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ARAŞTIRMA

Analysis of the relationships between electroneurography and boston questionnaire in obese female patients with carpal tunnel syndrome

Karpal tünel sendromu olan obez kadın hastalarda elekronörografi ile boston anketi arasındaki ilişkilerin analizi

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Abstract

Objective: The aim of the study was to clarify the relationships between Electroneurography (ENG) and Boston Questionnaire (BQ) in patients with Carpal Tunnel Syndrome (CTS).

Material-Method: One hundred and forty-one patients with CTS were enrolled to this study. The demographic data as age, gender, body mass index, symptoms duration and night pain of the patients were recorded. Tinel and Phalen tests were noted as positive or negative. The scores of the BQ Symptom Severity Scale (SSS) and the Functional Status Scale (FSS) were measured. Pain was assessed on Visual Analog Scale (VAS). Motor and antidromic sensory conduction velocities of the median and ulnar nerves were performed. Patients were divided to three groups as mild, moderate and severe CTS according to the ENG outcomes.

Result: The scores of the VAS pain and the BQ-FSS and SSS were found to be significantly higher in patients with moderate and severe CTS compared to those in mild CTS ($p<0.005$). The scores of BQ-FSS and SSS were correlated moderately with the duration of symptoms, median sensory nerve action potential (SNAP)-palm and second digit and strongly with VAS pain ($p<0.05$). It was found that BQ-SSS scores also correlated moderately with median distal motor latency(DML), and sensory nerve conduction velocity(SCNV)-palm and second digit ($p<0.05$).

Conclusion: The patients who have different clinical findings however similar pictures may be interpreted in the light of these results. When the clinician meet decreased median SNAP or elevated median DML and SCNV, he/she should be careful on both the symptom severity and functional impairment or functional deficiency alone respectively.

Keywords: Carpal tunnel syndrome, Electroneurography, Boston questionnaire.

Özet

Amaç: Bu çalışmanın amacı, Karpal Tünel Sendrom(KTS)'lu hastalarda elektronörografi (ENG) ile Boston Anketi (BA) arasındaki ilişkileri saptamaktır.

Materyal-Metot: Karpal Tünel Sendrom'lu yüz kırk bir hasta çalışmaya dahil edildi. Hastaların yaş, cinsiyet, vücut kitle indeksi, semptom süresi ve gece ağrısı gibi demografik bulguları kaydedildi. Tinel ve Phalen testleri negative veya pozitif olarak not edildi. BA Semptom Ciddiyet Skalası (SCS) ve Fonksiyonel Ciddiyet Skalası(FCS)'nın skorları belirlendi. Ağrı Vizüel Analog Skala (VAS) üzerinde değerlendirildi. Median ve ulnar sinirlerin motor ve antidromik duyusal iletim çalışmaları gerçekleştirildi. Hastalar ENG ciddiyetine göre hafif, orta ve ağır KTS olarak 3 gruba ayrıldılar.

Bulgular: Orta ve ciddi KTS'lu hastalarda hafif KTS'lu hastalardakine kıyasla VAS ağrı ve BA-SCS ve FCS skorları anlamlı olarak yüksek bulundu ($p<0.005$). BA-SCS ve FCS skorları, semptom süresi, median duyusal sinir aksiyon potansiyeli(DSAP)-avuçiçi ve ikinci parmak ile orta şiddette ve VAS ağrı ile güçlü olarak korele idi ($p<0.05$). Ayrıca, BA-SCS skorlarının median distal motor latans (DML) ve median duyusal sinir iletim hızı(DSİH)-avuçiçi ve ikinci parmak ile orta düzeyde korele olduğu bulundu ($p<0.05$).

Sonuç: Farklı klinik bulguları olan ancak benzer klinik tabloya sahip olan hastalar bu sonuçlar ışığında değerlendirilebilirler. Azalmış median DSAP veya artmış median DML ve DSİH, sırasıyla hem semptom ciddiyeti ve hem de fonksiyonel eksiklik veya sadece fonksiyonel kayıp açısından işaret verici olabilirler.

Anahtar Kelimeler: Karpal tünel sendromu, Elektronörografi, Boston anketi

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Introduction

Carpal Tunnel Syndrome (CTS) is the most frequent neuropathy of upper extremities (1). Women are more prone to develop CTS with a female to male ratio of 3:1 to about 10:1 (2) and its prevalence varies from 2.7-5.8% in women (1, 3, 4). Characteristics symptoms of CTS include paresthesia such as numbness, tingling, burning and/or wasting of thenar muscles and/or pain in the median nerve distribution region particularly in the first 3 digits and the median half of the 4th digit. These symptoms worsen in night and exist intermittently.

Boston Questionnaire (BQ) is a self-administered questionnaire which is developed to evaluate the symptom and functional severity in patients with CTS (5). On the other hand, electroneurography (ENG) is currently the gold standard in diagnosing and determining the severity of CTS (6), however, sometimes the severity of clinical status does not match up with the severity of ENG. Hence, the answers to the questions of "What does the severity of CTS depend on?" and how to understand the CTS severity?" have been investigated before (7, 8, 9). Also the relationships between severity of CTS defined by ENG and Boston questionnaire were researched (10, 11) and BQ and nerve conduction studies were suggested to be used together when monitoring the CTS patients (10). Moreover, while one study obtained no relationships between CTS severity determined by ENG and BQ (10), the other found nerve conduction studies to be correlated with functional severity score of BQ (11). These results are conflicting. Therefore we aimed to clarify the relationships between ENG which is the gold standard to evaluate disease severity of CTS and BQ.

Material-Method

Participants: One hundred and forty-one patients with CTS were enrolled to this study after the informed consents were obtained from all the participants. The study was approved by the local ethics committee. All the participants were women and housewives. Patients who undergone to surgery for CTS, and had any sensory or motor deficit in ulnar nerve, multiple diagnosis of the upper extremities such as lateral epicondylitis or cervical radiculopathy, history of systemic disease which lead individuals to be prone to CTS such as diabetes mellitus or hypothyroidism, concomitant systemic musculoskeletal conditions such as rheumatoid arthritis or fibromyalgia, pregnancy, previous fracture of the bones of upper extremity, trauma of the neck or ipsilateral shoulder and upper extremity and any other neurologic diseases were excluded from this study.

The demographic data including age, gender, body mass index (BMI), symptoms duration and night pain of the patients were recorded. Tinel and Phalen tests were noted as positive or negative.

Tinel test is the median nerve compression test in the carpal tunnel. A clinician performed the tinel test by percussion of the median nerve in the carpal tunnel with his/her hammer. Phalen test is a maneuver that stresses median nerve in the carpal tunnel. Patients were asked to flex their wrists to 60 degree bilaterally and wait 1 minute in the same position. These two tests designed to exacerbate the symptoms. To accept these two tests positive, a patients must describe pain and/or paresthesia such as numbness, tingling and/or burning in the median nerve distribution region particularly in the first 3 digits and the median half of the 4th digit (12, 13).

Self-reported measurements: The Turkish version of Boston questionnaire which consists of two parts, namely the Symptom Severity Scale (SSS) and the Functional Status Scale (FSS) was used to evaluate the patient's functional and clinical status linked to CTS. In the SSS, there are 11 questions which are scored with 1 (mildest) to 5 (most severe) points. The overall result is the mean of all 11 scores assessing pain severity, numbness and weakness at night and during the day. In the FSS, there are 8 questions which assess the difficulty in performing common hand-related tasks. Each question is scored on a 5 point scale (1: no complaint, 5: severe complaint). The overall score for functional status is the mean of all 8 answers. A higher symptom severity or functional status score indicates worse symptoms or dysfunction (14).

The patients were asked to rate intensity of hand or wrist pain they felt in the last two weeks on Visual Analog Scale (VAS) (15).

Electroneurography: The patients had to have at least 4 of the followings unilaterally or bilaterally to be enrolled to Electroneurography (ENG): pain and paresthesia (numbness, tingling, burning) in the median nerve distribution without extra median nerve territory symptoms; worsening of symptoms at night; positive Tinel sign; positive Phalen sign and self-reported hand strength deficits. Symptoms had to be present for at least six months.

ENG was performed with 2 channel ENG system (Micromed S.p.A 2009) by an experienced physician when the patient is sitting with her arm semi flexed. Motor and antidromic sensory conduction velocities of the median and ulnar nerves were performed. The distal sensory latency (DSL), sensory nerve conduction velocities (SNCVs), sensory nerve action potential (SNAP), distal motor latencies (DML), motor nerve conduction velocities (MNCVs) and compound muscle action potential (CMAP) of dominant extremity median and ulnar nerves were recorded. The median and ulnar motor conductions were performed on abductor pollicis and adductor digiti minimi muscles respectively and stimulation was performed on wrist and elbow for both. The median and ulnar sensory conductions was recorded with the surface bar electrode on the wrist and stimulation was performed on palm and second digit for median nerve and on fifth digit for ulnar nerve. Hands with surface temperature below 30°C were warmed using surface heater. Severity of the ENG was also classified according to standardized guidelines of the American Association of Electrodiagnosis, the American Academy of Neurology and the American Academy of Physical Medicine and Rehabilitation (6) and less than 40 mm/s median nerve sensory conduction velocity and greater than 4.20 ms median nerve distal motor latency were considered to be abnormal. Patients only with abnormal segmental comparative tests are classified to have minimal CTS, while individuals with

abnormal median nerve sensory velocity conduction and normal distal motor latency are considered to have mild CTS. To have moderate CTS, ENG has to reveal both abnormal median nerve sensory velocity conduction and distal motor latency. The patients who have abnormal median nerve motor distal latency and do not have median nerve sensory response are accepted to have severe CTS. Sensory and motor nerve conduction studies of ulnar nerve were performed in order to rule out lesions of ulnar nerve. Patients were divided into three groups as patients with mild, moderate or severe CTS according to the ENG results.

Statistical analysis: Data were analyzed using the Statistical Package for Social Sciences (SPSS) software version 15.0 for Windows (SPSS Inc., Chicago, IL). The distribution of the parameters was evaluated with One-Sample Kolmogorov Smirnov Test. For the presentation of continuous quantitative parametric and nonparametric variables; mean + standard deviation and median (25-75 interquartile ranges) were used respectively. For parametric variables, one-way ANOVA test was used for the comparisons between three groups. Levene's test was used to determine homogeneity of variances and in case of homogeneity of variance, post hoc Tukey test otherwise Tamhane's T2 were used. Three group comparisons for non-parametric data were performed by Kruskal–Wallis test. Post hoc analyses were performed Bonferroni corrections with a statistical significance of p=0.017. Spearman's or Pearson's rank correlation tests were performed to determine the relationships between continuous variables for parametric and non-parametric data respectively. P<0.05 was accepted as significant for all statistical analysis.

Results

The mean age of the patients was 46.0+11.8 years. The median of the symptom duration was 24 (9-48) months. Of the 141 patients, 68, 61 and 12 patients had mild, moderate and severe CTS respectively. These were presented in Table 1.

We divided the patients into three groups due to ENG outcomes as mild, moderate and severe CTS. The values of the age, the duration of symptoms, the VAS pain and the Boston FSS and SSS were found to be significantly different among three groups (p<0.05 for all) (Table 2). The scores of the VAS pain and the Boston FSS and SSS were found to be significantly higher in patients with moderate and severe CTS compared to those in mild CTS (p=0.001, 0.001, <0.001 and p<0.001, 0.001, <0.001 respectively).

The scores of Boston FSS and SSS were found to correlate moderately with the duration of symptoms, median sensory nerve action potential (SNAP)-palm and second digit and strongly with VAS pain (p<0.05 for all). We found Boston SSS also correlated moderately with median distal motor latency (DML), and median sensory nerve conduction velocity (SCNV)-palm and second digit (p<0.05 for all). This data were shown in Table 3.

Tablo 1. The demographic, clinical and ENG findings of the patients with CTS.

	Patients with CTS (n=141)
Age (year)	46.0±11.8
BMI (kg/cm^2)	48.3±7.9
Symptom duration (month)	24 (9-48)
VAS pain (cm)	10 (5-10)
Night pain (Y/N)	132/9
Severity of ENG (mild/moderate/severe)	68/61/12
Tinnel (N/P/PP)	10/52/79
Phalen (N/P/PP)	11/51/79
BQ-FSS	2.1 (1.4-2.8)
BQ-SSS	2.9±1.0
Median DML (ms)	4 (3.5-4.6)
Median CMAP (mV)	14.6±4.4
Median MCV (m/s)	55.6 (52.6-58.7)
Median DSL-palm (s)	1.9 (1.6-2.3)
Median SNAP-palm (µV)	51.0±34.9
Median SNCV-palm (m/s)	36.8 (29.2-40.6)
Median DSL-second digit (s)	3.0 (2.7-3.4)
Median SNAP-second digit (µV)	16.2±9.5
Median SNCV-second digit (m/s)	41.7 (34.4-44.6)
Ulnar DML (ms)	2.3 (2.2-2.6)
Ulnar CMAP (mV)	14.2±2.8
Ulnar MCV (m/s)	64.1±5.5
Ulnar DSL-fifth digit (s)	1.9±0.2
Ulnar SNAP-fifth digit (µV)	13.1 (10.1-17.7)
Ulnar SNCV-fifth digit (m/s)	54.7 (51.0-57.1)

mean±SD, median (25th percentile – 75th percentile)

ENG: Electroneurography, CTS: Carpal Tunnel Syndrome, BMI: Body mass index, VAS: Visual Analog Scale, Y/N: Yes/No, N:Negative, P:Positive, BQ-FSS: Boston Questionnaire Functional Severity Scale, BQ-SSS: Boston Questionnaire Symptom Severity Scale, DML: Distal motor latency, CMAP: Compound muscle action potential, MCV: Motor conduction velocity, DSL: Distal sensory latency, SNAP: Sensory nerve action potential, SCNV: Sensory nerve conduction velocity.

Tablo 2. The demographic and clinical data of the patients with mild, moderate and severe CTS according to the ENG findings.

	Patients with mild CTS (n=68)	Patients with moderate CTS (n=61)	Patients with severe CTS (n=12)	P
Age (year)	45.1±11.8^a	45.2±10.5^b	55.1±15.0^{a,b}	0.019
BMI (kg/cm^2)	46.8±7.8	49.6±8.0	49.7±6.8	0.118
Duration of symptoms (month)	12 (4.3-36)^a	24 (12-60)	42 (24-60)^a	<0.001
VAS pain (cm)	5 (5-10)^{a,b}	10 (5-10)^a	10 (10-10)^b	<0.001
BQ-FSS	1.9 (1.0-2.5)^{a,b}	2.5 (1.5-3.4)^a	2.6 (2.3-3.8)^b	<0.001
BQ-SSS	2.5±0.8^{a,b}	3.2±1.0^a	3.8±0.9^b	<0.001

mean±SD, median (25th percentile – 75th percentile)
p: p value for ANOVA and Kruskal Wallis
a,b: means p<0.05 between the groups with the same letter.

CTS: Carpal Tunnel Syndrome, ENG: Electroneurography, BMI: Body mass index, VAS: Visual Analog Scale, BQ-FSS: Boston Questionnaire Functional Severity Scale, BQ-SSS: Boston Questionnaire Symptom Severity Scale.

Tablo 3. Correlations between Boston FSS and FSS with ENG parameters and clinical features in patients with CTS (n=141)

	R(FSS)	P(FSS)	R(SSS)	P(SSS)
Duration of symptoms (month)	0.343	<0.001	0.328	<0.001
VAS pain (cm)	0.517	<0.001	0.728	<0.001
BQ-FSS	-	-	0.704	<0.001
BQ-SSS	0.704	<0.001	-	-
BMI (kg/cm^2)	0.121	0.152	0.159	0.060
Median DML (ms)	0.257	0.002	0.339	<0.001
Median CMAP (mV)	-0.145	0.086	-0.232	0.006
Median MCV (m/s)	-0.183	0.030	-0.142	0.093
Median DSL-palm (s)	0.116	0.172	0.127	0.133
Median SNAP-palm (µV)	-0.315	<0.001	-0.378	<0.001
Median SNCV-palm (m/s)	-0.220	0.009	-0.358	<0.001
Median DSL-second digit (s)	0.195	0.021	0.206	0.014
Median SNAP-second digit (µV)	-0.288	0.001	-0.400	<0.001
Median SNCV-second digit (m/s)	-0.266	0.001	-0.346	<0.001
Ulnar DML (ms)	-0.017	0.846	0.010	0.906
Ulnar CMAP (mV)	-0.017	0.840	-0.049	0.564
Ulnar MCV (m/s)	-0.013	0.876	0.042	0.621
Ulnar DSL-fifth digit (s)	0.005	0.953	-0.027	0.749
Ulnar SNAP-fifth digit (µV)	-0.169	0.045	-0.183	0.029
Ulnar SNCV-fifth digit (m/s)	-0.050	0.558	-0.071	0.403

BQ-FSS: Boston Questionnaire Functional Severity Scale, BQ-SSS: Boston Questionnaire Symptom Severity Scale, ENG: Electroneurography, CTS: Carpal Tunnel Syndrome, BMI: Body mass index, VAS: Visual Analog Scale, DML: Distal motor latency, CMAP: Compound muscle action potential, MCV: Motor conduction velocity, DSL: Distal sensory latency, SNAP: Sensory nerve action potential, SCNV: Sensory nerve conduction velocity

Discussion

Here we presented a comparative study seeking the relationships between nerve conduction studies and BQ among CTS patients. Expectedly, we found higher scores of Boston SSS and FSS and VAS pain in patients with moderate and severe CTS compared to those in patients with mild CTS. However there were no significant differences between patients with moderate or severe CTS in terms of pain, Boston SSS and FSS. This result may arise from this study population consisting of only obese patients. In addition, the scores of Boston SSS and FDS were correlated strongly with median SNAP of palm and second digit. This may indicate that a decrease in the amplitude of sensory nerve seem to be related to both symptom and functional severity. Moreover, we found Boston SSS to be correlated with median DML and median SCNV palm and second digit alone. This also may suggest that decreased velocities in median sensory conduction and elevated median DML were associated with symptom severity than functional impairment in patients with CTS.

There were few trials investigating the relationships between ENG and BQ in patients with CTS. Previously ENG findings were correlated with the BQ-FDS scores however there were no significant relationships between BQ-FSS and nerve conduction studies in non-obese patients with CTS. Nevertheless this significant association was lost in obese CTS patients (11). BQ was not associated with ENG findings in a previous study nonetheless BQ and ENG parameters were not compared head to head. Consistently, there were not found significant relationships between ENG findings and BQ (10, 16). In the latter studies, the authors concluded that BQ and ENG evaluated the different aspects of CTS (10, 16). In addition, BQ was reported to be sufficient in assessing open surgical release outcomes in patients with CTS and ENG did not seem to prove additional benefits (17). Contrarily, in the present study, we found significant relationships between nerve conduction studies and BQ in obese patients. These controversies with the previous studies may be a result of our study population, since the present study population consisted only of obese CTS patients. However, we did not select the obese patients contrariwise we collect patients who consecutively applied to our outpatient clinic. The population around our hospital which the study was performed may predominantly include obese housewives.

There are several limitations in this study which should be taken into account when interpreting the present results. The cross sectional design of this study is not the best way to define exact associations. All of the patients were obese. Therefore we cannot generalize the results to the general population. There were no male patients in this study. So this study failed to answer the associations in male patients. However the study population is relatively sufficient to conclude and is higher to that in previous studies (10, 11, 16).

While the median SNAP was related to both symptom severity and functional impairment, median DML and sensory velocities was associated with symptom severity alone.

Conclusion

The patients who have different clinical findings however same clinical pictures may be interpreted in the light of these results. Clinicians should pay attention to the ENG findings in CTS patients separately. Namely when the clinician meet decreased median SNAP or elevated median DML and SCNV, he/she should be careful on both the symptom severity and functional impairment or only functional deficiency respectively.

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