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*Full Length Research Paper*

# The electrophysiological analysis of carpal tunnel syndrome in a single center from Saudi Arabia

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**Carpal tunnel syndrome (CTS) is very common disease of the peripheral nervous system that is seen frequently in all electrophysiological laboratories across the world. It occurs with almost the same incidence across all populations. If left untreated, it can lead to functional impairment of the hand function. We looked at all patients presented to our clinic in a period of 6 months. Then, all cases of carpal tunnel syndrome were collected. All different variables were looked at and severity of the disease was evaluated and reported. 40 (57%) of all patients had the diagnosis of carpal tunnel syndrome. 35% of the patients had severe form of CTS. The majority of our cohort was female and almost 60% of the group was diagnosed with diabetes mellitus (DM). Carpal tunnel syndrome is common. The distribution of severity was variable across the three categories and most of our patients had DM on top on CTS diagnosis.**

**Keywords:** Carpal Tunnel Syndrome, Electrophysiologic studies, Diabetes

## INTRODUCTION

### Background

Carpal tunnel syndrome (CTS) is characterized clinically by the presence of sensory symptoms in the form of numbness, tingling, and feeling of heaviness of one or both hands. The classic symptoms occur usually at night where the patient gets awakened by the symptoms but may occur during daytime when the patient acquires flexion/extension position of the wrist.

It is very common disease with an estimated incidence of 99 per 100,000 population per year and general prevalence of 7-19% and it affects about 0.2% of the US clinic visits and results into 500000 CTS release surgeries (Von Shroeder and Botte, 1996; Ferry et al., 1998; Schappert and Rechtsteiner, 2008; Cullen et al., 2009).

Motor involvement can occur if the CTS release surgery is not done within reasonable time and may result into functional impairment of the hand functions, especially those muscles supplied by the median nerve.

It is a compressive disorder that causes focal ischemia to the nerve as well as mechanical damage to the nerve fibers.

Sensory fibers get affected first and the most due to the heavily myelinated fibers and high energy level in them and are more susceptible to focal compression (Sunderland, 1978).

The electrodiagnostic (EDX) techniques are used to detect this compression relies on the notion that with compression, there will be demyelinating lesion of the

segment being compressed that translate into prolonged sensory and/or motor latencies of the median nerve with variable slowness of conduction velocities of the affected nerves.

If there is strong clinical suspicion and the initial screen for demyelinating changes were not found, then comparative studies of the median versus ulnar or radial studies will show if there is mild degree of compression and hence demyelination (Jablecki et al., 1993).

The use of antidromic sensory nerve conduction studies (NCS) of the median nerve produces large sensory nerve action potential (SNAP) in comparison to orthodromic stimulation (Goddard et al., 1983; Melvin et al., 1966) and is used in most of the electrophysiological laboratories across the world.

## METHODS

Retrospective analysis of a single electrophysiologic clinic of consecutive patients presenting with clinical symptoms of carpal tunnel syndrome (CTS).

All data on patients collected between July 2016 to December 2016. Only adult patients above the age of 18 were included.

We have included all patients presenting to the clinic with any neurological complaints. Then the subgroup of patients who were diagnosed with CTS was included in the final analysis of the study.

Only descriptive analysis was done.

The diagnosis of CTS was based on the clinical presentation and then confirmed by (EDX) studies.

Antidromic NCS was done on the median nerve and compared to the ulnar nerve stimulation. Both nerves were stimulated at 14 centimeters distal to the recording electrode sited at the wrist area.

The degree of CTS was divided into three categories as follows:

Mild CTS—Prolonged (relative or absolute) sensory latencies with normal motor studies. No evidence for axon loss.

Moderate CTS—Abnormal median sensory latencies as noted for mild CTS, and (relative or absolute) prolongation of median motor distal latency. No evidence of axon loss.

Severe CTS—Any of the aforementioned NCS abnormalities with evidence of axon loss as defined by either: (1) an absent or low-amplitude SNAP or mixed NAP; (2) a low-amplitude or absent thenar CMAP; or (3) a needle EMG with fibrillation potentials or motor unit potential changes (large amplitude, long-duration motor unit potentials, or excessive polyphasic) (Werner and Andary, 2011).

We followed the recommendation by the American Association of Neuromuscular and Electrodiagnostic Medicine guideline to assess CTS (American Association of Electrodiagnostic Medicine et al., 2002). (Table 1)

Screening of the lower extremities was done only if the patient was symptomatic or the initial study was ordered by the treating physician to be screening for neuropathy in general.

Diabetic patients either carried the diagnosis already or they have had high glycated hemoglobin (HbA1c) level at the time of CTS diagnosis.

## RESULTS

70 patients presented to our clinic with various complaints and diagnoses of peripheral nervous system impairment. 40 patients were diagnosed with carpal tunnel syndrome (CTS) following the AANEM recommendation, which comprises about 57% of the total number of patients presented to the EDX clinic.

9 (22.5%) were male and the rest were female.

The median age was 58 years old and two patients were at the extreme of age limits, one at 18 and the other at the age of 89 years and most (60%) of the group was in the 50-70 years.

More than 80% of the whole group was diagnosed by evaluation of antidromic median SNAP versus ulnar SNAP at 14-centimeter distance. The rest of the patients had to have more comparative testing that included mixed studies and only a minority needed inching studies.

14 (35%) were in the category of severe CTS, 6 (14%) were moderate in severity and the rest were mild. There was no clear correlation between severity of the patients' symptoms and the severity in the electrodiagnostic studies.

24 (60%) have both hands affected. 10/24 (41.6%) have variable degree of involvement in either hand, which is severe in one hand the other will be of mild or moderate degree.

6 (14%) had clinical diagnosis other than CTS. The most common diagnosis was sensory motor axonal neuropathy and all of these patients had the diagnosis of diabetes as a confounding factor.

All 14 cases with severe CTS were referred to the hand surgeon for consideration of carpal tunnel release surgery.

24 (60%) of the group had the clinical and laboratory diagnosis of DM with an average level of glycated hemoglobin (HbA1c) above 7.

There was no clear association of the level of HbA1c level and the severity of CTS symptoms or findings in electrophysiological studies.

**Table 1.** AANEM practice recommendation for CTS electrodiagnostic studies

1. Standard: Sensory conduction studies across the wrist of the median nerve, and if the results are abnormal, of one other sensory nerve in the symptomatic limb.
2. Standard: If the initial median sensory nerve conduction study across the wrist has a conduction distance greater than 8 cm and the results are normal, additional studies as follows:
  - A. Comparison of median sensory nerve conduction across the wrist over a short (7–8 cm) conduction distance; or:
  - B. Comparison of median sensory conduction across the wrist with radial or ulnar sensory conduction across the wrist in the same limb; or:
  - C. Comparison of median sensory or mixed nerve conduction through the carpal tunnel to sensory or mixed nerve conduction studies of proximal (forearm) or distal (digit) segments of the median nerve in the same limb.
3. Guideline: Motor conduction studies of the median nerve recording from the thenar muscle and of one other nerve in the symptomatic limb to include measurement of distal latency.
4. Option: Electromyography of a sample of muscles innervated by the C5 to T1 spinal roots, including a thenar muscle innervated by the median nerve of the symptomatic limb.
5. Option: Comparison of the median motor nerve distal latency (second lumbrical) to the ulnar motor nerve distal latency (interossei).

All patients were advised to wear wrist splints to relieve the symptoms of CTS and only 30% of the population received neuropathic pain medications to relieve the pain and numbness.

## DISCUSSION

Carpal tunnel syndrome as expected is a very common disease of the peripheral nervous system that occurred in more than half of our patients visit to the electrophysiology clinic.

As seen in our results, we have variable severity of CTS across our cohort and about 50% of the patients had either moderate or severe compression diagnosed by electrodiagnostic studies.

As reported in other papers internationally, it affected mostly females and only 22.5% of the total number of patients was male.

There was no clear correlation between symptoms and the actual severity of CTS at the time of EDX studies. This indicates that all symptomatic patients should have diagnostic studies to find out the presence of severe form of CTS and to refer them as soon as possible for consideration of CTS release surgery. By doing so, the function of the hand can be preserved and early intervention means prevention of impairment of hand function and prevention of motor involvement and thumb disability.

We also found that the majority of our patients could be diagnosed by a simple 10 minute study that compares

median SNAP to ulnar SNAP, and that these patients has findings of demyelination in the form of delayed distal latencies and slowed conduction velocities on the median nerve in comparison to normal standard values. We only needed extra studies in a minority of our group. This finding elaborates on the easiness of CTS diagnosis and the need to refer all patients who has symptoms of numbness and tingling of the hands in a median nerve distribution to EDX clinic. Screening for other diagnoses of the peripheral nervous system disorders by extending the nerve conduction study to the lower extremities is not warranted as we only had 14% of our group carrying a diagnosis other than CTS.

An interesting finding is that 60% of our patients had the clinical and laboratory diagnosis of diabetes mellitus.

It is well known that DM is a predisposing factor to the development of CTS but it is not currently recommended to screen for DM with every patient presenting with CTS. In our population, and with the high rate of DM prevalence, I think we should be more vigilant and screen for the presence of DM with every case of CTS based on this finding.

Our limitations are mainly due to the design of the study that is retrospective. We could have over estimated the presence of DM by referral bias. As well the duration of the study could limit generalizability of the study to many subgroups of patients' populations.

This study could add to the literature by advocating for more electrodiagnostic studies to detect CTS as soon as possible and prevent hand dysfunction.

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