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RESEARCH ARTICLE

Ultrasonographic Assessment of Median Nerve Cross-Sectional Area in Obstetricians

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Abstract

Introductıon: : We aimed to investigate whether the median nerve cross-sectional area (MNCSA) is affected in obstetricians due to occupational reasons

Methods: In this cross-sectional study, 93 participants were included. The median nerve cross-sectional area was measured by high-resolution ultrasonography, and clinical symptoms of carpal tunnel syndrome were questioned.

Results: The measurements of MNCSA for the right hand were higher in ≥ 8 years of working experience than in < 8 years of working experience (11mm2 vs. 8 mm2, $p<0.001$). A significant positive moderate correlation was also between right MNCSA and working experience and daily ultrasonography practice ($r=0.557$; $p<0.001$, $r=0.561$; $p<0.001$, respectively).

Conclusion: This study showed that increased MNCSA was associated with obstetricians' working experience and daily ultrasonography practice. Considering the prevalence of carpal tunnel syndrome in specific occupational groups, MNCSA measurement by ultrasound may contribute to early diagnosis and convenient selection for further diagnostic tests.

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Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment in the upper extremity.[1] CTS was related to constitutional, hormonal, musculoskeletal, and work-related factors.[2] A higher incidence of CTS has been reported in the working population than in the general population.[3] Manual loading, including chronic wrist flexion, repetitive movements, firm grip, excessive force, and chronic vibration, has been associated with carpal tunnel syndrome.[2] Work-related carpal tunnel syndrome has also been reported in healthcare workers, including dentists and laboratory technicians.[4,5]

The gold standard for CTS diagnosis is the patient's clinical history and exclusion of other possible causes.[1] Confirmation of diagnosis by nerve conduction study (NCS) is a conventional approach.[6,7] But, NCSs are somewhat invasive, expensive, uncomfortable, and time-consuming procedures. Recently, median nerve cross-sectional area (MNCSA) measurement by high-resolution ultrasound probes has become essential in suggesting CTS when compatible with the patient's clinical history.[8]

We thought obstetricians might be more vulnerable to CTS-related symptoms because they are exposed to repetitive and forceful maneuvers during prolonged ultrasonographic examinations. Based on these, we aimed to investigate whether the MNCSA affected in obstetricians.

Material and Methods

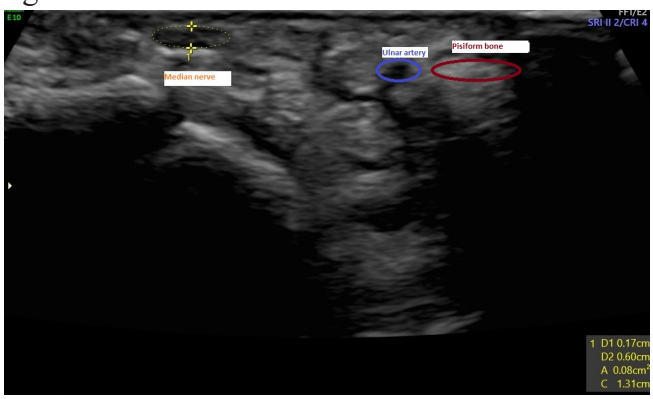
This cross-sectional study was carried out from April 2021 to January 2022 in Ankara City Hospital. Written informed consent was obtained from all participants. The study was approved by the Ministry of Health of the Republic of Turkey and the Medical Research Ethics Department of the hospital and adhered to the Declaration of Helsinki (E2-21-247).

This study included 93 participants. It enrolled obstetricians who had worked for at least one year in the Department of Obstetrics and Gynecology at Ankara City Hospital. The exclusion criteria were diabetes, thyroid diseases, rheumatoid arthritis, pregnancy, smoking, a history of orthopedic trauma in the wrists, and work experience of fewer than 12 months.

All participants replied to a self-administered questionnaire composed of two parts. The first part of the questionnaire included personal data of age, gender, height, weight, dominant hand, years of occupation, and practice time (hours) with ultrasound per day. In addition, all obstetricians in the study stated that they use their right hands during USG practice. The height and weight of the participants were converted to body mass index (BMI). The second part of the questionnaire included the presence of numbness and pain.

The ultrasonographic examination was performed by an obstetrician (D.O.) blinded to the participants' specialty and their answers to the questionnaire. The participants were examined with their forearms resting on the bed and their fingers in a semi-flexed position. A Voluson E10 ultrasound machine (Voluson™E10, GE Medical Systems, Zipf, Austria) was equipped with a 9-L 8-MHz linear array probe. The course of the median nerve in the carpal tunnel was evaluated in the sagittal and axial planes without pressing the prob. The sagittal view was used to obtain the first general view of the median nerve, but no measurement was made from this section. While getting the axial (cross-sectional) image, the probe was placed at the level of the wrist crease, and the median nerve visible in front of the flexor tendons was found. The pisiform bone location was obtained as a landmark; the probe was moved laterally to achieve a cross-sectional view of the nerve. At the level of the distal wrist crease, the cross-sectional area of the median nerve was measured. This area was measured three times, and the median value was used for analyses. As calculated in a previous study, the area calculation (measured to the nearest mm²) included a trace running just inside the echogenic surface of the median nerve.[9] An ultrasonographic image of the measurement is given in Figure 1.

Figure 1



Statistical analyses

The sample size was calculated using G Power software (version 3.1; Franz Faul, Universitat Kiel, Kiel, Germany). The effect size of 1.69 was determined

by a p-value of 0.1 and a power of 95% for the sample size. It was planned to include n=13 cases in each group.

Data analyses were performed using IBM SPSS Statistics for Windows (version 22.0, IBM, Armonk, NY, USA). Continuous variables are reported as mean ± standard deviations, and categorical values are reported as counts (percentages). The Kolmogorov-Smirnov test showed that the continuous variables did not conform to a normal distribution. The MNCSA medians and interquartile ranges (IQRs) were calculated and assessed for statistical significance using the Mann-Whitney U test. The proportions were compared using binary variables, the Fisher Exact test of independence. Spearman's correlation test was used to examine the relationships between variables. Percentile calculation was made for the working experience. All tests were considered statistically significant if the p-value was less than 0.05.

Results

This study included 93 obstetricians. Numbness, pain, and the measurement of the MNCSA were evaluated only for the right hand, as all participants stated that they used their right hand in USG practice. Table 1 shows the demographics and symptoms of the obstetricians.

Table1: Demographic and health features of the obstetricians

Age (years)		29.2 ± 4.8
BMI (kg/m²)		23.2 ± 2.8
Gender	Female	68 (73.1%)
	Male	25 (26.9%)
Working experience (years)		4.8 ± 4.1
Daily ultrasonography practice (hours)		1.8 ± 0.9
Right-hand numbness		17 (18.3%)
Right-hand pain		7 (7.5%)
Right MNCSA (mm²)		9.4 ± 1.7

a Values are presented as Mean±Standart Deviation or count (percentage)

There was no significant difference between the MNCSA of female and male obstetricians (Table 2). The data for the years of working experience are arranged from the smallest to the largest. The highest 25% of the working experience data was considered the top quartile. According to our study population, the working experience over ≥8 years was defined as the top quartile (75th percentile) for obstetricians, and the significant difference in MNCSA was reported in Table 3. When the working experience ≥8 years and <8 years were compared, the median age in the ≥8 years group was found to be significantly higher than <8 years (27 vs. 21, p<0.001). The participants' symptoms, according to their work experience, were compared in Table 4.

Table 2: Median nerve cross-sectional area (MNCSA) in the female and male obstetricians

	Female	Male	p-value
	(n: 68)	(n: 25)	
Right MNCSA(mm²)	9 (8;11)	9 (8;10)	.614

a The Mann Whitney U Test (median (IQRs))

Table 3: Differences in median nerve cross-sectional area (MNCSA) according to working experience

	≥8 years	< 8 years	p-value
	(n: 25)	(n: 68)	
Right MNCSA(mm²)	11 (10;13)	8 (8;9)	**<.001***

a The Mann Whitney U Test (median (IQRs))

Table 4: Symptoms of the participitants according to working experience

	≥8 years (n: 25)	<8 years (n: 68)	p value
Right hand numbness	6 (24%)	11 (16.2%)	.381**
Right hand pain	4 (16%)	3 (4.4%)	.081**

** Fisher's Exact Test

Table 5 represents the correlation between right MNCSA with BMI and occupational factors. No significant correlation was found between BMI and right MNCSA measurement. Still, there was a significantly positive moderate correlation between right MNCSA and working experience and daily ultrasonography practice (p<0.001, p<0.001, respectively).

Table 5: Correlation between Right MNCSA with BMI and occupational factors

	BMI (kg/m^2)	Working experience (years)	Daily practice
r value	.083	.557	.561
p value	.427	<0.001	<0.001

a Spearman's Rho Test

Discussion

Work-related risks of CTS have been reported in studies that showed occupations that involve repetitive forceful flexion and extension maneuvers of the hand/wrist.[10,11] Obstetricians often experience physical discomfort due to inappropriate hand/wrist positions and maneuvers to guide the probe during long-term USG examinations. The present study showed that obstetricians who had worked for eight years or more had a significantly higher MNCSA than those who had worked for less than eight years. This suggests the effect of increased exposure to ultrasound maneuvers in daily practice on the increase in the MNCSA. Although MNCSA was higher in those with more than eight years of experience, there was no significant difference in right-hand numbness and pain compared to those with less than eight years of experience. This suggests that changes in MNCSA associated with the years of work experience may occur before symptoms. Considering that there may be an increase in MNCSA before the symptoms of pain and numbness appear, scanning with USG allows obstetricians to be more attentive to symptom awareness.

Our study showed a significant positive correlation between increased MNCSA and the number of years of occupation and daily USG practice hours. This finding was consistent with the study that found that laboratory technicians who had symptoms of CTS had longer working hours than those who did not.[6] It was also supported by the study that found that dentists who had been practicing for many years were more likely to have symptoms.[12] The increase in MNCSA points out an association between working hours and the development of CTS symptoms.

Being overweight and obese has been shown to increase the risk of carpal tunnel syndrome, although there is insufficient evidence for the specific mechanism.[13] Our study could not find a relationship between BMI and MNCSA. This may be because the participants had the lowest BMI of 17.3 and the highest BMI of 27.8. This was consistent with previous studies, which noted a stronger association between BMI > 30 and complaints of CTS symptoms.[5,14]

Gender is frequently mentioned in studies on the etiology of CTS,[15] which have found that gender is an important factor, revealing that women were more likely than men to meet the case definition for CTS. One study showed that women had less palmar bowing and smaller carpal arch than men, so the narrow distal end of the carpal tunnel might lead to a higher incidence of CTS in women.[16] However, one study showed no significant difference in the occurrence of CTS symptoms between male and female dentists.[17] Our study found a similar MNCSA in female obstetricians compared to males. This finding was consistent with the study that showed an equal risk between the genders when occupational exposures were similar.[18] However, a previous study[19] found that the incidence was three times higher, especially in women aged 50-70. In our study, the female obstetricians were younger and fewer in number than the males, and our estimate may be inadequate to represent the prevalence among obstetricians.

Carpal tunnel syndrome is diagnosed based on clinical history and signs. The features of CTS are pain, numbness, tingling, and burning in the dispersion of the median nerve, which encloses the palmar side of the thumb, index and middle fingers, and the radial half of the ring finger.[20] Excessive chronic flexion and hyperextension of the wrist can increase pressure in the carpal tunnel. Median nerve compression causes inflammation, edema, thickening of the perineurium and endothelium, and median nerve swelling. Thus, these events can lead to median nerve dysfunction, resulting in CTS symptoms.[21] In our study, numbness and pain were higher in senior obstetricians than in residents, but there was no statistically significant difference. Previous studies have shown that there may be a dose-response relationship suggesting that hand positions involving prolonged and repetitive flexion or wrist extension increase the risk of CTS.[22] The results of our study may be because senior obstetricians have been in this occupation longer than residents. Although CTS is more common in dominant hands, the symptoms can occur in both hands. In our study, there were more right-handed participants than left-handed participants. This finding may be due to our study's higher number of right-handed obstetricians. In ad-

dition, left-handed obstetricians prefer to use their right hand during USG practice, which may explain the higher incidence of right-handed complaints in obstetricians. This is similar to the finding in a previous study that repetitive daily hand activities play an essential role in the etiology of CTS.[23] At the beginning of obstetrics training, residents should be informed about avoiding forceful wrist movements and using correct maneuvers when using the USG probe. A recent meta-analysis concluded that an increased cross-sectional area by ultrasonography has a sensitivity of 77.6% and a specificity of 86.8% for diagnosing carpal tunnel syndrome.[24] Similarly, ultrasound provides information in assessing CTS, as it can demonstrate the median nerve extension in the distal wrist crease in symptomatic individuals.[10] A previous study.[25] showed that after five minutes of appropriate teaching, the measurement of MNCSA by inexperienced ultrasound operators was consistent with that of an experienced operator. As ultrasound is a painless and quick method, it may be possible for obstetricians to scan CTS in symptomatic patients in their daily practice. Primary interventions can reduce discomfort and thus improve the quality of life of obstetricians suffering from this condition. Beyond that, the appropriate patient selection is ensured for referral to confirmatory diagnostic tests.

The strengths of our study are its novelty and prospective design. One limitation is that the study was conducted in a single center with relatively few participants. Another limitation was that the median age was higher in the group with a working experience of ≥8 years. In addition, electromyography and other tests did not confirm the diagnosis of CTS, and the participants' long-term results are unknown.

To the best of our knowledge, this is the first study to demonstrate the prevalence of CTS symptoms and measurement of MNCSA by ultrasound in a group of obstetricians. The present study showed that increased MNCSA was associated with obstetricians' working experience and daily practice hours.

In conclusion, considering the prevalence of CTS in specific occupational groups, MNCSA measurement by ultrasound may contribute to early diagnosis and convenient selection for further diagnostic tests. Due to its ease of use and low cost, ultrasound evaluation of MNCSA can be used in the daily practice of obstetricians.

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Consent: Written informed consent was obtained from all participants. The study was approved by the Ministry of Health of the Republic of Turkey and the Medical Research Ethics Department of the hospital and adhered to the Declaration of Helsinki (E2-21-247).

Data availability: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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