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Research Article

Regularity of cognitive variation after stroke and its related factors

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Abstract

Background and Purpose

Post-stroke cognitive impairment occurs frequently in the patients with stroke. This study was aimed to explore the regularity of cognitive variation after stroke and its related factors.

Methods

Inpatients with first-ever stroke were followed up for 12 weeks. The cognitive function was assessed using the Chinese version of the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) at acute phase (within 2 weeks after onset), 6 weeks and 12 weeks after stroke, respectively.

Results

Ninety-eight inpatients were enrolled in this study. MMSE scale analysis showed that 24.5% patients had cognitive impairment at acute phase, 12.1% at 6 weeks, 9.9% at 12 weeks after stroke. The prevalence of post-stroke cognitive impairment was 86.8%, 68.2%, and 38.0% respectively when MoCA scale was used. Logistic regression analysis showed older age, low educational status, hypertension, higher National Institutes of Health Stroke Scale (NIHSS), and post-stroke depression were significant variables associated with post-stroke cognitive impairment, while low education status, coronary heart disease, hypercholesterolemia, higher LDL-C level, and post-stroke depression were significant variables associated with recovery of cognition after stroke.

Conclusion

Cognition of stroke patients improved within 12 weeks after stroke. Low educational status, coronary heart disease, hypercholesterolemia, higher LDL-C level, and post-stroke depression may have negative impact on the recovery of cognitive function.

Keywords: Stroke; Post-Stroke Cognitive Impairment; Risk Factors

Introduction

Stroke is a major cause of disability and mortality worldwide mainly affecting mid-aged and elder populations. [1] Besides physical disorders, stroke also impairs cognitive function. [2] Cognitive impairment influences patients' daily life [3] as well as the recovery of physical function. [4] It is believed that cognitive impairment is a major reason for the disability after stroke. [5] Therefore, the prevention and treatment of post-stroke cognitive impairment (PSCI) is important for the improvement of stroke recovery and the quality of patients' life.

Previous studies have revealed that the prevalence of PSCI ranges from 35% to 47% after three months of stroke. [6-9] PSCI includes cognitive impairment with no dementia (CIND) and post-stroke dementia(PSD). [10] Patients with PSCI will have different outcomes after acute phase: the cognitive impairment of some patients will recover gradually , but others will remain or get worse .Researchers found that old age, low educational status, hypertension , severe white matter degeneration and diabetes mellitus are risk factors leading to PSCI deterioration. There still remain some arguments about the effects of gender, stroke location, stroke risk factors including hypertension, hyperlipidemia, heart disease history and drinking history on the PSCI. [11-15]

Thus, this prospective study was planned to measure the cognitive function of first-ever stroke patients using the Chinese version of the Mini-Mental State Examination (MMSE)[16] and Montreal Cognitive Assessment (MoCA) [17] at acute phase (within 2 weeks after onset), 6 weeks and 12 weeks after stroke, respectively, in order to explore the regularity of cognitive variation after stroke and its related factors.

Patients and methods

Patients

We enrolled 98 inpatients (≥ 45 years old, 69 men and 29 women) with first-ever stroke admitting to the First and Second Affiliated Hospital of Medical College of Xi'an Jiaotong University and Shaanxi Provincial People's Hospital between April and September 2013 at baseline. All patients and their caregivers provided informed consent.

Eligible patients had an acute ischemia stroke within 2 weeks at baseline inclusive, and met the WHO definition of stroke. Patients underwent detailed general physical and extensive laboratory tests and brain magnetic resonance imaging (MRI) examination and a set of neuropsychological tests. The lesion in brain diffusion weighted imaging (DWI) supported the diagnosis of acute ischemia stroke. The patients had Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) score ≤ 56, and the muscle strength of one side of upper limb ≥ 3 grade at least. Exclusion criteria for this study were unconsciousness, delirium and aphasia that impeded cognitive assessment.

Clinical Data Collection

Following variables were obtained from each eligible patient at baseline: demographics (gender, age and level of education), drinking history, neurological examination results (National Institutes of Health Stroke Scale, NIHSS), vascular risk factors (hypertension, diabetes mellitus, coronary heart disease), blood tests (TC, LDL-C) and brain imaging datas (the site of brain lesion).

The presence of hypertension, diabetes and coronary heart disease was defined according to the diagnosis and subsequent treatment by a physician at hospital or according to a relative report of previous and ongoing treatment for the respective conditions. Each diagnosis was based on the clinical guidelines published by Chinese Medical Association. Hypercholesterolemia was defined as plasma cholesterol level more than 5.2 mmol/L. Higher LDL-C level was defined as plasma LDL-C level more than 3.1mmol/L. Older age was defined as age ≥ 65 years old. Low education status was defined as having less than 6 years education. Higher NIHSS score was defined as NIHSS score ≥ 5. Cognitive improvement was defined as score of MMSE increased ≥ 2 during 12 weeks after stroke. Non-cognitive improvement was defined as score of MMSE increased < 2 ,decreased or remained during 12 weeks after stroke.

Cognitive function assessment

Blinded method was adopted in the cognitive function assessment. The cognitive function of participants was evaluated by trained doctors in acute phase (within 2 weeks of onset), 6 weeks and 12 weeks after stroke using MMSE and MoCA. The criteria of cognitive impairment was defined as illiterate ≤ 17 points, primary school graduates ≤ 20 points, secondary and higher school graduates ≤ 24 points on MMSE score[16,18], or ≤ 25 points on MoCA score[19]. Depression was evaluated by Center for Epidemiologic Studies Depression (CES-D), and ≤ 15 points for without depression, 16-19 points for possible depression, and ≥ 20 for definite depression.

Statistical analysis

The rank sum test was used to compare categorical variables with continuous variables. Logistic regression analysis was conducted to determine risk factors of PSCI and recovery of cognition after stroke. Independent variables included gender, age, and educational status, drinking history, lesion sites, diabetes mellitus, hypertension, coronary heart disease, total cholesterol, blood low-density lipoprotein, post-stroke depression and NIHSS scores. The dependent variables were MMSE scores below the cutoff points in any time point, and cognitive improvement or non-improvement. All statistical analysis was performed with SPSS 13.0 version (SPSS Inc., Chicago, IL). Continuous variables were described as χ±s, and categorical variables as numbers (percentile). Significant p values were set at 0.05 level.

Results

Demographics and clinical characteristics

A total of 98 patients were enrolled. Sixty-nine patients (70.4%) were male, and 29 patients (29.6%) were female. The median age was 61.2 years (range 46-81 years). The demography and clinical characters of stroke patients are shown in Table 1.

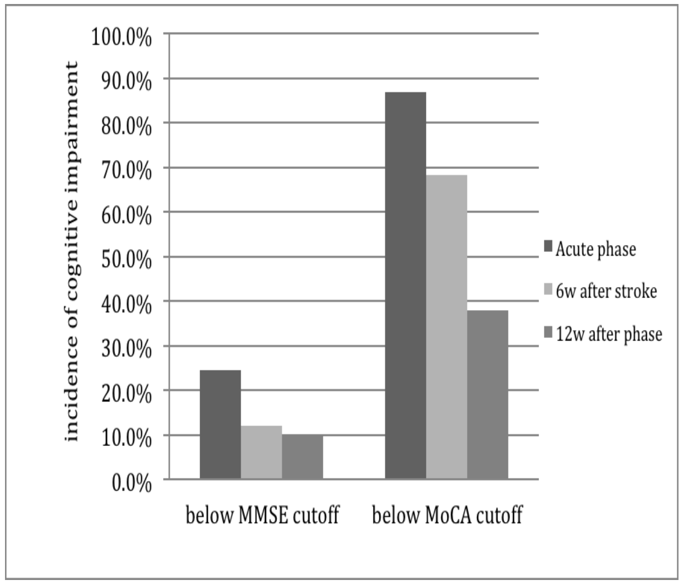
Table 1. Demography and stroke characteristics of patients.

	Cases (%)
No.	98
Sex(Male)	69(70.4)
Age (years): ≤ 54	17(17.3)
55- 64	47(48.0)
65- 74	26(26.5)
75-	8(8.2)
Education: illiterate	4(4.1)
primary School	15(15.3)
middle school and above	79(80.6)
Diabetes	10(10.2)
Hypertension	64(65.3)
Coronary heart disease	14(14.3)
Drinking history	10(10.2)
NIHSS score: <5	69(70.4)
5-10	17(17.3)
>10	12(12.3)
CES-D score: ≤ 15 points	63(64.3)
16-19 points	27(27.5)
≥ 20 points	8(8.2)

NIHSS-National Institute of Health Stroke Scale, CES-D-Center for Epidemiologic Studies Depression.

Regularity of post-stroke cognitive impairment

MMSE scale analysis showed that 13 patients (24.5%) had cognitive impairment at acute phase, 8 patients (12.1%) at 6 weeks, 7 patients (9.9%) at 12 weeks after stroke. The prevalence of PSCI was 86.8% (46/53), 68.2% (45/66), and 38.0% (27/71) respectively when MoCA scale was used. (Fig. 2)



Prevalence of post-stroke cognitive impairment

The scores of MMSE and of MoCA gradually improved within 12 weeks after stroke. The scores are higher in 6 weeks than that in acute phase, and better in 12 weeks than that in 6 weeks (Table 2).

Table 2. The scores of MMSE and MoCA at different time points after stroke

	N (cases)	MMSE score (χ ± s)	MOCA score (χ ± s)
Acute phase	53	24.51 ± 6.78	17.49 ± 7.61
6 weeks after stroke	66	26.63 ± 5.11*	20.59 ± 6.99*
12 weeks after stroke	71	28.02 ± 3.38**	24.22 ± 5.18**

MMSE-Mini-Mental State Examination, MoCA -Montreal Cognitive Assessment.

* 6 weeks after stroke compared to acute phase, $p \leq 0.001$;

** 12 weeks after stroke compared to 6 weeks after stroke, $p < 0.001$.

Risk factors related to PSCI and recovery of cognition after stroke

Logistic regression analysis showed that older age, low education status, history of hypertension, higher NIHSS score and post-stroke depression were significant variables associated with PSCI, (Table 3) while low education status, coronary heart disease, hypercholesterolemia, higher LDL-C level, and post-stroke depression affected the recovery of cognitive function after stroke. (Table 4)

Table 3. Risk factors associated with post-stroke cognitive impairment

variables	β value	$S_{\bar{x}}$	wald value	*p* value
older age	-0.124	0.062	3.977	0.046
low education status	0.560	0.224	6.269	0.012
hypertension	-3.705	1.245	8.849	0.003
higher NIHSS score	-0.325	0.145	5.038	0.025
post-stroke depression	4.613	1.762	8.325	0.018

NIHSS-National Institute of Health Stroke Scale,β-standardized regression coefficient

Table 4. Related factors associated with recovery of post-stroke cognitive impairment within 12 weeks

variables	β value	$S_{\bar{x}}$	wald value	*p* value
low education status	0.710	0.255	7.743	0.005
coronary heart disease	-3.649	1.754	4.329	0.037
hypercholesterolemia	-3.361	1.254	7.182	0.007
higher LDL-C level	-5.833	1.968	8.785	0.003
post-stroke depression	-3.612	1.253	4.358	0.023

β-standardized regression coefficient

Discussion

In this follow-up study, the prevalence of PSCI decreased and MMSE scores, MoCA scores gradually increased at three different time points within 12 weeks after stroke. It may indicate that cognitive function steadily improved within 12 weeks after stroke. The recovery of neurological function, cerebral compensation, physical and verbal functional recovery are suspected to be some of the mechanisms that cognitive function improvement. MMSE scores increased rapidly (average 2.12 points) in first 6 weeks, and there was a decrease trend of MMSE score increasing in the later 6 weeks (average 1.39 points), which indicated rapid recovery of cognitive function in early stage of stroke and cognitive recovery rate gradually slowed down later on. MoCA scores rose by a large margin within 12 weeks after stroke (6.73 points).

We find that the incident of cognitive impairment is different when using MMSE and MoCA. It may indicate that the MMSE is less sensitive than the MoCA in detecting cognitive impairment after acute stroke. The poorer performance of the MMSE at detecting PSCI maybe due to several factors. MMSE is used for screening different types of dementia, especially Alzheimer's disease [20], while MoCA is used for detecting mild cognitive impairment [19]. MMSE is designed well for inspecting memory function, particularly cortical function [21]. MoCA emphasize on executive function and visual spatial function belonged to sub-cortical functions on the contrary [19]. As shown by an earlier study, executive dysfunction after stroke performed the main dysfunction in cognitive impairment, but memory and cortical dysfunction are less affected [22-24]. The sub-cortical function progressively recuperate as time goes by, which makes MoCA scores climb up relatively faster.

Several studies were intended to identify the probable risk factors that influence cognitive recovery after stroke, but the results were inconsistent. In this study, we found that patients with older age, low education status, history of hypertension, higher NIHSS score and post-stroke depression were more likely to suffer from PSCI, while gender, drinking history, lesion sites, diabetes mellitus, coronary heart disease, total cholesterol, blood low-density lipoprotein, were not associated with PSCI. We also investigated that cognitive recovery after stroke was much slower in patients with low educational status, history of coronary heart disease, hypercholesterolemia, higher LDL-C level. Among these factors, low educational status is a well-known risk factor for dementia, which may be related to lower brain reserve [25]. What is more, coronary heart disease, hypercholesterolemia, higher LDL-C level are known to increase atherosclerosis and to be identified as risk factors for cerebrovascular disease [26]. They may promote the occurrence of cerebral atherosclerosis and affect cerebral blood flow. [27-29] Therefore, they could influence the recovery of cognitive function after stroke. It is beneficial for patients with PSCI to intervene atherosclerosis risk factors earlier, which will facilitate the recovery of cognitive function after stroke.

Post-stroke depression is a common psychiatric complication of stroke [30] and closely related to cognitive dysfunction. [31] In accordance with those studies, we demonstrate that post-stroke depression not only increased the occurrence of cognitive impairment after stroke, but also affected the recovery of cognitive function after stroke. It inferred that treatment of post-stroke depression may be in favor of the recovery of cognitive function after stroke.

It should be noted that our study has some limitations. The sample size in our study is not big enough, the follow-up period is shorter and the neurological dysfunction of enrolled patients is relative lighter. Further prospective studies involving large sample and long-term evaluation will be needed to determine the regularity of cognitive variation beyond 3 months after stroke, and whether control of vascular risk factors may slow down the progression of cognitive impairment after stroke.

In conclusion, our study found that cognitive function improves in the first 12 weeks of stroke, while vascular risk factors and post-stroke depression may affect the improvement of cognitive function after stroke. Our results may suggest that it is important to treat the vascular risk factors and post-stroke depression in patients with PSCI.

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Conflict of interest

Nil

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