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Original article

Incidence of delirium in hip fracture surgery at King Chulalongkorn Memorial Hospital

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Background: Postoperative delirium in hip fracture patients is a significant public health problem that affects the quality of patients' lives and increases morbidity and mortality rate.

Objective: To investigate the incidence of delirium and associated factors in elderly patients who underwent hip fracture surgery.

Methods: This is a cross-sectional descriptive study. Data were collected from the patients aged ≥ 65 years who underwent hip fracture surgery at King Chulalongkorn Memorial Hospital. The Thai Mental State Examination (TMSE) was used to investigate cognitive function preoperatively and on the 4th postoperative day. Postoperative delirium was assessed for 4 consecutive days using the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for delirium was used to confirm the diagnosis.

Results: There were 128 subjects recruited in the study; 92 women (71.9%), and 36 men (28.1%). Their mean age was 77.8 years. The study revealed that 21 patients (16.4%) developed postoperative delirium. Factors associated with delirium after hip fracture surgery were age, previous history of delirium, preoperative TMSE score ≤ 23 , and delayed surgery exceeding 48 hours after admission.

Conclusion: The incidence of postoperative delirium in elderly patients underwent hip fracture surgery at King Chulalongkorn Memorial Hospital was 16.4%. Age, previous history of delirium, low TMSE scores, and delayed surgery were associated with postoperative delirium.

Keywords: Delirium, elderly, hip fracture.

Today the number of older persons is increasing. In 2015, the elderly population in Thailand accounted for 14.6% of the entire population.⁽¹⁾ Most older persons have underlying health conditions caused by physical deterioration, making them at risk for falls and hip fractures. Hip fractures worldwide are estimated to increase from 1.66 million in 1990 to 2.6 million by 2025, and 4.5 million by 2050.⁽²⁾

In 2013, Wongtriratanachai P, *et al.* studied the incidence of hip fracture of patients 50 years and older in Chiang Mai province during 2006–2007 and found that there were 23,426 patients with hip fracture in 2006, which was expected to rise to 34,246 and 56,442 by 2025 and 2050 respectively.⁽³⁾ The main and the most effective treatment is surgery. However, surgery in older patients has a higher risk of complications

than surgery in the general population due to physiologic changes and underlying diseases. One of the most frequent and underdiagnosed complications is postoperative delirium.

The incidence of postoperative delirium in elderly patients with hip fracture ranges from 9.5% to 61.0%. It is a neuropsychiatric disorder caused by systemic disturbance that affects normal functioning of the nervous system.^(4,5) Risk factors associated with postoperative delirium include old age, dementia, severity of physical illness, hearing impairment or vision impairment, abnormal laboratory results, and certain medications.^(6,7) Delirium in the elderly has short-term and long-term effects.⁽⁸⁾ Namely, it increases postoperative mortality rate, decreases independent functioning, increases length of hospital stay⁽⁴⁾, increases medical expenses, and may cause deterioration in cognitive function for at least 1 year.⁽⁹⁾ A diagnosis of delirium in hospitals is frequently overlooked, delaying proper management. It is found that delirium is not diagnosed by the primary physician at a rate of 60.0%⁽¹⁰⁾

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As for consequences of acute postoperative delirium in hip fracture, it is found that patients suffering from delirium have higher mortality.^(11, 12) Effective prevention can reduce incidence of severe symptoms, length of symptoms leading to good treatment outcomes.^(6, 8) The objectives of this study were to investigate the incidence of postoperative delirium in patients with hip fracture undergoing surgery at King Chulalongkorn Memorial Hospital to study risk factors of postoperative delirium.

Materials and methods

This cross-sectional descriptive study aimed to explore the incidence of postoperative delirium in patients with hip fracture who underwent surgery at King Chulalongkorn Memorial Hospital. Inclusion criteria were patients older than 65 years diagnosed with hip fracture who underwent surgery at King Chulalongkorn Memorial Hospital and were able to understand and communicate in Thai. Exclusion criteria were: intubated patients, or other conditions interfering with communication, patients with urgent medical complications, preoperative delirium, dementia, profound visual impairment, profound hearing loss, pathological bone fractures, high energy fractures, and patients with multiple injuries. The study has been approved by the Research Ethics Review Committee for Research Involving Human Subjects of the Faculty of Medicine, Chulalongkorn University. Data were collected from 1 September 2019 to 31 August 2020. Initial data collection included demographic data, clinical data, risk factors for delirium, current patient condition and current treatment as reviewed from medical records in conjunction with patient interview and assessment within the first 24 hours of hospital admission. The Thai Mental State Examination (TMSE) was used to assess baseline cognitive level before the surgery and on the 4th postoperative day. Delirium was assessed for 4 consecutive days after the surgery using the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). A diagnosis of delirium was confirmed by a psychiatrist interviewed the subject according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).

Data collection tools included as follows :

- 1) Research questionnaires for the investigator to collect demographic and clinical data; gender, age, weight, height, marital status, physical illnesses, past medical history, and clinical data during the hospitalization
- 2) The TMSE was used to assess cognitive function. It is commonly used for dementia screening in Thailand. The cutoff point score for cognitive impairment is ≤ 23.0 ⁽¹³⁾
- 3) The CAM-ICU was selected for delirium screening for its good accuracy and ease of use. Also, the CAM-ICU is available in Thai, as translated by Mueankwan S. The sensitivity of the Thai CAM-ICU's algorithms was 92.3% (95% CI = 64.0 – 99.8%), while their specificity was 94.7% (95% CI = 85.4 – 98.9%).⁽¹⁴⁾

Statistical analysis

Demographic data of the participants were analyzed using descriptive statistics. Inferential statistics were used to analyze data related to risk factors of delirium. Data were express as mean \pm standard deviation (SD). Proportions of categorical data were compared using Chi-square test or Fisher's exact test. With regard to continuous data, the mean of variables was compared using unpaired *t* - test or Mann-Whitney U test. Risk factors were analyzed with univariate logistic regression to calculate the odds ratio of individual risk factors. Statistical significance level was set at $P < 0.05$. SPSS version 23.0 was used for all statistical analyses.

Results

There were 128 elderly patients who underwent hip fracture surgery at King Chulalongkorn Memorial Hospital and agreed to participate in this study. Their ages ranged from 65 – 103 years and the mean age was 77.8 years. The subjects consisted of 92 women (71.9%), and 36 men (Table 1). There were 21 patients (16.4%) who developed postoperative delirium. The most frequent day of delirium onset was on the 2nd postoperative day, accounting for 52.4% of total delirium cases (Table 2).

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

	Total (n = 128)		Delirium (n = 21)		No delirium (n = 107)		P - value
	N	Percentage	N	Percentage	N	Percentage	
Gender							0.562
Male	36	28.1	7	33.3	29	27.1	
Female	92	71.9	14	66.7	78	72.9	
Age (years)							
65 -69	25	19.5	1	4.8	24	22.4	
70-79	56	43.8	8	38.1	48	44.9	
80-89	37	28.9	10	47.6	27	25.2	
≥90	10	7.8	2	9.5	8	7.5	
Mean ± SD	77.8 ± 7.9		82.2 ± 7.1		76.9 ± 7.8		0.004*
Address							0.588
Bangkok and its vicinity	122	95.3	21	100	101	94.4	
Other regions	6	4.7	0	0.0	6	5.6	
Years of education (Mean ± SD)	6.4 ± 3.7		6.6 ± 4.1		6.3 ± 3.7		0.644
Marital status							0.005*
Single	18	14.1	5	23.8	13	12.1	
Divorced	5	3.9	3	14.3	2	1.9	
Widow	54	42.2	10	47.6	44	41.1	
Married	51	39.8	3	14.3	48	44.9	
Body mass index (kg/m²)							0.330
< 18.5	12	9.4	4	19.0	8	7.5	
18.5-22.9	90	70.3	12	57.1	78	72.9	
23-24.9	19	14.8	4	19.0	15	14.0	
25-29.9	5	3.9	1	4.8	4	3.7	
≥30	2	1.6	0	0.0	2	1.9	
Underlying diseases							
Diabetes	25	19.5	7	33.3	18	16.8	0.127
Hypertension	77	60.2	13	61.9	64	59.8	0.858
Dyslipidemia	65	50.8	14	66.7	51	47.7	0.111
Cardiovascular	26	20.3	6	28.6	20	18.7	0.373
Neurological disorders	26	20.3	11	52.4	15	14.0	< 0.001*

*Statistically significant values with $P < 0.05$.

Table 2. Number of patients diagnosed with new-onset delirium in each postoperative day.

Day of postoperative delirium onset	Frequency (%)
Day 1	6 (28.8)
Day 2	11 (52.4)
Day 3	2 (9.5)
Day 4	2 (9.5)

The study showed factors associated with postoperative delirium in elderly patients after hip fracture surgery. Concerning demographic data, age ($P = 0.004$) and marital status ($P = 0.005$) were significantly different between patients with and without postoperative delirium (Table 1). With regard to previous medication use, prior use of selective serotonin reuptake inhibitors (SSRIs) and other antidepressant agents (Ads) ($P = 0.039$), antipsychotics ($P < 0.001$), and sedative drugs ($P = 0.01$) were significantly associated with postoperative delirium (Table 3). Underlying diseases that were associated with postoperative delirium included psychiatric disorders ($P = 0.002$) and history of stroke ($P = 0.003$). Previous history of at least 1

inpatient treatment within the past year ($P = 0.010$) and history of delirium within the past year ($P < 0.001$) were also associated with postoperative delirium in the current admission. Other preoperative risk factors included patients' surgical wait time exceeding 48 hours ($P = 0.013$), and preoperative TMSE scores lower than 23 points ($P < 0.001$). Postoperative factors associated with delirium included longer length of hospital stay ($P < 0.001$), physical restraints ($P = 0.031$), postoperative infections ($P < 0.001$), postoperative use of sedatives ($P = 0.018$) or muscle relaxants ($P = 0.011$), and higher intraoperative blood loss ($P = 0.01$) were significantly associated with delirium (Table 4).

Table 3. Past medical history compared between the patients with and without postoperative delirium after undergoing hip fracture surgery.

	Total (n = 128)		Delirium (n = 21)		No delirium (n = 107)		P-value
	N	Percentage	n	Percentage	N	Percentage	
Prior medication use							
Tricyclic antidepressants	1	0.8	0	0.0	1	0.9	1.0
SSRIs and other Ads	13	10.2	5	23.8	8	7.5	0.039*
Antipsychotics	6	4.7	5	23.8%	1	0.9	<0.001*
BZD	22	17.2	8	38.1	14	13.1	0.01*
Tramadol	2	1.6	0	0.0	2	1.9	1.0
History of previous admission							
Never	89	96.5	8	38.1	81	75.7	0.001*
1 - 2 admissions	38	29.7	13	61.9	25	23.4	
3 - 4 admissions	1	0.8	0	0.0	1	0.9	
History of psychiatric disorders							
Yes	22	17.2	9	42.9	13	12.1	0.002*
No	106	82.8	12	57.1	94	87.9	
Depression	9	7.0	2	9.5	7	6.5	0.641
Anxiety	2	1.6	1	4.8	1	0.9	0.302
Insomnia	12	9.4	4	19.0	8	7.5	0.109
Psychosis/Bipolar	1	0.8	1	4.8	0	0.0	0.164
History of previous delirium							
Yes	18	14.1	12	57.1	6	5.6	<0.001*
No	110	85.9	9	42.9	101	94.4	
Type of neurological disorders							
MCI	6	4.7	2	9.5	4	3.7	0.255
Parkinson disease	10	7.8	3	14.3	7	6.5	0.211
Stroke	19	14.8	8	38.1	11	10.3	0.003*
TBI	2	1.6	0	0.0	2	1.9	1.0

*Statistically significant values with $P < 0.05$.

Ads = Anti-depressant drugs, BZD = Benzodiazepine, MCI = Mild cognitive impairment, SSRIs = Selective serotonin reuptake Inhibitor, TBI = Traumatic brain injury.

Table 4. Clinical data during the hospitalization.

	Total (n = 128)		Delirium (n = 21)		No delirium (n = 107)		P-value
	N	Percentage	N	Percentage	N	Percentage	
Length of hospital stay before surgery							0.013*
< 48 hours	90	70.3	10	47.6	80	74.8	
> 48 hours	38	29.7	11	52.4	27	25.2	
Length of hospital stay							<0.001*
≤ 14 days	107	83.6	10	47.6	97	90.7	
>14 days	21	16.4	11	52.4	10	9.3	
Mean ± SD	10.4±6.8		17.6±12.7		9.0±3.7		<0.001*
Type of operation							0.97
Bipolar hemi-arthroplasty	73	57.0	12	57.1	61	57.0	
CRIF with PFNA	37	28.9	7	33.3	30	28.0	
CRIF with multiple screw fixation	14	10.9	2	9.5	12	11.2	
CRIF with dynamic hip screw	3	2.3	0	0.0	3	2.8	
THA	1	0.8	0	0.0	1	0.9	
Physical restraints							0.031*
Yes	5	3.9	3	14.3	2	1.9	
No	123	96.1	18	85.7	105	98.1	
Complications							
Infections	17	13.3	9	42.9	8	7.5	<0.001*
Renal	12	9.4	5	23.8	7	6.5	0.027*
Cardiovascular	10	7.8	5	23.8	5	4.7	0.011*
Hematological	54	42.2	17	81.0	37	34.6	<0.001*
Postoperative medications							
Morphine	75	58.6	15	71.4	60	56.1	0.192
Fentanyl	42	32.8	7	33.3	35	32.7	0.956
Tramadol	93	72.7	16	76.2	77	72.0	0.691
Other sedatives	11	8.6	5	23.8	6	5.6	0.018*
Muscle relaxants	85	66.4	19	90.5	66	61.7	0.011*
Duration of operation (min)	96.4±17.5		89.5±19.3		97.8±16.9		0.154
Blood loss (ml)	179.5±87.9		242.5±94.9		167.2±81.3		0.001*
TMSE score							
TMSE pre-operation	24.2±4.2		21.0±4.5		24.9±3.8		<0.001*
TMSE post-operation	24.8±4.3		20.3±5.5		25.7±3.4		<0.001*

*Statistically significant values with $P < 0.05$.

CRIF = Closed reduction and internal fixation, PFNA = Proximal femoral nail antirotation, THA = Total hip arthroplasty, TMSE = Thai mental state examination

In the 37 patients with underlying neurological diseases (mild cognitive impairment, stroke, Parkinson's disease, traumatic brain injury), 13 patients (35.1%) developed postoperative delirium and had nearly 6 times increased risk for delirium compared with patients without neurological diseases (OR =

4.870, 95% CI 1.828 - 12.970, $P = 0.002$) (Table 5). It was also found that patients with TMSE scores lower than 23 points before surgery were at a higher risk for delirium than the group that had TMSE score higher than 23 points (OR = 5.926, 95% CI 2.165 - 16.217, $P = 0.001$) (Table 5).

Table 5. Logistic regression analysis of factors associated with delirium.

Factors	Odds ratio	95% confidence interval		P - value
Age (years)				
< 80	ref			
≥ 80	2.743	1.057	7.120	0.038 *
Marital status				
Married	ref			
Single, widowed, divorced	4.881	1.357	17.561	0.015 *
History of medical use				
SSRIs and other Ads	3.867	1.124	13.308	0.032 *
Antipsychotics	33.125	3.632	302.094	0.002 *
Benzodiazepine	4.088	1.438	11.620	0.008 *
History of previous admission				
Never	ref			
History of admission	5.062	1.890	13.561	0.001 *
History of psychiatric disorders	5.423	1.915	15.356	0.001 *
History of delirium	22.444	6.802	74.060	<0.001 *
History of neurological disorder	4.870	1.828	12.970	0.002 *
History of stroke	5.371	1.825	15.804	0.002 *
Length of hospital stay before operation				
< 48 hours	ref			
> 48 hours	3.259	1.247	8.521	0.016 *
Length of hospital stay (days)				
≤ 14 days	ref			
> 14 days	10.670	3.639	31.285	<0.001 *
Physical restraint (yes)	8.750	1.365	56.081	0.022 *
Complications				
Cardiovascular	6.375	1.658	24.517	0.007 *
Renal	4.464	1.262	15.788	0.02 *
Hematological	8.041	2.521	25.643	<0.001 *
Infections	9.281	3.013	28.592	<0.001 *
Blood loss (ml)				
≤ 200	ref			
> 200	7.500	2.664	21.116	<0.001 *
TMSE Pre-operation (score)				
≤ 23	5.926	2.165	16.217	0.001 *
> 23	ref			

*Statistically significant values with $P < 0.05$.

Ads = Anti-depressant drugs, SSRIs = Selective serotonin reuptake Inhibitor,

TMSE = Thai mental state examination

Discussion

This is the first study investigating the incidence of postoperative delirium after hip fracture surgery at King Chulalongkorn Memorial Hospital. Among 128 patients, 21 patients developed postoperative delirium leading to an incidence of 16.4%. Various factors were found to be associated with delirium including patients' age, marital status, neurological diseases, psychiatric disorders, use of antidepressants, antipsychotics, sedatives, history of inpatient treatment within the

past year, history of delirium within the past year, mild cognitive impairment, history of stroke, surgical wait time exceeding 48 hours, TMSE score lower than 23 points before surgery, total length of hospital stay, physical restraints, postoperative complications, use of sedatives and muscle relaxants after surgery, and intraoperative blood loss.

Compared to a previous study on incidence and risk factors of delirium in Siriraj Hospital in 2015⁽¹⁵⁾ among 80 people aged 60 years and older, it was found

that 36 patients developed delirium, accounting for 45.0%. In 18 of the 36 patients, delirium developed before surgery. The researchers assessed for delirium using CAM-ICU both before surgery, and repeated assessments for a total of 7 postoperative days. The incidence of delirium was higher than in our study, which may be explained by higher mean age (79.4 years), inclusion of preoperative delirium, and a longer follow-up period.

Patients with underlying neurological diseases, or evidence of cognitive impairment measured by having a TMSE score less than 23 have a 5-fold increased risk of delirium (Table 5). It can be inferred that patients with higher brain vulnerability have a higher risk of postoperative delirium. In concordance with previous studies^(16,17), factors related to postoperative delirium include old age, dementia, Parkinson's disease, stroke, and cognitive impairment.^(6,7)

This study also found that patients with history of psychiatric disorders will have a 5-fold higher risk compared to patients without psychiatric disorders (OR = 5.423, 95% CI 1.915 - 15.356, $P = 0.001$). It is consistent with a study conducted among patients with psychiatric disorders aged older than 65 years who were admitted to inpatient care and showed a prevalence of delirium ranging from 1.4% to 9.6%.^(18, 19) In addition to psychiatric disorders, psychoactive agents such as sedatives, anxiolytics, antidepressants, and antipsychotics are associated with postoperative delirium. Similarly, earlier studies indicated that the use of sedatives could increase postoperative delirium⁽¹⁷⁾ and the preoperative use of antipsychotics increased the risk of postoperative delirium by 2 - 7 times.^(20,21) The factors associated with postoperative delirium mentioned above are important information for planning delirium care^(10,22) in the future.

Based on this study, it was found that the group of patients with surgical delay for longer than 48 hours after admission had a higher rate of delirium compared to those who received surgery within 48 hours. The delayed surgery was possibly due to the need for stabilization of medical conditions such as arrhythmias, severe hypertension, or thrombotic disorders as well as the incoordination of care system and resource. Such factors may have indirectly led to delirium development. Additionally, the delirium patients had a tendency to stay hospitalized for longer than 14 days. We found that development of postoperative delirium was associated with increased odds of prolonged

hospitalization by 10 times. (Table 5) This prolonged hospitalization and delirium may also be associated with physical complications. Some prior studies reported preoperative and postoperative complications, including urinary tract infection, pneumonia, skin infection, and postoperative anemia that resulted in a hospital stay of more than 14 days.^(23, 24) All the aforementioned information supports a recommendation for surgery taking place within 48 hours for patients with hip fracture, which may decrease many complications, including postoperative delirium.^(25,26)

First, the number of the study population was small, making comparison of various factors not statistically significant. Secondly, the patients in this study were followed up for only 4 days after the surgery. Therefore, patients who developed delirium after the 4th day may not be included in the reported incidence. Lastly, we excluded patients with dementia and pre-operative delirious patients out from the study samples due to the limitation for study consent. However, these were patients who have high tendency to develop postoperative delirium which likely lowered the delirium incidence numbers of this study.

Conclusion

This study showed that the incidence of postoperative delirium in elderly patients who underwent hip fracture surgery was 16.4%. Many clinical factors are associated with postoperative delirium after hip fracture surgery. The increase in awareness of postoperative delirium in elderly patients undergoing hip fracture surgery, surveillance of risk factors in conjunction with diagnosis and prompt treatment of delirium are probably beneficial to treatment results as a whole.

Conflict of interest

The authors, hereby, declare no conflict of interest.

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