Original article

Prevalence of preoperative delirium and associated factors in elderly hip fracture patients at King Chulalongkorn Memorial Hospital

Warong Sitthisarunkul, Yanin Thipakorn, Paul Thisayakorn*

Department of Psychiatry, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

Background: Preoperative delirium in hip fracture is under-studied. Effective diagnosis, prevention, and management of preoperative delirium may be able to reduce the incidence of the postoperative complications.
Objective: To study the prevalence of preoperative delirium and its associated factors in elderly patients who underwent hip fracture surgery.
Methods: This is a cross-sectional study which collected the data from patients aged more than 65 years who underwent hip surgery at King Chulalongkorn Memorial Hospital. Preoperative cognitive status assessment was done by using the Thai Mental State Examination (TMSE) and The Confusion Assessment Method-Thai (CAM-T) on the day before surgery. The DSM-V criteria for delirium was used to confirm the diagnosis. Postoperative factors were assessed at bedside on day 2 after surgery and on discharge.
Results: There were 104 patients recruited in the study with a mean age of 81.3 years. In total, 24 patients developed preoperative delirium which equaled to 23.0%. Factors associated with preoperative delirium were cognitive impairment, Alzheimer's dementia, dyslipidemia, respiratory tract disease, history of previous delirium, a length of hospital stay before surgery of more than 48 hours and a TMSE score lower than 23. Preoperative delirium was associated with postoperative pulmonary complications and longer hospital stay.
Conclusion: The prevalence of preoperative delirium in hip fracture elderly patients was 23.0%. Many preoperative clinical factors and postoperative adverse outcomes were associated with preoperative delirium. Therefore, routine screening for delirium in elderly with hip fracture before the surgery may provide a benefit on the clinical outcome.

Keywords: Delirium, elderly, hip fracture.

Delirium is defined as an acute fluctuating change in behavior, alertness and attention.[1] Although the pathophysiology of delirium is unclear, recent scientific evidence support the theory that delirium is caused by multiple mechanisms. The neurotransmitters and neural circuits are believed to be deranged via oxidative stress, inflammation, hormonal dysregulation, neuronal aging and circadian dysregulation.[2] Patients with delirium have higher risk of clinical morbidity such as more medical complications, longer length of hospital stay [2], long-term cognitive impairment, as well as increased mortality.[3]

*Correspondence to: Paul Thisayakorn, Department of Psychiatry, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.
E-mail: paul.thi@chula.ac.th
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Hip fracture can cause delirium in up to 31.0% of patients [4], and the mortality was as high as 40.0% per year.[5] The current gold standard for hip fracture treatment is orthopedic surgery, as patients who undergo hip fracture surgery have 4 times lower mortality risk when compared with conservative treatment.[6] It is well established that common adverse consequences after a hip fracture surgery include postoperative delirium (as high as 28.0 – 50.0%)[7, 8], pneumonia, infection, myocardial infarction, increased length of hospital stay and mortality.[7] Important risk factors of postoperative delirium are increased age, dementia, and preoperative delirium.[9]

The research in preoperative delirium is lacking when compared to postoperative delirium. Inability to diagnose and manage preoperative delirium may contribute to a higher risk of postoperative morbidity and mortality. Interestingly, previous research has found different risk factors between preoperative and postoperative delirium.[10]

Effective diagnosis, prevention, and management of preoperative delirium may be able to reduce the incidence of the postoperative delirium and other postoperative complications. Therefore, we aimed to investigate the prevalence of preoperative delirium and its associated factors in the elderly patients with hip fracture undergoing an orthopedic surgery at King Chulalongkorn Memorial Hospital (KCMH).

Materials and methods

This is a cross-sectional descriptive study which aimed to explore the prevalence of preoperative delirium in the elderly patients with hip fracture who underwent surgery at KCMH. The inclusion criteria were as follows: 1) patients aged at least 65 years old who had hip fracture and underwent surgery at KCMH; and, 2) patients who can communicate in Thai. Exclusion criteria were as follows: 1) patients who could not communicate effectively due to severe sensory impairment or medical conditions; 2) hip fracture caused by high velocity accidents; and, 3) patients who had concurrent neurosurgical injury such as intracranial hemorrhage.

The study has been approved by the Research Ethics Review Committee for Research Involving Human Subjects the Faculty of Medicine, Chulalongkorn University. Data were collected from October 2020 to April 2021.

Initial data collection included demographic data, baseline clinical conditions, and risk factors for delirium. To clarify, we collected age, gender, body mass index (BMI), hearing impairment such as current hearing aids use or history of presbycusis, visual impairment such as current use of glasses or history of visual, loss, underlying diseases, cognitive impairment and history of delirium-inducing drugs. This part of data was obtained from medical records and interview of the patient and caretaker.

Preoperative cognitive status assessment was done by using the Thai Mental State Examination (TMSE). TMSE is a brief validated cognitive screening instrument with a total score of 30 points. The patients who scored below 23 were defined as having cognitive impairment. As delirium can be a confounding factor of assessing a valid baseline cognitive status, we also reviewed information from the medical record and family interview to determine baseline cognitive impairment.

Delirium was screened by the Confusion Assessment Method-Thai version (CAM-T), which was translated and validated by Wongpakaran N, *et al*. in 2011. It demonstrated 91.9% sensitivity and 100.0% specificity. [11] TMSE and CAM-T assessments were performed in the evening before the surgery. A diagnosis of delirium was confirmed by a psychiatric interview according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V).[12] Postoperative complications were assessed at bedside on day 2 after the surgical date and on the discharge date, as well as the final clinical data from the medical record after discharge. Postoperative data included Intensive Care Unit (ICU) length of stay, blood loss, duration of admission and postoperative complications.

Statistical analysis

SPSS version 22.0 was used for the statistical analysis. Demographic data of the subjects were analyzed using descriptive statistics. Data were presented as number and percentage, mean and standard deviation (SD), or median and interquartile range (IQR) as appropriate. Categorical data were compared using Chi-square test or Fisher's exact test. Continuous data were compared by unpaired *t* - test or Mann-Whitney U test. Risk factors of preoperative delirium and consequences from preoperative delirium were analyzed using logistic regression to calculate the odds ratio. Statistical significance was set at *P* - value less than 0.05.

Results

A total of 104 elderly patients who underwent hip fracture surgery at King Chulalongkorn Memorial Hospital from October 2020 to April 2021 consented to participate in this study. The majority of the subjects were female with their mean age of 81.3 years and mean BMI of 21.7 kg/m^2. Most patients (81.7%) had one or more underlying diseases. Other baseline demographic and clinical data are demonstrated in Table 1.

A total of 24 out of 104 patients (23.0%) developed delirium before the surgery. The most common subtype of delirium was hyperactive delirium, which accounted for 75.0% of the total delirium cases. This was followed by mixed and hypoactive delirium subtypes which accounted for 16.7% and 8.3% respectively.

The results revealed that cognitive impairment, Alzheimer's dementia, dyslipidemia, respiratory tract diseases, a previous history of delirium, a length of hospital stay before surgery more than 48 hours, and having a TMSE score lower than 23 were found to be significantly associated with increased delirium risk (Table 1).

After the surgery, we found that length of ICU stay, blood loss, durations of admission, and postoperative medical complications (pneumonia and cardiovascular complications) were correlated with preoperative delirium (Table 2).

Using logistic regression, only visual impairment and history of cognitive impairment were found to be significantly associated with preoperative delirium. The adjusted odds ratio of visual impairment was 5.383 (P = 0.041), and of history of cognitive impairment was 10.262 (P = 0.005) (Table 3). Preoperative delirium was found to be associated with all postoperative complications with an adjusted odd ratio of 4.001 (P = 0.023) (Table 4).

Table 1. Demographic and clinical data comparing between patients with and without delirium before hip fracture surgery.

Factors	Total		Non delirium		Delirium		*P*-value
	n = 104		n = 80		n = 24		
	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD	
Age (years)	81.3	± 7.9	80.5	± 7.7	83.8	± 8.4	0.730
Gender							0.698
Male	23	22.1	17	21.3	6	25.0	
Female	81	77.9	63	78.7	18	75.0	
Body mass index (kg/m^2)	21.7	± 3.7	21.8	± 3.7	21.0	± 3.6	0.407
Visual impairment	17	16.3	10	12.5	7	29.1	0.065
Auditory impairment	13	12.5	9	11.3	4	16.7	0.491
Underlying disease	85	81.7	65	81.3	20	83.0	0.065
Hypertension	64	61.5	49	61.3	15	62.5	0.912
Dyslipidemia	38	36.5	25	31.3	13	54.2	0.041*
Diabetes	29	27.0	23	28.8	6	25.0	0.719
Chronic kidney disease	21	20.2	14	17.5	7	29.2	0.249
Neurological disorders	19	18.3	12	15	7	29.2	0.136
Cardiovascular	16	15.3	12	15	4	16.7	1.000
Respiratory	4	3.8	1	1.3	3	12.5	0.038*
Baseline cognitive impairment	39	37.5	23	28.8	16	66.7	0.001*
Mild cognitive impairment	17	16.3	12	15	5	20.8	0.534
Alzheimer	7	6.7	3	3.8	4	16.7	0.048*
Vascular dementia	2	1.9	0	0	2	8.3	0.052
Parkinson disease	2	1.9	1	1.3	1	4.2	0.410
Others dementia	12	11.5	7	8.8	5	20.8	0.142
History of previous delirium	7	6.7	2	2.5	5	20.8	0.007*
History of Psychiatric disorders	10	9.6	7	8.8	3	12.5	0.693
Depression	6	5.7	4	5.0	2	8.3	0.620
Anxiety	3	2.8	2	2.5	1	4.2	0.549
Insomnia	2	1.9	2	2.5	0	0	1.000
Prior use of delirium inducing medications	61	58.7	45	56.3	16	66.7	0.363
Sedative-hypnotics	34	32.7	27	33.8	7	29.2	0.675
Analgesics-narcotics	33	31.7	25	31.3	8	33.3	0.847
Anticholinergic	14	13.4	10	12.5	4	16.7	0.733
Antihistamine	10	9.6	8	10	2	8.3	1.000
Antidepressant	9	8.6	7	8.8	2	8.3	1.000
Anticonvulsant	7	6.7	4	5.0	3	12.5	0.348
Length of hospital stay before surgery > 48 hours	45	43.3	29	36.3	16	66.7	0.009*
Pain scores							
Mild	47	45.2	34	42.5	13	54.1	0.324
Moderate	34	32.7	29	36.3	5	20.8	
Severe	18	17.3	15	18.8	3	12.5	
Thai mental state examination 1 day before surgery							
< 23	47	45	24	30	23	95	< 0.001*
Mean score	21.2	± 7.0	24.0	± 3.8	11.8	± 6.8	< 0.001*

*Statistically significant ($P < 0.05$)

Table 2. Postoperative conditions.

Postoperative conditions	Total		Non delirium		Delirium		*P* - value
	n or median	% or IQR	n or median	% or IQR	n or median	% or IQR	
ICU length of stay (hours)	15	17	15	15.5	16	3.5	0.001*[a]
Blood loss (ml)	200	300	200	200	325	300	< 0.001*[a]
Duration of admission (days)	9	5	8	5	12.5	8	< 0.001*[a]
Postoperative complications	32	30.0	18	22.5	14	58.0	0.001*
Anemia	9	8.6	6	7.5	3	12.5	0.439
Cardiovascular system	8	7.6	3	3.8	5	20.9	0.017*
Pneumonia	6	5.7	2	2.5	4	16.7	0.027*
Electrolyte imbalance	6	5.7	3	3.8	3	12.5	0.143
Urinary retention	5	4.8	3	3.8	2	8.3	0.334
Shock	4	3.8	3	3.8	1	4.2	1.000

a : Mann - Whitney u test; *Statistically significant ($P < 0.05$)

Table 3. Logistic regression testing the association of risk factors with preoperative delirium.

Factors	Adjusted Odds ratio	95 % Confidence interval		*P* - value
		Lower	Upper	
Age	1.003	0.909	1.107	0.950
Gender (female)	0.291	0.049	1.721	0.174
Body mass index	0.669	0.081	5.516	0.709
Visual impairment	5.383	1.073	27.002	0.041*
Hearing impairment	0.776	0.116	5.169	0.793
Presence of underlying disorders	0.612	0.093	4.015	0.609
History of cognitive impairment	10.262	2.048	51.409	0.005*
History of previous delirium	7.124	0.458	110.687	0.161
History of psychiatric disorders	1.116	0.100	12.415	0.929
Prior use of delirium inducing medications	1.718	0.428	6.899	0.445
Length of hospital stay before surgery > 48 hours	3.312	0.830	13.213	0.090
Pain score (Moderate severity[b])	1.457	0.211	10.078	0.703
Pain score (High severity[c])	0.615	0.074	5.117	0.653

a. Variable (s) entered on step 1: age, gender, BMI, visual impairment, hearing impairment, presence of underlying disorders, dementia, history of previous delirium, history of psychiatric disorders, drugs, length of hospital stay before surgery > 48 hours, pain score
b. Moderate severity define as pain score 4 - 7 from Numeric pain rating scale.
c. High severity define as pain score 8 - 10 from Numeric pain rating scale.
*Statistically significant ($P < 0.05$)

Table 4. Logistic regression testing the associated of risk factors with postoperative complications.

Factors	Adjusted Odds ratio	%95 Confidence interval		*P* - value
		Lower	Upper	
Age	1.023	0.958	1.093	0.493
Body mass index	4.107	0.767	21.982	0.099
History of cognitive impairment	2.240	0.753	6.660	0.147
Prior use of delirium inducing medications	1.316	0.472	3.672	0.600
Presence of uUnderlying disorders	1.904	0.195	1.642	0.393
Length of hospital staybefore surgery > 48 hours	0.567	0.195	1.642	0.295
Preoperative delirium	4.001	1.215	13.242	0.023*

Variable (s) entered on step 1: age, body mass index, presence of underlying disorders, history of cognitive impairment, medicationsPrior use of medication- related cause of delirium, length of hospital stay before surgery > 48 hours, preoperative delirium.
*Statistically significant ($P < 0.05$)

Discussion

In this study the most common subtype of delirium was hyperactive delirium. Many factors were found to be associated with preoperative delirium, including visual impairment, previous delirium history, baseline cognitive impairment, underlying dyslipidemia and respiratory disease and a wait time from admission to surgery longer than 48 hours. Preoperative delirium was associated with postoperative complications, including longer ICU stay, increased blood loss, extended duration of admission, and increased postoperative medical complications, particularly cardiovascular and respiratory tract conditions.

The preoperative delirium prevalence of this study was lower when compared with the study of Freter S, *et al*. in 2016 which reported a rate as high as 57.6%.[13] The younger mean age and lower rate of deliriogenic medications use in our study might explain why the prevalence in our study was lower. The rate of preoperative delirium in this study was closer to the 29.7% of the incidence reported by the study of Edlund A, *et al*. in 2001. The slight higher rate of Edlund's study may be explained by the higher rate of visual impairment and higher previous history of delirium.[14] A prior study in Thai patients in 2015 which aimed to assess the overall delirium incidence in hip fracture population found that preoperative delirium was present in 22.5% of patients (18 out of 80). This number was quite similar to the finding of our study.

By using the Chi-square test, underlying dyslipidemia, respiratory tract disease, cognitive impairment, Alzheimer's dementia, history of previous delirium, and a wait time before surgery of more than 48 hours were the preoperative factors which demonstrated statistical differences between the non-delirium and delirium group. However, only visual impairment and cognitive impairment were shown to be statistically associated with preoperative delirium when using logistic regression analysis. According to a retrospective study of Adunsky S, *et al*. in 2003, pre-fracture dementia and low Mini-Mental State Exam (MMSE) score were found to increase the risk of preoperative delirium.[4] Similar to previous studies, the waitng time to surgery, number of comorbidities, cognitive impairment, as well as preoperative opioid and lorazepam use were related to preoperative delirium.[10, 13] It was noted that the association of vascular dementia and hearing impairment of the patients with preoperative delirium in our cohort nearly reached statistical significance.

As for the association between preoperative delirium and post-hip fracture surgery outcomes, previous studies have reported that preoperative delirium was correlated with increased risk of postoperative delirium, pulmonary complications, and extended hospital stay.[4, 9] Unfortunately, our study did not collect postoperative delirium data, but our results did confirm other associations between preoperative delirium and post-surgical pulmonary complications, as well as longer hospital stay. Moreover, we found that preoperative delirium also was linked to more intraoperative blood loss, longer ICU stay, and cardiovascular complications.

Interestingly, increased pre and postoperative delirium were both associated with the increased intraoperative blood loss Increased operative blood loss in pre-operative delirium group of this study is in concordance with the previous report of our group which also showed more blood loss in post-operative delirium group.[15] The low platelet number and low mean platelet volume possibly fromin association with the immune-inflammatory disturbance during the delirious state may hypothetically explain this finding.[16] For preoperative cardiovascular complications, delirium can potentially activate the sympathetic nervous system and cause oxidative stress, which, together within addition towith the blood loss, postoperative pain and other physical derangements,. All of these contributory factors can trigger the can be all contributory factors that triggered cardiovascular complications during the hospital stay.[1, 17]

Some hip fracture cases that met the inclusion criteria were not collected due to the time constraints and miscommunication between the Department of Orthopedic Surgery and the Department of Psychiatry. This possibly led to a lower preoperative delirium incidence. Another limitation of this study was its small sample size. While our study had adequate power to study the prevalence of delirium in patients with hip fracture, the sample size might not have been large enough to study the association between all possible risk factors, which might explain why the association of some of the risk factors did not reach statistical significance. Also, our duration of follow-up after surgery was short and did not include any assessments after discharge from the hospital; therefore, we had limited opportunity to assess for longer term complications of preoperative delirium in elderly patients with hip fracture.

Conclusion

The prevalence of preoperative delirium in elderly patients who underwent hip fracture surgery was 23.0%. Visual impairment and history of cognitive impairment were associated with preoperative delirium. Furthermore, preoperative delirium might lead to many adverse postoperative outcomes. Therefore, increase in awareness of preoperative delirium in elderly patients undergoing hip fracture surgery, surveillance of risk factors in conjunction with early diagnosis and prompt management of delirium before surgery may provide an additional clinical benefit on the clinical outcomes in this population.

Conflict of interest statement

Each of the authors has completed an ICMJE disclosure form. None of the authors declare any potential or actual relationship, activity, or interest related to the content of this article.

Data sharing statement

The present review is based on the reference cited. Further details, opinions, and interpretation are available from the corresponding authors on reasonable request.

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