Original Article

Predictive Factor Analysis of Poor Outcomes after Early Hip Surgery in Osteoporotic Hip Fracture Patients

Kulachote N, MD[1], Chulsomlee K, MD[2], Sirisreetreerux N, MD[1], Orapin J, MD[1], Subhadrabandhu S, MD[1], Sa-ngasoongsong P, MD[1]

[1] Department of Orthopedics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[2] Chakri Naruebodindra Medical Institute, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Objective: To analyze the predictive factors related to the postoperative poor outcome within one year in the elderly patients sustained hip fracture (HF) and underwent early hip surgery (EHS) protocol.

Materials and Methods: A single-centered, retrospective study was conducted between 2010 and 2012 on elderly patients who sustained HF and underwent EHS within 72 hours. The perioperative data and outcome were reviewed using electronic database and telephone interview. "Poor outcome" was defined as composite outcome consisting of mortality and readmission related to HF during 1-year postoperative follow-up period. Multivariate logistic regression analysis was used to identify predictive factors related to the "poor outcome" at 3-month, 6-month, and 1-year postoperatively.

Results: A total of 82 HF patients were included. The average patients' age was 79 years (range 58 to 94 years). Sixty-four patients (75.6%) were female. The 1-year mortality was 11% (n = 9). The prevalence of poor outcome at 3-month, 6-month, and 1-year were 22.0%, 25.6%, and 31.7%, respectively. On multivariate analysis, hypoalbuminemia was significantly associated with the 3-month (odds ratio [OR] 0.78, 95% confidence interval [CI] 0.68 to 0.88, p=0.0001), 6-month (OR 0.88, 95% CI 0.78 to 0.99, p=0.04), and 1-year poor outcome (OR 0.89, 95% CI 0.79 to 0.99, p=0.03); whereas grade 4 of the American Society of Anesthesiologist (ASA) physical status was significantly associated with the 6-month (OR 6.37, 95% CI 1.52 to 26.73, p=0.01) and 1-year poor outcome (OR 5.11; 95% CI 1.50 to 17.46, p=0.01).

Conclusion: Preoperative hypoalbuminemia and grade 4 ASA status significantly correlated with the poor outcome after early hip fracture surgery.

Keywords: Elderly hip fracture, Early hip surgery, Predictive factor, Poor outcome

J Med Assoc Thai 2019;102(1):28-35
Website: http://www.jmatonline.com

Hip fracture (HF) is an important cause of disability and mortality among the geriatric patients. The 1-year mortality rate after HF was high as ranging from 14% to 36%[1-3]. While surgical management is the mainstay of HF treatment, most of these patients require a period of time for preoperative medical clearance due to their frailty and multiple comorbid diseases, and occasionally, resulting in delayed operation. Recent studies had been shown that delay HF surgery than 72 hours after admission would affect the postoperative outcome by significantly increasing 1-year mortality and postoperative complications, especially pneumonia and decubitus ulcer[4-6]. However, regarding to the clinical application of the early HF surgery; the 1-year mortality rate after this strategy was still high, as ranging between 9.9% to 18.8%[7-9], which could be implied that those frail elderly patients still had some significant risks that prone to develop postoperative morbidity and mortality such as: advanced age, male gender, poor general health status and nutritional status, pre-injury functional factors[10-15]. However, through the authors knowledge, the risk factors, which relate with the poor postoperative outcome after early HF surgery in elderly patients, still have not been explored. Therefore, the aim of the present study was to analyze predictive factors that correlate with the poor

Correspondence to:

Sa-ngasoongsong P.

Department of Orthopedics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Phone: +66-2-2011589, **Fax**: +66-2-2011599

Email: paphonortho@gmail.com

How to cite this article: Kulachote N, Chulsomlee K, Sirisreetreerux N, Orapin J, Subhadrabandhu S, Sa-ngasoongsong P. Predictive Factor Analysis of Poor Outcomes after Early Hip Surgery in Osteoporotic Hip Fracture Patients. J Med Assoc Thai 2019;102:28-35.

postoperative outcomes in the elderly HF patients who underwent the early surgical intervention.

Materials and Methods

Study design, participants, and inclusion and exclusion criteria

The present study was a single-centered retrospectively reviewed, and prior approval was obtained from the Institutional Board Review (Protocol number 06-54-22). The HF patients, during 1-year period (between January and December 2012), were all identified by using the hospital electronic records. The inclusion criteria were the patients who were: 1) aged over 55 years, 2) sustained low energy trauma, 3) diagnosed as HF, and 4) underwent early surgery within 72 hours. The exclusion criteria were patients who had: 1) pathological fracture other than osteoporotic HF (such as metastasis tumor or atypical femoral fracture), 2) multiple fractures, 3) non-operative treatment, and 4) bedridden status prior to fracture.

Data collection and outcome measurement

Demographic data in terms of age, gender, bone mass index (BMI), comorbidity disease, the American Society of Anesthesiologist (ASA) physical status[16], antithrombotic agent (antiplatelet or anticoagulant medication), fracture location and type, and pre-injury ambulatory status (either using gait aids or not) were recorded. The fractures location was classified into intracapsular and extracapsular fracture. The intracapsular fracture was defined as either of subcapital or midcervical femoral neck fracture. The extracapsular fracture was defined as a basicervical, intertrochanteric or subtrochanteric HF. Nondisplaced intracapsular fractures were treated with internal fixation as multiple screws fixation, while displaced intracapsular fractures were treated with bipolar hemiarthroplasty. Extracapsular fractures were treated with internal fixation as dynamic hip screw or proximal femoral nail.

The choice of anesthesia, as general or regional one, were all selected by the anesthesiologist.

The preoperative laboratory values, such as hemoglobin (Hb) level, glomerular filtration rate (GFR) and albumin level were collected. The perioperative data, such as, type of operation (either fracture fixation or arthroplasty), operative time, type of anesthesia (either general or regional anesthesia), intraoperative estimated blood loss, number of perioperative packed red cell (PRC) transfusion, length of hospital stay, major perioperative complications related to HF, and ambulatory status on the day of hospital discharge, were all recorded. Fracture fixation was used for nondisplaced femoral neck fracture and extracapsular fracture, whereas arthroplasty was used for displaced femoral neck fracture. The major perioperative complications were defined as: 1) cardiac complication which required inotropic drug and admitted into coronary care unit, 2) pulmonary complication which required ventilator support, 3) renal complication which required peritoneal or hemodialysis, 4) decubitus ulcer required surgical treatment, 5) infection which required intravenous antibiotic treatment, 6) symptomatic thromboembolic complication (acute stroke, symptomatic deep vein thrombosis (DVT) or symptomatic pulmonary embolism (PE), and 7) implant-related complication (intraoperative or postoperative peri-implant/peri-prosthetic fracture, failed or loosening implant). Poor outcome was defined as death or readmission due to HF related complication as mentioned above, and was collected at the 3-, 6-, and 12-months postoperative respectively. The postoperative data, such as: death, complications related to HF, and readmission were collected, by chart review and telephone interview.

Statistical analysis

Package of Social Sciences (SPSS) software version 18.0 was used to analyze the data. Normally distributed continuous data were presented as mean and standard deviation and compared with a Student t-test, while non-normally distributed continuous data were presented as median and interquartile range. Categorical data were presented as proportion of cases and compared with Fisher's exact test or Chi-square test as appropriate. Risk factors for poor outcome were compared between the patients with and without poor outcomes. Univariate logistic regression analysis was used to evaluate the association between risk factors and poor outcomes, and the predictive factors with values of $p<0.1$ were calculated by multivariate logistic regression analysis. Significance was defined as values of $p<0.05$.

Results

General characteristic data of study population

During 1-year study period, 88 elderly patients sustained HF injuries and underwent early surgery within 72 hours were included into the present study. Six patients were excluded due to pathological fracture (1 metastatic fracture, 4 atypical femur fracture, 1 non-operative treatment). Therefore, a total of 82 elderly HF patients were included into the present study. All

Table 1. General characteristics of 82 hip fracture patients

Characteristics	Value n (%)
Age (year), Median (IQR)	79 (74 to 84)
Gender	
Male	20 (24.4)
Female	62 (75.6)
Fracture location	
Intracapsular	34 (41.5)
Extracapsular	48 (58.5)
No. of significant comorbid disease	
0 to 1	43 (52.4)
≥2	39 (47.6)
ASA physical status	
2 or 3	43 (52.4)
4	39 (47.6)
History of antiplatelets or anticoagulants	32 (39.0)
Preinjury ambulatory level	
Without gait aid	48 (58.5)
With gait aid	34 (41.5)
Surgical treatment options	
Fracture fixation	51 (62.2)
Hemiarthroplasty	31 (37.8)
Length of hospital stay (day), Median (IQR)	7 (5 to 8)
In-hospital mortality	2 (2.4)
1-year mortality	9 (11.0)
1-year readmission	26 (31.7)

IQR=interquartile range; ASA=American Society of Anesthesiologists

patients were underwent hip surgery within 72 hours after hospitalized and completed 1-year follow-up period either in clinic or by telephone interview. The general characteristic data and risk factors for poor outcome during 1-year postoperative period were shown in Table 1 and 2. The average patients' age was 79 years (range 58 to 94 years), and sixty-two of them were female (75.6%). Thirty-three of them (41.5%) had femoral neck fracture, while 48 patients (58.5%) had extracapsular fracture (46 intertrochanteric fractures, and 2 subtrochanteric fractures). There were 9 (11.0%), 34 (41.5%), and 39 (47.6%) patients classified as ASA 2, 3, and 4, respectively. Thirty-two patients (39%) received antithrombotic agent before surgery (23 aspirin, 8 clopidogrel, and 1 warfarin). Fifty-one patients (62.2%) underwent internal fixation and 31 patients (37.8%) underwent hemiarthroplasty. At one-year postoperative period, 73 patients were still alive. Nine patients died within one year after operation (2 patient died in first admission, 7 patients died in readmission or at their residences). The one-year mortality was 11.0%. The causes of death were sepsis (6 cases), primary cancer (2 cases), and acute renal failure (1 case), respectively. There were 18 (22.0%), 21 (26.8%), and 26 (31.7%) patients who had poor outcomes within 3-month, 6-month, and one-year after surgery, respectively. The causes of readmission were respiratory tract or urinary tract infection (7 cases), bed sore (3 cases), fracture from recurrent fall (2 cases), acute stroke (2 cases), upper gastrointestinal bleeding (2 cases), DVT (2 cases, 1 case developed PE), and other complications (8 cases).

Risk factors for 3-month poor outcome

By univariate analysis, the predictive factors that were significantly associated with 3-month poor outcome were ASA grade 4, Hb, albumin, length of hospital stay, perioperative complication, and ambulatory status on the day of hospital discharge ($p<0.1$ all). However, multivariate regression analysis with excluding the ambulatory status on the day of hospital charge (MVAe) demonstrated that only albumin level was the significant independent predictor for 3-month poor outcome in elderly patients undergoing early HF surgery (odds ratio [OR] 0.78, 95% confidence interval [CI] 0.68 to 0.88, $p=0.0001$) (Table 3). The area under the curve (AUC) of this predictive model was 0.82 (95% CI 0.72 to 0.90).

Risk factors for 6-month poor outcome

The significant predictive factors for 6-month poor outcome from univariate analysis were ASA grade 4, the use of antithrombotic agents, Hb, albumin, use of PRC ≥2 units, length of hospital stay, perioperative complication, and ambulatory status on the day of hospital discharge ($p<0.1$ all). MVAe indicated that ASA grade 4 and albumin level were significant independent risk factors for 6-month poor outcome in these patients (ASA grade 4: OR 6.37, 95% CI 1.52 to 26.73, $p=0.01$; albumin level: OR 0.88, 95% CI 0.78 to 0.99, $p=0.04$) (Table 4). The AUC was 0.82 (95% CI 0.72 to 0.90).

Risk factors for 1-year poor outcome

Univariate analysis demonstrated that ASA grade 4, preinjury ambulatory status using gait aids, Hb, albumin, Use of PRC ≥2 units, length of hospital stay, perioperative complication, and ambulatory status on the day of hospital discharge were significantly associated with 1-year poor outcome ($p<0.1$ all). Nonetheless, multivariate analysis showed that

Table 2. Risk factors for poor outcomes during 1-year postoperative period

	3-month Poor outcome, n (%)			6-month Poor outcome, n (%)			1-year Poor outcome, n (%)		
	Positive (n = 18)	Negative (n = 64)	p-value	Positive (n = 21)	Negative (n = 61)	p-value	Positive (n = 26)	Negative (n = 56)	p-value
Age (year)@	79±8	79±8	0.83	79±7	80 (74 to 84)	0.59#	80±7	79±8	0.79
Sex: male	5 (27.8)	15 (23.4)	0.946	6 (28.6)	14 (23.0)	0.82	9 (34.6)	11 (19.6)	0.23
BMI (kg/m^2)@	21.3±3.5	21.7 (18.8 to 23.5)	0.750#	20.7±3.8	21.7 (19.2 to 23.6)	0.20#	21.1±3.6	21.7 (19.0 to 23.7)	0.60#
No. of comorbid diseases			0.97			0.79			0.54
0 to 1	1 (5.6)	6 (9.4)		1 (4.8)	6 (9.8)		1 (3.8)	6 (10.7)	
≥2	17 (94.4)	58 (90.6)		20 (95.2)	55 (90.2)		25 (96.2)	50 (89.3)	
ASA physical status			0.0015*			0.0001*			0.0001*
2 or 3	3 (16.7)	40 (62.5)		3 (14.3)	40 (65.6)		5 (19.2)	38 (67.9)	
4	15 (83.3)	24 (37.5)		18 (85.7)	21 (34.4)		21 (80.8)	18 (32.1)	
Extracapsular fracture	13 (72.2)	35 (54.7)	0.29	14 (66.7)	34 (55.7)	0.54	18 (69.2)	30 (53.6)	0.27
Use of antiplatelets and/or anticoagulants	5 (27.8)	27 (42.2)	0.40	5 (23.8)	27 (44.3)	0.16	10 (38.5)	22 (39.3)	0.86
Pre-injury ambulation status			0.03*			0.05*			0.07
Without walking aids	6 (33.3)	42 (65.6)		8 (38.1)	40 (65.6)		11 (42.3)	37 (66.1)	
With walking aids	12 (66.7)	22 (34.4)		13 (61.9)	21 (34.4)		15 (57.7)	19 (33.9)	
Preoperative laboratory values@									
Hb (g/dL)	10.4±1.8	11.3±1.8	0.06	10.5±2.0	11.4±1.8	0.050*	10.6±1.9	11.4±1.8	0.08
GFR (mL/minute/1.73 m^2)	42.1±14.8	47.1 (31.9 to 58.5)	0.38#	42.2±17.9	47.6 (32.4 to 58.2)	0.26#	42.1±17.0	47.1 (32.7 to 60.6)	0.21#
Albumin (g/dL)	29.0±5.4	36.2 (33.5 to 38.9)	<0.0001#*	30.2±5.9	36.1 (33.4 to 38.8)	<0.001#*	30.8±5.9	36.2 (33.6 to 38.8)	<0.001#*
Operation			0.21			0.45			0.25
Fracture fixation	14 (77.8)	37 (57.8)		15 (71.4)	36 (59.0)		19 (73.1)	32 (57.1)	
Arthroplasty	4 (22.2)	27 (42.2)		6 (28.6)	25 (41.0)		7 (26.9)	24 (42.9)	
Operative time (minute)@	148.6±38.3	142.5±42.1	0.58	147.7±38.0	142.6±42.5	0.65	146.3±36.2	142.7±43.5	0.71
General anesthesia	4 (22.2)	19 (29.7)	0.75	6 (28.6)	25 (41.0)	0.45	7 (26.9)	16 (28.6)	0.91
Estimated blood loss (mL)@	100 (50 to 250)	200 (50 to 300)	0.51#	100 (50 to 300)	200 (50 to 300)	0.68#	100 (50 to 300)	200 (75 to 300)	0.53#
PRC transfusion ≥2 units	8 (44.4)	17 (26.6)	0.24	10 (47.6)	15 (24.6)	0.09	12 (46.2)	13 (23.2)	0.07
Length of hospital stay (day)@	7.5 (6 to 14)	6 (5 to 8)	0.04#*	8 (6 to 14)	6 (5 to 8)	0.02#*	8 (6 to 14)	6 (5 to 8)	0.002#*
Perioperative complication	5 (27.8)	5 (7.8)	0.06	6 (28.6)	4 (6.6)	0.02*	7 (26.9)	3 (5.4)	0.02*
Ambulation on discharge	(n = 16)	(n = 64)	0.03*	(n = 19)	(n = 61)	0.05*	(n = 24)	(n = 56)	0.02*
With walking aid	5 (31.2)	42 (65.6)		7 (36.8)	40 (65.6)		9 (37.5)	15 (62.5)	
Wheelchair	11 (68.7)	22 (34.4)		12 (63.2)	21 (34.4)		38 (67.9)	41 (37.5)	

BMI=body mass index; ASA=American Society of Anesthesiologists; Hb=hemoglobin; GFR=glomerular filtration rate; PRC=packed red cell

@ Value presented as mean ± standard deviation (if having normal distribution), or median (interquartile range) (if having abnormal distribution)

p-value calculated from Mann-Whitney U test, * Significant difference with p<0.05

Table 3. Univariate and multivariate regression analysis for 3-month poor outcome

	UVA			MVA[e]		
	OR	95% CI	p-value	OR	95% CI	p-value
Age	0.99	0.93 to 1.06	0.83			
Male gender	1.26	0.39 to 4.10	0.71			
BMI	0.97	0.85 to 1.11	0.65			
Comorbid diseases ≥2	0.85	0.08 to 9.14	0.89			
ASA grade 4	6.44	1.59 to 26.13	0.01			
Extracapsular fracture	2.15	0.69 to 6.76	0.19			
Use of antiplatelets and/or anticoagulants	0.53	0.17 to 1.66	0.27			
Ambulant with walking aids	2.2	0.64 to 7.59	0.21			
Hb	0.74	0.54 to 1.01	0.06			
GFR	0.97	0.96 to 1.01	0.30			
Albumin	0.78	0.68 to 0.88	0.0001	0.78	0.68 to 0.88	0.0001
Operative time	1.00	0.99 to 1.02	0.58			
General anesthesia	0.68	0.20 to 2.32	0.54			
Estimated blood loss	1.00	1.00 to 1.00	0.50			
PRC transfusion ≥2 units	2.21	0.75 to 6.53	0.15			
Length of hospital stay	1.09	1.01 to 1.19	0.03			
Perioperative complication	4.54	1.14 to 17.99	0.03			
Ambulation on discharge	4.20	1.30 to 13.62	0.02			

UVA=univariate analysis; MVA=multivariate analysis; OR=odds ratio; CI=confidence interval; BMI=body mass index; ASA=American Society of Anesthesiologists; Hb=hemoglobin; GFR=glomerular filtration rate; PRC=packed red cell

[e] Multivariate analysis excluded factor "ambulation on discharge" due to the in-hospital mortality

Table 4. Univariate and multivariate analysis for 6-month poor outcome

	UVA			MVA[e]		
	OR	95% CI	p-value	OR	95% CI	p-value
Age	0.99	0.93 to 1.06	0.75			
Male gender	1.34	0.44 to 4.11	0.61			
BMI	0.91	0.78 to 1.05	0.18			
Comorbid diseases ≥2	1.22	0.11 to 13.84	0.87			
ASA grade 4	9.76	2.44 to 39.11	0.001	6.37	1.52 to 26.73	0.01
Extracapsular fracture	1.59	0.56 to 4.49	0.38			
Use of antiplatelets and/or anticoagulants	0.39	0.13 to 1.21	0.10			
Ambulant with walking aids	1.51	0.46 to 4.98	0.5			
Hb	0.75	0.56 to 1.01	0.05			
GFR	0.99	0.96 to 1.01	0.26			
Albumin	0.82	0.74 to 0.92	<0.001	0.88	0.78 to 0.99	0.04
Operative time	1.00	0.99 to 1.02	0.65			
General anesthesia	0.52	0.15 to 1.76	0.29			
Estimated blood loss	1.00	1.00 to 1.00	0.77			
PRC transfusion ≥2 units	2.79	0.99 to 7.86	0.05			
Length of hospital stay	1.09	1.00 to 1.18	0.04			
Perioperative complication	5.70	1.42 to 22.82	0.01			
Ambulation on discharge	3.27	1.12 to 9.53	0.03			

UVA=univariate analysis; MVA=multivariate analysis; OR=odds ratio; CI=confidence interval; BMI=body mass index; ASA=American Society of Anesthesiologists; Hb=hemoglobin; GFR=glomerular filtration rate; PRC=packed red cell

[e] Multivariate analysis excluded factor "ambulation on discharge" due to the in-hospital mortality

Table 5. Univariate and multivariate regression analysis for 1-year poor outcome

	UVA			MVA[e]		
	OR	95% CI	p-value	OR	95% CI	p-value
Age	1.01	0.95 to 1.07	0.79			
Male gender	2.17	0.76 to 6.14	0.15			
BMI	0.94	0.83 to 1.07	0.37			
Comorbid diseases ≥2	2.30	0.25 to 20.94	0.46			
ASA grade 4	8.87	2.88 to 27.31	<0.001	5.11	1.50 to 17.46	0.01
Extracapsular fracture	1.95	0.73 to 5.22	0.18			
Use of antiplatelets and/or anticoagulants	0.97	0.37 to 2.51	0.94			
Ambulant with walking aids	2.50	0.95 to 6.56	0.06			
Hb	0.78	0.60 to 1.03	0.08			
GFR	0.98	0.96 to 1.01	0.19			
Albumin	0.83	0.75 to 0.92	<0.001	0.89	0.79 to 0.99	0.03
Operative time	1.00	0.99 to 1.01	0.71			
General anesthesia	0.92	0.32 to 2.61	0.88			
Estimated blood loss	1.00	1.00 to 1.00	0.66			
PRC transfusion ≥2 units	2.84	1.05 to 7.63	0.04			
Length of hospital stay	1.15	1.03 to 1.28	0.01			
Perioperative complication	6.51	1.53 to 27.76	0.01			
Ambulation on discharge	3.52	1.30 to 9.55	0.01			

UVA=univariate analysis; MVA=multivariate analysis; OR=odds ratio; CI=confidence interval; BMI=body mass index; ASA=American Society of Anesthesiologists; Hb=hemoglobin; GFR=glomerular filtration rate; PRC=packed red cell

[e] Multivariate analysis excluded factor "ambulation on discharge" due to the in-hospital mortality

ASA grade 4 and albumin level were the significant independent risk factors for 1-year outcome after early HF surgery (ASA grade 4: OR 5.11, 95% CI 1.50 to 17.46, p=0.01; albumin level: OR 0.89, 95% CI 0.79 to 0.99, p=0.03) (Table 5). The AUC was 0.80 (95% CI 0.55 to 0.88).

Discussion

HF in elderly are difficult to manage and associated with high morbidity and mortality rate. Most patients are frail and afflicted with several comorbid diseases. The early HF surgery had been proven in its benefits for reducing the postoperative mortality and morbidity[4-6]. However, the morbidity and mortality among these patients were still high[7-9]. The present study aimed to identify the risk factors which associated with poor outcome of the patient underwent early HF surgery within 72 hours.

The result of the present study showed that 1-year mortality rate was 11.0% which was comparable with the previous studies[7-9]. The present study result showed the significant correlation of the pre-operative albumin level and the ASA physical status grade 4 with the poor outcome after early surgical treatment. The univariate analysis of pre-operative albumin level showed significant association with poor outcome at 3-month, 6-month, and 1-year postoperatively. The multivariate analysis showed a strong relationship between pre-operative albumin level and the poor outcome at all the study timing endpoints during 1-year follow-up period. The hypoalbuminemia can be caused by various conditions such as cirrhosis, congestive heart failure, malnutrition and chronic inflammation. Vincent et al reported the each 10g/L decline in serum albumin concentration significantly raised the odds of mortality by 137%, morbidity by 89%[17]. The correlation between hypoalbuminemia and HF mortality also have been reported[13,14]. Patients with hypoalbuminemia are more likely to develop postoperative complication and the one-year mortality is up to 3.9 times of those in the well-nourished patients. The present finding supports the important of albumin level in HF patients. The albumin level should be monitored and the cause of hypoalbuminemia must be identified. The albumin therapy to achieve more than 30g/L may reduce the morbidity and mortality after surgery[17]. Therefore, aggressive or intensive nutritional therapy, as early as after admission, might be beneficial for the elderly HF with severe malnutrition.

The present study results also showed a strong relationship between the grade 4 ASA physical status and 6-month and 12-month poor outcomes. The high grade ASA physical status, which directly related to the severity of patients' condition before surgery, was more specific to the preoperative patients' status than the number of concomitant comorbid diseases. Moreover, ASA physical status had been reported to associated with the short-term and long-term outcome after treatment in elderly HF(18). Therefore, the present study result supported the usefulness of ASA physical status to predict the outcome after the early hip surgery.

Moreover, the present study also found the ambulatory status on the day of hospital discharge was significantly correlated with the poor outcome in univariate analysis, but did not enter into multivariate analysis due to the lack of information of those patients who died during admission. However, the multivariate analysis in the patients who survived after admission (80 patients) showed that the independent predictive factors related to 3-month, 6-month, and 1-year poor outcomes were the same as in Table 3 to 5.

The present study also had some limitations. Firstly, the study was conducted retrospectively which possibly have recall bias and miss some clinical information that might affect the result of the study. Secondly, the sample size was relatively small. And lastly, the result of the study was solely based on only one academic center which might be different from the other centers. Therefore, the future multi-centered prospective study with larger sample size is required to find the other perioperative factors that associated with poor outcome after early HF surgery.

In conclusion, some perioperative factors such as albumin level and ASA physical status, are strongly correlated with the poor postoperative outcome after early HF surgery in elderly patients. Therefore, a careful and specific perioperative strategy might be needed in these extremely high-risk patients.

What is already known on this topic?

The mortality and morbidity after hip fracture surgery could be significantly reduced with early surgical intervention and using appropriate multidisciplinary approach.

What this study adds?

The risk factors for "poor outcome", as mortality and readmission due to hip fracture related cause, could be identified preoperatively, and might be specifically managed during perioperative and postoperative period.

Acknowledgement

The authors would like to thank Department of Orthopedics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University for all of the kindly help and permission to carry out the study.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Zuckerman JD. Hip fracture. N Engl J Med 1996; 334:1519-25.
2. Chariyalertsak S, Suriyawongpisal P, Thakkinstain A. Mortality after hip fractures in Thailand. Int Orthop 2001;25:294-7.
3. Vaseenon T, Luevitoonvechkij S, Wongtriratanachai P, Rojanasthien S. Long-term mortality after osteoporotic hip fracture in Chiang Mai, Thailand. J Clin Densitom 2010;13:63-7.
4. Simunovic N, Devereaux PJ, Sprague S, Guyatt GH, Schemitsch E, Debeer J, et al. Effect of early surgery after hip fracture on mortality and complications: systematic review and meta-analysis. CMAJ 2010; 182:1609-16.
5. Khan SK, Kalra S, Khanna A, Thiruvengada MM, Parker MJ. Timing of surgery for hip fractures: a systematic review of 52 published studies involving 291,413 patients. Injury 2009;40:692-7.
6. Moja L, Piatti A, Pecoraro V, Ricci C, Virgili G, Salanti G, et al. Timing matters in hip fracture surgery: patients operated within 48 hours have better outcomes. A meta-analysis and meta-regression of over 190,000 patients. PLoS One 2012;7:e46175.
7. Choi HJ, Kim E, Shin YJ, Choi BY, Kim YH, Lim TH. The timing of surgery and mortality in elderly hip fractures: A retrospective, multicenteric cohort study. Indian J Orthop 2014;48:599-604.
8. Sa-ngasoongsong P, Kulachote N, Sirisreetreerax N, Chanplakorn P, Laohajaroensombat S, Seeraprom J, et al. Outcome of early hip fracture surgery in elderly patients in ramathibodi hospital: a prospective cohort study. Rama Med J 2013;36:3-12.
9. Rosso F, Dettoni F, Bonasia DE, Olivero F, Mattei L, Bruzzone M, et al. Prognostic factors for mortality after hip fracture: Operation within 48 hours is mandatory. Injury 2016;47 Suppl 4:S91-7.
10. Alegre-Lopez J, Cordero-Guevara J, Alonso-Valdivielso JL, Fernandez-Melon J. Factors associated with mortality and functional disability after hip fracture: an inception cohort study. Osteoporos Int 2005;16:729-36.
11. Lyons AR. Clinical outcomes and treatment of hip fractures. Am J Med 1997;103:51S-63S.
12. Schroder HM, Erlandsen M. Age and sex as determinants

of mortality after hip fracture: 3,895 patients followed for 2.5-18.5 years. J Orthop Trauma 1993;7:525-31.
13. Koval KJ, Maurer SG, Su ET, Aharonoff GB, Zuckerman JD. The effects of nutritional status on outcome after hip fracture. J Orthop Trauma 1999;13:164-9.
14. Van Hoang H, Silverstone FA, Leventer S, Wolf-Klein GP, Foley CJ. The effect of nutritional status on length of stay in elderly hip fracture patients. J Nutr Health Aging 1998;2:159-61.
15. Bretherton CP, Parker MJ. Early surgery for patients with a fracture of the hip decreases 30-day mortality. Bone Joint J 2015;97-B:104-8.
16. American Society of Anesthesiologists. New classification of physical status. Anesthesiology 1963;24:111.
17. Vincent JL, Dubois MJ, Navickis RJ, Wilkes MM. Hypoalbuminemia in acute illness: is there a rationale for intervention? A meta-analysis of cohort studies and controlled trials. Ann Surg 2003;237:319-34.
18. Wolters U, Wolf T, Stutzer H, Schroder T. ASA classification and perioperative variables as predictors of postoperative outcome. Br J Anaesth 1996;77:217-22.