

Analysis of intraoperative transfusions of red blood cell concentrates in adults

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Abstract

Background. Transfusion of red blood cell (RBC) concentrates is the most common allogeneic transplantation. The aim of the study was to analyse the indications for RBC transfusions, compared to the estimated intraoperative blood loss and the actual requirements for blood transfusion.

Methods. We retrospectively analysed the files of 250 adult patients who were transfused over the year 2006, during various general, oncologic, trauma, vascular, plastic and thoracic surgical procedures. Preoperative screening was done in a hospital laboratory, whereas postoperative haemoglobin concentration and haematocrit were assessed at the bedside using a co-oximeter.

Results. The majority of RBC transfusions were started at relatively high haemoglobin concentrations (mean 5.6 mmol L⁻¹), contrary to the current guidelines. A high correlation coefficient ($r=0.82$) was found between the estimated blood loss and the volume of RBCs transfused; therefore we concluded that the observed blood loss was the main factor in transfusion decisions.

Conclusions. Despite enormous progress in transfusion science, the current practice in our institution is still far from ideal; RBCs are frequently transfused too early and without a real indication.

Key words: blood, red blood cell concentrate; blood, transfusion

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The allogenic transfusion of red blood cells (RBCs) is the commonest procedure carried out in medicine. For years, the use of blood and its preparations was treated liberally, assuming that benefits resulting from the elevated concentration of the main carrier of oxygen to the tissues exceeded the potential transfusion-related risks. The generally accepted indication for RBC transfusion was based upon the 10/30 rule, i.e. maintenance of haemoglobin concentration $>10\text{g dL}^{-1}$ ($>6.2\text{ mmol L}^{-1}$) and of haematocrit $>30\%$ [1]. Thanks to the most recent data regarding early and late post-transfusion complications, the approach to blood transfusions has become more rigorous [2]. Besides the values of haemoglobin and haematocrit, the benefits versus possible adverse reactions related to transplantation of the foreign tissue should be considered; moreover, the clinical symptoms accompanying ischaemia and additional examinations, which may be helpful in decision-making, are of importance [2, 3].

An operating theatre is the place where blood preparations are frequently transfused; in many cases,

the decision to institute the procedure should be taken quickly. An anaesthetist is under pressure of the operating field condition, the surgical team insisting on blood transfusion, even though he/she does not consider the procedure necessary.

The objective of the present study was to analyse the indications for intraoperative transfusions of RBC, compared to pre- and intraoperative counts of peripheral blood and estimated intraoperative blood loss.

METHODS

The retrospective analysis involved the medical histories of consecutive patients who were transfused RBCs during general, oncologic, traumatic, vascular, plastic and thoracic surgical procedures. Additionally, transfusion records were analysed. Based on premedication and anaesthesia charts, the patients' physical conditions were assessed according to ASA. Moreover, pharmacologic therapy, which might affect the intraoperative blood loss, was considered and estimated blood loss defined. Besides the

volume of RBC transfused, the type and volume of other blood preparations and fluids administered to supplement the volume of the circulating blood were recorded.

Furthermore, the strength of correlation between the volume of transfused RBCs and selected laboratory parameters was checked, if present. Routine preoperative blood tests were performed. Intraoperative testing was done with a co-oximeter (evaluating the concentration of haemoglobin and calculating secondarily the value of haematocrit) or in a hospital laboratory.

Depending on their distribution, the data were presented as means, standard deviations or medians (and ranges). The Student's t test or Mann-Whitney U test were used for comparisons. Correlations were checked using the Pearson or Spearman method. The strength of relations was characterised based on the correlation coefficients suggested by Stanisiz [4]. $P < 0.05$ was considered to represent statistical significance.

RESULTS

The medical records of 250 patients, who were intraoperatively transfused RBCs, were analysed. The median age was 64 (17-92) years and median body weight – 70 (38-115) kg. The population included 101 (40.4%) women and 149 (59.6%) men. The physical status assessed according to the ASA scale was as follows: class I – 12 patients, class II – 78, class III – 68, class IV – 68 and class V – 10 patients.

Moreover, the kinds of anticoagulants chronically received prior to surgery were: acetylsalicylic acid preparations – 13 patients, oral acenocoumarol derivatives – 3, and low-molecular-weight heparins – 18 patients.

The peripheral blood tests were performed preoperatively in each patient; the haemoglobin concentration was found to be 16.9 ± 1.4 mmol L⁻¹ while haematocrit $33.8 \pm 6.6\%$. The medians and ranges of RBC, WBC and PLT were 3.88 (1.1-5.5) T L⁻¹, 8.6 (0.56-32.6) G L⁻¹, and 254 (6.9-2121) G L⁻¹, respectively.

In total 199 general anaesthetic procedures were performed in the study group (79.6%); 45 patients (18%) underwent continuous epidural anaesthesia additionally to general anaesthesia, 4 patients (1.6%) received subarachnoid blockades and another 2 (0.8%) were under monitored anaesthetic surveillance. The median of procedure duration was 200 min (30-630).

All transfusions were performed in the operating room setting during surgery. The median of estimated blood loss was 1000 (0-8000) mL, and of RBCs transfused – 505 (225-3750) mL. In three cases, RBC concentrates were transfused although there was no blood loss. The total number of RBC concentrates transfused was 674. Twenty-four patients received only one unit of RBCs, 133 – two, 35 – three, 48 – four units and 10 patients more than eight units.

The peripheral blood testing performed immediately before the transfusions showed: Hb – 5.6 ± 11 mmol L⁻¹, RBC – 3.2 ± 0.6 T L⁻¹, and Ht – $27.7 \pm 5.3\%$. The median of PTL was 184 G L⁻¹.

The comparison of peripheral blood parameters before surgery and before RBC transfusion demonstrated

significant differences between : the concentrations of Hb ($p < 0.0001$), Ht ($p < 0.0001$), RBC ($p < 0.001$) and PLT ($p < 0.001$). The types and densities of the blood preparations transfused were listed in Table 1.

A very high correlation was found between RBC volume and estimated blood loss ($r = 0.82$; $p < 0.05$) whereas a high correlation between total volume of fluids and estimated blood loss ($r = 0.68$; $p < 0.05$). The average correlation was observed between the pre-transfusion Hb concentration and RBC volume transfused ($r = -0.43$; $p < 0.05$). A similar strength of correlations was found between pre-transfusion concentration of Hb and estimated blood loss ($r = -0.33$, $p < 0.05$). In contrast, there was no significant correlation between the concentration of haemoglobin before surgery and the volume of RBC transfused ($p = 0.08$).

During transfusions or after their completions, some patients received calcium chloride due to potential calcium deficits (caused by the supply citrate present in preparations); in the total number of 250 transfusions, calcium chloride was administered to 186 (74.4%) patients.

According to medical records, there were no RBC transfusion-related complications in the study population.

DISCUSSION

Allogenic RBC transfusion during surgery is the commonest method used to equalise the concentration of haemoglobin and RBC count, whose loss is usually caused by haemorrhage difficult to control and/or blood dilution due to intravenous infusion fluids. The wide use of RBC transfusions, in many cases accompanied by insouciant decisions regarding them, should be however weighed against the risks involved. Intraoperatively, acute post-transfusion complications are observed as acute haemolytic reactions, post-transfusion fever without a haemolytic reaction, circulatory fluid overload, anaphylactic reactions and metabolic disorders [5, 6]. The recent study carried out in a large population (10 100 patients) showed a significantly increased risk of death within 30 days after non-cardiac surgery [7].

The awareness of such risks resulted in much more restrictive approaches to blood transfusions. At present, instead of the 10/30 rule, RBC transfusions are recommended at lower concentrations of haemoglobin; its absolute value should not be the only indication for transfusion.

Our observations are largely conflicting with the current recommendations. The most striking observation is that the decisions regarding RBC supply were taken at relatively high concentrations of haemoglobin (5.6 mmol L⁻¹, on average), although the range was quite wide, which is rather similar to the old, liberal rules of RBC transfusions. However, it should be remembered that some haemoglobin determinations were performed in the laboratory remote from the operating suite. Thus, the results could have been slightly different from the real situation in the operating theatre setting. The values of haemoglobin, which should be considered as the absolute indications for RBC transfusions are being still disputed. The majority of authors suggest about 4.3 mmol L⁻¹ stipulating that in patients with cardiovascular diseases this value should be higher – 5.6 - 6.2 mmol L⁻¹ [8, 9, 10]. Moreover, it is emphasized that the supply of RBCs in

	Number of patients	Volume Median (mL)	Volume min. -max. (mL)
RBC concentrate	250	505	225-3750
Fresh frozen plasma	134	460	180-2180
PLT	6	280	210-560
Cryoprecipitate	2	280	200-360
Crystalloids	250	3000	500-8700
Colloids	250	500	100-2500
Total	250	4635	750-15575

Table 1. The type and volume of blood preparations and infusion fluids transfused

anaesthetised patients should be adjusted to the dynamically changing operating field conditions, such as haemorrhage or changes in the patients' general conditions and in the haemostasis system [10, 11]. The question whether the more liberal approach to RBC transfusions demonstrated in our study could have affected the perioperative period remains open for discussion. Based on the material gathered, particularly the small size of the population analysed, this question can not be answered. The analysis of 17 studies involving 3746 patients does not demonstrate any differences between the liberal and restrictive approaches in terms of mortality rates, cardiac incidents (including myocardial infarction), cerebral strokes, pneumonia or thromboembolic episodes. The restrictive policy is beneficial only in relation to the reduction in the number of infections yet does not affect the duration of hospitalisation [12].

Even if the attitude towards RBC transfusions at relative high concentrations of haemoglobin meets with criticism, it should be noticed that the correlation between estimated blood loss and the volume of blood preparations transfused is very high ($r=0.82$). This demonstrates that the decisions about transfusions were mainly based on estimated circulating blood loss; this estimated blood loss, particularly in emergency cases, may be the most valuable indication for an anaesthetist and a surgeon to supplement or not the potential blood deficits. Some surgical procedures with RBCs transfused were urgent vascular procedures, in which blood loss was particularly high and quick and effective provision of haemostasis was often impossible. On the other hand, in surgical procedures without sudden haemorrhages, the decision about blood transfusion based entirely on the volume of blood loss without blood tests, might arouse some doubts. This method of evaluation is inaccurate, particularly that gauze pads and drapes are soaked with blood and they are not routinely weighed (which is the case in our department).

Another doubt concerns the transfusions of only one unit of blood in 24 cases. In adult patients, such decisions are difficult to be justified. The transfusion of one RBC unit increases the concentration of haemoglobin by about 0.6 mmol L^{-1} , thus the effect appears irrelevant, particularly when the blood is transfused at low concentration of haemoglobin and the patient is put at risk of post-transfusion complications [14].

In as many as three cases, the RBCs were transfused when no blood was lost, which is difficult to explain, more

so that the maximum concentration of haemoglobin before transfusions was 8.4 mmol L^{-1} . According to the information provided by the attending anaesthetists, the decision was made under strong pressure from the surgical team.

The medical records did not include any data about transfusion-related complications. According to the literature, the incidence of early post-transfusion complications ranges from <0.01 to 1% [5, 15].

CONCLUSION

Indications for intraoperative RBC transfusions are considered over liberally.

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