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Risk factors of postoperative complications and in-hospital mortality after hip fracture among patients older than 80 years old: a retrospective study

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Abstract

Induction The mortality and morbidity in hip fracture is a big healthcare burden. How to identify risk patients preoperatively is important. The aim of study was to evaluate the risk factors of postoperative complications and mortality in patients older than 80 years old after hip fracture surgery.

Methods Patients older than 80 years old with the diagnosis of hip fracture who had surgical treatment from February 2013 to June 2021 at a single center in China were included for analysis. The primary outcome were postoperative complications and in-hospital mortality. Binary logistic regression was used to confirm the relationship between preoperative factors and postoperative complications/mortality.

Results 498 patients were included for analysis. 176 patients developed 265 episodes of complications and the incidence of postoperative complication was 35.3%. Postoperative pulmonary infection was the most common complication, followed by cardiovascular complications and postoperative delirium. And there were 10 postoperative in-hospital deaths (2.0%). Preoperative Charlson comorbidity index(CCI) was associated with postoperative complications (OR = 1.243, 95%CI 1.020–1.516, $P = 0.031$) and mortality (OR = 2.303, 95%CI 1.351–3.925, $P = 0.002$). However, American society of Anesthesiologists (ASA) score was not an independent risk factor for postoperative complication and mortality.

Conclusion CCI was the risk factor of poor postoperative outcome for patients older than 80 years old after hip fracture surgery. And CCI can be used as the potential tool of risk stratification for this group of patients.

Trial registration This study had been registered in www.chictr.org.cn and the registration ID was ChiCTR2400085291 on June 4th 2024.

Keywords Hip fracture, Charlson comorbidity index, American society of Anesthesiologists score, Postoperative complication

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Introduction

Hip fracture is increasing in incidence [1]. It occurs frequently in elderly patients and has poor outcomes. The 30-day mortality rate after surgical approaches approached 7% [2–4] and mortality rate within one-year after hip fracture has been reported to 25–30% [5, 6]. Early surgical management without delay has been recommended [7–10] and multidisciplinary collaboration is always needed perioperatively.

Elderly patients with hip fracture still remain as a big challenge to anesthesiologists, due to the increasing prevalence of morbidities [11]. Postoperative complications have been confirmed to be associated with increased medical cost after major surgery [12–14] and outcome [14–17]. Comorbidities are responsible for postoperative morbidities [18] and outcomes [19]. How to identify preoperative risk factors is important, since recognizing high risk patients preoperatively may decrease medical cost.

The Charlson comorbidity index (CCI) is a well-studied index which builds on information on specific comorbidities and was initially designed to predict mortality [17]. American Society of Anesthesiologists (ASA) score was developed to describe the overall health status and physiologic reserve of the patients. Although ASA score was not designed to predict postoperative complications, it has been confirmed to be associated with poor prognosis in different surgical procedures [20]. Previous studies had identified risk factors of postoperative complications after hip fracture surgery, which included preoperative anemia [21], ASA score [22], CCI [18], general anesthesia [23], delay in surgery [4, 23] and gender [6]. The correlation between ASA score and CCI had also been reported to be useful as predictors of mortality in hip fracture [24–26], however there was no consensus.

The aim of this study was to determine the risk factors of postoperative complications and mortality after hip fracture surgery in patients older than 80 years old.

Materials and methods

After the approval from the institutional review board (I-24PJ0501, approved on March 6, 2023), a retrospective, observational, single-center study was conducted. This study was reported according to the STROBE guidelines. Patients older than 80 years old who were diagnosed as hip fracture and had surgical treatment from February 2013 to June 2021 were enrolled for this study. Medical records and electrical anesthetic records were reviewed. The exclusion criteria included incomplete data, revision case, multiple traumas, open fracture or pathologic fracture.

Demographic and perioperative data of all patients were collected from electronic medical records and anesthetic records, which included age, sex, Body mass index (BMI), ASA, comorbidities, fracture type, the time from fracture to the surgery, anesthesia type, duration of surgery, type of surgery, length of hospital stay and postoperative intensive care unit stay (ICU). Fractures were classified into intracapsular (such as femoral neck fractures) and extracapsular fracture (such as intertrochanteric and subtrochanteric fractures). The strategy of surgery was determined by the fracture type, the degree of displacement and the condition of patients. Surgical strategies for patients with intracapsular fracture included internal fixation, hemiarthroplasty or total hip arthroplasty. Extracapscular fractures are managed primarily by internal fixation.

CCI was calculated on admission based on patients' past medical history and laboratory results [27]. The CCI score was calculated based on the diagnosis of the following comorbidities: acute myocardial infarction, congestive heart failure, peripheral vascular disease, cerebral vascular disease, dementia, chronic pulmonary disease, rheumatoid disease, liver disease, diabetes mellitus, hemiplegia or paraplegia, renal disease, malignancy, metastatic malignancy and AIDS/HIV.

The primary outcome was postoperative complications, which was defined as deviations from the normal postoperative courses [28] and in-hospital death. All complications were defined based on ICD-10 diagnosis codes that were not present on admission.

Statistical analysis was performed using SPSS 23.0 version. Categorical variables were compared using Chi Square and continuous variables were compared using T test. Univariate analysis was done to determine the association of risk factors of postoperative complications and in-hospital mortality. Preoperative variables with $P<0.25$ in univariate analysis were then incorporated into a forward, binary logistic regression model to explore the relationship between preoperative factors and postoperative outcome. Receiver operator characteristic curves were used to access the predictive capacity of CCI/ASA score. All variables with a $P<0.05$ were considered statistically significant.

Results

498 patients who underwent surgical procedure after hip fracture were included for analysis. The demographic characteristics were presented in Table 1. The mean age of all patients was 85.8 years old. The median ASA score and CCI score were 3 (range 1–5) and 0 (range 0–5) respectively. There were 10 postoperative in-hospital deaths (2.0%). 176 patients developed 265 episodes of complications and the incidence of postoperative complication was 35.3% (See Table 2). Postoperative pulmonary infection (71 episodes, 26.8%) was the most common complication, followed by cardiovascular complications (52 episodes, 19.6%) and postoperative delirium (35 episodes, 13.2%). There was no significant difference in

Table 1 Demographic characteristics and perioperative data of patients ($n=498$). Data were presented as the mean ± standard deviation, the number (percentile) or median [25th,75th interquartile range]

	Total ($n=498$)	Complications		*P*	Mortality		*P*
		yes($n=176$)	no($n=322$)		Alive($n=488$)	Dead($n=10$)	
Age, years old	85.8 ± 4.3	86.2 ± 4.3	85.6 ± 4.4	0.113	85.9 ± 4.3	87.5 ± 5.0	0.239
BMI(Kg/m^2)	21.9 ± 4.0	21.8 ± 4.3	21.9 ± 3.9	0.285	21.9 ± 4.1	20.6 ± 3.6	0.438
Sex				0.719			0.007
Male	155(31.1%)	53(30.1%)	102(31.7%)		148(30.3%)	7(70%)	
Female	343(68.9%)	123(69.9%)	220(68.3%)		340(69.7%)	3(30%)	
ASA	3 [3,3]	3 [3,3]	3 [3,3]	0.178	3[3,3]	3[3,4]	0.031
II	90(18.1%)	26(14.8%)	64(19.9%)		90(18.4%)	0	
III	369(74.1%)	135(76.7%)	234(72.7%)		362(74.2%)	7(70%)	
IV	37(7.4%)	14(8.0%)	23(7.1%)		34(7.0%)	3(30%)	
V	2(0.4%)	1(0.6%)	1(0.3%)		2(0.4%)	0	
CCI	0 [0,1]	1 [0,1]	0 [0,1]	0.019	0[0,1]	2[1.5,3.0]	< 0.001
0	281(56.4%)	87(49.4%)	194(60.2%)		279(57.2%)	2(20%)	
1	122(24.5%)	49(27.8%)	73(22.7%)		122(25.0%)	0	
2	70(14.1%)	29(16.5%)	41(12.7%)		65(13.3%)	5 (50%)	
3	21(4.2%)	8(4.5%)	13(4.0%)		19(3.9%)	2 (20%)	
4	2(0.4%)	1(0.6%)	1(0.3%)		2(0.4%)	0	
5	2(0.4%)	2(1.1%)	0		1(0.2%)	1 (10%)	
Anemia	203(40.8%)	79(44.9%)	124(38.5%)	0.166	198(40.6%)	5(50%)	0.971
Perioperative transfusion	253(50.8%)	110(62.5%)	143(44.4%)	0.000	243(49.8%)	10(100%)	0.002
Fracture type				0.488			0.284
intracapsular fracture	282(56.6%)	96(54.5%)	186(57.8%)		278(57%)	4(40%)	
extracapsular fracture	212(42.6%)	80(45.5%)	136(4.2%)		210(43%)	6(60%)	
Time from fracture to surgery(day)	5[2,10]	5[2.25,10]	5[2,10]	0.661	5[2,10]	4.5[2.0,9.25]	0.745
Surgical procedures				0.661			
Internal fixation	218(43.8%)	80(45.5%)	138 (42.8%)		212(43.4%)	6(60%)	
Hemiarthroplasty	279(56.0%)	96(54.5%)	183 (56.8%)		275(56.4%)	4(40%)	
Total hip arthroplasty	1(0.3%)	0	1(0.3%)		1(0.2%)	0	
Anesthetic type				0.301			0.701
General anesthesia	269(54.0%)	101(57.4%)	168(52.2%)		263(53.9%)	6(60%)	
Regional anesthesia	229(46.0%)	75(42.6%)	154(47.8%)		225(46.1%)	4(40%)	
The duration of procedure(minute)	77[60,98]	78[61,97]	76[57,100.75]	0.725	77[60,98]	78.5[58,149.25]	0.534
Admission to ICU	293(58.8%)	127(72.2%)	166(51.6%)	< 0.001	185(58.4%)	8(80%)	0.007
Length of hospital stay(day)	12[9,18]	16[11,22]	11[8,15]	< 0.001	12[9,17]	14.5[8,35]	0.452

age ($P=0.113$) and sex distribution ($P=0.719$) between patients with or without complications. Patients with postoperative complications had higher CCI scores when compared to those without complications ($P=0.019$). Patients with mortality had a higher proportion of Male ($P=0.007$), higher ASA score ($P=0.031$) and CCI ($P<0.001$).

Hemiarthroplasty was the most common surgical procedure. And the median length from fracture to surgery was 5 days. There was no difference in fracture type ($P=0.488$), time form fracture to surgery ($P=0.661$) and surgical procedures ($P=0.661$) between patients with and without complications. And Patients with complications or mortality had a higher incidence to be admitted to ICU postoperatively ($P<0.001$ and $P=0.007$ respectively), and patients with complications had longer length of hospital stay after operation ($P<0.001$). And patients with complications or mortality were more prone to be transfused perioperatively ($P<0.001$ and $P=0.002$ respectively).

The relationship between preoperative factors and complications or mortality in patients older than 80 years after hip fracture were presented in Table 3. Higher preoperative CCI was associated with postoperative complications (OR = 1.243, 95%CI 1.020–1.516, $P=0.031$) and mortality (OR = 2.303, 95%CI 1.351–3.925, $P=0.002$). The area under curve (AUC) of CCI score was 0.557 ($P=0.036$) for postoperative complication and 0.796 ($p=0.001$) for mortality. However, ASA score was not an independent risk factor for postoperative complication and mortality.

Table 2 Postoperative complications and death of patients after hip fracture surgery. Data were presented in number (percentage)

Primary outcome	Number ($n=265$)
Postoperative complications	
Postoperative pulmonary infection	71(26.8%)
Cardiovascular complications	52(19.6%)
Postoperative delirium	35(13.2%)
Urinary tract infection	28(10.6%)
DVT/PE	20(7.5%)
Acute kidney injury	12(4.5%)
Gastrointestinal bleeding	9(3.4%)
Dislocation	7(2.6%)
Cerebrovascular accident	6(2.3%)
Epilepsy	5(1.9%)
Sepsis	4(1.5%)
Acute choles/acute pancreatitis	4(1.5%)
Respiratory failure	2(0.8%)
Death	10(3.8%)

Discussion

Our results demonstrated that CCI score was an independent risk factor for postoperative complications and mortality in patients older than 80 years old after hip fracture surgery. The incidence of in-hospital complication was 35.3% and the in-hospital mortality was 2.0%. However, ASA score failed to reach significance as a predictive indicator.

The predictive role of CCI and ASA scores in short- and long-term complications and mortality had been reported in elderly patients after hip fracture surgery. However, there was no consensus which index performed best. Hansan et al. confirmed CCI were a risk factor for postoperative complications [29] and mortality [30]. CCI and ASA score had equal predictive ability of 30-day or 1-year mortality in patients above the age of 60 years after hip fracture [31], while Quach only confirmed ASA score is independently associated with 12-month mortality [32]. In our study, only CCI score was associated with postoperative complications and in-hospital mortality. The CCI score collected more detailed information about comorbidities. Although ASA score is more easily to acquire, for patients older than 80 years old, CCI score is more accurate to predict postoperative outcome. Both surgeons and anesthesiologists should pay special attentions to these patients perioperatively.

The median time from injury to surgery was 5 days in our study, which were longer than that recommended by the guideline [10]. Increased wait time had been confirmed to be associated with higher 30-day mortality [4], increased medical costs and length of hospital stay [33]. The long waiting time for surgery after hip fracture has also been reported as one of the main problems for this specific groups of patients in China [34]. Transferring geriatric patients to other hospital to get surgical treatment due to imbalanced medical resources is the main possible reasons for delayed surgery in China. And waiting for preoperative examination, such as echocardiography, may also contribute to the delayed surgery. Our results also showed there is great room for improvement in the perioperative management of hip fracture in China.

The incidence of admission to ICU in our study was 58.8%, which was higher than previous reported [35, 36]. There is non-consensus on the relation between postoperative admission to ICU and outcome, but routine ICU admission after surgery in unnecessary, even in patients older than 80 years. For patients after hip fracture surgery, delayed mobilization [37] and increased risk of delirium [38] may all contribute to poor outcome. So identification of patients' clinical status or clinical deterioration is more important than sending them routinely to ICU postoperatively for patients after hip fracture.

Our study had limitations. First, this was a retrospective cohort study and selection bias could not be avoided. This was also a single-institution study, and the results might not be representative for the whole population. The study design does not establish causality between CCI and postoperative outcome. Second, our analysis was limited to in-hospital outcome. The long-term outcome was not included for analysis. Third, the severity of comorbidities was not assessed in this study and the

Table 3 Multivariable analysis of risk factors associated with postoperative complications and mortality

Risk factor	Odds Ratio	95% confidence interval	*P* value
Postoperative complications			
Age	1.038	0.995–1.083	0.088
CCI	1.243	1.020–1.516	0.031
ASA score	1.192	0.821–1.732	0.356
anemia	1.062	0.728–1.550	0.754
Mortality			
Age	1.107	0.955–1.283	0.177
CCI	2.303	1.351–3.925	0.002
ASA score	3.054	0.850-10.975	0.087
Sex	4.071	0.968–17.121	0.055

severity of comorbidities could confound the analysis of postoperative outcome. Only patients who had surgery were included for analysis, and patients who died before operation or had non-surgical treatment were not included. In addition, the sample size was relatively small and the risk of type I error was high.

Despite those limitations, this retrospective study provided evidence that CCI might be used preoperatively to predict the outcome of patients older than 80 years old after hip fracture surgery. The ability to stratify patients preoperatively is important. Communication with patients and surgeons is necessary and optimization is required for patients with higher CCI. Further studies were necessary to confirm the association between CCI and postoperative outcome.

Abbreviations

ASA	American society of anesthesiologists
CCI	Charlson comorbidity index
BMI	Body mass index
ICU	Intensive care unit

Author contributions

ZH made contribution to data collection and manuscript preparation. ML performed statistical analysis and revised manuscript. YX contributed to the study design and data analysis. All authors have reviewed the manuscript.

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Data availability

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

Declarations

Ethics approval and consent to participate

This study was exempt from Institutional Review Board (IRB) review of Peking Union Medical College Hospital and was performed in accordance with the Declaration of Helsinki. The requirement for informed consent was waived due to the retrospective nature of our study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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