

Provocative Test's *Versus* Electrophysiological Studies as a Measure of Severity Grades of Carpal Tunnel Syndrome

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Abstract

- Background** Carpal tunnel syndrome (CTS) is the most common nerve entrapment, electrodiagnostic studies are a valid and reliable means of confirming the diagnosis.
- Objectives** The study aims to find a correlation between the presence of Tinel's sign and Phalen's maneuver and the degree of severity of the CTS and to compare it with severity of nerve conduction study of median nerve.
- Methods** The study involves 133 patients (102 females and 31 males) with CTS, all were examined for Phalen's maneuver and Tinel's sign and median and ulnar nerves electro physiological study in Al-Yarmouk Teaching Hospital and the Neurosciences Hospital in Baghdad between January 2010 and January 2011. Their ages ranged between (19-87) years. The patients were grouped into mild, moderate and severe CTS according to modified Padua scale of CTS severity. Statistical correlation was done using one way Anova test.
- Results** Positive Tinel's sign was seen in 25% and positive Phalen's maneuver in 28%, coexistent Tinel's sign and Phalen's maneuver positive at the same time were seen in 47%. Total Tinel's sign was 72% and total patients who had positive Phalen's sign was 75%. Mild, moderate and severe CTS were seen in 38%, 41% and 21% out of the total number of the studied patients.
- Conclusion** The study didn't find association between severity grading and provocative test, added to negative provocative tests in high percentage of patients. These results mandate the use of electrophysiological examination for the diagnosis of carpal tunnel syndrome and assessment of severity.
- Keywords** Carpal tunnel syndrome, Tinel's sign, Phalen's maneuver

Introduction

Carpal tunnel syndrome (CTS) is the commonest entrapment neuropathy which is characterized by a combination of clinical symptoms and signs arisen from compression of the median nerve at the wrist⁽¹⁾. It is characterized by tingling, numbness and pain in the first three fingers and half the ring finger of the hand, it is commonly radiating to the forearm^(1,2). Diagnosis of CTS is based on

clinical symptoms, physical signs, and nerve conduction abnormalities⁽³⁾.

Diagnosis based only on symptoms or signs are less reliable because other common disorders such as tendonitis and cervical radiculopathy may cause similar symptoms and signs. Thus, electrophysiological testing is often employed to confirm the clinical diagnosis.

Electrophysiological findings, includes abnormal sensory conduction over the tested segments

and prolonged terminal sensory and motor latencies. With more severe CTS cases, electrodiagnostic study usually shows some secondary axonal loss reflected in reduced amplitude and area of the compound muscle action potential (CMAP) in response to the stimulation at any point along the nerve⁽³⁾.

Phalen's maneuver and Tinel's sign are the most useful clinical signs for diagnosis of CTS. Tinel's sign elicited by tapping over the median nerve at wrist leading to tingling sensation in the distribution of the median nerve over the hand.

Phalen's maneuver was done by holding the wrist passively flexed for 30 seconds to 2 minutes, it was considered positive when leads to tingling sensation in the distribution of the median nerve over the hand⁽⁴⁾.

The accuracy of the diagnosis of CTS is important because the diagnosis often leads to surgical release of the carpal ligament in patients whose symptoms are refractory to non-operative therapy. If the symptoms are not due to CTS, then the patient is unlikely to benefit from surgery⁽²⁾.

We aim to find a correlation between the degree of severity of the CTS by nerve conduction study of median nerve and the presence of Tinel's sign and Phalen's maneuver and eventually if we can assess severity only by assessment of provocative tests.

Methods

A cross-sectional study enrolled 133 patients (102 females and 31 males) referred to Al-Yarmouk Teaching Hospital and the Neurosciences Hospital between Jan 2010 and Jan 2011 with hand complaints compatible with CTS and approved by electrophysiology as a CTS. Their ages ranged between (19-87) years. Seventy-five of the patients had left sided complaints and 58 had right sided complaints, we studied only the affected side. The patient verbal consent to be involved in the study was taken. Owing to the study is clinical one; it doesn't need an ethical approval.

The criterion for inclusion were clinically and electrophysiological proven CTS patients. The

criteria for exclusion were clinical or electrophysiological evidence of generalized peripheral neuropathy, evidences of cervical radiculopathies and any diseases leading to peripheral polyneuropathies such as diabetes mellitus, renal disease and rheumatologic diseases.

Clinical assessment was first done for each patient with special emphasis on Tinel's sign; which considered positive when tapping over the median nerve at the wrist leads to tingling sensation in the distribution of the median nerve over the hand. Phalen's maneuver was done by holding the wrist passively flexed for 1 minute, it was considered positive when leads to tingling sensation in the distribution of the median nerve over the hand.

Immediately thereafter, an electrophysiological study was done to prove the diagnosis of CTS. Nerve conduction studies were performed using standard techniques of supramaximal percutaneous stimulation with a constant current stimulator and surface electrode recording, maintaining skin temperature 32°C.

Sensory responses were obtained antidromically, stimulating at the wrist and recording from the index finger (median nerve) and little finger (ulnar nerve), with ring electrodes at a distance of 14 cm. Motor responses were obtained with stimulation at the wrist using belly-tendon recordings from the thenar muscles (median nerve) and hypothenar muscles (ulnar nerve) at a distance of 7 cm.

Sensory conduction velocity was the distal conduction velocity, determined by dividing the wrist-to-electrode distance (14 cm) by the distal onset latency of the sensory nerve action potential. For this study, the following median nerve measures were used:

- (1) baseline-to peak amplitude of the sensory nerve action potential (Amp-S);
- (2) distal onset latency of the sensory nerve action potential (DL-S);
- (3) conduction velocity of the sensory nerve fibers (CV-S);
- (4) baseline-to-peak amplitude of the compound muscle action potential (Amp-M); and

(5) distal onset latency of the compound muscle action potential (DL-M).

Carpal tunnel syndrome was defined as being present when ulnar nerve studies were normal and median nerve studies met one of the following criteria for abnormality based on normal values obtained and used in our laboratory: (1) DL-S > 3.7 ms; (2) DL-M > 4.4 ms; and (3) CV-S < 49 m/s.

All subjects were investigated for sensory nerve conduction velocity (SNCV) of affected and unaffected side median nerves and the same side ulnar nerve. Amplitude, SNCV and distal sensory latency were assessed antidromically using a pair of ring surface electrodes on the index finger and little finger.

Motor nerve conduction of affected and unaffected side median nerves and the same side ulnar nerve using surface electrode were also assessed. Also needle EMG study of affected side abductor pollicis and abductor digiti minimi muscles were done.

Examination was done with EMG/NCS apparatus Micro Med with setting for sensory studies were: Frequency: 100 Hz-10KHz. Sweep speed: 2 ms/Division. Sensitivity: 10 µV/Division, and for motor studies was: Frequency: 100-500 Hz. Sweep speed: 5 ms/Division. Sensitivity: 200 µV/Division. Diagnosis of CTS was based on the criteria of the American Association of Electrodiagnostic Medicine (AAEM) on getting 2 out of 3 following criteria ⁽⁵⁾.

1) Antidromic sensory conduction velocity for index digit segment less than 48.2 m/sec.

2) The difference between median and ulnar sensory nerve distal latencies with recording from the fourth digit (recording-stimulation distance was kept 14 cm) exceeding 0.5 ms.

3) Distal motor latency to abductor pollicis brevis muscle greater than 4.2 ms.

CTS severity was classified into mild, moderate and severe CTS according to the modified Padua Criteria ⁽⁶⁾: Mild CTS: Prolongation of median distal sensory latency > 3.5 ms or relative prolongation of median compared to ulnar distal sensory latencies over identical distances. Moderate CTS: Reduced median SNAP amplitude

(< 50% compared to unaffected side or < 10 µV are considered abnormal) or prolonged median motor distal > 4.5 ms.

Severe CTS: Reduced median CMAP amplitude (< 50% compared to unaffected side or < 4 mV), denervation of median innervated muscles on needle exam. After that the results of the presence of the Tinel's and Phalen's sign were correlated with each step of severity of the CTS using one way Anova test. Then each step of severity was correlated with presence of the provocative tests using one way Anova test.

Statistical analysis was done using graph pad software (Quick calc online calculator for Scientist) with P value less than 0.05 was the cutoff point of significant differences.

Results

Isolated Positive Tinel's sign only was seen in 33 out of 133 (25%) and Positive Phalen's maneuver only in 37 out of 133 (28%). Coexistent Tinel's sign and Phalen's maneuver positive at the same time were seen in 63 out of 133 (47%), (See Table 1). So the total patients who had Tinel's sign was 96 (33+63) out of 133 hands (72%) and total patients who had positive Phalen's sign was 100 (37+63) out of 133 (75%). Mild, moderate and severe CTS was seen in 51/133 (38%), 54/133 (41%) and 28/133 (21%) out of the total number of the studied patients. Both signs positive was seen in 25/63 (40%), 26/63 (41%), and 12/63 (19%), in mild, moderate and severe CTS respectively.

Table 1. The percentage of Tinel's and Phalen's signs

| Provocative test | Total |
|----------------------------|----------|
| + ve Tinel's sign only | 33 (25%) |
| + ve Phalen's only | 37 (28%) |
| Both + ve at the same time | 63 (47%) |
| Total | 133 |

Phalen's sign only was seen in 12/37 (32%), 15/37 (41%) and 10/37 (27%) in mild, moderate and severe CTS respectively. Tinel's sign only was seen in 14/33 (42.3%), 13/33 (39.4%) and

6/33 (18.2%) in mild, moderate and severe CTS respectively (Table 2 and 3).

Discussion

Carpal tunnel syndrome affects almost 5% of the population and is most common in middle-aged women, in about 70% of the cases; it is bilateral and is prevalent in the dominant hand.

The sensitivities of all the provocative tests are different according to the levels of electrodiagnostic severity ⁽⁷⁾. In the present study Positive Tinel's sign only was seen in (25%) and Positive Phalen's maneuver only in (28%).

Both Tinel's sign and Phalen's maneuver positive at the same time were seen in (47%). Total Tinel's sign was seen in 72% and total Phalen's maneuver positive was seen in 75%. These results is higher than the results of other studies that showed 62% and 45% of carpal tunnel syndrome had Tinel's sign and positive Phalen's test respectively. Phalen found a positive Tinel's sign in 73% of hands of patients with CTS ⁽⁸⁾. Stewart et al. and Gelmers *et al.* studies found Tinel's sign was seen in approximately 45% of their patients ^(9,10).

Table 2. Correlation of CTS severity with provocative tests of CTS

| CTS severity | + ve Both signs | + ve Phalen's sign | +ve Tinel's sign |
|--------------|-----------------|--------------------|------------------|
| Mild | 25/63 (40%) | 12/37 (32%) | 14/33 (42.3%) |
| Moderate | 26/63 (41%) | 15/37 (41%) | 13/33 (39.4%) |
| Severe | 12/63 (19%) | 10/37 (27%) | 6/33 (18.2%) |
| Total | 63/63 | 37/37 | 33/33 |

P = 0.577

Table 3. Correlation of provocative tests with the CTS severity

| Provocative Test | Mild | Moderate | Severe | Total |
|---------------------|---------------|--------------|--------------|-------|
| Tinel's Sign | 25/51 (49%) | 26/54 (48%) | 12/28 (43%) | 63 |
| Phalen's sign only | 12/51 (23.5%) | 15/54 (28%) | 10/28 (36%) | 37 |
| Both signs positive | 14/51 (27.5%) | 13/54 (24%) | 6/28 (29%) | 33 |
| Total | 51/133 (38%) | 54/133 (41%) | 28/133 (21%) | 133 |

P = 0.949

The results of phalen's sign in the present study was 75%; which is in approximate to the results of numerous studies of Phalen's maneuver in the hands of patients with suspected carpal tunnel syndrome which varied from 10% to 88%, with an average of 62% ^(11,12). The present study showed 38% of CTS was mild, 41% moderate and in 21% it was severe. This is different from Yazdchi *et al.* study who's percentage of moderate and severe severity groups were 53.8% and 13.5% respectively.

The higher rate of severe group and the lower rate of moderate severity group in the present study was related to poor awareness of the

disease and late seeking of medical consultation until reaching severe pain in Iraqi patients ⁽¹³⁾.

The present study results showed no correlation between presence of provocative signs whether phalen's sign or tinel's sign with steps of severity according to modified Padua scale of CTS severity; this results was not agreeing the conclusions of Italian CTS study group and Bland study whom demonstrated a good correlation between the clinical and electrophysiological staging of the CTS ^(14,2).

Also this result is not agreeing Ahn *et al.* study who found that Provocative tests have little merit as diagnostic tools in "severe" and "mild"

cases of CTS but the provocative tests are much more reliable in "moderate" cases⁽¹⁵⁾.

Based on the above results of the present study of no correlation between presence of provocative signs whether phalen's sign or tinel's sign with steps of severity of electrophysiological study and presence of positive phalen's sign and Tinel's sign in 20 % and 25% of healthy peoples respectively^(12,16), hence those electrophysiological studies is mandatory for diagnosis as well as for severity categorization; furthermore many reports suggested that the neurophysiologic finding of carpal tunnel syndrome has superior sensitivity compared to the clinical sign of the disease; so that the provocative tests often are negative in spite of obvious presentation of the syndrome and evident electrophysiological abnormalities of the disease⁽¹⁴⁾.

In conclusion, provocative tests of carpal tunnel syndrome is not elicited in good percentage of patients, no correlation between presence of provocative signs whether phalen's sign or tinel's sign with steps of severity of electrophysiological study and there is no correlation between severity of electrophysiological study and presence of provocative signs.

References

- Jillapalli D, Shefner JM. Electrodiagnosis in common mononeuropathies and plexopathies. *Semin Neurol*. 2005; 25:196-203.
- Bland JD. Carpal tunnel syndrome. *Curr Opin Neurol*. 2005; 18:581-5.
- Werner RA, Andary M. Carpal tunnel syndrome: pathophysiology and clinical neurophysiology. *Clin Neurophysiol*. 2002; 113(9):1373-81.
- Urbano FL. Tinel's sign and Phalen's maneuver: physical signs of Carpal tunnel syndrome. *Hospital phys*. 2000; 12:39-44.
- American Association of Electrodiagnostic Medicine, American Academy of Neurology, American Academy of Physical Medicine and Rehabilitation, Practice parameter for electrodiagnostic studies in carpal tunnel syndrome: Summary statement. *Muscle Nerve*. 2002; 25:918-22.
- Padua L, Lo Monaco M, Gregori B, et al. Neurophysiological classification and sensitivity in 500 carpal tunnel syndrome hands. *Acta Neurol Scand*. 1997; 96:211-7.
- Buch JN, Foucher G. Correlation of clinical signs with nerve conduction test in the diagnosis of carpal tunnel syndrome. *J Hand Surg Br*. 1994; 19:720-4.
- Phalen GS. The carpal tunnel syndrome: 17 years' experience in diagnosis and treatment of 654 hands. *J Bone Joint Surg Am*. 1966; 48:211-28.
- Stewart JD, Eisen A. Tinel's sign and the carpal tunnel syndrome. *Brit Med J*. 1978; 2:1125-6.
- Gelmers HJ. The significance of Tinel's sign in the diagnosis of carpal tunnel syndrome. *Acta Neurochir*. 1979; 49:255-8.
- Seror P. Phalen's test in the diagnosis of carpal tunnel syndrome. *J Hand Surg Br*. 1988; 13:383-5.
- Kuschnier SH, Ebramzadeh E, Johnson D, et al. Tinel's sign and Phalen's test in carpal tunnel syndrome. *Orthopedics*. 1992; 15:1297-302.
- Yazdchi M, Khandaghi R, Arami A. Evaluation of F-Wave in Carpal Tunnel Syndrome (CTS) and Its Prognostic Value. *J Neurol Sci* 2005; 22(1):15-20.
- Priganc VW, Henry SM. The relationship among five common carpal tunnel syndrome tests and the severity of carpal tunnel syndrome. *J Hand Ther* 2003; 16:225-36.
- Ahn DS, Kang DH. The relationship between Electro diagnostic Severity and Three Provocative Tests in Carpal Tunnel Syndrome. The complete plastic surgery experience/71ST annual ASPS/PSEF/ASMS.SCINTFIC meeting educational program 2002, volume 6; 985.
- Katz JN, Larson MG, Sabra A, et al. The carpal tunnel syndrome: diagnostic utility of the history and physical examination findings. *Ann Intern Med*. 1990; 112:321-7.

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