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## SCIENTIFIC ARTICLE

# Anesthesiologists' knowledge about packed red blood cells transfusion in surgical patients



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### KEYWORDS

Blood transfusion;  
Anesthesiology;  
Knowledge;  
Risks;  
Adverse effects

### Abstract

**Introduction:** Blood is an important resource in several lifesaving interventions, such as anemia correction and improvement of oxygen transport capacity. Despite advances, packed red blood cell (PRBC) transfusion still involves risks. The aim of this study was to describe the knowledge of anesthesiologists about the indications, adverse effects, and alternatives to red blood cell transfusion intraoperatively.

**Method:** Cross-sectional study using a questionnaire containing multiple choice questions and clinical cases related to relevant factors on the decision whether to perform PRBC transfusion, its adverse effects, hemoglobin triggers, preventive measures, and blood conservation strategies. The questionnaire was filled without the presence of the investigator. Likert scale was used and the average rank of responses was calculated. The Epi Info 7 software was used for data analysis.

**Results:** 79% of the institution's anesthesiologists answered the questionnaire; 100% identified the main adverse effects related to blood transfusion. When asked about the factors that influence the transfusion decision, hemoglobin level had the highest agreement (MR = 4.46) followed by heart disease (MR = 4.26); hematocrit (MR = 4.34); age (RM = 4.1) and microcirculation evaluation (MR = 4.22). Respondents (82.3%) identified levels of Hb = 6 g.dL<sup>-1</sup> as a trigger to transfuse healthy patient. Regarding blood conservation strategies, hypervolemic hemodilution (MR = 2.81) and decided by drugs (MR = 2.95) were the least reported.

**Conclusion:** We identify a good understanding of anesthesiologists about PRBC transfusion; however, there is a need for refresher courses on the subject.

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**PALAVRAS-CHAVE**

Transfusão sanguínea;  
Anestesiologia;  
Conhecimento;  
Riscos;  
Efeitos adversos

**Conhecimento dos anesthesiologistas sobre transfusão de concentrado de hemácias em pacientes cirúrgicos****Resumo**

**Introdução:** O sangue é importante recurso em diversas intervenções mantenedoras da vida, como corrigir a anemia e melhorar a capacidade de transporte de oxigênio. Apesar dos avanços, a transfusão de concentrado de hemácias (TCH) ainda envolve riscos. O objetivo deste estudo foi descrever o conhecimento dos anesthesiologistas sobre as indicações, os efeitos adversos e as opções ao procedimento de transfusão de concentrado de hemácias no intraoperatório.

**Método:** Estudo transversal que usou questionário com perguntas de múltipla escolha e casos clínicos, referentes a fatores relevantes na decisão de transfundir concentrado de hemácias, seus efeitos adversos, gatilhos de hemoglobina, suas medidas preventivas e estratégias de conservação de sangue. Respondido sem a presença do pesquisador. Usada a escala de Likert e feito cálculo do ranking médio das respostas. Análise dos dados feita com programa Epi Info 7.

**Resultados:** Dos anesthesiologistas da instituição, 79% responderam ao questionário e 100% identificaram os principais efeitos adversos relacionados à hemotransfusão. Questionados sobre os fatores que influenciariam na decisão de transfundir, o nível de hemoglobina obteve a maior concordância (RM=4,46), seguido de cardiopatia (RM=4,26), níveis de hematócrito (RM=4,34), idade (RM=4,1) e avaliação da microcirculação (RM=4,22). Dos entrevistados, 82,3% identificaram níveis de Hb=6 g.dL<sup>-1</sup> como gatilho para transfundir paciente sadio. Quanto às estratégias de conservação de sangue, a hemodiluição hipervolêmica (RM=2,81) e a deliberada por medicamentos (RM=2,95) foram as menos citadas.

**Conclusão:** Identificou-se uma boa compreensão dos anesthesiologistas a respeito da TCH. No entanto, há necessidade de cursos de atualização sobre o tema.

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**Introduction**

Blood is used as an important resource in many life-sustaining interventions.<sup>1</sup> Transfusion of allogeneic red blood cells is a widely used approach to treat anemia and improve the blood oxygen transport capacity during the perioperative period and in critically ill patients.<sup>2</sup> Studies show that approximately 85 million of packed red blood cells (PRBC) are transfused annually worldwide.<sup>3</sup> Despite the advances in transfusion medicine, transfusion of PRBC still involves risks, sometimes resulting in a wide spectrum of adverse reactions.<sup>4</sup> The use of blood products is also a costly practice for health care systems.<sup>5</sup> This problem has raised a debate in the medical literature, especially regarding the correct use of blood components.<sup>3,6</sup> In recent years, a significant fall in PRBC transfusion is observed. It is justified by educational initiatives aimed at raising awareness about the risks of transfusion and improved surgical techniques, as well as the need to consider options.<sup>2</sup> Thus, the decision-making in transfusion should consider the balance between risks and benefits and evaluate, in addition to hemoglobin values, the clinical aspects of the patient. Over the past two decades, the introduction of laboratory tests and improved donor screening have dramatically reduced the mortality and risk of procedure-related infections, and complications from non-infectious causes have become more frequent.<sup>7-9</sup> A British study reported that errors in blood product management, storage, and incorrect

component transfusions still remain frequent and most reports are related to human failure.<sup>10</sup> A more restrictive transfusion policy (which uses lower levels of hemoglobin as a trigger for transfusion) decreases the number of unnecessary transfusions, infections, and respiratory complications.<sup>11</sup> For more than 50 years there has been a concern to develop blood conservation strategies in order to minimize the need for transfusions. Nevertheless, these strategies have limitations, are rarely used, and most still need studies to determine risks and benefits.<sup>12-14</sup> In this study, we intend to verify the theoretical knowledge of anesthesiologists at the IMIP regarding some aspects of PRBC transfusion, such as indications, options, and adverse effects.

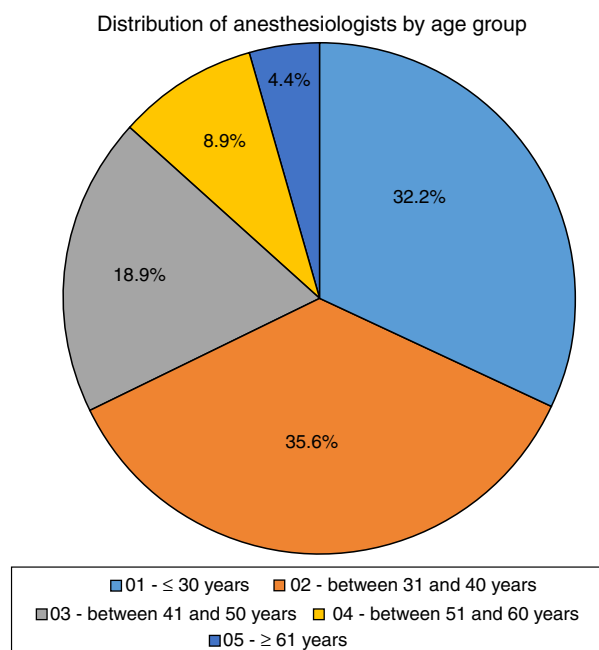
**Method**

After approval by the Human Research Ethics Committee of the *Instituto de Medicina Integral Prof. Fernando Figueira* (IMIP), a descriptive cross-sectional study was performed with the institution's anesthesiologists between October 2013 and October 2015. For this purpose, a questionnaire was developed with multiple choice questions and clinical cases regarding the relevant factors in the decision whether to perform PRBC transfusion, its adverse effects, hemoglobin triggers, preventive measures, and blood conservation strategies. The questionnaire was based on a scale (Likert) in which respondents specify their level

of agreement with a statement. The respondents had the following options for each question: "I totally disagree", "I disagree", "I do not agree or disagree", "I agree", and "I totally agree"; and the answers scored 1, 2, 3, 4 and 5, respectively. In the last session of the research instrument there were four clinical cases, with patients in different settings, of different age groups, and undergoing emergency surgeries, followed by a question ("In the above case, would you perform the transfusion previously?"), and the responses contained the same options and scores of the simple questions. In addition, the anesthesiologist had to respond in cursive form what was the preoperative hemoglobin level acceptable for each case. Pre-validation of the questionnaire was done in two stages. In the first stage, five anesthesiologists were randomly selected with the same study inclusion criteria, but they did not take part of it, in order to give an opinion about the instrument regarding the intelligibility, the aspects covered, and the items clarity, among others. The suggested changes were incorporated when there was consensus. In the second stage, five hematologists were invited to individually and non-presentially evaluate the adequacy of the instrument content. At this stage, the suggested modifications were automatically incorporated. Anesthesiologists who worked at IMIP were included. There were no exclusion criteria. The anesthesiologists were invited to participate in the study at their work place. The study purpose was informed to the physician and his/her collaboration was requested. Upon their acceptance and obtaining written informed consent, the questionnaire was delivered early in the morning or afternoon and collected at the end of the shift. The participant was instructed not to research the topic to answer the questions in the questionnaire. The evaluator was not present during the questionnaire completion. The assessment of agreement or disagreement of the evaluated questions was obtained through the average ranking (AR) method, which is calculated by the weighted average of each response. A value less than 3 is considered discordant, equal to 3 as indifferent or "no opinion", and greater than 3 as concordant. Blank responses were also counted and considered as neither agree nor disagree. AR calculation was performed according to the method indicated for the Likert scale analysis.

## Results

One hundred and fourteen anesthesiologists work in IMIP, allocated into five surgical centers (general, pediatric, obstetric, outpatient, and transplant), in addition to the diagnostic/imaging and hemodynamic center. Of this total, 90 interviewees accepted to participate in the survey, five contributed with the questionnaire validation, and 19 refused to participate or were not located. The mean age of participants was 37.94 years (27–76). The median was 33.5 years. Fig. 1 shows a distribution of respondents by age group. Of the 90 interviewees, 49 (54.4%) were female and 41 (46.6%) were male. All interviewees had a specialization in Anesthesiology. When asked which of the listed adverse effects were related to blood transfusion, infections and non-hemolytic febrile reaction had the highest agreement rates (AR=4.63; 96.7% totally agreed



**Figure 1** Age group of anesthesiologists.

or only agreed). Retinopathy had the highest disagreement (AR=2.64; 42.2% totally disagreed or only disagreed). Data are shown in Table 1. Regarding the factors that could modify the decision to transfuse, "hemoglobin levels" were the most remembered (AR=4.46; 94.4% totally agreed or only agreed). On the other hand, "ethnicity" obtained the most unfavorable results (70% totally disagreed or only disagreed) (Table 2). Regarding the hemoglobin levels that would justify a PRBC transfusion in low-risk ASA I patients, the respondents disagreed or totally disagreed almost unanimously with the values of 10 g.dL<sup>-1</sup> and 9 g.dL<sup>-1</sup>. Significant agreement values were observed at levels lower than 8 g.dL<sup>-1</sup> (60% agreed or totally agreed with the 7 g.dL<sup>-1</sup> level), and 6 g.dL<sup>-1</sup> was the most appreciated (82.3% agreed or totally agreed (AR=4.17) (Table 3). When asked about the actions that could prevent or ameliorate the risks related to blood transfusion, checking the patient's name on the blood product bag obtained the most favorable score (AR=4.7, 100% totally agreed or only agreed). On the other hand, the practice of hypervolemic hemodilution had 37.8% of "disagree" or "totally disagree" answers (Table 4). Table 5 shows the clinical settings and results regarding the opinion of anesthesiologists about the need to transfuse the patient previously and the acceptable preoperative hemoglobin level. In response to the first clinical case (Table 6), the vast majority of respondents disagreed or totally disagreed with the decision to transfuse previously (46.7% and 27.8%, respectively, with AR=2.09). As for the acceptable preoperative hemoglobin level, a mean of 9.32 g.dL<sup>-1</sup> was obtained, with a range of 1.35 and median of 10 g.dL<sup>-1</sup>. In the second clinical case analysis (Table 6), there was equivalence among participants: agreed/totally agreed (50%) and disagreed/totally disagreed (48.9%). For AR=3; the mean acceptable hemoglobin level was 8.4 g.dL<sup>-1</sup> with range of 1.32 and median equal to 8 g.dL<sup>-1</sup>. The third case also obtained similar agreement and disagreement scores

**Table 1** Results related to adverse effects inherent to blood transfusion.

Question	Totally agree	Agree	Do not agree or disagree	Disagree	Totally disagree	Average ranking
Infections	67.8% (61)	28.9% (26)	2.2% (2)	1.1% (1)		4.63
Febrile non-hemolytic reaction	66.7% (60)	30% (27)	3.3% (3)			4.63
Pulmonary injury	63.3% (57)	28.9% (26)	2.2% (2)	5.6% (5)		4.5
Kernicterus	20% (18)	26.7% (24)	31.1% (28)	16.7% (15)	5.6% (5)	3.38
Hypertensive retinopathy	1.1% (1)	15.6% (14)	41.1% (37)	31.1% (28)	11.1% (10)	2.64
Hypocalcemia	47.8% (43)	37.8% (34)	2.2% (2)	10% (9)	2.2% (2)	4.18
Purpura	16.7% (15)	38.9% (35)	26.7% (24)	14.4% (13)	3.3% (3)	3.51
Acute pancreatitis	5.6% (5)	33.3% (30)	34.4% (31)	25.6% (23)	1.1% (1)	3.16
Visual hallucinations	5.6% (5)	22.2% (20)	45.6% (41)	25.6% (23)	1.1% (1)	3.05
Hemosiderosis	23.3% (21)	43.3% (49)	17.8% (16)	14.4% (13)	1.1% (1)	3.73
Non-immune hemolysis	27.8% (25)	58.9% (53)	7.8% (7)	4.4% (4)	1.1% (1)	4.07
Bell's palsy	3.3% (3)	13.3% (12)	48.9% (55)	22.2% (20)	12.2% (11)	2.73
Oral candidiasis	5.6% (5)	16.7% (15)	32.2% (29)	37.8% (34)	7.8% (7)	2.74
Allergic reactions	61.1% (55)	36.7% (33)	2.2% (2)			4.58
Recurrence of neoplasias	23.3% (21)	35.6% (32)	16.7% (15)	15.6% (14)	8.9% (8)	3.48
Hemolysis	64.4% (58)	33.3% (30)	1.1% (1)	1.1% (1)		4.61
Claudications	11.1% (10)	21.1% (19)	38.9% (35)	23.3% (21)	5.6% (5)	3.08
Hypothermia	57.8% (52)	38.9% (35)	1.1% (1)	1.1% (1)	1.1% (1)	4.51

**Table 2** Results related to relevant factors in the decision to transfuse.

Question	Totally agree	Agree	Do not agree or disagree	Disagree	Totally disagree	AR
Age	45.6% (41)	38.9% (35)	2.2% (2)	6.7% (6)	6.7% (6)	4.1
Sex	4.4% (4)	10% (9)	13.3% (12)	43.3% (39)	38.9% (26)	2.17
Ethnicity	1.1% (1)	3.3% (3)	25.6% (23)	41.1% (37)	28.9% (26)	2.06
Surgery size	38.9% (35)	42.2% (38)	8.9% (8)	5.6% (5)	4.4% (4)	4.05
Surgical technique	25.6% (23)	46.7% (42)	13.3% (2)	7.8% (7)	6.7% (6)	3.76
Hemoglobin levels	54.4% (49)	40% (36)	3.3% (3)	2.2% (2)		4.46
Hematocrit levels	50% (45)	38.9% (35)	6.7% (6)	4.4% (4)		4.34
Blood pressure value	18.9% (17)	47.8% (43)	11.1% (10)	17.8% (16)	4.4% (4)	3.58
Presence of diabetes mellitus	8.9% (8)	32.2% (29)	27.8% (25)	24.4% (22)	6.7% (6)	3.12
Presence of pneumopathy	31.1% (28)	37.8% (34)	13.3% (12)	13.3% (12)	4.4% (4)	3.77
Presence of nephropathy	28.9% (26)	37.6% (34)	21.1% (19)	7.8% (7)	4.4% (4)	3.78
Presence of neoplasia	24.4% (22)	40% (36)	21.1% (19)	12.2% (11)	2.2% (2)	3.72
Results of microcirculation evaluation	43.3% (39)	42.2% (38)	10% (9)	2.2% (2)	2.2% (2)	4.22
Presence of cardiopathy	44.4% (40)	46.7% (42)	3.3% (3)	2.2% (2)	3.3% (3)	4.26

AR, average ranking.

**Table 3** Results related to hemoglobin triggers for ASA I patient.

Hb level (g.dL <sup>-1</sup> )	Totally agree	Agree	Do not agree or disagree	Disagree	Totally disagree	AR
Hb = 10	1.1 (1)		10% (9)	23.3% (21)	65.6% (59)	1.47
Hb = 9	1.1% (1)		11.1% (10)	31.1% (28)	56.7% (51)	1.57
Hb = 8	3.3% (3)	7.8% (7)	23.3% (21)	25.6% (23)	40% (36)	2.08
Hb = 7	22.2% (20)	37.8% (34)	14.4% (13)	13.3% (12)	12.2% (11)	3.44
Hb = 6	46.7% (42)	35.6% (32)	11.1% (10)	2.2% (2)	4.4% (4)	4.17

Hb, hemoglobina; AR, average ranking.

**Table 4** Results related to preventive measures and blood conservation strategies.

Question	Totally agree	Agree	Do not agree or disagree	Disagree	Totally disagree	AR
Detailed pre-transfusion history	55.6% (50)	41.1% (37)	3.3% (3)			4.52
Slow infusion in the first 50 mL	21.1% (19)	46.7% (42)	22% (18)	11.1% (10)	1.1% (1)	3.75
Use of hypotensive anesthesia	13.3% (12)	36.7% (33)	14.4% (13)	28.9% (26)	6.7% (6)	3.21
Refer patients with adjacent cardiopulmonary disease to treatment	33.3% (30)	54.4% (49)	10% (9)	1.1% (1)	1.1% (1)	4.17
Iron replacement for patients with iron deficiency anemia	38.9% (35)	50% (45)	7.8% (7)	1.1% (1)	2.2% (2)	4.22
Normovolemic hemodilution practice	23.3% (21)	47.8% (43)	14.4% (13)	11.1% (10)	3.3% (3)	3.76
Hypervolemic hemodilution practice	5.6% (5)	14.4% (13)	42.2% (38)	31.1% (28)	6.7% (6)	2.81
Deliberate hypotension practice	3.3% (3)	36.7% (33)	20% (18)	32.2% (29)	7.8% (7)	2.95
Use of antifibrinolytics	14.4% (13)	36.7% (33)	27.8% (25)	18.9% (17)	2.2% (2)	3.42
Preoperative autologous donation	25.6% (23)	61.1% (55)	11.1% (10)	2.2%		4.1
Intraoperative blood recovery	35.6% (32)	51.1% (46)	8.9% (8)	3.3% (3)	1.1% (1)	4.16
Use of erythropoietin	18.9% (17)	53.3% (48)	21.1% (19)	5.6% (5)	1.1% (1)	3.83
Checking patient's name in blood bag	70% (63)	30% (27)				4.7

AR, average ranking.

(40% totally agreed or only agreed and 46.6% totally disagreed or only disagreed.) AR = 2.91 and mean hemoglobin level = 7.86 g.dL<sup>-1</sup> (range = 1.15 and median = 8 g.dL<sup>-1</sup>). The final case (Table 6) followed the trend of the first, obtaining 74.5% of "disagree" and 12.5% of "totally disagree". For this case, AR = 2.28 and mean hemoglobin = 8.58 g.dL<sup>-1</sup> (range = 1,13 and median = 8.00 g.dL<sup>-1</sup>).

## Discussion

This study evaluated the knowledge of anesthesiologists of a single institution on blood transfusion. We found that there is a good understanding by anesthesiologists on the subject. Transfusion of blood components is related to adverse events and it is imperative that all professionals involved in its administration are trained and prepared to promptly identify and deal with the inherent adversities of

the procedure.<sup>15</sup> Avoiding unnecessary transfusions, using strategies to reduce bleeding during the perioperative period, and establishing blood transfusion-related routines may minimize these risks. Blood transfusion may be associated with the development of infections in surgical patients (most often bacterial, HIV, hepatitis B, hepatitis C, and HTLV infections); however, the transfusion medicine evolution has reduced these numbers satisfactorily. Nonetheless, reports of noninfectious reactions have increased in recent years.<sup>10</sup> The frequency of acute transfusion reactions (those occurring within the first 24 h after the procedure) is estimated to be between 0.2% and 10%, with non-hemolytic febrile reaction being the most frequent, followed by allergic reactions.<sup>16,17</sup> Among the anesthesiologists who participated in the study, most of them adequately identified the main transfusion infections and reactions, such as allergic and non-hemolytic febrile reactions, hemolysis and hypothermia, and demonstrated preparation for identifying

**Table 5** Results related to the clinical scenarios provided.

Case	Totally agree	Agree	Do not agree or disagree	Disagree	Totally disagree	AR	Average acceptable preoperative Hb level (g.dL <sup>-1</sup> )
Case 1	2.2% (2)	6.7% (6)	16.7% (15)	46.7% (42)	27.8% (25)	2.09	9.32
Case 2	47.8% (43)	2.2% (2)	1.1% (1)		48.9% (44)	3.0	8.4
Case 3	11.1% (10)	28.9% (26)	13.3% (12)	33.3% (30)	13.3% (12)	2.9	7.86
Case 4	4.4% (4)	11.1% (10)	11% (9)	57.8% (52)	16.7% (15)	2.28	8.58

Hb, hemoglobin; AR, average ranking.

**Table 6** Clinical settings provided.

## Cases

- 01 – J.S.J., 3-month old, 4.5 kg; ASA I. Presented with intestinal intussusception and rectal bleeding in the past few hours. Surgery was indicated after conservative treatment failure.
- 02 – M.A.F., 7-year old, 27 kg, asthmatic (3–4 exacerbations per month, treatment with  $\beta$ -2-agonist and inhaled corticosteroid). Requires intervention after a firearm projectile perforation. Hemodynamically stable and normal pulmonary auscultation on physical examination.
- 03 – A.J.S., 27-year old, ASA II. Surgery was requested after rupture of esophageal varices with abundant and constant bleeding.
- 04 – 62-year old patient, with systemic hypertension controlled and diagnosed 30 years ago. Brought to surgery after a traffic accident. Suspected spleen rupture, with less severe excoriations.

ASA, American Society of Anesthesiologists (physical status classification).

such reactions. Pulmonary injury related to transfusion and hemolysis also had significant agreement scores. It is now known that these reactions together account for more than 70% of the deaths caused by transfusion reactions.<sup>18</sup> Other reported adverse reactions were hypokalemia, hemosiderosis, purpura, neoplasia recurrence, kernicterus, claudication, and visual hallucinations; these professionals were trained to identify such reactions and to adequately manage the patient. There was also agreement that acute pancreatitis would be an adverse reaction to blood transfusion. However, we found no scientific support to justify this statement. In 15 years, the Serious Hazards of Transfusion recorded 49 confirmed cases of post-transfusion purpura, 40 cases of bacterial infections, and 22 cases of viral and parasitic infections.<sup>10</sup> The “purple” item obtained an AR > 3, but the low level of agreement caught our attention, which reinforces the need for updating the anesthesiologists on the occurrence of this complication. It is a consensus that transfusion should be guided not only by a trigger (hemoglobin level) because, despite the widely accepted hemoglobin levels equal to  $7\text{ g}\cdot\text{dL}^{-1}$ , the decision to transfuse should take into account the current hemoglobin level, the estimated blood loss, cardiac reserve, vital signs, and likelihood of ongoing bleeding, as well as the risk of tissue ischemia.<sup>2</sup> When searching the opinion of the professionals about the main factors in the decision to transfuse, hemoglobin level was the most important factor, followed by hematocrit levels, presence of cardiopathy, and results of the microcirculation evaluation. Age and sex appeared as minor factors. Regarding patients with heart disease, these patients really need a differentiated evaluation, as they have a lower tolerance to marked falls in hemoglobin level.<sup>2</sup> Regarding the incidence of adverse effects in patients below 18 years of age, it is estimated to be higher than that found in adults. Still regarding age, the incidence of these effects almost triples in children under 12 months compared with adults.<sup>19</sup> This British study estimated the

incidence of adverse events at 18:100,000 for children under 18 years, 37:100,000 for children under 12 months, and 13:100,000 for adults. A systematic review on Cochrane database found a moderate association between colorectal cancer recurrence and allogeneic red blood cell transfusion. This association increases with the administration of large volumes of blood.<sup>2</sup> Regarding surgical technique, studies demonstrate significantly greater blood loss in conventional colorectal surgery compared to the laparoscopic route, resulting in a greater need for transfusions and possibly a greater recurrence of colorectal cancer, a fact known to most of the respondents.<sup>20</sup> The results regarding the questionnaire third question highlight the tendency of anesthesiologists to choose a more restricted hemoglobin trigger, in agreement with the literature.<sup>2</sup> A meta-analysis with 2364 patients showed that the use of a hemoglobin trigger less than  $7\text{ g}\cdot\text{dL}^{-1}$  results in decreased in-hospital mortality, overall mortality, risk of further bleeding, acute coronary syndrome, pulmonary edema, and bacterial infections compared to a more liberal transfusion strategy.<sup>21</sup> The same strategy appears to have positive results in critically ill pediatric patients.<sup>8</sup> However, in cases involving pediatric patients, the anesthesiologists interviewed presented conflicting opinions regarding the transfusion decision.

As for actions that could prevent or minimize transfusion-related risks, only half of the professionals agreed or fully agreed to the item “use of antifibrinolytics”. In fact, studies using aprotinin and tranexamic acid in orthopedic surgeries have shown that the use of antifibrinolytics reduces the risk of PRBC transfusion.<sup>22</sup> It is noteworthy that anesthesiologists agree with the item “normovolemic hemodilution practice”, but disagree with the “hypervolemic hemodilution practice”. The hypervolemic hemodilution concept is relatively new, but studies have shown that it is as effective as normovolemic hemodilution in reducing the need for blood components, besides being easier to apply.<sup>23</sup> Despite the need for further studies, both practices have proven viable and safe in reducing the need for transfusion in ASA I–II adult patients.<sup>24</sup> Approximately 50% of reports of adverse events at a UK hemovigilance center are due to human errors, resulting in unnecessary, inappropriate, delayed transfusion of wrong components or inappropriate handling and storage of the components.<sup>10</sup> Although fully preventable, it is also the main cause of ABO incompatibility and an important cause of mortality.<sup>10,25</sup> Considering this data, almost all of the participants agreed on the importance of collecting a detailed history pre-transfusion and checking the patient’s name on the blood bag. It was possible to observe a divergence between participants regarding the item “practice of deliberate hypotension by drugs”, the AR remained unfavorable, but the agreement and disagreement scores were identical (40%). However, a meta-analysis of randomized clinical trials with 636 patients found that deliberate hypotension proved to be significantly effective in reducing the need for blood transfusion.<sup>26</sup> Thus, it contrasts with data on knowledge in this subject observed in this study. Autologous donation before an elective surgical procedure and transfusion in the patient during surgery decrease the allogeneic exposure in elective cardiac and orthopedic surgery.<sup>2</sup> But prior donation does not always eliminate the need for allogeneic blood.<sup>2</sup> The study participants agreed to the item “iron replacement” in patients with

iron deficiency anemia, and the literature shows that intravenous iron therapy is associated with a decreased need for allogeneic red blood cell transfusion in patients with anemia, but this benefit is counterbalanced by a potential increased risk of infection.<sup>27</sup> There was agreement among the participants regarding the use of erythropoietin as a preventive measure. Treatment with subcutaneous erythropoietin increases the amount of autologous blood that can be collected and minimizes the exposure of allogeneic blood in children undergoing open heart surgery.<sup>28</sup> In the analysis of responses to clinical settings, we observed the participants rejection to previous transfusion in all the cases presented. This rejection was greater in cases I and IV, but the divergence observed in the second and third cases make us reflect on what would be the correct conduct and when a PRBC transfusion would be unnecessary. Studies show that the use of protocols has the potential to significantly reduce transfusions without affecting the mortality rate.<sup>29</sup>

## Conclusion

The majority of anesthesiologists at this institution agreed with the literature on the adverse effects of blood transfusions, which are relevant factors in the decision to transfuse and hemoglobin trigger for ASA I patients. However, it was possible to observe some divergences, mainly regarding preventive measures and blood conservation strategies. Thus, the training of health professionals and the implementation of more updated protocols are required to standardize the procedures, in addition to expanding this study to other centers.

## Conflicts of interest

The authors declare no conflicts of interest.

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