

Relationship of vitamin D level, fasting blood sugar, and body mass index, to carpal tunnel syndrome severity

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Abstract

Aim: This study aims to investigate the relationship between Idiopathic Carpal Tunnel Syndrome (CTS) and Vitamin D Level, Body Mass Index (BMI), and Fasting Blood Sugar.

Materials and Methods: 54 CTS patients diagnosed electrophysiologically were included in the study. These patients' ages, genders, height and body weights, and body mass index values were recorded. Laboratory tests including vitamin D levels and fasting blood sugars were performed for each participant. The CTS stage was determined electrophysiologically and the Boston questionnaire and the visual analogue scale (VAS) were filled to assess total pain scores, symptom severities (CNS), and functional states (FSS).

Results: There was a statistically significant difference between the distribution of CTS stages in female patients and male patients ($p = 0.008$). There was no statistically significant difference between mild, moderate, and severe CTS stages in terms of age, body mass index, and fasting blood glucose ($p = 0.459$; $p = 0.232$; $p = 0.413$, respectively). There is a statistically significant difference between CTS stages in terms of vitamin D levels ($p < 0.001$). Vitamin D averages were observed to decline from mild to severe stages of CTS. According to the Boston Carpal Tunnel Syndrome functional status scale, it was determined that there is marginal statistical significance between the stages of CTS. It was observed that the mean functional status scale scores increased from the mild stage to the severe stage ($p = 0.055$). There was no statistically significant difference between mild, moderate, and severe CTS stages in terms of VAS pain and paresthesia scores and the Boston Carpal Tunnel Syndrome symptom severity scale ($p = 0.340$; $p = 0.359$; $p = 0.250$, respectively).

Conclusion: We found a significant relationship between the vitamin D level and the CTS stage. According to Boston Carpal Tunnel Syndrome Questionnaire, we found that there is a marginal statistical significance between the stages of CTS.

Keywords: Body mass index; boston carpal tunnel syndrome questionnaire; carpal tunnel syndrome; fasting sugar; vitamin D

INTRODUCTION

CTS is the most common entrapment neuropathy of the median nerve due to compression in the carpal tunnel (1). Many risk factors have been identified for CTS: Chronic diseases such as diabetes mellitus, thyroid dysfunction, rheumatoid arthritis, and features such as pregnancy, obesity, recurrent wrist movements, occupational causes, and female gender can be said as etiological causes (2).

The diagnosis is made by clinical and electrophysiological tests (3,4). Numbness, tingling, burning, and pain that spread towards the tips of the first 3 fingers can be counted as symptoms associated with CTS (5).

Many studies are showing that vitamin D deficiency, obesity, and high BMI values are a risk factor in CTS, but there are very few studies investigating fasting blood sugar levels in idiopathic CTS patients (6,7).

In this study, we aimed to investigate the relationship between Idiopathic Carpal Tunnel Syndrome (CTS) and Vitamin D Level, Body Mass Index (BMI), and Fasting Blood Sugar. According to our hypothesis, there is a close relationship between these features we investigated and CTS.

MATERIALS and METHODS

Participants

The study included 54 patients between the ages of 18-65 diagnosed with idiopathic carpal tunnel syndrome, who applied to the Hatay State Hospital Physical Medicine and Rehabilitation Outpatient Clinic and Hatay Mustafa Kemal University Neurology Outpatient Clinic. The patients were diagnosed with electrophysiologically and disease stages were determined [8]. Inclusion criteria were considered to be between the ages of 18-65, to voluntarily participate in the study, to be diagnosed with idiopathic CTS according

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to the history, clinical examination, and nerve conduction study results. Patients previously diagnosed with diabetes mellitus, chronic kidney and liver disease, acromegaly, rheumatological diseases, acute trauma, pregnancy, hypothyroidism, presence of surgery in the wrist area for any reason, atrophy or weakness in the thenar muscles, cervical radiculopathy, thoracic outlet syndrome, polyneuropathy, brachial neuropathy or proximal median nerve neuropathy, having had corticosteroid injection in the wrist area in the last 1 year and use of oral steroids or non-steroidal anti-inflammatory drugs in the last 3 months, lactation period, vitamin B12 deficiency, those <18, >65 years of age were excluded from the study, also patients using vitamin D for any reason or receiving osteoporosis treatment were excluded from the study.

Assessment Tools and Study Design

ENMG findings were obtained using the Medelec Synergy device at room temperature. The study was conducted with superficial electrodes using standard nerve conduction techniques, according to the protocol proposed by the American Academy of Neurology, the American Society of Electrodiagnostic Medicine, and the American Academy of Physical Medicine and Rehabilitation for CTS (Slowed velocity of the median nerve sensory conduction and/or reduced in amplitude was considered as Mild CTS. Sensory impairment in the median nerve and prolonged motor distal latency was considered as Moderate CTS. Failure to obtain median nerve sensory conduction and long motor distal latency was considered as severe CTS) (8).

The sociodemographic characteristics of the patients were recorded. The height and body weights of the patients were recorded. Body mass indexes were calculated by dividing body weight by the square of their height (kg / m²).

Vitamin D level measured from venous blood was evaluated on the same day with ENMG study from all patients. Measurements were made by the chemiluminescent microparticle immunological method with ARCHITECT brand device (Abbott Park, USA). Fasting blood sugar values of the patients from venous blood were recorded.

Statistical Analysis

The statistical analyses were performed using SPSS version 21 software package. For statistical analysis, Pearson Chi-Square Test, One-Way Analysis of Variance test, and Kruskal Wallis Tests were used. P<0.05 value was considered to be statistically significant.

This study was approved by the Clinical Study Ethics Committee of Mustafa Kemal University Tayfur Ata Sokmen Medical Faculty (Approval no: 2020/46).

RESULTS

Fifty-four patients diagnosed with CTS were included in the study. Forty-four of the patients were women. The patients were divided into mild, moderate, and severe stage CTS groups according to their ENMG results. There is a

statistically significant difference between the distribution of CTS stages in female patients and male patients ($p = 0.008$). While the incidence of female patients in mild, moderate, and severe stages was approximately similar; no male patients were observed in the severe CTS stage and only 20% of the male patients were found to be in the mild stage. There was no statistically significant difference between mild, moderate, and severe CTS stages in terms of age, body mass index, and fasting blood glucose ($p = 0.459$; $p = 0.232$; $p = 0.413$, respectively) (Table 1).

Table 1. Sociodemographic characteristics, BMI and fasting blood sugar according to CTS Stages

	CTS Stage			p
	Mild	Moderate	Severe	
Gender				
Female	14 (87.5%)	13 (61.9%)	17 (100.0%)	0.008*
Male	2 (12.5%)	8 (38.1%)	0 (0.0%)	
Age	47.63±12.88	51.43±10.45	51.71±7.74	0.459**
BMI	29.80±3.35	30.55±3.98	32.18±4.72	0.232**
Fasting Blood Sugar	89.06±6.94	89.90±7.59	92.24±6.65	0.413**

*: Pearson Chi-Square Test; **: One-Way Analysis of Variance

Table 2. Vitamin D levels, VAS and Boston scoring according to CTS Stages

	CTS Stage			p
	Mild	Moderate	Severe	
Vitamin D	17.75±9.00 ^a	14.59±5.35 ^a	8.27±4.40 ^b	<0.001***
VAS pain	6.13±0.96	6.57±1.63	6.82±1.38	0.340***
VAS paresthesia	6.38±1.09	6.76±1.41	7.06±1.30	0.359***
Boston Symptom Severity	2.62±0.86	2.83±0.93	3.16±0.92	0.250***
Boston Functional Status	2.20±0.55 ^b	2.47±0.78 ^{ab}	2.83±0.83 ^a	0.055**

***: One-Way Analysis of Variance; **: Kruskal Wallis Test

^{a,b}: Different letters on the same line express statistical significance

There is a statistically significant difference between CTS stages in terms of vitamin D levels ($p < 0.001$). Vitamin D averages were observed to decline from mild to severe stages of CTS. According to Post hoc test-Bonferroni correction, there was no statistically significant difference between mild and moderate stages, the average level of vitamin D in the severe stage was found to be statistically lower than both mild and moderate stages. According to the Boston Carpal Tunnel Syndrome functional status scale, it was determined that there is marginal statistical significance between the stages of CTS. It was observed that the mean functional status scale scores increased from the mild stage to the severe stage ($p = 0.055$). According to the Post-hoc Tukey Test, it was determined that only the severe stage was statistically significantly higher than the mild stage. There was no statistically

significant difference between mild, moderate, and severe CTS stages in terms of VAS pain and paresthesia scores and the Boston Carpal Tunnel Syndrome symptom severity scale ($p = 0.340$; $p = 0.359$; $p = 0.250$, respectively) (Table 2).

DISCUSSION

In this study, we aimed to investigate the relationship between Idiopathic Carpal Tunnel Syndrome (CTS) and Vitamin D Level, Body Mass Index (BMI), and Fasting Blood Sugar. We assumed that we would find a close relationship between these features and CTS, but we found no statistically significant difference between mild, moderate, and severe CTS stages in terms of body mass index, and fasting blood glucose ($p = 0.232$; $p = 0.413$, respectively). Only we found a statistically significant difference between CTS stages in terms of vitamin D levels ($p < 0.001$).

In the incidence and prevalence studies of the general population, CTS has been reported more frequently in women. Studies were reporting that CTS is seen more frequently in women at rates ranging from 5.7 to 1.4 (9). In our study, following the literature, CTS was found to be higher in women (44 female patients versus 10 male patients). In our study, we found a statistically significant difference between the CTS stage and gender ($p = 0.008$). While the CTS stage was observed with a similar frequency among women, there were no male patients with severe CTS stage. Most of the male patients were in the moderate stage (80%). This situation may be related to the higher prevalence of CTS in women and the delay in women's seeking treatment.

Previous studies have shown that the prevalence of CTS increases with age (6). The relationship between age and CTS has been tried to be explained by the increase in exposure to physical coercion as age increases (10). Also, studies are showing that the mean age of patients with bilateral CTS is statistically significantly higher than patients with unilateral CTS (6). In our study, we investigated the relationship between the CTS stage and age and we did not find a significant relationship between them. We think that this situation may be related to the insufficient number of patients included in the study.

Obesity has been shown in previous studies to be a risk factor for CTS. For the first time, Dieck and Kelsey defined increased body weight as a possible new risk factor for CTS in their epidemiological study (11). Subsequently, in the epidemiological study of Vessey et al. (15), a significant relationship was found between BMI and CTS (12). Similarly, Becker et al. and Stallings et al. found a significantly higher BMI value in the CTS group compared to the control group (6,13). Studies have suggested that individuals with high BMI values may be susceptible to entrapment neuropathy in areas such as the carpal canal, as the amount of adipose tissue in the neural support tissue will increase as in the whole body (3). In our study, patients were in the overweight and obese group according to their mean body mass index values. However, in our study, we did not find a significant relationship between

the CTS stage and BMI values. The fact that the severity of CTS obtained in our study was independent of the increased BMI value made us think that the ratio of body fat is not proportional to the amount of adipose tissue around the nerve.

There have been many studies examining whether DM affects the development of CTS, but their results are inconsistent (14). Also, studies are showing that the incidence of glucose metabolism abnormalities is high in CTS patients and the frequency of insulin resistance in CTS patients is higher than in the normal population (15). In our study, we investigated the relationship between fasting blood glucose and the CTS stage, but we did not find a statistically significant difference.

There are a limited number of studies investigating the relationship between Vitamin D and CTS. In a study, vitamin D binding protein level was found to be lower in patients with CTS compared to the control group (16). In another study, it was found that the CTS has a more severe course in patients with low vitamin D levels compared to the group with normal vitamin D levels (17). There are also studies showing that patients' pain is reduced by replacing vitamin D deficiency (18). But, there are also studies showing that there is no significant difference between the severity of CTS and vitamin D level (5). In our study, we investigated the relationship between the CTS stage and vitamin D level. We found that there is a statistically significant difference between CTS stages in terms of vitamin D levels ($p < 0.001$). Vitamin D averages were observed to decline from mild to severe stages of CTS. This can be explained by the loss of neuroprotective, anti-inflammatory and antiproliferative effects that may occur with vitamin D deficiency.

There are few studies in the literature examining the relationship between Boston scores, electrophysiological findings, and CTS stage. Akman et al. Reported a good correlation between Boston scores and electrophysiological findings (19). In the studies of Heybeli and colleagues and Mondelli and colleagues, there was no correlation between Boston scores and electrophysiological findings. They tried to explain this difference by saying that Boston Carpal Tunnel Syndrome Questionnaire evaluates different aspects of CTS with electrophysiological tests (20,21). In our study according to the Boston Carpal Tunnel Syndrome functional status scale, it was determined that there is marginal statistical significance between the stages of CTS. It was observed that the mean functional status scale scores increased from the mild stage to the severe stage ($p = 0.055$). According to the Post-hoc Tukey Test, it was determined that only the severe stage was statistically significantly higher than the mild stage. There was no statistically significant difference between mild, moderate, and severe CTS stages in terms of VAS pain and paresthesia scores and the Boston Carpal Tunnel Syndrome severity scale ($p = 0.340$; $p = 0.359$; $p = 0.250$, respectively).

LIMITATIONS

The limitations of the study include: More patients could be included in the study. Except for comparing patients within themselves, the control group could also be included in the study and the patients could be compared with the control group. Patients with vitamin D deficiency could be given replacement therapy and their clinical status after treatment could be investigated.

CONCLUSION

As a result, we found no statistically significant difference between mild, moderate, and severe CTS stages in terms of age, body mass index, and fasting blood glucose, but we found a statistically significant difference between CTS stages in terms of vitamin D levels. Vitamin D averages were observed to decline from mild to severe stages of CTS. According to Boston Carpal Tunnel Syndrome Questionnaire, in our study, it was determined that there is marginal statistical significance between the stages of CTS. There had been also many studies that support us or claim otherwise. More studies with a multicenter and large number of patients are needed to understand the role of the characteristics we investigated and other factors in the pathogenesis and to make the treatment of CTS patients more effectively in the future. Boston Carpal Tunnel Syndrome Questionnaire can be used more frequently to evaluate the pre-treatment status and post-treatment response of CTS patients. Fasting blood glucose, BMI, and vitamin D level should be investigated in all patients with suspected CTS, and necessary recommendations (such as weight loss, appropriate diet, and exercise) and vitamin deficiencies should be replaced.

Competing interests: The authors declare that they have no competing interest.

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