Delay between admission and surgery as a potential risk factor for postoperative morbidity and mortality in elderly patients with hip fractures: A retrospective study

Zhongdi Liu a, Zhe Du a, Hao Lu b, Zhongguo Fu b, Hailin Xu b, * a

Trauma Medicine Center, Peking University People's Hospital, China

b Department of Trauma and Orthopedics, Peking University People's Hospital, China

A R T I C L E   I N F O

Article history:
Received 7 November 2021
Received in revised form 3 July 2022
Accepted 18 July 2022
Available online xxx

Keywords:
Hip fractures
Timing of surgery
Surgical delay
Mortality

A B S T R A C T

Background: This study aimed to assess the impact of delay between admission and surgery on the postoperative outcomes such as mortality and related complications in elderly patients with acute hip fractures.

Methods: 840 patients aged ≥65 years from January 2009 to September 2015 were included in this retrospective study. According to the interval from admission to surgery, the patients were divided into four groups: group A (surgery within 24 h), group B (surgery within 24 h–48 h), group C (surgery within 48 h–72 h), and group D (surgery later than 72 h). Postoperative complications during hospitalization and mortality at different follow-up time points were compared.

Results: A total of 763 cases were successfully followed up, with an average follow-up time of 30.4 ± 13.1 months. The mean age of the patients was 79.4 ± 6.8 years. The difference in gross postoperative complications among groups was statistically significant in terms of pressure sore (P = 0.02), respiratory complications (P = 0.001), and urological complications (P < 0.001). The multivariate logistic regression analysis identified 3 factors independently associated with the postoperative morbidity, including age (odds ratio [OR] = 1.040), postoperative drainage volume (OR = 1.002) and time from admission to surgery (OR = 1.108). The difference in postoperative mortality among groups was statistically significant at 1 year (P = 0.046) after operation. The multivariate logistic regression analysis identified that age, postoperative drainage volume and time from admission to surgery were independently associated with mortality at 1 year post-surgery.

Conclusion: The incidence of postoperative morbidity and mortality in elderly patients with hip fracture is usually the result of multiple factors, surgeons should pay attention to the patient's age, postoperative wound status and surgical delay time, which may significantly affect the outcome of the treatment.

© 2022 The Authors. Published by Elsevier B.V. on behalf of The Japanese Orthopaedic Association. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Hip fracture is a common type of trauma, which often occurs in the elderly. It is characterized by high nonunion rate, high disability rate, slow recovery, and high fatality rate. It is reported that there are about 250,000 cases of hip fracture in the United States each year, while in China, the number of hip fracture patients is about one million each year, 95% of which are elderly patients [1,2]. The elderly often experience a variety of other internal diseases and need to stay in bed for a long time after injury, resulting in a higher incidence of perioperative pulmonary infections, urinary system infections, bedsores, and other complications, which pose great challenges in clinical treatment [3,4].

Surgery is still the primary treatment option for such patients. However, elderly patients with hip fractures often require adequate preoperative evaluation, and surgery is often delayed. At present, more attention has been given to the effects of operative timing on the prognosis of patients with hip fracture, but orthopedic experts...
still dispute the timing of surgery. Some scholars believe that elderly patients with hip fracture should be operated as soon as possible, even as an emergency operation, to reduce the incidence of complications and promote postoperative recovery [5–7]. While some experts believe that surgery should be postponed to improve the preoperative preparation in the traumatic response period after a fracture; the general state of patients should be evaluated and improved to enhance their surgical tolerance, and doctors should choose the best anesthesia and surgical methods according to the evaluation results [8–10].

The central clinical concern is usually the effect of delayed surgery on the incidence of postoperative complications and mortality in elderly patients with hip fracture. Respiratory system infection, urinary system infection, venous thrombosis, and pressure sores are the most common postoperative complications of hip fracture, which are also important factors that significantly affect the postoperative functional recovery and survival rate of patients. The exact postoperative mortality of hip fracture is not clear, and the effects of operative timing on short- and long-term mortality has been focused on the literature. Previous studies have shown that early surgery can reduce short-term mortality in elderly patients with hip fracture, but other studies have shown that early surgery for elderly hip fracture is not associated with improved mortality [4–6].

Since mortality in elderly patients with hip fracture is often associated with various comorbidities and surgical complications, it is difficult to pinpoint the decisive factors concerning short- and long-term mortality. The risk factors associated with the duration from admission to surgery have not been fully studied. Therefore, this study aimed to further clarify several unanswered questions about the effect of delay from admission to surgery on the outcome of hip fracture in the elderly. First, whether the time from admission to surgery affect intraoperative bleeding, postoperative drainage, length of hospital stay, and other operation-related indicators? Second, whether the time from admission to operation affect the incidence of postoperative surgical complications such as venous thrombosis, infectious complications, and pressure sores? Third, what is the effect of time from admission to operation on mortality at different time points within one year after hip fracture in elderly patients? This study may provide a reference for determining a reasonable preoperative waiting time range.

2. Materials and methods

2.1. Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) patients undergoing artificial joint replacement or intramedullary nail fixation for hip fracture, (2) men and women aged 65–100 years, and (3) weight of 40–100 kg.

The exclusion criteria included: (1) patients with multiple fractures, (2) pathological fracture of the hip caused by a tumor, (3) periprosthetic fracture of the affected hip, (4) occurrence of complications associated with injuries, such as phlebothrombosis, and (5) hemorrhagic disease or other contraindications for anticoagulant treatment (e.g., having a history of active

Fig. 1. Flow chart of patient inclusion in this study. 840 patients with acute hip fracture were recruited to the study. 77 patients were excluded because of multiple fractures or pathological fractures, venous thromboembolism or other contraindications for anticoagulant treatment.
bleeding, heparin-induced thrombocytopenia, and platelet count <100,000/mm³).

2.2. Patient demographics

From January 2009 to September 2015, 840 patients with hip fractures met the inclusion criteria. A total of 77 patients were excluded for the following reasons: 25 for multiple fractures or pathological fractures, 14 for preoperative complications associated with venous thromboembolism, and 38 for hemorrhagic disease or other contraindications for anticoagulant treatment. Finally, 763 people were successfully followed up in the present study. Written informed consent was obtained from all participants, and the study was approved by the Ethics Committee of the authors' affiliated institutions. The process of enrolment and exclusion of the patients was shown in Fig. 1 (Fig. 1). According to the timing of surgery, patients were grouped as having undergone surgery within 24 h (group A), 24–48 h (group B), 48–72 h (group C), and later than 72 h after admission (group D).

2.3. Preoperative assessment

All patients were thoroughly evaluated after admission, including evaluations regarding vital signs, nutritional status, laboratory test examination, cardiopulmonary function, comorbidities, and severity of other diseases. The patient's basic status were determined based on a patient's self-reported history or chronic persistence of a disease. Fracture type, operating methods, anesthesia mode was classified based on radiological data and the medical records.

2.4. Surgery

The surgical methods used on the patients were mainly divided into two types: internal fixation and joint replacement. Internal fixation mainly refers to the intramedullary nail system. According to the patient's condition, joint replacement included total hip replacement or artificial femoral head replacement. All operations were performed by the same qualified surgeon. All patients received standard anticoagulant therapy in the perioperative period to prevent venous thromboembolism.

2.5. Clinical measurement details

2.5.1. Surgical data

Surgical data refers to the clinical data and records related to a surgical operation. Data related to the surgical treatment of patients were collected, including fracture type, basic complications, operation mode, operation time, intraoperative blood loss, and post-operative drainage volume.

2.5.2. Postoperative morbidity

Postoperative morbidity refers to other diseases that occur during the treatment of a disease and are related to the treatment of that disease. In the present study, postoperative morbidity during hospitalization was counted separately for specific types of complications, including poor wound healing, pressure sores, deep venous thrombosis of the lower extremity, respiratory system complications, cardiogenic complications, and urinary system complications. Each patient's length of hospital stay was recorded.

2.5.3. Postoperative mortality

Postoperative mortality is defined as the percentage of patients receiving surgical treatment who die of any cause within a certain period of time after surgery. All patients were followed up by telephone at different time points (1 month, 3 months, 6 months, 1 year) after surgery, and the time and cause of death were recorded to determine the short-term and long-term postoperative mortality of patients in different groups.

2.6. Statistical analysis

Service Solutions statistical software (SPSS 20.0, IBM, Armonk, NY, USA) was used for statistical analysis. Continuous variables were expressed as mean ± standard deviation (SD)/median (upper quartile, lower quartile). The measurement data were first tested for

### Table 1
Characteristics of patients in each group.

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Group A (n = 137)</th>
<th>Group B (n = 101)</th>
<th>Group C (n = 119)</th>
<th>Group D (n = 406)</th>
<th>Total (n = 763)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean ± SD</td>
<td>79.3 ± 7.3</td>
<td>79.8 ± 6.0</td>
<td>80.3 ± 6.9</td>
<td>79.1 ± 6.9</td>
<td>79.4 ± 6.8</td>
<td>0.503</td>
</tr>
<tr>
<td>Male/Female</td>
<td>38/99</td>
<td>28/73</td>
<td>40/79</td>
<td>131/275</td>
<td>237/526</td>
<td>0.6</td>
</tr>
<tr>
<td>Weight (kg), mean ± SD</td>
<td>60.0 ± 11.0</td>
<td>57.1 ± 10.5</td>
<td>59.1 ± 12.2</td>
<td>58.3 ± 11.1</td>
<td>58.0 ± 11.2</td>
<td>0.38</td>
</tr>
<tr>
<td>BMI, mean ± SD</td>
<td>22.1 ± 3.9</td>
<td>22.0 ± 3.4</td>
<td>22.6 ± 3.9</td>
<td>22.2 ± 3.6</td>
<td>22.2 ± 3.7</td>
<td>0.584</td>
</tr>
<tr>
<td>Follow-up time (months), mean ± SD</td>
<td>32.3 ± 10.6</td>
<td>32.9 ± 12.4</td>
<td>28.3 ± 15.3</td>
<td>29.8 ± 13.3</td>
<td>30.4 ± 13.1</td>
<td>0.017</td>
</tr>
<tr>
<td><strong>Basic comorbidity, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>35.8 (49/137)</td>
<td>37.6 (38/101)</td>
<td>37.0 (44/119)</td>
<td>42.1 (171/406)</td>
<td>39.6 (302/763)</td>
<td>0.49</td>
</tr>
<tr>
<td>Diabetes</td>
<td>32.8 (45/137)</td>
<td>32.7 (33/101)</td>
<td>33.6 (40/119)</td>
<td>38.7 (157/406)</td>
<td>36.0 (275/763)</td>
<td>0.45</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>2.3 (3/137)</td>
<td>7.9 (8/101)</td>
<td>7.6 (9/119)</td>
<td>10.3 (42/406)</td>
<td>8.1 (62/763)</td>
<td>0.03</td>
</tr>
<tr>
<td>Chronic bronchitis</td>
<td>5.1 (7/137)</td>
<td>5.9 (6/101)</td>
<td>5.9 (7/119)</td>
<td>9.6 (39/406)</td>
<td>7.7 (59/763)</td>
<td>0.22</td>
</tr>
<tr>
<td>Renal inadequacy</td>
<td>3.6 (5/137)</td>
<td>3.0 (3/101)</td>
<td>5.0 (6/119)</td>
<td>3.7 (15/406)</td>
<td>3.8 (29/763)</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Fracture type, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.526</td>
</tr>
<tr>
<td>Femoral neck fracture</td>
<td>55.5 (76/137)</td>
<td>51.5 (52/101)</td>
<td>52.9 (63/119)</td>
<td>58.4 (237/406)</td>
<td>56.1 (428/763)</td>
<td></td>
</tr>
<tr>
<td>Intertrochanteric fracture</td>
<td>44.5 (61/137)</td>
<td>48.5 (49/101)</td>
<td>47.1 (56/119)</td>
<td>41.6 (169/406)</td>
<td>43.9 (335/763)</td>
<td></td>
</tr>
<tr>
<td><strong>Operating methods, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.002</td>
</tr>
<tr>
<td>Total hip replacement</td>
<td>29.2 (40/137)</td>
<td>15.8 (16/101)</td>
<td>14.3 (17/119)</td>
<td>16.3 (66/406)</td>
<td>18.2 (139/763)</td>
<td></td>
</tr>
<tr>
<td>Hemiarthroplasty</td>
<td>25.5 (35/137)</td>
<td>33.7 (34/101)</td>
<td>37.8 (45/119)</td>
<td>42.1 (171/406)</td>
<td>37.4 (285/763)</td>
<td></td>
</tr>
<tr>
<td>PINA</td>
<td>45.3 (62/137)</td>
<td>50.5 (51/101)</td>
<td>47.9 (57/119)</td>
<td>41.6 (169/406)</td>
<td>44.4 (339/763)</td>
<td></td>
</tr>
<tr>
<td><strong>Anesthesia mode, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Combined spinal-epidural anesthesia</td>
<td>56.9 (78/137)</td>
<td>30.7 (31/101)</td>
<td>40.3 (48/119)</td>
<td>35.7 (145/406)</td>
<td>39.6 (302/763)</td>
<td></td>
</tr>
<tr>
<td>Epidural anesthesia</td>
<td>24.1 (33/137)</td>
<td>49.5 (50/101)</td>
<td>37.8 (45/119)</td>
<td>46.1 (187/406)</td>
<td>41.3 (315/763)</td>
<td></td>
</tr>
<tr>
<td>General anesthesia</td>
<td>19.0 (26/137)</td>
<td>19.8 (20/101)</td>
<td>21.8 (26/119)</td>
<td>18.2 (74/406)</td>
<td>19.1 (146/763)</td>
<td></td>
</tr>
</tbody>
</table>
normality, and then compared between groups by using one-way ANOVA test or Kruskal-Wallis H test, as appropriate. Counting data were described by rate and composition ratio, and the differences between the groups were compared using the chi-squared test (or Fisher's exact probability method). A multivariate logistic regression analysis was employed to examine the independent association between different independent values and postoperative morbidity and mortality. Survival analysis were performed to examine the direct association between different independent values and postoperative death. A value of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Demographic results

A total of 840 cases were included in this study, and complete follow-up data were obtained from 763 patients, with an average follow-up time of 30.4 ± 13.1 months. The mean age of the patients was 79.4 ± 6.8 years. According to the timing of the surgery, the patients were divided into four groups as described above. There was no significant difference in average age, sex, and body mass index between the groups ($P = 0.503$, $P = 0.60$, $P = 0.584$, respectively). The other characteristics of the patients in each group are shown in Table 1. All the data of patient characteristics were extracted from patients’ inpatient medical records.

3.2. Effect of time between admission and operation on postoperative morbidity during hospitalization

The median operative time, blood loss during surgery, drainage volume after surgery, and hospital stay in each group are shown in Table 2. There was no significant difference in operation time, intraoperative hemorrhage, and postoperative drainage among groups A, B, C, and D ($P = 0.23$, $P = 0.70$, $P = 0.79$, respectively). However, there was a significant difference in the duration of hospital stay between the groups ($P < 0.001$, Table 2). As for the postoperative complications, there were significant differences in the occurrence rate of pressure ulcers, lung infection or urinary tract infection ($P = 0.02$, $P = 0.001$, $P < 0.001$, respectively). Patients who underwent surgery within 48 h (group A, group B) had lower pulmonary and urinary infection rates during hospitalization than those who waited for surgery for more than 48 h (group C, group D) ($P = 0.001$, $P < 0.001$). The incidence of pressure sores was higher in patients with delayed surgery (group D) than those with earlier surgery ($P = 0.02$).

Whether the patient developed pressure ulcers, lung infection or urinary tract infection after surgery or more than one of the three complications were used as the criteria to determine whether postoperative complications during hospitalization occurred, and multivariate logistic regression analysis was conducted. The results showed that time from admission to surgery was significantly associated with postoperative complications during hospitalization (OR, 1.108; 95% CI, 1.012–1.123). Other significant variables were age (OR, 1.040; 95% CI, 1.010–1.071) and postoperative drainage (OR, 0.992; 95% CI, 0.980–1.004) (Table 3).

3.3. Effect of time between admission and operation on postoperative mortality

Fisher’s exact probability method results showed that there was no significant difference in mortality among the four groups at 1, 3, and 6 months postsurgery ($P > 0.05$). However, the difference in mortality among the four groups was statistically significant at 1 year postsurgery ($P = 0.046$) (Table 4). Pairwise comparison results showed that the mortality in group A was lower than that of group C ($P = 0.03$) and group D ($P = 0.028$) at 1 year postsurgery. The results ruled out mortality from other causes (e.g., underlying diseases, complications of non-surgical causes).

Kaplan-meier method was used to perform survival analysis at 1 year after surgery. The Log Rank test result of the overall comparison of the survival curves of the four groups was $P = 0.50$. According to the results of Log Rank test, it can be considered that there was no difference in the 1-year survival rate of patients undergoing surgery with different preoperative waiting time. However, the survival functions of each group crossed significantly, indicating the possible existence of confounding factors (Fig. 2), so multivariate logistic regression analysis was used to correct the confounding factors. The result showed 3 factors were identified independently associated with the mortality at 1 year after surgery. The adjusted results are summarized in Table 5, which were: age (OR = 1.104), postoperative drainage volume (OR = 0.992) and time from admission to surgery (OR = 1.117) (Table 5).

Based on the results of multivariate logistic regression analysis, age, postoperative drainage volume and time from admission to surgery were considered to be the influencing factors for the 1-year postoperative survival rate of elderly patients with hip fracture.

### Table 2: Surgical information and postoperative complications during hospitalization in each group [median (lower-upper quartile)].

<table>
<thead>
<tr>
<th>Patient information</th>
<th>Group A (n = 137)</th>
<th>Group B (n = 101)</th>
<th>Group C (n = 119)</th>
<th>Group D (n = 406)</th>
<th>Total (n = 763)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surgical information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation time (min)</td>
<td>170 (140,190)</td>
<td>160 (130,180)</td>
<td>160 (137,180)</td>
<td>155 (140,180)</td>
<td>160 (140,180)</td>
<td>0.23</td>
</tr>
<tr>
<td>Intraoperative</td>
<td>150 (55,200)</td>
<td>100 (50,200)</td>
<td>100 (60,200)</td>
<td>100 (95,200)</td>
<td>100 (80,200)</td>
<td>0.70</td>
</tr>
<tr>
<td>Hemorrhage (mL)</td>
<td>175 (100,310)</td>
<td>150 (100,250)</td>
<td>150 (100,220)</td>
<td>160 (110,235)</td>
<td>160 (100,250)</td>
<td>0.79</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>18 (14,21)</td>
<td>14 (10,18)</td>
<td>16 (11.5,18)</td>
<td>17 (13,21)</td>
<td>17 (13,20)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Postoperative complications, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor incision healing</td>
<td>1.5 (2/137)</td>
<td>2.0 (2/101)</td>
<td>3.4 (4/119)</td>
<td>1.7 (7/406)</td>
<td>2.0 (15/763)</td>
<td>0.68</td>
</tr>
<tr>
<td>Symptomatic DVT/PE</td>
<td>0.7 (1/137)</td>
<td>1.0 (1/101)</td>
<td>2.5 (3/119)</td>
<td>1.2 (5/406)</td>
<td>1.3 (10/763)</td>
<td>0.61</td>
</tr>
<tr>
<td>Major bleeding</td>
<td>4.4 (6/137)</td>
<td>9.9 (10/101)</td>
<td>7.6 (9/119)</td>
<td>11.1 (45/406)</td>
<td>9.2 (70/763)</td>
<td>0.11</td>
</tr>
<tr>
<td>Pressure sore</td>
<td>2.9 (4/137)</td>
<td>5.0 (5/101)</td>
<td>8.4 (10/119)</td>
<td>10.6 (43/406)</td>
<td>8.1 (62/763)</td>
<td>0.02</td>
</tr>
<tr>
<td>Cardiac complications</td>
<td>2.2 (3/137)</td>
<td>2.0 (2/101)</td>
<td>2.5 (3/119)</td>
<td>4.7 (19/406)</td>
<td>3.5 (27/763)</td>
<td>0.34</td>
</tr>
<tr>
<td>Respiratory complications</td>
<td>5.8 (8/137)</td>
<td>5.0 (5/101)</td>
<td>14.3 (17/119)</td>
<td>16.7 (68/406)</td>
<td>12.8 (98/763)</td>
<td>0.001</td>
</tr>
<tr>
<td>Urological complications</td>
<td>3.5 (5/137)</td>
<td>4.0 (4/101)</td>
<td>9.2 (11/119)</td>
<td>14.5 (59/406)</td>
<td>10.4 (79/763)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

### Table 3: Multivariate analysis of risk factors associated with postoperative morbidity during hospitalization.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR and 95% CI</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.040 (1.010–1.071)</td>
<td>0.008</td>
</tr>
<tr>
<td>Postoperative drainage (mL)</td>
<td>1.002 (1.000–1.004)</td>
<td>0.021</td>
</tr>
<tr>
<td>Time from admission to surgery</td>
<td>1.108 (1.012–1.121)</td>
<td>0.026</td>
</tr>
</tbody>
</table>

$OR$ odd ratio, CI: confidential interval.
4. Discussion

Hip fracture is the most common type of fracture in the aging population [11,12]. Patients with hip fractures are often older than 65 years of age and often have hypertension, diabetes, coronary heart disease, bronchitis, and other diseases. Among elderly patients, hip fractures are associated with an in-hospital mortality rate of 7–14% and profound temporary and, sometimes, permanent impairment of independence and quality of life [13]. Some authors recommend that fracture surgery be performed within 24 h of injury for better functional outcomes and lower costs [7,14]. However, many other studies have suggested that a delay in the timing of surgery to medically optimize patients and decrease the risk of perioperative complications [9,15]. At present, an increasing amount of attention is being given to surgical timing regarding the prognosis of hip fracture patients [10,16,17].

4.1. Effect of time between admission and operation on postoperative mortality

The effects of surgical timing on short- and long-term mortality have been investigated in many studies [18,19]. Deaths occurring within 30 days of surgery are generally referred to as short-term deaths, and deaths occurring within 1 year of surgery are referred to as long-term deaths. Several studies have shown that early surgery can reduce short-term mortality in patients with hip fractures [20]. Owing to the deteriorating physical and mental state of elderly patients with hip fractures, they have a high mortality rate, and the effect of operative timing on long-term mortality in patients with hip fractures is often difficult to verify [21–23]. Bohm E et al. conducted an intervention study to assess initiatives aimed at meeting a 48-h benchmark for hip fracture surgery. They found that coordinated, region-wide efforts to improve the timeliness of hip fracture surgery can successfully reduce time-to-surgery and appear to reduce the length of hospital stay and adjusted mortality at 1 year [24]. In an observational, retrospective study, Nyholm et al. showed that patients who underwent a surgical delay of more than 12 h had an increased risk of 30-day mortality, and those who experienced a surgical delay of more than 24 h had increased 90-day mortality [25]. In this study, we found that patients who underwent surgery within 24 h had lower 1-year mortality than those who waited for surgery for more than 48 h after ruling out deaths from other causes. Our data confirmed the previous reports on the association between delayed surgery and increased mortality in elderly patients admitted for hip fracture repair. In addition, age and postoperative drainage are also factors that significantly affect the 1-year postoperative survival rate of elderly patients with hip fracture.

4.2. Effect of time between admission and operation on postoperative morbidity

After hip fracture, patients cannot move due to pain, which affects cough and urination function. Rodríguez-Fernandez et al. retrospectively studied the effect of delayed surgery on the prognosis of hip fractures and found that delayed surgery increased the incidence of urinary tract infection [26]. Our data showed that early surgery (<48 h) can reduce the incidence of pressure ulcers, lung infection, or urinary tract infection after surgery during hospitalization.

Increased age has been well-acknowledged as one of risk factors for postoperative morbidity. In this study, the multivariate logistic regression analysis results showed that the age of patients not only affected the incidence of postoperative morbidity during hospitalization, but also as an important factor affecting the 1-year survival rate of patients. It was a surprising finding that postoperative drainage volume was identified to be associated with postoperative morbidity during hospitalization and 1-year survival rate of patients in multivariate analysis, which was rare mentioned by previous studies. Postoperative wound drainage volume is usually related to the overall and local situations of patients, reflecting coagulation function, degree of wound injury, nutritional status and other factors. This study also suggests that it is related to the long-term survival of patients after surgery, which should be paid attention to by surgeons. The relationship between the timing of surgery and the number of days in hospital has not been universally established. Most reports show that early surgery shortens the overall length of hospital stay [27]. The results of this study showed that the length of hospital stay in different groups was significantly different. However, the comparison between groups showed that early surgery did not significantly shorten the duration of hospitalization. Since the length of a patient’s hospital stay depends on a number of
5. Limitations

There are several limitations in this study. First, this is a single-center, retrospective, case–control study, so there exists a bias in the study design. Second, those with more complex medical conditions or severer injuries may be more likely to undergo late surgery, and this group experienced more complications, which may compromising the effectiveness of the analysis results. Thirdly, the duration of this study is long, some may occur in medical institutions during this period, and the follow-up sample is relatively small. In addition, differences in operating methods and anesthesia mode in each group may also cause results bias. A large prospective study is needed to verify our conclusions.

6. Conclusion

Our results confirmed that a delay between admission and surgery was associated with postoperative morbidity (pulmonary infection, urinary infection, and pressure sores) during hospitalization and mortality at 1 year postsurgery. Surgery performed within 48 h reduces the incidence of postoperative complications during hospitalization and improves 1-year postoperative survival. Attention should be paid to the age of patients and postoperative blood loss from the wound. A better understanding of these risk factors can help surgeons anticipate risk factors and provide the most appropriate treatment for elderly patients with hip fractures.

Author contributions

ZDL, HLX contributed to the final interpretation, abstracted and arbitrated quality data, and wrote the first draft of the manuscript. ZDL and HLX were involved in drafting the manuscript, revising it critically and performed the statistical analysis. ZGF proposed many valuable suggestions for improving the process and helped to draft the manuscript. All authors have read and approved the final manuscript.

Declaration of competing interest

We have no conflict of interests.

Acknowledgements

The authors would like to acknowledge Editage (www.editage.cn) for English language editing.

References


