Carpal tunnel syndrome: a clinical and electrophysiological study of 220 consecutive cases at King Fahd Hospital of the University, Al-Khobar

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ABSTRACT

Objectives: To study the clinical and electrophysiological profile of patients with clinically diagnosed carpal tunnel syndrome (CTS) in the Eastern Province of Saudi Arabia.

Setting: Neurology service at the King Fahd Hospital of the University (KFHU), Al-Khobar, Saudi Arabia.

Patients and methods: Two hundred and twenty consecutive patients (181 female, 39 male, mean age 37 and 44 years respectively), referred with a clinical diagnosis of CTS to the neuromuscular laboratories of KFHU between August 1991 and August 1995, formed the study group. They all had clinical evaluation and standardized nerve conduction studies (390 hands) performed by the same examiner. A control group of 64 normal subjects (31 females, 33 males, mean age 37 and 43 years respectively) were concurrently studied.

Results: Carpal tunnel syndrome was confirmed in 265 hands (68%). The mean distal sensory peak latency (DSL) in milliseconds (ms) ± standard deviation (SD) was 4.61 ± 1.54 ms (227 hands, 58.2%). The mean distal motor latency (DML) was 5.87 ± 1.5 ms (195 hands, 50%). In 38 hands (9.7%) no sensory responses were recordable. Of these 4 hands (1%) had no motor responses as well. Seventy four percent of the patients were below 45 years of age. The main presenting symptoms were numbness (88.7%), pain in the hands (69.8%) and weakness (35.5%). Sixty percent of the patients presented to hospital within one year of onset of symptoms. The frequency of associated conditions was highest for diabetes mellitus in 13.1% of the patients.

Conclusions: The clinical and electrophysiological patterns of CTS in Saudi Arabia are similar to those reported from developed countries.


Keywords: Carpal tunnel syndrome, median neuropathy, nerve conduction studies, Saudi Arabia.

Entrapment neuropathy of the median nerve at the wrist, carpal tunnel syndrome (CTS), is the most common mononeuropathy diagnosed worldwide.1-4 The clinical diagnosis is based on the typical presenting symptoms which include nocturnal paresthesia in the distribution of the median nerve and pain which often awakes the patient from sleep.1,5 Women are more affected than men and most commonly in the fifth and sixth decades.6 Carpal tunnel syndrome may run in families6,7 and it may be associated with diabetes mellitus,8,8 chronic renal failure,9 rheumatoid arthritis,8,10 amyloidosis,11 tuberculosis,12 acromegaly,13,14 myxedema15 and hyperparathyroidism.16 The clinical signs in the majority of patients with CTS include hypesthesis involving the first three digits and the radial half of the fourth digit with typical sensory splitting into median and ulnar halves.17 Provocation of the symptoms may be induced by passive flexion or hyperextension of the affected hand at the wrist for more than one minute, Phalen's sign18 or percussion of the median nerve at the wrist, Tinel's sign.19 A recently described provocation test, the carpal compression test, was reported to have a higher sensitivity and specificity for the diagnosis of CTS.20 The electrophysiological confirmation of the diagnosis of CTS by demonstrating focal slowing at the wrist was pioneered by Simpson.21 A comprehensive review of the usefulness of nerve conduction studies (NCS) and electromyography (EMG) for the evaluation of patients with CTS22 with a summary statement on practice parameters were recently published. The use of magnetic resonance imaging (MRI) for the diagnosis of CTS was recently reported.23,24 Reports on CTS from the Kingdom of Saudi Arabia are scarce. The present study reports the clinical and electrophysiological profile of 220 patients (390 hands) who were seen

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consecutively at the neurodiagnostic laboratories of King Fahd Hospital of the University, Al-Khobar between 1991 and 1995.

Patients and methods All consecutive patients referred with the clinical diagnosis of CTS between August 1991 and August 1995 were evaluated clinically and electrophysiologically. The KFHU is a referral tertiary care hospital for the entire Eastern Province with an estimated population of three million. A study group of 220 patients (181 females, 39 males) and a control group of 64 normal subjects (33 males, 31 females) were concurrently evaluated electrophysiologically.

A questionnaire form and a local examination were used to screen the patients for the main symptoms, predisposing conditions, presence of sensory loss, muscle atrophy, weakness, Tinel’s and Phalen’s signs. The nerve conduction studies were performed uniformly by one of the authors (AA) using standardized techniques on a Nicolet Spirit Electromyography system (Nicolet Instrument Corporation, Madison, Wisconsin, USA). The measurements were carried out at room temperature. Supramaximal percutaneous constant current electrical stimuli was applied to the median nerve at the wrist 8 cm from the proximal surface-recording electrode over the abductor pollicis brevis muscle. Antidromic sensory recording from digit 2 was used with stimuli applied 14 cm proximally at the wrist. The same conduction distances were used for the ulnar nerve measurements. Antidromic sensory measurements were also obtained for the superficial radial nerve at a stimulation distance of 10 cm. A total of 390 hands were tested. The SPSS statistical package was used for the analysis of data.

Results A total of 220 patients, 181 females with a mean age of 37 years (range 14-65 years) and 39 males with a mean age of 44 years (range 21-71 years) formed the study group. Seventy four per cent of them were below 45 years of age and the female to male ratio was 5:1. Fig. 1 shows the age and sex distribution. The normal control group included 64 subjects; 31 females with a mean age of 37 years (range 24-64 years) and 33 males with a mean age of 43 years (range 19-71). The peak incidence of CTS for both sexes was in the age group 31-40 years. The majority of the patients were housewives 71.9% (158). Other associated occupations included professionals 10.9% (23); office work 9.6% (21); manual work 4.5% (10); students and technicians 1.1% (2) each. The frequency of associated conditions was highest for diabetes mellitus at 13.1% (29). Five patients only (2.1%) presented during pregnancy. Other conditions included rheumatoid arthritis 6.7% (15); previous trauma to the wrist 4.4% (10); thyroid disorders 1.5% (3) and gout 3.0 (7). The most common presenting symptoms were numbness in 88.7% (195); pain in the hands in 69.8% (154); weakness in 35.5% (78) and thenar muscle atrophy in 17.8% (39). Tinel’s and Phalen’s signs were present in 48% (106) and 43% (94) of the patients respectively. Sixty percent of the patients presented within 12 months of onset of symptoms with the majority of them presenting within the first 6 months. The remaining 40% of patients presented after 2 years or more.

Table 1 gives the results of nerve conduction studies for the median, ulnar and superficial radial nerves for the study and control groups. Carpal tunnel syndrome was confirmed in 265 hands (68%). In 227 hands (58.2%) the distal sensory peak latencies (DSL) were prolonged 4.61±1.54 (normal <3.5 ms). In addition, 38 hands (9.7%) had no recordable sensory nerve potentials. The distal motor latencies (DML) were prolonged 5.87±1.50 (normal <4.5 ms) in 195 hands (50%). Four more hands had no recordable evoked muscle potentials.

Table 2 shows the results of 195 hands with electrophysiologically confirmed CTS categorized into mild (DML 4.5-4.9 ms), moderate (DML 5.0-5.9 ms) and severe CTS (DML ≥ 6.0 ms). The ulnar nerve studies were carried out on 315 hands for motor (DML 2.84±0.31 ms) and 197 hands for sensory (DSL 2.58±0.24) measurements. Sensory superficial radial nerve measurements were carried out in 96 hands (DSL 2.03±0.33 ms). The DML for the median nerve in the control group (64 patients) was 3.60±0.32 ms (71 hands) and the DSL 2.98±0.38 ms (30 hands). The DML for the ulnar nerve was 2.74±0.35 ms (66 hands) and the DSL 2.72±0.14 ms (21 hands). The DSL for the superficial radial nerve was 2.33±0.31 ms (53 hands).

Discussion Nearly fifty years after the first report on spontaneous compression of the median nerve at the carpal tunnel,28 the carpal tunnel syndrome is now recognized as the most common peripheral mononeuropathy.3 Females have been the predominant victims of CTS.5,29 In the present
Table 1: Electrophysiological measurements for the median, ulnar and superficial radial nerves in the study and control groups given as MEAN ± SD in ms.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Patients</th>
<th>Controls</th>
<th>p-value</th>
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<tbody>
<tr>
<td><strong>MIDN NERVE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DML (ms)</td>
<td>5.57 ± 1.50</td>
<td>3.6 ± 0.32</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CMAP (mV)</td>
<td>5.25 ± 5.47</td>
<td>8.85 ± 2.33</td>
<td>= 0.243</td>
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<tr>
<td>MCV (ms)</td>
<td>5.25 ± 8.08</td>
<td>60.24 ± 5.87</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>DSL (ms)</td>
<td>2.5 ± 1.54</td>
<td>2.98 ± 0.38</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SNAP (μV)</td>
<td>4.25 ± 10.73</td>
<td>3.420 ± 7.41</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>ULNAR NERVE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DML (ms)</td>
<td>2.82 ± 0.31</td>
<td>2.74 ± 0.35</td>
<td>&lt; 0.091</td>
</tr>
<tr>
<td>CMAP (mV)</td>
<td>5.25 ± 5.03</td>
<td>9.25 ± 2.31</td>
<td>&lt; 0.697</td>
</tr>
<tr>
<td>MCV (ms)</td>
<td>4 ± 0.07</td>
<td>61.02 ± 5.65</td>
<td>&lt; 0.269</td>
</tr>
<tr>
<td>DSL (ms)</td>
<td>2.5 ± 0.24</td>
<td>2.72 ± 0.14</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SNAP (μV)</td>
<td>28.5 ± 10.38</td>
<td>32.43 ± 9.61</td>
<td>&lt; 0.147</td>
</tr>
<tr>
<td><strong>SURFACE NERVE</strong></td>
<td></td>
<td></td>
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<tr>
<td>DML (ms)</td>
<td>2.05 ± 0.33</td>
<td>2.33 ± 0.31</td>
<td>&lt; 0.180</td>
</tr>
<tr>
<td>CMAP (mV)</td>
<td>5.25 ± 12.08</td>
<td>34.57 ± 6.87</td>
<td>&lt; 0.585</td>
</tr>
</tbody>
</table>

CMAP: compound muscle action potential; MCV: motor conduction velocity; SNAP: sensory nerve action potential. p-values: one-tailed t-test of independent samples at 5% level after testing for homogeneity of the variance using the Levene test.

series, the female to male ratio was 5:1. However, it was notable that our patients are relatively younger, predominantly in the third and fourth decades rather than the usually reported fifth and sixth decades. This probably relates to the well-established general public and medical awareness of the condition and the widespread use of electrodiagnostic tests for confirmation of the diagnosis. The high degree of awareness may also be noted from the fact that nearly 50% of the patients in the present series presented within 6 months of onset of symptoms.

The most frequently associated condition with CTS in our patients was diabetes mellitus (13%). This is not dissimilar to that reported from the West where diabetes was found in 7.5-11.5% of patients with CTS. The frequency of 7% for rheumatoid arthritis (RA) was much lower than that of 23% reported from the West. The cases of CTS presenting during pregnancy accounted for only 2% compared to the recently reported 7% from the West. This may be related to the younger marital age in our population compared with western women.

Considering occupation as a risk factor for CTS, the incidence was highest for housewives (80%) which is probably the result of the dual effect of gender and domestic manual activity. The frequency in professionals and office employees (20%) possibly reflects the excessive wrist movement involved in the increasing use of desktop computers and keyboards as an emerging risk factor. The relation of forceful repetitive physical tasks and vibration in manual workers to a higher risk of CTS was previously reported. The heavy manual workers and laborers in our series showed a frequency of only 4.5%. This is probably due to the low number of our male population and gender. The clinical diagnosis of CTS was based on the recommended clinical criteria including a typical history of pain and paresthesia in the distribution of the affected median nerve, reproduction of symptoms by provocative tests and presence of sensory motor impairments. The provocative tests of Phalen and Tinel were positive in nearly 50% of the patients.

A recently added provocative test, the pressure test, was reported to have a sensitivity of 87-100% and 90% specificity with a faster mean reaction time of 9 seconds.

The nerve conduction measurements in our study and control groups were uniformly carried out by the same examiner (AA). The percentage of symptomatic hands with abnormal sensory studies using conventional conduction methods was 68% compared to 75% reported by Loong. The percentage abnormal motor studies in our series was 51% compared to 74% by Jackson; 63% Kimura and 49% Carrol. The percentage abnormal motor studies in our series was 51% compared to 74% by Jackson; 63% Kimura; 60% De Lean and 38% Loong. Using a more refined technique like palmer stimulation raises the sensitivity of detecting selective conduction abnormalities in the wrist-to-palm segment to 92%. In a recent study, comparison of digital sensory studies showed that digit 1 was the most sensitive in identifying focal slowing of sensory conduction across the wrist in mild cases of CTS with normal DML, whereas in patients.
Table 2 - Motor results (MEAN ± SD, N hands) for patients with electrophysiologically confirmed CTS, categorized into mild (DML 4.5-4.9 ms), moderate (DML 5.0-5.9 ms) and severe subgroup (DML ≥ 6.0 ms).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
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<tbody>
<tr>
<td>DML (ms)</td>
<td>4.70 ± 0.14 (66)</td>
<td>5.40 ± 0.28 (68)</td>
<td>7.68 ± 1.44 (61)</td>
</tr>
<tr>
<td>CMAP (mV)</td>
<td>9.61 ± 5.46 (66)</td>
<td>9.02 ± 5.63 (68)</td>
<td>6.05 ± 4.65 (61)</td>
</tr>
<tr>
<td>MCV (m/s)</td>
<td>56.80 ± 5.90 (66)</td>
<td>(68)</td>
<td>53.18 ± 7.59 (61)</td>
</tr>
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</table>

with prolonged DML, the sensitivity of sensory conduction is not significantly different among digits 1-4. The mean DML and DSL of the median nerve in our control subjects are similar to those reported by Kimura38 and Carroll39 respectively. The degree of involvement of the median nerve in CTS is reflected in Table 2 where the motor measurements show steady deterioration with severity of the condition. The usefulness of ultrasonographic evaluation of the thickness of the palmar radiocarpal ligament and width of the carpal tunnel in hemodialysis patients with CTS was recently reported. However, the use of all these modalities in confirming the diagnosis of CTS must be correlated with the clinical criteria of the presenting symptoms and signs. The present study shows that the clinical and electrophysiological patterns of carpal tunnel syndrome in Saudi Arabia are similar to those reported from developed countries.

References

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