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ORIGINAL ARTICLE

Transfusion of Blood Products in the Postoperative of Cardiac Surgery

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Abstract

Background: The indiscriminate use of blood transfusion in surgery has been associated with increased risk of infection and increased length of hospital stay.

Objective: To identify the average amount of bleeding and rates of transfusion of blood products in the postoperative period of patients undergoing cardiac surgery in a cardiology center.

Methods: Medical records of patients who underwent myocardial revascularization surgery and/or heart valve replacement with use of cardiopulmonary bypass (CPB) were analyzed. Perioperative data such as CPB time, hematocrit and hemoglobin values were collected after surgery. The amount of bleeding (mL), blood transfusion (IU), clinical complications and time of hospitalization were also recorded. The correlation between bleeding in the postoperative period and blood transfusion was performed using the Spearman correlation. A $p < 0.05$ was considered statistically significant.

Results: A total of 423 patients undergoing coronary artery bypass grafting (51.5%) or heart valve replacement (33.6%) were included. During the first 24 hours, the average bleeding volume was 353.3 ± 268.3 mL. Transfusion of blood products was required in 40.1% of cases, most frequently (70.6%) in the immediate postoperative period. Red blood cell concentrate was the most frequently used product (22.9% and 60%).

Conclusion: The occurrence of bleeding in the cases was low, and when transfusion of blood components was indicated, red blood cell concentrates were the most widely used component.

Keywords: Cardiac Surgery; Postoperative Care; Blood Transfusion/methods; Transfusion Reaction/complications.

Introduction

Patients undergoing cardiac surgery are prone to excessive postoperative bleeding. In addition, it is known that the passage of blood through the cardiopulmonary bypass (CPB) circuit triggers the release of inflammatory mediators, resulting in a series of changes in hemostasis. Other situations such as thrombocytopenia, disseminated intravascular coagulation, and liver failure may also influence the occurrence of acute anemia, which should be corrected immediately.[1,2]

However, the indiscriminate use of blood products in cardiac surgery has been associated with increased risk of infection, increased need for mechanical ventilation, increased organ failure, longer length of hospital stay, and higher mortality rates. [3-6]

Although blood transfusion may become imperative for the management of postoperative cardiac surgery patients, several efforts have been made to restrict and standardize transfusion practice and improve outcomes for patients.[7-9]

Much has been discussed about the optimal time for transfusion, although there is no global standardization of hematocrit and hemoglobin values, but only a consensus on clinical criteria. In practice, efforts have focused on maintaining hemoglobin values between 7 and

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9 g/dL.[10] Literature data suggest that hemoglobin levels are not sufficient for the decision to transfuse a patient and individual characteristics such as age, comorbidities and perfusion. associated parameters should be considered to minimize possible complications.[11]

Previous studies have shown that the need for blood transfusion may be reduced by the use of acute normovolemic hemodilution,[12-14] and prophylactic intravenous administration of concentrated fibrinogen or tranexamic acid immediately before and after myocardial revascularization, which reduces the frequency of postoperative bleeding and fibrinolysis in high-risk populations.[15-17] Other methods such as the use of intraoperative autotransfusion in CPB cardiac surgery, hemofiltration, preoperative autologous blood donation and erythropoietin pretreatment, as well as the recognition of normovolemic anemia, have been described to reduce blood transfusion and its potential adverse effects.[18,19]

In this context, this study was designed to assess the amount of bleeding and the number of transfusions in an institution where a high number of cardiac surgeries are performed, located in southern Brazil.

Patients and Methods

Consecutive medical records of patients who underwent cardiovascular surgery from January 2015 to July 2016 were retrospectively analyzed in a cardiology center located in the south of the country. Patients of both sexes, aged ≥18 years, undergoing myocardial revascularization surgery, valve replacement surgery, or both, with use of cardiopulmonary bypass, were included in the study. Exclusion criteria were emergency surgery and incomplete medical records. After the selection of a convenience sample from the surgery list of the institution, the records of health teams (developments and requirements) were reviewed in electronic and/or paper medical records, to collect the information for a specific database.

Demographic and clinical variables, as well as previous comorbidities were collected for sample characterization. The data from pre-, intra- and post-operative periods such as the time of CPB, and hematocrit and hemoglobin values were collected at one, 12 and 24 hours after surgery. The occurrence of bleeding (mL), transfusion of blood products (IU), clinical complications and time of hospitalization were also recorded.

Ethical Considerations and Statistical Analysis

The study was approved by the Research Ethics Committee of the institution, under number 4906/13, and conducted according to the ethical principles related to access and analysis of data of the 466/12 Resolution of the Brazilian National Health Council. A term of commitment and confidentiality for the use of data from medical records was used.

The data were analyzed with the Statistical Package for Social Sciences (SPSS) version 20.0, considering a significance level of $p < 0.05$ for all tests. Categorical variables were described as absolute numbers (n) and relative (%) frequencies and continuous variables were expressed as mean and standard deviation for those with normal distribution or median and interquartile range for those without normal distribution. The correlation between bleeding in the postoperative period and blood transfusion was performed using the *Spearman* correlation. To verify the normality of the data, the Shapiro Wilk test was used. The other associations were performed using the chi-square test.

Results

A total of 423 medical records of patients undergoing elective cardiac surgery with CPB were analyzed. The surgeries performed included coronary artery bypass grafting (51.5%) and valve replacement surgery (33.6%). The study population had a mean age of 60.5 ± 12 years old, and hypertensive or active smoking patients were 77.8% and 28.6%, respectively. These and other baseline characteristics are described in Table 1.

Laboratory Results

The average blood loss through mediastinal and pleural drainage in the perioperative and immediate postoperative periods within the first 24 hours, was 353.3 ± 268.3 mL. The method of measuring perioperative bleeding was by weighing the compresses. The average hematocrit and hemoglobin values in the postoperative period were 31 ± 4.3% and 10.2 ± 1.4g/dL, respectively (Table 2).

Transfusion Parameters

A total of 170 patients (40.1%) required blood transfusion, with 627 bags of blood components, in the pre-, intra- and postoperative periods. Transfusion of red blood cell concentrates was the most used procedure

Table 1 – Demographic and clinical characteristics of the study population (n = 423)

Variable	
Age (years)	60.5 ± 12.4
Male	274 (64.8)
Ischemic heart disease	210 (51.8)
Comorbidities	
Hypertension	329 (77.8)
Active smoking	121 (28.6)
Ex-smoker	96 (22.7)
Dyslipidemia	120 (28.4)
Coronary artery disease	84 (19.9)
Obesity	44 (10.4)
Diabetes Mellitus	94 (22.2)
Ejection fraction (%)	64 (52;70)
Coronary artery bypass grafting	218 (51.5)
Valve replacement surgery	142 (33.6)
Coronary artery bypass grafting and valve replacement surgery	33 (7.8)
CPB time (min)	80 ± 31
Aortic clamping time (min)	58 ± 25
Intensive care unit hospitalization time (days)	4 (3;5)
Time ofhospitalization (days)	14 (10;20)

Categorical variables expressed as n (%); continuous variables expressed as mean ± standard deviation for normal distribution or median and interquartile range for variables without normal distribution

(n=144; 84.7%), and other 26 patients (15.2%) received more than one blood component including fresh plasma, cryoprecipitate, and platelet concentrates. These and other information are described in Table 3.

A greater number of blood bags was used 12 hours after surgery. A weak and reverse correlation was found between bleeding in the postoperative period and blood transfusion r = 0.13 to p = 0.008. (Figure 1).

A total of 146 cases of complications were observed in the immediate postoperative period, of which, 66 (45.2%) needed blood transfusions. There were 11 cases (7.5%) of arrhythmia, 27 (18.5%) of hemodynamic complications, 21 (14.4%) respiratory complications, three (2.1%) renal complications, and four (2.7%) of neurological complications (Table 4).

Discussion

The risks inherent in cardiac surgery are a constant concern due to patients' more advanced age, the greater number of associated comorbidities and the extension of indications for specific groups of patients. The importance of documenting the amount of bleeding in the perioperative period of cardiac surgery has already been established in the literature. This information is important in determining the medical conduct to be taken during the period of hospitalization of the patients.

The massive transfusion of red cell concentrates is strongly associated with reduction of survival and is an independent predictor of early and late mortality outcomes after coronary artery bypass grafting.[20-26]

The average blood loss within the first 24 postoperative hours was 353.3 ± 268.3 mL, and 40% of the patients received blood products. These findings were significantly lower than results reported in the literature. Results of studies conducted with a similar population showed higher transfusion rates, explained by an average volume of 750 ± 250 mL bleeding on the first day after intervention,[21,24] and the need for blood transfusion in approximately half of the patients studied.[23,25] A prospective cohort study conducted with the participation of European surgical services confirmed that severe hemorrhage is uncommon in low-risk patients submitted to cardiac surgery but may be associated with major complications, stressing that even mild bleeding can result in increased risk of adverse events.[22]

The criteria for blood transfusions in general practice and in cardiac surgery vary between institutions and professionals. It has been shown that a conservative strategy (hemoglobin <7.0 g.dL-1) is as effective and possibly more effective than a liberal strategy (hemoglobin <10.0 g.dL-1),[26] reducing blood transfusion complications. However, other studies considered hemoglobin values <8.4 g.dL-1 as a trigger to determine blood transfusion, in order to maintain serum hemoglobin levels >9.0 g.dL-1.[27,28] At the institution where the present study was conducted, blood products are transfused based on patients' clinical conditions, rather than predetermined thresholds or triggers. High doses of vasopressor, signs of severe ventricular dysfunction, weaning failure from mechanical ventilation, assessment of fluid balance, fluid resuscitation and bleeding are among the factors that determine the need for blood transfusions.

In the present study, 40% of the patients were transfused, most frequently with red blood cell concentrates. Transfusion was more frequent in the immediate postoperative period, when hematocrit and hemoglobin levels were lower. Laboratory parameters remained within the normal range in the pre- and intraoperative periods, with less frequent transfusion.

Effective measures for reducing the volume of bleeding should be adopted to reduce the use of blood components. Precautions such as a careful analysis

Table 2 – Laboratory results in the perioperative period of patients undergoing cardiac surgery (n=423)

Variables	Preoperative period	Intraoperative period	Immediate postoperative period
Hematocrit (%)	39.6 ± 4.2	32 ± 6.7	31 ± 4.3
Hemoglobin (g/dL)	13.1 ± 1.7	10 ± 2.1	10.2 ± 1.4
Bleeding (mL)	0.00	413.5* (290;580)	200* (100;300)

*Variables expressed as mean ± standard deviation. * median and interquartile range*

Table 3 – Descriptive analysis of blood transfusion results (n=170)

	Transfusions	Red blood cell concentrates	Red blood cells associated with other blood products
Preoperative	5 (2.9)	3 (1.8)	2 (1.1)
Intraoperative	45 (26.5)	39 (22.9)	6 (3.6)
Postoperative	120 (70.6)	102 (60)	18 (10.4)

Categorical variables expressed as n (%)

of family history of bleeding, appropriate laboratory evaluation, administration of erythropoietin two to three weeks before the surgery, determination of serum iron and oral iron administration, in addition to the use of antifibrinolytics, normovolemic hemodilution, autotransfusion by intraoperative blood reuse in cardiac surgery and hypothermia during CPB, are some of the strategies used in health services.[29]

Among the clinical complications observed in this study, there was a predominance of arrhythmias and hemodynamic and respiratory complications. Although these events are commonly observed in the immediate postoperative period, the transfusion of even smaller amounts of blood can increase adverse clinical outcomes. Infections as mediastinitis, generalized sepsis and acute renal failure have also been documented in similar populations.[29]

Current transfusion practices need to be reevaluated. Despite improvements in the methods of donor selection and careful clinical screening, blood transfusions are still susceptible to complications. Health teams should continue with preventive strategies in complex interventions associated with increased requirement of blood transfusion, such as cardiac surgeries, by intensifying treatment of anemia in the preoperative period, and the use of minimally invasive surgical techniques and of standardized institutional protocols to rationalize the use of blood components. These measures can increase the quality of care and minimize adverse events inherent to major procedures such as cardiovascular surgeries.

Limitation of the study

A retrospective cohort study, with review of medical records, can limit the conclusions, and should be considered as a generator of hypothesis, representative of the clinical practice in a large center for cardiac surgery. It is important to mention that the transfusions were indicated by medical criteria, without a pre-established minimum value of hemoglobin levels.

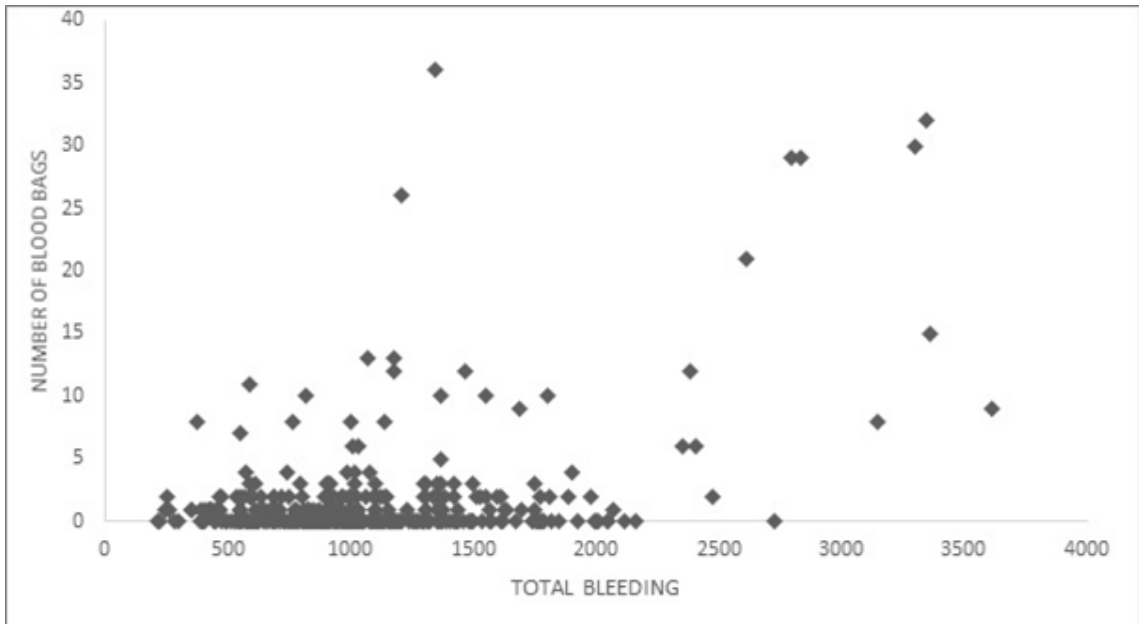

Figure 1 – Relation between the amount of bleeding and number of transfused blood bags.

Table 4 – Postoperative complications of patients undergoing cardiac surgery (n=146)

Complications	Transfusions		
	No	Yes	P
Total	80(54.7)	66(45.2)	< 0.00
Hemodynamic	18(12.3)	27 (18.5)	< 0.00
Respiratory	15 (10.3)	21(14.4)	< 0.00
Arrhythmias	43(29.4)	11 (7.5)	<0.80
Renal	3 (2)	3(2.1)	< 0.46
Neurologic	1 (0.7)	4 (2.7)	<0.15

Categorical variables expressed as n (%). Chi-square test.

Conclusion

In the present study, bleeding rates in patients submitted to cardiac surgery were lower than those reported in the literature. When transfusion of blood components was indicated, red blood cell concentrates were the most widely used component.

Author Contributions

Conception and design of the research: Giordani JN, Borges CT. Acquisition of data: Giordani JN, Borges CT. Analysis and interpretation of the data: Giordani JN, Borges CT, Moraes MA. Writing of the manuscript: Giordani JN, Borges CT, Mariani PE, Costa LM. Critical revision of the manuscript for intellectual content: Bridi LH, Santos ATL, Kalil RAA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics approval and consent to participate

This study was approved by the Ethics Committee of the IC/FUC under the protocol number 4906/13. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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