The Influencing Factors of Postoperative Delirium in Elderly Hip Fracture Patients: What Should Treatment Focus On

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Abstract

Background: The postoperative delirium is a common yet serious complication in elderly patients with hip fracture, it's necessary to evaluate the potential risk factors of delirium in patients with hip fracture, to provide reliable evidence to the clinical management of hip fracture.

Methods: Elderly patients who underwent hip fracture surgery in our hospital from June 1, 2019 to May 31, 2021 were selected. The characteristics and treatment data of delirium and no delirium patients were collected and compared. Multivariate logistic regression analysis was conducted to analyze the influencing factors affecting postoperative delirium in elderly patients with hip fracture.

Results: A total of 245 patients with hip fracture were included, the incidence of postoperative delirium in patients with hip fracture was 13.06%. There were significant differences in the age, BMI, history of delirium, estimated blood loss and duration of surgery (all $p<0.05$). There were significant differences in the albumin and TSH between delirium and no delirium group(all $p<0.05$), Logistics analyses indicated that ge≥75y(OR3.112,95%CI1.527~5.742), BMI ≥24 kg/m^2(OR2.127,95%CI1.144~3.598), history of delirium(OR1.754,95%CI1.173~2.347), estimated blood loss≥400ml(OR1.698,95%CI1.427~1.946), duration of surgery≥120min(OR2.138,95%CI1.126~3.085), preoperative albumin≤40g/L(OR1.845,95%CI1.102~2.835) and TSH≤2mU/L(OR2.226, 95%CI1.329~4.011) were the independent risk factors of postoperative delirium in patients with hip fracture(all $p<0.05$).

Conclusions: Postoperative delirium is very common in elderly patients with hip fracture, and it was associated with many risk factors, clinical preventions targeted on those risk factors are needed to reduce the postoperative delirium.

Background

With the aging of the population, the incidence of hip fractures is increasing year by year[1]. It is reported that the incidence of hip fractures is 11.1% in men and 22.7% in women[2, 3]. Almost half of hip fractures occur in patients 70 years of age or older, and it is estimated that 18–28% of elderly hip fracture patients die within a year[4]. Hip fractures in the elderly seriously affect their quality of life and bring about a lasting decline in physical fitness, which leads to an increase in the morbidity and mortality[5]. Postoperative delirium is the most common type of complication after hip fracture[6, 7]. Delirium is an acute mental disorder, which is often manifested as a decrease in concentration, sustained ability, and easy to be interfered with[8]. During the illness, there are fluctuations in the condition every day, usually manifested as daytime sleepiness and night irritability. Studies[9, 10] have reported that patients with delirium hip fractures during hospitalization have a worse prognosis than those without delirium. Delirium during the perioperative period will seriously affect the patient's treatment effect, increase the mortality rate or the need for home care after discharge, increase the number of hospitalization days, costs, and hospital-acquired complications[11, 12] .

In clinical practice, it is often due to the lack of knowledge of medical staff and the complexity and change of symptoms, which is about 32. 46% of delirium is often undetected or not treated, which will bring more serious consequences to the patient[13]. 30-40% of perioperative delirium can be prevented, and effective prevention of delirium can minimize its occurrence and related adverse consequences[14, 15]. Therefore, we aimed to analyze the characteristics and related influencing factors of postoperative delirium in patients with hip fractures, to provide evidence support for the treatment of clinical hip fractures and the prevention of postoperative delirium.

Methods

Ethics

In this study, all methods were performed in accordance with the relevant guidelines and regulations. Our study had been verified and approved by the ethical committee of Hainan Hospital of Chinese Medicine affiliated to Guangzhou University of Chinese Medicine (approval number:190084). For patients with delirium, the written informed consent from guardians for such patients were obtained. And for the patients without delirium, written informed consents were obtained from patients.

Patients

Elderly patients who underwent hip fracture surgery in our hospital from June 1, 2019 to May 31, 2021were selected as the research patients. The inclusion criteria for patients in this study were: age ≥ 60 years; the hip fracture met the diagnostic criteria for hip fractures; patient underwent elective surgery in our hospital; all patients and their families had been informed and signed an informed consent form; clinical data was complete. Exclusion criteria: patients with a history of brain surgery; patients with hearing impairment; patients with malignant tumors; patients taking sedatives or antidepressants; patients who were unwilling to participate in this study.

Diagnosis of delirium

According to the diagnostic criteria in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) of the American Psychiatric Association[16], the confusion assessment method (CAM) was used as a diagnostic tool for the diagnosis of delirium[17]. CAM includes 4 items: ①acute onset and fluctuating changes in mental state; ②inattention; ③thinking disorder; ④change of consciousness level.

Data collection

Two authors independently collected following clinical data: age, gender, body mass index(BMI), hypertension, diabetes mellitus, hyperlipidemia, history of delirium, type of fracture, postoperative ability of daily living(ADL) score, method of anesthesia, estimated blood loss and duration of surgery. Besides, all patients underwent preoperative laboratory examinations. We collected following indicators: albumin, hemoglobin, blood sugar, creatinine, urea nitrogen, triiodothyronine(T3), thyroxine (T4), serum thyroid stimulating hormone (TSH),

Free triiodothyronine (FT3), free thyroxine (FT4), arterial partial pressure of oxygen (PaO_2)

arterial partial pressure of carbon dioxide ($PaCO_2$).

Statistical method

We used SPSS 25. 0 Software to carries out statistical analysis of relevant data. Measurement data was expressed by mean ± standard deviation, measurement data between groups was expressed by independent sample t test, count data was expressed by number of cases and percentage, and count data were compared by Chi-square test. We used multivariate logistic regression to analyze the factors affecting postoperative delirium in elderly patients with hip fracture. In this study, P <0. 05 meant that the difference between the groups was statistically significant.

Results

The characteristics of included patients

A total of 245 patients with hip fracture were included in this study, and 32 patients had been diagnosed as delirium, the incidence of postoperative delirium in patients with hip fracture was 13.06%. As showed in Table 1, there were significant differences in the age, BMI, history of delirium, estimated blood loss and duration of surgery(all $p<0.05$). No significant differences in the gender, hypertension, diabetes mellitus, hyperlipidemia, type of fracture, postoperative ADL score and method of anesthesia had been found (all $p>0.05$).

Table 1
The characteristics of included patients

Items	Delirium group(n=32)	No delirium group(n=213)	t/χ^2	p
Age(y)	78.84±7.36	71.21±5.83	10.731	0.014
Male/female	12/20	84/129	1.926	0.085
BMI (kg/m^2)	25.32±3.56	21.20±2.98	1.142	0.026
Hypertension	21(62.63%)	110(51.64%)	1.165	0.101
Diabetes mellitus	13(40.63%)	78(36.62%)	1.224	0.094
Hyperlipidemia	14(43.75%)	82(38.50%)	1.707	0.089
History of delirium	17(5 3.13%)	19(8.92%)	1.113	0.021
Type of fracture			1.188	0.107
Femoral neck fracture	13(40.63%)	81(38.03%)		
Intertrochanteric fracture	18(56.25%)	129(60.56%)		
Subtrochanteric fracture	1(3.12%)	3(1.41%)		
Preoperative ADL score	95.42±7.18	94.95±9.84	22.107	0.073
Method of anesthesia			1.882	0.096
Lumbar anaesthesia	19(59.38%)	124(58.22%)		
General anaesthesia	13(40.63%)	89(41.78%)		
Estimated blood loss(ml)	455.07±62.85	369.12±58.23	38.467	0.002
Duration of surgery(min)	147.12±36.77	102.37±24.16	19.236	0.008

Preoperative laboratory examination results

As showed in Table 2, there were significant differences in the albumin and TSH between delirium and no delirium group(all $p<0.05$), no significant differences in the hemoglobin, blood sugar, creatinine, urea nitrogen, T3, T4, FT3, FT4, PaO_2 and $PaCO_2$ were found(all $p>0.05$).

Table 2
The preoperative laboratory examination results

Items	Delirium group(n=32)	No delirium group(n=213)	t/χ^2	p
Albumin(g/L)	38.05±6.22	44.96±5.34	7.116	0.025
Hemoglobin(g/L)	122.03±19.74	120.84±14.09	17.253	0.091
Blood sugar(mmol/L)	7.42±1.08	7.51±1.33	1.650	0.102
Creatinine(μmol/L)	76.95±8.31	75.32±8.84	6.041	0.087
Urea nitrogen(mmol/L)	7.73±1.02	7.24±1.27	1.636	0.099
T3(mU/L)	1.41±0.12	1.38±0.11	1.204	0.112
T4(mU/L)	95.03±12.54	96.23±14.04	8.345	0.063
TSH(mU/L)	1.62±0.22	2.74±0.52	1.224	0.022
FT3(mU/L)	3.13±0.97	3.30±0.83	1.137	0.059
FT4(mU/L)	16.84±4.03	16.59±5.18	3.284	0.064
PaO_2(mmHg)	84.36±12.65	86.89±15.11	9.705	0.131
$PaCO_2$(mmHg)	33.82±5.78	32.41±6.05	4.822	0.061

Logistic regression analyses

The variable assignment of multivariate logistic regression were presented in Table 3. As indicated in Table 4, Age≥75y(OR3.112,95%CI1.527~5.742), BMI ≥24 kg/m^2(OR2.127,95%CI1.144~3.598), history of delirium(OR1.754,95%CI1.173~2.347), estimated blood loss≥400ml(OR1.698,95%CI1.427~1.946), duration of surgery≥120min(OR2.138,95%CI1.126~3.085), preoperative albumin≤40g/L(OR1.845,95%CI1.102~2.835) and TSH≤2mU/L(OR2.226, 95%CI1.329~4.011) were the independent risk factors of postoperative delirium in patients with hip fracture(all $p<0.05$).

Table 3
The variable assignment of multivariate logistic regression

Factors	Variables	Assignment
Delirium	Y	Yes=1, no=2
Age(y)	X_1	≥75y=1, <75y=2
BMI(kg/m^2)	X_2	≥24=1, <24=2
History of delirium	X_3	Yes=1, no=2
Estimated blood loss(ml)	X_4	≥400=1, <400=2
Duration of surgery(min)	X_5	≥120=1, <120=2
Albumin(g/L)	X_6	≤40=1, >40=2
TSH(mU/L)	X_7	≤2=1, >2=2

Table 4
Logistic regression analysis on the risk factors of postoperative delirium in patients with hip fracture

Items	β	SE	OR	95%CI	p
Age≥75y	0.122	0.495	3.112	1.527~5.742	0.012
BMI ≥24 kg/m^2	0.217	0.356	2.127	1.144~3.598	0.029
History of delirium	0.143	0.518	1.754	1.173~2.347	0.042
Estimated blood loss≥400ml	0.257	0.522	1.698	1.427~1.946	0.013
Duration of surgery≥120min	0.187	0.236	2.138	1.126~3.085	0.046
Albumin≤40g/L	0.124	0.331	1.845	1.102~2.835	0.017
TSH≤2mU/L	0.114	0.642	2.226	1.329~4.011	0.009

Discussions

Postoperative delirium refers to the acute psychopathic syndrome with cognitive dysfunction and other related symptoms as the main manifestation after the patient undergoes surgery. The delirium patient has disturbances in consciousness, perception, thinking, mood, memory, attention, and sleep cycle[18]. Postoperative delirium has a high morbidity and related mortality in elderly patients[19]. According to reports[20, 21], the incidence of delirium after hip fracture in the elderly ranges from 5.15–48.37%, which may be related to the differences of diagnostic criteria of delirium. Previous study[22] has analyzed 232 cases of elderly patients with hip fracture and has found that delirium occurred in 30.2% of patients, and

the survival rate of this part of patients 40 months after surgery was 63.6%, which was much lower than the normal patient's survival rate of 81.0%. Besides, previous studies[23–25] have founded that patients with delirium have longer hospital stays, higher medical costs, and the incidence of dementia after discharge can be as high as 38%, and postoperative hip function and independent living ability of delirium patients are difficult to restore to the preoperative level, which seriously affects the prognosis of patients. Therefore, early prevention, detection and treatment of delirium have important clinical significance for improving the prognosis of patients with hip fracture. The results of our study have indicated that the incidence of postoperative delirium in patients with hip fracture is 13.06%, and age≥75y, BMI ≥24 kg/m^2, history of delirium, estimated blood loss≥400ml, duration of surgery≥120min, preoperative albumin≤40g/L and TSH≤2mU/L were the independent risk factors of postoperative delirium in patients with hip fracture, clinical measures targeted on those risk factors are needed to prevent the onset and development of postoperative delirium.

With the increase of age, the organs and tissues of elderly patients degenerate and their functions decline, and there are often many chronic underlying medical diseases such as the cardiovascular system, respiratory system, and endocrine system[26]. At the same time, they are also easy to merge due to decreased appetite and intake, and metabolic disorders, leading to malnutrition[27]. Studies[28, 29] have shown that elderly patients with hip fractures ≥73 years of age are 1.83 times more likely to develop delirium after surgery than those aged <73 years. At the same time, studies[30, 31] have shown that age is attributable to preoperative malnutrition in elderly patients with medullary fractures, and it is one of the main risk factors of delirium in elderly patients, which is consistent with the results of this study.

The duration of surgery is a risk factor for delirium after hip fracture surgery in the elderly. The reasons may be that the prolonged operation duration means prolonged anesthesia time and stress duration of surgical trauma[32]. However, the function of various organs in elderly hip patients has a certain degree of degradation, and then suffers a longer surgical trauma and stress level, the body is more likely to be decompensated, and the central system of norepinephrine-acetylcholine is more likely to be unbalanced, causing brain to be extremely excited, leading to the occurrence of delirium[33, 34]. In addition, the prolonged surgery duration for elderly patients with hip fractures also means increased surgical trauma and intraoperative blood loss, excessive blood loss has aggravated the hypoxia of brain cells, resulting in the occurrence of delirium[35]. Therefore, preoperative doctors should formulate individualized surgical plans according to the specific conditions of the patients, speed up the operation process, reduce intraoperative blood loss, shorten the operation time, and reduce the use of intraoperative anesthetics.

Hypoproteinemia is one of the manifestations of patients with malnutrition, so the patient's nutritional status has a certain correlation with the occurrence of postoperative delirium[36]. Studies[37, 38] have shown that the risk of postoperative delirium among elderly patients with hip fracture is 3 times that of those with normal nutrition and 2.5 times that of those with malnutrition. Some studies[39, 40] believe that the application of high-protein nutritional supplements before surgery can improve the clinical outcome of surgical patients. Therefore, the monitor and correction of albumin level is vital to the prognosis of patients with hip fracture surgery.

Hip fracture surgery is traumatic and usually takes a long time, thus the postoperative stress response is obvious. It disrupts the hypothalamus-pituitary-thyroid axis of the patient and affects thyroid function[41]. Thyroid hormone is an essential substance for maintaining the normal function of the central nervous system and is closely related to human mental activity[42]. Related studies[43, 44] have shown that the inflammatory response of the systemic system caused by postoperative stress can lead to delirium by increasing the permeability of the blood-brain barrier. Thyroid hormone can significantly affect the body's protein metabolism, has a diuretic effect and stimulating effect on the function of the adrenal cortex, and affects the function of the cardiovascular system, thereby affecting the blood flow of important organs such as the liver, kidney, and brain. As the number of brain cells in the elderly decreases year by year with age, the cerebral blood flow is also reduced, the metabolic level is significantly reduced, the central neurotransmitter is reduced, and the nerve conduction speed slows down, resulting in widespread brain dysfunction, coupled with the primary disease and surgical trauma, the combined effect of other influencing factors makes elderly patients become prone to postoperative delirium[45, 46].

This study has certain shortcomings. First of all, the sample size of the study included in this study is small, and the possibility of false positive results cannot be ruled out. Secondly, this study is a retrospective study design, the included research indicators are limited, and future prospective studies are needed to further analyze the related factors of postoperative delirium. Finally, there is a certain difference between the incidence of delirium in this study and previous related studies. The reason may be due to the different diagnostic criteria and postoperative follow-up time for delirium, the possibility of internal bias in the study cannot be ruled out. Therefore, future studies with larger samples size are needed to further elucidate the potential influencing factors of postoperative delirium.

Conclusions

In conclusion, we have found that postoperative delirium is very common is patients with hip fracture, and for patients with age≥75y, BMI ≥24 kg/m^2, history of delirium, estimated blood loss≥400ml, duration of surgery≥120min, preoperative albumin≤40g/L and TSH≤2mU/L, they may have higher risks for the development of postoperative delirium, early alert and preventions should be taken in advance to reduce the onset of postoperative delirium. Still, limited by sample size and study design, future studies with larger sample and rigorous design are highlighted to further ascertain the risk factors of postoperative delirium in patients with hip fracture, to provide reliable evidence to the management of hip fracture.

Abbreviations

DSM-V: Diagnostic and Statistical Manual of Mental Disorders

CAM: confusion assessment method

BMI: body mass index

ADL: ability of daily living

T3: triiodothyronine

T4: thyroxine

TSH: thyroid stimulating hormone

FT3: free triiodothyronine

FT4: free thyroxine

PaO_2:arterial partial pressure of oxygen

$PaCO_2$: arterial partial pressure of carbon dioxide

Declarations

Ethics approval and consent to participate

In this study, all methods were performed in accordance with the relevant guidelines and regulations. Our study had been verified and approved by the ethical committee of Hainan Hospital of Chinese Medicine affiliated to Guangzhou University of Chinese Medicine (approval number:190084). For patients with delirium, the written informed consent from guardians for such patients were obtained. And for the patients without delirium, written informed consents were obtained from patients.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Author contributions

C Y, M Y designed research; C Y, M Y, N N, L L, L P conducted research; C Y, M Y analyzed data; L P wrote the first draft of manuscript; C Y, L P had primary responsibility for final content. All authors read and

approved the final manuscript.

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