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Research Article

Blood Transfusion: Particularities of the Critical Patient in Medical Intensive Care

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Abstract

Blood transfusion is a therapeutic act frequently performed in intensive care. We conducted a retrospective study in the medical resuscitation department of Hassan II University in Casablanca, between January 1 and June 30, 2022, with objectives of evaluating transfusion practices in intensive care setting, transfusion thresholds, mortality and prognosis factors.

During the study period, 361 patients were admitted, among them 52 required a blood transfusion. The average age was 44.16 years. Patients with a pathological history represented 62.32% of the cases. Diabetes was the most frequently found. The average SAPSS II score is 24.25 points, the average APACHE II score is 11.76. Reasons of hospitalization were dominated by diabetic ketoacidosis (19.2%), leptospirosis (7%). Fresh frozen plasma (FFP) was the most transfused blood product (35.43%), followed by Platelet Pellet (PP) (32.81%) and Blood Pellet (BP) (31.74%). The average consumption of BP was 4.309 units per patient, that of FFP was 9.21 units and that of PP was 9.52 units per patients. Complications were noted in 42 patients (80.71%), 7.8% of whom experienced complications from blood transfusion. The mortality rate was 68.8%, it is significantly related to blood transfusion pf platelet pellet, history of diabetes, SAPSS II score, length of stay and taking anti-infectious chemotherapy and TCA on admission.

Finally, we stress the usefulness of rationalizing blood transfusion and the considerable interest in promoting alternatives to homologous transfusion, while hoping that the latest regulatory innovations in blood transfusion will be adopted in all hospitals.

Keywords: Blood transfusion; Epidemiological characteristics; Prognostic factors; Medical resuscitation

Introduction

Blood transfusion is one of the greatest achievements of modern medicine. Its advantages impact the quality of life of patients and make it possible to reduce morbidity and mortality in certain pathological situations [1]. It is a therapeutic procedure which consists of administering intravenously to a subject, called a recipient, blood or one of its components (red blood cells, platelets, granulocytes, plasma, proteins) taken from another subject called a donor [2]. Nearly a third of intensive care patients require a blood transfusion during their hospital stay, in order to compensate for blood loss in the event of hemorrhagic syndromes and to improve hemostasis, the transport of oxygen to the tissues and in certain situations, limit the risk of myocardial ischemia.

The objective of our study is to describe the epidemiological and clinical profile of transfused patients, identify the most used blood products, evaluate the frequency of blood transfusion, note the incidents encountered and specify the prognostic factors and the evolution of these patients.

Materials and Methods

Retrospective descriptive and analytical study spread over 6 months, from January 1 to June 30, 2022, within the medical intensive care unit of Hassan II University of Casablanca, we included all patients transfused during the study period.

Data were collected from the department's blood transfusion register and patient medical records available in the department's archives. These data were entered on an operating sheet which included epidemiological, clinical, biological, therapeutic and evolutionary variables. For the assessment of severity, we used the SAPS II (Sequential organ failure assessment) score and the APACHE II (Acute physiology and chronic health evaluation) score.

Quantitative variables were expressed as mean ± standard deviation or median. While qualitative variables were expressed as percentages. The Chi^2 test or Fisher's exact test for qualitative variables and student t test or the Wilcoxon test for quantitative variables. A p value less than 0.05 were considered significant.

Results

From January 1 to June 30, 2022, 361 patients were hospitalized in the medical intensive care unit, including 52 patients requiring a blood transfusion, representing a hospital incidence of 14.41%. The age was between 16 and 89 years with a mean of 44.16 ± 18 years. The age group most affected was between 20 and 35, with a female predominance of 69%. 62.32% of transfused patients had a pathological history, diabetes was the most common (33.8%) followed by arterial hypertension (14.1%). The reason for hospitalization of transfused patients was dominated by diabetic ketoacidosis (19.2%) and leptospirosis (9%). Concerning the severity scores, the average value of the APACHE II score was 11.76 ± 4.91 with extremes of 2 to 31. The average SAPS II was 24.25 ± 27.32 with extremes of 6 to 73.

The clinical characteristics at admission were: fever (36.6%), polypnea (84.9%), average oxygen saturation 95% (40.23%), tachycardia (61.5%), arterial hypotension (4.1%) with hypertension

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in 37.33% and a neurological deficit was found in 19.2% of patients. The hemoglobin level was less than 7 g/dl in 17.55% of cases with an average level of 10.09 ± 3.1, the hematocrit was less than 35% in 66.76% with an average level of 28.55 ± 6.9, thrombocytopenia less than 50,000/mm was found in 15.88% of cases with an average rate on admission of 160,543/mm. Concerning the hemostasis assessment, the prothrombin level was less than 30% in 6.2% of patients with an average at admission of 60.9%. Activated partial thromboplastin time less than 30 was found in 36.96%. Hypofibrinogenemia was found in 6.5% of patients.

Therapeutic treatment in our department consisted of: mechanical ventilatory assistance (78.7%), use of vasoactive drugs (38.6%), anticoagulation (78.7%), anti-infectious chemotherapy (90.6%) of which the main molecules were third generation cephalosporins and aminoglycosides. The distribution of patients according to blood group and rhesus revealed the predominance of O+ (48.42%) followed by A+ (38.46%). Based on the clinical and paraclinical examination, the indications for transfusion of labile blood products were dominated by anemia (77.6%) followed by thrombocytopenia (19.2%). The three blood derivatives used were: packed red Blood Cells (CG), Packed Platelets (PP) and Fresh Frozen Plasma (FFP) (Table 1). The total number of units transfused in our series was 520 units: 187 units of PFC or 35.43%, 170 units of CP or 32.81% and 163 units of CG or 31.74%.

Table 1: Nature of blood products transfused.

Nature PSL	Number of patients	Percentage %
CG alone	19	36.7
CP alone	4	7.1
FFP alone	2	3.8
CG+CP	4	7.1
CG+FFP	14	26
CP+FFP	2	3.8
CG+CP+FFP	7	13.7

The transfusion frequency varied from one to 10 transfusion episodes for all PSLs per patient. 49.4% of patients required only one transfusion episode, while 22.1% required 2 transfusion episodes during the duration of their hospitalization. The prevention of certain immunological and infectious side effects of transfusion can be achieved by the use of specific qualifications and transformations of the transfused labile blood products. In our investigation, no transformation or qualification was prescribed. The duration of hospitalization varied from 1 to 97 days with a mean duration of 18.06 ± 18 days. The evolution was favorable in 44 patients or 85.71%. However, the occurrence of complications was noted in 80.71% of patients, 71.42% were infectious, the most incriminated germs were acinetobacter followed by klebsiella, 11.5% were thromboembolic and 17.3% presented a reaction to blood transfusion. Type of fever chills, renal failure, hemodynamic instability and skin reactions.

In our series, the mortality rate was 68.8%. It was dominated by septic complications (37.66%) followed by neurological complications (14.28%) and the others represented 16.88%. In the univariate analysis of the hemostasis assessment, the TCA level on admission was considered a poor prognosis factor (Table 2).

Table 2: Biological factors associated with mortality.

Biological variables at admission	Survivors N=17	Deaths N= 35	*p*
Hemoglobin g/l	10.4 ± 2.8	10.9 ± 2.1	0.089
Hematocrit %	31 ± 7.8	33.8 ± 5.9	0.17
Prothrombin %	62.4 ± 19.3	67.1 ± 22.9	0.372
Platelets/mm	160153 ± 124270	213625 ± 133747	0.349
Activated partial thromboplastin time	29.1 ± 15.3	28.7 ± 16.7	0.023
Fibrinogen g/l	4.8 ± 2.3	4.4 ± 2.1	0.413
C-reactive protein mg/l	129.7 ± 101.5	146 ± 98	0.665

Discussion

Blood transfusion is a therapy which consists of administering blood or one of the components (red blood cells, platelets, granulocytes, plasma, proteins) coming from one or more healthy subjects called "donors" to one or more subjects. Patients called "recipients" [3]. Blood transfusions are one of the most widely used health interventions [4]. Quality transfusion medicine involves ensuring the benefits of this therapeutic act and reducing its risks, which requires the healthcare team to carefully adhere to the recommendations of good transfusion practice. Adequate transfusion safety requires basic knowledge, continuous and repeated training so that the transfusion procedure takes place according to the rules of the art [5]. The main indications for CG transfusion in intensive care:

- Shock despite correction of hypovolemia
- The persistence, despite the correction of hypovolemia, of symptoms of poor tolerance associated with a decrease in hemoglobin level.

The most common signs of seriousness are:

- Syncope, dyspnea, tachycardia, angina, orthostatic hypotension, transient ischemic attack.
- In elderly or coronary patients: appearance or worsening of a neurological deficit.
- In subjects with heart or respiratory failure: impaired alertness, fainting, arterial hypotension, significant reduction in PaO_2.
- In healthy young subjects: excessive polypnea, HR>130 bpm/min, persistent arterial hypotension.

The notion of transfusion threshold is criticized, because transfusion is a complex decision in which, in addition to hemoglobin concentration, cardiac reserve, estimation of bleeding speed and clinical tolerance are involved. There is no single transfusion threshold for all patients and the decision to transfuse must take into account the type of pathology and comorbidities of each individual [6,7]. Indeed, elderly patients hospitalized in intensive care units or suffering from cerebrovascular, coronary or respiratory pathology are currently considered as a population with less tolerance to anemia [8]. The thresholds selected are:

- 7 g/dl in people without a pathological history
- 8-9 g/dl in people with a history of cardiovascular disease
- 10 g/dl in people who do not clinically tolerate lower concentrations or suffer from acute coronary insufficiency or proven heart failure [6,7,9]

The use of Fresh Frozen Plasma (FFP) for therapeutic purposes is strictly reserved for situations which indisputably require it [10]:

- Severe consumer coagulopathy with collapse of clotting factors
- Acute hemorrhage, with global deficiency of coagulation

factors

- Complex deficiency in coagulation factors, when specific coagulant fractions are not available: fibrinogen<1g/l, TP<40%, TCA>1.5-1.8 times the control value [11].

To these indications, we must add thrombotic thrombocytopenic purpura and hemolytic-uremic syndrome in adults. PFC should never be used as a filler solution. Prophylactic administration of FFP is not indicated before the occurrence of bleeding or coagulopathy in a patient with normal factor concentrations (Table 3) [12].

Certain factors are likely to increase the consumption of blood products in intensive care, in particular a significant reduction in the risk of viral transmission, the demonstration by surveys of mortality from insufficient or too late transfusion, greater than the risks of the transfusion itself-even. Other factors are likely to reduce it, including the facilitated preoperative use of recombinant human Erythropoietin (EPO), the demonstration of the effectiveness of anti-fibrinolytics [13]. Studies have been conducted to evaluate the incidence and consumption of labile blood products in intensive care units (Table 4) [14].

The identification of potentially fatal complications linked to the transfusion of blood derivatives, but also the relative shortage of products linked to the reduction in potential donors, has led in recent years to a re-evaluation of this transfusion practice (Table 5). Others suggest potentially beneficial results of transfusions including the study by Wu et al. [15] in cardiac patients and the SOAP (sepsis occurrence in acutely ill patients) study [16,17].

This analysis is complicated by the fact that patients who receive transfusions obviously have higher mortality than others, due to the initial condition that required the transfusion. It is therefore necessary to use univariate and multivariate analyzes to separate the specific effects of transfusions (Table 6). Other studies showed conflicting results regarding the relationship between blood transfusion and mortality, suggesting that it may no longer be associated with increased rates of mortality and may be associated with improved survival [18].

Transfusion is a delegated medical act bringing together a prescriber (doctor) and a transfuser (nurse, doctor). The prescriber of a transfusion must ensure that it is controlled by safety objectives. The transfusion act is carried out by a doctor who engages his individual responsibility even if he delegates the performance of the act to paramedical personnel who, depending on the type of failure, error or fault likely to occur, will then be considered as responsible. We see that transfusion safety concerns the safety of products and the safety of transfusion practices.

Conclusion

The transfusion of blood products in an intensive care unit is an essential act but one that requires rigor and vigilance. Better knowledge of the frequencies, causes and mechanisms of immunological and infectious transfusion accidents should make it possible to better establish indications, thus increasing the use of different blood saving techniques as soon as possible in emergency situations. Monitoring transfused patients requires cardiovascular monitoring and close clinical-biological monitoring to early detect any accident or complication linked to this procedure.

The lack of blood donation at the level of transfusion centers constitutes a major problem and leads to a shortage of blood products, which has a negative impact on the care of needy patients.

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Table 3: Indications for transfusion of platelet pellets.

Transfusion	Indications
Preventive	During central thrombocytopenia: threshold of 100,000/mm^3
	Invasive procedure (lumbar puncture, bone marrow biopsy, central catheter, digestive endoscopy plus biopsy, bronchial endoscopy plus bronchoalveolar lavage, liver biopsy puncture, dental avulsions) or surgical if the platelet level is less than 50,000/mm3 (a recommendation of 100,000/mm3 for ophthalmology and neurosurgery interventions and 80,000/mm3 during epidural)
Curative	During central thrombocytopenia when hemorrhages appear in thrombocytopenic subjects or those suffering from thrombopathy
	In the case of peripheral thrombocytopenia, the indication is given if the hemorrhagic manifestations are at the forefront and do not correct themselves quickly, despite the initiation of etiological treatment.

Table 4: Consumption of PSL in intensive care unit.

Author	Place	Number of patients	% of transfused
Herebt et al. [6]	Canada	5298	0.25
Groeger et al.	United States		16% in medical intensive care and 27% in surgical intensive care
SOAP study (2002)	198 European intensive care units	3147	0.33
ABC STUDY	195 intensive care units in Western Europe	1136	0.37
Our study	Medical intensive care unit	161	0.31

Table 5: Effect of blood transfusion on mortality.

Author	Study	Number of patients	Mortality rate	Effect of transfusion
Vincent et al. [8]	145 intensive care units Western Europe	1136	0.227	Increases mortality
Corwin et al. [15]	248 intensive care units in the United States	4892	0.18	Increases length of stay
Palmieri et al. [12]	21 regional burn centers in Canada and USA	666	0.21	Associated with mortality and infection
Our study	Medical intensive care Morocco	35	0.688	Increases mortality

Table 6: Prognostic factors associated with blood transfusion.

Author	Location and duration of the study	Number of patients transfused	Mortality rate	Prognostic factors
Josset 2004	Rouen University Hospital 6 months	1887	0.094	Age: 75 years, admission to intensive care unit, male gender, PFC or CP transfusion
Dessert 2008	Grenoble University Hospital 2 years	534	0.266	SAPSS II score, number of CGs, length of stay, respiratory failure, immunosuppression, use of ventilation, use of drugs
Da Silva 2012	Servidor Hospital in Brazil	167	0.611	Female gender, organ dysfunction, cardiovascular diseases, immunosuppression
Salah alhamoud 2012	University Hospital in Kuwait 13 months	99	0.242	APACHE II score, SOFA score, mechanical ventilation, duration of ventilation
Our 2019 study	Medical intensive care Morocco 6 months	35	0.688	ATCD diabetes, admission for diabetic ketoacidosis, SAPSS II score, Glasgow score, length of stay, use of chemotherapy, TCA bac on admission