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Risk factors in pregnancy-related carpal tunnel syndrome

Gebeliğe bağlı karpal tünel sendromunda risk faktörleri

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ABSTRACT

Aim: The purpose of our study was to highlight carpal tunnel syndrome (CTS), which is generally overlooked by physicians in pregnant women, resulting in inadequate diagnosis and treatment, and to investigate the related risk factors in pregnant women, who are diagnosed with CTS.

Materials and Methods: In our study, the demographic, clinical, and laboratory data of 82 pregnant women, who were diagnosed with CTS, who were in the 3rd trimester, and whose pregnancy follow-ups were performed by us between March 2018-2023, and 82 pregnant women in the control group were assessed retrospectively.

Results: Body mass index (BMI) values were observed to be significantly higher in the group with CTS compared to the group without CTS(p:0.036). The HbA1c level was 5.4±0.2 in the group with CTS, and 5.1±0.3 in the group without CTS, and it was significantly higher in the group with CTS(p:0.038). The TSH level was 2.9±0.6(mIU/L) in the group with CTS, and 2.4±0.5(mIU/L) in the group without CTS, and it was significantly higher in the group with CTS(p:0.042). A positive, statistically significant, and moderate correlation was detected between the CTS-6 value and BMI (p:0.006, r=0.438). Another statistically significant, positive, and weak correlation was detected between the CTS-6 score and HbA1c level(p:0.028, r=0.234).

Conclusion: It is especially important to pay attention to many risk factors because subclinical CTS during pregnancy can lead to permanent complications. We think the present study's findings are important for healthcare providers and will contribute significantly to the understanding of the relationship between CTS and pregnancy by shedding light on the relationship between relevant variables and the prevalence of CTS.

Keywords: Carpalitunnel syndrome, CTS-6, Pregnancy

ÖZ

Amaç: Bu çalışmanın amacı gebelerde genellikle hekimler tarafından gözden kaçırılan, tanı ve tedavide yetersizliğe neden olan karpal tünel sendromunu (KTS) vurgulamak ve KTS tanısı alan gebelerde ilişkili risk faktörlerini araştırmaktır.

Gereç ve Yöntemler: Bu çalışmada Mart 2018 - Mart 2023 tarihleri arasında hastanemizde gebelik takipleri yapılan, 3. trimesterde KTS tanısı alan 82 gebe ile kontrol grubundaki 82 gebenin demografik, klinik ve laboratuvar verileri retrospektif olarak değerlendirildi.

Bulgular: KTS saptanan grupta beden kitle indeksi (BMI) saptanmayan gruba göre anlamlı derecede yüksek saptandı (p:0.036). HbA1c düzeyi KTS saptanan grupta 5.4±0.2, saptanmayan grupta ise 5.1±0.3 olup KTS grubunda anlamlı olarak yüksek saptandı (p:0.038). TSH düzeyi KTS saptanan grupta 2.9±0.6 (mIU/L), saptanmayan grupta ise 2.4±0.5 (mIU/L) olup, KTS grubunda anlamlı olarak yüksek saptandı (p:0.042). KTS-6 değeri ile BMI skoru arasında pozitif, istatistiksel olarak anlamlı ve orta düzeyde bir korelasyon tespit edildi (p:0.006, r=0.438). KTS-6 skoru ile HbA1c düzeyi arasında istatistiksel olarak anlamlı, pozitif ve zayıf bir korelasyon daha tespit edildi (p:0.028, r=0.234).

Sonuç: Gebelikte subklinik KTS kalıcı komplikasyonlara neden olabileceğinden birçok risk faktörüne dikkat etmek özellikle önemlidir. Bu çalışmanın bulgularının sağlık çalışanları açısından önemli olduğunu ve ilgili değişkenler ile KTS prevalansı arasındaki ilişkiye ışık tutarak KTS ile gebelik arasındaki ilişkinin anlaşılmasına önemli katkı sağlayacağını düşünüyoruz.

Anahtar Kelimeler: Karpal tünel sendromu, KTS-6, Gebelik

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INTRODUCTION

A group of symptoms known as carpal tunnel syndrome (CTS) result from by pressing of the median nerve inside the carpal tunnel. The carpal tunnel is a tunnel that has no elasticity and cannot adapt to different pressure situations (1). However, it's not entirely inflexible since the carpal bones make sliding movements on each other during wrist movements and, therefore, they can stretch the canal slightly. In anatomical terms, the carpal tunnel gets narrow in sections towards 2.0-2.5 cm distally (1). Patients with CTS suffer High Intra-Carpal tunnel pressure which spikes at that point. Mechanical pressure on the nerve sheath or interruption of blood circulation may block the conduction of the median nerve, which may cause CTS (1). The general population is estimated to have a 4% prevalence of CTS (2). It has been proposed that the morphology of women may make them more susceptible to CTS (3). The most prevalent entrapment neuropathy is thought to be CTS (4). CTS symptoms include intense pain in the hand and wrist and paresthesia (sensation of numb, buzzing and burn) in the median nerve distribution (the first three fingers and the middle half of the fourth digit) (4). Often, symptoms appear gradually and at nights, and the pain may radiate to the arm. Grip strength may be quite weak in these patients (5). Over time, the thenar eminence muscles might weaken, and in over 50% of instances, the condition affects both sides (5). Tinel's, Phalen's, and Median Nerve Compression are standard tests that are used in clinical examinations to diagnose CTS and can either produce or exacerbate symptoms (6). With a sensitivity of 49–84% and a specificity of 95%, electrodiagnostic testing carried out by a qualified electromyographer is the most accurate diagnostic technique (6). With a high degree of sensitivity and specificity, electrodiagnostic investigations are an essential electrophysiological follow-up to the history and examinations in the diagnosis of CTS (4, 6). The existence and severity of wrist median neuropathy can be assessed by nerve conduction tests and electromyography (EMG) (4, 6). CTS usually develops idiopathically (7). However, it is also considered that CTS is associated with some pathological (thyroid disease, colles fracture, polyneuropathies, etc.) and physiological (pregnancy, menopause) conditions (7). One of the most prevalent physiological factors linked to CTS is thought to be pregnancy (7). However, the data on its incidence in the literature are quite contradictory (7). Physiological evidence suggests that elevated pressure in the carpal tunnel causes the deterioration of the median nerve functions (8). Studies regarding the CTS dominance at pregnancy reported a wide spectrum because different methods were used in diagnosis (9, 10). The pathophysiology of CTS during pregnancy is shown as fluid accumulation under the influence of hormonal fluctuations during pregnancy (11). The kidneys increase blood volume in the third trimester of pregnancy by increasing fluid retention and the simultaneous increase in estrogen, progesterone, and aldosterone levels plays roles in the development of CTS (12). Predisposing factors supporting the onset of symptoms in this period were shown to be the changes in glucose levels, edema, and hypersensitivity of the relevant nerve (13). As the pregnancy progresses, the incidence of CTS also increases (14). Most pregnant women show symptoms that are sufficiently painful to interfere with their ability to sleep and use their hands. The quality of life of these individuals appears to be significantly affected (14). The purpose of the present study was to highlight CTS, which is often overlooked by physicians in pregnant women, resulting in inadequate diagnosis and treatment, and to examine the related risk factors in pregnant women diagnosed with CTS.

MATERIALS AND METHODS

The research had a retrospective case-control design in line with the Helsinki Declaration. Informed consent forms were taken from the participants. The research was started after receiving ethics committee approval number 2024/250 from our hospital. The study was conducted in the 3rd trimester of pregnancy follow-up in the clinic between March 2018 and 2023, who described upper extremity complaints (numbness in the hands or arms, tingling, pain, pain coming from the neck to the arms, etc.) and therefore were consulted to the neurology department. A total of 82 pregnant women who were diagnosed with CTS during pregnancy and 82 pregnant women in the control group were included in the research. Being diagnosed previously with CTS, having a history of treatment, chronic hypertension, diabetes mellitus, and known connective tissue disease were considered as exclusion criteria. The age, gravidity, parity, birth weight, gestational age, body mass index (BMI) values, first and fifth minute Apgar values, glycated hemoglobin (HbA1C), HOMA-IR, fasting glucose, Thyroid stimulating hormone (TSH), FreeT3 (fT3), FreeT4 (fT4), Anti-thyroglobulin (Anti-tg), Anti-thyroid peroxidase (Anti-TPO) values, systolic and diastolic blood pressure values of the patients were evaluated retrospectively. Blood results of insulin resistance and thyroid function parameters of all patients included in the study, performed at 24-28 weeks, were evaluated retrospectively. Weakness, numbness, night numbness, thenar atrophy, and Tinel and Phalen Tests were performed with the CTS-6 evaluation method modified by Graham (15). The CTS-6 scale evaluates six basic criteria out of 26 points, according to history, symptoms, and physical examination results. It is possible to diagnose CTS with a probability of >12=0.80 and > 5=0.25 according to the CTS-6 scoring results (15). In this scale, patients who scored 12 points or more were evaluated as CTS-6 positive, and patients who scored less than 12 points were evaluated as CTS-6 negative (15). The correlation between CTS-6 values and risk factors was also evaluated in the present study. The Nihon

Kohden Neuropack S3 MEB-9600 Device was used at our hospital's EMG laboratory to conduct nerve conduction tests. Median motor and sensory nerve conductions and ulnar motor and sensory nerve conductions were studied in the upper extremity under normal room temperature and by ensuring that the skin temperature was at least 31-32 degrees. The data analysis was conducted with the SPSS 26.0 (IBM Inc. Chicago, IL, USA). The Kolmogorov-Smirnov Test was employed to make an evaluation regarding the normality distribution of the data. Normally distributed data were given as Mean±SD. The Student's t-test was employed to make a comparison on normally distributed data and the Chi-Square Test and Fisher's Exact Test were used to make an evaluation regarding the categorical variables. The degree of correlation between two variables and their link to one another was assessed using the Pearson Correlation Test. In every test, a p-value of less than 0.05 was deemed statistically significant.

RESULTS

The average age of the 164 participants was 30.6±9.7 years and the average BMI score was 26.8±4.8 kg/m^2 in this research. The mean gravidity of the patients was 2.1±0.8, mean parity was 1.8±0.7, week of birth was 37±2.4, birth weight was 2990±860 g, first-minute Apgar score was 7.9±0.9, and fifth-minute Apgar score was 8.5±0.6. No significant differences were detected with regard to age and parity averages between the group with CTS and the group without CTS (p:0.810, p:0.840, respectively). There were no significant differences between the group with CTS and the group without CTS with regard to week of birth and birth weight (p:0.770, and p:0.830, respectively). The first and fifth-minute Apgar scores (p:0.760, p:0.740, respectively) did not significantly vary between the CTS group and the non-CTS group. The CTS group had considerably higher BMI ratings than the non-CTS group (p: 0.036) (Table 1).

Among the patients who participated in the study, the glucose level in the CTS group was 90.1±9.9 (mg/dl), and 82.5±9.7 in the non-CTS group (mg/dl), and no significant difference was seen between the groups (p:0.270). The HbA1c level was found to be 5.4±0.2 in the CTS group, and 5.1±0.3 in the non-CTS group, and it was significantly higher in the CTS group (p:0.038). HOMA-IR level was 2.1±0.3 in the CTS group, and 2.1±0.1 in the non-CTS group, and no significant difference was observed between the groups (p:0.870). The TSH level was found to be 2.9±0.6 (mIU/L) in the CTS group, and 2.4±0.5 (mIU/L) in the non-CTS group, and it was significantly higher in the CTS group (p:0.042). No significant differences were detected in fT3 and fT4 values between the CTS group and the non-CTS group (p:0.790, p:0.820, respectively). No significant difference was found in Anti-Thyroid peroxidase and Anti-Thyroglobulin values between the CTS group and the non-CTS group (p:0.220, p:0.420, respectively). The systolic blood pressure level was 128±10 (mmHg) in the CTS group, and 122±10 (mmHg) in the non-CTS group, and no significant differences were found between the groups (p:0.640). The diastolic blood pressure level was 85±11 (mmHg) in the CTS group, and 81±10 (mmHg) in the non-CTS group, and no significant differences were found between the groups (p:0.550) (Table 2).

A positive, statistically significant, and moderate correlation was observed between the CTS-6 value and BMI (p:0.006, r=0.438). Another positive, statistically significant, and weak correlation was detected between the CTS-6 score and HbA1c level (p:0.028, r=0.234). There was a positive, statistically significant, and weak correlation between CTS-6 score and TSH level (p:0.018, r=0.208) (Table 3).

Table1. Demographic and clinical characteristics of the participants

	CTS (+) n:84	CTS (-) n:84	Total n:168	
	Mean±SD			p
Age (year)	30.8±9.4	30.5±9.8	30.6±9.7	0.810
BMI (kg/m^2)	28.8±3.7	25.7±4.7	26.8±4.8	**0.036**
Gravidity	2.2±0.7	2.1±0.8	2.1±0.8	0.890
Parity	1.8±0.6	1.7±0.8	1.8±0.7	0.840
Birth week	37±2.2	37±2.6	37±2.4	0.770
Birth weight (g)	3020±820	2950±870	2990±860	0.830
1st minute Apgar score	8±0.8	7.8±0.9	7.9±0.9	0.760
5th minute Apgar score	8.4±0.5	8.5±0.7	8.5±0.6	0.740

*CTS: Carpal tunnel syndrome, BMI: Body mass index

Table 2. The comparison of clinical and laboratory data according to the presence of CTS

	CTS (+) n:84	CTS (-) n:84	Total n:168	
	Mean±SD			p
Glucose (mg/dl)	90.1±9.9	82.5±9.7	87.7±9.7	0.270
HbA1c (%)	5.4±0.2	5.1±0.3	5.3±0.2	**0.038**
HOMA-IR	2.1±0.3	2.1±0.1	2.1±0.2	0.870
TSH (mIU/L)	2.9±0.6	2.4±0.5	2.6±0.5	0.042
fT3 (pg/ml)	2.7±0.2	2.6±0.4	2.6±0.3	0.790
fT4(ng/dl)	1.4±0.1	1.3±0.2	1.3±0.2	0.820
Anti-Thyroid peroxidase (IU/ml)	68.40±20.1	62.40±18.50	64±25.20	0.220
Anti-Thyroglobulin (IU/ml)	40.4±8.6	42±6.8	40.9±7.8	0.420
Systolic Pressure (mmHg)	128±10	122±10	124±13	0.640
Diastolic Pressure (mmHg)	85±11	81±10	82±13	0.550

*CTS: Carpal tunnel syndrome, HbA1c: Glycosized hemoglobin, TSH: Thyroid stimulating hormone, fT3: Free T3, fT4: Free T4

Table 3. The relationship between CTS-6 score and clinical and laboratory data

	Grade 1-2	Grade 3-4	Grade 5	Grade 6
1. CTS-6 score	1			
2. BMI (kg/m²)	.438 **	1		
3. HbA1c (%)	.234 *	.317 **	1	
4. TSH (mIU/L)	.208 *	.292 **	.301	1

* CTS: Carpal tunnel syndrome, BMI: Body mass index, HbA1c: Glycosized hemoglobin, TSH: Thyroid stimulating hormone, **r: Spearman correlation coefficient

DISCUSSION

Although the relationship between pregnancy and CTS is already known, untreated CTS symptoms in pregnant women are a common occurrence in the gynecology practice. There is no agreement about the results of the several research that looked at the risk factors of CTS. In the present study, the extent of CTS was evaluated in pregnant women, taking into account various demographic data and characteristics of possible risk factors. It was reported in previous studies that advanced maternal age is a risk factor for CTS during pregnancy (9). In the present study, no significant difference was found with regard to age between the CTS group and the non-CTS group. In their study, Hanif et al. reported no relationship between age and CTS, similar to our results (14). No significant difference is reported in the literature in the nerve conduction study parameters for CTS in studies conducted with pregnant women with primigravida and multigravida history (15-17). Similarly, no significant differences were seen in our study between the two groups with regard to gravidity averages. Contradictory results were reported in studies evaluating the relationship between parity and CTS in the literature. Meems et al. reported in their study that they detected no relationships between parity and CTS (10). Wright et al. reported that there may be a relationship between increasing parity and CTS (9). No significant difference was found in our study with regard to parity averages between the groups with and without CTS. Research indicates that BMI, as for the general population, is a separate risk factor for CTS related to pregnancy (9). It was also reported that the difference in weight increase at pregnancy is correlated with the prognosis of CTS (17). Many studies report significant relationships between obesity and the risk of CTS development on a global scale (18-20). Weimer et al. showed that when compared to slim people, the risk of CTS increased 2.5 times among those who were categorized as obese (BMI < 20) (21). In our study, the group with CTS had a considerably higher BMI than the group without it. In our investigation, we also found a somewhat strong, positive, statistically significant link between the BMI and the CTS-6 score. Maternal physiology and behavior, such as increased blood volume, uterine mass, interstitial fluid volume, growing fetus, and belly fat cause weight gain during pregnancy (22). It is considered that in the transverse carpal ligament, the decreased blood flow to the median nerve because of the increased edema and adipose tissue developing during pregnancy causes

CTS (22). Gestational Hypertension, which may develop secondarily to weight gain, and diabetes-related systemic pregnancy problems can also result in reduced blood supply to the median nerve and an elevated CTS risk (22). Although its exact origin is not clear, increased Vascular Endothelial Growth Factor (VEGF) and advanced glycation end products (consistent with median nerve edema caused by hyperglycemia, increased sensitivity to external stress, nerve myelin ischemia, and axonal degeneration) seem to play roles in the development of CTS (23). In their study, after dividing patients into three groups as severe, moderate, and mild based on the severity of CTS, Demirel et al. showed that individuals with CTS had substantially higher fasting blood sugar and HbA1c values than those without CTS (24). Rydberg et al. showed that high plasma glucose and HbA1c levels were linked with an increased risk of CTS and that the presence of diabetes was an important risk factor in this regard (25). In our study, glucose and HOMA-IR levels did not have significant differences between the groups, and the HbA1c level was significantly higher in the group with CTS. Also, a positive, statistically significant, and weak correlation was detected between the CTS-6 value and HbA1c level in our study. The relationship between hypothyroidism and the development of CTS was shown in multiple studies in the literature (26-28). Excessive amounts of mucopolysaccharides, hyaluronic acid, and glycosaminoglycans may accumulate in the subcutaneous tissues in the presence of hypothyroidism (26). A narrow space exists in the carpal tunnel where pseudomucinous substances accumulate and this causes the median nerve compression and causes CTS (26). In an investigation to find out how common CTS is in hypothyroidism-affected women, 20 of 300 hypothyroidism patients were examined because hypothyroidism is more common in women with CTS. It was reported that there were 160 individuals with mild CTS and 160 with moderate CTS (26). These numbers showed that a significant portion of women diagnosed with hypothyroidism were diagnosed with CTS (27). In a meta-analysis of Shiri et al., the results of 10 studies were summarized and it was concluded that CTS was strongly associated with hypothyroidism (28). TSH levels were considerably higher in the CTS group in our investigation, which is consistent with results from the literature. We also found a small but statistically significant positive association between the TSH level and the CTS-6 score. In the literature, some studies report that hypertension is generally associated with edema during pregnancy because of fluid retention, which will elevate the pressure within the tunnel and increase the CTS development risk (29, 30). However, it is already known that long-term hypertension is generally associated with different types of neuropathies (31). Unlike the literature data, no significant relationships were found in our study between diastolic and systolic blood pressure levels and the presence of CTS. The difference between this relationship in the literature and the results of our study may be because patients diagnosed with chronic hypertension were excluded from our research. Voitk et al. showed in their study that only 46% of symptomatic pregnant women consulted a doctor because of hand symptoms and only 35% of them received treatment (32). It is considered that the most important reason for this is that patients do not explain their symptoms or physicians do not question patients about their symptoms. When the studies conducted using the electrodiagnostic method in the diagnosis of CTS are reviewed, the results show that the prevalence of CTS is high during pregnancy, but the prevalence is reported to be low in studies where only clinical tests were used (33). Padua et al. reported the prevalence of CTS in pregnant women as 7-43% according to electrodiagnostic findings and 31-62% according to clinical findings (33). Graham et al. reported that the correlation between the pretest probability determined by CTS-6 and the posttest probability calculated based on EMG results was quite high (34). For this reason, we think that the CTS-6 Test is a useful noninvasive scale for making a preliminary diagnosis and it was applied to our patients during the first examination. The most important limitation of the study was that it was designed retrospectively. Also, the limited number of participants in the study restricted the adequate evaluation of risk factors in pregnant women diagnosed with CTS. Confirmation of each patient evaluated with CTS-6 scoring by electrodiagnostic method, and in this way, confirming the presence of CTS can be shown as the strength of the study.

CONCLUSION

It is important to pay special attention to the risk factors that may lead to the development of CTS because subclinical CTS during pregnancy can lead to permanent complications. Diagnosis and management of such risk factors to be modified may prevent disease progression. We believe that the results of the present research are important for healthcare providers and will contribute significantly to the understanding of the relationship between CTS and pregnancy in the literature by shedding light on the relationship between the relevant variables and the prevalence of CTS.

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