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Electrodiagnostic Testing Characteristics of Diabetic People with Carpal Tunnel Syndrome*

Características eletrofisiológicas das pessoas diabéticas com síndrome do túnel do carpo

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Abstract

Objective The present study aimed to correlate electroneuromyography (ENMG) findings in diabetic and nondiabetic subjects with carpal tunnel syndrome (CTS).

Methods In total, 154 patients were evaluated in a hand surgery outpatient clinic. All ENMG tests were bilaterally performed by a single neurologist. Qualitative variables were described for all patients with CTS according to their diabetic status, and the chi-squared test was used to reveal any association. A joint model was adjusted to determine the influence of diabetes on ENMG severity in CTS patients.

Results The sample consisted of 117 women and 37 men, with an average age of 56.9 years old. Electroneuromyography demonstrated bilateral CTS in 82.5% of the patients. Diabetes was identified in 21.4% of the cases. Severe ENMG was prevalent.

Conclusion There was no association between diabetes and ENMG severity in patients with CTS. Level of evidence IV, case series.

Keywords
- diabetes
- electromyography
- median neuropathy
- paresthesia
- carpal tunnel syndrome

Resumo

Objetivo O presente trabalho teve por objetivo verificar se existe correlação entre a síndrome do túnel do carpo (STC) e eletroneuromiografia (ENMG) de pacientes diabéticos e não diabéticos.

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Métodos Foram avaliados 154 pacientes em um ambulatório de cirurgia da mão. Todas as ENMGs avaliadas foram realizadas por um único neurologista, bilateralmente. As variáveis qualitativas foram descritas para todas as pessoas em acompanhamento devido à STC segundo a presença de diabetes e foi verificada a associação com uso do teste qui-quadrado. Foi ajustado o modelo conjunto para verificar a influência da diabetes na gravidade da ENMG em pacientes com STC.

Resultados Foram incluídos no presente estudo 117 mulheres e 37 homens, com média de idade de 56,9 anos. Eletroneuromiografia demonstrando STC bilateral foi observada em 82,5% das pessoas. Pessoas diabéticas foram identificadas em 21,4% dos casos. Eletroneuromiografia com padrão grave foi prevalente.

Conclusão Não houve associação entre a presença de diabetes e a gravidade da ENMG em pessoas com STC. Nível de evidência IV, série de casos.

Palavras-chave
- diabetes
- eletromiografia
- neuropatia mediana
- parestesia
- síndrome do túnel do carpo

Introduction

Carpal tunnel syndrome (CTS) is a frequent neuropathy in diabetic patients, affecting 14% of diabetics with no neuropathy and 30% of subjects with diabetic neuropathy.[1,2] Carpal tunnel syndrome is common in diabetic patients because of surrounding synovial tissue changes and secondary nerve damage due to elevated blood glucose levels.[3]

The most common neurological complications in diabetic subjects include symmetric sensorimotor polyneuropathies and focal neuropathies; compressive neuropathies of the upper extremity are the most frequent complications in any stage of diabetes.[4]

The potential pathogenesis of diabetic CTS involves increased circulating levels of inflammatory cytokines resulting from the final glycation product, which causes demyelination and peripheral axonal loss, and increases the susceptibility of several nerves, including the median nerve, to compression.[5]

Although the literature reports characteristics of diabetic subjects with and without CTS,[3] few recent publications demonstrate clinical, epidemiological and electroneuromyographic findings in CTS patients with diabetes or not. The present study aimed to describe any differences in clinical and electroneuromyography (ENMG) findings in both diabetic and nondiabetic subjects with CTS.

Casuistry and Methods

Cross-sectional study performed at a hand surgery outpatient clinic and evaluating 154 patients. The procedures complied with the Research Ethics Committee, authorization number 3.640.789, and with the Declaration of Helsinki from 1964. All participants signed an informed consent form.

Both male and female subjects, aged > 18 years old, with positive upper limb ENMG for CTS were included in the study. Pregnant women, patients with type I diabetes or with a history of previous wrist surgery were excluded from the sample.

All ENMGs were bilaterally performed by a single neurologist, unrelated to this study, using a Neuropack EMG electroneuromyograph (S1, MEB-9400K, Nihon Kohden Corporation, Tokyo, Japan).

The electroneuromyographic findings were classified according to the Stevens system as mild (sensory conduction changes alone), moderate (sensory and motor conduction changes) and severe (altered sensory and motor conduction in addition to denervation signs on needle electromyography).[6]

Age, as a quantitative variable, was described as mean and standard deviation (SD) values. Qualitative variables were described for all patients with CTS and positive ENMG findings according to their diabetic status, and the chi-squared test was used to reveal any association.[7]

In total, 159 subjects with positive ENMG findings for CTS were treated; since 5 subjects were excluded due to incomplete reports, the final study sample consisted of 154 participants.

Regarding gender, 117 (76.0%) women and 37 men (24.0%) were included. The average age was 56.9 ± 10.9 years old (mean and SD). Body mass index (BMI) was within the normal range in 71 (46.1%) subjects, with 51 (33.1%) overweight and 32 (20.8%) obese patients. The ENMG demonstrated bilateral CTS in 127 (82.5%) subjects and unilateral CTS in 27 (17.5%) subjects. Thirty-three (21.4%) patients were diagnosed with diabetes, and 121 (78.6%) were not diabetics. Fifty-two (33.8%) subjects had only one systemic disease in addition to diabetes, whereas 52 (33.8%) had ≥ 2 diseases, and 50 (32.4%) presented no comorbidities.

For statistical analysis, a joint model was adjusted to determine the influence of diabetes on ENMG severity in CTS patients. Variables with a descriptive level < 0.20 in bivariate tests ($p < 0.20$) were inserted in the model. Significance was set at a 5% level.

Results

Eighteen (11.7%) subjects presented a mild ENMG pattern, whereas 64 (41.6%) had a moderate pattern and 72 (46.7%) had a severe pattern.

►**Table 1** shows that diabetes was more frequent among women with CTS ($p = 0.023$). In addition, the frequency of associated systemic diseases was higher in diabetic patients compared with nondiabetic patients ($p < 0.001$).

Table 1 Characteristics of subjects with carpal tunnel syndrome and diabetes

Variable	Diabetes		*p-value*
	No ($n = 121$)	Yes ($n = 33$)	
Age (years old)			0.244*
Mean ± standard deviation	56.4 ± 10.9	58.9 ± 11	
Median (minimum; maximum value)	56 (30; 84)	58 (33; 89)	
Gender,*n* (%)			**0.023**
Female	87 (71.9)	30 (90.9)	
Male	34 (28.1)	3 (9.1)	
BMI classification,*n* (%)			0.121
Normal	61 (50.4)	10 (30.3)	
Overweight	37 (30.6)	14 (42.4)	
Obesity	23 (19)	9 (27.3)	
ENMG laterality,*n* (%)			0.150
Unilateral	24 (19.8)	3 (9.1)	
Bilateral	97 (80.2)	30 (90.9)	
Systemic conditions,*n* (%)			**<0.001**
1	50 (41.3)	2 (6.1)	
≥ 2	21 (17.4)	31 (93.9)	
None	50 (41.3)	0 (0)	

Abbreviations: BMI, Body mass index; ENMG, electroneuromyography. Chi-squared test.
*T-Student test.

►**Table 2** shows that only CTS laterality was associated with CTS severity ($p < 0.001$), and patients with bilateral CTS had more severe ENMG findings.

Diabetes was not statistically associated with ENMG severity ($p = 0.466$).

►**Table 3** shows that CTS laterality in ENMG was influenced in a statistically significant way ($p = 0.023$). Bilateral CTS patients had ENMG grades 44% more severe compared with patients with unilateral positive findings.

Diabetes did not influence the ENMG grade for CTS ($p = 0.927$).

Discussion

In population-based studies, the prevalence of CTS is higher in women and increases with age;[4] it is estimated that the incidence in females is up to three-fold higher when compared with males.[8] According to Papanas et al.,[9] the prevalence of CTS in diabetics ranges from 11 to 25%, and the condition is more common in women. Our results were consistent with the literature, with an increased prevalence of CTS in women with a mean age of 56 years old in nondiabetics and 58 years old in diabetic subjects.

Table 2 Description of carpal tunnel syndrome grades according to the characteristics evaluated and statistical tests results

Variable	ENMG Classification			*p-value*
	Mild	Moderate	Severe	
Age (years old)				0.081*
Mean ± standard deviation	56.3 ± 10.6	54.8 ± 10.8	58.9 ± 10.8	
Median (minimum; maximum value)	54.5 (42; 83)	55 (30; 81)	58 (41; 89)	
Gender,*n* (%)				0.373
Female	14 (12)	45 (38.5)	58 (49.6)	
Male	4 (10.8)	19 (51.4)	14 (37.8)	
BMI classification, *n* (%)				0.821
Normal	8 (11.3)	31 (43.7)	32 (45.1)	
Overweight	6 (11.8)	18 (35.3)	27 (52.9)	
Obesity	4 (12.5)	15 (46.9)	13 (40.6)	
ENMG laterality,*n* (%)				**< 0.001**
Unilateral	10 (37)	15 (55.6)	2 (7.4)	
Bilateral	8 (6.3)	49 (38.6)	70 (55.1)	
Systemic conditions, *n* (%)				0.516
1	7 (13.5)	19 (36.5)	26 (50)	
≥ 2	4 (7.7)	21 (40.4)	27 (51.9)	
None	7 (14)	24 (48)	19 (38)	
Diabetes				0.466
No	16 (13.2)	50 (41.3)	55 (45.5)	
Yes	2 (6.1)	14 (42.4)	17 (51.5)	

Abbreviations: BMI, Body mass index; ENMG, electroneuromyography. Chi-squared test.
*ANOVA.

Table 3 Model explaining the electroneuromyography grade and carpal tunnel syndrome relationship according to evaluated characteristics

Variable	Coefficient	95% Confidence interval		*p-value*
		Inferior value	Superior value	
ENMG (bilateral)	1.44	1.05	1.98	**0.023**
Diabetes	1.01	0.79	1.30	0.927
Age (years old)	1.001	0.991	1.011	0.836

Abbreviation: ENMG, electroneuromyography.
Generalized linear model with Poisson distribution and logarithmic link function.

Phalen[10] reported that the median nerve from diabetic subjects may be more susceptible to compression within the carpal tunnel when compared with nondiabetics. In the

1960s, Mulder et al.[11] found a 9% prevalence of diabetes in people with CTS, whereas Blodgett et al.[12] reported a 6.4% prevalence. In 1985, Comi et al.[13] reported a 7.7% prevalence, and Kouyoumdjian,[14] 4.4%. The number of diabetics in our sample (21.4%) was considerably higher compared with the literature. We believe this is due to our service being a regional reference, with a high number of cases.

According to Becker et al.,[15] a high BMI constitutes a risk factor for CTS; other risk factors include female gender, age ranging from 40 to 60 years old and diabetes. For Bland,[16] diabetic patients with CTS have a higher frequency of overweight and obesity compared to those with normal BMI. Our results are consistent with those from the aforementioned authors, with a higher prevalence in women aged 56 years old. Although 69.7% of the diabetics with CTS were overweight or obese, there was no difference compared with nondiabetics (49.6%).

Spahn et al.[17] found bilateral CTS in 50 to 60% of cases. In our sample, 82.46% of the patients had bilateral electroneuromyographic changes, with 44% of them presenting severe ENMG. However, there was no correlation between laterality and ENMG severity ($p = 0.023$).

We observed a considerable number of people with common systemic conditions, including hypertension, rheumatological and cardiological diseases (67.6%), with significant differences between diabetics and nondiabetics. On the other hand, no statistical difference was found in ENMG between diabetic and nondiabetic CTS patients ($p = 0.927$). This may be related to the heterogeneity of the evaluated group, since age, female gender, high BMI, time of evolution, and adequate or inadequate clinical control were shown to be independent risk factors for CTS.

The evaluation of CTS patients at a regional reference service to assess the relationship between diabetes and ENMG severity is a positive point of our study.

A limitation of the present study may be related to the fact that CTS patients may not represent the real influence of diabetes on the severity of ENMG for assessing this condition, since many diabetics are followed-up at the endocrinology service.

It is also not possible to affirm peremptorily that there is a relationship between the greater severity of electroneuromyographic findings and CTS bilaterality. Further studies, with a larger sample and more comprehensive inclusion criteria, are required to assess this relationship.

Conclusion

We conclude that CTS is prevalent in women at the 5th decade of life, both diabetics and nondiabetics, and that there is no association between diabetes and ENMG severity in subjects with CTS.

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Conflict of Interests
The authors have no conflict of interests to declare.

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