Original Article

TEXTO & CONTEXTO ENFERMAGEM
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# BLOOD ORDERS AND PREDICTORS FOR HEMOTRANSFUSION IN ELECTIVE FEMUR FRACTURE REPAIR SURGERY

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## ABSTRACT

**Objective:** to estimate the incidence of red blood cell concentrate orders in elective femur fracture repair surgeries and to identify predictors for hemotranfusion.
**Method:** retrospective cohort study conducted with 271 patients submitted to femur fracture repair surgery between July 2013 and July 2016. Surgical and transfusion data were obtained from patient charts and the Transfusion Management System. Association between sociodemographic and clinical variables related to the surgical procedure and the occurrence of red blood cell concentrate transfusion was analyzed using descriptive statistics, the chi-squared test, relative risk, and odds ratio. Multivariate analysis was performed using binomial logistic regression.
**Results:** the incidence of blood orders for patients undergoing femur fracture repair surgery was 87%. Ninety-one (33.6%) patients received red blood cell concentrate transfusions. Even though placing blood orders is recommended, given the possibility of intra- or postoperative transfusions, only 52 (47.2%) blood transfusions occurred in the preoperative period. The variables female sex, low preoperative hemoglobin levels and procedure lasting longer than 120 minutes presented statistical significance ($p<0.05$) and were considered predictors for hemototransfusion.
**Conclusion:** Perioperative nursing must be aware of the importance of blood orders for all patients undergoing femur fracture repair surgery, including in the preoperative period, with special attention to patients who are female, previously anemic and submitted to long-lasting procedures.

**DESCRIPTORS:** Elective surgical procedures. Femoral fractures. Blood transfusion. Blood loss, surgical. Patient safety.

**HOW CITED**: Isidoro REC, Silva KFN, Oliveira JF, Barichello E, Pires PS, Barbosa MH. Blood orders and predictors for hemotransfusion in elective femur fracture repair surgery. Texto Contexto Enferm [Internet]. 2019 [cited YEAR MONTH DAY]; 28:e20180129. Available from: http://dx.doi.org/10.1590/1980-265X-TCE-2018-0129

## SOLICITAÇÃO DE RESERVA E PREDITORES PARA HEMOTRANSFUSÃO EM CIRURGIAS ELETIVAS DE FRATURA DE FÊMUR


### RESUMO

**Objetivo:** estimar a incidência da solicitação de reserva de concentrado de hemácias em cirurgias eletivas de correção de fratura de fêmur, e identificar os preditores para a ocorrência da hemotransfusão.
**Método:** estudo de coorte retrospectivo realizado com 271 pacientes submetidos à cirurgia de correção de fratura de fêmur, no período de julho de 2013 a julho de 2016. Os dados cirúrgicos e transfusionais foram obtidos a partir da análise dos prontuários e do Sistema de Gestão Transfusional. Utilizou-se a estatística descritiva e, teste qui-quadrado, risco relativo, razão de chances para analisar a associação de variáveis sociodemográficas e clínicas, referentes ao procedimento cirúrgico, com a hemotransfusão de concentrado de hemácias. Para a análise multivariada utilizou-se a regressão logística binomial.
**Resultados:** a incidência de solicitação de reserva para os pacientes submetidos à cirurgia de correção de fratura de fêmur foi de 87,0%. e 91 (33,6%) pacientes foram transfundidos com concentrado de hemácias. Apesar da recomendação de solicitar reserva, tendo em vista a possibilidade de transfusão no intra ou pós-operatório, 52 (47,2%) transfusões ocorreram no período pré-operatório. Houve significância estatística ($p<0,05$) para as variáveis sexo feminino, nível baixo de hemoglobina pré-operatória e duração do procedimento superior a 120 minutos, considerados como preditores para a hemotransfusão.
**Conclusão:** é fundamental que a enfermagem perioperatória tenha o conhecimento da importância da reserva sanguínea para todos os pacientes submetidos ao tratamento cirúrgico da fratura de fêmur, inclusive no pré-operatório, atentando para os pacientes do sexo feminino, previamente anêmicos e submetidos aos procedimentos de longa duração.



**DESCRITORES:** Procedimentos cirúrgicos eletivos. Fraturas do fêmur. Transfusão de sangue. Perda sanguínea cirúrgica. Segurança do paciente.


## SOLICITUD DE RESERVA Y PREDICTORES PARA HEMOTRANSFUSIÓN EN CIRUGÍAS ELECTIVAS DE FRACTURA DE FÉMUR


### RESUMEN

**Objetivo:** estimar la incidencia de solicitud de reserva de concentrado de hematíes en cirugías electivas de corrección de fractura de fémur, e identificar los predictores para práctica de hemotransfusión.
**Método:** Estudio de cohorte retrospectivo realizado con 271 pacientes sometidos a cirugía de corrección de fractura de fémur, entre julio de 2013 y julio de 2016. Datos quirúrgicos y de transfusiones obtenidos del análisis de historias clínicas y del Sistema de Gestión Transfusional. Se utilizó estadística descriptiva, test de chi-cuadrado, riesgo relativo y razón de oportunidades para analizar la asociación de variables sociodemográficas y clínicas referentes al procedimiento quirúrgico con transfusión de concentrado de hematíes. Para el análisis multivariado se utilizó regresión logística binomial.
**Resultados:** la incidencia de solicitud de reserva para pacientes sometidos a cirugía de corrección de fractura de fémur resultó ser del 87,0%. y 91 (33,6) pacientes foram transfundidos con concentrado de hematíes. A pesar de la recomendación para solicitar reserva, considerando la posibilidad de transfusión intra o postoperatoria, 52 (47,2%) transfusiones se efectuaron en período preoperatorio. Existió significatividad estadística ($p<0,05$) para las variables: 5sexo femenino, bajos niveles de hemoglobina preoperatoria y duración del procedimiento superior a 120 minutos, considerados como predictores de la hemotransfusión.
**Conclusión:** Resulta esencial que la enfermería perioperatoria tenga conocimiento de la importancia de la reserva sanguínea para todos los pacientes sometidos al tratamiento quirúrgico de la fractura de fémur, incluso en el preoperatorio, estando pendientes de los pacientes femeninos, con anemia previa y sometidos a procedimientos de larga duración.



**DESCRIPTORES:** Procedimientos quirúrgicos electivos. Fracturas del fémur. Transfusión sanguínea. Pérdida de sangre quirúrgica. Seguridad del paciente.

## INTRODUCTION

In hospital operating rooms, various complex care processes are carried out by professionals who are subject to error. In these systems, patients are vulnerable, and the quality of treatment directly hinges on the good working of these processes. An estimated 37.6% of surgical procedures result in adverse events that could be avoided by adopting safe care practices.[1]

Focused on surgical patient safety, the World Health Organization (WHO) established an essential goal of surgical teams recognizing and being prepared for potential blood loss. A member of the surgical team must check the availability of blood components before induction of anesthesia, because even with all the advances of surgical and anesthetic techniques, blood transfusions are still an essential therapeutic and irreplaceable strategy to increase survival of surgical patients who experience great blood loss.[2–3]

In Brazil, specific regulations that address hemotherapy procedures define that samples collected prior to blood transfusions for compatibility tests are valid for 72 hours and must be sent to laboratories using suitably labeled collection tubes. Analyzing the sample, sending samples to large centers to identify the specificity of the previously detected antibodies, and diligently and safely duly compatible Red Blood Cell (RBC) concentrate, are processes that demand time.[4]

Thus, in elective surgery with potential risk for blood loss, both blood orders and sample collections must be carried out with time to spare before the surgery.[4]

Blood orders for surgical procedures consist of a pre-established list with the maximum number of compatible RBC concentrate units in order to reduce costs and waste, enable greater agility when dispensing blood components during emergencies, optimize communication between the surgical team and the transfusion agency, and provide increased surgical and transfusion safety.[5–9]

Femur fractures are a severe public health problem, incurring elevated costs and mortality rates. It is estimated that as of 2050, more than 6 million femoral neck or transtrochanteric fractures will occur worldwide.[10] Moreover, this type of injury results in expected blood loss, which may be aggravated during surgery; therefore, surgical teams must be alert, especially in cases in which patients already present low hemoglobin levels before the surgery.[11–12]

In this context, the nursing team plays an important role, remaining at the patient's side at every step of the surgical procedure and hemotherapy cycle and implementing actions that can ensure patient safety and the quality of care.

The present study was proposed based on the relevance of the theme to Perioperative Nursing and the paucity of studies on the topic. Furthermore, the literature associates the use of blood order tables with cost reduction, and thus more studies are necessary to investigate blood orders from the perspective of surgical and transfusion safety.[13]

The goal of this investigation was to estimate the incidence of RBC concentrate orders in elective femur fracture repair surgeries and to identify the predictors for hemotransfusion.

## METHOD

This was a quantitative retrospective cohort study. It was carried out in a public large-capacity teaching hospital and a regional blood center located in a municipality in the Triângulo Mineiro region of Minas Gerais, Brazil.

The study population consisted of all patients submitted to elective femur fracture repair surgery at the hospital between July 2013 and July 2016, and who met the following inclusion criteria: 18 years old or older and having undergone elective femur fracture repair surgery at any location on the bone during the studied period. Patients who underwent femoral skeletal traction, surgical wound debridement, or who had a diagnosis of hip arthrosis were excluded, as these are surgical

approaches that do not necessarily involve fractures, in addition to patients whose charts were not found after three attempts with the archive service.

The retrospective data collection period (July 2013 to July 2016) was chosen because the Hemocenter's Transfusion Management System was implemented in July 2013, thus ensuring greater organization, availability and legibility of the recorded transfusion data. During this time, 311 patients underwent elective femur fracture repair surgery and, of these, 271 met the inclusion criteria, composing this study's population (n).

The data were collected by the researcher from patient charts by the researcher at the surgical ward's statistical service, by reviewing patient charts in the Medical Archive and Statistical Service, blood component orders with transfusion data, as well as through the Transfusion Management System.

A specific data collection instrument was created by the researchers to guide data collection, based on the pre-anesthesia and surgical data records and the institutions' standardized blood order forms. This instrument covered the following aspects: sociodemographic and clinical variables (sex, date of birth, weight, height, preexisting conditions, preoperative use of anticoagulants and/or antiplatelets, preoperative hemoglobin levels, hematocrits, and platelets); data from the surgical and anesthetic procedure (date of admission and of surgical procedure, total duration of surgery in minutes, type of anesthesia, anesthetic-surgical complications during the procedure and in the post-anesthesia recovery room, American Society of Anesthesiologists (ASA) classification; data about surgical blood orders (number of blood orders for surgery since admission, date and time of the order closest to surgery, volume of blood components reserved by the transfusion agency, volume of blood components requested), and data about transfusion (volume of transfused blood components, time of blood transfusion).

The instrument created by the researchers were submitted to face validity by a panel of three reviewers, all nurses, with professional experience in the surgical and transfusion care process and with PhD degrees.

The data were inserted in an electronic spreadsheet on Excel® for Windows XP and validated using double entry (typing). Next, they were imported to the Statistical Package for the Social Sciences® (SPSS®) version 24.0 for processing and analysis.

The incidence of surgical orders of RBC concentrate was given by:[14]

$$\text{Rate of Incidence} = \frac{\text{number of "new cases" in a given period}}{\text{number of people at risk in the specified period}} \times 100$$

To calculate the rate of incidence, the numerator was defined as the number of surgical RBC concentrate orders for patients submitted to elective femur fracture repair surgery between July 2013 and July 2016. The denominator was defined as the number of patients submitted to elective femur fracture repair surgery, during the specified period.

In terms of the characteristics of patients and of blood orders and blood transfusions, absolute and relative frequency distribution were used for categorical variables, and measures of central tendency (mean and median), and variability (ranges and standard deviation) were used to analyze quantitative variables. Bivariate descriptive statistics and contingency tables were also employed to identify the association between blood transfusion and the following variables: sex, age, ASA, preoperative hemoglobin levels, preoperative use of anticoagulants and/or antiplatelets and the duration of the surgical procedure.

Binomial logistic regression was employed to identify predictors of blood transfusion, whose outcome was the transfusion of RBC concentrate. Significance level was set at 5% ($p<0.05$), thus ensuring a 95% confidence level.

Because this was a retrospective study based on the analysis of patient charts, documents at the transfusion management system and the surgical ward statistics system, the Research Ethics Committee wavered the need for informed consent forms. The research subjects were ensured anonymity, with the data collection instruments identified with numbers.

## RESULTS

In the retrospective period between July 2013 and July 2016,5,475 orthopedic surgeries were performed, and, of these, 311 were elective femur fracture repairs, according to the analysis of the surgical ward's statistics system of the studied institution.

The sample (n) of this study consisted of 271 patients, as shown in figure 1.

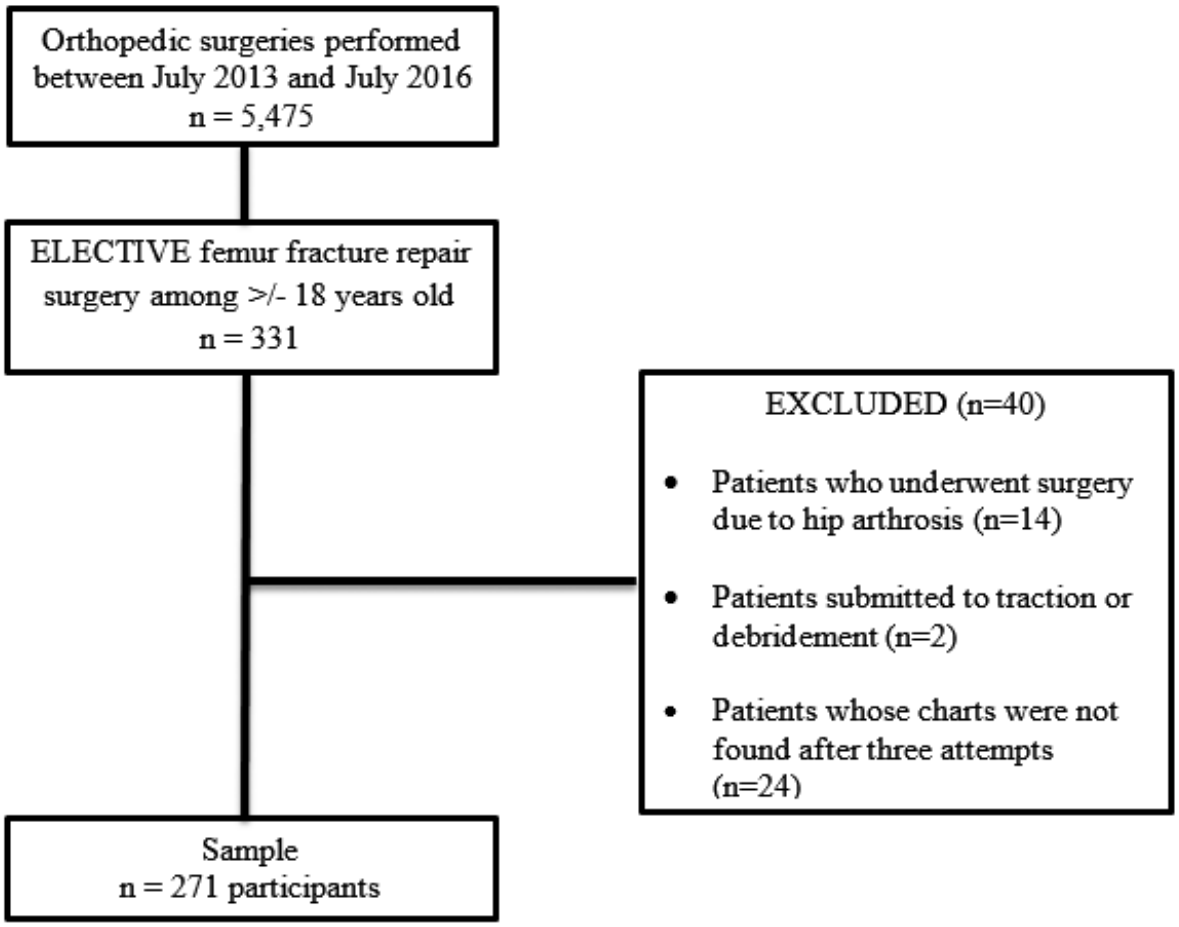


**Figure 1** - Sample flow chart. Uberaba, MG, 2017

Information was gathered from 271 patient charts. Mean age at the date of surgery was 64.22 years (± 20.680), ranging between 18 and 95 years of age. Mean patient weight = was 71.22 kg (± 13.677 kg), with a minimum of 30 kg and a maximum of 140 kg. Mean height was 1.69 m (± 0.104 m) A large amount of data was lost due to incomplete anthropometric records kept on the patient charts, representing a limitation of this study in terms of the analysis of these variables.

Table 1 illustrates the sociodemographic and clinical profile of the patients included in the study.

**Table 1** - Sample distribution by sociodemographic and clinical variables. Uberaba, MG, Brazil, 2017. (n=271)

| Variables | n | % |
|---|---|---|
| Sex | | |
| Female | 137 | 50.6 |
| Male | 134 | 49.4 |
| ASA* | | |
| ASA* I | 49 | 18.1 |
| ASA* II | 160 | 59 |
| ASA* III | 54 | 19.9 |
| ASA* IV | 8 | 3 |
| Use of anticoagulants and/or antiplatelets | | |
| Yes | 36 | 13.6 |
| No | 235 | 86.7 |
| **Total** | **271** | **100** |

*ASA= American Association of Anesthesia.

In terms of preexisting conditions, 142 (52.4%) patients had cardiovascular diseases (systemic arterial hypertension, heart disease), 65 (24%) presented endocrine diseases (hypothyroidism, diabetes *mellitus*) and 43 (15.9%) had neurological disorders (Alzheimer's, Parkinson's) Regarding the use of anticoagulants and/or antiplatelets, 36 (13.6%) patients used these medications in the preoperative period, and their use was suspended for surgery, according to clinical assessment and the specific suspension routine for each type of drug.

Considering preoperative laboratory profile, mean hemoglobin and hematocrit levels were below the reference values adopted by the institutional laboratory, with mean hemoglobin at 11.061 g/dl (±1.4909), minimum of 8.3g/dl and maximum of 15.3 g/dl (women), and 11.737 (±2.2079), minimum of 7.2 g/dl and maximum of 18.8 g/dl (men). The total mean hematocrit count was 34.115 g/dl (±5.3730). Mean preoperative platelet levels were within normal limits among the studied patients.

Spinal anesthesia was the main choice of anesthesia used in 247 (91%) surgical procedures, followed by spinal anesthesia associated with nerve block in 14 (5.2%), and general anesthesia in six (2.2%) patients; four (1.6%) patients were given associated epidural anesthesia. The mean number of days between admission and surgical procedure was 6.09 (±5,561), minimum of zero and maximum of 46 days, and the mean duration of surgical procedures was 166.77 minutes, ranging from 52 to 295 minutes.

In terms of the types of anesthetic-surgical complications during surgery in the immediate postoperative period, 31 (11.4%) patients presented low blood pressure (mean arterial pressure < 60 mmHg), 21 (7.7%) pain, 18 (6.6) decreased skin oxygen saturation, 14 (5.2%) excessive bleeding (loss greater than 500 ml), nine (3.3%) required other anesthetic interventions (complementation with a second type of anesthesia), seven (2.6%) presented tachycardia (>100 bpm), six (2.2%) vomit, six (2.2%) agitation, three (1.1%) bradycardia (<60 bpm), two (0.7%) high blood pressure (systolic blood pressure >140-159 mmHg/diastolic blood pressure >90-99 mmHg) and one (0.4%) presented an allergic drug reaction.

The incidence of surgical orders of RBC concentrate was 87%. Regarding RBC concentrate orders made by the surgical team and the number of orders reserved by the transfusion agency (frequency of new orders for the same patient), of the 271 (100%) patients submitted to femur fracture repair surgery, 178 (65.7%) had one order put it, with a mean of 1.17 (± 0.839) orders between the date of admission and date of surgery, minimum of zero and maximum of eight new orders. Moreover, 35 (12.9%) patients were submitted to surgery without an order of RBC concentrate. The high demand for blood orders can be explained by the postponement of orthopedic surgeries because of the need to stabilize the patient's clinical condition, lack of operating rooms or lack of human and material resources.

For 88 (37.6%) patients, surgical blood orders had been placed one day before the surgery and for 56 (23.9%) patients, the order had been placed during the elective surgery. Some orders had also been made more than 72 hours before the date of the surgery, a period greater than the shelf-life of pre-transfusion samples, as shown in table 2.

**Table 2** - Distribution of patients by time in days between date of last blood order and date of surgery. Uberaba, MG, Brazil, 2017. (n=234*)

| Blood order placed | n | % |
|---|---|---|
| Blood order placed on the day of surgery | 56 | 23.9 |
| Blood order placed 1 day before surgery | 88 | 37.6 |
| Blood order placed 2 days before surgery | 44 | 18.8 |
| Blood order placed 3 days before surgery | 18 | 7.7 |
| Blood order placed 4 days before surgery | 17 | 7.3 |
| Blood order placed 5 days before surgery | 3 | 1.3 |
| Blood order placed 6 days before surgery | 1 | 0.4 |
| Blood order placed 7 days before surgery | 2 | 0.9 |
| Blood order placed 9 days before surgery | 1 | 0.4 |
| Blood order placed 11 days before surgery | 2 | 0.9 |
| Blood order placed 12 days before surgery | 1 | 0.4 |
| Blood order placed 15 days before surgery | 1 | 0.4 |
| **Total** | **234** | **100** |

*Two pieces of data regarding this variable presented were lost due to incomplete data.

The present study showed differences between the volume ordered by the surgical team and that set aside by the transfusion agency. Based on clinical practice, for most patients (55.1%), the surgical team requested two units of RBC concentrate, totaling 378 RBC concentrate units ordered during the studied period. In turn, the transfusion agency, based on the model protocol of the Hemominas Foundation, reserved one unit of RBC concentrate for most patients (75.8%), for a total of 301 units.

However, in terms of transfusions of RBC concentrate, until hospital discharge, 91 (33.6%) patients had received transfusions, with a total of 110 transfusions and 238 RBC concentrate units consumed, with two units being the most commonly used volume. Furthermore, the preoperative period saw the greatest amount of RBC concentrate transfusions and consumption, as shown in table 3.

**Table 3** - Distribution of blood transfusions by number of units of RBC concentrate transfused and period of transfusion. Uberaba, Minas Gerais, Brazil, 2017. (n=110)

| Bags of transfused RCB concentrate per period | Preoperative | | Intraoperative | | Immediate postoperative | | Mediate postoperative | | Total number of transfusions by quantity |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n |
| 1 unit | 18 | 34.6 | 7 | 39 | 10 | 47.6 | 3 | 15.9 | 38 |
| 2 units | 18 | 34.6 | 8 | 44.4 | 10 | 47.6 | 11 | 57.8 | **47** |
| > than 2 units | 16 | 30.8 | 3 | 16.6 | 1 | 4.8 | 5 | 26.3 | 25 |
| **Total** | **52** | **100** | **18** | **100** | **21** | **100** | **19** | **100** | **110** |

Multivariate analysis of the sociodemographic and clinical variables in relation to the mean occurrence of blood transfusion in patients submitted to elective femur fracture repair surgery showed statistical significance ($p<0.05$) for sex, preoperative hemoglobin level and duration of procedure. Female patients, low preoperative hemoglobin and procedures lasting more than 120 minutes were predictors of RCB concentrate transfusions. ASA variables, age, and use of anticoagulants and/or antiplatelets did not present statistical significance, as shown in table 4.

## DISCUSSION

The predominance of female patients submitted to femur fracture repair surgery observed in this study is corroborated by other recent studies.[12,15–20]

Osteoporosis, falls from standing height as a mechanism of injury, exposure to more house chores, greater prevalence of chronic disease, and more fragile physical structure make the female gender more susceptible to this type of fracture.[21–24]

Regarding mean patient age, similar results have been found by studies that evaluated populations in the same age group as those in the present study.[17,25] However, studies that excluded patients under the age of 60 obtained higher means.[19–20]

A study conducted in China showed lower mean weight (58.83±11.01 kg) than that in the present study, which can be related to the physical characteristics of Chinese individuals. Cardiovascular disease, associated with mortality and rehospitalization rates, was the main comorbidity found in this and other similar studies. This reinforces the aggravating characteristics of patients submitted to this type of surgery.[26–27]

Low preoperative hemoglobin levels was another aggravating factor for individuals with femur fractures. A retrospective study with 7,420 patients showed an increase in 30-day mortality in patients with low hemoglobin levels on admission, even after correcting for comorbidities.[28] Anemic patients presented a lower rate of recovery of physical capacity.[29–30]

In line with the findings of the present investigation, a study with 1,817 participants found that 53.4% were classified as ASA II.[31] Although the study showed significant risk of interoperative hypotension, similar to the results of the present study, in which hypotension was the most frequent complication, and that epidural anesthesia is still the main choice of and moat recommended type of anesthesia for this type of surgery.[25–26,32]

Regarding time in days between date of admission and date of surgery, differences were found between Brazilian and international studies, with means between 1.44 and 19 days. It is worth emphasizing that delays in femur fracture repair surgery greater than 48 hours increase the risk of complications and can result in greater one-year mortality rates.[12,15,27]

**Table 4** - Multivariate analysis among sociodemographic and clinical variables and the occurrence of hemotransfusion. Uberaba, MG, Brazil, 2017 (n=91)

| Predictors | Occurrence of transfusion | | Bivariate Analysis | | | Logistic Regression | |
|---|---|---|---|---|---|---|---|
| | Yes | No | RR (CI) | or (CI) | *p* | adjusted OR (CI) | *p* |
| ASA | | | | | | | |
| ASA I and II | 69 (33%) | 140 (67%) | 0.930 (0.632-1.370) | 0.896 (0.494-1.624) | 0.718 | 0.997 (0.519-1.917) | 0.994 |
| ASA III and IV | 22 (35.5%) | 40 (64.5%) | | | | | |
| Sex | | | | | | | |
| Female | 55 (40.1%) | 82 (59.9%) | 1.494 (1.057-2.112) | 1.826 (1.094-3.048) | 0.021 | 2.266 (1.229-4.176) | **0.009** |
| Male | 36 (26.9%) | 98 (73.1%) | | | | | |
| Use of anticoagulants and/or antiplatelets | | | | | | | |
| Yes | 14 (38.9%) | 22 (61.1%) | 1.187 (0.758-1.859) | 1.306 (0.633-2.692) | 0.469 | 1.571 (0.699-3.529) | 0.274 |
| No | 77 (32.8%) | 158 (67.2%) | | | | | |
| Age | | | | | | | |
| Adult | 32 (32.7%) | 66 (67.3%) | 0.957 (0.674-1.361) | 0.937 (0.553-1.586) | 0.808 | 1.160 (0.600-2.243) | 0.659 |
| Older Adult | 59 (34.1%) | 114 (65.9%) | | | | | |
| Hemoglobin Levels | | | | | | | |
| Altered | 82 (39.8%) | 124 (60.2%) | 2.875 (1.532-5.394) | 4.115 (1.930-8.773) | <0.001 | 4.618 (2.082-10.245) | **<0.001** |
| Normal | 9 (13.8%) | 56 (86.2%) | | | | | |
| Duration of surgery | | | | | | | |
| Up to 120 minutes | 15 (20.5%) | 58 (79.5%) | 0.535 (0.330-0.869) | 0.415 (0.220-0.784) | 0.006 | 0.424 (0.213-0.842) | **0.014** |
| >120 minutes | 76 (38.4%) | 122 (61.6%) | | | | | |

*ASA=American association of Anesthesia

Delays in surgery can impact medical expenses and the quality of care given to femur fracture patients. Decreasing delays in surgeries can limit the consequences of this fracture. In Brazil, according to the recommendation of the Ministry of Health, surgical treatment of femoral neck fractures must be carried out as quickly as possible, as long as the patient is clinically fit to undergo surgery, and professionals should wait for no longer than 48h after the fracture occurred.[33–34]

Regarding the duration of the surgical procedure, the present study showed a mean duration of 166.77 (±59.534) minutes, similar to that found in recent studies, whose duration times varied between 71.8 and 176 minutes.[26,35]

A documentary study carried out in the South of Brazil analyzed the completion and content of a surgical safety checklist in 257 orthopedic surgeries. The results showed a 51.8% incidence of blood orders, lower than that found in the present study.[36] This discrepancy can be explained by the type of surgery performed, as femur fracture repair surgeries are procedures in which greater blood loss is predicted and, therefore, more surgical blood orders are placed.

The dissonance and variability regarding volume of RBC concentrate requested by the surgical team and the volume reserved by the transfusion agency was also common in other studies.[37–39] A study conducted in the Blood Center of the State of Rio de Janeiro in 2016 showed a high number of emergency orders, and the number of bags ordered from the transfusion agency was decided practically by intuition.[40]

Thus, adopting the surgical blood order table and adjusting it to local reality facilitates more effective management of blood banks, reducing unnecessary testing, because pre-transfusion testing takes time and is essential to patient safety. Furthermore, expanding phenotyping and compatibilizing for C, c, E, e (Rh system) and K (Kell system) antigens is recommended whenever possible for all individuals undergoing elective surgery in order to reduce rates of red cell alloimmunization and hemolytic transfusion reactions. Surgical teams must also pay attention to the 72-hour shelf-life of blood bank samples.[4,9,41–42]

Despite recent recommendations of rationalized blood use, a wide-reaching study conducted in 2016 assessed 2,225,054 cases of arthroplasty between 1993 and 2011 and found an alarming increase in the use of blood products in this type of surgery in the United States.[43] Corroborating these data, in addition to the present study, another investigation showed great demand for transfusions in femur fracture repair surgeries.[15–17,25,30,44]

When the Rate of Transfused Patients (IPT) recommended by the *Fundação Hemominas* is greater than 10%, the foundation's guidelines suggest placing prior surgical RCB concentrate orders. In the present study, this index was 35.5%, corroborating the premise that the surgical treatment of femur fractures requires blood orders for all patients. The volume requested must also be adjusted in the studied institution, because most patients used more blood bags than recommended by the table adopted by the institution.[9]

Regarding period of transfusion, this study showed that most patients were transfused in the preoperative period, with a greater amount of RCB concentrate units, which can be attributed to great blood loss in this period. Preoperative transfusion aims to improve surgical safety, and it is ideal for patients with hemoglobin levels lower than 100 g/dl before the surgery, to avoid hemoglobin levels falling under 80 g/dl during or after the surgery[12].

ASA scores, age and preoperative use of anticoagulants and/or antiplatelets did not show statistically significant results as predictors for blood transfusion, corroborating a study that showed that the use of heparin in the preoperative period did not increase risk of bleeding, and another study which showed that it was safe to conduct surgery 24 hours after the last dose of clopidogrel.[26,45]

On the other hand, a retrospective study associated ASA classification with the need for intraoperative blood transfusion; however, it also observed that the literature presents conflicting results

when using the ASA classification as an algorithm for blood orders, because the risk of hemorrhage is determined by the procedure.[31]

Other similar research associated the female gender with blood transfusion, among them, a retrospective study with 1,484 participants carried out in Tel Aviv, Israel.[46–48] However, some authors have not observed gender-related differences regarding the need for blood transfusions in their studies.[16,35]

Other authors[16,41,47,49–51] have also shown low preoperative hemoglobin levels to be associated with increased risk of blood transfusion.

Teaching hospitals may be more prone to prolonged surgeries. Greater duration of surgery was also a predictor of blood transfusion, in this and other studies, which points to the need for special attention when surgeries are estimated to last long, and to have knowledge about blood transfusion.[35,41,49,51–53]

Limitations of the present study include its retrospective design, which can imply incomplete data on forms and charts, and lack of data from coagulation tests. However, these limitations did not compromise reaching the proposed objectives.

## CONCLUSION

The incidence of surgical orders of RBC concentrate for patients submitted to femur fracture repair in the studied period was 87%, with a mean of 1.17 (±0.839) units requested between the date of admission and date of surgery, and 35 (12.9%) patients underwent surgery without any blood order.

Predictors for blood transfusion were: female sex, low preoperative hemoglobin levels, and surgery duration greater than 120 minutes; which points to the need for more attention to this group, and the need to create tools that indicate the volume of RBC concentrate, based on research that involves clinical aspects.

Regarding the occurrence of blood transfusions, 91 (33.6%) patients received RBC concentrate; most transfusions were performed in the preoperative period, with 52 (47.2%) occurrences.

Differences were observed in the volume of blood requested by the surgical team and that reserved by the transfusion agency, which requires the creation of a tool adjusted to local realities which later can be extended to other specific surgical procedures.

In light of the above, as part of surgical teams, it is essential that nursing teams, which assist patients from hospital admission to the postoperative period, recognize the importance of surgical blood orders, the shelf-life of blood samples, and factors that influence the need for blood transfusions, ensuring the availability of RBC concentrate units that are duly compatible with patients with femur fractures, thus contributing to safer surgical care.

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## NOTES

### ORIGIN OF THE ARTICLE

Article extracted from the thesis - Analysis of blood orders in elective femur fracture repair surgeries, presented to the Graduate Healthcare Program, *Universidade Federal do Triângulo Mineiro*, in 2017

### CONTRIBUTION OF AUTHORITY

Conception of study: Isidoro REC, Barbosa MH.
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### ACKNOWLEDGEMENTS

The authors thank the Coordination for the Improvement of Higher Education Personnel - BRAZIL (CAPES) - Financing Code 001 - for the support in the accomplishment of this study.

### ETHICS COMMITTEE IN RESEARCH

Approved by the Research Ethics Committee of the *Universidade Federal do Triângulo Mineiro*, resolution No. 1.676215 e Certificate of Presentation for Ethical Appraisal (CAAE) N. 57792816.9.0000.5154; and by the Research Ethics Committee of the Hemominas Foundation, resolution no. 1.768.375 and CAAE N. 57792816.9.3001.5118.

### HISTORICAL

Received: April 6, 2017
Approved: October 2, 2018

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