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Original article

Quantifying microsleep to help assess subjective sleepiness ☆

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Abstract

Background: The qualitative presence of microsleep during the multiple sleep latency test (MSLT) has been shown to correlate with an increased incidence of subjective complaints of sleepiness, tiredness, accidents/near accidents, and gap driving. However, there is no data on how to quantify microsleep and effectively incorporate it as a diagnostic tool in the measurement of sleepiness. The purpose of this study was to integrate microsleep with the MSLT score and determine if it improved the correlation between the MSLT and symptomatic sleepiness.
Methods: The charts of 54 patients who had an MSLT score of greater than 5 min and the presence of microsleep on at least one nap were reviewed. If microsleep was present in a given nap it was used as a surrogate for sleep onset. This MSLT plus microsleep score (MSL-M) was then averaged into the total sleep latency and compared to the MSLT score to determine if it improves correlation with the Epworth sleepiness scale (ESS). A microsleep nap percentage (MNP) was also obtained and correlated with ESS to determine if a better association could be derived.
Results: Using the Spearman correlation the MSL-M improved the correlation with the ESS when compared to MSLT ($r = 0.106$ versus $r = 0.063$), but the results were not statistically significant. Of note, both the MSLT and MSL-M were only weakly correlated to the ESS. The MNP also did not have a good correlation with ESS ($r = -0.099$).
Conclusions: The addition of microsleep onset to the MSLT score as a quantitative assessment tool failed to significantly enhance the correlation between subjective and objective accounts of sleepiness, beyond the improvement seen in the MSLT value by the simple presence of microsleep alone.

Keywords: Microsleep; Excessive daytime sleepiness; Epworth sleepiness scale; Multiple sleep latency test

1. Introduction

The measurement of sleepiness is of vital importance to the science of sleep medicine. There are various tests in clinical use for the measurement of sleepiness. Two of the most common are the Epworth sleepiness scale (ESS) and the multiple sleep latency test (MSLT). Though of essential clinical use, each of these tests has

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significant limitations and to date a "gold standard" evaluation of sleepiness has not been found [1].

The ESS developed by Johns [2] is a subjective rating of "trait" sleepiness in various situations that helps factor in the arousal drive to establish an assessment of a patient's global level of sleepiness. The MSLT, on the other hand, is an objective measure of sleepiness that primarily judges sleep drive, while limiting the effect of external arousal stimuli.

Microsleep, subjectively related to the sensation of "nodding off", is associated electrophysiologically with short episodes of slow eye movements, or interruption of the blinking artifacts characteristic of full wakefulness, and is accompanied by the presence of a theta rhythm on electroencephalogram (EEG) [3]. The length of microsleep is generally accepted to be from 3 s to a maximum of 15 s. Shorter durations would be difficult to detect visually and longer times would be scored as sleep onset.

It has recently been shown that when microsleep determination is included in the evaluation of MSLT, the specificity and sensitivity of the MSLT improved by more than 25% [4]. This trial was limited to the qualitative presence of microsleep in at least two of the naps, in essence noting whether or not microsleep was present in any of the naps. However, there are no data on how to utilize microsleep quantitatively and assess its impact on the measurement of sleepiness.

The purpose of this study was to develop a quantitative scale of microsleep and establish whether or not a stronger association between subjective and objective sleepiness can be found.

2. Methods

Patients who presented to the Institute of Sleep–Wake Disorders at Hackensack University Medical Center complaining of sleepiness were asked to complete an ESS questionnaire. The patients were seen by a board-certified sleep physician and were asked as part of their general evaluation about the presence of memory or concentration deficits, accidents/near accidents, and gap driving that were felt to be linked to sleepiness. The patients then underwent an overnight polysomnogram (PSG) followed by MSLT.

The inclusionary criteria were being older than 18 years of age and having an MSLT score of greater than 5 min with the presence of microsleep in at least one nap, as judged by the registered polysomnographic technologist scoring the study. The exclusionary criteria included patients who were using continuous or bilevel positive area pressure, were on home oxygen, had had major organ failure, were using hypnotics or stimulants, and were unable to accurately complete the ESS or did not answer at least two of the three questions regarding sleepiness (memory, gap driving, and accidents).

The data were obtained by a retrospective chart review. Between January 2002 and July 2003 (our study period), 260 charts were reviewed and, of these, 54 patients met these criteria. These MSLTs were then reviewed by two sleep physicians to determine whether they felt that microsleep was present. Where there was a dispute regarding the presence of microsleep, the studies were then analyzed by the chief polysomnography technician and reevaluated by the physicians who made the final determination. In this fashion there was more than 95% agreement in scoring.

Of the 54 subjects, 31 were male and 23 were female. Patient characteristics and clinical diagnoses can be found in Table 1. The majority had sleep-disordered breathing ($n = 41$), either obstructive sleep apnea as defined by the International Classification of Sleep Disorders (ICSD) criteria or upper airway resistance syndrome as defined by Guilleminault [5]. The other diagnoses were in line with ICSD criteria.

3. Procedures and measures

Full-night PSG was performed with an MSLT the following day. The testing was performed on Sandman equipment, using standard 14-channel montage.

Patients were told to stop all sedative and antidepressant medication for at least one week prior to testing. No alcoholic or caffeinated beverages were allowed less than 6 h before bedtime.

The MSLTs were performed using standard protocol, as described by the Association of Sleep Disorders Centers task force [6]. All but one of the subjects had four daytime naps. Sleep stages were scored following Rechtschaffen and Kales scoring methods with 30-s epochs. Microsleep was defined as a short period of

Table 1
Descriptive characteristics and primary diagnoses

Patients (M, F)	54 (31, 23)
Age mean (SD, range)	48.31 (12.82, 21–79)
MSLT mean (SD, range)	9.53 min (3.55, 5–18.75)
MSL-M mean (SD, range)	7.67 min (3.26, 3.40–16.32)
ESS mean (SD, range)	14.04 (5.20, 1–24)
Accident/near miss responses (Y, N)	53 (14, 39)
Gap driving responses (Y, N)	51 (25, 26)
Memory/concentration responses (Y, N)	52 (34, 18)
Total sleep night prior to MSLT mean (SD, range)	6.66 h (1.43, 0.87–11.15)
No. of patients with SDB	41
No. of patients with insomnia	2
No. of patients with PLMD	2
No. of patients with insufficient sleep syndrome	2
No. of patients with normal study	2
No. of patients with narcolepsy	1
No. of patients with hypersomnolence	1
No. of patients with depression	1
No. of patients with fibromyalgia	1
No. of patients with poor sleep hygiene	1