Red blood cells transfusion in intensive care unit

Transfusão de concentrado de hemácias na unidade de terapia intensiva

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ABSTRACT

Background: Anemia is a common problem upon patient's admission in the intensive care unit, and red blood cell transfusion is a frequent therapy. The causes of anemia in critical patients undergoing red blood cell transfusion are several: acute loss of blood after trauma, gastrointestinal hemorrhage, surgery, among others.

There are currently few studies available regarding the use of blood components in intensive care unit patients. Although blood transfusions are frequent in the intensive care unit, optimized handling criteria are not clearly defined, and no guideline are available.

Objectives: To analyze the clinical indications for red blood cell use in the intensive care unit.

Methods: The medical records of the patients admitted to the intensive care unit receiving red blood cells transfusion were analyzed for the period between January 1st 2005 and December 31, 2005. This study was accepted by the Research Ethics Committee – Comitê de Ética em Pesquisa (CEP) – of the Universidade do Sul de Santa Catarina (UNISUL).

Results: The transfusion rate was 19,33%, and most of the patients were male. Predominant age range 60 years or older. The mortality rate among transfused patients was of 38.22%. The transfusions criteria were low serum hemoglobin (78%) and the mean pre–transfusion hemoglobin was 8.11 g/dL.

Conclusions: Polytrauma and sepsis/septic shock were the most frequent pre-transfusion diagnosis. Low hemoglobin level was the main clinical criterion, with average pre-transfusion hemoglobin 8.11 g/dL.

Keywords: Erythrocytes; Erythrocyte transfusion; Intensive care units

INTRODUCTION

Blood transfusion had a real established scientific background only after blood circulation was discovered and described by Willian Harvey in 1628. The first blood transfusion report is from Oxford in 1666, between dogs. In 1818, London, James Blundell performed the first blood transfusion in humans.[1,2]

Only in 1937 the ABO terminology was adopted during the International Blood Society Meeting. In 1940 Landsteiner and Wiener discovered the Rh system. This discovery introduced a solid foundation for blood transfusion.[2,3]

Anemia has been a common issue when patients are admitted to the intensive care unit (ICU), and packed red cells transfusion one of the most frequent ICU interventions. Acute blood loss following trauma, gas-

trointestinal hemorrhage, surgery, among other causes of anemia, are contributing factors for red blood cells transfusion indication in critically ill patients.[4,5]

In the last decade, the red blood cells transfusion practice in critically ill patients has been subject to several investigations. Relevant studies in the USA found that the mortality risk increases proportionally to the number of transfused packed red blood cells units, usually above two units. This event was related to adverse effects, however, it was found that the most ill patients (and thus more prone do decease) were those who received more blood transfusions.[6-8]

Aiming rational blood use, it has been tried to identify the least tolerated hemoglobin level in humans, but this remains unknown. However, it is known that 7 g/dL hemoglobin is tolerated. Thus, the hemoglobin and hematocrit parameters have been questioned in several trials, particularly from the nineties on.[9]

Although blood transfusions are frequent in ICU, the optimized handling criteria are not clearly established, including with no specific guideline available.[5,9-11]

The most widely known consensus on blood transfusion is from the American Society of Anesthesiologists (ASA). In this document, transfusion is rarely indicated if Hb is above 10 g/dL, and almost always indicated when Hb is below 6g/dL.[12]

Blood transfusion may be indicated according to the risk group:

- low risk group: patients aged below 55 years old, with no evidence of heart disease, Acute Physiology and Chronic Health Evaluation system II (APACHE II) below 20, should only be transfused if hemoglobin (Hb) is below 6-7 g/dL.
- moderate risk group: well balanced and stable heart disease patients, with a transfusion threshold of Hb 8 g/dL.
- high risk group: patients above 55 years old, with post-operative complications not allowing anemia compensation should be transfused to keep Hb above 10 g/dL.[6,9,12]

This study aim is to describe the pre-transfusion hemoglobin values and clinical criteria at the Intensive Care Unit of Hospital Nossa Senhora da Conceição, in Tubarão – SC, in 2005.

METHODS

This was a transversal, retrospective study of medical records review; 1174 patients were admitted to the Hospital Nossa Senhora da Conceição - HNSC's (Tubarão – Santa Catarina - Brazil) intensive care unit in the period between January 1st 2005 and December 31, 2005.

The data collection sheet had the following information: age, gender, ICU stay information (stay length, death/non death, ICU admission diagnosis, comorbidities, unit of origin), red cell transfusion data (ABO/Rh, number of transfusion events, clinical indication, diagnosis, number of transfused units, pre-transfusion hemoglobin and hematocrit), other blood components transfusion data (blood components used, number of events, number of transfused units).

The transfusion rate was considered the percent of patients in the study receiving red cells transfusion during the ICU stay over the number of ICU admitted patients in the study period.[5,6,10] Transfusion event (TE) was defined as request, during the ICU stay, of a blood component transfusion by means of the data collection sheet completion, registering when it involved red blood cells, other blood components, in addition of the clinical indication and diagnosis. A TE may consist in several units of a given blood component, and the patient may underwent several TE in a 24 hours period.[13]

After data collection, these were processed by *Epidata* and later analyzed by *Epiinfo.* The data were analyzed by rates and proportions. The categorical variables were expressed as absolute values and percent. Continuous variables were expressed as mean (± standard deviation).

The study was approved by the Research Ethics Committee (REC) of Universidade do Sul de Santa Catarina (UNISUL) under registration number 07.085.4.014. III. It is important highlighting that the patients were not exposed to risks. The patient's identification and all information collected in the study were kept confidential.

RESULTS

Of the 1,174 patients admitted, only 227 patients received packed red blood cells during their stay, however only 157 patients were included in the study. The 70 excluded patients had no sufficient data for the data collection sheet, or their records were not found. Thus, in 2005 the HNSC ICU stay transfusion rate was 19.33% (n=227). Among the transfused patients, 38.22% (n=60) died during the ICU stay.

Regarding age, the range was between 14 and 95 years, with most of the patients (41.43%) above 60 years old (n=65). Patients under 20 years old were

9.55% (n=15), 20-29 years 7.64% (n=12), 30-39 years 14.64% (n=23), 40-49 years 14.64% (n=23) and 50-59 years 12.10% (n=19). The male gender was slightly more frequent, with 56.05% (n=88) patients receiving red blood cells transfusion in the HNSC ICU.

Of the patients receiving packed red blood cells, 43.94% (n=69) stayed in the ICU for 1-7 days, 21% (n=33) 8-14 days, 23 (n=14.64%) 15-21 days, 10.82% (n=17) 22-28 days, and 9.6% (n=15) more than 29 days.

According to the origin, there was predominance of patients coming from the surgical center 40.78%; (n= 64) followed by patients from emergency and internal medicine departments, with 26.75% (n=42) and 20.38% (n=32), respectively. Surgical clinic corresponded to 1.91% (n=3), obstetrics 2.54% (n=4) and from other hospitals 7.64% (n=12).

Regarding blood components use, 526 packed red cells units were transfused, 330 units of frozen fresh plasma, 222 units of platelets and only 2 units of platelets pool (Table 1). A rate of 0.44 red blood cells units/overall admission in the ICU, or 1.44 red blood cells units/day was used in this period.

Regarding the diagnosis recorded in the transfusion events, from the total 254, the most frequent was polytrauma, followed by sepsis/septic shock, with 27.22% (n=69) and 19.68% (n=50) respectively (Table 2).

The clinical criteria for red blood cells transfusion, recorded on the transfusion requests were: low hemoglobin (Hb) concentration, hemorrhage and pre-operative. Low hemoglobin concentration responded for 78% (n=198) of the red blood cells units transfused, hemorrhage for 20% (n=52) and pre-operative 2% (n=4).

In the packed red blood cells transfusions, their amount ranged between 1 and 10 units per transfusion event, and in 66% (n=166) cases 2 units were transfused per transfusion event (Figure 1).

Table 1 – Number of transfused patients, transfusion events and red blood cells units used in the intensive care unit according to the blood component

Blood component	Patients	Transfusion events	Units used
	N	N	N
Packed red blood cells	157	254	526
Frozen fresh plasma	60	86	330
Platelet concentrate	13	18	222
Platelets pool	2	2	2

Table 2 – Distribution, in absolute and percent, of transfusion events and red blood cells units used, according to the transfused patients diagnosis

Diagnosis	Events of transfusion	Units transfused
Polytrauma	69 (27.22)	149 (28.36)
Sepsis/septic shock	50 (19.68)	95 (18.06)
Gastrointestinal diseases	27 (10.62)	47 (8.93)
Post-operative	29 (11.41)	58 (11.02)
Circulatory system diseases	22 (8.66)	38 (7.22)
Acute hemorrhage	13 (5.11)	45 (8.55)
Cardiovascular diseases	12 (4.72)	32 (6.08)
Neurologic diseases	11 (4.33)	20 (3.80)
Neoplasias	5 (1.96)	11 (2.09)
Infective diseases	11 (4.33)	21 (3.99)
Blood diseases	5 (1.96)	10 (1.90)
Total	254 (100.00)	526 (100.00)

Results expressed as N (%).

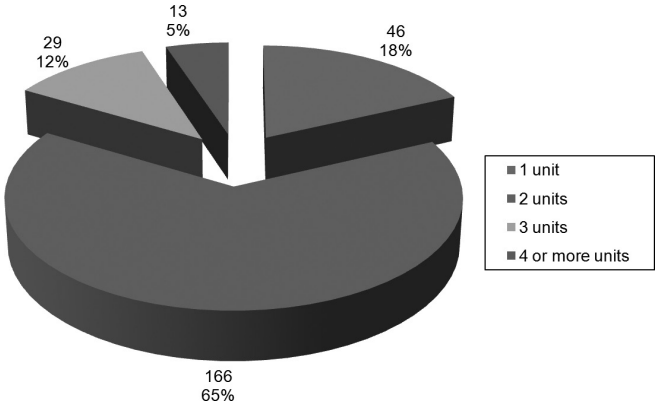

Figure 1 – Absolute number and percent distribution of red blood cell units transfused in each transfusion event.

In most of the transfusion events, 77.88% (n=190) with red blood cells, the patients had a pre-transfusion hematocrit (HT) between 20 and 30%; HT<20 corresponded to 11.88% (n=29) and HT >30 to 10.24% (n=25). In 10 transfusion events there was no record on the pre-transfusion hematocrit. In red blood cells transfusions, the pre-transfusion hemoglobin ranged between 4.4 and 12.6 g/dL, and in 70.16% (n=134) of the transfusion events Hb was between 7.0 and <10.0 g/dL. Hb < 7.0 corresponded to 19.37% (n=37) and Hb ≥ 10 to 10.47% (n=20). The mean was 8.11 g/dL, with ± 1.39 standard deviation.

With the above data, it was found lack of blood metric criteria in many transfusion events, being used

Table 3 – Distribution according to indication criterion and pre-transfusion hemoglobin value

Indication criteria	<7.0	7.0 – < 10.00	≥10.00	
Hemorrhage	3 (10.00)	12 (40.00)	15 (50.00)	30 (100.00)
Pre-operative	-	2 (100.00)	-	2 (100.00)
Low Hb level	34(21.38)	120 (75.48)	5 (3.14)	159 (100.00)
Total	37(19.37)	134 (70.16)	20 (10.47)	191 (100.00)

Hb - hemoglobin. Results expressed as N(%).

in this cases only the diagnosis and clinical criterion for the procedure. Yet, in the patients with all data, there was a predominance of 62.82% (n=12) with low Hb level, with pre-transfusion hemoglobin between 7.0 and 10.0 g/dL (Table 3).

DISCUSSION

Anemia is prevalent among critically ill patients, thus being common in the ICU. Thus, blood transfusions are often prescribed during the ICU stay.[14-19] With this treatment it is expected to improve the tissues oxygenation, preventing organic dysfunction development. However, recent studies have shown that blood transfusion is not effective in sepsis patients.[15,18,20]

In the studies using restrictive parameters, the mortality rate was 13%.[10,17] In the HNSC, the transfused patients mortality was 38.22%. Red blood cells transfusion is associated to long ICU and hospital stay and increased mortality.[10]

In trials conducted in the United States (USA) and Scotland, the hemoglobin (Hb) rate was below 9 g/dL in 25% of the ICU admitted patients. The anemia features in these patients overall showed normochromic and normocytic red blood cells, consistent with chronic disease anemias.[6,18]

The transfusion rates range widely worldwide. In the United Kingdom, it was 52%.[5] Yet, in the Eastern Europe and Scotland, the rates were 37% and 39.5%, respectively.[10,14,18] These rates are similar to other studies conducted in Brazil, 35%.[21,22] The transfusion rate for the patients in the HNSC study was 19,33%. Significant differences found in the transfusion rates may be explained by the patients population profile within a given hospital, as well as by the recommended treatments and possible complications.[17]

Regarding the age range, in the study by Walsh et al. the mean patient's age found was 54.7 years, and in the Eastern Europe 33.4% of the patients were above 70 years old.[17,18] In the HNSC ICU there was a predominance of patients aged 60 years or older, and this feature is repeated in Brazilian ICUs.[21,22] This predominance of older patients coincides with a lager number of comorbidities and hospital stay.[6,17]

In the study by Hebert et al., it was seen a prevalence of the male gender, 64%, similar to the observed in the Eastern Europe study.[10,17] In the HNSC ICU the prevalence found was 56.05%, very close to the observed by Chohan et al, 58%, as well as in the Brazilian multicenter study by Lobo et al.[5,22] However, the studies did not show a gender influence on pre-transfusion parameters, nevertheless the populations differences.[6,10,18]

There is an association between the ICU stay and packed red cells transfusion; the longer is the ICU stay, the higher is the transfusion rate.[6,17] Vicent et al. found that 17.8% of transfused patients stayed for at least 7 days in the ICU.[17] In this trial, the observation was different, as 43.94% (69) packed red cells transfused patients stayed less than 7 days in the ICU. This is repeated in other Brazilian trials, both the multicenter and the one by the HUCFF, where the mean ICU stay was 6 days.[21,22]

Hebert et al. found a 39% incidence of packed red blood cells transfused patients coming from the surgery center, and 16% from the emergency.[10] In the Eastern Europe 57.5% of the patients admitted due to emergency surgery were transfused.[17] In the studied period, the HNSC ICU admitted patients unit of origin which was most transfused was the surgery center (40.78%), followed by emergency (26.75%) and internal medicine (20.38%).

In the study by Walsh et al., the mean red blood cells transfused units per admission in ICU patients was 1.87.[14] The mean in our samples was 0.44 red blood

cells units per admitted patients, or 1.44 red blood cells units/day.

In a study involving Canada researchers, among the pre-transfusion diagnosis for red blood cells transfusion, the circulatory system diseases were predominant (28%), followed by polytrauma (20%) and sepsis (6%).[10] In the study by Vicent et al., prevailed the coronary ischemic diseases (18.2%), circulatory system diseases (16.5%) and respiratory system diseases (15.6%).[17] Regarding the diagnosis for HNSC ICU patients, predominance of polytrauma (27.22%) was identified, followed by sepsis/septic shock (19.68%) in patients receiving red blood cells transfusion.

The criteria for indicating packed red blood cells transfusion are variable among different institutions. However, a wider range of clinical indications is seen in critically ill patients, suggesting that intensivist physicians individualize their decision based on the patient's disease severity.[9]

In the Eastern Europe it was seen that 61% of the red blood cells transfusions were not due to hemorrhage.[17] Yet, in the United Kingdom, 20% of the transfusions were hemorrhage-related, while in the Scotland study (2004) it was 21%, different from the 2006 data where the percent was 39% for the same indication.[5,14,18] Among red blood cells transfusion indications in the HNSC ICU there was a predominance of low hemoglobin concentration, with 78%, followed by hemorrhage with 20%. In the Brazilian studies, more than 50% of the transfusion indications are related to the hemoglobin level, with no relationship to active bleeding.[21,22]

The number of red blood cells transfused units ranged between 2.6-4.1 units/patient in an ICU multicenter study.[10] In Scotland it was found that the ICU surviving patients used an average 2.3 units per TE of this blood component.[18] In the HNSC ICU, regarding the packed red cells transfusions amount, it ranged between 1 and 10 units per TE, and in 66% of the cases were used two units.

Since 1941 the ASA recommends that packed red blood cells are routinely transfused with Hb values below 10 g/dL or HT below 30%, however there is no sufficient scientific evidence to support this practice.[12] Regarding the pre-transfusion HT value, 90% of the patients were transfused when this was below 30%.

It was believed that Hb concentration should be kept above 10 g/dL for assuring a good oxygen supply to the tissues.[23] However, the lower Hb level tolerated by humans is currently unknown, however it is known that the 7 g/dL hemoglobin level is bearable.[9] The hemoglobin concentration has been the most trustful parameter for red blood cells transfusion, although some guidelines oppose to this parameter alone.[17]

Pre-transfusion Hb found in USA and Eastern Europe were respectively 8.5 g/dL and 8.4 g/dL.[6,17] In two different studies in Scotland, the mean pre-transfusion Hb was 7.8 g/dL when not associated to hemorrhage, which was similar to the one in Brazilian ICUs.[14,18,21,22] Most of the TE in HNSC ICU had as criterion pre-transfusion Hb values equal or above 7 and below 10 g/dL, averaging 8.11 g/dL (standard deviation ± 1.39).

In a Canadian study, red blood cells transfusion offered no advantage for normovolemic patients with pre-transfusion Hb values above 7 g/dL. Although moderate anemia is well tolerated in critical patients with several diagnosis, the reduction of Hb and/or HT lowering in heart disease patients increases this specific group mortality.[10]

Several guidelines on red blood cells use have a trend to lowering the hemoglobin values as transfusion indication thresholds.

Based mainly on the data found in the Canadian study, many authors have recommended red blood cells transfusion in critically ill patients with a hemoglobin concentration below 7.0 g/dL, avoiding transfusions with values above 10.0 g/dL.[10,14,23]

CONCLUSION

This study has no ambition to serve as a therapeutic base for any Brazilian hospital center, but rather proposing a discussion on indications for the red blood cells use in ICUs. It is seen that some Brazilian ICUs are already adapting to a judicious use of blood, however more studies are needed in this area for a bolder scientific base.

In this study the mean pre-transfusion hemoglobin concentration was 8.11 g/dL. Being low hemoglobin concentration the main clinical criteria, and most frequent pre-transfusion diagnosis polytrauma and sepsis/septic shock, blood metric criteria are still missing for some transfusion events.

RESUMO

Introdução: A anemia é um problema comum na admissão dos pacientes nas unidades de terapia intensiva, sendo a

prática de transfusão de concentrado de hemácias uma terapêutica freqüente. As causas de anemia em pacientes críticos que realizam transfusão de concentrado de hemácias são várias: perda aguda de sangue após trauma, hemorragia gastrointestinal, cirurgia, dentre outras. Atualmente, poucos estudos são disponibilizados sobre o uso de hemocomponentes em pacientes sob cuidados intensivos. Embora as transfusões sangüíneas sejam freqüentes em unidades de terapia intensiva, os critérios de manejo otimizados não são claramente definidos, não existindo, inclusive, *guidelines* específicos.

Objetivos: Analisar as indicações clínicas do uso do concentrado hemácia na unidade de terapia intensiva.

Métodos: Foram analisados os prontuários dos pacientes internados na unidade de terapia intensiva que realizaram transfusão de concentrado de hemácias no período de 1º de janeiro de 2005 a 31 de dezembro de 2005. O trabalho foi aceito pelo Comitê de Ética em Pesquisa da Universidade do Sul de Santa Catarina (UNISUL).

Resultados: A taxa de transfusão foi de 19,33% %, tendo predomínio do gênero masculino. Prevalência de paciente com idade superior ou igual a 60 anos. A taxa de óbitos nos pacientes transfundidos com concentrado de hemácias foi de 38,22%. O critério de indicação de transfusão mais freqüente foi por baixa concentração de hemoglobina (78%) com média da hemoglobina pré–transfusional de 8,11g/dl.

Conclusões: Os diagnósticos pré-transfusão mais frequentes são politrauma e sepse/choque séptico. Baixa concentração de hemoglobina é o principal critério clínico com média pré–transfusional de 8,11g/dl.

Descritores: Eritrócitos; Transfusão de eritrócitos; Unidades de terapia intensiva

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