Research Paper:
Use of Cross-Sectional Area of Median Nerve in Diagnosis of Carpal Tunnel Syndrome

Nafiseh Mohebi[1], Maryam Abdollahi[1]*, Saeed Razmeh[2]

1. Department of Neurology, School of Medicine, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran.
2. Department of Neurology, School of Medicine, Shahid Beheshti Hospital, Yasuj University of Medical Sciences, Yasuj, Iran.

Use your device to scan and read the article online

Citation: Mohebi N, Abdollahi M, Razmeh S. Use of Cross-Sectional Area of Median Nerve in Diagnosis of Carpal Tunnel Syndrome. Avicenna J of Neuropsychophysiology. 2017; 4(2):33-36. http://dx.doi.org/10.32598/ajnpp.4.2.33

doi: http://dx.doi.org/10.32598/ajnpp.4.2.33

Funding: See Page 35

Article info:
Received: 10 August 2016
Accepted: 25 December 2016
Available Online: 01 May 2017

Keywords:
Carpal Tunnel Syndrome, Ultrasonography, Cross-sectional area of median nerve

ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy. It occurs due to compression of median nerve in the wrist. This study evaluates the usefulness of Cross-Sectional Area (CSA) of the median nerve in the diagnosis of CTS. The aim of the study was to determining the diagnostic value of cross-sectional area of median nerve in CTS.

Materials and Methods: In this cross-sectional study, 86 cases of CTS (59 patients) and 16 normal subjects as the control group underwent ultrasonography of the wrist. The results of ultrasonography of two groups were compared.

Results: The data showed a significant difference in the CSA of median nerve between the patients with CTS and control group and also we observed significant difference in CSA of the median nerve according to grading of CTS based on Nerve Conduction Study (NCS).

Conclusion: Based on the study results, determining CSA of median nerve can be an effective method in CTS evaluation.

1. Introduction

Carpal Tunnel Syndrome (CTS) is a common disorder of the median nerve caused by the pressure on the median nerve at the wrist joint. It is prevalent among women, especially during pregnancy [1, 2]. It can be caused by many diseases, including diabetes mellitus, hypothyroidism, rheumatoid arthritis, acromegaly, and trauma as well as bone fracture [3].

The diagnosis of CTS is based on signs and symptoms and Electromyography (EMG) studies [4]. Although the electrodiagnostic testing is very specific, there is a chance of 10%–20% false-negative rate [5]. EMG studies can detect the level and severity of the lesion but Ultrasonography (USG), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) can assess the pathologic causes of CTS in bone and soft tissue [6, 7]. Of these methods, the ultrasonographic examination is more available and cheaper. According to recent stud-

* **Corresponding Author:**
Maryam Abdollahi, PhD
Address: *Department of Neurology, School of Medicine, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran.*
E-mail: *ssrahimi842@gmail.com*

ies, the Cross-Sectional Area (CSA) of the median nerve helps in diagnosis of CTS [5]. The purpose of our study was to document the significance of the ultrasonographic CSA of the median nerve in the diagnosis of CTS.

2. Materials and Methods

A total of 59 patients with the symptoms of numbness and paresthesia in their median nerve distribution (In total 86 wrists of them were affected) were referred from the neurology clinic after the confirmation of the clinical diagnosis by Nerve Conduction Study (NCS). The Research Ethics Committee approved this study and all patients signed written informed consent before participation in the study. In our study, positive NCS findings for CTS comprised mean sensory velocity of 50 m/s, sensory distal latency of 3.5 and motor distal latency of 4.2 ms.

The inclusion criteria for the study participants were aged between 20 and 60 years and the patients' disease confirmed by EMG-NCS. The exclusion criteria were having the history of wrist operation or anatomical variations, trauma, and hematological disorder. A total of 16 wrists without symptoms were selected as the control group. The ultrasonographic examinations were performed using high-resolution ultrasonography with a 7-10 MHz linear transducer (HDI 5000; Philips Medical Systems, Bothell, WA, USA). The CSA of the median nerve were measured from the proximal carpal tunnel. For the assessment of severity in NCS, we used the following scale:

Grade 0: Normal; Grade 1: Very mild, CTS show only with most sensitive tests; Grade 2: Mild, slow sensory median distal latency, slow sensory median nerve conduction velocity with normal terminal motor latency; Grade 3: Moderate, slow distal motor latency to Abductor Policies Brevis (APB) <6.5 ms, slow sensory median nerve conduction velocity with preserved sensory action potential; Grade 4: Severe, absent sensory action potential with preserved motor response, terminal latency to APB<6.5 ms; Grade 5: Very severe, distal latency to APB> 6.5 ms; and Grade 6: Extremely severe, sensory and motor response are not detectable [8].

Before the test, the normality of the data distributions for each group was determined by the Kolmogorov-Smirnov test. The study population characteristics were presented by descriptive statistics (mean and standard deviation) and study quantitative variables were compared by inferential statistics (student t test). All statistical analysis was done in SPSS V. 22. P<0.05 was considered as the significant level for all tests.

3. Results

All 86 wrists of 59 patients (23 men, 36 women) diagnosed with CTS and 16 wrists of 8 control patients (3 men, 5 women) were examined. The mean age of study participants was 51.6 years. Some of the patients had a history of diabetes mellitus (9 patients), hypothyroidism (4 patients). The median nerve was detected in the proximal carpal tunnel. There were significant differences between the patients and control groups (P=0.02) regarding the mean CSA of median nerve.

The mean CSA of median nerve was 11 mm^2 in patients and 6 mm^2 in controls. There were no significant differences in the mean CSA of median nerve between the men and women in the patients group (P=0.98). There were not significant differences in mean CSA of median nerve according to signs and symptoms in the patients group (P=0.28), in the patients with pain (12 mm^2), in patients with numbness and paresthesia (10 mm^2), and in the patients with atrophy (14 mm^2) (Table 1). However, there was significant difference according to severity of CTS in NCS (P=0.007) (Table 2).

4. Discussion

Ultrasonography is a proven and effective method because it is quick, easy to use, and available [9]. MRI is

Table 1. The mean CSA of median nerve according to signs and symptoms

Signs and Symptoms	No.	CSA, mm^2 (Mean±SD)
Pain	30	12±15
Paresthesia	25	10±3
Numbness	27	10±3
Atrophy	4	15±4

AJNPP

Table 2. The mean CSA of median nerve according to signs and symptoms

Severity	No.	CSA, mm^2 (Mean±SD)
Very mild	15	11±18
Mild	42	12±11
Moderate	10	9±2
Severe	2	13±3
Very severe	1	14±1
Total	68	

better than sonography in diagnosing CTS because it has more resolution in showing soft tissue and subtle CTS. However, it is expensive, time-consuming and not available in many clinical settings [10, 11]. There are three important findings for the diagnosis of CTS: Swelling of the median nerve in the carpal tunnel, Flattening of the nerve in the distal carpal tunnel, and Bowing of the flexor retinaculum. The swelling and flattening of the nerve have been proven to be the two most reliable factor in the diagnosis of CTS [12, 13].

Significant differences were seen between CTS patients and controls in the CSA of the median nerve in our study and previous similar studies, but this difference is variable in various studies. In our study, the median nerve CSA was 11 mm^2 in CTS patients and 6 mm^2 in controls. In Duncan et al. study, the mean CSA is reported as 12.7 mm^2 and 7 mm^2 in CTS and control group, respectively [14]. In Buchberger et al. study, the mean CSA is reported as 14.5 mm^2 in the patients and 7.9 mm^2 in the control [15]. This difference in the results is due to the location of ultrasonography and measurement techniques.

In the present study, we did the measurements from the proximal levels of carpal tunnel. In this location, the median nerve is easily distinguishable in the wrist. Afshin et al. did not observe significant differences in mild, moderate and severe CTS cases when assessing the CSA of median nerve [16]. In the present study, however, we found significant differences between patients according to grading of CTS in Nerve Conduction Study (NCS) and the greatest CSA was seen in the patients with grade 5 (very severe) (Table 2). In our study, we also determined the difference in the CSA according to signs and symptoms. The CSA in the CTS patients with atrophy was more than that in other patients and it was 10 mm^2 in the patients with paresthesia and numbness that was less than that in the patients with pain (Table 1).

5. Conclusion

As a result, we suggest that CSA ultrasonography can be an effective method for the diagnosis of CTS. Also it is a particularly useful tool in the evaluation of the severity of CTS.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by ethics committee of Iran University of Medical Sciences.

Funding

This study was supported by Iran University of Medical Sciences.

Conflict of interest

All the authors declare they have no conflict of interest.

Acknowledgements

The authors would like to appreciate Maryam Zaribafian for typing and editing the paper.

References

[1] Ibrahim I, Khan W, Goddard N, Smitham P. Carpal tunnel syndrome: A review of the recent literature. The Open Orthopaedics Journal. 2012; 6(1): 69–76. [DOI:10.2174/1874325001206010069] [PMID] [PMCID]

[2] Mashoof AA, Levy HJ, Soifer TB, Miller-Soifer F, Bryk E, Vigorita V. Neural anatomy of the transverse carpal ligament. Clinical Orthopaedics and Related Research. 2001; 386:218-21. [DOI:10.1097/00003086-200105000-00028]

[3] Werner R, Armstrong TJ. Carpal tunnel syndrome: Ergonomic risk factors and intracarpal canal pressure. Physical Medicine and Rehabilitation Clinics of North America. 1997; 8(3):555-569. [DOI: 10.1016/S1047-9651(18)30317-6]

[4] Ghasemi-rad M, Nosair E, Vegh A, Mohammadi A, Akkad A, Lesha E, et al. A handy review of carpal tunnel syndrome: From anatomy to diagnosis and treatment. World Journal of Radiology. 2014; 6(6):284-300. [DOI:10.4329/wjr.v6.i6.284] [PMID] [PMCID]

[5] Ooi CC, Wong SK, Tan AB, Chin AY, Bakar RA, Goh SY, et al. Diagnostic criteria of carpal tunnel syndrome using high-resolution ultrasonography: Correlation with nerve conduction studies. Skeletal Radiology. 2014; 43(10):1387-94. [DOI:10.1007/s00256-014-1929-z] [PMID]

[6] Allmann KH, Horch R, Uhl M, Gufler H, Altehoefer C, Stark GB, et al. MR imaging of the carpal tunnel. European Journal of Radiology. 1997; 25(2):141-5. [DOI:10.1016/S0720-048X(96)01038-8]

[7] Dalinka MK. MR imaging of the wrist. AJR American Journal of Roentgenology. 1995; 164(1):1-9. [DOI:10.2214/ajr.164.1.7998519] [PMID]

[8] Bland JD. A neurophysiological grading scale for carpal tunnel syndrome. Muscle & Nerve. 2000; 23(8):1280-3. [DOI:10.1002/1097-4598(200008)23:83.0.CO;2-Y]

[9] Padua L, Pazzaglia C, Caliandro P, Granata G, Foschini M, Briani C, et al. Carpal tunnel syndrome: Ultrasound, neurophysiology, clinical, and patientoriented assessment. Clinical Neurophysiology. 2008; 119(9):2064-9. [DOI:10.1016/j.clinph.2008.05.004] [PMID]

[10] Yao L, Gai N. Median nerve cross-sectional area and MRI diffusion characteristics: Normative values at the carpal tunnel. Skeletal Radiology. 2009; 38(4):355-61. [DOI:10.1007/s00256-008-0626-1] [PMID]

[11] Kobayashi S, Hayakawa K, Nakane T, Meir A, Mwaka ES, Yayama T, et al. Visualization of intraneural edema using gadolinium-enhanced magnetic resonance imaging of carpal tunnel syndrome. Journal of Orthopaedic Science. 2009; 14(1):24-34. [DOI:10.1007/s00776-008-1291-x] [PMID]

[12] Wong SM, Griffith JF, Hui ACF, Tang A, Wong KS. Discriminatory sonographic criteria for the diagnosis of carpal tunnel syndrome. Arthritis & Rheumatism. 2002; 46(7):1914–21. [DOI:10.1002/art.10385] [PMID]

[13] Kotevoglu N, Gülbahce-Saglam S. Ultrasound imaging in the diagnosis of carpal tunnel syndrome and its relevance to clinical evaluation. Joint Bone Spine. 2005; 72(2):142-5. [DOI:10.1016/j.jbspin.2004.03.012] [PMID]

[14] Duncan I, Sullivan P, Lomas F. Sonography in the diagnosis of carpal tunnel syndrome. American Journal of Roentgenology. 1999; 173(3):681-4. [DOI:10.2214/ajr.173.3.10470903] [PMID]

[15] Buchberger W, Judmaier W, Birbamer G, Lener M, Schmidauer C. Carpal tunnel syndrome: Diagnosis with high resolution sonography. American Journal of Roentgenology. 1992; 159(4):793-8. [DOI:10.2214/ajr.159.4.1529845] [PMID]

[16] Mohammadi A, Afshar A, Etemadi A, Masoudi S, Baghizadeh A. Diagnostic value of cross-sectional area of median nerve in grading severity of carpal tunnel syndrome. Archives of Iranian Medicine. 2010; 13(6):516-21. [PMID]