Section: Radiology

Original Research Article

EVALUATION ON ULTRASONOGRAPHY OF MEDIAN NERVE IN CARPAL TUNNEL SYNDROME IN PATIENTS WITH HYPOTHYROIDISM: A TEACHING HOSPITAL BASED STUDY

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Abstract

Background: Patients with hypothyroidism frequently develop carpal tunnel syndrome (CTS), a peripheral entrapment neuropathy. Electrodiagnostic (EDX) techniques are typically used to confirm the clinical diagnosis of CTS. **Materials and Methods:** This study comprised 46 people who had been diagnosed with hypothyroidism. At the time of diagnosis and three months after hormone replacement, an electrodiagnostic workup and an ultrasound evaluation of the right and left median nerves were performed. **Result:** There was a significant difference ($P < 0.02$) between the motor and sensory functions of the right and left median nerves before and after therapy. On the right side, the mean CSA-d shifted from 13.6±2.06 mm2 to 10.8±2.02 mm2, while on the left side, it altered from 13.3±2.07 mm2 to 9.8.0±1.21 mm2. The proximal median nerve cross sectional area (CSA-p) change, however, was significantly less statistically significant. **Conclusion:** A noninvasive diagnostic technique that may be utilized to predict the prognosis of CTS is the US measurement of the median nerve cross sectional area.

INTRODUCTION

Patients with hypothyroidism frequently suffer from musculoskeletal issues,[1] and the most prevalent compression syndrome affecting the upper extremities is carpal tunnel syndrome (CTS).[2] Patients with hypothyroidism frequently develop carpal tunnel syndrome (CTS), an entrapment neuropathy. In the general population, the frequency is believed to be between 1% and 5%, with a higher prevalence among women and those over 55.[3] Certain features of peripheral nerves, including decreased expression of the key myelin proteins, demyelination, loss of myelinated and unmyelinated fibers, and delayed regeneration, have been demonstrated to be profoundly impacted by aging.[4] In order to avoid irreversible consequences, early diagnosis is necessary. Clinical symptoms (such numbness, nocturnal paresthesia, and pain in the median nerve region) and signs (like Tinel, Phalen, and Reverse Phalen signals) are typically indicative of CTS.[5] Electrodiagnostic investigations, the diagnostic reference standard test, are required to validate the diagnosis. Additionally, it is carried out to rule out alternative diagnoses and assess the severity of CTS, which is a crucial element influencing the course of treatment and long-term results.[6] Age-related changes in the electrophysiological properties of nerves include decreased conduction velocities when comparing young and middle-aged individuals. As a result, the typical values of nerve conduction study (NCS) measurements and EDX characteristics fluctuate slightly with age. There is an increasing tendency for alternative diagnostic techniques because EDX is costly, time-consuming, and has a high rate of false-positive and false-negative outcomes.[7] Ultrasonography (US) has demonstrated its potential utility in this disease in a number of investigations. US is a practical, easy, quick, accurate, affordable, and noninvasive technique that is being utilized more and more to diagnose CTS.[8,9] This study proposes to assess the evaluate the efficacy of ultrasound in newly diagnosed hypothyroid patients suffering from median nerve entrapment before and after hormone replacement therapy.

MATERIALS AND METHODS

This present study was carried in the department of Radiology, World College of Medical Sciences Research and Hospital during the period from January, 2022 to December, 2022 . This study comprised 46 CTS patients who also had hypothyroidism. None of these patients received

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medical therapy for hypothyroidism because their diagnosis was recent. The study excluded patients with a family history of neuropathy, a history of wrist fractures, a history of prior wrist surgeries and injections, and patients with other causes of neuropathy, such as diabetes mellitus, alcoholism, liver and kidney disease, the use of drugs known to cause neuropathy, cancer, or other serious illnesses.

Biochemical and pathological analysis: Measurements were made of the following laboratory tests: complete blood count, urea, creatinine, and random blood glucose; liver enzymes; electrolytes; vitamin B12; and folic acid. To rule out other potential causes of neuropathy, testing were conducted at the beginning of the trial, and every test came back normal. TSH, free T3, and free T4 levels were assessed. According to established procedures and median nerve ultrasonography, patients with FT4 levels below 10.8 pmol/ml and TSH values above 5.4 uIU/ml were diagnosed with hypothyroidism and had the initial electrodiagnostic test. Following their attainment of euthyroid status, all patients were monitored monthly for FT4, FT3, and TSH levels for three months. They were then given the proper dosages of thyroxine to treat hypothyroidism. Patients had an ultrasound examination at the end of this time. Patients sat with their arms extended, hands supine, wrists flat on a surface, and fingers semiflexed, close to the examiner. Other than the probe's weight, no extra effort was used to prevent any artificial nerve distortion. The median nerve's cross-sectional area (CSA) was measured at the proximal forearm (CSA-P) and distal wrist (CSA-D). By drawing a continuous line around the inner hyperechoic rim of the median nerve with electronic calipers, the CSA of the median nerve was measured at the proximal inlet of the carpal tunnel, at the level of the pisiform bone as a landmark, and 12 cm proximal in the forearm [10]. The average value of the three measurements of the CSA was used for analysis. It was forbidden for the examining radiologist to inquire about the patients' symptoms. The referral neurologist's written request that the patient be checked for median nerve thickness was the only information given to the examining radiologist. Without knowing the outcomes of the clinical and electrodiagnostic tests, the ultrasound evaluation was carried out. SPSS-20 Statistics was used to conduct the statistical analysis. Mean ± standard deviations are used to report all data. The pre- and post-treatment values were compared using the Paired-Samples T Test. To assess differences between more than two sets of nonparametric data, Kruskal-Wallis H was employed.

RESULTS

The patients in Figure 1 were 20 females with a mean age of 55.4±12.32 years, ranging from 26 to 66 years, and 26 males with a mean age of 56.6±12.34 years, ranging from 29 to 70 years.

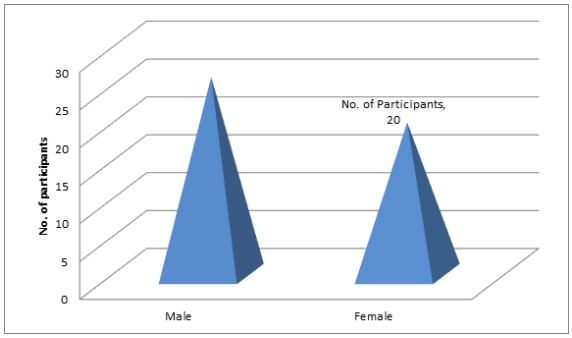

Figure 1: Shows the no. of participants a/c to gender.

Following the creation of a euthyroid state, the distal median nerve cross sectional area (CSA-d) decreased statistically significantly, according to the ultrasonographic evaluation. On the right side, the mean CSA-d shifted from 13.6±2.06 mm2 to 10.8±2.02 mm2, while on the left side, it altered from 13.3±2.07 mm2 to 9.8.0±1.21 mm2. The proximal median nerve cross sectional area (CSA-p) change, however, was significantly less statistically significant. After three months of restoring a euthyroid condition, 30 patients (65.21%) experienced good clinical and ultrasonographic improvement, but 16 patients (34.78%) did not. Eight (17.39%) of the 16 patients with carpal tunnel syndrome were kept on medical treatment for a long time in order to improve. Conversely, eight patients (17.39%) were referred for carpal tunnel surgery [Table 1]. Compared to patients who were recommended for surgery after partial response to therapy, those who responded to hormonal replacement therapy (HRT) had reduced CSA-d ($p<.005$) on both sides.

Table 1: Shows the response of the participants.

Variables	No of patients		Total
	Male(26)	Female(20)	46
Age in years	56.6±12.34	55.4±12.32	0.12
Respondd to treatment (No of patients)	22 (47.82%)	08 (17.39%)	30 (65.21%)
Required medical treatment (No of patients)	3 (6.52%)	5 (10.86%)	08 (17.39%)
Required surgical treatment (No of patients)	5 (10.86%)	3 (6.52%)	08 (17.39%)

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DISCUSSION

Compression and entrapment of the median nerve at the wrist can result in a variety of symptoms known as carpal tunnel syndrome (CTS). It is the peripheral nerve entrapment syndrome that is most frequently documented.[11] Early and precise diagnosis of median nerve entrapment is essential. Despite being widely used as the diagnostic reference standard approach, electrodiagnostic studies have limitations in diagnosing CTS, which has caused doctors to look for other methods. These days, the US is quickly gaining popularity and usage, mostly due to its easier accessibility, noninvasiveness, affordability, and quick examination periods.[12] The flattening ratio, swelling ratio, bowing of the flexor retinaculum, reduced longitudinal excursion on dynamic testing, and CSA at different levels are only a few of the nerve architecture and biomechanics that US may evaluate.[13] According to several research conducted in the US, over 500,000 carpal tunnel releases occurred in 2006, and 0.2% of all ambulatory care visits were related to CTS.[14,15] According to a previous study, entrapment neuropathy was the most common (35%) in 52% of hypothyroid individuals with peripheral nervous system involvement, while axonal neuropathy was observed in 9% of these patients. Prior to starting hormone replacement treatment, all of the hypothyroid individuals in our study that were chosen had significantly lower FT4 and FT3 levels and much higher TSH levels. Every patient demonstrated electrodiagnostic signs of carpal tunnel syndrome at the time of initial evaluation. Our patients had reduced motor and sensory nerve conduction velocities, lower motor and sensory median nerve amplitudes, and larger sensory and motor distal latencies. According to some research, the majority of people diagnosed with primary hypothyroidism still exhibit carpal tunnel syndrome symptoms and electrophysiological indicators after reaching a euthyroid condition.[16] All of the participants in this study had just received a diagnosis of hypothyroidism and the symptoms and/or indicators of carpal tunnel syndrome. Thirty of the patients had a significant improvement in their symptoms once their thyroid functions were restored with hormonal replacement treatment. This was in line with the findings of Kececi and Degirmenci's study,[7] which showed that following three months of suitable hormone replacement therapy, 13 out of 15 patients with recently diagnosed hypothyroidism linked to carpal tunnel syndrome showed improvement. Additionally, Arafat and his associates,[17] found that after receiving hormone treatment, 84.2% (n=48) of their patients had an improvement in their median nerve functioning, but 15.8% (n=9) of them continued to experience symptoms of carpal tunnel syndrome. The severity, duration, and treatment plans of carpal tunnel syndrome may all have an impact on this diversity in response to treatment. The limitations of electrodiagnostic studies include their inability to visualize intrinsic abnormalities in the nerve, their inability to provide information about structures around the nerve, and their discomfort.[18] High-resolution ultrasonography has been suggested as a helpful diagnostic technique for CTS in recent years.[19] Ultrasonography is appealing for diagnosing CTS since it is widely accessible, inexpensive, noninvasive, and requires less time for testing. The most used ultrasonography technique for diagnosing CTS is the measurement of the median nerve's cross-sectional area (CSA) at the wrist. According to several reports, the median nerve area at the distal wrist crease should be between 7.4 and 9.7 mm2, while the values needed to diagnose CTS should be between 9.2 and 15.4 mm2.[20] There is a range of 72 to 89% for sensitivity and 59 to 98% for specificity. Distal CSA ranged from 9.2 to 17.1 mm2, with the averages for the right and left median nerves in our study being 12.4 and 12.3 mm2, respectively. Additionally, the mean inlet CSA was 8.7 mm2 in healthy controls and 14.6 mm2 in CTS, according to Tengfei et al.[21] Furthermore, Seok et al,[23] discovered that the distal CSA differed considerably from mild, moderate, and severe instances of carpal tunnel syndrome (13.5 mm2, 14.67 mm2, and 18.74 mm2), while Andrea et al,[22] showed that the distal CSA was 16.8 mm2. The distal and proximal CSA of the right median nerve in our study were 13.6±2.06 mm2 and 10.8±2.02 mm2, respectively. The CSA values on the left side were 9.8.0±1.21 mm2 and 13.3±2.07 mm2, respectively. Following hormone replacement, the right side's values were 11.0±1.4 mm2 (distal) and 0.086±.003 mm2 (proximal), whereas the left side's values were 11.0±1.6 mm2 (distal) and 8.2±.0.4 mm2 (proximal). Hormonal management significantly improved the electrophysiology and radiographic results of 30 individuals.

CONCLUSION

In conclusion, after three months of euthyroidism, patients with hypothyroidism can treat their carpal tunnel syndrome with hormonal replacement therapy. We came to the conclusion that the US is a practical, noninvasive test that might be used as a diagnostic technique to look into CTS. The median nerve cross sectional area can be used as a reference to identify people who might benefit from surgery when they have a symptomatic median nerve entrapment.

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