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ORIGINAL RESEARCH

The Surgical Timing and Prognoses of Elderly Patients with Hip Fractures: A Retrospective Analysis

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Background: Guidelines exist for the surgical treatment of hip fractures, but the association between the surgical timing and the incidence of postoperative complications and other important outcomes in elderly patients with hip fracture remains controversial.

Objective: This study aims to explore the association between the surgical timing and the prognoses in elderly patients with hip fracture.

Methods: A total of 701 elderly patients (age ≥ 65 years) with hip fractures who were treated in our hospital from June 2020 to June 2021 were selected. Patients who underwent surgery within 2 d of admission were assigned to the early surgery group, and those who underwent surgery after 2 d of admission were assigned to the delayed surgery group. The prognosis indices of the patients in the two groups were recorded and compared.

Results: The length of postoperative hospitalisation in the early surgery group was significantly lower than that in the delayed surgery group ($P < 0.001$). The European quality of life questionnaire (EQ-5D) utility in the delayed surgery group was significantly lower than that in the early surgery group at 30 days and 6 months after operation ($P<0.05$). Compared with the delayed surgery group, the incidence of pulmonary infection, urinary tract infection (UTI) and deep vein thrombosis (DVT) in the early surgery group were significantly lower. There were no significant differences between the two groups in terms of mortality and excellent rates of the HHS at six months after the operation. In addition, the early surgery group had a lower readmission rate than the delayed surgery group [34 (9.5%) vs 56 (16.3%), $P = 0.008$].

Conclusion: Earlier surgery can reduce the incidence of pulmonary infections, UTI, DVT and readmission rate among elderly patients with hip fractures, shorten postoperative hospitalisation.

Keywords: Hip fracture, elderly patients, timing of surgery, prognosis

Introduction

Hip fractures are the most common type of fracture among elderly people and have significant morbidities and possible life-threatening complications.[1] Surgeries, such as total or partial hip replacements, are the common treatments for hip fractures.[2] At the same time, the timing of surgery is considered to play an important role in survival. International clinical practice guidelines recommend surgical treatment of acute hip fractures within 24–48 hours after admission,[3,4] but these recommendations are still controversial.[5] Proponents of early treatment argue that early surgical intervention could improve the prognoses of patients and minimises the time a patient is confined to bed rest, thereby reducing the risk of associated complications, such as pressure sores, deep vein thrombosis (DVT) and urinary tract infection (UTI)[6,7] However, those favouring a delay believe it provides the opportunity to optimise patients' medical status, thereby decreasing the risk of perioperative complications.[6,8] Most studies have shorter follow-up observation times and tend to pay more attention to the survival rate of patients, while ignoring the postoperative quality-of-life concerns caused by psychological changes and decreased physical and social functions.[9,10] The association of the timing of surgery and the prognosis of elderly patients with hip fractures needs more research to explore these issues.

This study retrospectively analysed the clinical and six-month follow-up data of elderly patients admitted to our hospital with hip fractures. More specifically, the following question was addressed: Among patients 65 years of age or older who underwent surgery for hip fractures, what was the effect of early surgery, relative to delayed surgery, on all-cause mortality and postoperative complications?

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Data and Methods

Population

A total of 701 elderly patients with hip fractures admitted to our hospital from June 2020 to June 2021 were recruited as subjects. All data collected from patients medical files retrospectively.

The inclusion criteria were as follows: (1) patients who were ≥65 years old, (2) patients with hip fractures, and (3) patients with complete preoperative examinations who had received surgical treatment.

The exclusion criteria were as follows: (1) patients with old fractures (fractures over three weeks), (2) patients with pathological fractures, (3) patients who had received conservative treatment, or (4) patients who refused follow-up and had incomplete data.

The subjects were divided into two groups according to surgical timing. Those who had received surgery within 2 d of admission were placed into the early surgery group, while those who received surgery after 2 d of admission were placed into the delayed surgery group.[11–13] The patients were followed up six months later by phone or outpatient service, when they completed questionnaires used to determine the survival status and Harris Hip Scores (HHS) (Figure 1). This study was approved by our hospital ethic committee. Patients were contacted by telephone and informed consent was obtained.

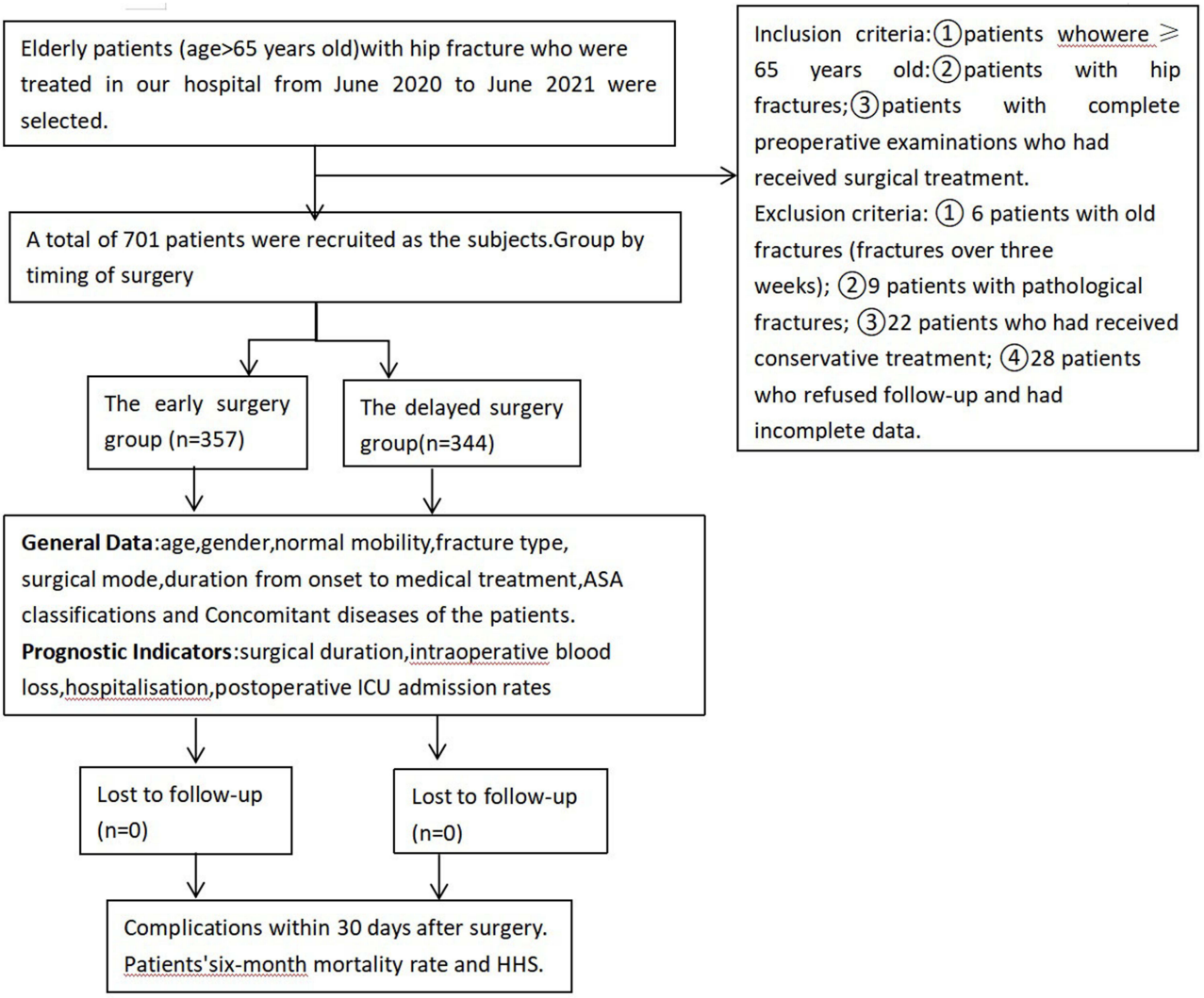

Figure 1 Flow Diagram of Participant Recruitment.

Data Collection Procedures

Data were collected from all included patients included demographics (age, gender and normal mobility), fracture type (femoral neck, intertrochanteric or subtrochanteric), surgical mode (closed reduction and internal fixation of femoral neck fracture, artificial femoral head replacement, total hip arthroplasty, closed reduction and intramedullary nail of intertrochanteric fracture), duration from onset to medical treatment and American Society of Anaesthesiologists (ASA) physical status classifications of the patients.

Observations of Prognostic Indicators

Perioperative indicators were as follows: surgical duration, intraoperative blood loss, postoperative hospitalisation, and postoperative intensive care unit (ICU) admission rates (the percentage of patients admitted to ICU after surgery). Quality of life index at 30 days and 6 months after operation.In this study, the European quality of life questionnaire (EQ-5D) was used to evaluate the postoperative health status of elderly patients with hip fracture. The content includes: action ability, self-care, daily activities, pain/discomfort, anxiety/depression. The score of each item includes: 1 point (no difficulty), 2 points (moderate difficulty), and 3 points (extremely difficult). According to the choices made by the respondents in the questionnaire, the EQ-5D score is converted into the EQ-5D index through the utility value conversion table The higher the EQ-5D index, the better the quality of life. The Chinese EQ-5D score conversion system table was used.[14]

Complications within 30 d after surgery were as follows: pulmonary infection, UTI, cardiovascular event, cerebral infarction, delirium, DVT of the lower limbs, PE, pressure ulcer, stress ulcer with bleeding, intestinal obstruction, incision infection and others.

Prognostic indicators were as follows: patients' six-month mortality rate and HHS. The HHS can be divided into four grades based on address pain, walking function, daily activity and range of motion, comprising excellent (90–100 points), good (80–89 points), medium (70–79 points) and poor (<70 points).[15] The excellent and good rates of hip joint function were calculated as (excellent + good) cases / total cases × 100%.

Statistical Processing

The SPSS™ Statistics v26.0 software was adopted for data analysis. The measurement data were tested for normality using the Shapiro–Wilk normality test, with the results expressed as mean (standard deviation) (mean [SD]). Those conditions not aligned with the normal distribution were described with median and interquartile range (M [Q1, Q3]). The Categorical variable data were expressed as the percentage of cases (n%). Measurement variable data were compared by Student's *t*-test when the distribution was normal or by the Fisher's exact test if it the distribution was not normal. Chi-squared tests were used for categorical variable data. A P value of <0.05 was deemed statistically significant.

Results

General Clinical Data

A total of 701 patients were included in this study. Among them, 357 patients (104 male and 253 female) with an average age of 80.10 years (8.20) were placed into the early surgery group. The remaining 344 patients (97 male and 247 female) with an average age of 79.56 years (8.15) were placed into the delayed surgery group. There were no significant differences in age, gender, Body Mass Index (BMI), normal mobility, fracture type, surgical mode, duration from the onset to medical treatment, ASA physical status classification or concomitant diseases between the two groups (Table 1).

Comparison of Perioperative Indicators

The perioperative parameters between the two groups were compared and the results are presented in Table 2. There were no significant differences in surgical duration, intraoperative blood loss or postoperative ICU admission rates between the two groups. The length of postoperative hospitalisation in the early surgery group (4 [3, 5] d) was shorter than that of the delayed surgery group (5 [4, 7] d), with a significant difference ($P < 0.001$). The EQ-5D utility value was 0.552 (0.196) in the early operation group and 0.511 (0.195) in the delayed operation group 30 days after operation, the difference was

Table 1 Comparison of General Clinical Data Between Two Groups

Index	Early Surgery Group (n=357)	Delayed Surgery Group (n=344)	Statistical values	*P* value
Age (years) **(mean [SD])**	80.10 (8.20)	79.56 (8.15)	0.878[a]	0.380
Gender [n(%)] Male Female	 104 (29.1) 253 (70.9)	 97 (28.2) 247 (71.8)	0.075[b]	0.785
BMI	22.83 (3.69)	22.98 (3.91)	−0.535 [a]	0.592
Normal activity [n(%)] To be assisted Walk by oneself	 119 (33.3) 238 (66.7)	 114 (33.1) 230 (66.9)	0.003[b]	0.957
Trauma to Visit (h)	16.50 [7.00, 58.00]	20.00 [7.00, 48.00]	−0.497[c]	0.619
Fracture type [n(%)] Femoral neck Intertrochanteric and Subtrochanteric	 194 (54.3) 163 (45.7)	 202 (58.7) 142 (41.3)	1.367[b]	0.242
Surgical mode [n(%)] Closed reduction and internal fixation of femoral neck fracture Artificial femoral head replacement Total hip arthroplasty Closed reduction and intramedullary nail of intertrochanteric fracture	 36 (10.1) 123 (34.6) 37 (10.4) 160 (44.9)	 32 (9.3) 133 (38.7) 39 (11.3) 140 (40.7)	0.864[b]	0.834
ASA classification [n(%)] ASA I ASA II ASA III	 265 (74.2) 90 (25.2) 2 (0.6)	 232 (67.4) 105 (30.5) 7 (2.0)	5.884[b]	0.053
Concomitant diseases [n(%)]				
Hypertension	214 (59.9)	182 (52.9)	3.530[b]	0.060
CAD	69 (19.3)	76 (22.1)	0.817[b]	0.366
Arrhythmia	30 (8.4)	39 (11.3)	1.699[b]	0.192
CPD	24 (6.7%)	35 (10.2%)	2.708[b]	0.100
Digestive tract diseases	18 (5.0)	20 (5.8)	0.204[b]	0.652
Diabetes	108 (30.3)	105 (30.5)	0.006[b]	0.938
CRI	9 (2.5)	8 (2.3)	0.028[b]	0.866
Cerebral infarction	65 (18.2)	65 (18.9)	0.055[b]	0.815
Parkinson	8 (2.2)	7 (2.0)	0.036[b]	0.851
Mental illness	10 (2.8)	7 (2.0)	0.435[b]	0.510
Tumor	21 (5.9)	23 (6.7)	0.192[b]	0.661

Notes: [a]Student's *t*-test; [b]chi-squared test; [c]Fisher's exact test.
Abbreviations: ASA, American Society of Anesthesiologists; CAD, coronary heart disease; CPD, Chronic Pulmonary Disease; CRI, chronic renal insufficiency; SD, standard deviation; BMI, Body Mass Index.

statistically significant ($P<0.05$); The EQ-5D utility value was 0.707 (0.147) in the early operation group and 0.652 (0.189) in the delayed operation group 6 months after operation, with a statistically significant difference ($P<0.05$).

Complications Within 30 Days After Surgery

The incidence of complications within 30 d after surgery were counted. The results showed that the proportion of pulmonary infections in the early surgery group was significantly lower than that in the delayed surgery group [26 (7.3%)

Table 2 Comparison of Perioperative Indicators Between the Two Groups

Index	Early Surgery Group (n=357)	Delayed Surgery Group (n=344)	Statistical values	*P* value	Risk Ratio (95% Confidence interval)
Surgical duration (h) **(mean [SD])**	1.03 (0.36)	1.17 (2.66)	−0.993[a]	0.321	–
Intraoperative blood loss (mL)	150 [100, 200]	200 [100, 200]	−1.372[b]	0.170	–
Postoperative Hospitalization stay (d)	4 [3, 5]	5 [4, 7]	−10.175[b]	<0.001	–
ICU admission [n (%)]	63 (17.6)	69 (20.1)	0.666[b]	0.414	1.082 (0.900, 1.300)
EQ-5D utility value					
30 days after operation	0.552 (0.196)	0.511 (0.195)	2.788[b]	0.005	-
6 months after operation	0.707 (0.147)	0.652 (0.189)	4.183[b]	<0.001	-

Notes: [a]Student's *t*-test; [b]Fisher's exact test.
Abbreviations: SD, standard deviation; EQ-5D, the European quality of life questionnaire.

vs 41 (11.9%), $P = 0.037$]. The incidence of UTIs was 17.6% in the early surgery group and 32.3% in the delayed surgery group, and the difference between the two groups was statistically significant [63 (17.6%) vs 111 (32.3%), $P < 0.001$]. In addition, the incidence of DVT was significantly lower in the early surgery group compared with the delayed surgery group [27 (7.6%) vs 59 (17.2%), $P < 0.001$]. The occurrence of other complications, such as cardiovascular events, cerebral infarction, delirium, PE, pressure ulcer, stress ulcer with bleeding, intestinal obstruction and incision infection, were not statistically significantly different between the two groups (Table 3).

Prognostic Indicators Six Months After Surgery

Six months after surgery, the mortality rate was 5.9% and 6.7% in the two groups, respectively, with no significant difference. The readmission rate in the delayed surgery group was significantly higher than that in the early surgery group six months after surgery, and the difference was statistically significant [34 (9.5%) vs 56 (16.3%), $P = 0.008$]. According to the HHS, in the early surgery group, there were 288 cases with excellent and good scores and 62 cases with medium and poor scores, and the overall excellent and good rate was 82.3%. In the delayed surgery group, there were 259 cases with excellent and good scores and 78 cases with medium and poor scores, and the overall excellent and good rate was 76.9%. There was no significant difference in the excellent and good rate of HHS between the two groups (Table 4).

Table 3 Complications Within 30d After Surgery Between the Two Groups

Index	Early Surgery Group [n(%)]	Delayed Surgery Group [n(%)]	$\chi 2$	*P* value	Risk Ratio (95% Confidence Interval)
Pulmonary infection	26 (7.3)	41 (11.9)	4.355	0.037	1.280 (1.041, 1.575)
Urinary tract infection	63 (17.6)	111 (32.3)	20.068	<0.001	1.443 (1.245, 1.672)
Cardiovascular events	12 (3.4)	19 (5.5)	1.937	0.164	1.264 (0.945, 1.689)
New cerebral infarction	0 (0.0)	3 (0.9)	—	0.118	2.047 (1.897, 2.208)
Delirium	6 (1.7)	8 (2.3)	0.372	0.542	1.168 (0.738, 1.851)
DVT	27 (7.6)	59 (17.2)	14.964	<0.001	1.480 (1.254, 1.748)
Pulmonary embolism	0 (0.0)	1 (0.3)	—	0.491	2.041 (1.892, 2.201)
Pressure ulcer	5 (1.4)	7 (2.0)	0.419	0.517	1.193 (0.735, 1.936)
Stress ulcer with Bleeding	5 (1.4)	6 (1.7)	0.134	0.714	1.114 (0.646, 1.920)
Intestinal obstruction	1 (0.3)	3 (0.9)	0.290	0.590	1.533 (0.866, 2.713)
Incision infection	1 (0.3)	2 (0.6)	0.373	0.541	1.361 (0.609, 3.039)

Abbreviation: DVT, Deep vein thrombosis.

Table 4 Mortality, Readmission Rate and HHS Six Months After Surgery

Index	Early Surgery Group [n(%)]	Delayed Surgery Group [n(%)]	Statistical values	*P* value	Risk Ratio (95% Confidence Interval)
Mortality	21 (5.9)	23 (6.7)	0.192	0.661	1.070 (0.798, 1.434)
HHS			3.121	0.077	1.177 (0.492, 1.038)
Excellent and good	288 (82.3)	259 (76.9)			
Medium and poor	62 (17.7)	78 (23.1)			
Readmission rate	34 (9.5)	56 (16.3)	7.144	0.008	1.320 (1.101, 1.583)

Abbreviation: HHS, Harris Hip Score.

Complications Within Six Months After Surgery

Six months after surgery, the early surgery was associated with a lower incidence of urinary tract infection (19.6% vs 32.6%, $P < 0.001$), deep venous thrombosis (9.8% vs 18.3%, $P < 0.001$), and pressure ulcer (3.4% vs 9.6%, $P < 0.001$). However, there was no significant difference in the presence of other complications (Table 5).

Discussion

In this study, we investigated the relationship between the surgical timing and postoperative complications, main outcomes of elderly patients with hip fracture. Compared with the delayed surgery group, the early surgery group significantly reduced the average postoperative hospital stay and the incidence of complications within 30 d after surgery, such as pulmonary infections, UTIs and DVT. In addition, at six months after surgery, although early surgery had no significant effect on patient mortality compared with delayed surgery, early surgery significantly reduced patient rehospitalisation rates.

Hip fractures are one of the deadliest fractures among the elderly. A systematic review concluded that multiple factors, such as age, pre-fracture function, health status, fracture type, pain, anaemia, muscle strength and early activity level, affect the prognoses of patients.[16]

In this study, it was found that the incidence of pulmonary infection, UTIs and DVT of the lower limbs within 30 d after surgery was lower in the elderly patients with hip fracture who underwent early surgery. There are many potential complications, such as Urinary retention (UR), aspiration pneumonia (AP), dislocation, surgical site infection, fractures around the prosthesis and venous embolism, which can occur after the large-scale application of hip replacement surgery, so an experienced medical staff and a proper medical environment are important determinants for ensuring appropriate prognoses.[17–19] Furthermore, the results of previous studies showed that the fewer the days of hospitalisation, the lower the incidence of lung infections, because long-term bed rest could make elderly patients with weakened immune function more susceptible to infections.[20,21] The orthogeriatric program succeeded in preventing and treating perioperative complications.[22]

Table 5 Complications Within 6 Months After Surgery Between the Two Groups

Index	Early Surgery Group [n(%)]	Delayed Surgery Group [n(%)]	$\chi 2$	*P* value	Risk Ratio (95% Confidence Interval)
Pulmonary infection	35 (9.8)	49 (14.2)	3.275	0.070	1.528 (0.963, 2.425)
Urinary tract infection	70 (19.6)	112 (32.6)	15.285	<0.001	1.979 (1.402, 2.795)
Cardiovascular events	14 (3.9)	21 (6.1)	1.760	0.185	1.593 (0.796, 3.186)
New cerebral infarction	2 (0.6)	6 (1.7)	2.177	0.170	3.151 (0.632, 15.720)
Delirium	11 (3.1)	12 (3.5)	0.092	0.834	1.137 (0.495, 2.612)
DVT	35 (9.8)	63 (18.3)	10.550	0.001	2.063 (1.324, 3.213)
Pulmonary embolism	2 (0.6)	4 (1.2)	0.750	0.443	2.088 (0.380, 11.475)
Pressure ulcer	12 (3.4)	33 (9.6)	11.325	0.001	3.051 (1.548, 6.011)
Stress ulcer with Bleeding	6 (1.7)	8 (2.3)	0.372	0.542	1.393 (0.478, 4.057)
Intestinal obstruction	2 (0.6)	5 (1.5)	1.414	0.278	2.618 (0.505, 13.585)
Incision infection	1 (0.3)	2 (0.6)	0.373	0.618	2.082 (0.188, 23.065)

Abbreviation: DVT, Deep vein thrombosis.

Pulmonary infections are common postoperative complications in elderly patients with hip fractures.[23] Research demonstrates that early surgery can mitigate the risk of pneumonia after surgery,[24,25] which is consistent with the results of the present study. According to the analysis, there may be multiple reasons for early surgery to reduce the occurrence of postoperative pulmonary infections. Elderly patients often have a decreased immune capacity. When elderly patients survive for a long time in a highly pathogenic environment like a hospital, the risk of infection is greatly increased. However, early surgery reduces the length of the postoperative hospital stay and avoids prolonged exposure of elderly patients to the highly pathogenic environment of the hospital, thereby reducing the risk of pulmonary infection. Moreover, under stress conditions, such as pain and trauma, various inflammatory factors can be released and induce a systemic inflammatory response. Early surgery can shorten pain continuance, thereby reducing the release of inflammatory factors. Therefore, surgery should be performed at the earliest opportunity to reduce the incidence of postoperative pulmonary infection.

The most common infectious complication in patients with hip fractures is UTI.[20] This complication may be related to bed rest, urinary retention, indwelling catheters and other factors. Rodriguez–Fernandez et al[26] reported that delayed surgery increases the incidence of UTIs, which is consistent with the results of the present study. Therefore, early surgery is recommended to shorten the bed rest period and reduce the incidence of UTIs.

Additionally, there is also a high incidence of DVT of the lower limbs during the perioperative period for elderly patients with hip fractures.[27] This may be related to the following factors: swelling soft tissues around the area of the incision compresses veins, impacting blood flow; bed rest is required after the onset of a fracture; and traumatic stress increases blood viscosity. It has been suggested in some studies[27,28] that prolonged preoperative waiting time is one of the most important risk factors for DVT. Therefore, the incidence of DVT for elderly patients with hip fractures can be effectively reduced by conducting early surgery, ending bed rest and implementing early ground activities and functional exercises.

Postoperative complications significantly influence the length of the postoperative hospital stay.[28] Studies[29] have concluded that early surgery can shorten hospitalisation for patients with hip fractures, which is consistent with the results of the present study. In the present study, patients in the early surgery group have shorter postoperative hospital stay. Therefore, it is proposed that early surgery can shorten the length of the postoperative hospital stay, which would reduce the burden on families and also help conserve limited medical resources.

Postoperative mortality is one of the most important prognostic criteria. There are still controversies regarding the influence of surgical timing on postoperative mortality of elderly patients with hip fractures. According to some studies,[30,31] surgical timing is intricately linked to postoperative mortality, which can be reduced by prompt surgery. However, Bretherton et al[9] reported that delayed surgery would significantly increase the incidence of postoperative complications but has no influence on the three-month and one-year mortality rate after surgery. A potential reason for this conclusion may be that the sample size was not large enough to show the difference in mortality rates. Some elderly patients have numerous comorbidities, and they lose their mobility after the onset of fractures. Traumatic surgery can induce serious complications, which would require intensive care after surgery. In the present study, the surgical timing was found to exert no influence on the postoperative ICU transfer rate and short-term mortality. This indicates that early surgery should be performed after a thorough assessment. For patients suffering from concomitant diseases and unstable conditions, and for those with high surgical risks, surgery should be delayed appropriately to allow them to actively adjust their state.

The HHS and EQ-5D are an important indicator for evaluating the efficacy of hip joint surgery. In the present study, medical follow-up continued for six months. There was no significant difference in the HHS between the two groups, indicating that surgical timing has little influence on the short-term recovery of hip joint function after surgery. But the EQ-5D utility in the delayed surgery group was significantly lower than that in the early surgery group at 30 days and 6 months after operation. The recovery of hip joint function after surgery may be mainly related to the extent of the fracture, general condition and postoperative rehabilitation exercise, amongst other factors. Moreover, there were no significant differences in the intraoperative blood loss and surgical duration between the two groups, indicating that surgical timing would not affect the surgical course.The results are consistent with previous studies.[32,33]

This study encountered limitations. First, it was a single-centre retrospective analysis, which may have encompassed selection bias and overlooked some clinically significant data. Therefore, a multicentre, large sample and strictly designed clinical study is required for further exploration. Second, the impact of some other variables on the prognosis of elderly patients, such as the type of fracture, the impact of comorbidities, and differences between genders, were not addressed. Third,

the present study was constrained by the available resources and timeframes of the research project, and multivariate analysis was not performed. In future studies, multiple variables should be considered, multivariate analysis implemented, and rigorous clinical studies designed to further investigate the factors affecting the prognosis of elderly patients with hip fractures.

Conclusion

Early surgery is associated with a lower rate of perioperative complications in elderly patients with hip fractures. Early surgery can shorten the length of the postoperative hospitalisation and bed rest for patients and reduce complications such as pulmonary infections, UTIs, and lower extremity DVT associated with bed rest. There were no significant differences between the two groups in terms of mortality and excellent rates of the HHS at six months after the operation.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Beijing Jishuitan Hospital. No identifiable participant information (such as patients' images, faces, or names) was disclosed in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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