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ORIGINAL ARTICLE • HIP - FRACTURES

Analysis of risk factors for perioperative mortality in elderly patients with intertrochanteric fracture

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Abstract

Objective To investigate risk factors for perioperative death in elderly patients with intertrochanteric fracture.

Methods Clinical data from 1051 cases with intertrochanteric fracture from March 2005 to March 2015 were reviewed and analyzed, and causes of death during the perioperative period were statistically analyzed. Various indicators were compared by t test and χ^2 test. Multivariate analysis was performed using non-conditional logistic regression analysis.

Results Chronic diseases of major organs (heart, brain, and lung), postoperative complications, and various indicators within 24 h after admission (albumin, hemoglobin, brain natriuretic peptide [BNP], glucose, creatinine, arterial blood pH, PaO^2, and APACHE II) were statistically significantly different between patients who survived and those who died. Logistic regression analysis indicated that postoperative complications, APACHE II score, BNP, and chronic diseases of major organs were the risk factors for perioperative mortality in elderly patients with intertrochanteric fracture.

Conclusion BNP and APACHE II score could be used as important reference indexes for predicting possible perioperative mortality in elderly patients with intertrochanteric fracture and chronic diseases of major organs. Complications after fracture may be also risk factors.

Keywords Elderly patients · Intertrochanteric fracture · Perioperative mortality · Risk factors

Introduction

Intertrochanteric fracture often occurs in the elderly population [1]. With the rapid development of society and aging of the population, the number of elderly patients with intertrochanteric fractures is increasing every year [2]. Because of the combined effect of comprehensive factors such as physiological decline, underlying diseases, trauma reaction, and complications, high mortality rates are seen in elderly patients with intertrochanteric fractures [3]. The mainstay of treatment choice for intertrochanteric fracture is surgery [4]. However, elderly patients often have more underlying diseases, making perioperative management of intertrochanteric fractures in elderly patients a very difficult problem for physicians in orthopedics departments [5]. And some studies focused on factors predicting the mortality rate of patients with intertrochanteric fractures [6–9] and other factors predicting mortality, such as age, sex, blood albumin, hemoglobin, BNP, blood glucose, creatinine, arterial blood pH, PaO^2, and APACHE II score within 24 h after admission. Age, respiration, body temperature, heart rate, mean arterial pressure, blood sodium, blood potassium, type of anesthesia, postoperative complications, and chronic disease of major organs have been less analyzed together in the same study.

Fully understanding the risk factors for perioperative mortality in elderly patients with intertrochanteric fractures would enable active and reasonable treatment to ensure the safety of the operation and improve the operative effect to better restore the patient's function, prolong the patient's life, and reduce perioperative mortality.

This study retrospectively analyzed the main causes of death in elderly patients with intertrochanteric fractures during the perioperative period in order to identify risk factors. And we tried to determine the effects of these factors on perioperative mortality in patients with intertrochanteric fractures in the elderly.

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Data and methods

Criteria for inclusion and exclusion of cases

Criteria for case inclusion in the study were age 65 years or older; patients with intertrochanteric fracture confirmed by X-ray; patient able to provide basic self-care; patient without cognitive impairment before the fracture; and patients' agreement to be included in the study. Case exclusion criteria were multiple fractures; intertrochanteric fracture caused by a tumor; obsolete fracture; and patients with mental illness.

Research objectives

From March 2005 to March 2015, 1080 elderly patients with intertrochanteric fractures were admitted to our hospital. According to the inclusion and exclusion criteria, 29 patients did not meet the criteria for inclusion (12 patients with pathological fractures and 17 with obsolete fractures). Finally, the study included 1051 patients, including 515 males (49.00%) and 536 females (51.00%); the average age was 84.68 ± 19.25 years (range, 65–104 years). According to the AO/OTA fracture classification system, there were 122 patients with A1.1, 121 with A1.2, 111 with A1.3, 125 with A2.1, 118 with A2.2, 112 with A2.3, 109 with A3.1, 116 with A3.2 and 117 with A3.3.

Treatments after admission

After admission, patients' vital signs were closely observed. Patients who underwent limb continuous skin traction in order to reduce pain were also observed. Conditions before the patient's injury such as living conditions, basic diseases, and drugs were fully understood. The relevant preoperative examination was perfected to develop a complete preoperative assessment. When necessary, a physician was consulted to actively control the corresponding medical diseases. The general operation was done 2–5 days after the injury. Intramedullary nail fixation was used by the same group of surgeons.

Research methods

According to whether death occurred, 1051 elderly patients with intertrochanteric fractures were divided into the survival group (985 patients) and the death group (66 patients) and the following observation indexes were entered into the database: gender, age, chronic diseases of major organs (heart, brain, and lung), mode of anesthesia, postoperative complications, and various indicators within 24 h after admission (body temperature, respiration, heart rate, brain natriuretic peptide (BNP), albumin, hemoglobin, blood glucose, serum sodium and potassium, creatinine, arterial blood pH value, arterial oxygen pressure, mean arterial pressure, and Acute Physiology And Chronic Health Evaluation [APACHE] II score) and the average value of the indicators was recorded.

Statistical analysis

Statistical analysis was performed using the SPSS 22.0 statistical software analysis system. Measurement data were compared with t test, and data are reported as the mean ± standard deviation (SD). Numerical data were compared with χ^2 test. Risk factors for death in elderly patients with intertrochanteric fractures were analyzed using non-conditional logistic regression. The difference in the effective rate was statistically significant at $P < 0.05$.

Results

Distribution of the causes of death during the perioperative period is shown in Table 1.

Single-factor analysis

Measurement data

There were statistically significant differences in main factors between the survival group and the death group including blood albumin, hemoglobin, BNP, blood glucose, creatinine, arterial blood pH, PaO^2, and APACHE II score within 24 h after admission. There were no statistically significant differences between the two groups with respect to age, respiration, body temperature, heart rate, mean arterial pressure, blood sodium, or blood potassium (Table 2).

Table 1 Distribution of causes of death during the perioperative period

Cause of death	*N*	Percentage
Cardiovascular accident	18	27.27
Multiple organ failure	16	24.24
Cerebrovascular accident	15	22.72
Pulmonary infection	15	22.72
Hemorrhage of digestive tract	1	1.51
Other	1	1.51

Numerical data

There were significant differences in postoperative complications and chronic disease of major organs between the two groups. But there was no significant difference in gender or the mode of anesthesia between the two groups (Table 3).

Non-conditional logistic regression analysis of risk factors for death

Ten factors were statistically significant ($P < 0.05$) in the single-factor analysis. These factors were determined by logistic regression analysis. The results showed that postoperative complications, BNP, APACHE II scores, and chronic diseases of major organs had an impact on the occurrence of death (Table 4).

Table 2 Comparison of measurement data between the survival and death groups

Index	Death group	Survival group	*t*	*P*
Mean age ± SD (years)	84.55 ± 5.71	82.90 ± 3.27	− 0.643	0.509
Temperature (°C)	37.46 ± 0.58	37.31 ± 0.66	0.371	0.613
Respiratory rate	23.98 ± 4.23	24.04 ± 4.03	− 1.641	1.123
Heart rate	109.63 ± 19.93	106.22 ± 13.56	− 1.199	0.179
BNP (pg/mL)	744.34 ± 609.18	479.15 ± 303.94	0.599	0.002
Blood albumin (g/L)	27.39 ± 6.16	29.25 ± 5.98	− 2.894	0.034
Hemoglobin (g/L)	109.69 ± 21.33	89.14 ± 29.66	1.410	0.040
Blood glucose (mmol/L)	17.73 ± 6.81	13.46 ± 6.54	1.194	0.034
Creatinine (mmol/L)	109.74 ± 91.95	91.84 ± 84.31	− 2.292	0.029
Blood sodium (mmol/L)	136.16 ± 7.79	137.52 ± 7.13	0.212	0.882
Blood potassium (mmol/L)	4.74 ± 0.31	4.78 ± 0.36	− 0.369	0.517
Blood pH	7.35 ± 0.22	7.35 ± 0.19	3.181	0.038
Arterial oxygen partial press (mmHg)	83.19 ± 3.33	90.68 ± 14.57	2.234	0.009
Mean arterial pressure (mm Hg)	91.91 ± 17.94	92.07 ± 16.42	0.607	0.653
APACHE II score	31.66 ± 7.52	19.44 ± 5.25	− 6.753	0.001

Table 3 Comparison of numerical data between the death and survival groups

Index	Death group ($n = 66$)	Survival group ($n = 985$)	χ^2	*P*
Sex, males/females	35/31	480/505	7.345	0.897
Postoperative complications, yes/no	37/29	345/640	6.459	0.031
Chronic disease of major organs, yes/no	34/32	234/751	7.133	0.004
Mode of anesthesia, general/intravertebral	20/46	491/494	4.284	0.311

Table 4 Non-conditional logistic regression analysis of risk factors for death

Variable	PE	SE	Wald	*P*	OR	95% CI
BNP	− 0.742	0.332	20.301	0.000	0.421	0.483, 0.524
Blood albumin	− 1.720	0.698	17.093	0.533	0.099	0.037, 1.432
Hemoglobin	− 2.541	0.993	6.532	0.472	0.150	0.813, 1.625
Blood glucose	− 3.180	0.849	3.171	0.924	0.801	0.955, 0.827
Creatinine	1.059	0.412	7.462	0.519	0.228	0.123, 1.624
Blood pH	1.541	0.625	5.532	0.414	0.293	0.217, 1.429
Arterial oxygen partial press	− 1.966	0.861	3.468	1.028	0.920	0.824, 1.877
APACHE II score	5.112	1.802	19.737	0.000	19.722	8.96, 25.23
Postoperative complications	− 0.012	0.004	6.951	0.022	0.903	0.986, 1.286
Chronic disease of major organs	− 1.908	1.093	3.994	0.046	0.514	0.026, 0.846
Constant	− 2.195	2.934	0.806	0.257	0.157	

SE standard error, *PE* parameter estimation, *OR* odds ratio, *CI* confidence interval

Discussion

With the aging of the population, more and more patients are subject to intertrochanteric fractures [10]. Due to weaker physical functioning, elderly patients often have a variety of underlying internal diseases and may have severe osteoporosis. Intertrochanteric fracture is one of the main causes of death in elderly patients [11]. If the patient's condition allows, they should be treated as early as possible after the fracture to prevent more complications [12].

Complications after traumatic fracture are often further aggravated and the difficulty of treatment increases, which makes the mortality and complications from intertrochanteric fractures very high in the elderly [13]. Therefore, fully understanding the risk factors for perioperative mortality and providing timely and reasonable perioperative treatments for elderly patients with intertrochanteric fractures is needed and is the key to safety and stability during the perioperative period. In order to fully understand the risk factors for perioperative mortality in elderly patients with intertrochanteric fractures, we retrospectively studied data from 1051 elderly patients who had intertrochanteric fractures and analyzed the possible factors influencing perioperative mortality.

Cardio-cerebral vascular accidents, pulmonary infection, and multiple organ failure were the main causes of perioperative death in elderly patients with intertrochanteric fractures. Univariate analysis showed that blood albumin, hemoglobin, BNP, blood glucose, creatinine, arterial blood pH, PaO^2, and APACHE II score within 24 h after admission were risk factors for death in elderly patients with intertrochanteric fractures. Therefore, for patients with these risk factors, we should actively find and deal with internal medical complications before the operation to prevent an internal imbalance of the body. According to each patient's specific conditions, we conducted a targeted auxiliary examination, made full preparation and an evaluation before the operation, and determined the time for the operation. At the same time, we need to adopt advanced means for multifaceted monitoring, especially the monitoring of the respiratory, cardio-cerebral vascular systems, and liver and kidney functions. In order to achieve the expected effect, we should also strive for early recognition and active treatment of postoperative complications and prevent the deterioration of the disease.

Non-conditional logistic regression analysis showed that postoperative complications, BNP, APACHE II scores, and chronic diseases of major organs were risk factors for death. More preoperative chronic diseases of major organs and postoperative complications, as well as higher values of BNP and APACHE II score, could indicate a greater risk of death in elderly patients with intertrochanteric fractures. Therefore, during clinical observations, we should raise the importance of the two indicators of BNP and APACHE II score.

BNP is a hormone released from cardiac myocytes [14]. Studies have shown that an increase in BNP concentration is positively correlated with the degree of damage to cardiac function [15]. When patients are adequately treated but still maintain a high BNP level, it indicates that the patient's prognosis is poor. Therefore, BNP concentration should be monitored during the perioperative period in elderly patients with intertrochanteric fractures. The occurrence of cardiovascular accidents could be avoided.

The APACHE II score can predict the incidence of surgical mortality and complications [16]. According to the risk assessment, decisions can be made as to whether the operation should be done immediately or if conservative treatment should be administered.

Our study has some limitations. There were 27 cases of death in preoperative stage and 39 cases of death in postoperative stage. Although 1051 patients were given painless treatment, we still did not know whether postoperative death was related to surgical complications. According to these results of a large retrospective study, we have examined only these risk factors on perioperative mortality in patients with intertrochanteric fractures in the elderly.

Perioperative deaths that occur in elderly patients with intertrochanteric fracture are the result of interactions between various risk factors, but the effect of each risk factor on mortality risk is different. Our study found that BNP, APACHE II score, chronic diseases of major organs, and postoperative complications were risk factors with a relatively large impact on perioperative deaths in elderly patients with intertrochanteric fractures. So the patient with high BNP, high APACHE II score, chronic diseases of major organs, and postoperative complications need to be carefully assessed, because they may have higher risk of perioperative deaths. These results may provide clinically useful information and correct evaluation for the patients.

Conclusions

We consider BNP and APACHE II score could be used as important reference indexes for predicting possible perioperative mortality in elderly patients with intertrochanteric fracture and chronic diseases of major organs. Complications after fracture may be also risk factors.

Compliance with ethical standards

Conflict of interest The authors declare that we have no conflict of interest.

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