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Original article

Ultrasonography as a tool in diagnosis of carpal tunnel syndrome☆

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ABSTRACT

Objective: We aimed to determine the value of ultrasonography (US) in the diagnosis of carpal tunnel syndrome (CTS).
Methods: Two hundred patients (400 hands) were submitted to wrist US to measure median nerve area (MNA), questioning on paresthesia and pain in the median nerve territory, Tinel and Phalen maneuvers. An MNA >9 mm^2 was considered diagnostic of CTS.
Results: Measurement of MNA by US was >9 mm^2 in 27% of the hands. A good association with pain ($p < 0.0001$), paresthesia ($p < 0.0001$), Tinel test ($p < 0.0001$) and Phalen test ($p < 0.0001$) was found. According to the clinical criteria for classification of CTS from American Academy of Neurology the MNA by US had 64.8% of sensibility and 77.0% of specificity in this sample.
Conclusion: Measurement of MNA by US performs well and can be used as first option for the investigation of patients with CTS.

Ultrassonografia no diagnóstico da síndrome do túnel do carpo

Palavras-chave:
Síndrome do túnel do carpo
Ultrassonografia
Dor na mão
Parestesia na mão

RESUMO

Objetivo: Determinar a importância da ultrassonografia (US) no diagnóstico da síndrome do túnel do carpo (STC).
Métodos: Duzentos pacientes (400 mãos) foram submetidos a uma US do punho para medir a área do nervo mediano (ANM). Foram perguntados quanto à presença de parestesia e dor no território do nervo mediano e submetidos aos testes de Tinel e Phalen. Uma ANM > 9 mm^2 foi considerada diagnóstica de STC.

☆ This study was originated in the Rheumatology and Radiology departments of Hospital Universitário Evangélico de Curitiba, Curitiba, PR, Brazil.

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Resultados: O valor da ANM medida pela US foi > 9 mm² em 27% das mãos. Foram encontrados uma boa associação com a dor ($p < 0{,}0001$), parestesia ($p < 0{,}0001$), teste de Tinel ($p < 0{,}0001$) e teste de Phalen ($p < 0{,}0001$). De acordo com os critérios clínicos para a classificação da STC da American Academy of Neurology, a ANM medida pela US teve 64,8% de sensibilidade e 77% de especificidade nessa amostra.

Conclusão: A mensuração da ANM pela US é adequada e pode ser usada como primeira opção para a investigação de pacientes com STC.

Introduction

Carpal tunnel syndrome (CTS) is the most frequent entrapment neuropathy, it is due to the compression of the median nerve at the wrist.[1] The history and physical examination, including provocative signs such as Tinel and Phalen maneuvers, have been considered highly suggestive of the diagnosis.[2] Eletroneuromyography (EMG) studies are usually considered to prove it,[3] but this is a test that is not readily accessible and not well tolerated by all the patients that preclude its repetition for patient's follow up.

Recently wrist ultrasonography (US) with measurement of the median nerve area (MNA) has been considered an alternative to EMG.[4] An MNAof 9 mm² in the distal carpal tunnel, at levels of pisiform bone is considered diagnostic of CTS.[5,6] According to some researchers this is an exam with high sensitivity and specificity in CTS diagnosis[4–6]; others are not so enthusiastic. Mondelli et al.[1] found that almost 1/4 of patients with diagnosis of mild cases of CTS diagnosed clinically could not have been detected by US. Carvalho et al.,[5] in a review, found that MNA US measurement has 82 to 86% of sensibility and 48 to 87% of specificity.

One of the problems of studying CTS is the lack of consensus to establish the definitive diagnosis.[7] Neurologists traditionally establish it based more on the outcome of nerve conduction studies than on the patients' signs and symptoms.[7] In contrast, hand surgeons appear to give considerably more importance to the patients'signs and symptoms.[7] The lack of universally accepted classification criteria may be responsible for the diversity of results seen in the literature.

To look further into the usefulness of US to diagnose CTS, we measured the MNA of 200 individuals to analyze if this measure could predict which patient had or not clinical symptoms of CTS.

Patients and methods

Two hundred hospital workers (35 men and 165 women) were invited to participate in the study. After approval of local Committee of Ethics in Research and patient's signature of consent term, all participants filled the Katz diagram for pain and numbness in the median nerve area.[8] Physical examination included Phalen[1] and Tinel test.[1] Tinel's test[1] was performed by tapping the median nerve at the wrist, and this was repeated four to six times. The presence or absence of radiating pain or paraesthesia in the median nerve distribution was recorded. Phalen's test[1] was executed by asking each subject to hold hand with the wrist in complete palmar flexion with elbow extended and forearm pronated. The Phalen's test was considered positive if symptoms were reproduced in 1 min.

The MNA was measured by US equipment (Toshiba XARIO XG, Tokyo, Japan), with a multifrequential linear transductor of 12 MHz at volar distal surface of the wrist (at the level of pisiform and tuberosity of scaphoid) by a blind technician. For the examination, patients should be seating in a chair with arms extended and hands with finger semiextended. A MNA with more than 9 mm² was considered diagnostic of CTS.[5]

Data were collected in frequency and contingency table. The sample distribution was tested by Kolmogorov–Smirnov test. Central tendency was expressed in median and interquartile range (IQR) as the sample distribution was nonparametric. Association studies were done by chi-squared (χ^2) test. Adopted significance was of 5%. Calculation was done with specific software (Graph Pad Prism version 5.0, San Diego, USA).

Results

The studied sample was formed by 35 men and 165 women with median age of 40.0 years (ranging from 18.0 to 74.0 years; IQR of 27.0–49.0 years). In this sample 39/200 (19.5%) were afrodescendant; 156/200 (78%) caucasians, and 5/200 (2.5%) orientals. According to labor activities, 142/200 (71%) had manual work and 58/200 (29%) had white collar work.

In the 400 examined hands, paresthesia was found in 108/400 (27.5%), pain in 106/400 (26.5%), positive Tinel test in 99/400 (24.7%) and positive Phalen's test in 97/400 (24.2%). Both symptoms (pain and paresthesia) were found simultaneously in 74/400 (18.5%) and both signs (Tinel and Phalen's) in 60/400(15%).

MNA at US had a median value of 8 mm² (ranging from 4 to 21 mm²; IQR of 6.0–10.0 mm²). In 108/400 (27%) hands the value of MNA was >9 mm² characterizing presence of CTS by the US.

Comparing the presence of signs and symptoms in those with MNA >9 mm² with those with ≤9 mm² by US, it was found the results shown in Table 1.

If the CTS diagnosis were made according to American Academy of Neurology criteria[9] that considers classic/probable cases those with paresthesia or pain in at least 2 of the first 3 fingers, the MNA by US had 64.8% of sensibility and 77.0% specificity in this sample.

Table 1 – Presence of symptoms and signs of carpal tunnel syndrome according to the value of median nerve area measured by ultrasound.

	MNA with >9 mm^2 $n = 108$	MNA with ≤9 mm^2 $n = 292$	p
Paresthesia	61/108 (56.4%)	47/292 (16.0%)	<0.0001
Pain	50/108 (46.2%)	56/292 (19.1%)	<0.0001
Tinel's sign	56/108 (51.8%)	43/292 (14.7%)	<0.0001
Phalen's sign	55/108 (50.9%)	42/292 (14.3%)	<0.0001

MNA, median nerve area.

Discussion

CTS is a very common entity. It affects from 2.7 to 5.8% of general population.[1–8] More than 80% of the patients are above 40 years of age and women are affected more commonly than men.[5] Bilateral involvement appears in nearly half of the cases but the dominant hand is the first and most severely involved.[5] This syndrome is considered mainly as a sensory disorder because the sensory fibers of the median nerve are more affected than the motors.[10] So, CTS patients complain of symptoms such as dull pain and tingling sensation in the thumb, index, and middle finger or paraesthesia and stiffness of hand primarily at night.[10] Atrophy in thenar muscle, weakness or clumsiness of hand, dry skin, swelling or color change in the hand also can be seen in some cases, but usually they are late findings[11] and this stage should be avoided by the early and correct treatment.

Paresthesias in the hands are nonspecific findings and may have multiple causes such as other neuropathies (diabetic, alcoholic etc.), other nerve entrapment disorders (cervical radiculopathy, thoracic outlet syndrome, etc.) and even by musculoskeletal disorders such as fibromyalgia.[12–15] The clinical judgment that relies solely on clinical findings can be misleading.

To have an exact diagnosis is of vital importance for many reasons. One of them is that the rate of success in the treatment is in direct dependence of diagnostic certainty. CTS can be treated both conservatively and with median nerve release surgery.[16] Surgery is often indicated in the failure of conservative treatment. A meta-analysis by Shi et al.[16] showed that surgery was superior to non-surgical intervention regarding improvement of eletrophysiological studies.

Other important reason for diagnostic accuracy is directly associated to work compensation. There is reasonable evidence that regular and prolonged use of hand-held vibratory tools increases the risk of CTS by 2 fold.[17] There is also a substantial body of evidence that tasks with continued and highly repetitious flexion or extension of the wrist increases the risk of CTS, especially when allied with a forceful grip.[17] Since this relationship has important ongoing implications for individual workers, work practice and workers'compensation systems, diagnosis based only in patient's complains may not be well acceptable. A study by Szabo,[17] done in California, estimated that nonmedical costs for CTS, including early retirement and disability are about US$10,000 per hand. The same author, taking into account medical costs, and indirect costs covered by patients and families assessed that, the total cost of a CTS patients varies from US$20,000 to US$100,000 per person.

In this context the use of MNA by US emerges as a useful tool evaluation. It has a good cost–benefit ratio, it is well tolerated by the patients, it is easy to perform and it can also diagnose associated disorders and neural anatomic variations. This last aspect may be of importance for surgical planning.

The present study showed that US is significantly associated with clinical signs and symptoms of CTS. It also showed a reasonable sensitivity and specificity so it that can be performed as a first line test, reducing the need of electroneurographic studies.

The measurement of MNA by US is useful as a first line diagnostic tool in patients with suspected CTS.

Conflicts of interests

The authors declare no conflicts of interest.

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REFERENCES

1. Mondelli M, Filippou G, Gallo A, Frediani B. Diagnostic utility of ultrasonography versus nerve conduction studies in mild carpal tunnel syndrome. Arthritis Rheum. 2008;59:357–66.
2. Leblanc KE, Cestia W. Carpal tunnel syndrome. Am Fam Physician. 2011;83:952–8.
3. Alfonso C, Jann S, Massa R, Torreggiani A. Diagnosis, treatment and follow-up of the carpal tunnel syndrome: a review. Neurol Sci. 2010;3:243–52.
4. Turrini S, Rosenfeld A, Juliano Y, Fernandes ARC, Natour J. Image diagnosis of Carpal tunnel syndrome. Rev Bras Reumatol. 2005;45:81–5.
5. Carvalho KMD, Soriano EP, Carvalho MVD, Mendoza CC, Vidal HG, Araújo ABV. Level of evidence and grade of recommendation of articles on the diagnostic accuracy of ultrasonography in carpal tunnel syndrome. Radiol Bras. 2011;44:85–9.
6. Wong SM, Griffith JF, Hul ACF, Lo SK, Fu M, Womg KS. Carpal tunnel syndrome: diagnostic usefulness of sonography. Radiology. 2004;232:93–9.
7. Bachmann LM, Jüni P, Reichenbach S, Ziswiler HR, Kessels AG, Vögelin E. Consequences of different diagnostic "gold standards" in test accuracy research: carpal tunnel syndrome as an example. Int J Epidemiol. 2005;34:953–5.
8. Aroori S, Spence RAJ. Carpal tunnel syndrome. Ulster Med Soc. 2008;79:6–17.

9. Rempel D, Evanoff B, Amadio PC, De Krom M, Franklin G, Franzblau A, et al. Consensus criteria for the classification of carpal tunnel syndrome in epidemiologic studies. Am J Public Health. 1998;88:1447–51.
10. Giannini F, Cioni R, Mondelli M, Padua R, Gregori B, D'Amico P, et al. A new clinical scale of carpal tunnel syndrome: validation of the measurement and clinical-neurophysiological assessment. Clin Neurophysiol. 2002;113:71–7.
11. Park SK, Lee JH, Lee HG, Ryu KY, Kang DG, Kim SC. Predictive value of sensory nerve conduction in carpal tunnel syndrome. J Korean Neurosurg Soc. 2006;40:401–5.
12. You H, Simmons Z, Freivalds A, Kothari MJ, Naidu SH. Relationships between clinical symptom severity scales and nerve conduction measures in carpal tunnel syndrome. Muscle Nerve. 1999;22:497–501.
13. American Association of Electrodiagnostic Medicine, American Academy of Neurology, American Academy of Physical Medicine Rehabilitation. Literature review of the usefulness of nerve conduction studies and electromyography for evaluation of patients with carpal tunnel syndrome. Muscle Nerve. 1993;16:1392–414.
14. De Campos CC, Manzano GM, De Andrade LB, Castelo Filho A, Nóbrega JA. Translation and validation of an instrument for evaluation of severity of symptoms and the functional status in carpal tunnel syndrome. Arq Neuropsiquiatr. 2003;61: 51–5.
15. Nacir B, Genc H, DuyurCakit B, Karagoz A, Erdem HR. Evaluation of upper extremity nerve conduction velocities and the relationship between fibromyalgia and carpal tunnel syndrome. Arch Med Res. 2012;43:369–74.
16. Shi Q, MacDermid JC. Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? A systematic review. J Orthop Surg Res. 2011;6:1–17.
17. Szabo RM. Carpal tunnel syndrome as a repetitive motion disorder. Clin Orthop. 1998;351:78–89.