Memory and Executive Screening for the Detection of Cognitive Impairment in Obstructive Sleep Apnea

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is commonly associated with cognitive dysfunction, which is more apparent in severe OSA and impairs quality of life. However, the clinical screening methods for these impairments in OSA are still limited. In this study, we evaluated the feasibility of using the Memory and Executive Screening (MES) for assessing cognitive performance in OSA.

Materials and Methods: Twenty-four patients with nonsevere OSA and 36 patients with severe OSA participated in this study. All participants underwent comprehensive, laboratory-based polysomnography and completed assessments of cognitive function, which included both the MES and the Beijing version of the Montreal Cognitive Assessment (MoCA-BJ).

Results: Both the total MES scores and 5 recall scores of the MES (MES-5R) were significantly lower in the severe OSA group than those in the nonsevere OSA group. The patients with severe OSA performed worse on the memory subtests of the MES-5R, especially on immediate recall. The sensitivity and specificity of the MES for identifying cognitive impairment in patients with OSA were 63.89% and 66.67%, respectively, for a cutoff value of <92 out of 100 points. An optimal cutoff between nonsevere and severe OSA was also set at 45 points (MES-5R) and at 0.94 points (MES ratio). Compared with the MES, the MoCA-BJ had similar sensitivity (61.11%) and specificity (66.67%).

Conclusions: The MES is an acceptable tool for detecting cognitive dysfunction in patients with OSA. The sensitivity and specificity of the MES were similar to those of the MoCA-BJ. The MES-5R and total MES scores can assess the presence and severity of cognitive impairment in patients with severe OSA.

Key Indexing Terms: Memory and Executive Screening; Obstructive sleep apnea; Cognitive impairment. **[Am J Med Sci 2017;354(4):399–407.]**

INTRODUCTION

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder characterized by repeated episodes of upper airway obstruction during sleep resulting in nocturnal intermittent hypoxia and sleep fragmentation.[1] One of the undesirable consequences of abnormal breathing during sleep is neurocognitive dysfunction,[2-5] which is more apparent in severe OSA and seriously impairs quality of life. However, because of the absence of specific biomarkers of cognitive impairment and the diversity of cognitive behaviors,[2] it is much more difficult to find a simple and feasible way to detect cognitive deficits in OSA. Thus, researchers and clinicians have been trying to find a fast and effective method for detecting cognitive impairments in patients with OSA.[6,7] There appears to be a more urgent need for this method in China, because the number of patients with OSA is increasing, and these individuals are rarely diagnosed.[8]

Currently, many objective and subjective techniques are used to examine cognitive impairments in OSA.[7-11] Many objective methods cannot be applied to patients due to the high cost. A variety of shorter or longer subjective screenings have been chosen to assess the cognitive performance of subjects with OSA.[7-11] However, some subjective assessments contain questionnaires that are difficult to use, time consuming and threatening to patients. On the other hand, more studies have demonstrated that OSA-related cognitive dysfunction affects a variety of domains, including attention,[9,12] executive function,[13-16] decision-making,[17] learning and memory.[15,18] Many differences have been found among these assessments, including the involved cognitive domain and item coverage, completion rate and diagnostic accuracy. Thus, an easy and effective method is needed for the early detection of cognitive deficits in patients with OSA.

The Memory and Executive Screening (MES) is a brief and useful screening tool with high sensitivity and specificity for detecting cognitive impairments.[19] The MES includes brief tests of recall memory and executive function. The subtests of the MES can be used alone for detecting changes in specific cognitive domains in some diseases. For example, executive function in patients with Moyamoya disease has been effectively evaluated by the executive subtests of the MES (MES-EX).[20,21] Moreover, the score range for memory and executive function is large enough to identify mild cognitive impairment, and it can be reliably and easily scored without the need of a complex algorithm or computer

program. In addition, this test does not require participants to write and could be administered in less than 5-10 minutes by most clinical staff without any specialized testing materials.[19] The MES has been effectively applied to the evaluation of cognitive impairments in many diseases, such as metabolic disorder,[22] cerebrovascular disease[20,21,23] and Alzheimer's disease.[19] However, the use of the MES for the cognitive assessment of patients with OSA has not been reported.

In our study, the MES was used to evaluate the cognitive functions of patients with OSA and was compared to the Beijing version of the Montreal Cognitive Assessment (MoCA-BJ). The reliability and validity of the MES were investigated, and the possibility of using the MES for the cognitive assessment of adult patients with OSA was determined.

MATERIALS AND METHODS

Participants

A total of 60 male patients with OSA were recruited from the Sleep Center at the First Hospital of Jilin University (Changchun, China). All participants reported no history of having received treatment for sleep-related breathing disorders, presence of other sleep disorders (such as central sleep apnea, insomnia, restless leg syndrome and rapid eye movement behavior disorder), neurologic or psychiatric disorders or head trauma, recent alcoholism or use of psychotropic drugs, and major surgery within the past 3 months. All procedures were approved by the ethics committee of the First Hospital of Jilin University (Reference number: 2013-031). Written informed consent was obtained from all participants in accordance with the Declaration of the First Hospital of Jilin University. The Chinese versions of these tests were administered by trained researchers.

All patients with OSA were evaluated and diagnosed based on the results of an overnight sleep study (polysomnography [PSG]) according to the standard criteria, an apnea-hypopnea index (AHI) ≥ 5 without any previous therapy. Before the night of the PSG, the cognitive function of the subjects was evaluated using the MES and MoCA-BJ, daytime sleepiness was measured by the Epworth Sleep Scale (ESS), and sleep quality was evaluated by the Pittsburgh Sleep Quality Index (PSQI). The order of the 4 tasks in each session was counterbalanced across the subjects. In addition, demographic data, medical history, current medications, recent mental status, lifestyle and family history were also obtained from all subjects.

Neck circumference (NC) was measured at the level of the cricothyroid cartilage in the Frankfort horizontal plane. Waist circumference was measured at the midpoint between the anterior superior iliac crest and the lowest rib, and hip circumference was measured at the level of the maximal gluteal protrusion. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2), and waist-to-hip ratio (WHR) was determined by waist circumference (cm) divided by hip circumference (cm).

Epworth Sleepiness Scale

The ESS is a standardized tool due to its reliability, consistency and ease of use and is the most frequently and widely used subjective assessment of daytime sleepiness.[24,25] The simplified Chinese version of ESS has been used for many years.[26-28] Nowadays, it is a common practice in almost all Chinese sleep clinics. The ESS contains 8 items involving 8 daily life scenarios, with each item assessed on a 0-3 scale. The total scores of the ESS range from 0-24. The cutoff point for excessive daytime sleepiness is set at ≥ 10. A score of less than 10 is generally considered clinically normal. Values ≥ 10 are considered to indicate significant sleepiness.

Pittsburgh Sleep Quality Index

The PSQI is a 19-item self-rated questionnaire for evaluating subjective sleep quality and disturbance over the past month in clinical populations.[29] The 19 items are combined into 7 clinically derived components, including (1) sleep duration, (2) sleep disturbance, (3) sleep latency, (4) daytime dysfunction due to sleepiness, (5) sleep efficiency, (6) overall sleep quality and (7) sleep medication use. Each component score is weighted equally from 0 (no difficulty) to 3 (severe difficulty). The 7 component scores are added to obtain a global score ranging from 0-21, with higher scores indicating worse sleep quality. The cutoff point for poor sleep quality is set at >5.

Memory and Executive Screening

The MES is a brief cognitive test for detecting mild cognitive impairment.[19] There are 3 indicators for cognition evaluation using the MES. One indicator reflects recall memory. Subjects are instructed to first remember 1 sentence 3 times with 10 key points in the square brackets ([Li] [Xiao-Ming] has [two] [gray] [puppies] and lives at [No.58], [He-xi] [town], [Yong-an] [county]) and to free delay recall 2 times, including short-delayed recall—the fourth time and long-delayed recall—the fifth time. The subject receives 1 point for each key point he or she answers correctly. The summation of the 5 recall scores is the MES-5R. The second indicator reflects executive function (MES-EX). The 4 subtests of the MES-EX are the verbal fluency test, sequential movement tasks, conflicting instructions task and inhibitory control test. The total possible score is 100, with 50 each for the MES-5R and MES-EX. The MES ratio is calculated by the score of the MES-5R/the score of MES-EX.

The Beijing Version of the Montreal Cognitive Assessment

The MoCA-BJ is one of the 5 Chinese versions of MoCA, and has been used to test cognitive function in patients.[8,30,31] It contains the following cognitive