

Original Article

Analysis of One-year Postoperative Mortality and Risk Factors of Elderly Patients with Intertrochanteric Fractures after PFNA

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ABSTRACT

Background: Intertrochanteric fracture is very common in elderly patients, It is one of the main reasons for the elderly to be hospitalized, and is closely related to the mortality rate. With the speeding up of the population aging, the treatment of intertrochanteric fracture is becoming more and more significant. PFNA (Proximal femoral nail antirotation) is the most commonly used surgical method, although the surgical technique has improved a lot, the postoperative mortality rate after one year is still high. If we can take active and effective control measures against the high-risk factors affecting mortality in time, it will help to improve the prognosis. **Aim:** To study the 1-year postoperative mortality rate of elderly patients with intertrochanteric fractures after being treated with proximal femoral nail antirotation (PFNA) and its influencing factors. **Patients and Methods:** The data of patients with intertrochanteric fracture treated by PFNA in our hospital during the period from August 2016 to April 2020 were retrospectively studied, and the data of age, sex, type of fracture, preoperative comorbid diseases, American Society of Anesthesiology (ASA) score, the timing of the operation, duration of operation, preoperative and postoperative hemoglobin levels, albumin level, and postoperative complications were collected through medical records, and the survival rate of patients in 1 year after operation was investigated by telephone follow-up, and single-factor analysis was carried out to analyze related influencing factors. **Results:** A total of 80 patients with complete data were followed up for 1–23 months (mean 12.5 months), and totally 22 patients died within 1 year, the mortality rate was 27.5%. Single analysis results suggested that the differences in factors such as age, number of preoperative combined diseases, ASA score, preoperative and postoperative albumin levels, and postoperative complications between the survival group and the death group were statistically significant ($P < 0.05$). **Conclusion:** The risk factors affecting long-term death in the treatment of intertrochanteric fractures in elderly patients with PFNA shall be taken into consideration fully, and the improvement of preoperative and postoperative health status will help to reduce the postoperative mortality and improve the efficacy of surgery.

KEYWORDS: Elderly, intertrochanteric fracture, mortality, PFNA, risk factors

With the aging of society, the incidence of hip fractures in the elderly has increased significantly, and hip fractures are mainly intertrochanteric fractures and femoral neck fractures. It is reported that the postoperative mortality of elderly patients with intertrochanteric fractures is higher than that of femoral

neck fractures.^[1] In this study, the 1-year mortality and risk factors of the elderly patients with intertrochanteric

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fractures after being treated PFNA were analyzed. The clinical data of elderly patients with intertrochanteric fracture treated with PFNA from August 2016 to April 2020 in the department of orthopedics of our hospital were retrospectively analyzed based on telephone follow-up and medical records. The risk factors for mortality were evaluated with survival or death in the first year after the operation as a dependent variable and reported as follows.

OBJECTS AND METHODS

Inclusion and exclusion criteria

1. Inclusion criteria: 1) patients with intertrochanteric fracture treated in our hospital during the period from August 2016 to April 2020, 2) patients aged ≥ 60 years who were treated with PFNA performed by the same group of doctors, 3) patients whose injuries were all low energy injuries caused by falls, 4) patients without fractures of other sites, and 5) patients who had been followed up for more than 1 year or till the death of the patient if a patient died within a year. 2. Exclusion criteria: 1) patients aged < 60 years, 2) patients with high energy injuries, such as traffic accident, falling from a height, etc., 3) patients with multiple injuries, and 4) patients with pathological fracture caused by tumors. The study was approved by the ethics committee of The Affiliated Suzhou Science & Technology Town Hospital of Nanjing Medical University, and all the patients signed the informed consent.

Methods

1. Operation methods: All the patients were treated by internal fixation with proximal femoral nail antirotation (PFNA) under general anesthesia, and measures were taken to prevent thrombosis after operation in combination with systematic rehabilitation exercise of limbs.

2. Data collection: The data of age, sex, type of fracture, preoperative combined disease, ASA score, the timing of the operation, duration of operation, preoperative and postoperative hemoglobin levels, albumin level, and postoperative complications were collected through medical records, and the time of death and cause of death of the patients died were investigated through telephone follow-up.

3. Related definitions: 1) The preoperative and postoperative complications included hypertension, diabetes mellitus, sequela of stroke, coronary heart disease, heart failure, chronic obstructive pulmonary disease, pneumonia, pulmonary embolism, and so on, which were classified into > 2 or ≤ 2 according to presence or absence. 2) American Society of Anesthesiology (ASA) score: Score I, those who

were healthy with no systemic disease and good cardiorespiratory function. Score II, those who had mild systemic disease, slight limitation of cardiopulmonary function, and could engage in general activities. Score III, those with slightly serious systemic disease, decompensation of cardiopulmonary function, restriction in general activities, and discomfort. Score IV, those with severe systemic disease, poor cardiopulmonary function, and even discomfort at rest. Score V: those on the verge of death. There were no Score V patients in this study. 3) According to the time from injury to surgery, the patients were divided into those having surgery within 48 h and those having surgery over 48 h these two types. 4) According to Arbeitsgemeinschaft Fur Osteosynthesefragen (AO)/Orthopedic Trauma Association (OTA) classification, type A1.1-A2.1 intertrochanteric fractures were stable, and type A2.2-A3.3 intertrochanteric fractures were extremely unstable.^[2]

4. Statistical methods: All the data were analyzed with SPSS 21.0 statistical software with the above risk factors as the independent variables and the survival state (Death or survival) of patients 1 year after the operation as the dependent variables, and comparison of single factor counting data between groups was made by χ^2 test. $P < 0.05$ was considered statistically significant.

RESULTS

General information

In this study, a total of 80 patients including 35 males and 45 females (31 patients aged 60–75 years, 26 patients aged 76–85 years, and 23 patients aged over 85 years) were enrolled. Among them, 37 cases were with intertrochanteric fractures classified as A1.1-A2.1, 43 cases were with intertrochanteric fractures classified as A2.2-A3.3, 31 cases had surgery within 48 h after injury, 39 cases had surgery over 48 h after injury, 60 cases had not more than two types of comorbid diseases, 20 patients had more than two kinds of comorbid diseases, 39 cases were with ASA score I to II and 41 patients were with ASA score III to IV, 48 cases had preoperative hemoglobin level less than 110 g/L, 32 cases had preoperative hemoglobin level ≥ 110 g/L, 14 cases had preoperative albumin level less than 30 g/L, 66 patients had preoperative albumin level more than 30 g/L, 10 cases had surgery time less than 1 h, 50 cases had operation time between 1 and 2 h, 20 cases had surgery time more than 2 h, 67 cases had postoperative hemoglobin level less than 110 g/L, 13 cases had postoperative hemoglobin level not less than 110 g/L, 34 cases had postoperative albumin

Table 1 Single factor analysis of one-year mortality of elderly patients with intertrochanteric fractures after PFNA

Influencing factors	Death group (n=22)	Survival group (n=58)	χ^2	P
Sex			0.482	0.488
male	11	24		
female	11	34		
Age			7.032	0.03
60~75	5	26		
76~85	6	20		
>85	11	12		
Type of fracture			2.542	0.111
Stable (A1.1~A2.1)	7	30		
Unstable (A2.2~A3.3)	15	28		
Timing of operation			0.614	0.433
≤48h	7	24		
>48h	15	34		
Preoperative combined disease			6.771	0.009
≤2 kinds	12	48		
>2 kinds	10	10		
ASA score			8.225	0.004
I~II	5	34		
III~IV	17	24		
Preoperative hemoglobin level (g/L)			2.048	0.152
<110	16	32		
≥110	6	26		
Preoperative albumin level (g/L)			11.518	0.001
≤30	9	5		
>30	13	53		
Duration of operation			0.071	0.965
<1h	5	5		
1~2h	12	38		
>2h	5	15		
Postoperative hemoglobin level (g/L)			2.709	0.1
<110	16	51		
≥110	6	7		
Postoperative albumin level (g/L)			5.547	0.019
≤30	14	20		
>30	8	38		
Postoperative complications			10.948	0.001
≤2 kinds	9	46		
>2 kinds	13	12		

level not less than 30 g/L, 46 cases had albumin level more than 30 g/L, 55 cases had less than two kinds of postoperative complications, and 25 cases had more than two kinds of postoperative complications.

Follow-up results

The follow-up period ranged from 1 to 23 months (Mean 12.5 months) and in a year after the operation, totally 22 cases died and 58 cases survived, and the mortality rate was 27.5%. The causes of death were as follows: Six cases of cardiovascular accident, two cases of cerebrovascular accident, eight cases of pulmonary infection, and six cases of other reasons.

Correlation analysis

Single-factor analysis results indicated that differences in factors such as age, preoperative combined disease, ASA score, preoperative and postoperative albumin levels, and postoperative complications between the survival group and the death group were statistically significant ($P < 0.05$), and there were no statistically significant differences in sex, fracture type, operation time, and preoperative and postoperative hemoglobin levels between the survival group and the death group ($P > 0.05$) [Table 1].

DISCUSSIONS

Intertrochanteric fractures often occur in the elderly and are usually caused by minor traumatic injuries such as falls. The conservative treatment is mainly bed rest, but the elderly normally have many basic diseases and poor general situation, long-term bed rest is easily leads to cardiovascular and cerebrovascular diseases, pneumonia, pulmonary embolism, muscular atrophy, bedsores, and other complications which are even life-threatening. At present, PFNA treatment is often recommended. PFNA is of the following advantages: 1. minimally invasive, easy operation, less trauma, and quick recovery after the operation, 2. conforming to biomechanics fixation and beneficial to fracture healing, and 3. suitable for all kinds of intertrochanteric fractures based on characteristics of osteoporosis of the elderly. Despite these advantages, a high postoperative mortality rate has been reported in the literature.^[3] There are many factors influencing the 1 year mortality rate of elderly patients with intertrochanteric fractures after PFNA, and it is beneficial to improve the outcome if active and effective control measures can be taken timely for high-risk factors influencing the mortality.^[4] In this study, the single factor analysis results suggested that the differences in age, the number of preoperative comorbid diseases, ASA score, preoperative and postoperative albumin levels, and postoperative complications between the survival group and the death group were statistically significant ($P < 0.05$).

1. Age factor There is considerable controversy in the literature, many scholars^[5] argue that with the increase in age, organ aging, low body immunity, obviously lower stress ability to operation, anesthesia, trauma, and cardiovascular and cerebrovascular diseases, pneumonia and other complications, the death rate of the elderly goes up. However, some scholars^[6] have found that age is not an independent factor affecting postoperative mortality after excluding the differences in preoperative complications. The results of this study showed that the mortality rate of patients aged 60–75 was 16.1%, that of patients aged 76–85 was 23.1%, and that of patients aged over 85 years old was as high as 47.8%, indicating that the elderly patients suffered from functional failure had a high mortality rate under various effects such as trauma, operation, and anesthesia.

2. Preoperative comorbid disease and ASA score factors It is reported that^[7] the number of preoperative comorbid diseases of more than two is an independent risk factor after a hip fracture operation. A high ASA score indicates that the patients have multiple preoperative comorbid diseases. The most common preoperative comorbid diseases are cardiovascular and

cerebrovascular diseases and chronic lung diseases. Patients with cardiovascular disease are likely to be induced coronary artery spasms, resulting in insufficient coronary perfusion, myocardial infarction, arrhythmias, and even heart failure under the stress of fracture trauma, surgery, and anesthesia. Roche *et al.*^[8] reported that the 30-day mortality of patients with hip fracture comorbid with cardiac insufficiency after the operation was eight times higher than that of healthy patients, and the 1-year postoperative mortality was five times higher than that of healthy patients. Patients with sequela of cerebral infarction before the operation are likely to be induced cerebral infarction again because of the great fluctuation of blood pressure during or after the operation, which will cause respiratory and circulatory disturbance, exacerbating pneumonia and lung infection, and the death rate is increased accordingly. Luise *et al.*^[9] found that the preoperative mortality rate of patients with COPD was 60%–70% higher than that of those without COPD by following up on nearly 1,000 elderly patients with hip fractures. Patients with lung disease after the operation are more likely to be induced lung infection, systemic inflammatory reaction, organ dysfunction, or even multiple organ dysfunction, and the death rate is increased accordingly.

3. Preoperative and postoperative albumin level factors Albumin level is one of the commonly used indicators for clinical observation of the nutritional status of patients. Malnutrition of elderly patients is the result of many factors, such as natural aging, disease, trauma and stress, insufficient nutrition intake, and excessive loss. Chung *et al.*^[10] reported that patients with mild, moderate, and severe malnutrition had 15%, 34%, and 67% higher death risk after hip fracture operation than those in the control group. In this study, we found that there were significant differences in preoperative and postoperative low albumin levels between the death group and the survival group, suggesting that the improvement of preoperative and postoperative nutritional status of them has a positive effect on the outcome.

4. Factor of postoperative complications The common postoperative complications in elderly patients with hip fracture include cardiovascular disease, lung infection, anemia, electrolyte disturbance, hypoalbuminemia, etc., and the number and type of postoperative complications are considered to be important factors influencing the survival of patients.^[11] The multiple hits of trauma, anesthesia, and surgery result in the redistribution of the patient's fluid circulation, weakening of the compensatory ability of multiple organs, the increase in myocardial oxygen consumption, and the insufficiency

of coronary perfusion, which may cause complications such as arrhythmia, myocardial infarction, and heart failure. Compared to patients without cardiovascular problems, some studies have reported a 92% increase in 1-year mortality after surgery.^[7] Pulmonary infection is one of the most common postoperative complications in elderly patients, mainly because: 1. with the increase in age, the patients have decreased immunity, impaired function of respiratory mucosa, and decreased lung compliance, 2. air duct injury caused by general anesthesia intubation, 3. restricted cough function caused by pain, 4. Dropsy pneumonia caused by long-term bed rest, and 5. decreased organ compensation ability caused by postoperative anemia and hypoproteinemia. Lung infection is also considered to be the initiating factor for multiple organ failure.^[12] It is found that lung infection and respiratory failure are the leading causes of death for the elderly with hip fractures.^[13] In this study, we found that the main causes of death in the death group were cardiovascular disease and pulmonary infection. Therefore, measures should be taken to improve cardiac function and actively prevent pulmonary infection after operation for patients with poor cardiorespiratory function, especially patients who have comorbidity with cardiopulmonary insufficiency, which has a positive effect on improving the survival rate after the operation.

5. Other factors: In this study, the results did not suggest that there were significant differences in factors such as sex, fracture type, the timing of the operation, duration of operation, and hemoglobin level between the death group and the survival group. The influence of gender on the survival rate of patients after hip fracture surgery is controversial in the literature, and some scholars^[14] believe that male patients' risk of concurrent cardiovascular and cerebrovascular disease is higher than that of female patients because they have more bad habits such as smoking and drinking than female patients, so the postoperative mortality rate is higher. However, some scholars^[15] have found that gender itself does not influence postoperative mortality after excluding the risk of complications. With good stability after the operation and good efficacy for patients with unstable fractures, PFNA is simple to be operated, and the operation duration of PFNA was 1–2 hours in most cases of the group. In this study, there were no significant differences in the factors such as fracture type, operation time, hemoglobin level, and so on between the death group and the survival group. It is thought that^[16] early operation is favorable for pain relief so that patients can have functional exercises earlier, so as to reduce the bed rest time and various complications. However, due to many underlying diseases and limited organ compensation ability, elderly patients are likely to suffer

from excessive physiological burden due to multiple hits of trauma, anesthesia, and surgery, thus increasing their risk of death. We believe that early surgery can reduce the risk of postoperative complications and death of patients without specific underlying diseases, and it is beneficial to reduce the mortality rate after operation by actively correcting the comorbid diseases before operation and operating as soon as the physical conditions permit for elderly patients with many underlying diseases and poor physical conditions.

To sum up, factors such as age, number of preoperative combined diseases, ASA score, albumin level, and postoperative complications should be taken into full consideration when treating elderly patients with intertrochanteric fracture by PFNA, and active correction of preoperative and postoperative complications and improvement of patients' nutritional status will improve the outcome and increase the survival rate of patients. This study has some shortcomings such as a small sample size, single-center retrospective study, incomplete data, etc., which may lead to deviations. In the future, a multicenter study with a large sample size is expected to better illustrate the risk factors for the survival rate of elderly patients with intertrochanteric fractures after PFNA.

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Conflicts of interest

There are no conflicts of interest.

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