Preoperative anemia and hospitalization time are the independent factors of preoperative deep venous thromboembolism in Chinese elderly with hip fracture

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Abstract

Aim This study was designed to explore the prevalence condition and risk factors of preoperative deep venous thromboembolism (DVT) in Chinese elderly with hip fracture.

Methods From January 1, 2012, to December 31, 2018, 273 elderly over 70 years old with elective hip surgery were collected from the electronic medical records. Collected Data included demographic characteristics, comorbidities, ASA classification, types of surgeries, types of anesthesia, operation time, fracture to operation time, perioperative blood transfusion, preoperative hemoglobin level, anemia, blood-gas analysis, cardiac function, electrocardiograph, lower limb venous ultrasound and hospitalization time.

Results In all patients, 15 patients (5.6%) had venographic evidence of DVT in affected limbs before surgery. Three of all patients received an temporary inferior vena cave filter placement. Fracture to surgery time, preoperative hemoglobin level, anemia, pulmonary disease and hospitalization time were statistically different between DVT group and non-DVT group (P<0.05 for all). Moreover, preoperative anemia (OR: 0.144, 95%CI: 0.026-0.799, P=0.027) and hospitalization time (OR: 1.135; 95%CI: 1.023-1.259, P=0.017) were the two independent risk factors for preoperative DVT. Conclusion Preoperative anemia and hospitalization time were independent risk factors for venous DVT in Chinese elderly with hip fracture.

Background

Venous thromboembolism (VTE) including deep vein thrombosis (DVT) and pulmonary embolism (PE) is a serious and preventable complication after hip fracture[1, 2–4]. The risk for VTE among patients undergoing major orthopedic surgery, particularly hip fracture surgery, is the highest among all surgical patients. The incidence of DVT has been reported to be as high as 80% in patients without prophylaxis measures. If prophylaxis
measures are taken, it also can reach up to 9% to 62%[2–6]. Pedersen et al.[7] have proposed that hip fracture was associated with increased subsequent risk of VTE in a population-based cohort study of 110563 patients with incident hip fracture. The risk of VTE increased 17-fold in the first 30 days after hip fracture, declining to a 2.1-fold increase from 31 to 365 days following hip fracture. Risk factors for VTE include age, obesity, chronic obstructive pulmonary disease, atrial fibrillation, anemia, depression, trauma, total knee arthroplasty, hypercoagulable states and postoperative complications[8]. Shahi et al have also pointed out that the advanced age (greater than 70 years old, OR: 1.3, 95% CI:1.1–1.4) is the risk factors for developing in-hospital VTE[9]. Moreover, hip fracture surgery is an urgent surgical procedure that should be performed as early as possible after fracture. It has been reported that preoperative DVT had an incidence of 6–9% in patients with hip fracture receiving surgery within the 48 hours, whereas the rate could be raised to 54.5–62% when there was a delay for more than 48h [10]. However, because these kinds of patients usually have more severe comorbidities, which are often required multi-disciplinary consultation and preoperation prepare and evaluation, these patients often have a delayed surgery for 48h and even developed DVT preoperatively. There may be several reasons leading to these negative results: the lower extremities surgery, prolonged immobility during the post-operative period, and coagulation-fibrinolysis system activity during the surgery [11]. However, limited studies has been performed to observe the risk factors of preoperative DVT in Chinese elderly over 70 years old with hip fracture. Thus, the purpose of this study was to explore the prevalence condition and risk factors of preoperative DVT in Chinese elderly over 70 years old with hip fracture.

Patients And Methods

This retrospective single-center study enrolled 273 patients over 70 years old with hip
fracture and elective surgery in Hainan Hospital of Chinese People’s Liberation Army general hospital from January 1, 2012 to December 31, 2018. Exclusion criteria for this study included age<70 years, multi-type of fracture and conservation treatment. All Data were collected from the electronic medical records. Collected Data included demographic characteristics, comorbidities (including diabetes, hypertension, stroke, ischaemic heart disease, arrhythmia, congestive heart failure, and COPD). Hemoglobin level, erythrocyte sedimentation, ESR, D-dimer, ASA classification, types of surgeries, types of anesthesia, operation time, fracture to operation time, perioperative blood transfusion, preoperative hemoglobin level, anemia, blood-gas analysis, cardiac function, electrocardiograph, lower limb venous ultrasound and hospitalization time. Types of hip fractures included the femoral neck, intertrochanteric, subtrochanteric, and proximal shaft fractures. Performed surgeries included hip replacement and fixation procedures. All of the patients received venography ultrasound in lower limbs before operation. DVTs were classified into three types: central type, peripheral type, and mixed type. Central type referred to thrombus occurring in iliac and femoral veins. Peripheral type was defined as thrombosis in calf veins. DVT was classified as mixed type when involving the whole deep venous system of lower limb. Venography was performed again before leave hospital. The diagnosis of DVT was according to Robinov group’s criterion [12]. Besides, the definition of preexisting anemia in this study is (male Hb < 120 g/L, female Hb < 110 g/L).

Statistically analysis

Continuous data were presented as the means and standard deviations (SD). Categorical data were presented as the numbers and percentages. Univariate logistic regression analyses were performed to detect the risk factors through the comparison between DVT group and non-DVT group. These factors were then included in multivariate logistic regression analyses to detect the risk factors independently affecting the DVT. Odds ratios
were displayed with a 95% confidence interval if the p<0.05. P<0.05 was considered statistically significant. All data were analyzed in Statistic Package for Social Science (SPSS) version 19.0 (SPSS Inc, Chicago, USA).

Results

Clinical characteristics

All patients had an average age of 78.2±11 years, and 57% were women. There were 3.4% of patients with surgery within the 48 hours after the fracture. Fifteen patients (5.6%) had limb DVT (10 cases were peripheral type and 5 cases were central type). No PE occurred in the perioperative period.

Univariate analyses

In the univariate analysis, fracture to surgery time, preoperative hemoglobin level, anemia, pulmonary disease and hospitalization time were statistically different between DVT group and non-DVT group (P<0.05 for all). There were no statistical difference between two groups in age, gender, diabetes, hypertension, stroke, ischaemic heart disease, arrhythmia, congestive heart failure, international normalized ratio (INR) and ESR (P>0.05) (Table 1).

Multivariate analyses

Multivariate logistic regression analyses confirmed that preoperative anemia (OR: 0.144, 95% CI: 0.026–0.799, P = 0.027) and hospitalization time (OR: 1.135; 95%CI: 1.023–1.259, P = 0.017) were the two independent risk factors for preoperative DVT (Table 2).

Discussion

This study demonstrated that the overall incidence of DVT after hip fracture was 5.6%, and no PE occurred in all patients. In addition, multivariate logistic regression analyses indicated that pre-operative anemia and hospitalization time were the independent risk factors for preoperative DVT after hip fracture. However, 3.4% of patients underwent the
surgery within the 48 hours after the fracture.

Hip fracture is one of the most common orthopedic conditions. The risk of VTE in patients with hip fracture is massive, which is the second most frequent complication of surgery. Previous research has shown that, in the absence of VTE prophylaxis, total and proximal DVT rates were approximately 50% and 27%, respectively [2]. Reboerts et al[3] and Hefley et al[4] have reported that the incidence of DVT was about 6%-9% in patients with hip fracture. They have pointed out that the main risk for these results was delayed surgery. In addition, Wong et al have been reported that the incidence of VTE was 6.4% after proximal hip fracture in Singapore[5]. Mok et al have also reported that the incidence of VTE was 8% after proximal hip fracture in Hong Kong[6]. All above results are the same to our results. What’s more, there was an epidemiological study about the DVT rate after major orthopedic surgery in Asia, which has indicated that the rate of DVT observed after hip fracture surgery(42%) was similar to those reported in western patients(36-60%), but the rate of proximal DVT was lower (7.2% vs 17-36%)[13]. After reviewing all these papers, it seems prudent to perform surgery as early as possible in order to improve the recovery and reduce peri-operation the mortality, morbidity and other complications, preferably within the 48 hours after the fracture.

Unfortunately, in this study, only 3.4% of patients were undergoing surgery within the 48 hours after the fracture. Delayed surgery for these kinds of patients is known to be one of the most important factors contributing to the high incidence of preoperative DVT [4]. The guidelines from the United States and Canada have recommend that hip fracture surgery should within the 48 hours after the fracture [14]. The same study has also pointed out that waiting time longer than 24 hours was associated with the higher risk-adjusted likelihood of 30-day mortality(6.5% vs 5.8%)[15]. However, multi-disciplinary consultation and preoperative evaluation are often required owing to the prevalence of severe
comorbidities in these patients. They are often delayed for 48 hours or even have preoperative DVT. In clinical work, targeting within the 48 hours, even in the 24 hours, represents a significant change in practice because 66% of the patients did not receive surgery within time frame [15]. But it is difficult to according this standard, especially in the developing country. In a prospective epidemiological study in the 19 centers across Asia, the time between hip fracture and surgery mean days was 11.0±12.4 in patients undergoing elective orthopedic surgery[13].

Globally, the prevalence of anemia is 12.7% for men and 23.9% for the elderly [16], which is associated with worse outcome [17]. However, the incidence of anemia at admission in individuals with hip fracture is high, varying from 12.3% with hemoglobin level less than 10 g/dL to 40.4% with hemoglobin level less than 12 g/dL[18]. Even over half the patients with hip fracture are anemic at admission [19]. Anemia in patients with hip fracture is closely related to increased mortality, prolong admission, higher readmission rate and increased mortality rate [20]. Halm et al. have observed the anemia (hemoglobin<12.0 g.dl) at admission in 40.4% of 550 patients with hip fracture, and reported that anemia at admission was related to hospitalization time and death or readmission with the 60 days [21]. The lower hemoglobin level at admission is not owing to bleeding from trochanteric fracture, but reflects the anemia before the injury. Anemia contributes to and is connected with reduced physiological reserve, function and mobility [22], which may increase VTE risk and prolong hospitalization time. Smith et al have reported that the average delay of surgery was 5.7 days for patients with DVT versus 3.2 days for those without DVT (p = 0.021)[22]. Recently study has also indicated that preoperative anemia (Hemoglobin<10.0 g/dl) was independently associated with lower 6-month functional scores and lower physical health-related quality of life scores for hip fracture surgery[24]. Preoperative anemia in individuals undergoing orthopedic surgery is associated with perioperative
blood transfusion, which can be connected with longer hospital stays[25]. Furthermore, most patients in this study often had cardiovascular disease before surgery, which reminded that we should actively correct perioperative low hemoglobin to reduce the risk of cardiovascular events.

Hip fracture is common, costly, and often associated with poor outcome among older adults. It is logical to perform surgery as early as possible in order to avoid these complications. However, a longer period of preoperative evaluation and optimization will always be necessary. Besides, more and more evidence have suggested that comprehensive geriatric assessment decreased the risks of complications after hip fracture[26]. Reducing hospitalization time including early discharge to home or rehabilitation facilities can reduce the high case-fatality rate and healthcare costs, and increase the numbers of available public hospital beds[27]. The aim of lowering the costs of hospital-based care must be balanced against the clinical needs of the patients.

Nordstrom et al have also pointed out that the shorter hospitalization time after hip fracture was associated with increased risk of death after discharge[28]. At present, in most areas of China, elderly with hip fracture are mainly treated with home rehabilitation after discharge, which leads to the lack of professional medical guidance in the early postoperative period. European and North American studies have shown that care provision by more nurses with at least bachelor’s degrees are associated with lower mortality after surgery[29–30]. A previous study has also pointed out that the mean postoperative length of stay was 5 days in the USA and 34 days in the Japan, and the risk of death after hospital discharge was doubled in the USA in comparison with Japan[28]. Therefore, in practice, the costs and benefits need to be assessed on a case-by-case basis, not just the emphasis on the bed conversion and medical costs. Furthermore, it is necessary to change the concept that hip fracture has been described as geriatric disease
rather than orthopedic disease. Comanaged geriatric fracture center program that has resulted in lower than the predicted hospitalization time and readmission rates, with short time to surgery, low complication rates and low mortality [31-32]. Kammerlander et al. have been pointed out that the interdisciplinary team could achieve the lowest in-hospital mortality rate (1.14%), the lowest hospitalization time (7.39 days) and the lowest mean time to surgery (1.43 days) [33].

**limitations**

This study was a single-center retrospective analysis and all data were retrospectively collected. A multi-center randomized controlled trial is needed in the future.

**Conclusion**

This study found that the independent risk factors for DVT in perioperative patients with hip fractures older than 70 years were preoperative anemia and prolonged hospitalization time. In addition, the incidence of DVT was the same to those in other Asian and Western countries. This study suggests that correct anemia before operation is beneficial to reduce the occurrence of DVT. At the same time, coronary heart disease and cerebrovascular diseases are often associated with such patients before operation. Active correction of anemia is also beneficial to reduce the risk of cardiovascular events during perioperative period. In addition, prevention and control measures for deep vein thrombosis should be actively strengthened during perioperative period and after discharge for domestic patients with late discharge.

**Abbreviations**

DVT: deep venous thromboembolism; VTE: Venous thromboembolism; ASA: American Society of Anesthesiologists; PE: pulmonary embolism; ESR: erythrocyte sedimentation; BMI: body mass index; Hb: Hemoglobin;
Declarations

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Availability of data and materials

The datasets used and/or analysed during the current study are not publicly available. All data are available from the corresponding author upon reasonable request.

Author’s contributions

Hong Zhang and Ze-Guo Feng contributed to the design of the study and the review of the literature. Long Feng, Weixiu Yuan, Mingda Duan, Chaohai Jin, Longhe Xu, Zhipeng Xu participated in data collection, analysis and drafting of the manuscript. All authors have read and approved the manuscript.

Ethics approval and consent to participate

The study was approved by the ethical committee of the Chinese People’s Liberation Army General Hospital.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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