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Original Article

Polysomnographic abnormalities in patients with vascular cognitive impairment-no dementia

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ABSTRACT

Objectives: We aimed to investigate subjective sleep quality and polysomnographic sleep structure features in patients with vascular cognitive impairment-no dementia (VCIND).
Methods: Fifty-six patients with VCIND, 48 patients with simple stroke (without cognitive impairment), and 48 control subjects were included. The Pittsburgh Sleep Quality Index (PSQI) and polysomnography (PSG) were used to analyze their sleep characteristics. The Montreal Cognitive Assessment (MoCA) was conducted to assess mental state.
Results: Patients with VCIND had higher PSQI scores compared with control subjects and simple stroke patients ($P < .01$). PSG revealed that patients with VCIND or stroke were more likely to experience prolonged sleep latency (SL), decreased sleep efficiency (SE), increased arousal, and reduced deep sleep and rapid eye movement (REM) sleep than controls. Patients with VCIND had significantly longer SL, increased periodic leg movements in sleep (PLMS), decreased SE, and increased arousal and sleep fragmentation compared to patients with simple stroke ($P < .05$). In VCIND patients, a significant positive correlation was found between SE and MoCA scores ($r = 0.632$; $P < .001$), though PSQI, SL, and arousal index were significantly negatively associated with MoCA scores ($r = -0.787$, -0.740, -0.772, respectively; $P < .001$ for all).
Conclusions: VCIND patients had different abnormal sleep features, including decreased SE, increased PLMS, and prolonged SL and sleep fragmentation. Abnormal sleep in VCIND may be associated with cognitive impairment.

1. Introduction

Vascular cognitive impairment (VCI) that does not meet dementia criteria is called VCI-no dementia (VCIND) and is characterized by early or mild cognitive impairment (MCI) due to cerebrovascular injuries with an insidious nature [1]. VCIND has been reported to occur in 26.9% of patients approximately 3 months after stroke onset [2]. Early diagnosis and appropriate interventions may help to improve the prognosis in VCIND. If there is no early detection or correct treatment, VCIND may most likely progress to dementia [3]. Studies have found that cognitive impairment often is accompanied by disrupted sleep which, in turn, is believed to exacerbate cognitive deficits [4,5]; however, information on sleep disruption in VCIND remains limited. For these reasons, the aim of our study was to investigate the level of cognitive impairment and the clinical and polysomnographic characteristics of sleep disturbance in patients with VCIND.

2. Subjects and methods

2.1. Patients with VCIND

All VCIND patients were admitted in the Department of Neurology of the First Affiliated Hospital of the PLA General Hospital from January 2006 to June 2010. The following criteria described by Rockwood et al. [6] were used for VCIND diagnosis and patient inclusion: (1) presence of cerebrovascular disease, confirmed by cerebral magnetic resonance imaging (MRI); (2) evidence of cognitive impairment by neuropsychologic assessment; (3) cognitive impairment occurring within 3 months after stroke onset; (4) causal relation between cerebrovascular disease and cognitive impairment, excluding other diseases; (5) Hachinski ischemic score [7] of 7 or higher; and (6) not meeting the criteria for the

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Table 1
Clinical features of the subjects.

	VCIND	Stroke	Controls
Total number	56	48	48
Men	38	32	33
Women	18	16	15
Outpatients	24	22	20
Inpatients	32	26	28
Education			
University	7	5	7
Senior high school	43	37	36
Junior high school/lower	6	6	5
Age, y			
Mean ± SD	63 ± 2.49	61 ± 5.72	62 ± 3.51
Range	50–66	47–68	51–67
Body mass index, kg/m^2			
Mean ± SD	21.03 ± 2.86	21.99 ± 2.05	20.82 ± 3.74
Range	17.2–24.7	18.3–25.1	17.7–26.1
NIHSS score, mean ± SD	5.25 ± 2.11	4.63 ± 2.33	
Comorbidities			
Hypertension	35	23	14
Diabetes mellitus	31	17	12
Hyperlipidemia	26	19	13
Mental disorders	0	0	0
HRSD-17	3.36 ± 1.23	3.29 ± 1.69	2.83 ± 1.53
HAM-A	3.25 ± 1.32	2.88 ± 1.27	2.81 ± 1.49
Hemiplegia (right/left)	13(0/13)	11(0/11)	0
Cerebral MRI			
Subcortical stroke (basal ganglia and/or thalamus)	29*	35	0
Diffuse white matter hyperintensities	26	15	5
Hemispheric stroke (right/left)	27(10/24)*	13(6/8)	0

Abbreviations: VCIND, vascular cognitive impairment-no dementia; SD, standard deviation; NIHSS, National Institutes of Health Stroke Scale; HRSD-17, Hamilton Rating Scale for Depression; HAM-A, Hamilton Anxiety Rating Scale; MRI, magnetic resonance imaging.
* Significant difference between VCIND and stroke patients (χ^2 test, 4.88; $P < .027$).

diagnosis of dementia. Patients were not eligible for the study if they had Alzheimer disease (AD) or other conditions that might affect the Montreal Cognitive Assessment (MoCA) [8] and the Pittsburgh Sleep Quality Index (PSQI) [9] scores, including mental disorders, depression, and psychologic problems; in particular, the Hamilton Anxiety Rating Scale and the Hamilton Rating Scale for Depression were used. All patients received a neuropsychologic test battery within 3 months after stroke.

2.2. Patients with simple stroke

In addition, simple stroke patients were recruited in the same period with the following inclusion criteria: (1) patients with acute brain stroke whose clinical features were in line with the revised diagnostic criteria of the European Stroke Foundation in 2003 [10] and (2) patients whose diagnosis was confirmed by cranial MRI who were willing to participate and showed no significant cognitive impairment on clinical and cognitive tests. Patients were not eligible for the study if they had a history of conditions that might affect the MoCA and PSQI scores, including mental disorders, depression, and psychologic problems; in particular, the Hamilton Anxiety Rating Scale and the Hamilton Rating Scale for Depression were used. All patients received a neuropsychologic test battery within 3 months after stroke.

2.3. Control subjects

Control subjects were recruited among patients who had a physical examination in our hospital in the same period, who did not have notable lesions at cerebral MRI assessments, and who did not show significant cognitive impairment on clinical and cognitive tests. This group was not formed by healthy control subjects but by individuals who had comorbidities similar to those of the other groups, excluding stroke.

Table 1 shows the clinical features of the 3 groups of recruited subjects. There were no significant differences in age, sex, body mass index, education level, or proportion of inpatients, as well as in the prevalence of hypertension, diabetes mellitus, and hyperlipidemia between the 3 groups. Analysis of variance was used for age and body mass index, and the χ^2 test was used for sex, education level, proportion of inpatients, and for the prevalence of hypertension, diabetes mellitus, and hyperlipidemia. There was no significant difference in National Institutes of Health Stroke Scale score between the VCIND group and the stroke group. However, basal ganglia lesions were less frequent in VCIND patients, while hemispheric lesions were more frequent in this group compared to the single stroke group. Volumetrics were not performed in our study. Only patients with left hemiplegia were recruited, and those with right hemiplegia were excluded. Our study was approved by the Ethics Committee of the First Affiliated Hospital of Chinese PLA General Hospital.

2.4. Methods

2.4.1. Neuropsychologic tests

The levels of cognitive function were evaluated by using the MoCA [11]. The MoCA contains 8 cognitive domains and 11 inspection items, including spatial/executive ability, name, attention, count, language, abstract thinking, memory, and directional force. Scores range from 0 to 30 points. The assessment standard of cognitive impairment is MoCA <26 points. The PSQI is a 21-point tool containing 7 components, including subjective sleep quality, sleep latency (SL), sleep duration, sleep efficiency (SE), sleep disturbance, use of sleep medication, and daytime dysfunction. This tool was used to assess sleep habits during the past month (a higher score indicated poorer sleep quality) in all participants.