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The Correlation Between Timing of Surgery and the Need for RBC Transfusions in the Geriatric Intertrochanteric Fracture Population

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Abstract

Objective: To identify whether the timing of surgery affects red blood cell (RBC) transfusion requirements in the elderly with intertrochanteric fractures. **Methods:** We retrospectively studied all patients undergoing surgical fixation of their intertrochanteric fractures in our hospital between January 2009 and December 2018 and analyzed the relationship between the timing of surgery and RBC transfusion. **Results:** A total of 679 patients were included in this study. The need for RBC transfusion was lower in the patients who underwent surgery within 12 h after admission (timing of surgery <12 h, <12 h group) than those who underwent surgery over 12 h after admission (timing of surgery >12 h, >12 h group) ($P = 0.046$); lower in the the patients who underwent surgery within 24 h after admission (timing of surgery <24 h, <24 h group) than in those who underwent surgery over 24 h after admission (timing of surgery >24 h, >24 h group) ($P = 0.008$), and lower in the <24 h group compared to the patients who underwent surgery within 48 h after admission (timing of surgery <48 h, <48 h group) ($P = 0.035$). Moreover, the need for RBC transfusion was lower in the <24 h group (in the first 24 h from admission to surgery) than in the 24-48 h group (in the second 24 h from admission to surgery) ($P = 0.016$), and also lower in the <24 h group compared to the 48-72 h group (in the third 24 h from admission to surgery) ($P = 0.047$). However, there were no differences between the <12 h group and 12-24 h group, between the <12 h group and <24 h group, and between the 12-24 h group and <24 h group, respectively. **Conclusion:** Timing of surgery within 24 h contributes to the reduction of RBC transfusion in the elderly with intertrochanteric fractures.

Keywords

timing of surgery, blood transfusion, intertrochanteric fractures, the elderly

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Introduction

Hip fracture is an important and debilitating condition in the elderly, especially in older women. Although the epidemiological data vary by country, it is estimated that 6% of men and 18% of women globally tend to suffer from hip fractures.[1] With increasing aging, the number of hip fractures worldwide might increase from 1.66 million in 1990 to 6.26 million in 2050.[2]

Intertrochanteric fracture, one kind of hip fracture, is among the most common fractures treated by orthopedic surgeons worldwide. As almost half of the hip fractures are intertrochanteric fractures, within 30 years, the number of this kind of fractures is expected to exceed 3 million a year. Consequently, the intertrochanteric fracture is probably to become one of the greatest social burdens in the near future. It usually results in comorbidities, poor quality of life, sarcopenia, disability, and mortality after a fracture.

Undoubtedly, intertrochanteric fractures, just like other fractures, lead to blood loss and frequently require blood products' transfusion, especially the patients with anemia before

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this fracture. Blood transfusions and especially red blood cell (RBC) transfusions are life-saving measures. Nonetheless, it is important to realize that blood transfusions can also potentially cause patient morbidities. Blood transfusions are correlated with an increased risk of bacterial infections,[3-7] possibly increased mortality[8-10] and longer length of stay in hospital.[7] There are also substantial costs involved in the collection, preparation, transport, and administration of blood.

Globally, more than 81 million units of RBC are transfused every year.[11] Many of these transfusions are given to surgical patients, including the elderly with intertrochanteric fractures. In fact, blood loss can occur as a consequence of both fracture and surgery. Delay from admission to operation in elderly patients with hip fractures has been shown to increase mortality,[12-14] postoperative infections,[14-17] and length of in-hospital stay.[15-19] Still, the relationship between the timing of surgery and blood transfusion is still controversial.[7,20] Desai et al found no correlation with delay to operation and transfusion requirements,[21] while Mattisson et al confirmed an increased rate of preoperative transfusions among patients with delayed surgery of more than 24 hours.[22] Therefore, the purpose of this study was to assess whether the exact timing of surgery after fracture affects transfusion requirements. We performed a retrospective study at a single level I trauma centre from 2009 to 2018 and analyzed the relationship between the timing of surgery and RBC transfusion requirements in the elderly with intertrochanteric fractures.

Materials and Methods

The inclusion criteria were the following: patients with intertrochanteric fractures who underwent surgical fixation at our department between January 2009 and December 2018. The exclusion criteria were: patients (1) aged 60 years or younger; (2) had delayed diagnosis of intertrochanteric fracture longer than 1 day; (3) with pathological fracture; (4) were hospitalized due to polytrauma or other serious comorbidities; (5) had documented hematologic disease or were therapeutically anticoagulated before fracture; (6) were admitted for revision surgery; (7) with femur shaft fracture complication during surgery, or (8) had pre- or postoperative gastrointestinal bleeding complication.

The study was approved by the Ethics Committee of Guangzhou First People's Hospital. All methods were carried out in accordance with the Helsinki declaration. All patients' information, including laboratory tests and operative records, were collected from our hospital's patient database. RBC transfusion information was collected from our hospital's blood transfusion laboratory.

The type of intertrochanteric fracture (AO-OTA 31A) and surgical fixation were documented based on a review of patients' preoperative and postoperative radiographs. Fixation methods used included a dynamic hip screw (DHS) and cephalomedullary nails. The DHS used was from Synthes. The cephalomedullary nails were either proximal femur nail (PFN, Synthes) or proximal femur nail anti-rotation (PFNA, Synthes) or modified proximal femur nail (F nail, Sanatmatal, Hungary).

The following data were recorded from the patients' electronic charts: age, gender, timing of surgery, length of in-hospital stay, and need for preoperative, intraoperative, and postoperative blood transfusion. The timing of surgery was defined as the time from admission to our hospital's emergency department to the start of the operation. Criteria for blood transfusion administration were hemoglobin (Hb) < 80 g/L or Hb < 90 g/L with signs or symptoms of anemia.

All patients received thromboembolic prophylaxis: 5000 units of low molecular-weight heparin were given on admission day, heparin was withdrawn 12 h before the operation and restarted on the first day after surgery (at least 6 h postoperatively).

Statistical Analysis

All independent variables (timing of surgery, age, gender, preoperative hemoglobin level, fixation method, length of in-hospital stay, hospital mortality, and RBC transfusion) were recorded as measurement data or counting data. Measurement data were expressed in means and standard deviations. Statistical analyses were performed using the Student *t*-test for measurement data, the Chi-Square test, or Fisher's exact test for counting data to analyze the relationship among the independent variables. We considered results to be significantly different at $p < 0.05$.

Results

A total of 679 patients who underwent fixation of their intertrochanteric fractures during the study period were included in this study. Among these, 442 were women (65.1%, mean age was 82.1 years), and 237 were men (34.9%, mean age 80.1 years) aged 81.4 (range 60–102) years. The preoperative Hb was 109.11g/L. The mean timing of surgery was 76.3 hours. Four hundred eighty-three patients were fixed with nails and 196 with DHS. Four hundred seventy-eight patients received transfusion (70.4%), where the average RBC transfusions were 3.83 units (1 unit of RBC roots in approximately 200 ml whole blood)(Table 1).

We found the patients needed different RBC transfusions based on timing of surgery, and those who underwent early surgery needed less RBC transfusion than those with delayed surgery (Figure 1). RBC transfusion was significantly lower in patients who underwent surgery within 12 h of admission (<12 h group) than those that received surgery after 12 h of admission (>12 h group), lower in patients who underwent surgery within 24 h of admission (<24 h group) than those that received surgery after 24 h of admission (>24 h group)($P = 0.046$ and $P = 0.008$, respectively). RBC transfusion was no different when comparing the timing of surgery within 48 h (<48 h group) with the timing of surgery after 48 h (>48 h group) or the timing of surgery within 72 h (<72 h group) with the timing of surgery after 72 h (>72 h group). Interestingly, when we compared the <24 h group with the <48 h group, the RBC transfusion was also significantly different ($P = 0.035$). Moreover, the RBC transfusion was significantly lower in the <24 h group (within the first 24 h of admission) than

Table 1. Clinical Characteristics (n = 679) of Intertrochanteric Fractures.

Gender:	
male	237
female	442
Age, years:	
60-69	49
70-79	186
80-89	336
>90	108
Hemoglobin, g/L	109.11 ± 16.99
Timing of surgery, hours:	
≤12	10
12-24	17
24-48	121
48-72	115
>72	395
Surgical type:	
Cephalomedullary nail	483
DHS	196
RBC transfusion, units	3.83 ± 4.03
Length of stay in hospital, days	21.05
In-hospital mortality, cases	21

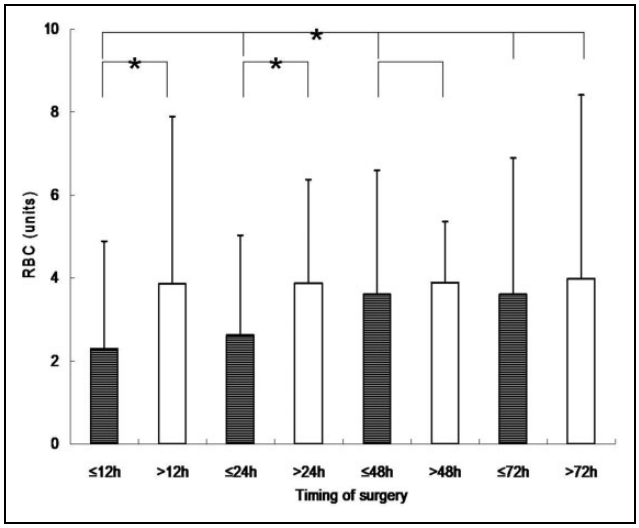

Figure 1. RBC transfusion (unites) in relation to timing of surgery. The need for RBC transfusion was lower in patients who underwent surgery within 12h after admission (<12h group) than those who underwent surgery over 12h after admission (>12h group)(P = 0.046); lower in the patients who underwent surgery within 24h after admission (<24h group) than in those who underwent surgery over 24h after admission (>24h group) (P = 0.008), and lower in the <24h group compared to those who underwent surgery within 48h after admission (<48h group) (P = 0.035); there was no difference between the other groups.

the 24-48 h group (within the second 24 h of admission) ($P = 0.016$), and lower in the <24 h group than the 48-72 h group (within the third 24 h of admission) ($P = 0.047$)(Figure 2). However, when we compared <24 h group with 24-48 h group, we found no differences in clinical parameters, including age, sex, fix method, preoperative Hb, length of in-hospital stay, and in-hospital mortality between the 2 groups (Table 2).

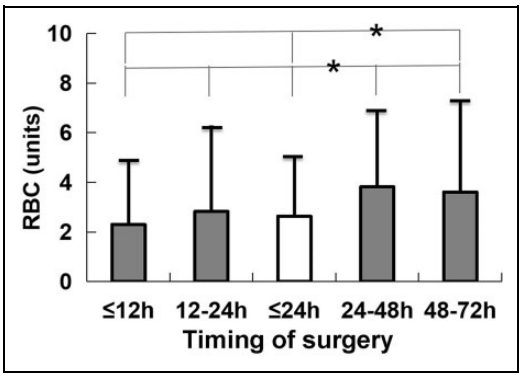

Figure 2. The correlation between RBC transfusion (unites) and timing of surgery. RBC transfusion was lower in the <24h group (the first 24h from admission to surgery) than in the 24-48h group (the second 24h from admission to surgery) (P = 0.016), and lower in the <24h group than the 48-72h group (the third 24h from admission to surgery) (P = 0.047); no difference were observed between the other groups.

Discussion

This study's main finding was that timing of surgery within 24 hours was associated with decreasing RBC transfusions requirement in elderly with an intertrochanteric fracture.

It is essential to identify whether the timing of surgery can affect blood transfusion requirements in the elderly with intertrochanteric fractures. The incidence of intertrochanteric fracture has been steadily increasing, and it is expected to occur even more frequently with increasing rates of the aging population all over the world. Currently, surgery is used for almost all intertrochanteric fractures in the elderly. Blood loss occurs due to both the fracture and the surgery; therefore, blood transfusion is frequently used, especially in patients with primary anemia. Because of the potential risk of blood transfusion and the relative shortage of blood resources, the elderly may profit from lower transfusion. However, while a patient is awaiting surgery, continued blood loss, commonly present at the fracture site, may lead to greater blood loss and greater needs for transfusion.

Several studies have reported different adverse effects on delayed surgery, including increased mortality, morbidity, infections, or length of stay in hospitals.[7,8,16,23,24] However, the effects of delayed surgery on blood transfusion requirements in intertrochanteric fracture patients are still controversial.[7,20] Many factors, including age, sex, primary anemia, nutrition, fracture type, and surgery method, may affect blood transfusion requirements.[20] Nevertheless, the timing of surgery is the only factor that we can directly intervene. After analyzing the relation between different timing of surgery and RBC transfusions, we found that timing of surgery within 24 hours was associated with decreasing blood transfusions requirement in elderly with an intertrochanteric fracture.

Table 2. The Correlation Between the Timing of Surgery and Clinical Parameters.

Clinical Parameter	≤24 h (n = 27)	24-48 h (n = 121)	*P* value
Age (years)	79.96 ± 8.99	81.45 ± 8.26	0.405
Male/Female (cases)	7/20	42/79	0.380
DHS/Nail (cases)	9/18	31/90	0.414
Preoperative Hb (g/L)	110.22 ± 14.6	108.87 ± 17.60	0.670
Length of stay in hospital (days)	18.96 ± 7.41	19.56 ± 12.12	0.806
In-hospital mortality (cases)	0	3	1.000*

*Fisher's exact test.

In contrast, Hagino et al showed no difference in transfusion rates comparing early surgery (up to 1 day after admission) and late surgery (later than 1 day after admission) in hip fracture patients.[25] Desai and colleagues also found no correlation between delay in operation and transfusion requirements.[21] They thought this might be related to the formation of hematoma around the fracture site. By allowing the fracture hematoma to fully stabilize, the active bleeding before surgery would be minimized, eventually resulting in less blood loss and lower blood transfusion intraoperatively. Still, all of the studies mentioned above enrolled different fracture types and various operations. Mattisson et al argued that femoral neck fractures and inter- or subtrochanteric fractures should be separately analyzed due to their inherent differences in bleeding tendency due to the tamponade effect of the articular capsule on intracapsular fracture bleeding, excessive soft tissue injury, and bleeding for extracapsular fractures.[22]

Furthermore, Mattisson et al confirmed an increased rate of preoperative transfusions among patients with unstable intertrochanteric or subtrochanteric hip fractures operated with an intramedullary nail who awaited surgery more than 24 hours.[22] We support their view on the relationship between the timing of surgery and blood transfusion. Yet, the pathophysiology of intertrochanteric fractures is not the same as the one in subtrochanteric fractures. Moreover, Desai and colleagues' study[21] included the patients who had diagnosis delayed even for 1 week, while in our study, the patients with delayed admission longer than 1 day were excluded. Thus, our results may be more reasonable as we only included the elderly patients with intertrochanteric fractures and no delayed fracture diagnosis over 1 day.

Therefore, because waiting for surgery was associated with an increased blood transfusion requirements, we suggest that the timing of surgery within 24 h may be better for the elderly with intertrochanteric fractures.

Limitations

The present study has some limitations. Firstly, as this was a retrospective study, there may be inherent differences in medical comorbidities between the transfused and non-transfused patient samples that were not discerned by this study. Secondly, the elderly patients were generally given a transfusion based on the criteria of Hb less than 80 g/L or Hb less than 90 g/L with signs/symptoms of anemia. This threshold is consistent with Carson and colleagues' study (they compared the difference between restricted and liberal transfusion threshold).[26] Similarly, we attempted to decide to transfuse as uniform as possible; however, there are some difficulties concerning this matter.[26] As there is no strict transfusion protocol, deciding whether to transfuse or not was always made on an individual basis considering several factors such as ongoing Hb value, blood pressure, cardiac disease, and other factors.[25] Since determining signs or symptoms of anemia are subjective, and a lack of uniformity inherently exists among treating physician groups, these may have led to some inconsistencies in the decision to apply RBC transfusion.[26] Thirdly, the sample size is small. There were just 148 patients who underwent fixation surgery within 48 h and only 27 patients within 24 h. Therefore the results may be somewhat biased due to the numerous intertrochanteric fracture population. Finally, patients with stable and unstable intertrochanteric fractures were not separately analyzed. Thus, it should be assumed that 3- and 4-part intertrochanteric fractures are most likely to cause greater blood loss. Consequently, future prospective studies with a larger sample size are needed to further confirm our findings.

Conclusions

Timing of surgery within 24 h may contribute to a reduced need for blood transfusion in the elderly with intertrochanteric fractures.

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Declaration of Conflicting Interests

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