

# Clinical profile, electrodiagnosis and outcome in patients with carpal tunnel syndrome: a Singapore perspective

Tay L B, Urkude R, Verma K K

## ABSTRACT

**Introduction:** Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy seen in our neurodiagnostic laboratory referrals. We describe the clinical profile, and outcome in patients with electrophysiological diagnosis of CTS seen in our centre over a six month period.

**Methods:** A retrospective study was carried out and included 134 consecutive patients with CTS referred to the Neurodiagnostic Laboratory, National Neuroscience Institute, from October 2003 to March 2004, for the confirmatory testing. Severity grade was assigned following American Association of Electrodiagnostic Medicine criteria of CTS.

**Results:** The majority of patients were female (81.3 percent) with mean age of presentation being 53.6 years. Chinese women constitute the majority racial group. Paraesthesia (70.1 percent) and numbness (19.4 percent) were the presenting sensory symptoms. In the nerve conduction study, 108 patients had bilateral CTS with 35 having unilateral symptoms. Dominant hand involvement was present in 92.3 percent. Overall, 40.3 percent had mild, 46.3 percent had moderate and 13.4 percent had severe CTS, with median duration of symptoms of two, four and 12 months, respectively. Follow-up data were available for 115 patients. 27 patients with surgical treatment showed resolution or improvement in 53.3 percent with moderate CTS, and 83.3 percent with severe CTS, at three-month follow-up. 14 patients turned up for six-month follow-up and 92.9 percent showed improvement in symptoms. 88 patients were managed conservatively; symptoms were unchanged or worsened in 80.6 percent with mild CTS, 65.9 percent with moderate CTS, and 62.5 percent with severe CTS at three-

month follow-up. Of the 54 patients who turned up for six-month follow-up, the clinical symptom remain unchanged or worsened in 68.5 percent.

**Conclusion:** The severity of CTS is associated with longer duration of symptoms. Sensory symptoms and dominant hand involvement is more common. There is a high default rate in the clinical follow-up. Early surgical intervention results in either resolution or improvement in symptoms, whereas conservative management does not affect the natural history with symptoms that persisted or worsened with time.

**Keywords:** carpal tunnel syndrome, electrodiagnosis, entrapment neuropathy, nerve conduction, neuropathy

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## INTRODUCTION

Carpal tunnel syndrome (CTS) is the most commonly-encountered entrapment neuropathy with an incidence of 139 per 100,000 person-years for men and 506 per 100,000 person-years for women<sup>(2)</sup>. The symptoms and signs are caused by compression of the median nerve along the carpal tunnel, which is formed on the distal, medial, and lateral sides by the carpal bones and on the volar surface by the deep transverse carpal ligaments. The classic symptoms of CTS are numbness and paraesthesia in the first three fingers of the hand, which is commonly exacerbated at night<sup>(2)</sup>. The diagnostic signs include sensory loss along the lateral aspect of the hand, motor weakness and wasting of abductor pollicis brevis (APB) muscle, and eliciting Tinel's and Phalen's sign at the wrist.

The nerve conduction study (NCS) study is a definite diagnostic test for CTS with high degree of sensitivity and specificity. This test demonstrates a distal lesion of the median nerve and excludes other peripheral conditions resulting in similar

Neurodiagnostic  
Laboratory  
National Neuroscience  
Institute  
11 Jalan Tan Tock  
Seng  
Singapore 308433

Tay L B, DCP  
Senior Medical  
Technologist

Urkude R, MBBS  
Clinical Fellow

Department of  
Neurology

Verma K K, MD,  
DABPN  
Consultant

Correspondence to:  
Dr Kamal K Verma  
Tel: (65) 6357 7171  
Fax: (65) 6357 7137  
Email: kamal\_verma@  
nmi.com.sg

symptoms<sup>(2,3)</sup>. We carried out a retrospective study describing the demographical characteristics, clinical profile and outcome in the patients with confirmed CTS.

## METHODS

At the National Neuroscience Institute (NNI) Neurodiagnostic Laboratory, patients with suspect CTS are referred from orthopaedic surgery, neurology and neurosurgery departments for confirmatory testing. The retrospective study was conducted in consecutive patients referred with a suspected diagnosis of CTS over a period of six months from October 2003 to March 2004. Patients undergoing the tests completed a questionnaire with the technologist prior to the test. The clinico-epidermiological parameters included age, sex, race, dominant hand, symptomatic side, symptoms and sign, duration of symptoms and predisposing factors<sup>(4)</sup>.

Motor and sensory NCS of median and ulnar nerve were performed in both hands, unless the patient refused. The temperature was maintained at  $>32^{\circ}\text{C}$  during the procedure. For motor NCS, the median and ulnar motor nerves were stimulated at wrist 6.5 cm proximal to the active recording electrode. The sensory responses were obtained at digit II and digit V for the median and ulnar nerves, stimulating antidromically at 13 cm and 11 cm, respectively. The normative value in our laboratory for median motor latency is  $<4.5$  ms and median sensory distal peak latency  $<3.5$  ms.

If the routine conduction studies did not demonstrate CTS, than the following additional tests were carried out<sup>(5)</sup>: Palmar study-median sensory recording at wrist with mid-palm stimulation at 2nd-3rd space and ulnar sensory recording at wrist with mid-palm stimulation at 4th-5th space at a distance of 8 cm orthodromically from recording active electrode is performed. The difference in sensory peak latency of  $\geq 0.4$  ms was considered significant. The latency difference was measured at digit IV for the median and ulnar sensory nerves was measured at the wrist at a distance of 14 cm, and a difference in peak latency by  $\geq 0.4$  ms was considered significant. Comparison of median and radial sensory peak latency at thumb at a distance of 10 cm with difference of  $\geq 0.5$  ms was considered significant. In patients with APB wasting, and absent response, median and ulnar distal motor latency at 2nd lumbrical-interosseus muscles was recorded stimulating at wrist 10 cm from the active recording electrode.

Neurophysiological tests graded the CTS into the mild, moderate, and severe categories, according to the American Association of the Electrodiagnostic

Medicine (AAEM) criteria<sup>(5)</sup>. In the patients with bilateral CTS, the neurophysiological grade in the more severely affected hand was noted.

(A) Mild CTS: prolonged distal sensory peak latency with  $\pm$  decreased sensory amplitude; (B) Moderate CTS: abnormal median sensory peak latencies with prolongation of the distal motor latency; (C) Severe CTS: prolonged motor and sensory distal peak latency either with a low or absent SNAP or CMAP; (D) Very severe CTS: absent thenar motor or sensory response either with a present or absent lumbrical response. Outcome of the surgical or conservative management was measured at three and six months. The clinical symptoms were assessed as resolved, improved, same or worse. Follow-up was done by reviewing the case report files.

## RESULTS

Of the patients coming to the neurodiagnostic laboratory over a period of six months, 134 patients, and 242 hands with CTS confirmed on electrophysiological study were included. The majority of the patients were female (81.3%)<sup>(6)</sup> and of the Chinese race (89.55%). The mean age at presentation was 53.6 years, with the youngest patient at 28 years and oldest at 84 years. More than two-thirds of the patients were between 40 and 70 years of age (Fig. 1). Through the questionnaire and clinical examination, the predominant sensory symptoms were paraesthesia and numbness present in 70.1% and 19.4% of patients, respectively<sup>(7)</sup>. Only 10.4% had APB muscle wasting and 10.5% patients had APB weakness. Tinel's and Phalen's sign were positive in 33.6% and 23.9% of patients, respectively. The median duration of symptoms at presentation was three months, with a range of two to 60 months. Predisposing conditions such as diabetes mellitus were present in 18 patients (13.4%) while seven patients (5.2%) had hypothyroidism at the time of presentation<sup>(8)</sup>.

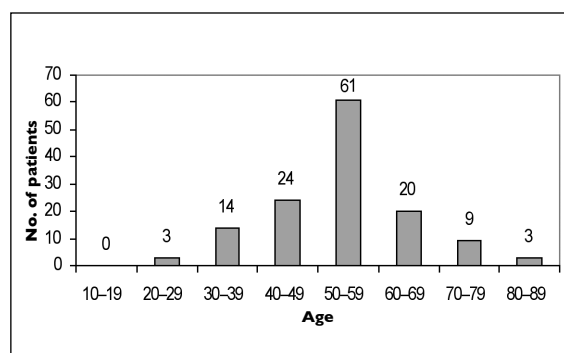
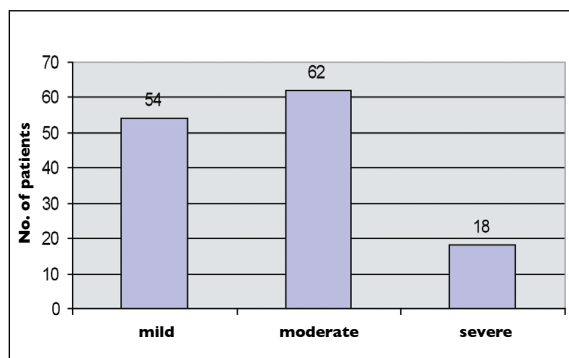


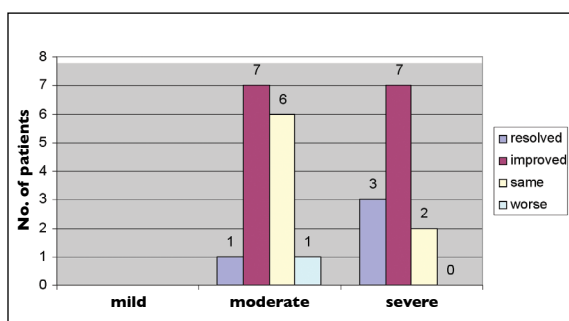
Fig. 1 Age distribution of patients.



**Fig. 2** Grading of CTS in the patients.

NCS revealed bilateral CTS in 108 (80.6%) and unilateral CTS in 26 (19.4%). There were 35 patients (32.4%) with bilateral CTS being symptomatic unilaterally. Dominant hand involvement was present in 124 patients (92.3%). Overall, 54 patients (40.3%) had mild CTS, 62 (46.3%) had moderate CTS and 18 (13.4%) had severe CTS (Fig. 2). The median duration of symptoms for mild, moderate and severe CTS were two months, four months and 12 months, respectively, suggesting the increasing severity of CTS with longer duration of symptoms.

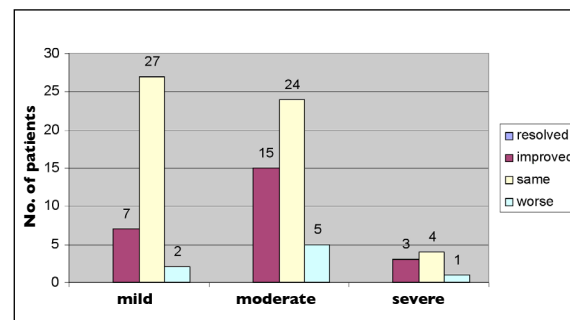
Follow-up data was available in 115 patients (85.8%). They were 27 patients with moderate (15) and severe (12) CTS that underwent surgery for CTS release. The clinical symptoms were improved in eight patients with moderate CTS and ten patients with severe CTS at the three-month follow-up (Fig. 3). 14 patients turned up for the six-month follow-up, out of which 92.9% showed improvement in their clinical symptoms.



**Fig. 3** Outcome at three months for the surgically-treated group.

Of the 88 patients who were managed conservatively, 36 patients had mild CTS, 44 patients had moderate CTS and eight patients had severe CTS. The clinical symptoms remained the same or worsened in 29 patients

(80.6%) with mild CTS, 29 patients (65.9%) with moderate CTS and five patients (62.5%) with severe CTS at three-month follow-up (Fig. 4). The data of only 54 patients were available at six-month follow-up; of these, 68.5% of patient's clinical symptoms remained unchanged or worsened<sup>(9-11)</sup>.



**Fig. 4** Outcome at three months for the conservatively-treated group.

## DISCUSSION

CTS is the most common entrapment neuropathy, with prevalence of 10-20% for symptoms in the population-based studies<sup>(12)</sup>. In our study, there is a higher predominance of female patients with CTS with a ratio of 10:2, compared to other studies<sup>(1,13,14)</sup>. The proportion of the Chinese population is also higher. This difference is most likely due to the referral pattern and ethnic composition of the local population. The mean age at the time of presentation is similar to that of other studies and follows a normal distribution<sup>(2)</sup>.

The majority of the patients presented with dominant hand involvement. This was noted in both right- and left-handed individuals, and the clinical symptoms appeared to be more severe in the dominant hand when symptoms are bilateral<sup>(14)</sup>. The predominant group had mild to moderate severity (86%). Predisposing conditions such as diabetes mellitus, hypothyroidism, trauma or collagen vascular diseases were present in 19% of patients. Hence, screening for predisposing conditions should be done in suspect cases<sup>(8)</sup>.

In our follow-up data, there is a high default rate with only 40% of patients still on follow-up at six months. We believe that this is due to a variety of factors, including fluctuating symptoms, no detriment to health and socioeconomic situations (clinic visits, medical expenses and loss of wages). The surgically-treated group showed improvement in 66.7%<sup>(15)</sup> with complete resolution of symptoms in 15% patients, which is similar to the other reported series. In conservatively-managed patients, 68.5% showed

either no change or a deterioration in their symptoms. Hence, it is imperative that the need to follow-up is emphasised in these patients.

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