STUDY OF CLINICAL, ELECTROPHYSIOLOGICAL, ULTRASONOGRAPHIC PROFILE IN PATIENTS WITH CARPAL TUNNEL SYNDROME

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ABSTRACT

BACKGROUND

Carpal tunnel syndrome is the commonest entrapment neuropathy where median nerve gets entrapped in the tunnel formed by transverse carpal ligament (which is an unyielding fibrous structure) and carpal bones. Carpal tunnel syndrome prevails among individuals whose occupation need repeated wrist movements and also in certain medical conditions like diabetes mellitus, rheumatoid arthritis and hypothyroidism. Electrophysiological study of median nerve at wrist and ultrasonogram of the wrist helps in diagnosing carpal tunnel syndrome and to plan management.

Aim- To evaluate the clinical, electrophysiological and ultrasonographic profile of patients presenting with symptoms of carpal tunnel syndrome (CTS).

MATERIALS AND METHODS

The study was conducted at Neurology Department, Government Stanley Medical College Hospital between January 2017 and August 2017. All subjects who satisfied the inclusion criteria and given their consent for the study underwent detailed neurological evaluation followed by biochemical investigations, electrophysiological study and ultrasonogram of both wrists. Biochemical investigations done were fasting blood sugar, postprandial blood sugar, thyroid profile, renal function test and rheumatoid arthritis factor. All patients who presented with paraesthesia of hands, mainly tingling or numbness in the median nerve distribution with or without objective signs of Tinel or Phalen were included in the study. Patients who have been previously diagnosed and on treatment for symptoms of carpal tunnel syndrome and other causes of neuropathy were excluded. SPSS software and Chi-square test were used for statistical analysis.

Study Design- A cross-sectional descriptive study.

RESULTS

Most common age group affected was between 40 and 50 years with Female: Male ratio 3: 1 indicating female predilection. Dominant right hand is commonly involved compared to left hand. Type 2 diabetes was found in 30.6% and hypothyroidism was found in 11.3% in the study. In Electrophysiological Study (EPS), moderate grade was found in 50% of the patients. Ultrasonogram of the wrist had positive correlation irrespective of electrophysiological grading.

CONCLUSION

Bilateral carpal tunnel syndrome patients had severe electrophysiological grade with positive correlation with ultrasonogram of wrist helping in deciding the mode of treatment- medical versus surgical.

KEY WORDS

Carpal Tunnel Syndrome, Electrophysiological Study, Median Nerve, Ultrasonogram.

HOW TO CITE THIS ARTICLE: Revathy G, Velusamy S, Jeyaraj MK, et al. Study of clinical, electrophysiological, ultrasonographic profile in patients with carpal tunnel syndrome. J. Evolution Med. Dent. Sci. 2018;7(32):3614-3616, DOI: 10.14260/jemds/2018/811

BACKGROUND

Carpal tunnel syndrome is the commonest entrapment neuropathy with an incidence of 139 per 100,000 person-years for men and 506 per 100,000 person-years for women.⁽¹⁾

'Financial or Other Competing Interest': None.

Submission 22-06-2018, Peer Review 23-07-2018,

Acceptance 30-07-2018, Published 06-08-2018.

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DOI: 10.14260/jemds/2018/811

The clinical features include pain and paraesthesias in the thumb, radial three and half fingers which exacerbate at night.⁽¹⁾ Sometimes, patient may experience paraesthesia extending to shoulder. The classic test of nerve compression include Tinel's (Light percussion over the volar aspect of wrist elicits tingling sensation) and Phalen manoeuvre (Flexion of the wrist to 90 degrees for 30 to 60 secs aggravate paraesthesia).

The definite diagnostic test for CTS is nerve conduction study with high degree of sensitivity, 56% to 86% and specificity 94% to 99%.⁽²⁾ It demonstrates a distal compression of the median nerve and excludes other peripheral conditions resulting in similar symptoms.^(1,3)

Ultrasonogram of the wrist is also used as a diagnostic tool for CTS as it is readily available, non-invasive and helps

to assess various parameters of median nerve like size, vascularity, anatomical variations and surrounding structures.⁽⁴⁾

Aim

To evaluate the clinical, electrophysiological and ultrasonographic profile of patients with carpal tunnel syndrome.

MATERIALS AND METHODS

Study Design

A cross-sectional descriptive study.

Study Population

Patients above 15 yrs. of age who presented to Neurology Department, Government Stanley Medical College Hospital, Chennai with symptoms and signs of paraesthesia and sensory disturbance of radial three and half fingers with or without objective signs of Tinel's and Phalen. The sample size was 62.

All patients above 15 yrs. of age with symptoms of paraesthesia and sensory disturbance of radial three and half fingers and also whole hand with extension to shoulder with or without objective signs of Tinel's and Phalen, who had given informed consent were included in the study.

Patients who have been previously diagnosed and on treatment for symptoms of carpal tunnel syndrome and other causes of neuropathy were excluded.

Methodology

All subjects who satisfied the inclusion criteria and given their consent for the study underwent detailed neurological evaluation followed by biochemical investigations, electrophysiological study and ultrasonogram of both wrists. Biochemical investigations done were fasting blood sugar, postprandial blood sugar, thyroid profile, renal function test and Rheumatoid Arthritis factor. Electrophysiological test.⁽⁵⁾

a. Median motor study recording abductor pollicis brevis. Stimulating wrist and antecubital fossa
b. Ulnar motor study recording abductor digiti minimi. Stimulating at wrist and elbow
c. Median and ulnar F responses
d. Median sensory response, recording digit 2, stimulating at wrist
e. Ulnar sensory response, recording digit 5, stimulating at wrist
Table 1. Parameters of Nerve Conduction Study Recorded

Nerve Conduction Studies- Normal Adult Values

Median Studies	Comparison Studies
Prolonged distal motor latency > 4.4 ms	Difference between distal motor latency of median and ulnar nerves > 1.1 ms
Prolonged sensory (digit 2) latency > 3.5 ms	Difference between sensory latency of median and ulnar nerves > 0.2 ms
	Difference between median and ulnar digit 4 sensory latencies $\geq$ 0.5 ms
Table 2. Electrophysiological Parameters taken to confirm CTS	

Mild CTS	Prolongation of sensory latency and decrease in the amplitude of median sensory nerve action potential
Moderate CTS	Prolongation of distal latency of median motor nerve in addition to mild CTS criteria
Severe CTS	Absence of sensory potential, prolongation of distal latency and decrease in the amplitude of median motor nerve
Table 3. Electrophysiological Grading of CTS⁽⁶⁾	

Ultrasonogram of Wrist

All the patients underwent ultrasonogram of wrist. Real time high resolution ultrasonogram (Esaote MyLab 6) with 7.5 MHZ linear array transducer were used in the study. Patients were made to sit at a comfortable position facing the radiologist with forearm resting on the table with palm facing up. Median was assessed in transverse and longitudinal planes in the carpal tunnel by references to anatomical landmarks- pisiform bone or the hook of the hamate or the distal wrist crease. The US criteria⁽⁷⁾ we use for diagnosing the median nerve compression at the carpal tunnel include increased cross-sectional area proximally to the compression site, usually at the level of the proximal pisiform bone (Normal cross-sectional area of the median nerve is not greater than 9 mm²) nerve flattening (in the transverse section the nerve is at least 3 times wider than it is thickness) and lower echogenicity.

RESULTS

A total of 62 patients above age 15 yrs. were taken up in the study after applying inclusion and exclusion criteria. Majority of patients were in age group between 41 and 50 yrs. followed by 31 to 40 yrs. and then above 50 yrs. Among 62 patients, 15 (24.2%) were males and 47 (75.8%) were females which indicate female predilection. Paraesthesia was the commonest symptom and it was present in 57 patients (91.9%). Tinel's sign was present in 28 (45.2%) patients and Phalen sign in 26 (21.9%) patients. Among 62 patients, 19 (30.6%) were diagnosed with type 2 diabetes, 7 (11.3%) were hypothyroid, 6 (9.7%) were positive with Rheumatoid arthritis and 3 (4.8%) were diagnosed with renal failure.

Out of 62 patients, 18 (29%) patients had CTS in right hand, 12 (19%) had left CTS and bilateral CTS in 14 (23%) and normal electrophysiological study were present in 18 (29%) out of 62 patients. In bilateral CTS, 12 (85.7%) were females and 2 (14.2%) were males. In right hand CTS, females were 14 (77.8%) and 4 (14.8%) were males and in left hand CTS females were 9 (75%) and 3 (25%) were males.

Age Group (Years)	Number (n)
Above 50	11
41-50	33
31-40	18
Table 4. Showing Age distribution of Study Population	

All patients who had abnormal electrophysiology of CTS had increase in cross-sectional area with right hand CTS, left hand CTS and bilateral CTS.

Electrophysiological Grading	Right Hand (n=18)	Left Hand n=12	Bilateral n=14
Mild	8 (44%)	4 (33%)	-
Moderate	6 (33%)	6 (50%)	6 (43%)
Severe	4 (22%)	2 (17%)	8 (57%)
Table 5. Electrophysiology Study of CTS Patients			

There was 100% correlation ($p < 0.05$) between electrophysiological and ultrasonographic increase in cross-sectional area with right hand CTS, left hand CTS and bilateral CTS irrespective of electrophysiological grading of CTS which is statistically significant.

Ultrasound Parameter	Number (n)
Increased cross-section area of median nerve	44
Nerve flattening	35
Lower echogenicity	36

Table 6. Ultrasonographic Study of CTS Patients

DISCUSSION

A total of 62 patients (88 hands) were included in the study as having carpal tunnel syndrome clinically. Majority of patients affected were in age group of 40 to 50 years followed by 30 to 40 years with female predominance compared to male and male: female ratio was 1: 3. In a study by Vinay et al,⁽⁸⁾ the mean age was 44.21 years with female predominance (M: F 3: 11) and also in a study by Kasundra et al,⁽⁹⁾ mean age was 43.9 ± 4 years and male: female ratio of 13: 79 which was similar in our study.

Commonest symptoms were nocturnal paraesthesia and numbness over radial 3 and half fingers which were present in 91% of patients with Tinel's sign in 45.2% and Phalen's in 41.9%. In a study by Kasundra GM et al,⁽⁹⁾ Tinel's test was present in 78.5% and Phalen's test was positive in 84.9%. In a study by Tay LB et al,⁽¹⁰⁾ 70% of patients showed nocturnal paraesthesias.

Majority of patients (43.5%) had no specific cause. Type 2 Diabetes Mellitus (DM) was present in 30.6%, 11.3% were hypothyroid, 9.7% were positive with Rheumatoid arthritis and 4.8% were diagnosed with renal failure which was similar to study done by Hussein Mohammed Malibary et al.⁽¹¹⁾ DM was the most common associated disease to CTS 35.9% followed by hypothyroidism 14.1%.

Commonest electrophysiological grading in the study was moderate grade, while severe grading of CTS is noted in patients with bilateral CTS.

In our study, ultrasonogram showed increase in cross-sectional area of median nerve at wrist in all 44 (100%) patients, which had abnormal electrophysiological study suggestive of CTS. Sharma M et al from Chandigarh⁽¹²⁾ and Min-Kyu Kim et al⁽¹³⁾ have studied the role of ultrasonography in diagnosis of carpal tunnel syndrome and found that there was high degree of correlation between ultrasonography and electrophysiological parameters in patients with CTS. Kapuścińska et al also reported that all patients in their study ($n = 62$) had median nerve compression in ultrasonographic study.⁽¹⁴⁾ Limitations in the study were small sample size and early CTS could have been diagnosed using combined sensory index, which was not measured in the present study.

CONCLUSION

Electrophysiological study is the gold standard in diagnosing and grading the severity of CTS. Most common electrophysiological abnormality with bilateral CTS is absent median sensory nerve action potential. Ultrasonogram of the wrist showing increase in cross-sectional area of median

nerve irrespective of severity of electrophysiological grading of CTS. Ultrasonogram also helps to rule out structural lesions like ganglion or neuroma and to decide on medical versus surgical treatment.

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