

ELECTRO-PHYSIOLOGICAL PATTERN AND SEVERITY GRADING OF CARPAL TUNNEL SYNDROME

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Abstract

Background: Carpal Tunnel Syndrome (CTS) is a constellation of symptoms and signs caused by entrapment of the median nerve at the wrist. Nerve Conduction Study (NCS) serve as an objective supplementary modality in the diagnosis of CTS and is used for severity assessment with high degree of sensitivity and specificity. Severity assessment is a crucial step for defining prognosis of CTS.

Methodology: The study was a hospital based observational cross sectional study and was conducted in the department of Neurology, DMCH on 50 patients with clinical diagnosis of CTS with electro-physiological confirmation from July, 2017 to June, 2019. Equal number of age and sex matched healthy people were included in the study. All the cases had clinical evaluation and standardized electrophysiological studies of upper limbs using the same protocol.

Result: The mean age of CTS patients was 43.06 (± 10.54) years and majority of the them were female (74%). In patients with CTS, electrophysiological study of median nerve revealed the following mean value MDL=5.98 \pm 1.63 ms, SDL=4.24 \pm 0.59 ms, CMAP = 6.16 \pm 3.22mv, MNCV = 54.46 \pm 6.76 m/s, SNAP = 11.65 \pm 13.42 μ V. In Comparison to mild to moderate CTS other than CMAP, all other parameters have significant changes. In case of moderate to severe grade of CTS, all the parameters have significant changes. Amongst the 50 CTS patients, there was bilateral involvement in 21 (42%) and unilateral involvement in 29 (58%) patient. According to electrophysiological grading, 15 (21%) were in mild group; 35 (49%) were in moderate group and 21 (30%) were in severe group. According to the clinical grading, 31 (44%) were in mild group, 25 (35%) in moderate and 15 (21%) were in severe group.

Conclusion: From this study it could be concluded that CTS is more common in female. Sensory symptoms and dominant (right) hand involvement were more common. NCS provides additional and independent objective evidence in the diagnosis and severity assessment of CTS patients. Assessment of severity in CTS patients is a crucial step for defining prognosis and therapeutic measures.

Key words: Carpal Tunnel Syndrome (CTS), Nerve Conduction Study(NCS)

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Introduction:

Carpal Tunnel Syndrome (CTS) is a constellation of symptoms and signs caused by entrapment of the median nerve at the wrist. It is the most common form of all entrapment neuropathy and is one of the most frequent reasons for referral for an electro diagnostic study¹. The commonest early symptom is intermittent tingling, paresthesia of the palmar aspect of first three

and half fingers and lateral 2/3 rd. of the hand on the affected side. Nocturnal paresthesia is particularly common. Women are affected more often than men^{2,3}. The dominant hand is usually affected first and more severely affected^{1,4}.

Nerve Conduction Study (NCS) provides a quantitative measurement of the of median nerve physiological function. It confirms median neuropathy at wrist and can also assess the

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severity. Severity assessment of CTS is important for defining prognosis and therapeutic measures. NCS are being increasingly used for severity assessment with high degree of sensitivity and specificity.

The aim of this study was to see the pattern of clinical and electrophysiological grading of CTS patients who presented at the department of Neurology, Dhaka Medical College Hospital.

Materials and Method:

The study was a hospital based observational cross sectional study and was conducted in the department of Neurology, DMCH from July, 2017 to June, 2019. Fifty (50) patients with clinical diagnosis of CTS with electro-physiological confirmation and equal number of age and sex matched healthy people were included in the study. Informed written consent was taken and ethical issues were ensured. For each case, relevant history was taken and physical examination was done. Relevant demographic and clinical data were recorded in a predefined data sheet.

NCS of upper limb was done in every case with a NK MEB 2002 machine. Motor and sensory NCS of median and ulnar nerves were done for every patient. The parameters for evaluation of the state of CTS were (1) median motor distal latency (MDL), (2) median compound muscle action potential (CMAP), (3) median sensory distal latency (SDL), (4) median sensory potential amplitude (SNAP), (5) median motor conduction velocity (MCV). The patients were diagnosed electro-physiologically positive CTS patients on the basis of “reference value” which were calculated from the mean data of normal healthy people ± 2SD.

MacKinnon’s Clinical severity grading ⁵:

- Mild** Presence of only sensory symptoms (pain, paresthesia and/or numbness).
- Moderate** Presence of motor symptoms (weakness).
- Severe** Presence of muscle wasting.

Electro-physiological Grading of CTS:

It was done using the **American Association of the Electro Diagnostic Medicine (AAEM)** criteria ⁶:

- Mild CTS:** Prolonged median distal sensory latency with ± decreased sensory amplitude.
- Moderate CTS:** Abnormal median sensory latency with prolongation of distal motor latency.
- Severe CTS:** Prolonged motor and sensory distal latency either with a low or absent SNAP or CMAP.
- Very severe:** Sensory or motor potentials effectively unrecordable.

Data were analyzed by computer with the help of SPSS (Statistical Package for Social Sciences) version 23.0. Statistical analyses were done by using appropriate statistical test like ‘chi-square’ test and student ‘t’ test, where applied. Statistical significance is set at 0.05 level and confidence interval at 95% level.

Results

The study was carried out by 50 normal healthy people (Group-1) and 50 CTS patients (Group-2). The mean age of Group-1 was 40.54 (±14.89) years and Group-2 was 43.06 (±10.54) years. Amongst the 50 CTS patients, majority were female (74%) and only 26% were male.

Table-I
Age Distribution of CTS patients and normal healthy people

Age Group (Years)	Group-1 (n=50)		Group-2 (n=50)		p-value
	Number	Percentage (%)	Number	Percentage (%)	
18 – 30	15	30	09	18	>0.05
31 – 40	11	22	11	22	
41 – 50	09	18	19	38	
51 – 60	12	24	10	20	
> 60	03	06	01	02	
Total	50	100	50	100	
Range (Years)	19 – 80	20 - 70	Mean±SD (Years)		40.54 ±
14.89	43.06 ± 10.54				

Table-II
Sex Distribution of CTS patients and Normal healthy people

Variable	Group-1 (n=50)		Group-2 (n=50)		p-value
	Number	Percentage (%)	Number	Percentage (%)	
Male	19	38	13	26	
Female	31	62	37	74	> 0.05
Total	50	100	50	100	

Tingling of the hand was found to be the most common symptom being present in 49 (98%) patients followed by paresthesia in 40 (80%),

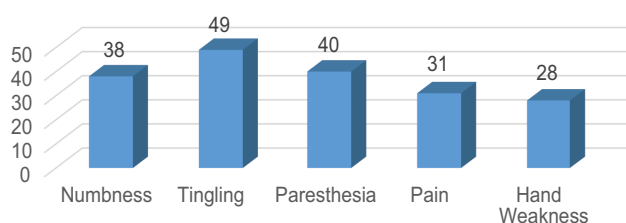


Fig-1: *Clinical symptoms of the CTS Patients (n=50)*

numbness in 38 (76%), pain in 31 (62%) and hand weakness in 28 (56%) patients. Phalen's sign of the hand was found to be the most common sign being present in 32 (64%) patients followed by Tinel's sign in 28 (56%) and muscle wasting was found in 11 (22%) patients.

Comparison of the NCS variables between CTS patients and normal healthy people shows that there was highly significant difference ($p < 0.001$) between two groups regarding median nerve MDL, CMAP, MNCV, SDL and SNAP. (Student 't' test was done)

Table-III
Comparison of the NCS Variables between Group-1 (n=50) and Group-2 (n=50)

Variables		Group-I		Group II		p-value
		Mean	SD	Mean	SD	
MEDIAN	MN MDL (ms)	3.47	0.39	5.98	1.63	< 0.001
	MN CMAP (mV)	9.0	2.11	6.16	3.22	< 0.001
	MN MNCV (m/s)	58.56	4.84	54.46	6.76	< 0.001
	MN SDL (ms)	2.56	0.34	4.24	0.59	< 0.001
	MN SNAP (iV)	46.57	12.31	11.65	13.42	< 0.001
ULNAR	UN MDL (ms)	2.51	0.32	2.43	0.24	> 0.05
	UN CMAP (mV)	7.99	1.88	8.19	2.02	> 0.05
	UN MNCV (m/s)	61.08	6.12	61.2	6.21	> 0.05
	UN SDL (ms)	2.21	0.35	2.06	0.23	> 0.05
	UN SNAP (iV)	43.09	13.67	38.60	15.30	> 0.05

Hand involvement in CTS Patients revealed bilateral involvement in 21 (42%) and unilateral involvement in 29 (58%) patient. So, the total number of hands with CTS were 71. Right hand was involved in 41 (57.7%) and the involvement of left hand was in 30 (42.25%).

Table-IV

Hand Involvement of CTS Patients (n=71)

Hand Involved	Right hand	Left Hand	Total
Unilateral	20	09	29
Bilateral	21	21	42
Total	41	30	71

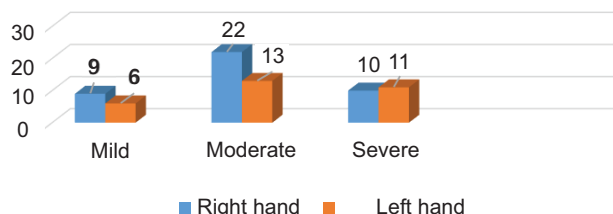


Fig.-2: Severity grading of CTS patients in right and left hand (n=71)

Severity grading of right and left hand revealed 15 (21%) were mild where 09 were in right hand and 06 were in left hand; 35 (49%) were moderate where 22 were in right hand and 13 were in left hand; 21 (30%) were severe where 10 were in right hand and 11 were in left hand.

Electrophysiological Severity grading of CTS patients and their significance. In Comparison to mild to moderate CTS other than CMAP, all other parameters have significant changes. In case of moderate to severe grade of CTS, all the parameters have significant changes. (Student ‘t’ test was done)

Table-V

Electrophysiological Severity grading of CTS patients and their significance (n=71)

Variable	Mild		Moderate		‘p’ value
	Mean	SD	Mean	SD	
MDL (ms)	4.08	0.53	5.78	0.77	< 0.05
CMAP (mV)	7.91	2.57	7.40	2.12	> 0.05
MNCV (m/s)	52.36	5.07	55.91	4.44	< 0.05
SDL (ms)	4.04	0.48	4.38	0.64	< 0.05
SNAP (iV)	21.54	14.91	16.72	11.12	< 0.05

Variables	Moderate		Severe		‘p’ Value
	Mean	SD	Mean	SD	
MDL (ms)	5.78	0.77	7.81	2.1	< 0.05
CMAP (mV)	7.40	2.12	4.25	2.66	< 0.05
MNCV (m/s)	55.91	4.44	42.31	20.62	< 0.05
SDL (ms)	4.38	0.64	0	0	< 0.05
SNAP (iV)	16.72	11.12	0	0	< 0.05

Clinical grade of 50 patients with 71 proved CTS hand, 31 (44%) were in mild grade, 25 (35%) in moderate and 15 (21%) were in severe grade.

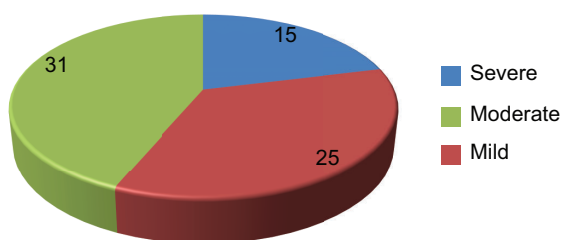


Figure 3: Distribution of Clinical Grading of CTS (n=71)

Discussion

The present study was designed to find out the electro-physiological pattern and severity grading of carpal tunnel syndrome (CTS). In this study, total number of participants were 100, with 50 clinically and electro-physiologically confirmed CTS patients and 50 healthy people. The mean age of CTS patients was 43.06±10.54 years and the highest age group was in the 41-50-year age group (38%). Majority of CTS

patients in this study were female (74%) with a male to female ratio of 1:3. Srikanteswara, P.K. et al. showed the mean age at presentation was 49.68 ± 11.7 years ranged from 25 to 81 years, majority of the them were female (78%), with a male to female ratio of 1: 3.5 ⁷.

In this study, tingling of the hand was found to be the most common symptom being present in 49 (98%) patients. Phalen's maneuver was the most common sign present in 32 (64%) patients followed by Tinel's sign in 28 (56%) and muscle wasting was found in 11 (22%) patients. Abdalla, S.F. et al (2017) in their study stated that out of 671 patients with CTS, paresthesia was reported by 339 patients (70%) ⁸.

This study revealed there was bilateral involvement in 21 (42%) and unilateral involvement in 29 (58%) patients. So, the total number of hands with CTS were 71. Right hand (dominant) was involved in 41 (57.7%) and the involvement of left hand was in 30 (42.25%). Khan, M.W.A. (2015) examined 90 patients with CTS and found bilateral CTS in 36(40%) and unilateral CTS in 54(60%). Dominant hand involvement was present in 82 patients (91.1%) ⁹.

Regarding NCS variables of median nerve of 50 normal healthy people, the mean value was as following MDL= 3.47 ± 0.39 ms, SDL= 2.56 ± 0.34 ms, CMAP = 9.0 ± 2.11 mv, MNCV = 58.56 ± 4.84 m/s and SNAP = 46.57 ± 12.31 iV. The reference value was taken from mean ± 2 SD as the normal highest/lowest limit of the normal. Naseem et al. 2016 described the normative data of upper limb motor nerve conduction in Northern Kerala population on 125 males and 125 female normal healthy people. They found median motor CMAP = 9.66 ± 2.32 mV, MDL= 3.15 ± 0.18 ms and MNCV= 57.0 ± 1.97 m/s ¹⁰.

In this study NCS variables of median nerve in CTS patients revealed that the mean revealed MDL= 5.98 ± 1.63 ms, SDL= $4.24 \pm .59$ ms, CMAP = 6.16 ± 3.22 mv, MNCV = 54.46 ± 6.76 m/s and SNAP = 11.65 ± 13.42 iV. Analysis shows that there was highly significant difference ($p < 0.001$) between two groups regarding median nerve MDL, CMAP, MNCV, SDL and SNAP. These results are consistent with the study done by Murthy and Meena 1999 ¹¹.

Electrophysiological Severity grading of CTS of this study, patients were categorized into mild,

moderate and severe according to operational definition. In mild cases, MDL = 4.08 ± 0.53 ms, CMAP = 7.91 ± 2.57 mV, MNCV = 52.36 ± 5.07 m/s, SDL = 4.04 ± 0.48 ms and SNAP = 21.54 ± 14.91 iV. In moderate cases, MDL = 5.78 ± 0.77 ms, CMAP = 7.40 ± 2.12 mV, MNCV = 55.91 ± 4.44 m/s, SDL = 4.38 ± 0.64 ms and SNAP = 16.72 ± 11.12 iV. In Severe grading, MDL = 7.81 ± 2.1 ms, CMAP = 4.25 ± 2.66 mV, MNCV = 42.31 ± 20.62 m/s. In comparison to mild to moderate CTS, other than CMAP, all other parameters have significant changes ($p < 0.05$). In case of moderate to severe grade of CTS, all the parameters have significant changes ($p < 0.05$).

Out of 71 hands, 15 (21%) were in mild grade; 35 (49%) were in moderate grade; 21 (30%) were in severe grade. Ogura T. et al. (2003) found in their study, 60 upper limbs of 37 patients with idiopathic CTS were examined, the grading of CTS was mild in 21 upper limbs, moderate in 21 upper limbs, and severe in 18 upper limbs ¹².

Conclusion

From this study it could be concluded that CTS was more common in female. Sensory symptoms and dominant (right) hand involvement were more common. NCS provides an additional and independent objective evidence in the diagnosis and assessment of severity of CTS patients. Assessment of severity of CTS is important for defining prognosis and therapeutic measures. There should be nationwide large scale study to find out the electro physiological pattern and severity grading of CTS.

Limitations

Sample size is relatively small in relation to huge number of populations in Bangladesh and may not reflect the exact picture of the country. As purposive sampling technique was used, there was more chance of selection bias and further follow up could not be done.

Ethical Issues and Conflict of Interest

The study was approved by Ethical Committee of Dhaka Medical College Hospital. No conflict of interest was declared by the authors regarding the study.

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