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Ultrasonographic Evaluation of Carpal Tunnel in Pregnant Women with Diabetes Mellitus

Diabetik Gebelerde Karpal Tünelin Ultrasonografik Değerlendirilmesi

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ÖZ

Amaç: Diabetik gebelerde karpal tünel sendromu tanısı için median sinir alanının ultrasonografik olarak değerlendirilmesi.

Gereç ve yöntemler: Tip 1, tip 2 diabetes mellitus (DM) ve gestasyonel diabetes mellitus (GDM) tanısı olan gebeler prospektif olarak değerlendirildi. GDM tanısı için tek basamaklı 75 gr oral glukoz tolerans testi kullanıldı. Median sinir el bileğinin distal seviyesinde karpal tünel giriş seviyesinde USG kullanılarak tespit edildi ve en büyük sinir alanı ölçümü yapıldı. Ölçüm sonrası hastalara ellerinde ağrı, uyuşukluk ve parastezi olup olmadığı soruldu. Diabetik grup yaş, gebelik haftası, gebelikte alınan kilo, median sinir alanı ve şikayetler açısından kontrol grubu gebe hastalarla karşılaştırıldı.

Bulgular: DM grubunda 107 gebe hasta ve kontrol grubunda 113 gebe hasta bulunmakta idi. DM grupta median sinir alanı kontrol grubuna göre anlamlı olarak artmış bulundu (p< 0,001). Diabetik subgruplar ve insülin kullanımı açısından median sinir alanı alçümlerinde farklılık saptanmadı. Elde ağrı diabetik grupta anlamlı olarak daha sık idi ve median sinir alanı ile gebelikte alınan kilo arasında pozitif ilişki mevcuttu.

Sonuç: USG diabetik gebelerde genel popülasyonda olduğu gibi karpal tünel sendromu tanısında ilk tercih olarak kullanılabilecek bir yöntemdir. Hem gebelik hem de diabet karpal tünel sendromu için risk faktörü olduğu için bu hastalara özellikle şikayetleri mevcut ise rutin gebelik takipleri sırasında yapacakları basit bir median sinir alanı ölçümü ile güncel yaklaşım olan basit koruyucu tavsiyelerde bulunarak hayat kalitelerinde artış sağlayabilir.

Anahtar kelimeler: karpal tünel, diabetes mellitus, gebelik , ultrason

ABSTRACT

Objective: To determine the ultrasonography (USG) values of median nerve cross-sectional area (MN-CSA) in pregnant women with and without diabetes mellitus (DM) to confirm carpal tunnel syndrome (CTS).

Materials and Methods: We prospectively studied pregnant women who have been diagnosed with pregestational type 1 and type 2 DM or gestational DM (GDM) due to positive GDM screening tests. One-step GDM screening (2 h - 75 g oral glucose tolerance test (OGTT)) was used at 24–28 weeks of gestation and diagnosis of GDM. MN was identified at the level of distal wrist crease in transverse sections with USG and maximal MN-CSA was calculated then, asked the patient complaints about her hand (paraesthesia, pain, numbness). The DM group was compared to the control group according to age, week of pregnancy, weight gain during pregnancy, MN-CSA, and presence of compliments.

Results: There were 107 DM pregnant women and 113 controls in the study group. The median value of MN-CSA was higher in the DM group than in the control group (p< 0,001). There was no difference between groups in terms of DM subgroups and insulin requirement. Hand pain is significantly frequent in the DM group than in controls. There has been a positive correlation between weight gain during pregnancy and MN-CSA (p =0,011; r=0,245).

Conclusion: USG can be a first-line diagnostic test for CTS in the diabetic pregnant population, as recommended for the general population before. Both pregnancy and DM are stated as risk factors for CTS, these patients must be evaluated more carefully about this issue and proper advices should be given to improve their life quality.

Keywords: Carpal tunnel syndrome, diabetes mellitus, ultrasonography, median nerve

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most frequent peripheral neuropathy of pregnancy that is caused by median nerve compression during its pathway through the carpal tunnel in the wrist (1, 2). Paresthesia, numbness, and pain in the first three fingers and the radial side of the ring finger especially at the night, are the typical symptoms of CTS (3,4). Symptoms generally occur bilaterally but the dominant hand tends to affect more (5). Median nerve (MN) swelling secondary to compression is the main reason for these complaints (6).

Physiologic changes in pregnancy can lead to the development of CTS during pregnancy. Peripheral edema occurs in approxi-

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mately 80 % of pregnant women and could cause MN compression at the carpal tunnel and results swelling proximal to the compression site is seen as an increase in median nerve cross-sectional area (MN-CSA). Furthermore, diabetes mellitus (DM) was pointed as a risk factor for CTS (7). Diagnosis of CTS is done mainly by the clinical history of the patient with the exclusion of other possible causes (3). However, sonographic measurement of increase MN-CSA is become popular recently to confirm CTS (8-10). Additionally, in the practice guideline for the diagnosis of CTS of The American Association of Neuromuscular & Electrodiagnostic Medicine; sonographic measurement of MN-CSA at the carpal tunnel inlet is recommended as an accurate tool (11).

Ultrasonography (USG) is essential for antenatal follow-up and obstetricians are well-experienced for sonographic examinations. Thus, MN-CSA measurement can be done on diabetic pregnant women who are monitored for routine antenatal care and possible early diagnosis might improve the life quality in such a high-risk group for CTS.

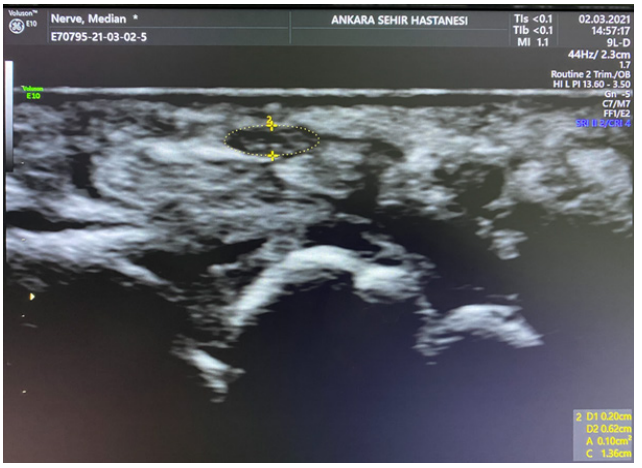
In this prospective study, we hypothesized that DM would increase MN-CSA in pregnant women. We aimed to compare the sonographic measurements of MN-CSA in pregnant women with and without DM.

MATERIALS AND METHODS

This is a prospective study that was conducted between April 1, 2021, and June 31, 2021, in the Turkish Ministry of Health Ankara City Hospital with pregnant women who have been diagnosed with pregestational type 1 and type 2 DM or gestational DM (GDM) due to positive GDM screening test. One-step GDM screening (2 h - 75 g oral glucose tolerance test (OGTT)) was used at 24–28 weeks of gestation and diagnosis of GDM was done according to the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria; fasting plasma glucose (FPG) ≥ 92 mg/dL, or 1 h plasma glucose (1 h-PG) ≥ 180 mg/dL, or 2 h plasma glucose (2 h-PG) ≥ 153 mg/dL. (12). Women are known to have previous wrist fracture or median nerve injury, systemic diseases other than DM, prior history of CTS (before pregnancy) were excluded. Patients compared with an age-matched non-diabetic control group of pregnant women. Written informed consent was obtained from all participants. The applied protocol was approved by the Medical Research Ethics Department (E2-21-250).

Pregnant women were evaluated during their routine antenatal visits. USG of both hands' MN was performed by the same maternal-fetal medicine specialist then, asked the patient complaints about her hand (paresthesia, pain, numbness). All USG measurements were performed using a 9-L 8-MHz linear probe (Voluson TM E10, GE Medical Systems, Zipf, Austria), when the wrist is in a neutral position and fingers are placed in a semi-flexed resting position, with the flexion of the elbow approximately 60 degrees. MN was identified at the level of distal wrist crease in transverse sections with classic honeycomb appearance (13) than, maximal MN-CSA was calculated by machine software, after manually tracing or with the provided ellipse tool, not including the hyperechoic nerve rim (epineurium) surrounding the MN (Figure 1).

Figure 1



Ultrasonographic measurement of median nerve cross sectional area (MN-CSA). The DM group was compared to the control group according to age, week of pregnancy, body-mass index (BMI), MN-CSA, and presence of complaints.

All statistical analyses were performed using IBM SPSS Statistics for Windows (version 22.0, IBM, Armonk, NY, USA). Continuous variables are reported as mean ± standard deviation, and categorical values are reported as counts (percentages). The Shapiro Wilk test was used to evaluate the normal distribution of the continuous variables. MN-CSA median values and interquartile ranges (IQRs) were calculated and assessed for statistical significance with the Kruskal-Wallis test and the Mann-Whitney U test as appropriate. The proportions were compared using binary variables the chi-squared test of independence or Fisher's exact test. $p<0.05$ was considered statistically significant.

RESULTS

Demographic features and clinical characteristics of patients with DM (n = 107) and patients in the control group (n = 113) are shown in Table 1.

Table 1: Demographic and Clinical Characteristics

	Pregestational DM (n:29)		Gestational DM (n:78)	Control (n:113)
	Type 1 (n:6)	Type 2 (n:23)		
Age (Mean±SD)	27±3,6	31,8±5,6	32,2±5,4	28,7±6,8
Gravidity (Mean±SD)	1,8±1,2	2,7±1,1	2,6±1,4	2,6±1,3
Parity (Mean±SD)	0,5±1,2	1,4±1,1	1,3±1,1	1,3±1,1
BMI (Mean±SD)	28,2±3,2	33,5±6,4	34±5,4	32,4±5,4
Gestational Age (Mean±SD)	21±13,4	31,3±7,2	34,7±3,8	26,7±9
Gestational Weight Gain (kg) (Mean±SD)	8,3±4,1	11,8±5,7	10,6±6,7	5,6±2,8
Right median nerve area (cm^2) (Mean±SD)	8,3±1,9	9,1±2,1	8,8±2	7,1±2,1
Left median nerve area (cm^2) (Mean±SD)	8,7±1,9	8,3±2	8,5±2,1	7,1±2,1
Hand numbness (n (%))	0	8 (34,8%)	19 (24,4%)	17 (15%)
Hand pain (n (%))	1 (16,7%)	3 (13%)	6 (7,7%)	2 (1,8%)

BMI: body mass index

Table 2 provides the median value of MN-CSA and it was higher in the DM group than in the control group (p< 0,001).

Table 2: Median Nerve Area in Diabetes Mellitus Group and Control group

	DM group (n:107)	Control group (n:113)	p value
Right median nerve area (cm^2) (median (IQR))	8 (7;10)	7 (6;8)	**<0,001****
Left median nerve area (cm^2) (median (IQR))	8 (7;9)	7 (6;8)	**<0,001****

**The Mann Whitney U Test

There was no difference between DM subgroups about MN-CSA (Table 3).

Table 3: Median Nerve Area in Diabetes Mellitus Subgroups

	Pregestational DM (n:29)		Gestational DM (n:78)	P value
	Type 1 (n:6)	Type 2 (n:23)		
Right median nerve area (cm^2) (median (IQR))	8 (7;8)	9 (8;9)	8 (7;10)	0,440*
Left median nerve area (cm^2) (median (IQR))	8,5 (7;9)	8 (7;9)	8 (7;10)	0,869*

* The Kruskal-Wallis Test

Insulin requirement and MN-CSA connection were shown in Table 4 and, insulin requirement did not influence MN-CSA.

Table 4: Median Nerve Area and Insülin Requirement Relation

Insulin	Yes (n:65)	No (n:42)	p value
Right median nerve area (cm^2) (median (IQR))	9 (8;10)	8 (7;9)	0,151**
Left median nerve area (cm^2) (median (IQR))	8 (7;10)	7,5 (7;9)	0,308**

**The Mann Whitney U Test

Hand pain is significantly frequent in the DM group than controls when numbness was similar between the two groups (Table 5). There has been a positive correlation between weight gain during pregnancy and MN-CSA (p =0,011; r=0,245).

Table 5: Clinical Symptoms in DM and control group

	DM group (n:107)	Control group (n:113)	p value
Hand numbness (n (%))	27 (25,2%)	17 (15%)	0,059***
Hand pain (n (%))	10 (9,3%)	2 (1,8%)	**0,013*****

*** Chi Square Test

DISCUSSION

Both pregnancy and DM are well-known risk factors for CTS (3,7). But there is no available data about this issue in the literature to date. In this study, we found an increase MN-CSA in the DM group compared with controls in a sample of the pregnant population. Also, there has been a positive correlation between weight gain during pregnancy and MN-CSA.

CTS is frequent in pregnancy and has a negative effect on life quality due to pain and numbness. USG evaluation of MN was pointed as a first-line confirmative test in the general population before (14). Similarly, sonographic evaluation of MN at the time of routine antenatal follow-up could lead to early diagnosis of CTS with typical symptoms and some conservative treatment modalities might be recommended especially high-risk groups like DM.

There is not an exact cut-off for MN-CSA for CTS diagnosis. There are several reports ranging from 8.5 to 15 mm^2 for CTS diagnosis (14-18). The lack of consensus about this topic might be related to the heterogeneity of the study populations (age, sex, race ext.) and differences in the measurement techniques and types of equipment. Additionally, there is no study about pregnancy-related CTS and USG evaluation to date. In the present study, we found significantly increased MN-CSA value in the DM group (8 mm2) than the control group (7 mm2) (p<

0,01). Oliveira et. al. showed that the prevalence of CTS increased in DM pregnancies when compared who did not develop in the third trimester (19). Hyperglycemic response of the MN results as an increased MN-CSA and DM was stated as a risk factor for CTS (7) and consistent with this data we found higher MN-CSA value in the DM group than controls.

The gold standard for CTS diagnosis is clinical history with the exclusion of other possible causes (3). Consistently in the DM group, the common symptom of CTS; hand pain, was significantly more reported than in the control group.

Confirmation of CTS diagnosis by nerve conduction study (NCS) is a conventional approach in the general population (3, 10) but, NCS is an invasive, uncomfortable, and time-consuming procedure and not preferred as a first-line diagnostic test in the pregnant population. Although, for the CTS diagnosis accuracy of USG is high besides its advantages like safety and availability (20). After all, USG evaluation of MN-CSA has to be adopted routine antenatal follow-up for pregnant women especially in the presence of CTS symptoms.

A positive correlation was found between weight gain during pregnancy and MN-CSA. There are several studies that pointed excessive weight gain during pregnancy could lead the CTS symptoms (2,21,22). Fluid retention and peripheral edema might be more evident in overweighted pregnant women which can be an explanation of this result.

Diagnosis of the CTS in pregnancy is important because symptoms are severe enough to negatively affect hand function and life quality, especially in sleep. It is shown that CTS can have an independent negative effect on sleep during the last trimester (1). However, this situation is generally underestimated by both patients and obstetricians (23,24). Simple USG evaluation of the MN especially in symptomatic diabetic pregnant women could allow simple interventions for these patients like avoiding extreme flexion of the wrist or wrist splints to hold the wrist in a neutral position that results in reduce CTS symptoms (1,2,25,26).

The main strengths of this study were its novelty, prospective design, and attract the attention of obstetricians about a frequent problem in pregnancy. The researchers were not blinded to the presence or absence of DM, which was the main limitation of this study. Next, we could not follow the patients' postpartum symptoms, as a second limitation.

In conclusion, USG can be a first-line diagnostic test for CTS in the diabetic pregnant population, as recommended for the general population before (14). As both pregnancy and DM are stated as risk factors for CTS, these patients must be evaluated more carefully about this view of point and proper bits of advice should be given to improve life quality. Additionally, the risk of symptom persistence increased in the DM pregnancy population, and hand surgery consultation might be a logical approach in their management. Further studies of larger numbers of patients are necessary to confirm the results reported here.

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