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ORIGINAL RESEARCH

Assessment of motor nerve conduction, skeletal muscle strength and endurance in hypothyroid individuals

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ABSTRACT

Introduction: Neuromuscular dysfunction is caused by hypothyroidism. The length of time and severity of the hormone insufficiency are associated with the severity of neuromuscular signs and symptoms.Hypothyroidism frequently causes peripheral neuropathy and polyneuropathy due to axonal damage or nerve demyelination.Since hypothyroidism can result in both myopathy and neuropathy, the purpose of the study was to evaluate the functional state of skeletal muscle and examine how hypothyroidism affects motor nerve transmission. **Methodology:** This study was done as a case control Study. The current investigation was carried out for a year in the Department of Physiology's Neurophysiology Research Laboratory. There are 60 people in all, 30 of them are in the study group and the remaining 30 are in the control group.Nerve conduction was investigated using the Medicare Systems (RMS) EMG EP MARK-II MACHINE. **Results:** In comparison to the control group, the hypothyroid group's mean values for the right and left median nerve conduction velocities were lower. However, there was no discernible difference between mean values for the right and left median nerve conduction velocities. The hypothyroid group's mean handgrip strength (kg) in the right upper limb was statistically significant lower than that of the control group. There was no statistically significant in the left upper limb. The hypothyroid group's mean values for the right and left upper limb HGE were lower than those of the control group, and this difference was statistically significant. **Conclusion:** Our findings have led us to the conclusion that hypothyroidism is associated with myopathy and neuropathy of the median nerve. The longer the condition lasts, the more severe the neuropathy and myopathy become. Early diagnosis of myopathy is crucial to preventing muscle deterioration and ensuring quality of life in hypothyroid individuals, as myopathy develops earlier than neuropathy.

Keywords: nerve conduction, hand grip, endurance, hypothyroid

INTRODUCTION

Thyroid hormone regulates gene expression, myelin synthesis, and axonal transport, all of which have a significant impact on the timing and rate of the central nervous system's development as well as the myelination of neurons.[2]. According to the Indian Thyroid Society (ITS), the most prevalent condition resulting from a hormone deficit is hypothyroidism. Worldwide, iodine deficiency is thought to be the most frequent cause of hypothyroidism.

Neuromuscular dysfunction symptoms are brought on by hypothyroidism. The length of time and severity of the hormone insufficiency are associated with the severity of neuromuscular signs and symptoms. After hormone replacement, electrophysiological and morphological alterations improve[1]. Hypothyroidism frequently causes peripheral neuropathy and polyneuropathy due to axonal damage or nerve demyelination. The Schwann cells are impacted by the metabolic change brought on by the hormone imbalance, which causes a segmental demyelination that leads to segmental neuropathy. A degenerative nerve condition called peripheral polyneuropathy can lead to a chronic impairment. It typically presents as exhaustion, numbness, paraesthesia, weakness, loss of reflexes, and loss of vibration sense[2].

Symptoms of hypothyroid myopathy typically include proximal muscular weakness, an elevated creatine kinase level, and a polymyositis-like myopathy.[3,4] An electrodiagnostic technique called nerve conduction study (NCS) is used to determine the kind and extent of peripheral nerve dysfunction as well as to examine the functional state of the nerves. It is currently frequently employed for accurate peripheral nerve

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function characterization as well as for the exact identification of neural lesions.[5]

A reliable indicator of overall muscle strength and endurance is handgrip strength (HGS). You can lift more weight and hold it for longer if your hands, wrists, and fingers are strong. High levels of activation in the hand and forearm flexor muscles are necessary for many daily tasks. These are the muscles used to hold objects so that you can have a firm grip on them. Muscular endurance and absolute strength can both be predicted using the handgrip dynamometer test. The Handgrip Dynamometer's predictive value may be a helpful tool for predicting muscular strength and endurance, which often call for more involved evaluation. An effective method for evaluating muscle strength that is simple to do in an outpatient setting is HGD testing.

Since hypothyroidism can result in both myopathy and neuropathy, the purpose of the study was to evaluate the functional state of skeletal muscle and examine how hypothyroidism affects motor nerve transmission. Nerve conduction velocity and amplitude in the median nerve were measured in order to evaluate the neuronal integrity. Handgrip dynamometry was used to measure the strength and endurance of the muscles. We aimed to investigate the frequency of neuropathy and myopathy in hypothyroid individuals, as well as the correlation between these characteristics and the length of sickness and thyroid condition after replacement treatment. Our study's objective is to evaluate the hypothyroid participants' skeletal muscular strength, endurance, and motor nerve conduction.

MATERIALS AND METHODS

This study was done as a case control Study.The current investigation was carried out for a year in the Department of Physiology's Neurophysiology Research Laboratory. There are 60 people in all, 30 of them are in the study group and the remaining 30 are in the control group. People between the ages of 20 and 50 who were hypothyroid were included as cases, whereas people who were euthyroid were included as controls.

Patients under 20 and over 50 years of age. Subjects who regularly work out. Participants with secondary hypothyroidism and those on neuropsychotropic medications were excluded, but those with diabetes mellitus, cardiovascular disease, and neuromuscular illness were included.

A thorough medical, personal, and therapeutic history was gathered. We gathered information on their medical history, including diabetes, thyroid conditions, cardiovascular illness, neurological disorders, menstrual cycles, and physical activity. Three millilitres of antecubital vein venous blood were drawn in a disposable syringe and placed in a vacutainer for blood studies while aseptic precautions were taken. After letting the blood coagulate at room temperature, it is centrifuged at 3000 rpm to extract the serum. This separated serum was utilized to estimate TSH, FT3, and FT4 and was kept in a deep freezer at -20°.

Nerve conduction was investigated using the Medicare Systems (RMS) EMG EP MARK-II MACHINE. By gradually increasing the intensity of stimulation and monitoring the wave's amplitude, the nerve was stimulated at the wrist, 3 cm proximal to the distal wrist crease, and between the palmaris longus and flexor carpi radialis tendons. In both upper limbs, the median nerve's elbow-wrist segment was examined. The NCV is computed by dividing the latency difference in milliseconds by the distance in millimetres between two stimulation locations. The unit of measurement is m/s.

RESULTS

Most of patients were in age group of 20-40 years in hypothyroid and control group respectively. Out of 30, 28 subjects were female and 2 subjects were male in hypothyroid indicating that women are predominantly affected by hypothyroidism than men.The mean value of BMI in Hypothyroid group (25.74) was higher than control group (23.43).The p value of BMI between control and hypothyroid group was statistically significant.

Table 1: Comparison of Thyroid profile in Hypothyroid and Control group

Thyroid Profile	CASES	CONTROLS	P VALUE
MEAN TSH	7.04±4.83	2.25±1.55	0.001*
MEAN FT4	1.71±0.64	2.42±1.4	0.001*
MEAN FT3	0.98±0.48	1.25±0.23	0.009

The Mean TSH in Hypothyroid group was higher than the Control group and p value was highly statistically significant.The Mean value of FT4 in Hypothyroid group was lower than the Control group and highly statistically significant. The mean value of FT3 in Hypothyroid group was lower than the control group and it was statistically significant.

Table 2: Nerve conduction test comparison

Variable		Case		Control		P-Value
		Mean	S.D	Mean	S.D	
CONDUCTION	CV-Rt	59.03	6.11	60.46	4.13	.292

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VELOCITY	CV-Lt	59.85	5.38	60.38	4.43	.677
DISTAL LATENCY	DL –Rt	3.31	.74	3.30	.51	.952
	DL –Lt	3.19	.63	3.25	.49	.692
AMPLITUDE OF CMAP	Amp -Rt	13.09	5.34	13.08	3.10	.986
	Amp -Lt	12.77	4.80	12.65	4.11	.918
HAND GRIP STRENGTH	HGS -Rt	11.27	3.38	13.70	2.42	.002**
	HGS -Lt	9.90	3.06	11.10	1.67	.065
HAND GRIP ENDURANCE	HGE -Rt	25.57	12.345	33.33	9.08	.007**
	HGE -Lt	22.70	11.37	28.77	7.64	.018*

In comparison to the control group, the hypothyroid group's mean values for the right and left median nerve conduction velocities were lower. However, there was no discernible difference between the hypothyroid and control groups' mean values for the right and left median nerve conduction velocities. The mean values of the right and left median nerve distal latency did not differ significantly between the hypothyroid and control groups. There was no statistically significant difference in the mean amplitude of the right and left median nerve CMAP between the hypothyroid and control groups.

The hypothyroid group's mean handgrip strength (kg) in the right upper limb was statistically significant lower than that of the control group. There was no statistically significant difference in the mean HGS (kg) in the left upper limb between the hypothyroid and control groups. The hypothyroid group's mean values for the right and left upper limb HGE were lower than those of the control group, and this difference was statistically significant.

We then looked at the Pearson correlation of different parameters. Distal latency and disease duration had a positive association, although it was not statistically significant. Although not statistically significant, there was a negative connection between the length of the disease and the left median nerve conduction velocity, CMAP amplitude, and handgrip endurance.

Although not statistically significant, there was a negative connection between TSH and handgrip endurance, left median nerve CMAP, and right median nerve conduction velocity. Although it was not statistically significant, there was a positive connection between TSH and the distal latency of right median nerve CMAP. Although they were not statistically significant, there was a positive association between FT4 and the right median nerve conduction velocity as well as the right and left median nerve amplitude of CMAP. Although FT4 and the distal latency of the right and left median nerves were negatively correlated, this relationship was not statistically significant.

There was a positive correlation between FT3 and right median nerve conduction velocity, amplitude of CMAP but they are not statistically significant.There was a negative correlation between FT3 and distal latency of right median nerve CMAP but it was not statistically significant.

DISCUSSION

Hypothyroidism is a common endocrine disorder mostly affecting women. It produces manifestations of peripheral neuropathy affecting motor, sensory and mixed nerves producing chronic disability .Aim of our study was to assess the Motor Nerve Conduction in Right and left Median nerve and to assess skeletal muscle strength and endurance in both upper limbs.

In terms of median nerve motor conduction parameters, the hypothyroid group's right and left median nerve conduction velocities (m/s) were lower than those of the control group, but this difference was not statistically significant. This study was comparable to one conducted by Jalilzadeh SH et al[6], who looked into how peripheral nerve function was affected by subclinical hypothyroidism.They conducted electro diagnostic studies on the deep peroneal, tibial, median, and ulnar nerves, and they found no appreciable changes in peripheral nerve function in patients with subclinical hypothyroidism.

Patients who had had the condition for more than five years were more likely to develop neuropathy, although these results were not statistically significant. There was no association between the level of thyroid stimulating hormone in the serum and the development of neuropathy. Five of the thirty participants in my study who had been there for more than five years developed bilateral median nerve neuropathy. Similar to the studies mentioned before, there was an association between the length of the illness and the development of neuropathy. In contrast to a study by SS Karne et al. [7] my research found a link between thyroid function tests and neuropathy in the right median nerve.

In contrast to my study, Satish Waghmare et al , Ahmad Faraz et al , Ashwini A Mahadule et al in their study found that significant reduction in nerve conduction velocity in hypothyroid than the control group. [8-10]

Although not statistically significant, the hypothyroid group's right and left median nerve CMAP distal latency (m/s) was greater than that of the control group. The distal latency increased along with the duration of hypothyroidism. A study by Ashwini A. Mahadule et al. [10] on motor conduction measures in newly diagnosed and untreated hypothyroidism found a statistically significant correlation between the duration of hypothyroidism and delayed distal latency in the right median nerve. Significantly longer distal motor latencies, smaller CMAP amplitudes, and

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delayed MNCV for bilateral median, ulnar, and posterior tibial nerves were observed in hypothyroid patients.

There was no decrease in the amplitude of CMAP in the hypothyroid group when comparing the amplitude (mv) of right and left median nerve CMAP in the hypothyroid group to the control group. However, the amplitude of the CMAP in the median nerve decreased as the hypothyroidism's duration increased. However, there was no statistically significant relationship between the length of hypothyroidism and the amplitude reduction. SS Karne et al.'s investigation was comparable to this observation. [7]

Although not statistically significant, the hypothyroid group's handgrip strength (kg) in both the right and left upper limbs was less than that of the control group. The hypothyroid group's handgrip endurance (Sec) in both the right and left upper limbs was statistically substantially lower than that of the control group. Handgrip endurance decreases with increasing length; nonetheless, this negative correlation was not statistically significant.

Reduced handgrip strength (HGS) and significant hand grip endurance (HGE) in the hypothyroid group suggest myopathy, which is consistent with a study by R F Duyff et al.[11] that assessed muscle weakness in patients with hypothyroidism and hyperthyroidism. In contrast to hypothyroidism, which is more difficult to cure and suggests myopathy, the neuromuscular symptoms appeared quickly and early in the course of the condition, were severe, and disappeared entirely with treatment.

Madariaga MG et al,[12] has done review of hypothyroidism cases for twenty five years. Type II fiber atrophy, type I fiber hypertrophy, central nuclei disposition, necrosis, increased percentage of type I fibers, decreased percentage of type II fibers, inflammatory infiltration, and the presence of core-like structures were the most frequently observed findings in the thirty-two cases they reviewed for polymyositis-like syndrome. This is comparable to my research, which found a negative relationship between handgrip endurance and thyroid stimulating hormone.

Peripheral neuropathy is caused by metabolic changes brought on by hypothyroidism [13]. When there is damage to the mitochondria, oxidative metabolism changes and ATP generation decreases. Peripheral neuropathy results from altered axonal transport brought on by decreased adenosine triphosphate (ATP) owing to decreased ATPase activity and decreased Na+/K+ pump activity. These modifications first impair the nerve's ability to operate, and then they cause structural changes [14].

Entrapment neuropathy in hypothyroidism may arise from the mechanical interference of mucinous infiltrations in peripheral nerves with the metabolic exchange of nutrients and catabolic products to and from the neuron.[15]The most common cause of nerve damage in hypothyroidism is median nerve entrapment at the wrist, which results from mucinous debris being deposited in the tissue surrounding the nerve. A change in the distribution of muscle fiber types from fast-twitch to slow-twitch type I fibers is another factor contributing to myopathy in hypothyroidism. Myopathy in hypothyroidism is caused by reduced metabolic function, including impaired glucose metabolism and decreased metabolic turnover.

CONCLUSION

Our findings have led us to the conclusion that hypothyroidism is associated with myopathy and neuropathy of the median nerve. The longer the condition lasts, the more severe the neuropathy and myopathy become. In subjects with elevated TSH levels, the neuropathy and myopathy are more noticeable. When neuropathy is treated and the patient maintains their euthyroid condition, the symptoms return to normal. Even with effective treatment, myopathy's characteristics and the structural alterations in muscles are irreversible.

Early diagnosis of myopathy is crucial to preventing muscle deterioration and ensuring quality of life in hypothyroid individuals, as myopathy develops earlier than neuropathy. Therefore, in an OP setup, handgrip dynamometry combined with skeletal muscular endurance measurement can be utilized as a screening technique to identify patients who are being evaluated for myopathy. This will encourage the patient to follow up frequently and to comply well with treatment.

REFERENCES

1. Faraz A, Singhal S, Hossain MM, Siddiqui SS. Effect of Hypothyroidism on Motor Nerve Conduction Studies: A Cross Sectional Study. Annals of International Medical and Dental Research. 2017; 3:1-4.
2. Waghmare S, Pajai S, Chaudhari AR, Pawar S, Shende V, Sewagram W. Motor neuropathy in hypothyroidism: A case-control study. Health. 2015 Jul;3(3).
3. Charles Robert Harigton et al-Chemistry of thyroxine-Biochem J 1927:21(1:) - 169-183.
4. Ronald C. Hamdy The Thyroid Gland: A Brief Historical Perspective SouthMed J. 2002;95(5).
5. Mahadule AA, Jadhao PS, Phatak MS. Motor conduction parameters in recently diagnosed and untreated hypothyroidism. Annals of neurosciences. 2015 Jan;22(1):6.
6. Jalilzadeh SH, Bahrami A, Eftekharosadat B, Mobasseri M, Pezeshki Z. Peripheral nerve function in subclinical hypothyroidism: A case-control study.International Journal of Endocrinology and Metabolism. 2006 Jan;2006 (2, Spring):78-83.
7. Karne SS, Bhalerao NS. Nerve conduction studies in patients with primary hypothyroidism. Thyroid Research and Practice. 2016 Sep 1;13(3):131.
8. Waghmare S, Pajai S, Chaudhari AR, Pawar S, Shende V, Sewagram W. Motor neuropathy in hypothyroidism: A case-control study. Health. 2015 Jul;3(3).
9. Faraz A, Singhal S, Hossain MM, Siddiqui SS. Effect of Hypothyroidism on Motor Nerve Conduction Studies: A Cross Sectional Study. Annals of

DOI: 10.69605/ijlbpr_13.11.2024.127

International Medical and Dental Research. 2017: 3:1-4.

10. Mahadule AA, Jadhao PS, Phatak MS. Motor conduction parameters in recently diagnosed and untreated hypothyroidism. Annals of neurosciences. 2015 Jan;22(1):6
11. Duyff RF, Van den Bosch J, Laman DM, van Loon BJ, Linssen WH. Neuromuscular findings in thyroid dysfunction: a prospective clinical and electrodiagnostic study. Journal of Neurology, Neurosurgery & Psychiatry. 2000 Jun 1;68(6):750-5
12. Madariaga MG, Gamarra N, Dempsey S, Barsano CP. Polymyositis-like syndrome in hypothyroidism: review of cases reported over the past twenty-five years. Thyroid. 2002 Apr 1;12(4):331-6.
13. Ihsan M. Ajeena et al - Prevalence of Neuromuscular Abnormalities in Newly Diagnosed Patients with Thyroid Dysfunction - American Journal of Research Communication 2013: Vol 1 (3).
14. Karne SS, Bhalerao NS. Nerve conduction studies in patients with primary hypothyroidism. Thyroid Research and Practice. 2016 Sep 1;13(3):131.
15. Sindoni A, Rodolico C, Pappalardo MA, Portaro S, Benvenga S. Hypothyroid myopathy: A peculiar clinical presentation of thyroid failure. Review of the literature. Reviews in Endocrine and Metabolic Disorders. 2016 Dec 1;17(4):499-519.