

Delirium in the Acute Phase of Ischemic Stroke: Incidence, Risk Factors, and Effects on Functional Outcome

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Objective: The aim of this prospective cohort study was to assess the incidence and risk factors of delirium following acute ischemic stroke, as well as its effects on functional outcome. **Methods:** Two hundred and sixty-one patients with acute ischemic stroke were screened for delirium during the first week after admission. Delirium was diagnosed according to the Confusion Assessment Method. If delirium was present, delirium rating scale-revised-98 was used to assess its severity. Neurologic deficits were assessed with the National Institutes of Health Stroke Scale (NIHSS). Brain magnetic resonance imaging assessment quantified the infarction, white matter lesions, and medial temporal lobe atrophy. Functional outcome assessment included the modified Rankin Scale and Lawton Instrumental Activities of Daily Living scale at 3 and 6 months after the index stroke. **Results:** Thirty-eight (14.6%) patients with acute ischemic stroke developed delirium during the first week of admission. Patients with poststroke delirium (PSD) were older, had higher NIHSS scores on admission, and were more likely to have a previous stroke, an infection, and a left cortical infarct. Furthermore, left cortical infarction, older age, severer neurological deficit and having a previous stroke increased the risk of PSD. PSD was associated with a worse functional outcome. **Conclusion:** The incidence of delirium was 14.8% in the first week after admission with acute ischemic stroke. Age, having a previous stroke, stroke severity, and left-cortical infarction were independently predictors of PSD. PSD may result in a significantly worse functional outcome.

Key Words: Delirium—ischemic stroke—functional status—MRI—psychiatric symptoms

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Introduction

Delirium is an acute confusional state that develops over a short period of time and fluctuates during the course of the day.¹ It is the most frequent psychiatric syndrome in hospitalized subjects,² and it occurs in about 10%–25% of all acute general hospital admissions and in 20%–40% of elderly patients.³ Delirium is the result of the interplay between patient characteristics (eg, frailty, low cognitive reserve, and cerebral damage) and exogenous factors (eg, medication, infections, and stress).⁴ It has been reported to be associated with several clinical situations, including surgery, acute stroke, pulmonary infection, and intensive care.⁵

Poststroke delirium (PSD) is a common complication in the acute phase of stroke. There are only a small number of studies that have investigated the incidence of PSD, which varies from 11.8% to 66%.^{6,7} However, these

studies recruited both hemorrhagic and ischemic stroke patients and had conflicting findings. It appears critical to study a homogeneous group of subjects.

Thus, we conducted this study to investigate the incidence, risk factors, and effects on functional outcome of PSD in Chinese patients with ischemic stroke.

Materials and Methods

Participants and Setting

The study was conducted at Division I, Department of Neurology, Dongguan People's Hospital between June 1st, 2016 and June 30th, 2017. The inclusion criteria for the study were as follows: (1) aged over 18 years; (2) first or recurrent acute ischemic stroke occurring within 7 days before admission; and (3) had brain magnetic resonance imaging (MRI) examination. The exclusion criteria were as follows: (1) transient ischemic attack, cerebral hemorrhage, subdural hematoma, or subarachnoid hemorrhage; (2) central nervous system diseases other than stroke (eg, dementia, Parkinson's disease, or multiple sclerosis); and (3) severe mental disorders before the index stroke (eg, schizophrenia). The study protocol was approved by the Ethics Committee of Dongguan People's Hospital. The consent of all subjects was obtained in accordance with the Declaration of Helsinki.

Collection of Demographic and Clinical Data

Socio-demographic and clinical variables including age, sex, history of stroke, vascular risk factors, and treatment were recorded on a standard data collection form. The subtype of ischemic stroke was judged by neurologists during hospitalization based on the Trial of Org 10172 in Acute Stroke Treatment subtype system.⁸

Assessment of PSD

PSD was assessed by a trained neurologist Jianfeng Qu (JFQ). Each patient was screened for delirium for the first time between day 1 and 3 after admission, and for a second time between day 5 and 7. If the patient was discharged before day 5, only the first screening was performed. We aimed to screen the patients for PSD twice, as PSD can occur at any time during the hospitalization period.⁹ Delirium was assessed using the Confusion Assessment Method (CAM).¹⁰ If the CAM was positive, delirium was diagnosed and the severity of delirium was assessed daily with the delirium rating scale-revised-98.¹¹ DRS-R-98 includes a 13-item severity scale and a 3-item diagnostic scale. The severity scale quantifies multiple parameters such as language, thought process, two motoric presentations, and the components of cognition. Items 1 to 14 were scored on a 4-point scale and items 15 and 16 were scored on a 3-point scale, resulting in a range for the total score from 0 to 46. The Chinese version of the DRS-R-98 has been validated.¹² For each PSD patient,

follow-up of delirium was performed until it was cured, which was defined as having a negative CAM. The PSD patients were treated by their neurologists according to national clinical practice guidelines.¹³

Follow-Up of the Participants

All participants were followed up for 6 months via telephone. We assessed the clinical outcomes at 3 and 6 months according to the modified Rankin Scale (mRS) and functional status. Functional status was evaluated by the Lawton Instrumental Activities of Daily Living (IADL) scale.¹⁴ The IADL examines a person's present functional level and identifies improvement or deterioration over time. The eight domains of function measured by the IADL are using a telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility for own medications, and handling finances. The total IADL score is calculated by summing the points obtained for each item. The maximum IADL score is 32. A higher IADL score reflects poorer IADL performance. We defined a poor outcome as an mRS score greater than or equal to 3 or an IADL total score greater than 75th percentile of the IADL total score.

MRI Assessment

Brain MRI scans, including T1-weighted imaging, T2-weighted imaging and diffusion-weighted imaging (DWI) were performed on each participant with a 3.0-T system (Sonata, Siemens Medical, Erlangen, Germany) within 7 days of admission. DWI spin-echo echo-planar imaging (EPI; time of repetition/time of echo/excitation = 2162/76/1, matrix = 128 × 128, field of view [FOV] = 230 mm, slice thickness/gap = 6 mm/1 mm, EPI factor = 47, acquisition time = 25.9 seconds) with three orthogonally applied gradients was used with a *b* value of 0 and 1000. Axial SE T1 (TR/TE/excitation = 488/15/1, FOV = 230 mm, slice thickness/gap = 6 mm/1 mm, matrix = 256 × 256, time of acquisition = 1 minute 24.8 seconds) and TSE T2 (TR/TE/excitation = 3992/110/2, turbo factor = 15, FOV = 230 mm, slice thickness/gap = 6 mm/1 mm, matrix = 512 × 512, time of acquisition = 1 minute 55.8 seconds) images were also acquired.

A neurologist (YKC) who was blinded to each patient's clinical information and assessment results measured the MRI variables as follows:

- (1) *Brain infarcts*: The sites and volume of acute lesions in DWI were examined. The sites of the acute infarcts were divided into cortical regions (frontal, temporal, parietal and occipital lobes), subcortical regions (subcortical white matter, basal ganglia, and thalamus), brain stem, and cerebellum. The total area of acute infarcts on DWI was measured with manual outlines. Acute

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