Role of Ultrasound in Diagnosing Carpal Tunnel Syndrom

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Abstract

Back ground: Carpal tunnel syndrome is the most commonly diagnosed entrapment neuropathy of the upper extremity. Ultrasound has emerged as an alternative confirmatory test for Carpal tunnel syndrome, however, its potential role is limited by lack of adequate data for sensitivity and specificity.

Aim of study: to assess the usefulness of ultrasound in the diagnosis of carpal tunnel syndrome for cases their diagnosis confirmed by surgery.

Patients and Methods: a prospective study during a period from August 2014 to August 2015, in which 40 patients with a clinical diagnosis of carpal tunnel syndrome, all patients were subjected to examination by high-resolution ultrasound and then all were operated upon by fasciatomy to confirm diagnosis, then sensitivity, specificity and accuracy of ultrasound were calculated.

Results: the present study included 40 patients; 36 females and 4 males, 5 left hand and 35 right, age range 20-50 years; mean±SD (37.28±9), Sensitivity for PD and FR were 90% and 75% respectively, specificity for PD and FR were77.5% and 85% respectively, and accuracy for PD and FR were 84% and 83% respectively.

Conclusions: The present study included 40 patients 36 females and 4 males, 5 left hand and 35 right, age range 20-50 years; mean±SD (37.28±9), sensitivity for PD and FR were 90% and 75% respectively, specifity for PD and FR were 77.5% and 85% respectively and accuracy for PD and FR were 84% and 83% respectively.

Conclusion; ultrasound is a useful method for confirming diagnosis of median nerve involvement in patients with carpal tunnel syndrome.

Keywords: Carpal tunnel syndrome, Ultrasonography, flattening ratio, palmar displacement.

Introduction:

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy and peripheral entrapment mono neuropathies, usually occurs due to localized compression of the median nerve in the carpal tunnel, this syndrome was first reported by Phalen. in 1950, although its cause is unknown, this condition is predominant in middle-aged women [1-5], and associated with obesity, pregnancy, diabetes mellitus, wrist repetitive stress and hypothyroidism. CTS diagnosis is primarily based on clinical history of burning pain, numbness, and nocturnal paresthesia along the median nerve distribution, physical examination and signs, such as Tinel sign and Phalen sign and Durkan test, electro diagnostic studies (EDTs) (nerve conduction and electromyography) and imaging techniques, the clinical signs are moderately sensitive and specific [6-8]. (EDTs) have limitations as they are uncomfortable and do not directly assess the anatomy of the median nerve and its surrounding structures, and false negative and false positive results had been reported [7-11]. Ultrasonography has emerged by Buchberger 1991 as an important diagnostic investigation for CTS.[12-13]. A number of ultrasonographic changes have been demonstrated in CTS including swelling of the median nerve, flattening of the nerve, palmar bowing

and thickening of the flexor retinaculum and changes in the median nerve appearance [12], however, specific ultrasonographic criteria may vary from study to study.

Ultrasonic imaging findings:

Buchberger 1991 and his co-worker, who first studied the efficacy of ultrasound in the diagnosis of CTS, reported that thickening of the median nerve, flattening of the nerve within the carpal tunnel and bowing of the flexor retinaculum were all features diagnostic of CTS. Later in 1992 he and other researchers showed that By measuring the flattening ratio (FR) by dividing nerve transverse axis to its antero-posterior axis, which is of at least 3 at level of hamate bone, or a displacement of the flexor retinaculum above 4 mm or more from the straight line between the attachments to the trapezium tubercle and the hamate bone are sonographic signs suggestive of CTS [14- 17]

Patients and methods:

A retrospective intervention study performed at Al Yarmouk teaching hospital between July 2014 to the end of July 2015 on 40 patients with unilateral symptoms and signs of carpal tunnel syndrome, with age range 20-50, mean±SD (31.07±7.439), four of them were males and 36 were females; rartio1/9 . In thirty five the right side was affected and 5 the left. All patients were treated surgically and followed up for relief of symptom.

Written and verbal consents were obtained from all patients.

Inclusion criteria:

All patients had to have positive clinical diagnosis of CTS and experience relive of their symptom during follow up after surgery for inclusion.

Exclusion criteria include:

Patients with a history of previous wrist surgery or fracture and conditions associated with other neuropathy.

US examination:

All patients underwent sonographic evaluation that was performed by senior radiologist. Ultrasound (US) examination is performed by using a 5- 13 MHz linear array transducer at the radio diagnosis department. Median nerve was examined in the transverse and longitudinal planes along the carpal tunnel. Each wrist was evaluated for the presence or absence of the 2 sonographic criteria which are the PD and FR.

Statistical analyses:

The sensitivity, specificity, accuracy, positive predictive values of US were calculated. All proved by surgery. Estimation of MSD, T test and Chi-square have been done.

Results:

In the present study 40 patients; 36 female and 4 male, 5 left hand and 35 right, ranging in age between 20–50 years; mean±SD (37.28±9) (Table 1). Results of clinical tests were shown in table-2.

All patients underwent U/S examination measuring the PD of and FR (tables 3&4). Sensitivity for PD and FR were 90% and 75% respectively, specificity for PD and FR were77.5% and 85% respectively, positive predictive value for PD and FR were 80% and 83% respectively and accuracy for PD and FR were 84% and 83% respectively (table-5).

Table-1: Distribution of study sample according to basic variables.

Variable	Mean ± SD or percentage
Age	31.07±7.439
Sex	Male 10%, female 90%
Weight	68.33± (8.31)
Height	161.63 ±(6.03)
BMI	26.13± (2.75)
Side	Right 87.5%, Left 12.5%

Table-2: Results of clinical tests.

Clinical test	Number of patients		Total	p-value
	Positive	Negative		
Phalen test	37	3	40	0.0001
Reverse Phalen	35	5	40	0.0001
Tinel's sign	38	2	40	0.0001
p-value was 0.0001				

Table 3: Means and SD measurement of PD in patient and correlations in multiple parameters with their Chi-square, significant & confidence interval.

Gender & side	PD	t-test		C.I.
	Mean (SD)	t-Value	P-Value	
Male	4.78 ±1.16	-3.94	0.002**	95% 0.67-2.3
Female	3.9 ±0.68	-6.36	0.000***	95% 0.71-1.08
Left	4.1±0.75	-2.5	0.024*	95% 0.09-1.42
Right	3.97 ±0.78	-0.835	0.407	95% 0.77-1.04
Total	3.99 ±0.77	-6.705	0.000***	95% 0.71-1.13

Table 4: Means and SD measurement of FR in patient and correlations in multiple parameters with confidence interval.

	FR	t-test		C.I.
	Mean (SD)	t-Value	P-Value	
Male	5.75 (0.1)	-7.2	0.000***	95% 1.17-2.16
Female	4.6 (0.93)	-7.659	0.000***	95% 1.35-1.62
Left	4.83 (1.13)	-2.64	0.019*	95% 0.27-2.42
Right	4.72 (0.89)	-6.93	0.000***	95% 0.91-1.64
Total	4.75 (0.77)	-7.34	0.000***	95% 1.02-1.55

Table (5): results of u/s diagnosis in CTS.

Parameter	Sensitivity	Specificity	Positive Predictive value	Accuracy	P-value
PD>3.3	90%	77.5%	80%	84%	0.0001
FR>4	75%	85%	83%	80%	0.0001

Discussion:

Carpal tunnel syndrome (CTS) is a clinical syndrome resulting from compression of the median nerve within fibro-osseous tunnel at the wrist [18]. In the present study male to female ratio was 1:9 with housewife 10 out of the 40, this fact may be due to the hormonal changes during menstrual cycle and pregnancy and the overload in their house work that most of housewives are subjected to [19]. Accurate diagnosis of carpal tunnel syndrome and its differentiation from other causes of hand morbidity are essential, particularly if the patient is a candidate for surgery [20] .the diagnosis usually based on typical clinical signs and symptoms, Ultrasound has been advocated as a non-invasive, low cost technique for diagnosis of CTS, enables morphologic assessment including FR and PD [16,21]. Robert A. Werner 2011[22] in his study about CTS documented that in the majority of cases a careful history and physical examination are sufficient to make a diagnosis of CTS and make initial treatment decisions. However, many patients present with multiple problems and or their presentation are atypical. An Electrodignostic (EDS) examination can confirm the clinical impression of CTS, which is reassuring for both the patient and physician however several authors have recommended the need for further studies about the role of imaging modalities in the diagnosis of CTS, considering that there are some drawbacks in the diagnostic accuracy of EDS. Koyuncuoglu et al. [23] revealed positive US findings in patients who had CTS clinical diagnosis, with negative EDS in 30.5% of these patients. In this study all patients were evaluated clinically and had relief of their symptom after surgery, Carlo Martinoli [24] in his study documented that the US criteria for median nerve compression include the FR, and PD. This study showed that U/S findings of median nerve (FR >4 mm and PD>3.3mm) were useful in diagnosing CTS (table-6), Duncan et al found FR to be 3.17 in CTS patient, Buchberge and Sarria found it as >3.3 to be significant, they also measured PD and accepted >4 mm a significant value [13,15,25]. In this study we evaluated the accuracy of the two sonographic signs in predicting CTS, sensitivity for FR was 75% and specificity 85%, Kok-Yu Chan *et al.* 2011 found them to be 70% and 83% while Naranjo *et al* 2007study showed them to be 65% and of 47 % successively[26-27].

In the present study the sensitivity for PD was 90%, and specificity was 77.5% and this in accordance with Ahmed Abdul Bari *et al* 2013 who found sensitivity for PD to be 72% and specificity as 100%, this difference of could be due to small numbers of patients they included while Mallouhi *et al* study showed sensitivity 65%, and specificity of 68% [28, 29].

Conclusions:

ultrasonic measurements of the PD and FR are valuable method for diagnosing median nerve involvement in patients with carpal tunnel syndrome.

Recommendation:

This study showed that there is a significant correlation between median nerve deformation and displacement in carpal tunnel, this information may be helpful to understand the pathology of CTS.

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