Medical Journal of Babylon
Vol. 13- No. 2: 445 - 451 , 2016
http://www.medicaljb.com
ISSN 2312-6760©2016 University of Babylon

Original Research Article

The Value of Wrist-Palm Median Motor Conduction Velocity in The Diagnosis of Carpal Tunnel Syndrome

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Accepted 17 April, 2016

Abstract

Carpal tunnel syndrome is the commonest entrapment neuropathy. Typically patients presented with acroparasthesia and pain mainly at night. The study aims to find the value of wrist-palm median motor conduction velocity in the diagnosis of carpal tunnel syndrome.

171 patient suffer from classical symptoms and signs of carpal tunnel syndrome enrolled in the study and compared to 100 healthy control. All patients and controls undergo neurophysiological testing including wrist-palm median motor conduction velocity measurement. The study results show that most patients with carpal tunnel syndrome show abnormal wrist-palm median motor conduction velocity with sensitivity of 91% and specificity 80%.

The study concluded thatmidpalm-wrist median motor conduction velocity is an easily performed electrophysiological technique. It don't require additional equipment or expertise and give high sensitivity and specificity in the diagnosis of CTS.

Key words: Carpal tunnel syndrome, nerve conduction study, wrist-palm median motor conduction velocity, entrapment neuropathy.

الخلاصة

تعتبر متلازمة اعتلال العصب الرسغي من اكثر أنواع الاعتلال العصبي الانحباسي شيوعا. وعادة ما يعاني المرضى من تنمل الأطراف وآلام وتكون أساسا في الليل.

يهدف البحث إلى العثور على أهمية قياس سرعة التوصيل العصبي بين الرسغ والكف للعصب الوسطي الحركي في تشخيص متلازمة النفق الرسغي.

سجل 171 مريض يعانون من أعراض وعلامات كلاسيكية لمتلازمة النفق الرسغي في الدراسة وتمت مقارنتهم مع 100 شخص من الأصحاء. خضع جميع المرضى و مجموعة السيطرة لاختبارات التوصيل العصبي بما في ذلك قياس سرعة التوصيل العصبي بين الرسغ والكف للعصب الوسطي الحركي .وأظهرت الدراسة إن معظم المرضى الذين يعانون من متلازمة النفق الرسغي اظهروا نتائج غير طبيعية عند قياس سرعة التوصيل العصبي بين الرسغ والكف للعصب الوسطي الحركي مع حساسية 91٪ وخصوصية 80٪.

الخلاصة: قياس سرعة التوصيل العصبي بين الرسغ والكف للعصب الوسطي الحركي هي تقنية الكهربية يمكن تأديتها بسهولة. أنها لا تتطلب معدات أو خبرات إضافية وتعطي حساسية وخصوصية عاليتين في تشخيص متلازمة العصب الرسغي.

الكلمات المفتاحية: متلازمة العصب الرسغي, التخطيط العصبي الكهربائي, قياس سرعة التوصيل العصبي بين الرسغ والكف للعصب الوسطي الحركي, اعتلال الأعصاب الانحباسي.

Introduction

Carpal tunnel syndrome (CTS) is the commonest entrapment neuropathy. It has been related to many factors like occupational factors including deviated wrist postures, especially when combined with repetitive and forceful use of the hand[1].Symptoms usually start gradually, with frequent tingling and/or numbness in the palm and the lateral three fingers and half of the ring finger. A person with CTS may wake up at night from paraesthesia and need to ‘‘shake out’’ the hand or wrist[2]. Between 55% and 65% of CTS cases present bilaterally, and the condition can be associated with hypothyroidism, diabetes, and rheumatoid arthritis, among others. CTS may present in late pregnancy but is usually transient[3].

The diagnosis of CTS is clinical and is basedon symptoms and on the distribution of sensory alterations in the hand. Also diagnosis can be made by means of neurophysiological methods for evaluating the conduction velocity of the median nerve across carpal ligament. The sensitivity of electrodiagnostic tests on the mediannerve ranges from 49% to 84%, while specificities around 95% have been registered[4].

NCS provides the most objective, quantitative & non-invasive assessment of myelinated nerve fibre dysfunction, and has an important complimentary function in cases of atypical clinical presentation, or when other underlying causes such as neuropathy are suspected[6].

Materials and Methods

This case control study was conducted at the period of July 2012 to May 2015. It included 171 patients and 100 control subjects. Control subjects who were healthy and free from any clinical feature of the disease have the same age, gender and body mass index parameters as those of patients.

Diagnosis of CTS was based on the American Academy of Neurology clinical diagnostic criteria (AAN, 1993) summarized here: paresthesia, pain, weakness or clumsiness of the hand provoked or worsened by sleep, sustained hand or arm position, repetitive action of the hand or wrist that is relieved by changing posture or by shaking of the hand; sensory deficits in the median innervated region of the hand and motor deficit or hypotrophy of the median innervated thenar muscle; symptoms elicited by Phalen test (1 min passive forced flexion of the wrist), performed on each patient[6].

Exclusion criteria

1- clinical or electrodiagnostic features of polyneuropathy or radiculopathy.

2- paste history of disease that affect nerve function like diabetes.

3- drug or toxic exposure that damage nerves like chemotherapeutic agents.

Nerve Conduction Study

Nerve conduction study of median and ulnar nerves was done both sensory and motor with F-wave studies was done for the patients and control. Internal comparison nerve conduction tests was done and include: Comparison of median to ulnar palmar mixed latencies (orthodromic),comparison of median to ulnar sensory latencies recording ring finger (antidromic),comparison of median to ulnar motor latencies recording second lumbrical and second interossei, respectively and comparison of median to radial sensory latencies recording thumb (antidromic)[7].

1- Routine median motor nerve conduction study:the test was done recording from Abductor Pollicus Brevis (APB) muscle and stimulating at the wrist (middle of the wrist between the Flexor Carpi Radialis and Palmaris Longus tendons) and at the elbow (Antecubital fossa over the brachial artery pulse). Distal motor

latency>4.4 ms and CMAP amplitude<4 mV were considered abnormal.

2- Routine sensory motor nerve conduction study:- is done whole recording from index finger and stimulating at the wrist with distance between recording and stimulating electrode fixed at 12 cm.

3- Routine ulnar motor nerve conduction study to exclude more widespread polyneuropathy: Recording was done on Abductor Digiti Minimi muscle and the ulnar nerve was stimulated at the wrist (medial wrist adjacent to Flexor Carpi Ulnaris tendon), below the elbow (3–4 cm distal tomedial epicondyle) and above the elbow (10–12 cm from below elbow site). Distal Latency >3.3 ms and Amplitude <6 mV were considered abnormal.

4- Routine ulnar sensory nerve conduction study:- done by recording at the little finger and stimulating above ulnar nerve at the wrist with distance between stimulating and recording electrode kept fixed at 12 cm.

5- Wrist-palm median motor conduction velocity: Motor nerve conduction study of the median nerve was done while recording as usual from APB but stimulating the median nerve 6 cm distal to the wrist site (on a line drawn from the median wrist to the web space between the index and middle fingers). Stimulating median nerve at the wrist was done as usual and conduction velocity was measured between midpalm-wrist segment of median nerve. A value less than 45m/sec is considered as abnormal and is diagnostic of CTS[8].

Statistical analysis

The collected data were revised and introduced to a computer using Statistical package for Social Science (SPSS 15.0.1 for windows; SPSS Inc, Chicago, IL, 2001). Data were presented and suitable analysis was done according to the type of data obtained for each parameter. Data were expressed as Mean ± SD for quantitative measures and both number and percentage for categorized data. The comparison between two groups was assessed using the unpaired t-test for numeric variables. The comparison between three groups was assessed using ANOVA test for parametric data. ROC curve was used to find sensitivity and specificity of the test.

Results

Demographic data

The demographic data of patients and controls is shown on table 1

Table 1:demographic data of study group

Variable	Patients	Control
Age (years)	39±11	31±13
Sex (female/male)	162/9	91/9
Duration of symptoms (months)	5	0

Symptom profile

The study found that most patients were presented with parasthesia of hand at median nerve distribution and pain, while control group was symptom free. The symptom profile of patients is shown in table 2.

Table 3:symptom profile of the patients

Symptom	No. of patients (%)
Parasthesia	165 (95%)
Pain	1105 (79%)
Nocturnal symptoms	85 (50%)
Weakness	13 (2.5%)

Nerve Conduction Study Findings

The results of nerve conduction study of both median and ulnar nerves both motor and sensory findings are shown in table 3, 4, 5 and 6.

Table 3:NCS findings of median nerve motor study for both patients and control

Variables			P-value
Latency (ms)	**Patient**	4±1.1	0.002
	Control	2.6±0.2	
Amplitude (mv)	**Patient**	8.3±2.3	0.00
	Control	10±1.7	
CV (m/s)	**Patient**	58±6	0.5
	Control	61±6	

Table 4:NCS results of ulnar nerve motor study for both patients and control

Variables			P-value
Latency (ms)	**Patient**	2±0.2	0.3
	Control	2±0.2	
Amplitude (mv)	**Patient**	10.2±5	0.9
	Control	10.1±1.8	
CV (m/s)	**Patient**	61±8	0.5
	Control	62±7	

Table 5:NCS findings of median nerve sensory study for both patients and control

Variables			P-value
Latency (µs)	**Patient**	2.5±0.9	0.004
	Control	2±0.1	
Amplitude (µv)	**Patient**	28±19	0.00
	Control	47±20	

Table 6: show midpalm-wrist median motor conduction velocity in patients and control

	Patient	Control	P-value	Sensitivity	Specificity
Midpalm-wrist median motor conduction velocity (μs)	31±11	62±13	0.00	91%	80%

Discussion

The diagnosis of carpal tunnel syndrome (CTS) continues to be neurophysiologically and clinically controversial[9] because of the lack of clearly stated, widely agreed on, and formally established diagnostic criteria for it as well as absence of gold standard diagnostic test[10].

Neurophysiologically the diagnostic tests of CTS can be categorized into ordinary (measurement of motor and sensory conduction parameters of median nerve) and more sensitive internal comparative diagnostic tests techniques that compare the median sensory or motor conduction across carpal tunnel with an adjacent nerve in the same hand which does not pass through the carpal tunnel and presumed to be normal[11]. These comparative tests increase the sensitivity of electrodiagnosis of CTS to 95%[4].

In our study, we test the conduction study of median nerve between wrist-palm segment during its passage in the carpal tunnel and found that this test has very high sensitivity (91%) and specificity (80%) compared to other electrodiagnostic techniques of CTS.

This result agree with other studies [12-17], that found wrist-palm conduction velocity has high sensitivity (81%) and specificity (95%) in the diagnosis of CTS, while other studies [18, 20] found higher sensitivity (88%) which is comparable to that seen in our study.

The variation in sensitivity seen between variable studies is probably related to patient selection. In the present study we select every patient with CTS regardless of their severity while other studies with lower sensitivity select patients with negative ordinary NCS who has milder disease.

Also the study help to resolve important questions and debates about CTS electrodiagnosis like:-

1- Generally, it is said that testing sensory part of median nerve is more sensitive than testing the motor part in the diagnosis of CTS because 85% of median nerve fibers that innervate the hand is sensory fibers[21] and so it's more likely to be compressed by narrow carpal tunnel. Limited number of studies have investigated the usefulness of motor studies in the diagnosis of CTS; however, no consensus has been reached regarding which motor conduction technique is the most valuable[22]. This study showed that motor nerves is compressed as early as sensory one and it's abnormal early in the course of disease. This result also seen in other studies [17].

2- The study calculates the transcarpalconduction velocity of median nerve (between the midpalm-wrist segment) and this is short segment (6 cm) will help to localize the lesion of median nerve into short distance and then help in the confirming its presence. On the other hand measurement of conduction velocity over long segment probably give normal results because of the dilution of focal pathology by the normal remaining long segment(16), [23].

3- The measurement of wrist-palmmedian motor conduction velocity considered as a direct internal comparison technique. These techniques will control the effects of temperature, age and even the

effects of superimposed diseases on the test results[24].

The limitations of the study are, 1- There is still debate over the gold standard for diagnosis of CTS. Pathology is the sole definite method. However, it is not possible to perform pathologic examination in all patients with suspected CTS. More sensitive and specific diagnostic approaches therefore need to be developed, and this study was designed to study them[16].

Conclusions

Midpalm-wrist median motor conduction velocity is an easily performed electrophysiological technique. It don't require additional equipment or expertise and give high sensitivity and specificity in the diagnosis of CTS.

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