathy, biochemical findings, and electrophysiological outcomes are summarized below.

Table 1: *Demographic Characteristics of Hypothyroid Patients (n = 160).*

Variable	Category	Frequency	Percentage
Age Group (years)	18–30	37	23.1%
	31–50	72	45.0%
	51–70	51	31.9%
Gender	Male	56	35.0%
	Female	104	65.0%

Demographics

As shown in Table 1, the majority of patients belonged to the 31–50 years age group (45%), followed by 51–70 years (31.9%). Younger patients aged 18–30 years constituted 23.1% of the study population. Females represented a larger proportion (65%) compared to males (35%), reflecting the higher prevalence of hypothyroidism among women.

Clinical Assessments

The clinical symptoms suggestive of peripheral neuropathy are summarized in Table 2. Paresthesia was the most frequently reported symptom (45%), followed by burning sensation and muscle weakness. Reduced or absent deep tendon reflexes were observed in 13.7% of patients during neurological examination.

Table 2: *Clinical Symptoms of Peripheral Neuropathy in Hypothyroid Patients (n = 160).*

Symptom	Frequency	Percentage
Paresthesia (numbness/ tingling)	72	45.0%
Burning sensation	38	23.8%
Muscle weakness	28	17.5%
Reduced deep tendon reflexes	22	13.7%
Total	160	100%

Table 3: *Biochemical Thyroid Hormone Levels in Hypothyroid Patients (n = 160).*

Parameter	Mean	Standard Deviation
TSH (mIU/L)	12.8	±4.6
Free T4 (ng/dL)	0.71	±0.18
T3 (ng/mL)	0.89	±0.21

The biochemical thyroid hormone profile is presented in Table 3. The mean thyroid stimulating hormone (TSH) level was elevated at 12.8 ± 4.6 mIU/L, consistent with hypothyroidism. Mean free T4 and T3 levels were reduced, confirming thyroid hormone deficiency among the study participants.

Table 4: *Nerve Conduction Study Findings Among Patients with Neuropathy (n = 68).*

Type of Neuropathy	Frequency	Percentage
Sensory neuropathy	32	47.1%
Sensorimotor neuropathy	22	32.4%
Motor neuropathy	14	20.5%
Total	68	100%

Among patients who underwent nerve conduction studies (n = 68), all demonstrated abnormal electrophysiological findings consistent with neuropathy. As shown in Table 4, sensory neuropathy was the most common electrophysiological pattern (47.1%), followed by sensorimotor neuropathy (32.4%). Pure motor neuropathy was less frequent.

Table 5: *Correlation Between Thyroid Hormone Levels and Neuropathy Severity.*

Variable	Correlation Coefficient (r)	p-value
TSH vs Neuropathy Severity	0.46	0.002
Free T4 vs Neuropathy Severity	-0.38	0.006
T3 vs Neuropathy Severity	-0.29	0.014

Correlations

Table 5 summarizes the correlation analysis. A moderate positive correlation was observed between TSH levels and the severity of neuropathy ($r = 0.46$, $p = 0.002$), indicating that higher TSH levels were associated with more pronounced neuropathic manifestations. Negative correlations of moderate strength were observed between free T4 ($r = -0.38$, $p = 0.006$) and T3 levels ($r = -0.29$, $p = 0.014$) with neuropathy severity, suggesting that lower thyroid hormone levels were associated with increased severity of neuropathy.

Overall, these findings suggest an association between thyroid hormone imbalance and peripheral nerve dysfunction; however, these results should be interpreted cautiously in light of the study design and statistical limitations.

DISCUSSION

Hypothyroidism is a known but often underestimated cause of neurological complications, including peripheral neuropathy. Thyroid hormones play a crucial role in maintaining neuronal metabolism, axonal transport, and myelin integrity, and their deficiency may lead to structural and functional changes in peripheral nerves.[11] The present study was conducted to assess the occurrence of peripheral neuropathy in hypothyroid patients and to evaluate its association with thyroid hormone levels. The findings of this study suggest a relatively high frequency of neuropathy among the studied population and indicate a possible association between biochemical thyroid dysfunction and neurological manifestations.[12]

In this study, the majority of patients belonged to the middle age group (31–50 years), followed by those aged 51–70 years. This age distribution is consistent with previous studies reporting that hypothyroidism is commonly diagnosed in middle adulthood. The relatively lower proportion of younger patients may reflect the lower prevalence of thyroid dysfunction in early adulthood.[13]

The gender distribution observed in this study is also consistent with known epidemiological trends, with a higher proportion of female patients. This finding supports previous evidence that hypothyroidism is more prevalent among women, possibly due to hormonal, autoimmune, and genetic factors.[14]

Paresthesia was the most frequently reported neurological symptom, followed by burning sensation and muscle weakness. These findings are consistent with earlier studies and highlight that sensory symptoms are often the earliest manifestations of peripheral nerve involvement in hypothyroidism. However, variations in symptom frequency across studies may be related to differences in patient selection and diagnostic criteria.[15]

The pathophysiology of hypothyroid-related neuropathy is multifactorial. Reduced thyroid hormone levels may impair mitochondrial activity and energy production, leading to disruption of axonal transport. Additionally, accumulation of glycosaminoglycans in tissues may result in nerve compression and edema, contributing to impaired nerve conduction.[16]

Biochemical analysis in this study demonstrated elevated TSH levels with reduced T3 and T4 levels, confirming hypothyroidism. A positive correlation was observed between TSH levels and neuropathy severity, while negative correlations were observed with T3 and T4 levels. These findings are in agreement with previous

studies; however, the strength of association should be interpreted with caution due to the observational nature of the study.[17]

Nerve conduction studies showed that sensory neuropathy was the most common electrophysiological pattern, followed by sensorimotor neuropathy. These findings are consistent with earlier studies suggesting that sensory fibers are affected earlier in the disease process.[18]

In the present study, approximately 42.5% of patients who underwent nerve conduction studies showed evidence of neuropathy. This finding should be interpreted carefully, as nerve conduction studies were performed only in patients with clinical suspicion of neuropathy, which may have influenced the observed frequency.[19]

The findings also suggest that neurological symptoms may occur even in patients with moderate biochemical abnormalities. This highlights the importance of early recognition and evaluation of neurological symptoms in hypothyroid patients.[20]

This study emphasizes the need for a detailed neurological assessment in patients with hypothyroidism[21]. Clinical examination combined with biochemical testing and nerve conduction studies can help in early detection and appropriate management of neuropathy.[22]

The study has several limitations. Duration of hypothyroidism and treatment status were not assessed, which may act as potential confounding factors. Additionally, nerve conduction studies were not performed in all patients, which may limit the generalizability of the findings.

Further multicenter studies with larger sample sizes and longitudinal follow-up are recommended to better understand the relationship between thyroid dysfunction and peripheral neuropathy.

CONCLUSION

The current study suggests that peripheral neuropathy is a relatively common neurological complication among patients with hypothyroidism. The clinical features, including paresthesia, burning sensation, and muscle weakness, were found to be associated with electrophysiological abnormalities identified on nerve conduction studies. The findings indicate a possible association between thyroid hormone imbalance and neuropathic manifestations**,** with higher TSH and lower thyroid hormone levels potentially contributing to peripheral nerve dysfunction**.** However, these findings should be interpreted with caution due to the observational design of the study and certain methodological limitations**.** These results highlight the importance of early diagnosis of hypothyroidism, careful neurological evaluation, and timely management to potentially reduce the risk of neurological complications and improve patient outcomes. Further large-scale and longitudinal studies are recommended to confirm these findings.

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Additional Information

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AUTHORS CONTRIBUTIONS

Serial Number	Author's Full Name	Intellectual Contribution to the Paper in Terms of
1.	Irfan Ullah	Study design and methodology.
2.	Akhtar Hussain	Paper writing.
3.	Dur-e-Sameen	Data collection and calculations.
4.	Rimsha Azhar	Analysis of data and interpretation of results.
5.	Hina Azeez	Literature review.
6.	Sajjad Ahmad	Data collection.
7.	Amna Hilal	Referencing.