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Delay of Surgery does not Increase Transfusion Rates in Extracapsular Proximal Femur Fractures Stabilized with Intramedullary Implants

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Abstract

Scope: Aim of the study was to determine whether the delay of surgery increased transfusion requirements in extracapsular proximal femur fractures stabilized with intramedullary implants.

Materials and Methods: We performed an internal audit (retrospective analysis of prospectively collected data) on blood transfusion requirements for hip fractures. Into this study were included 151 consecutive extracapsular proximal femur fractures in patients older than 55 years operated in our clinic over 9 months.

Results: About the 126 patients operated using a short intramedullary implant, the time from admission to surgery did not correlate with transfusion needs (p=0.650). Patient's age was positively correlated with the number of the received transfusions (p=0.125). Patient's hemoglobin at admission was inversely correlated (p<0.001), whereas the duration of surgery was positively correlated with the number of transfusions (p=0.091). For 25 patients operated using a long intramedullary implant, the preoperative hemoglobin was the only significant influence for transfusion (p=0.005). Patients operated in the day of admission needed fewer transfusions compared to patients with delayed intervention: differences not statistically significant (p=0.222). Patients with sub trochanteric fractures required significantly more red blood cell mass (1.1 ± 1.1 versus 1.6 ± 1.0 units, p=0.024) and fresh frozen plasma (0.5 ± 1.3 versus 1.2 ± 1.4 units, p=0.014) spending nearly twice as long to operate (64.0 ± 21.8 versus 123.4 ± 45.7 minutes, p<0.001).

Conclusions: The postponement of surgery did not increase the need of allogenic blood. Nonetheless, the older patients with lower baseline hemoglobin at admission undergoing to longer surgeries, did not require more perioperative transfusions.

Keywords: Transfusion rates; Extracapsular proximal femur fractures; Trochanteric fractures; Intramedullary osteosynthesis; Gamma Nail

Introduction

Proximal femur (hip) fractures are a common reason for hospital admittance in orthopedic trauma centers. They occur in frail, elderly population with significant comorbidities that need to be addressed for perioperative management. Due to the aging population, the number is expected to steadily rise and constitute a major social, economic and healthcare burden [1,2]. Extracapsular fractures involve the intertrochanteric region with or without diaphyseal extension. The current treatment is ostheosynthesis, with intramedullary implants starting to be the most common choice [3,4]. Surgeries are routinely performed on an urgent basis. However, patient's status at admittance frequently postpones intervention [5]. Underlying medical conditions, bleeding from the fracture site and during surgery increase the use of transfusion to where 47% of patients receive allogenic blood products [6,7]. Reducing transfusion requirements may limit potential disease transmission, mitigate transfusion-related immune modulation which impacts nosocomial infection and cancer recurrence as well as decrease use of hospital resources [6-8]. We aimed to determine whether delay of surgery increases transfusion requirements in extracapsular proximal femur fractures stabilized with intramedullary implants.

Materials and Methods

We performed an internal audit (retrospective analysis of prospectively collected data) on blood transfusion requirements for hip fractures in our department. Extracapsular proximal femur fractures in patients older than 55 years admitted to our academic clinic over 9 months were scrutinized. Using the patient's hospital admittance log a total of 164 consecutive cases (164 patients) was included. All electronic charts and X-rays were subsequently reviewed by two

authors. 126 patients had recent, unilateral, extracapsular proximal femur fractures involving the trochanteric region – the Standard nail group. We also included 25 sub trochanteric fractures and case where the fracture line extended to the proximal diaphysis – the Long nail cases. In all cases internal fixation was performed using standard (Figure 1) or long – 25 cases (Figure 2) Gamma3 nails (Stryker, USA). Surgical technique adhered to the manufacturer's recommendations. All procedures were performed under regional anesthesia (spinal, epidural or combined spinal-epidural). Cases that did not undergo surgery (risks exceeded benefits – 4 or died prior to surgery - 1), old fractures at admittance (over 2 weeks -3), patients operated using non intramedullary implants – dynamic hip screw (3) and those who had high energy trauma or politrauma (2) were excluded. The study was approved by the Hospital's Ethics Committee and Research department.

Figures 1: Internal fixation using standard Gamma 3 nails (Stryker, USA).

Statistical Analysis

Data were collected and analyzed using the SPSS v.17 software suite (SPSS Inc. Chicago, IL, USA) and are presented as medians and interquartile range for continuous variables without Gaussian distribution or average ± standard deviation for continuous variables with Gaussian distribution. To assess the significance of the differences between groups, Mann-Whitney-U and Kruskal-Wallis tests (medians, non-Gaussian populations) respectively unpaired t-student and ANOVA (averages, Gaussian populations) tests were used. Continuous variable distributions were tested for normality using Shapiro-Wilk test. The correlation between studied variables was evaluated using Spearman's rank sum correlation coefficient (non-Gaussian distributed variables), it's statistical significance being assessed using the t-distribution score test. In this study a p value of <0.05 was considered as the threshold for statistical significance.

Figures 2: Internal fixation using long Gamma 3 nails (Stryker, USA).

Results

In the Standard nail group 95 (75.39%) patients were female and 44 (34.92%) were operated within 24h from hospital admittance. Red Blood Cell mass (RBC) was administered to 74 (58,7%) for an average of 1.82 units per patient. 58% of females and 73% of males were already anemic preoperatively. 3 patients died in the postoperative interval. In the Long nail group 16 (64%) patients were female and 11 (44%) were operated within 24h from hospital admittance. RBC was administered to 23 (92%) for an average of 1.78 units per patient. 81% of females and 66.6% of males were already anemic preoperatively. 2 patients died in the postoperative interval. Anemia was defined as hemoglobin values of less than 12.3 g/dL for females and 14 for males respectively. Patient's baseline characteristics are presented in in Table 1.

	Standard Nails	Long Nails	p
Number of patients	126	25	n/a
Age (years)	79.6 ± 8.9	74.1 ± 10.2	0.006
Days from admission to intervention	1.9 ± 2.2	3.0 ± 4.4	0.052
Days of hospitalization	13.1 ± 3.8	16.9 ± 6.7	0.01
RBC units	1.1 ± 1.1	1.6 ± 1.0	0.024
FP units	0.5 ± 1.3	1.2 ± 1.4	0.014
Hemoglobin at admission (g/dL)	11.7 ± 1.8	11.8 ± 1.9	0.781

Hemoblobin at discharge (g/dL)	10.6 ± 1.1	10.5 ± 2.1	0.756
Duration of the operation (minutes)	64.0 ± 21.8	123.4 ± 45.7	<0.001

Table1: Patient's baseline characteristics. RBC - Red Blood Cell mass; FFP - Fresh frozen plasma.

Standard Nails In the univariate analysis, we found that the value of RBC is positively correlated with the number of days from the admission to operation (Spearman's r=0.153), however this correlation was only marginally significant (p=0.088), most probably due to a type II statistical error. The differences between average days from admission to intervention were not significant in respect to the number of RBC received during hospitalization (Table 2).

	RBC 0	RBC 1	RBC 2	RBC 3	RBC 4	p
Days from admission to intervention	1.63 ± 2.14	1.86 ± 1.81	2.25 ± 2.45	3.11 ± 3.10	1.60 ± 1.14	0.373

Table 2: Differences between average days from admission to intervention in respect to the number of received RBC.

We observed that patients operated in the day of admission had a lower median number of RBC needed (median RBC=0) compared to patients with delayed intervention (median RBC=1); however, these differences were only marginally significant (p=0.069; Mann-Whitney U test). In the multivariate regression model built, having dependent variable the number of RBC received, and independent predictors the number of days from admission to intervention, patient's age, patient's hemoglobin at admission and the minutes spent in the operation, we observed the following impacts on the number of RBC received:

Patient's age: was positively correlated with the number of RBC received: Exp (β)=0.118; p=0.125 revealing thus that older patients tend to need more RBC during their admission.

Patient's hemoglobin at admission was reversely correlated with the number of RBC received: Exp (β)=-0.644; p<0.001 revealing that patients with lower hemoglobin at admission are needing more RBC.

The duration of surgical procedure was positively correlated with the number of RBC: Exp (β)=0.128; p=0.091 which means that a longer duration of the surgical intervention is associated with a higher number of RBC needed during admission.

The delay in time from admission to intervention didn't prove to be associated with the number of RBC: Exp (β)=-0.035; p=0.650.

Long nails

In the univariate analysis, we found that the value of RBC is positively correlated with the number of days from the admission to operation (Spearman's r=0.153), however this correlation was not statistically significant (p=0.385). The average number of days from admission to intervention had no significant differences in respect to the number of RBC received during hospitalization (Table 3).

	RBC 0	RBC 1	RBC 2	RBC 3	P
Days from admission to intervention	2.50 ± 3.54	2.90 ± 5.69	3.67 ± 4.12	2.00 ± 2.00	0.986

Table 3: The average number of days from admission to intervention in respect to the number of RBC received.

We observed that patients operated in the day of admission had a lower median number of RBC needed (median RBC=1) compared to patients with delayed intervention (median RBC=2); however, these differences were not statistically significant (p=0.222; Mann-Whitney U test). In the multivariate regression model built, having dependent variable the number of RBC received, and independent predictors the number of days from admission to intervention, patient's age, patient's hemoglobin at admission and the minutes spent in the operation, the only component which had a significant impact was the patient's hemoglobin at admission, having an Exp (β)=-0.617; p=0.005. This means that higher hemoglobin at admission leads to a decreased number of RBC received during the hospitalization.

Discussion

Our study showed no tendency towards increased total allogenic blood transfusion by postponing surgery in patients with fractures in the trochanteric region that are operated using an intramedullary implant. We have confirmed that patient's age, hemoglobin at admission and longer duration of surgery increase RBC consumption, similar to data in the literature [6,7]. Kadar et al. found that predictors for allogenic blood transfusions in fragility hip fractures were a shorter wait time from admission to surgery, older age, low preoperative hemoglobin and type of surgical implant [6]. Desai et al. identified factors leading to increased blood transfusion were female gender, lower hemoglobin at hospital admittance, fracture type and fixation method [7]. Subtrochanteric and intertrochanteric localizations were more predictive for allogenic blood transfusion compared to femoral neck fractures. At the same time, fracture internal fixation using a dynamic hip screw decreased by half the risk of transfusion compared to intramedullary nail or hemiarthroplasty [7]. They did not found an association with age, delay to operation or duration of surgery [7]. Hou et al. determined factors influencing blood loss are older age, duration of operation, initial haemoglobin, intra-operative blood loss, type of fracture and anesthesia [9]. In addition, the mean transfusions were also higher with intramedullary implants compared to dynamic cephalic screw and plate [9]. The minor differences in results may have been caused by analysis of hip fractures as a whole as opposed to focusing on trochanteric region and intramedullary osteosynthesis as in our study. Osteosynthesis for a trochanteric/subtrochanteric fracture compared to arthroplasty for a femoral neck fracture and the use of intramedullary implants have been shown to produce more surgery related bleeding [6-9]. However, intramedullary implants have shown a clear trend to becoming much more popular than previous systems of dynamic cephalic screw and plate [3,4]. This is probably mainly due to improved biomechanical stability, percutaneous technique or surgeon preference [3,4]. Even in our own department, compared to data from a previous study which analyzed hip fractures operated between 2008 and 2012, the use of intramedullary implants has risen drastically from

around one quarter to virtually all cases. Furthermore, there are significant differences when standard or long nails are used. In our study, this was equivalent to the presence of an intertrochanteric or sub trochanteric fracture respectively [10]. The use of a long nail almost doubled the duration of surgery, the percentage of patients who are transfused (58.7% versus 92%), the administration of RBC and even more of FFP from equivalent starting hemoglobin values (see Table1). In our analysis, between 58-81% of females and 66-73% of males were already anemic when they were admitted to hospital, due to the presence of a recent fracture but also preexisting conditions. This is important to be noted since preoperative anemia is an independent poor prognostic factor for clinical outcome [11]. In our patient sample we also applied additional measures to reduce bleeding. Fresh frozen plasma was used as adjuvant therapy to reduce intraoperative bleeding, in patients with liver disease, those who had been on oral anticoagulant therapy and to reconstitute whole blood. Another measure was intraoperative and/or immediately postoperative administration of tranexamic acid according to a regimen previously described [12]. The need for transfusion was decided for each individual case and several orthopedists and anesthesiologists were involved. There was no particular adherence to either a restrictive (7-8 g/dL) or liberal (8-9 g/dL) regimen regarding the hemoglobin value which triggered the allogenic blood transfusion. The majority of patients in this age group have associated cardiovascular disease. The eventual debut of an acute coronary syndrome may benefit from higher hemoglobin levels [13]. However, there is concern regarding transfusion-related immune modulation which may lower the body's response to prevent and fight infections or increase the risk for cancer (such as colorectal) reoccurrence [8]. In a randomized trial of hip fracture patients with underlying cardiovascular disease or other risk factors, Carson et al showed that a restrictive transfusion regimen was not inferior to a liberal one [14,15]. The authors reevaluated the group at 3 years and found that the liberal regimen was also safe and did not lead to long-term immunosuppression severe enough to influence mortality or cause of death [16]. In addition, physical recovery is similar after both restrictive and liberal RBC transfusion strategy [17]. Currently available evidence appears not to support the use of liberal transfusion threshold in preference to more restrictive triggers in patients without symptoms of acute anemia [18]. There are several weaknesses with our study. Our retrospective design has prevented us from accurately acquiring additional data on causes for delay of surgery. However we may speculate that the most common cause were medical reasons such as cardiovascular abnormalities or anticoagulant therapy but also administrative reasons. These factors have been previously reported in the literature, with no difference in clinical outcome [5]. Patients who were operated early after admission should also not have any additional risks in relationship with the time of day at which the procedure was performed. The relatively small number of patients prevented us from revealing the influence of chronic anticoagulant therapy and liver disease. The number was determined by a recent change in managing extracapsular proximal femur fracture in our hospital. This meant going further back with data collection would have resulted in an increase in heterogeneity and confounding factors. We have made several approximations: the first and last recorded hemoglobin values were considered admittance and discharge values respectively. Transfusions were measured as total amount but the exact timing of administration was not noted. Our patients received different types of blood products: the majority received red blood cell (RBC) mass and fresh frozen plasma (FFP) but several were given whole blood. To be able to perform the statistical analysis we made the assumption that one unit of whole blood equals to one unit of RBC plus one of FFP. Postponing surgery did not increase overall allogenic blood requirement. Nonetheless, patients that are older, have lower baseline hemoglobin at admission and undergo longer surgeries will require more perioperative transfusions.

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All authors equally contributed to set up of this paper.

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