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Relationship between electrodiagnostic findings and sleep disturbance in carpal tunnel syndrome: A controlled objective and subjective study

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Abstract

Objective: This controlled objective and subjective study aimed to evaluate the relationship between insomnia severity and electrodiagnostic findings in patients with carpal tunnel syndrome (CTS).

Methods: Twenty-one patients with an established clinical and electrodiagnostic diagnosis of CTS before surgery were included. Sleep characteristics were monitored objectively over 4 to 9 nights by means of actigraphy. On the following morning, participants completed a sleep log that conveyed their subjective impressions of how they had slept. All patients also completed the Insomnia Severity Index questionnaire. The correlation of these findings with patients' motor latency and sensory latency was evaluated using Spearman correlation analysis.

Results: We found no correlation between sensory or motor latencies and all sleep measures.

Conclusion: Electrodiagnostic findings and sleep severity in patients with CTS appear to be independent measures, and they do not correlate with each other.

Keywords

Carpal tunnel syndrome, electrodiagnostic, insomnia, nerve conduction test, sleep, sensory latency, motor latency

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Introduction

Night wakening owing to numbness is one of the diagnostic criteria for carpal tunnel syndrome (CTS).[1] Recent studies have found that CTS results in frequent nighttime awakenings, an increase in fragmented sleep, and increased daytime sleepiness and dysfunction.[2–4] However, the mechanism linking CTS and insomnia is unclear. McCabe et al.[5–7] reported that patients with CTS are more likely to prefer sleeping on their side than control patients. Another theory relates to the finding that wrist extension and flexion increase pressure in the carpal tunnel, especially during the nighttime.[8,9]

CTS is a clinical diagnosis based on a combination of symptoms and characteristic physical findings; the diagnosis of CTS may be subsequently confirmed with electrodiagnostic studies.[10,11] Yet studies on electrodiagnostic findings and patients' CTS-related symptoms and function have yielded mixed results.[12–16]

In a recent study, Gaspar et al.[17] emphasized the need to evaluate the potential association of preoperative electrodiagnostic findings with sleep symptom severity. Therefore, the purpose of the present study was to investigate the relationship between insomnia severity and electrodiagnostic findings in patients with CTS.

Patients and methods

Ethical statement

This study was approved by the local institutional review board, and informed consent was obtained from all patients.

Patients

We recruited patients with an established clinical and electrodiagnostic diagnosis of CTS preoperatively. All patients completed a data collection form querying their age, sex, height, weight, and dominant hand.

Sleep assessment

Insomnia questionnaire. All patients completed a short insomnia questionnaire, the Insomnia Severity Index (ISI),[18] which is a brief self-report instrument that measures a patient's perception of their insomnia. The ISI targets the subjective symptoms and consequences of insomnia as well as the degree of concerns or distress caused by those difficulties. The ISI comprises seven items that assess the severity of sleep onset and sleep maintenance difficulties (both nocturnal and early morning awakenings), satisfaction with the current sleep pattern, interference with daily functioning, noticeability of impairment attributed to the sleep problem, and degree of distress or concern caused by the sleep problem. Each item is rated on a scale of 0 to 4, and the total score ranges from 0 to 28. A higher score suggests more severe insomnia. The total score is interpreted as follows: 0 to 7, absence of insomnia; 8 to 14, subthreshold insomnia; 15 to 21, moderate insomnia; and 22 to 28, severe insomnia.

Sleep log. All patients completed a sleep log[19] that contained five items: 1) the time of going to bed, 2) sleep onset latency, 3) number of awakenings, 4) time of final awakening, and 5) perceived sleep quality.[1–5] Sleep quality was rated by participants on a scale of 1 to 5.

Actigraphy. Sleep quality and continuity were measured for 1 week using a wrist actigraph (Respironics Model II; Philips, Inc., Andover, MA, USA), which is a wristwatch-sized device that uses a proprietary software algorithm to derive sleep estimates from limb movement activity collected over extended periods of use. The following data were collected: sleep

latency (the time interval from bedtime to onset of sleep), total sleep duration, sleep efficiency (sleep duration/time span from bedtime to time of waking), and number of arousals (periods of sleep interruption or perturbation lasting longer than 3 minutes). Actigraphy has been validated for measuring insomnia.[20,21]

Statistical analysis

Categorical variables are presented as frequency and percentage, and continuous variables are expressed as mean, standard deviation (SD), median, and range. The correlations between sensory and motor latencies and sleep measures were estimated using Spearman correlation analysis. Statistical analyses and data management were performed using SAS 9.4 software (SAS Institute, Cary, NC, USA). Statistical significance was considered with $P<0.05$.

Results

Twenty-one patients, 13 women and 8 men (Table 1) with average age 52 years (range, 25–77 years), were included in this study. The mean sensory latency was 4.2 ms (SD 0.8), and mean motor latency was 5.2 ms (SD 1.2).

Insomnia Severity Index results

All patients completed the ISI questionnaire (Table 2), and the mean score was 16.6 (SD 5.1). Eighteen (90%) patients had some degree of insomnia (ISI score $\geq$8),

Table 1. Patients' demographic and clinical data.

Patient no.	Sex	Age (y)	Dominant hand	BMI	Motor latency (ms)	Sensory latency (ms)	Padua score
1	Female	54	Right	22	5.3	4.7	Mod.
2	Male	36	Right	32	4.7	3.8	Mod.
3	Female	47	Right	24	5.4	4.3	Mod.
4	Female	56	Left	24	5	3.7	Mod.
5	Female	48	Right	26	5.3	3.8	Mod.
6	Female	25	Right	29	4.6	3.4	Mod.
7	Male	63	Right	22	5.8	7	Mod.
8	Female	49	Right	28	3.8	3.8	Mod.
9	Male	57	Right	28	4.7	3.6	Mod.
10	Female	66	Right	25	9.4	4.2	Mod.
11	Female	48	Right	37	6	4.7	Mod.
12	Male	46	Right	35	6	4.2	Mod.
13	Male	77	Right	27	4.2	3.7	Mild
14	Female	62	Right	25	3.7	4.2	Mild
15	Female	54	Right	22	6.2	4.1	Mod.
16	Male	39	Right	28	4.3	5.4	Mild
17	Female	69	Right	30	6.1	4.2	Mod.
18	Female	57	Right	23	3.9	3.8	Mild
19	Female	62	Right	26	4.5	3.3	Mod.
20	Male	40	Right	28	5.1	4.1	Mod.
21	Male	46	Right	28	4.8	3.6	Mod.

BMI, body mass index.

Note: According to the Padua scale, mild carpal tunnel syndrome (CTS) indicates slowing of median digit–wrist segment and normal distal motor latency; moderate CTS indicates slowing of median digit–wrist segment and abnormal distal motor latency.

Table 2. Sleep measures.

Variable	N	Mean	SD	Minimum	Median	Maximum
Mean ISI score	21	16.6	5.1	6	17	28
Mean sleep quality score, sleep log	21	2.8	0.8	1.2	3	5
Mean no. awakenings, sleep log	21	2.8	1.1	1.4	2.5	6.4
Mean no. arousals, actigraph	17	24.9	6.3	15.5	24.2	42.5
Mean sleep efficiency, actigraph (%)	17	78.4	6.7	60.9	79.1	87.5

ISI, Insomnia Severity Index; SD, standard deviation.

Table 3. Relationship between sensory latency and the sleep parameters.

	N	Correlation coefficient	P-value
Mean ISI score	21	0.005	0.981
Mean sleep quality, sleep log	21	0.046	0.840
Mean no. awakenings, sleep log	21	−0.409	0.065
Mean no. arousals, actigraph	17	−0.133	0.608
Mean sleep efficiency, actigraph	17	0.009	0.969

ISI, Insomnia Severity Index.

Table 4. Relationship between motor latency and sleep parameters.

	N	Correlation coefficient	P-value
Mean ISI score	21	−0.055	0.822
Mean sleep quality, sleep log	21	−0.275	0.226
Mean no. awakenings, sleep log	21	−0.257	0.260
Mean no. arousals, actigraph	17	−0.446	0.072
Mean sleep efficiency, actigraph	17	0.148	0.569

ISI, Insomnia Severity Index.

categorized as follows: subthreshold or mild (3 patients, 14%), moderate (14 patients, 66%), and severe (2 patients, 10%). The ISI scores demonstrated that most patients had difficulty with fragmentary sleep but had no problem with falling asleep or waking up early. Most patients mentioned interference with daily functioning. We found no correlation between sensory or motor latency and results of the ISI (Tables 3 and 4).

Sleep log results

All patients completed a sleep log for 4 to 9 days (Table 2). The mean sleep quality score was 2.8 (SD 0.8), and mean number of waking episodes was 2.8 (SD 1.1). We found no correlation between sensory or motor latency and results of the sleep log (Tables 3 and 4).

Actigraphy results

Seventeen patients used the wrist actigraph for 4 to 9 nights (Table 2). The mean sleep efficiency was 78.4% (SD 6.7), and the mean number of waking episodes was 24.9 (SD 6.3). We found no correlation between sensory or motor latency and the results of actigraphy (Tables 3 and 4).

Discussion

Our study reinforces the findings of previous studies that have demonstrated the importance of insomnia and its interference with daily functioning.[2–4]

The relationship between electrodiagnostic findings and CTS symptom severity has been evaluated in several studies. Most investigations have used the Carpal Tunnel

Syndrome Assessment Questionnaire (CTSAQ), a self-report measure of CTS-related functional limitations and symptom severity. The functional status scale assesses one's ability to perform nine common hand-related tasks. The symptom severity scale includes 11 items that assess pain, numbness, and weakness at night and during the day.[22] You et al.[14] examined the relationships between the CTSAQ and electrodiagnostic measures. Those authors found that the severity scale for primary symptoms (e.g., numbness, tingling, and nocturnal symptoms) was more closely related to nerve conduction measures than secondary symptoms (e.g., pain, weakness, and clumsiness). Dhong et al.[12] found that the CTSAQ correlated more with motor latency. Padua et al.[16] found a strong relationship between hand functional measures and neurophysiologic measures.

Nevertheless, Chan et al.[15] found no correlation between electrodiagnostic findings and patient-related symptoms and function when using Levine's questionnaire. In addition, Longstaff et al.[13] found no relationship between the type of symptoms and severity according to electrophysiological findings. The present study is the first to examine the correlation between electrodiagnostic findings and insomnia severity as measured using a questionnaire, sleep log, and actigraphy; we found no correlation according to our analysis.

There are several limitations to our study. First, we only included patients prior to surgery, so mild cases of insomnia were not examined. Second, the small number of patients could potentially affect the significance of the results. Last, we did not examine sleep characteristics using polysomnography, which is the gold standard for that purpose. Despite these limitations, our findings have important clinical and research implications, as this is the first study to assess insomnia severity and electrodiagnostic findings.

Declaration of conflicting interest

The authors declare that there is no conflict of interest. No benefits in any form have been or will be received from a commercial party directly or indirectly related to the subject of this article.

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