Dominance in hands and cross-sectional area of median nerve in carpal tunnel syndrome

Mohammad Jafar Rezaie[1], Mohammad Farzizadeh[2], Farhad Naleini[3], Ayoob Rostamzadeh[4*]

1. Cellular and Molecular Research Center, Anatomical Sciences Department, Faculty of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran.
2. Department of Radiology, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran.
3. Department of Radiology, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran.
4. Department of Anatomical Sciences, Faculty of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran.

Corresponding author: Tel: +98 9187225635 Fax: +98 3833334911
Address: Department of Anatomy and Neuroscience, Faculty of Medicine, Shahrekord University of Medical Sciences, Rahmatiye Town, Shahrekord, Iran.
E-mail: ayoobrostamzade@gmail.com
Received; 2015/04/13 revised; 2015/05/10 accepted; 2015/05/23

Abstract

Introduction: Currently, neuroresearchers report that the median nerve shows severity-correlated intracarpal enlargement in idiopathic carpal tunnel syndrome (CTS) as a most common peripheral neuropathic disorder. The purpose of this paper was to investigate ultrasonography morphological findings in patients with idiopathic CTS and comparing some physical properties such as age, gender, BMI with dominancy in the hands.
Materials and methods: This research was a cross sectional study that conducted in Al-Zahra hospital. 125 patients who came to ultrasonography department for any reason were studied randomly and selected by a convenience method. The thickness of median nerves of these patients was measured by ultrasonography and analyzed based on age, sex, BMI and dominancy and non-dominancy in hand for each patient separately as main aim of our study. The data collected entered to computer and analyzed by SPSS software. The chi- square and t-student tests were used for data analysis.
Results: The mean cross-sectional area of right median nerve in right-handed patients was 0.063±0.02 cm^2 and for left median nerve in the same group was 0.056±0.022 cm^2. Results demonstrates differences in cross-sectional area of median nerve in dominant hand in comparison to non-dominant-hand in right-handed ones ($P<0.001$). Again, mean cross-sectional area of left median nerve in left-handed patients was 0.064±0.013 cm^2 and for right median nerve in the given group was 0.057 ± 0.017 cm^2.
Conclusion: No relation between median nerve, BMI and age was existed and probably we can apply ultrasonography as a diagnostic imaging tool to distinguish between competent and non-competent median nerves.
Keywords: Carpal tunnel syndrome, Ultrasonography, Median nerve, Peripheral neuropathy

Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment disorder, hence, worth studying and investigating, and is one of a group of disorders categorized by several different terms: repetitive stress injuries, chronic upper limb pain syndrome, or repetitive motion disorders (1,2). All of these problems are generally associated with repetitive and forceful use of the hands

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]

that damage muscles and bones of the upper extremities (3). The diagnosis of this disorder is often clinical symptoms (burning pain, numbness, and nocturnal parasthesia in the median nerve distribution), and signs, such as Tinel sign (tapping over the median nerve producing dysesthesias) and Phalen sign (dysesthesias with wrist flexion) and electro-diagnostic testing; supporting evidence is derived from a number of diagnostic studies (2,4). Imaging may provide important information in entrapment neuropathies, particularly in cases of equivocal electrophysiologic studies (4). Currently it is proved that the cross section of median nerve is increased in CTS especially at its entrance to the carpal tunnel (2, 5). Ultrasonography as a safe, low cost, rapid, accurate and noninvasive method can be used to assess changes in the nerve shape and exclude anatomic variants and space occupying alterations as ganglion cysts, tenosynovitis and echogenicity, swelling of the median nerve, flattening of the nerve, palmar bowing and thickening of the flexor retinaculum (2, 5-7). Unfortunately, sufficient data on whether this thickness can be affected by some other causes like age, sex, BMI and dominancy in hand do not exist (2). The aim of this study is to understand the relation between cross-sectional median nerve thickness and sex, age, weight and dominancy in hand as interfering factors in patients who referred to Al-Zahra Isfahan hospital. Moreover the mean cross-sectional area cut-off point to diagnose CTS differs in different studies and no general consensus on the exact degree of this area do exist, so these controversies made us to perform a research on this issue specially on normal population and we have interpreted our data based on the age, sex, BMI and dominancy in hand.

Material and methods

This is a cross-sectional study that conducted in Al-Zahra hospital in Isfahan, Iran. 125 patients who came to ultrasonography department for any reason without history of hand surgery, diabetes, acromegaly and signs or symptoms of CTS between January 2009 and January 2010 were examined by an expert general practitioner and included in this study. Those who were not cooperative or with anatomical variations of median nerve or underwent wrist surgery were excluded from our study. Examinations were performed using high-resolution ultrasonography (GE Company, model-G50) applying 5-10 megahertz probe. All wrists were evaluated in the neutral position with the palm up and the fingers semi-extended. The full course of the median nerve in the carpal tunnel was evaluated. The thickness of median nerves of these patients was measured by ultrasonography (Figure 1). The cross-sectional areas of median nerves were measured from the proximal carpal tunnel at the level of pisiform bone and all patients' data like age, sex, BMI and dominancy were registered in a separate questionnaire. The data collected entered to computer and analyzed by SPSS software (V.20, IBM Corp., USA, 2013). The chi- square, T student and Pierson correlation tests were used for data analysis. The level of significance in all stages was considered $P<0.05$.

Results

In this research 125 patients with no signs and symptoms of neuropathy were studied. The mean age was 41.3±14.8 years. This mean for men was 41.1±15.3 and for women was 41.5±14.2. 71(56.8%) of the patients were male and 54 (43.2%) were female. There is no statistically difference between age of male and female (P=0.9). The results of this study showed that there was no relation between the patients age and cross-sectional areas of median nerve (P=0.21). The mean of body mass index (BMI) was 25.8±4.9 and according to BMI scaling, 6 (4.8%) had low weight, 55 (44%) had normal weight, 38 (30.4%) had

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]

over weight and 26 (20.8%) were fat. The mean cross-sectional area of median nerve in both hands was 0.059 ±0.02 cm. This mean was 0.058±0.02 and 0.062±0.02 cm for left and right hand respectively and the difference between two hands was statistically significant (P=0.001). The left and right hands cross-sectional areas of median nerve in the male and female is shown in Table 1.

Table 1. The mean ± SD of cross-sectional areas of median nerve in hands of the male and female.

Hands	Sex	Mean±SD	P value
Left	Male	0.061± 0.022	0.028
	Female	0.053 ± 0.017	
Right	Male	0.065 ± 0.021	0.018
	Female	0.057 ±0.016	

According to this table we find a statistical difference between males and females for the cross-sectional area of median nerves (P=0.02). The mean ± SD of cross-sectional areas of median nerve by BMI grouping was shown in Figure 1 and according to one way ANOVA there was no relation between BMI and median nerve thickness (P>0.05).

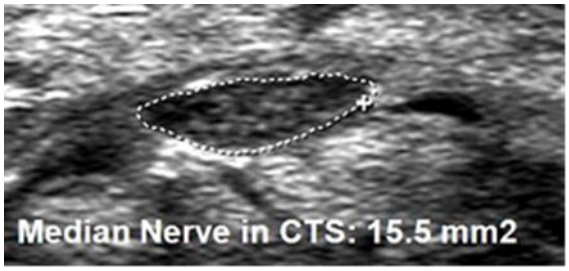


Figure 1. Measurement of median nerves thickness of patients with carpal tunnel syndrome.

The measurement of cross-sectional areas of median nerve by dominant and non-dominant hands was 0.063±0.019 and 0.056±0.021, respectively and the difference between dominant and non-dominant hands was significant (P<0.001). The total mean cross section of median nerve in both hands in males and females was 0.063±0.022 and 0.055±0.017, respectively and the difference between male and female was statistically significant (P<0.05). Finally, according to Pierson correlation test, a weak correlation between age and cross-sectional thickness of median nerve is seen which means the older the citizen , the higher the cross section of median nerve, but based on this test, the correlation was not statistically significant (P>0.05). Figure 2 shows the correlation between patients' age and cross-sectional thickness of median nerve.

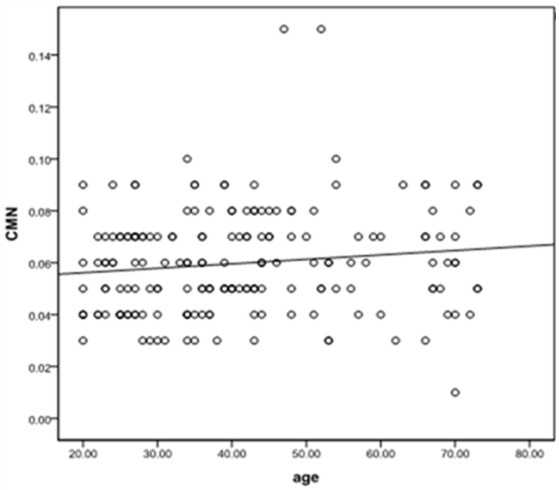


Figure 2. Correlation between age and cross-sectional thickness of median nerve (CMN).

Discussion

As most researches shows, it is proved that signs and symptoms of CTS relate directly to the cross section of median nerve (2, 5), but it is not our goal of study. Since, some disorders and diseases such as carpal tunnel syndrome are related to the cross-section of median nerve and this area is probably affected by some variability's such as sex, age, weight and dominancy in hand (5), and these afore-mentioned items have not been considered in most studies, it seems necessary to measure them as criterions for diagnosis and to interpret its' results according to these items. In the present study, the mean cross-section of median nerve was 0.059±0.02 cm^2 in all of CTS patients. This mean was 0.058±0.02 and 0.062±0.02 cm for left and right hand respectively. To be honest, one of the most outstanding and inspiring thing in our study is that we conducted it on healthy and normal population without any signs and symptoms related in any way to CTS, a priority which no study work on it. In

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]

the study of Nakamichi KI. et al., the mean cross section of median nerve in patients with signs and symptoms of CTS was higher than control group (2) .In this study control group which has not been considered in our study is seen, moreover Nerve conduction velocity (NCV) of median nerve in all patients was measured to improve findings accuracy, but many variables with probable roles in the diagnosis of CTS such as sex, age, BMI and dominancy in hand had not been measured, those which our study was based on. Moreover as noted previously our study is performed on healthy persons who were unique and outstanding by itself. In study of Yesildage A. et al., 148 wrists of 86 patients with carpal tunnel syndrome and 76 wrists of 45 control patients were examined. All measurements showed significant differences between patients and controls in cross-sectional area of the median nerve in diagnosing CTS (3). Against our study, many variables such as BMI, age and dominancy weren't mentioned, items which our study was based on, but background diseases such as diabetes and RA as an effective factors on CTS have been taken into considered. Moreover all data were interpreted according to their EMGs findings. Furthermore more patients and the existence of control group catches eye in this study. Again, against this study, as noted previously our study was performed on healthy persons, which was unique and outstanding by itself. In study Ashraf A. et al., the ultrasonographic measurements of median nerves cross-sectional areas were found to be increased significantly in patients with carpal tunnel syndrome when compared to controls (4). One of the most inspiring point about afore-mentioned studies like this, is having control group which helps to understand the sensitivity and specificity and to come to a cut-off point, which haven't been calculated in our study, but interfering items as discussed before were not mentioned, items we proved to play role in interpreting data. Again, against this study, as noted previously our study was performed on healthy persons, which was unique and outstanding by itself. In study of Miedany Y. et al., 96 hands with CTS were studied. In comparison with the control group, ultrasonography assessment of the median nerve in the patients group showed that the swelling of the median nerve at the entrance to the carpal tunnel appears to be the most reliable criterion for diagnosing CTS (5). Similarly, in this study background variables such as age, sex and BMI were measured. Moreover, in this study duration of symptoms and nerve conduction studies were measured but dominancy as an important factor has not been considered as in our study (5) and this by itself shows the importance of our study and its unique characteristics more than before. Again, against this study, as noted previously our study was performed on healthy persons, which was unique and outstanding by itself. In the study of Britz and his colleges 43 wrists of 32 patients with obviously clinical CTS and 5 asymptomatic people have been studied. According to the results of this study, MRI is shown to be a good and sensitive diagnostic modality with 100 percent of patients seemed to have abnormality in the shape of median nerve (7). In study Uchiyama S. et al., 105 wrists of 105 females with CTS and 36 wrists of healthy control citizens were studied applying MRI (7). Based on this study; the cross-section of median nerve is shown to be increased. Furthermore, relationship between the severity of CTS and MRI changes of median nerve and also the degree of curving of transverse carpal ligament is shown (8). One more research performed on 373 wrists of affected patients by Pasternack II. et al., the rise in the cross-section area and T2W signal of median nerve in MRI is demonstrated. Moreover the aggravation in the curve of flexor retinaculum is suggested too. According to this study, a significant difference between right and left hands

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]

about the thickness of median nerves do exist. Some of studies showed that above 85% of population is right hand .Thus activity of right hand are more than the left and therefore, mean of median nerve thickness in right hand is higher than the left one (9). Other analysis of this data showed that the mean±SD of cross-sectional area of the left median nerve in men and women was 0.061±0.022 and 0.053±0.017 respectively and the difference between males and females was statistically significant (P=0.028) .Moreover there is a significant relation between males and females in right hand cross-sectional thickness of median nerve which means 0.065 ±0.021 and 0.057±0.016 for men and women respectively (P=0.018). Despite public idea, there is no relation between age and thickness of median nerve. Also no correlation between BMI and median nerve thickness do exist. Finally there is a significant difference between thickness of median nerve in dominant and non-dominant hands and between thickness of median nerve and sex. It is logical that dominant hand have more activity than non-dominant hand and the risk of CTS for dominant hand is higher than non-dominant one.

Conclusion

According to our results, measurement of median nerve thickness based on dominancy in hands seems necessary for the diagnosis of CTS. Moreover, when a patient referred to hospital for diagnosis of CTS, at first we must ask him or her about the dominancy in hand, since thickness of median nerve probably depends on dominancy in hand. Furthermore, our results showed no relation between median nerve thickness and BMI and age do exist and probably we can apply ultrasonography diagnostic imaging biomarker to distinguish between competent and non-competent median nerve. In addition, attention to dominancy in hand and sex for interpretation of ultrasonographic reports must be considered.

Acknowledgments

We appreciate the patients and their attendants for their helpful collaboration. The authors would like to thank the hospitals personnel offices for their technical assistance.

References

1. Kele H. Ultrasonography of the peripheral nervous system. Perspect Med. 2012;1(1):417-21.
2. Nakamichi KI, Tachibana S. Ultrasonographic measurement of median nerve cross-sectional area in idiopathic carpal tunnel syndrome: diagnostic accuracy. Muscle Nerve. 2002;26(6):798-803.
3. Yesildag A, Kutluhan S, Sengul N, Koyuncuoglu H, Oyar O, Guler K, et al. The role of ultrasonographic measurements of the median nerve in the diagnosis of carpal tunnel syndrome. Clin Radiol. 2004;59(10):910-5.
4. Ashraf A, Jali R, Moghtaderi A, Yazdani A. The diagnostic value of ultrasonography in patients with electrophysiologicaly confirmed carpal tunnel syndrome. Electromyograph Clin Neurophysiol. 2008;49(1):3-8.
5. El Miedany Y, Aty S, Ashour S. Ultrasonography versus nerve conduction study in patients with carpal tunnel syndrome: substantive or complementary tests? Rheumatology. 2004;43(7):887-95.
6. Britz GW, Haynor DR, Kuntz C, Goodkin R, Gitter A, Maravilla K, et al. Ulnar nerve entrapment at the elbow: correlation of magnetic

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]

resonance imaging, clinical, electrodiagnostic, and intraoperative findings. Neurosurgery. 1996;38(3):458-65.

7. Uchiyama S, Itsubo T, Yasutomi T, Nakagawa H, Kamimura M, Kato H. Quantitative MRI of the wrist and nerve conduction studies in patients with idiopathic carpal tunnel syndrome. J Neurol Neurosurg Psychiatry. 2005;76(8):1103-8.
8. Pasternack II, Malmivaara A, Tervahartiala P, Forsberg H, Vehmas T. Magnetic resonance imaging findings in respect to carpal tunnel syndrome. Scand J Work Environ Health. 2003:189-96.
9. Yazdchi M, Tarzemani MK, Mikaeili H, Ayromlu H, Ebadi H. Sensitivity and specificity of median nerve ultrasonography in diagnosis of carpal tunnel syndrome. Int J General Med. 2012;5:99.

[Downloaded from jbrms.medilam.ac.ir on 2026-11-25]