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Nerve Conduction Response by Using Low-Dose Oral Steroid in the Treatment of Carpal Tunnel Syndrome (CTS)

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Abstract: ***Introduction:*** *Now a day's Carpal tunnel syndrome is the most common entrapment neuropathy. The carpal tunnel syndrome (CTS) is a medical condition that caused by compression of the median nerve as it travels through the wrist at the carpal tunnel.*

Objectives: *The main objective of the study is to find out that short-term low-dose oral steroid is effective in the conservative treatment in mild to moderate carpal tunnel syndrome by evaluating nerve conducting responses.*

Methodology: *This is a prospective case-control study. The study place was Department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU). Duration of the study was one year. There were two groups of samples. One group of 30 patients were designated as control and another group of 30 patients designated as cases. Both the groups were matched in respect to age and sex and CTS symptoms for more than 3 months.*

Results: *After treatment [(MN MDL - right side: control 4.9% and cases 10.68%, left side: control 10.26% and cases 10.43%) (CMAP - right side: control 13.88% and cases 23.98%; left side: control 13.22% and cases 23.91%)] with P value of < 0.001 in both control and cases except left control subjects -P>0.50. As well as, there was also significant percent change from before to after treatment [(MN SDL - right side: control 5.3% and cases 13.98%; left side: control 4.45% and cases 13.98%) (SNAP - right side: control 6.54% and cases 13.19%; left side: control 5.44% and cases 1.36%)] with P value of < 0.001 in both control and cases which were highly significant.*

Key Words: *Nerve Conduction Response, Low-Dose Oral Steroid, Carpal Tunnel Syndrome (CTS)*

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I. Introduction

The carpal tunnel is a passageway of the wrist on the palmer side which is connected to the forearm to the hand. The carpal tunnel syndrome (CTS) is a medical condition that caused by compression of the median nerve as it travels through the wrist at the carpal tunnel. The carpal tunnel syndrome occurs when the tunnel becomes narrowed or when tissues surrounding the flexor tendons swell, putting pressure on the median nerve. These tissues are called the synovium. The Signs and symptoms are numbness, pain and tingling. The most common early symptom of CTS is the intermittent tingling paraethesia of the palmar aspect of the first three and half digits and lateral two-thirds of the hand of the affected side.

At present Carpal tunnel syndrome is the most common entrapment neuropathy. The other less common forms of entrapment of neuropathies are cubital tunnel syndrome (cubital tunnel syndrome is a condition that involves pressure or stretching of the ulnar nerve at the elbow. It is also known as the "funny bone" nerve), tarsal tunnel syndrome (tarsal tunnel syndrome is a compression neuropathy and painful foot condition), meralgia paraesthetica (Meralgia paresthetica is pain or numbness in the outer thigh. It does not caused by injury to the thigh, it causes by injury to a nerve that extends from the spinal column to the thigh) and so on.

Women are three times more susceptible to carpal tunnel syndrome than men. The prevalence of CTS in general western European population has been estimated to be at 3% to 5.8% for women and 0.6% to 2.1% for men. . The prevalence of CTS in general western European population has been estimated to be at 3% to 5.8% for women and 0.6% to 2.1% for men

This disease affect the dominant hand first the tingling of hand becomes more continuous as the disease progress, frequently associated with pain of the affected hand, and ultimately wasting of muscles on the palm

and weakness of the grip. The known associated conditions and diseases for CTS are female sex, obesity, pregnancy and acromegaly, hypothyroidism, rheumatoid arthritis and repeated use of vibrating hand tools, though in many cases there are none. Persons with diabetes or other metabolic disorders are also at high risk of CTS. Usually CTS affects only the adults.

Treatments are available for CTS, such as medications or surgeries. There are also many therapeutics approaches, such as conservative which is avoiding excess use of hand as CTS got worse by work performed with affected hand, use of splint, oral steroid, local steroid, diuretics, and oral pyridoxine therapy. CTS patients should avoid repetitive wrist and hand motions and if possible they should not use vibratory tools. In a study, Kanaan and Sawaya (2001) observed that approximately 80% of patients with CTS initially respond to oral steroids. Surgery should be considered when CTS does not respond to conservative measures. It has been reported that patients who consume alcohol portend a poorer outcome after surgery.

Nerve conduction studies (NCS) is considered as the most effective diagnostic tool for CTS due to its high sensitivity and specificity[1]. As these studies are being a great utility for outcome comparisons, they are also appropriate for excluding other diagnoses as well[2]. The effect of aging upon the peripheral nervous system has been studied and it is well known that aging modifies all nerve conduction parameters, including amplitude, latency, and conduction velocity[1]. However, it was also observed those patients with severe CTS or no abnormalities on baseline nerve conduction study (NCS) had poorer results after surgery also observed that older patients and factors, such as poor mental health, significant alcohol consumption, longer disease duration and male gender, also portend a poorer outcome after surgery. Considering all this observations this research is done to see the low dose of steroids is effective on carpal tunnel syndrome or not through the response in nerve conduction studies.

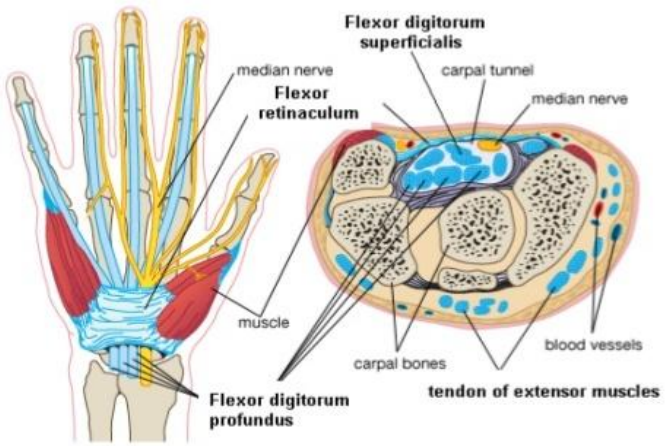

Figure: 01: Anatomy of Carpal Tunnel. Palmer view and cross sectional of the wrist

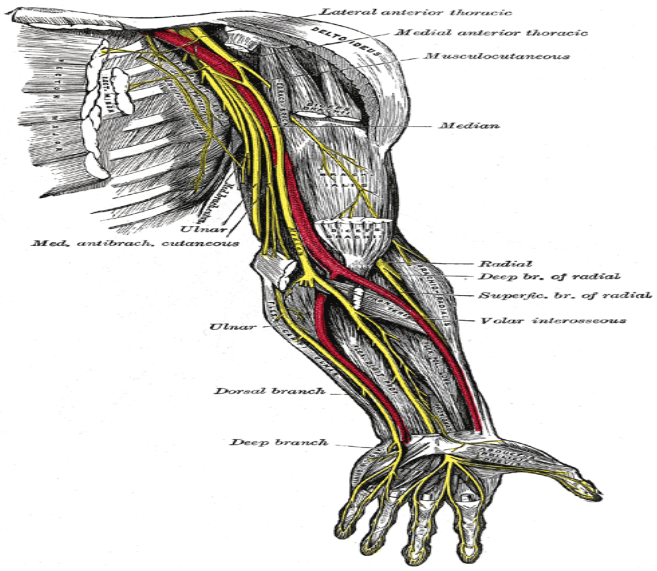

Figure: 02: The nerves of the upper limb dissected from the anterior aspect, showing the course of median and ulnar nerves, their branches and their relation with other structures.

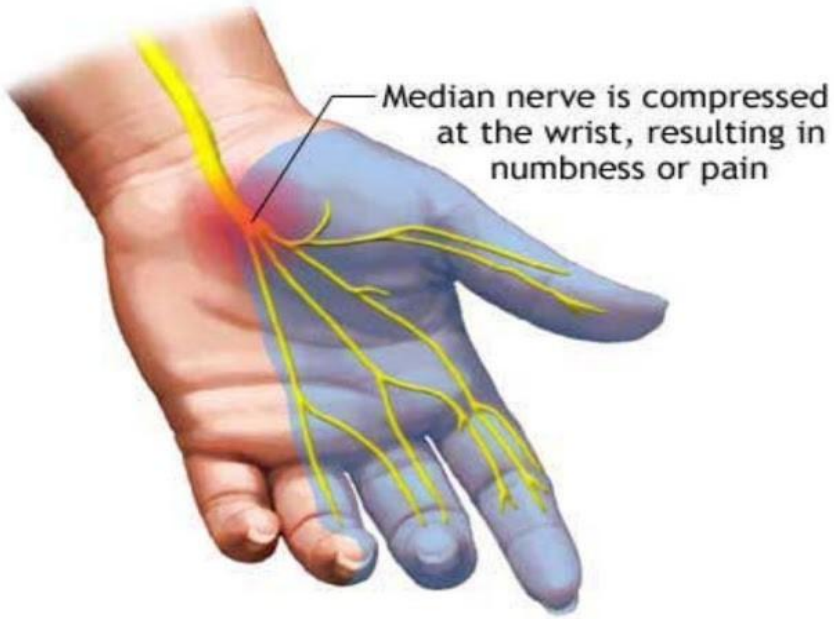

Figure: 03: Symptomatic area (shaded) of the right hand in CTS

II. Objectives:

The general aim of the study is:

To find out that short-term low-dose oral steroid is effective in the conservative treatment in mild to moderate carpal tunnel syndrome by evaluating nerve conducting responses

Other aims include:

- To correlate the clinical features of patients with carpal tunnel syndrome (CTS) with neuron conductive parameters.
- To find out the associated conditions or diseases along with CTS.
- To find correlation between global symptom score (GSS) and CTS.

III. Methodology

Table-1: Study type, place of study and duration

Study type:	**Place of study**	**Duration of study**
Prospective case-control study	Department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU)	One year

Inclusion criteria:

Table-2: CTS diagnosed Clinically and Electrophysiologically

Clinically	Electrophysiologicaly
Symptoms of CTS for more than 3 months CTS symptoms exacerbated by work Nocturnal exacerbation Positive Tinel's sign phalenmanoeuvre	Median sensory distal latency more than 3.1 ms Median motor distal latency more than 4.4 ms Difference between distal motor latency of median and lnar nerve more than 1.1 ms Difference between distal sensory latency of median and lnar nerve more than 0.2 ms

Exclusion criteria:

- Symptoms less than 3 months
- CTS-like condition seems as clinical cervical radiculopathy, proximal median neuropathy or significant polyneuropathy
- Exclusion of hypothyroidism, diabetes mellitus, pregnancy, vibrating users
- Cognitive impairment interfering with subjects ability to follow instructions and describe symptoms

- Recent peptic ulcer or history of steroid intolerance

Sampling Techniques:
Convenient type of non-probability sampling technique was applied for the study.
Grouping of study population:
Divided into 2 groups:
- Group-A (Control): CTS treated with physiotherapy
- Group-B (Case): CTS treated with oral steroids

Sample Size:
There were two groups of samples. One group of 30 patients were designated as control and another group of 30 patients designated as cases. Both the groups were matched in respect to age and sex and CTS symptoms for more than 3 months.

Data analysis procedure:
The following steps analyzed collected data,
- All relevant information from history, clinical examinations and investigations were collected in a predesigned data collection sheet.
- Then the collected data was entered into SPSS (Statistical Package for Social Science) computer software program.
- The entered data was checked and verified.
- The same program analyzed data.
- Statistical calculations were performed by SPSS computer program.
- P value <0.05 was taken as minimum level of significance.
- According GSS, CTS is classified into mild, moderate and severe groups:
  Group 1-Mild: GSS up to 15
  Group 2-Moderate: GSS up to16-35
  Group 3-Severe: GSS up to 36-50
- Resulting global symptoms score (GSS) was evaluated.
- The efficacy of treatment assessments were made at baseline and at one month.
- Electro diagnosis was repeated at the end of the study to validate improvement.

Procedure of NCS

Motor and sensory nerve conduction studies (NCS) of the median nerves were done using the conventional techniques. This was done by a machine which is a particular hardware fitted with a computer. The hardware is loaded with particular software. The special hardware has a separate keyboard, patient input box, stimulating and recording electrodes. The machine requires separate isolated power supply and grounding to avoid electrical artifacts. The studies were performed using standard recording stainless disc electrode, stainless steel ground, ring electrode and bipolar surface stimulator. The standard filer settings for motor (2-10,000 Hz) and sensory (10-5,000 Hz) studies were used. Stimulus strength 10-15% above the maximal stimuli skin temperature was maintained between 32 and 34°C as far as possible.

The compound muscle action potential was recorded with a surface electrode placed on the belly of the abductor pollicis brevis (APB) muscle.

The reference electrode was placed 3 cm distal to the recording electrode. Motor nerve conduction velocity was calculated for each patient by stimulating the nerve at the wrist (placed 7 cm proximal to the recording electrode) and elbow using supramaximal stimuli. The motor distal latency was measured from the stimulus artifact to the onset of action potential. The sensory NCS was done by stimulating the digital branches of the nerve again using supramaximal stimuli and recording from the wrist.

Motor and sensory NCS of the ulnar nerve were done in a similar way. Needle electromyography in abductor pollicis brevis muscle was done for presence of either fibrillation potential or reinnervation.

IV. Results:

A total number of 30 control and 30 cases of age and sex matched respondents were examined.

Table-1: Treatment response on nerve conduction study - MN MDL, CMAP and MN SDL, SNAP - of both upper limbs in control (n=30) and case (n=30) groups

Parameters	Nerve conduction study		Percent (%) change from before treatment to after treatment	P value
	Before treatment (Mean±SD)	After treatment (Mean±SD)		
MN MDL (ms)				
Right				
Control	5.16±0.32	4.91±0.35	-4.90	<0.001***
Case	5.18±0.47	4.61±0.34	-10.68	<0.001***
Left				
Control	4.75±0.92	4.70±0.52	10.26	>0.05ns
Case	4.97±0.71	4.44±0.62	-10.43	<0.001***
CMAP (mV)				
Right				
Control	8.18 ±0.94	9.28±0.83	13.88	<0.001***
Case	7.76±1.22	9.47±0.73	23.98	<0.001***
Left				
Control	9.50± 1.38	10.67±1.05	13.22	<0.001***
Case	8.47±1.82	10.18±1.14	23.91	<0.001***
CMAP (mV)				
Right				
Control	8.18 ±0.94	9.28±0.83	13.88	<0.001***
Case	7.76±1.22	9.47±0.73	23.98	<0.001***
Left				
Control	9.50± 1.38	10.67±1.05	13.22	<0.001***
Case	8.47±1.82	10.18±1.14	23.91	<0.001***
MN SDL (ms)				
Right				
Control	3.89 ±0.17	3.68±0.20	-5.30	<0.001***
Case	3.86±0.27	3.31±0.19	-13.98	<0.001***
Left				
Control	3.64±0.38	3.47±0.33	-4.45	<0.001***
Case	3.69±0.34	3.23± 0.19	-12.01	<0.001***
SNAP (μV)				
Right				
Control	13.77 ±1.14	14.65±1.05	6.54	<0.001***
Case	13.65±1.52	15.37±1.35	13.19	<0.001***
Left				
Control	14.98± 1.10	15.77±1.11	5.44	<0.001***
Case	14.38±2.42	15.75±1.78	11.36	<0.001***

Paired Student's't' test
ns = not significant
*** = significant

Above table 1 shows the MN MDL, CMAP and MN SDL, SNAP of both hands in control and cases as well as their comparison and significance of differences.
Analysis shows that there was significant percent change from before to after treatment [(MN MDL - right side: control 4.9% and cases 10.68%, left side: control 10.26% and cases 10.43%) (CMAP - right side: control 13.88% and cases 23.98%; left side: control 13.22% and cases 23.91%)] with P value of < 0.001 in both control and cases except left control subjects -P>0.50. As well as, there was also significant percent change from before to after treatment [(MN SDL - right side: control 5.3% and cases 13.98%; left side: control 4.45% and cases 13.98%) (SNAP - right side: control 6.54% and cases 13.19%; left side: control 5.44% and cases 1.36%)] with P value of < 0.001 in both control and cases which were highly significant.

Table-2: Treatment response on nerve conduction study - difference between MN MDL, UN MDL and MN SDL, UN SDL - of both upper limbs in control (n=30) and case (n=30) groups

Difference Between MN MDL, UN MDL (ms) and MN SDL, UN SDL (ms)	Nerve conduction study		Percent (%) change from before treatment to after treatment	P value
	Before treatment (Mean±SD)	After treatment (Mean±SD)		
MN MDL, UN MDL (ms)				
Right				
Control	2.54±0.48	2.39±0.49	-5.60	<0.01**
Case	2.53±0.64	1.71±0.46	-30.22	<0.001***
Left				
Control	2.26±0.66	2.09±0.62	-7.28	<0.001***
Case	2.22±0.77	1.59±0.49	-29.28	<0.001***
MN SDL, UN SDL (ms)				
Right				
Control	1.82 ±0.44	1.65±0.44	-9.62	<0.001***
Case	1.83±0.79	1.36±0.82	-26.27	<0.001***
Left				
Control	1.52±0.62	1.36±0.56	-9.18	<0.001***
Case	1.50±0.60	1.05± 0.42	-29.20	<0.001***

Paired Student's't' test
/ * = significant

Above table 2 shows the difference between the MN MDL, UN MDL and MN SDL, UN SDL of both hands in control and cases as well as their comparison and significance of differences.
Analysis shows that there was significant percent change from before to after treatment (right side: control 5.6% and cases 30.22%; left side: control 7.28% and cases 29.28% for MN MDL, UN MDL) with P value of P <0.001 and (right side: control 9.62% and cases 26.27%; left side: control 9.17% and cases 29.2% for MN SDL, UN SDL) with P value of < 0.001 in both control and cases which were significant.

Table-3: Treatment response on global symptom score in control (n=30) and case (n=30) groups

Parameters	Global symptom score		Percent (%) change from before treatment to after treatment	P value
	Before treatment (Mean±SD)	After treatment (Mean±SD)		
Right limb				
Control	19.27±3.46	13.33±2.59	-30.66	<0.001**
Case	18.83±5.22	7.67±2.22	-56.98	<0.001***
Left limb				
Control	16.50±7.26	11.57±5.14	-25.72	<0.001***
Case	17.87±6.91	7.00±2.85	-54.30	<0.001***

Paired Student's't' test
*** = significant

Above table 3 shows the global symptoms score of both hands in control and cases as well as their comparison and significance of differences.
Analysis shows that there was significant percent change from before to after treatment (right side: control 30.66% and cases 56.98%; left side: control 25.72% and cases 54.3%) with P value of <0.001 in both control and cases which were significant.

Table-4: Side-effect of drugs in control (n=30) and case (n=30) groups

Side-effect	Control No. (%)	Case No. (%)	P value
No	30 (100.0)	19 (63.3)	<0.001***
Yes	0	11 (36.7)	
Nausea		7 (63.6)	
Epigastric pain		6 (54.5)	
Tarry tools		0	
Leg oedema		2 (18.2)	
Cushingold appearance		1 (9.1)	
Blood pressure raised		1 (9.1)	

Chi-square test
*** = significant

Above table 4 shows the side-effects of drug in control and cases and their comparison is also given.
Analysis shows that there were significant drug side-effects in cases and P value is < 0.001 which is significant.

V. Discussion

This was a hospital-based study which was carried out to see the effectiveness of low dose steroid in the treatment of carpal tunnel syndrome (CTS). The study subjects were from the Department of Neurology (outdoor), and the patients referred to Neurophysiology Centre for electrophysiological testing in the Department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka. During the study period, from January to December, 2005, 30 patients were diagnosed as CTS clinically and confirmed by electrodiagnostically, were evaluated. There were 30 control and 30 CTS cases included in this series.

Table-1 of this study shows that the MN MDL and CMAP had significant percent change from before to after treatment (right: control 4.9% and case 10.68%; left: control 13.22% and cases 23.91%). This

observation suggests that prednisolone is effective in mild to moderate CTS patients. Similar studies showed significant improvement of MN MDL and CAMP in 4-week prednisolone group[3,4]. On the other hand, MN SDL' and SNAP of this study shows that had significant percent change from before to after 4-week treatment (right: control 5.3% and cases 13.98%; left: control 4.45% and cases 11.36%). This observation also suggests that prednisolone is effective in mild to moderate CTS patients. Similar studies showed significant improvement of electrodiagnostic parameters [3,5].

Table-2 of this study shows that the difference between MN MDL and UN SDL had significant percent change from before to after 4-week treatment (right: control 5.6% and cases 30.22%; left: control 7.28% and cases 29.28%). Similar studies showed significant improvement of electrodiagnostic parameters [4,6]. So, this study is consistent with above mentioned studies. Furthermore, the study difference between MN SDL and UN SDL had significant percent change from before treatment to after 4-week treatment (right: control 9.62% and cases 26.27%; left: control 9.17% and cases 29.2%). Similar studies showed significant improvement of electrodiagnostic parameters [4].

Table-3 of this study shows that the global symptoms score (GSS) had significant percent change from before treatment to after 4-week treatment (right: control 30.66% and cases 56.3%; left: control 25.72% and cases 56.3%). Similar studies showed that the GSS improved in 66% [4]. The difference between this study and those of above studies may be due to small number of study population in this study.

Table-4 of this study shows that there is side-effects of drug in cases, but most of the side-effects were nonspecific and not harmful to the patients.

Steroids are effective at reducing swelling on account of their anti-inflammatory action. Considering all the above observations, it is established that this study showed that oral steroid (prednisolone) in the treatment of mild to moderate carpal tunnel syndrome is effective.

VI. Conclusion

It may be concluded that low-dose short-term oral steroid can be an effective treatment in mild to moderate carpal tunnel syndrome. As the values of the NCS were significant, the NCS parameters used in this study for diagnosis of CTS would be helpful to neurophysiologists in our country for evaluation of similar cases and correlate other diseases in the near future. Furthermore, this study would stimulate the necessity of further study in a larger scale in the future, which may be helpful for clinicians and researchers for decision making as well as health planners to contribute in better management of CTS.

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