Research Square

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Prevalence and Risk Factors of Delirium Among Stroke Patients

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Abstract

Background

Delirium is a common but often underdiagnosed neuropsychiatric syndrome among hospitalized patients, particularly in those with acute neurological conditions such as stroke. Post-stroke delirium (PSD) is associated with prolonged hospital stays, increased mortality, and poorer functional outcomes. While previous studies have explored various risk factors for PSD, findings remain inconsistent across populations and clinical settings. This study aims to investigate the prevalence of delirium among stroke patients and to analyze its risk factors.

Methods

From October 2023 to July 2024, a total of 281 stroke patients from the Neurology and Neurosurgery Departments of Guizhou Provincial People's Hospital were selected using a convenience sampling method. The Confusion Assessment Method for the ICU (CAM-ICU) was used for delirium diagnosis.

Results

The overall prevalence of post-stroke delirium (PSD) was 20.28% (57/281). Stroke type, smoking, alcohol consumption, NIHSS score, WBC count, and the presence of physical restraints were identified as risk factors for PSD, while hemoglobin (Hb) served as a protective factor.

Conclusions

The prevalence of PSD in this study was relatively high. Nursing staff should consider these factors in stroke patient care and take proactive preventive measures to reduce the occurrence of PSD.

Clinical Trial Registration: Not applicable.

1. Introduction

Stroke, also known as cerebrovascular accident, is a type of cerebrovascular disease primarily characterized by intracerebral hemorrhage or ischemia. Its main types include ischemic stroke and hemorrhagic stroke. Stroke is known for its high incidence, high disability rate, and high mortality rate,[1] significantly increasing the care burden on healthcare providers. Although the global age-standardized mortality rate of stroke has declined in recent years, the age-standardized prevalence continues to rise markedly.[2] Delirium is a common complication among stroke patients, with clinical manifestations that include altered levels of consciousness, changes in orientation, memory, thought, or behavior. It can rapidly develop into a fluctuating state in a short time, leading to adverse outcomes such as prolonged hospitalization, impaired mobility, long-term cognitive decline, increased risk of dementia, and even death.[3, 4] Currently, studies focusing on post-stroke delirium (PSD) remain limited. Existing evidence

shows that nurses often lack adequate knowledge of delirium, and confidence in its recognition and management remains insufficient, contributing to underdiagnosis and misdiagnosis of PSD.[5]

Although international clinical guidelines advocate for early and proactive identification of risk factors and symptoms in high-risk stroke survivors,[6, 7] the detection of delirium in acute care settings is still suboptimal.[8] Furthermore, due to the lack of specific nursing guidelines for stroke detection and management, clinical attention to PSD remains inadequate.[9] Delirium management in nursing is a multifaceted process that involves both pharmacological and non-pharmacological interventions.[10] Early and rapid identification of delirium is crucial for initiating timely interventions, preventing related complications, and mitigating functional decline.[11]

Therefore, this study aims to assess the prevalence of delirium among stroke patients using the Confusion Assessment Method for the ICU (CAM-ICU), and to explore its influencing factors from multiple dimensions, including clinical characteristics and laboratory indicators. Identifying these risk factors can assist nursing staff in early detection and provide a reference for developing targeted PSD prevention and management strategies, ultimately aiming to reduce its prevalence.

2. Materials and Methods

2.1 Participants

From October 2023 to July 2024, 281 stroke inpatients were enrolled from the Neurology and Neurosurgery Departments of Guizhou Provincial People's Hospital using convenience sampling. **Inclusion criteria**: (1) Diagnosed with ischemic or hemorrhagic stroke (Chinese Stroke Guidelines, 2018/2019)[12, 13]; (2) Age ≥ 18; (3) Hospitalization > 24 hours; (4) Glasgow Coma Scale (GCS) score > 8; (5) Provided informed consent. Exclusion Criteria: (1) Patients who had experienced delirium prior to hospital admission; (2) patients with a history of psychiatric disorders or dementia; (3) patients with severe visual, auditory, and/or speech impairments that prevented effective communication. According to the sampling principle proposed by Wang Jialiang,[14] the required sample size should be 5 to 10 times the number of questionnaire items. Considering a potential 10% rate of invalid responses, and given that the questionnaire included 34 items, the final targeted sample size was set at 300.

All procedures were performed in compliance with relevant laws and institutional guidelines and have been approved by the Ethics Committee of Guizhou Provincial People's Hospital (Approval No.: Ethics-Research–2024–055).

2.2 Study Tools

2.2.1 General Information Questionnaire

The general information questionnaire was developed by the researchers based on literature review and expert consultation in nursing, tailored to the objectives of this study. It consists of three main sections:

(1)Basic patient information: including name, age, gender, ethnicity, marital status, place of residence, educational level, smoking history, and alcohol consumption history; (2)Clinical data: including types of chronic comorbidities, history of stroke, hearing impairment, visual impairment, stroke type, Barthel Index score, NIHSS score,[15] presence of infection, and physical restraint; (3) Laboratory indicators: including hemoglobin level, white blood cell count, and platelet count.

2.2.2 Glasgow Coma Scale (GCS)

The Glasgow Coma Scale (GCS) was developed in 1974 by Graham Teasdale and Bryan Jennett at the University of Glasgow to assess a patient's level of consciousness and degree of coma.[16] The scale consists of three components: eye-opening response (4 points), verbal response (5 points), and motor response (6 points), with a total score ranging from 3 to 15. Higher scores indicate closer to normal consciousness, whereas lower scores reflect more severe impairment.

In this study, the GCS was used primarily to screen eligible participants with scores greater than 8.

2.2.3 Confusion Assessment Method for the ICU (CAM-ICU)

The CAM-ICU was developed by Ely et al.[17] as a modification of the original Confusion Assessment Method (CAM) specifically for use in ICU patients. It is known for its simplicity, high accuracy, and time efficiency. CAM-ICU is widely recommended by clinical guidelines and authoritative literature, and is commonly used by nurses in patients with trauma, neurological conditions, or undergoing surgery. The CAM-ICU evaluates four key features: Acute onset or fluctuating course; Inattention; Altered level of consciousness; Disorganized thinking. A diagnosis of delirium is confirmed when both features and are present, along with either feature or .

2.2.4 Method of Data Collection

Data were collected using standardized paper-based questionnaires. All participants were screened strictly according to the inclusion and exclusion criteria. Prior to the investigation, members of the research team received uniform training. Patients were informed of the study's purpose and significance, and written informed consent was obtained before distributing the questionnaires. During data collection, researchers used standardized instructions to explain the questionnaires. Upon completion, each questionnaire was reviewed immediately for completeness and collected on the spot. A total of 281 valid questionnaires were returned, yielding a response rate of 93.67%.

2.2.5 Statistical Analysis

All data were analyzed using SPSS version 26.0. Continuous variables with normal distribution were expressed as mean ± standard deviation, while those with non-normal distribution were described using median and interquartile range (IQR). Categorical variables were reported as frequency and percentage.

Univariate analysis of categorical variables was performed using the chi-square test. Based on the results of normality testing, continuous variables were analyzed using either the independent samples t-test or the Mann–Whitney U test for non-parametric comparisons. Binary logistic regression analysis was conducted to identify independent risk factors. A P-value < 0.05 was considered statistically significant.

3. Results

3.1 General Characteristics and Univariate Analysis of PSD

The 281 patients ranged in age from 21 to 92 years (mean = 60.18 ± 14.13), with 184 males (65.48%) and 97 females (34.52%). Univariate analysis using the chi-square test indicated that stroke type, smoking, alcohol consumption, Barthel Index (BI), infection, and physical restraint were significantly associated with PSD (P < 0.05). See Table 1. Normality tests were conducted for NIHSS scores, Hb, WBC, and PLT levels, and all variables were found to deviate significantly from normal distribution (P < 0.001). See Table 2.

Table 1
Univariate Analysis of Delirium in Stroke Patients (N = 281)

Variable	Non-PSD (n = 224, 79.72%)	PSD (n = 57, 20.28%)	χ^2	P-value
Stroke type			5.26	0.022 *
– Ischemic	77 (34.37%)	10 (17.54%)		
– Hemorrhagic	147 (65.63%)	47 (82.46%)		
Age group			0.113[a]	0.945
– < 60 years	106 (47.32%)	28 (49.12%)		
– 60–74 years	76 (33.93%)	18 (31.58%)		
– ≥ 75 years	42 (18.75%)	11 (19.30%)		
Gender			3.714[b]	0.054
– Male	140 (62.50%)	44 (77.19%)		
– Female	84 (37.50%)	13 (22.81%)		
Education level			4.372[a]	0.112
– Low	86 (38.39%)	15 (26.32%)		
– Medium	85 (37.95%)	30 (52.63%)		
– High	53 (23.66%)	12 (21.05%)		
Marital status			0.478[a]	0.924
– Widowed	17 (7.59%)	3 (5.26%)		
– Married	199 (88.84%)	52 (91.24%)		
– Single	3 (1.34%)	1 (1.75%)		
– Divorced	5 (2.23%)	1 (1.75%)		
Chronic diseases			2.303[a]	0.316
– None	89 (39.73%)	23 (40.35%)		
– 1–2 conditions	126 (56.25%)	29 (50.88%)		
– ≥3 conditions	9 (4.02%)	5 (8.77%)		
Ethnicity			0.516[b]	0.472

Notes: *P < 0.05; **P < 0.01; ***P < 0.001; [a] Fisher's exact test; [b] multiple-response items

Variable	Non-PSD (n = 224, 79.72%)	PSD (n = 57, 20.28%)	χ^2	P-value
– Han	194 (86.61%)	52 (91.23%)		
– Minority	30 (13.39%)	5 (8.77%)		
Residence			0.184[b]	0.668
– Rural	88 (39.29%)	20 (35.09%)		
– Urban	136 (60.71%)	37 (64.91%)		
Smoking			20.439[b]	< 0.001 ***
– Yes	84 (37.50%)	41 (71.93%)		
– No	140 (62.50%)	16 (28.07%)		
Alcohol use			21.271[b]	< 0.001 ***
– Yes	79 (35.27%)	40 (70.18%)		
– No	145 (64.73%)	17 (29.82%)		
Stroke history			0.138[b]	0.71
– Yes	25 (11.16%)	8 (14.04%)		
– No	199 (88.84%)	49 (85.96%)		
Hearing impairment			0.693[b]	0.405
– Yes	14 (6.25%)	6 (10.53%)		
– No	210 (93.75%)	51 (89.47%)		
Visual impairment			1.543[b]	0.214
– Yes	14 (6.25%)	6 (10.53%)		
– No	210 (93.75%)	51 (89.47%)		
Barthel Index			11.644[a]	0.009 **
– ≤40	102 (45.53%)	40 (70.18%)		
– 41–60	18 (8.04%)	4 (7.02%)		
– 61–99	83 (37.05%)	10 (17.54%)		
– 100	21 (9.38%)	3 (5.26%)		

Notes: *P < 0.05; **P < 0.01; ***P < 0.001; [a] Fisher's exact test; [b] multiple-response items

Variable	Non-PSD (n = 224, 79.72%)	PSD (n = 57, 20.28%)	χ^2	P-value
Infection			7.781[b]	0.005 **
– Yes	1 (0.45%)	4 (7.02%)		
– No	223 (99.55%)	53 (92.98%)		
Restraint			15.083[b]	< 0.001 ***
– Yes	1 (0.45%)	6 (10.53%)		
– No	223 (99.55%)	51 (89.47%)		
Notes: *P < 0.05; **P < 0.01; ***P < 0.001; [a] Fisher's exact test; [b] multiple-response items				

Table 2
Normality Test for Continuous Variables (N = 281)

Name	Sample size	Mean	SD	Skewness	Kurtosis	K- *S Test(p)*	S- *W Test(p)*
NIHSS	281	3.612	2.248	2.058	14.134	0.000***	0.000***
Hb	281	130.690	25.279	0.107	0.644	0.000***	0.028*
WBC	281	4.582	1.068	2.062	12.695	0.000***	0.000***
PLT	281	213.765	81.464	1.716	5.701	0.000***	0.000***

3.2 Multivariate Analysis of PSD

Variables with statistical significance in univariate analysis—including stroke type, smoking, alcohol consumption, BI score, infection, restraint, NIHSS score, Hb, and WBC—were included in a binary logistic regression model, with PSD as the dependent variable. Results showed that stroke type, smoking, alcohol use, infection, restraint, NIHSS score, Hb, and WBC were significant predictors of PSD. See Table 3.

Table 3
Binary Logistic Regression Analysis of Risk Factors for PSD (N = 281)

Independent variable	*β*	*SE*	*Wald*	*P*	*OR*	95%CI	
						Lower	Upper
Constant	-2.234	4.025	0.308	0.579	0.107	-10.122	5.654
Smoking	1.219	0.487	6.271	0.012*	3.385	0.265	2.174
Alcohol use	1.062	0.496	4.585	0.032*	2.892	0.090	2.034
Stroke type	1.546	1.298	1.418	0.234	4.690	-0.999	4.090
Barthel Index (BI)	-0.197	0.226	0.765	0.382	0.821	-0.639	0.245
Infection	2.075	1.494	1.928	0.165	7.965	-0.854	5.004
Restraint	4.233	1.493	8.044	0.005**	68.950	1.308	7.159
NIHSS Score	0.205	0.084	5.992	0.014*	1.228	0.041	0.369
Hb	-0.052	0.010	25.889	0.000***	0.949	-0.073	-0.032
WBC	0.816	0.218	14.049	0.000***	2.261	0.389	1.242

4. Discussion

4.1 Notable Prevalence of Post-Stroke Delirium (PSD)

This study revealed a PSD prevalence of 20.28%, which is slightly lower than the 27.07% reported by Pasinska et al.[18] and the 25.0% indicated in a recent meta-analysis by Ye et al.,[19] yet higher than the 10.7% found in a prospective observational study by Nydahl et al.[20] in Germany. The differences may be attributed to variations in study populations, assessment tools, and socioeconomic contexts across countries and regions.

Previous studies have shown that up to two-thirds of ICU nurses have limited knowledge of delirium, increasing the risk of misdiagnosis or missed diagnosis.[21] Many healthcare professionals also feel inadequately trained to assess and manage delirium effectively.[22] Therefore, nursing administrators should strengthen education and training related to PSD to reduce its incidence and alleviate the clinical and financial burden on stroke patients.

4.2 Risk Factors for PSD

The results of this study indicate a significant association between stroke type and the occurrence of post-stroke delirium (PSD), with patients experiencing hemorrhagic stroke being at a higher risk of developing delirium than those with ischemic stroke. This finding is consistent with the results reported by Ye et al.[19] The underlying reason may be that hemorrhagic stroke involves intracerebral bleeding

due to vascular rupture, which causes damage to brain parenchyma and dysfunction of neural cells, thereby increasing the likelihood of delirium.[23]

To reduce the incidence of PSD, community healthcare providers should strengthen education and health management for the general population to help prevent hemorrhagic stroke, thereby indirectly decreasing the risk of PSD.

This study also found that the incidence of delirium was higher in male patients than in females. This may be attributed to two factors. First, estrogen levels in women are generally higher than in men. Estrogen has been shown to effectively suppress the release of peripheral and central proinflammatory cytokines and to help protect the blood–brain barrier from damage to a certain extent.[24] Second, unhealthy lifestyle habits such as long-term smoking and alcohol consumption are more prevalent in men. When such behaviors are abruptly stopped, neurotransmitter levels in the brain—such as dopamine and serotonin—may undergo drastic changes, disrupting neural signal transmission and triggering delirium.[25]

Moreover, multivariate analysis showed that smoking, alcohol use, physical restraint, higher NIHSS scores at admission, and elevated WBC levels had significant positive associations with PSD, while hemoglobin (Hb) was a significant protective factor. Smoking and alcohol consumption have been confirmed in multiple studies as independent risk factors for delirium.[26, 27] Psychotropic substances in tobacco and alcohol can impair the metabolic function of brain cells, reduce intercellular communication, and hinder information processing, thereby triggering delirium.[28]

This study identified physical restraint as a risk factor for delirium. The use of restraints may intensify patient agitation and contribute to reduced physical and cognitive function.[29] Some studies suggest that while combining physical restraints with sedative medications may enhance immobilization, both interventions are independently associated with an increased risk of delirium.[30] Therefore, healthcare providers are advised to carefully evaluate treatment plans, avoiding medications and nursing practices that may precipitate delirium.

NIHSS score was also identified as a risk factor for PSD. The higher the score, the greater the risk of delirium, likely due to the extent of neurological impairment. This finding is consistent with results reported by Mansutti et al.[31] It is recommended that nurses closely monitor male patients with high NIHSS scores and a history of smoking or alcohol use, ensuring early identification of risk factors and timely implementation of preventive management strategies.

Hb was found to be a protective factor against delirium in this study, consistent with findings by Kijima et al.[32] The brain relies heavily on oxygen and glucose for its metabolic processes, which occur at a high rate and require adequate oxygen supply. Low Hb levels impair the body's ability to deliver oxygen, potentially lowering blood oxygen saturation and triggering delirium.

In recent years, the concept of prehabilitation through nutrition and exercise has been introduced in nursing, aiming to enhance immunity, improve circulation, and boost antioxidant capacity by optimizing patients' nutritional and physical status prior to treatment.[33] This approach has shown promise in reducing postoperative complications.[34] Given the close relationship between a patient's nutritional status and nursing education and dietary management, healthcare professionals should assess nutritional conditions during patient care and provide timely support and guidance to families. This may help prevent Hb reduction caused by malnutrition and reduce the risk of delirium.

Additionally, elevated WBC was identified as a risk factor for PSD. Studies have shown that inflammatory cytokines such as interleukin−1 and interleukin−6 may induce delirium by activating endothelial cells, impairing cerebral blood flow, increasing blood–brain barrier permeability, and altering neurotransmission.[35, 36–37] Nurses play a vital role in hospital infection control and can help reduce the incidence of delirium through effective infection prevention strategies. In a study by Korean researchers Song, Lee, and Jung,[38] infection control was incorporated as part of a delirium prevention protocol, showing significant outcomes.

In future practice, it is recommended that nurses adopt a comprehensive approach to delirium prevention and management by considering all potential risk factors and implementing coordinated interventions. Further studies exploring PSD risk factors may expand on the present findings by increasing the sample size and incorporating additional serum biomarkers. This will allow for an in-depth exploration of the underlying mechanisms of PSD and enable clinical staff to rapidly identify high-risk individuals and initiate targeted early interventions to prevent disease onset.

5. Conclusion

This study investigated the prevalence and associated risk factors of delirium among stroke patients, revealing a PSD (post-stroke delirium) prevalence rate of 20.28%. Patients with hemorrhagic stroke were found to be at a higher risk of developing delirium compared to those with ischemic stroke. Smoking, alcohol consumption, elevated NIHSS scores, increased white blood cell (WBC) count, and the use of physical restraints were identified as significant risk factors for PSD, while hemoglobin (Hb) served as a protective factor.

As a single-center study, although it included nearly 10 months of inpatient data from the neurology and neurosurgery departments, it did not analyze the prevalence of PSD among stroke patients in the emergency department. Therefore, the sample size was relatively limited. Future research may expand the sample size and include additional hospital departments based on the current study to identify more potential risk factors associated with PSD. This would support clinical healthcare providers in developing early and targeted prevention and management strategies for delirium in stroke patients.

Meanwhile, it is recommended that nursing administrators enhance the training and supervision of clinical nursing staff on PSD-related knowledge. By equipping nurses with a comprehensive understanding of delirium assessment and prevention strategies, the incidence of PSD can be effectively

reduced—thereby alleviating the clinical and financial burden on stroke patients and improving their overall quality of life.

Abbreviations

Post-stroke delirium (PSD); Confusion Assessment Method for the ICU (CAM-ICU); hemoglobin (Hb); Glasgow Coma Scale (GCS); interquartile range (IQR);NIHSS score(NIH Stroke Scale)

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Guizhou Provincial People's Hospital (Approval No.: Ethics-Research-2024-055).Patients were informed of the study’s purpose and significance, and written informed consent was obtained before distributing the questionnaires. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Conflict of interest disclosure

The authors declare no conflicts of interest.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Lihong Xian: Conceptualization, Methodology, Writing - original draft.Yujie Li: Data curation, Formal analysis, Visualization. Huan Yan: Software, Data curation, Writing - review & editing. Project administration, Methodology, Formal analysis. Simin Li: Investigation, Resources, Validation. Huanhuan Zhu: Investigation, Visualization, Writing - review & editing. Fengyin Zhang: Resources, Validation,

Supervision. Juan Li : Conceptualization, Supervision, Writing - review & editing. All authors read and approved the final manuscript.

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