Bloodless esophageal replacement in children with corrosive esophageal strictures - report of two cases

Dragica Vučelić1, Nebojša Savic2, Dejan Stojakov1,2, Predrag Sabljak1,2, Brankica Nenadić3, Ljubica Tomasević4, Miloš Bjelogrlić1,2, Ebrahim Keramatollah1, Bratislav Špica1, Dejan Veličkovic1, Vladimir Stjukić1, Predrag Peško1,2
1 Clinic for Digestive Disease, First Surgical Clinic, Clinical Center of Serbia, Belgrade
2 Institute for Cardiovascular Disease, Clinical Center of Serbia, Belgrade
3 Institute for Anaesthesiology and Reanimatology, Clinical Center of Serbia

Background. Esophageal replacement is major procedure with high risk for perioperative alloge
eic blood transfusion (ABT), especially in pediat
cric patients due to nutritive deficiency, anemia, small body weight and blood volume. Autologous
blood policy is particularly important in female children. Methods. We present treatment strategy with the aim of avoiding ABT, that have been applied in two female pediatric patients with caustic stricture of thoracic esophagus. The patients were 7 and 8 years old, with body weight 34 and 23.5 kg, respectively. Protocol was based on the stimulation of haematopoetic system with erythropoietin, iron therapy and preope
rative autologous blood donation (PABD). In the first patient, with a history of previous retrosternal bypass esophagocoloplasty and extraction of necrotic colonic graft, delayed reconstruction - transhiatal subtotal esophagectomy and gastric pull-up with cervical anas
tomosis were performed. In the second patient, repeated ineffective dilatations of esophageal stricture were reason for retrosternal left colon interposition and exclusion of native esophagus. Results. No adverse events were attributed to preoperative blood donation period. No allo
genic blood products were used during perioperative period. Both patients had uneventful postope
rative course. Conclusion. In specialized instituti
ons for esophageal surgery, PABD with administration of erythropoietin and iron therapy, enable bloodless esophageal replacement, even in children.

Key words: esophageal surgery, autologous blood donation, erythropoietin, iron

INTRODUCTION

Clinical use of transfusion therapy is an effective therapeu
tic method for the treatment of a variety of clinical indications. However, over the past more than three decades the paradigm shift associated with the in
creased appreciation of the possible harmful effects of ABT has led to the reevaluation of clinical transfusion practices and the use of alternatives to ABT. ABTs bear risks of associated immunologic and infective reactions: acute and delayed hemolytic reactions, febrile and allergic reactions, transfusion related acute lung injury, graft versus host disease, bacterial contamination, immunosuppression that has been particularly implicated in the increased postoperative infection rate, red blood cell alloimmunisa
tion as well as induction of antibodies for other blood cells and transmission of infectious agents. Faced with the major problems of preventing and minimizing hepatitis B, hepatitis C and HIV, we are confronted by new viral agents like prion and other unknown infectious or noxious agents. The incidence of ABT risks increases in a non-linear fashion with the number of transfusions.

Blood conservation has become an essential concept that can prevent serious complications caused by ABT. This concept may be especially beneficial in children, partic
arially in children planning for major surgery. Children tend to be susceptible to infection and immune disorders because their immune system has not yet completely matured. Consequently, complications caused by ABT may be more severe in children than in adults. As children would normally be expected to have a much longer life span than adults, it is important to prevent any risk of infection as well as of the other ABT complications. Therefore, exposure to allogeneic blood should be avoided as much as possible in children.

PATIENTS AND METHODS

We present treatment strategy (autologous blood donation - ABD in combination with concurrant administration of intravenous iron and subcutaneously (s.c) recombinant human erythropoietin - rhEpo therapy) in two female pedi
diatric patients with caustic stricture of cervical and thoracic esophagus, who planned for esophageal reconstruc-
TABLE 1
HEMOGLOBIN AND HEMATOCRIT VALUES DURING THE DONATION PROGRAMM AND INTERVALS BETWEEN COLLECTIONS AND OPERATION

<table>
<thead>
<tr>
<th>Case</th>
<th>Hemoglobin (g/L)</th>
<th>Hematocrit (%)</th>
<th>Interval (days)</th>
<th>Operation</th>
<th>1st - 2nd</th>
<th>2nd - 3rd</th>
<th>Last Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>119/36.1</td>
<td>119/36.5</td>
<td>119/37.1</td>
<td>122/37.6</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>127/37.5</td>
<td>117/34.3</td>
<td>/</td>
<td>102/29.8</td>
<td>7</td>
<td>/</td>
<td>7</td>
</tr>
</tbody>
</table>

The patients were 7 and 8 years old, with body weight 34kg and 23.5kg, respectively. Inclusion criteria for PABD were: pretreatment hematocrit value (the 33% is the minimum acceptable according to American Association of Blood Banks - AABB), good haemodynamic status, no concomitant infection and suitable venous access. We estimated a good patient's ability to understand and cooperate with donation process. Preoperative autologous donation procedure was clearly explained to ensure complete understanding and compliance by the patient during blood donation. Informed consent was obtained from parents.

Blood donation volumes were calculated from the body weight in kilograms and the standardized blood volume per kilogram which was taken to be 70-75 mL/kg for patients <12 years old. Blood volume was assumed not to be change during the period of treatment.

The amount of blood to collect as well as the amount of the anticoagulant to remove from the collection bag before the donor blood is collected were estimated and adjusted according to formulas for collection of blood from individuals who weigh less than 50 kg, that provides by The Technical Manual of the AABB. They are as follows:
1. Volume of blood to collect (V) = donor weight (in kg) / 50 x 450 mL.
2. Amount of anticoagulant required (AC) = V x 100 x 14 mL.
3. Amount of anticoagulant to remove (ACR) = V x 100 x 63 AC.

At each phlebotomy, blood was drawn and saline was then infused for volume replacement. The volume of blood collected each time was around 7mL/kg (10% circulatory volume) and around 9mL/kg (12% circulatory volume) respectively, obtained using a 16-gauge needle in a standard triple bag close collection system (Grifols, Spain) with collecting bag containing CPD (citrate phosphate dextrose) and one of the transfer bag containing optimal additive storage medium SAG-M (saline adenine glucose mannitol). Autologous blood processed and stored as a blood components: red blood cells re-suspended in adjusted volume of additive solution (RBC-SAG-M) and fresh frozen plasma (FFP).

The circulating red blood cell (Rbc) mass was calculated by multiplying the patient's whole blood volume by the body hematocrit (Het) at that time. Body Het was determined by multiplying the peripheral venous Het by 0.91. The volume of Rbc collected was calculated by multiplying the blood volume collected by the peripheral Het at donation. The Rbc production (excess over baseline) over the donation period was then calculated according the formula:

Rbc production = Rbc mass phlebotomy losses + Rbc mass (day of surgery) - Rbc mass (at first donation).

In order to replace tissue iron stores and to sustain erythropoietic response as well as to prevent development of the sideropenic anemia as a result of the repeated venipuncture, patients were given both i.v. iron supplementation and s.c. Epo therapy using individual designed protocols adapted to the individual patient's baseline anemia degree and blood requirements in perioperative period.

PATIENT 1

First patient was a 7 years old girl with body weight 34 kg. She had a previous history of failed esophageal reconstruction due to corrosive stricture of the esophagus. One year before admission, retrosternal transposition of long segment of colon were performed but the following day colonic graft were extracted due to necrosis. Delayed reconstruction - subtotal transthiatal esophagectomy with gastric pull-up and cervical esophagogastric anastomosis was planned to be performed. (Figure 1).

On admittance, baseline blood chemistry parameters were as follows:
1. Rbc 4.79x10^12/L (normal 3.86-5.72x10^12/L),
2. Hemoglobin (Hb) 119g/L (119-175g/L),
3. MCV 74 fl (83.0-97.0),
4. MCH 25pg (27.0-34.0),
5. MCHC 340g/L (320-345),
6. platelet count (Plt) 345x 10^9/L (158-400x10^9/L),
7. serum iron (S-Fe) 7.5 mmol/L (11-32),
8. total iron binding capacity (TIBC) 81.9 mmol/L (44.8-75.1),
9. transferrin saturation 9%, ferritin 16.5 µg/L (5-170).

Patient was scheduled to donate preoperatively three autologous blood units in 10 days intervals. Surgery was scheduled to be performed 10 days after last donation.

In the three weeks period, started one week before the first donation, patient received iron sucrose (Veufex<sup>®</sup>, Vifor, Switzerland) in a total dose of 900 mg. Patient was given three times a week 100 mg iron sucrose diluted in 150 mL of 0.9% sodium chloride over a two hour infu-
FIGURE 1A, 1B
FIRST PATIENT: 1A) CORROSIVE STRicture OF CERVICAL ESOPHAGUS (ONE YEAR AFTER EXTRACTION OF NECROTIC COLONIC GRAFT); 1B) TWO WEEKS AFTER TRANŞIATAL SUBTOTAL ESOPHAGECTOMY WITH GASTRIC PULL-UP WITH CERVICAL ESOPHAGOASTROSTOMY
TABLE 2

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Body weight</th>
<th>Collected volume (mL)</th>
<th>Storage volume RBC-SAG-M +FFP (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>F</td>
<td>34</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>F</td>
<td>23.5</td>
<td>210</td>
<td>210</td>
</tr>
</tbody>
</table>

The actual blood volume collected each time was 240 mL and the total volume collected was 720 mL (approximately 20 mL/kg). The total storage volume was 960 mL (500 mL RBC SAGM and 460 mL FFP) (Table 2).

Intraoperatively, one RBC SAGM (170 mL) unit and three FFP units (460 mL) were infused. Postoperatively blood loss was minimal. On the 3rd postoperative day Hb level was 106 g/L when the patient was given 170 mL autologous RBC SAGM. On the 8th postoperative day (Hb 119 g/L) patient received 160 mL autologous RBC SAGM because we didn't want to discharge the blood unit.

On the 14th postoperative day the patient left the hospital. On discharge, blood chemistry parameters were as follows:

Rbc 5.04×10^{12}/L, Hb 128 g/L, Hct 39.2%, MCV 77.7 fl, MCH 23.4 pg, MCHC 327 g/L, RDW 17.4%.

PATIENT 2

Second patient was a 8 years old girl with body weight 23.5 kg. Six years before admission, the patient had been involved in an accident (ingestion of corrosive agent) that resulted in corrosive stricture of thoracic esophagus. Ineffective multiple esophageal dilations and excision of the native esophagus were planned to be performed. (Figure 2).

On admission, baseline blood chemistry parameters were as follows:

Rbc 4.42×10^{12}/L (normal 3.86-5.72×10^{12}/L), Hb 127 g/L (119-175 g/L), Hct 37.5% (36.0-53.0%), MCV 84.9 fl (83.0-97.0), MCH 28.7 pg (27.0-34.0), MCHC 339 g/L (320.0-345), RDW 14.5%, Plt 238×10^9/L (158-400×10^9/L), S-Fe 21.3 mmol/L (11-32), TIBC 68.2 mmol/L (44.8-75.1), transferrin saturation 31%, feritin 70.2 mg/L (5-170).

Patient was scheduled to donate preoperatively two autologous blood units under standard condition (i.e. one blood unit weekly), after initial administration of iron medication during the week before the first donation. Surgery is scheduled to be performed within 15-20 days from blood donation starting.

In preoperatively period, patient received a total of 312.5 mg ferric gluconate (Ferrlecit®, Aventis, Deutschland). Before the first donation, patient was given three times a week 62.5 mg ferric gluconate diluted in 150 mL of 0.9% sodium chloride over a two hour infusion at each administration. Then, after each donation patient received 62.5 mg ferric gluconate. Recombin™ was administered s.c. three times a week in the two weeks preceding the operation, starting at the same time with the first PABD. Patient received a total of 12000 U given in six divided doses of 2000 U (around 90 U/kg at each administration).

Last phlebotomy was performed 8 days before surgery. At donation start Hb level was 127 g/L, before the second donation 117 g/L and at the time of operation 102 g/L (Table 1).

The actual blood volume collected each time was 210 mL and the total volume collected was 420 mL (approximately 18 mL/kg). The total storage volume was 540 mL (270 mL RBC SAGM and 270 mL FFP) (Table 2).

Estimated blood loss during operation was minimal, so only one unit of autologous RBC SAGM (140 mL) and FFP (150 mL) were infused intraoperatively. Within the first 24 postoperative hours drainage was minimal.

On the first postoperative day (Hb 112 g/L) the rest of collected autologous blood products (130 mL RBC SAGM and 140 mL FFP) was transfused.

On discharge, on the 14th postoperative day, Hb level was 117 g/L. Other parameters were as follows:

Rbc 3.79×10^{12}/L, Hct 33.1%, MCV 87.4 fl, MCH 30.3 pg, MCHC 347 g/L, RDW 16.2%.

RESULTS

All planned PABDs were successfully made. There were no complications related to PABD and Epo/iron therapy. In the first case, over the period of donation there was an increased Rbc production above baseline of 290 mL. In the second case, minimal Rbc production of 25 mL was occurred.
In both patients, planned esophageal reconstruction was successfully performed. After the operation the patients were admitted to the intensive care unit, where all vital parameters were closely monitored for 48 h. Both patients had an uneventful postoperative course, and left the hospital on 14th postoperative day, on normal diet.

Patients required no allogeneic blood product during perioperative period.

**DISCUSSION**

For many years blood transfusion using donated blood has been an accepted therapy for blood loss associated with surgical procedures. Growing recognition of the risks of transmitting infection by allogeneic transfusion and community concern regarding the safety of donated blood has changed this perception. There has been an increase in the use of alternatives to ABT such as autologous blood transfusion techniques and therapeutic interventions to minimize blood loss.**
Autologous blood transfusion techniques have emerged as the principal means to avoid or reduce the need for ABT. These techniques involve the collection and reinfusion of the patient’s own blood by using PABD, preoperative acute normovolemic hemodilution, intraoperative salvage of blood from the surgical field, or postoperative blood salvage by which drained blood is collected and reinfused within the first 6-8 postoperative hours. These techniques have been developed mainly in the field of orthopedic, cardiovascular and neurosurgery for adults as well as children.

These techniques are being utilized increasingly in adults. In all instances, techniques should be tailored to the individual patient and aimed at providing stable hematological and hemodynamic conditions throughout the surgical procedure. The goal is more difficult to achieve in children. In children, exclusion criteria based on age, weight, general condition and hematological state have a critical role in a decision-making process, to ensure a safe procedure and exclude patients who may not be optimal candidates for the procedure.

PABD is widely used despite the controversy and lack of definitive controlled trials establishing its efficacy or cost effectiveness. In cooperative children weighing at least 30 kg, PABD can be performed as easily as in adult patients. However, PABD in younger or smaller children entails several problems. PABD may be ineffective due to noncompliance during blood collection, relatively small blood volume that can be withdrawn and baseline anemia. Many pediatric patients often have iron deficiency anemia, which is made worse by repeated sampling.

The first use of PABD in pediatric surgery was described by Cowell and Swinehard in children who underwent orthopedic procedures. A total of 193 patients donated 444 U of blood for use in a variety of orthopedic procedures. The patient’s age range was 7 to 20 years and weight range was 25 to 76 kg. The patients had blood drawn approximately every week and the last phlebotomy was performed 1 week before surgery. The authors reported a reaction rate of 9.9% which included dizziness, fainting, nausea and/or vomiting, extreme apprehension and hypertension. The most serious complication occurred in a patient who fell after donation and suffered a nasal fracture. Authors concluded that PABD could be safely accomplished in children and young adults.

Mae Ewen et al. reported on the use of autologous blood in 118 children and young adults who had spinal surgery. All patients weighed less than 45.5 kg (range 30 to 45.4 kg), and their age range was 4 to 20 years. The average amount of donated whole blood was 811 mL. Sixty-three percent of patients received only autologous blood during their surgical procedures.

In a study by Longatti et al., 11 children aged 3 to 23 months received autologous blood for craniosynostosis surgery. The patient’s weight range was 6.7 to 12 kg. Blood was collected preoperatively to maintain the Hct at or above 28% and collected intraoperatively to maintain a Hct of at least 25%. Between 53 and 200 mL of blood was withdrawn pre- and intraoperatively. Sixty-four percent of patients received only autologous blood.

The most quoted reference on autologous blood donation in pediatric population is Silvergeld’s article. The author reported the results of 413 of 413 U of blood donated by a total of 180 patients. There were 127 girls and 53 boys, aged 8 to 18 years. The smallest patients weight 2.7 kg. Patients donated 1 to 5 U (mean 2.29 U per patient). Four children experienced donor reactions, and none was reported as severe. Surgical procedures for which the patients donated were primarily orthopedic (169 of 180). The remaining 11 were reconstructive surgical operations. Overall 96% of the patients required transfusions, and 88% of patients had their transfusion needs met entirely with autologous blood.

In pediatric cardiac surgery, Masuda M. and colleagues conducted PABD for 80 patients. Their ages ranged from 3 to 15 years and body weights ranged from 12.9 to 65 kg. Twenty patients were younger than 5 years. Forty percent of the patients had a body weight of less than 20 kg. At each phlebotomy procedure, an average of 255 ± 96 mL of blood was collected (76±40 mL in patients less than age 5, 217±46 mL for those between 5 and 10, and 356±60 mL in those older than 11). The total stored volume was 735±588 mL for all patients (621±233 mL for those younger than 5, 644±284 mL for those between 6 and 10, and 920±496 mL for those older than 11). Blood was donated during an average of 3.1±1.5 phlebotomies before the operations. The last donation was done 7 days or more before the operation. During the donation period, oral iron supplements were administered daily for patients whose hemoglobin level was less than 15 g/dL. Seventy-five of 80 patients (94%) were free from ABT during their hospital stay. There was no need for ABT in 100% of those under the age of 5, in 90% of those between 6 and 10, and in 93% of those older than 11. They concluded that PABD is a safe and effective method of blood conservation in cardiac surgery, that has been applied to patients as young as 3 years of age.

In Masuda H et al report, thirty-seven patients weighing under 20 kg accepted PABD and underwent cardiac operations for a simply cardiac anomaly. The range of weight was 13 to 20 kg and that of age was 3 to 9 years. Twenty-five age and weight matched patients who were not cooperative or refused PABD (for fear, locomotive problems and religious forbiddance) served as control subjects. Five to 10 mL/kg autologous blood was obtained at every donation, which was performed by simple withdrawal and storage of the leopfrog method. The total volume of stored autologous blood was 46±1 mL/kg per donation. Hemoglobin level immediately before the operation were significantly lower in the PABD group than in the control group. On the contrary, the reticulocyte level was significantly higher in the PABD group. In preoperative donation patients postoperative recovery in hemoglobin level was significantly better, which is concurrent with a higher reticulocyte level. The authors concluded that PABD can be performed safely with clinical efficiency.
even in children under 20 kg, and that this can be improved through coupling with another procedure.

Taguchi et al. reported that PABD was found to be safe and effective means for elective general pediatric surgical procedures for avoidance of ABT, in children ranging in age from 1 to 11 years old and weighing from 9.7 to 42 kg.

All this reports indicate that PABD is safe and feasible and can be used for children of a wide range of age and weight and in a variety of surgical procedures.

Some investigators recommend the administration of oral iron therapy during the course of PABD. Variability in practice was seen, including administration of iron as surgery was planned, 1 week before the first phlebotomy, or at the time of the first phlebotomy with continuing at least until the day of surgery, but frequently for days to weeks after the procedure and/or until the Hb level returned to normal.

Knowledge of the scientific and physiological basis of Epo has supported the use of rhEpo, the primary growth factor for red blood cells, in patients undergoing elective surgery. It has been suggested that the most effective way to minimize the use of allogeneic blood is the combination of preoperative Epo therapy with the procurement of autologous blood by acute normovolemic haemodilution or donation. Various studies reported that patients given rhEpo during the donation period have accelerated red cell production, thus allowing an adequate volume of blood to be collected preoperatively without an excessive fall in hemoglobin level. Goodnough et al. suggested that persons like children with low blood volume and hence less mobilizable circulating iron would benefit from Epo stimulation to increase red cell volume for ABT. Until Sonzogni et al. report, no data existed on Epo therapy associated with PABD in children. Though it is expensive, general agreement exist on its ability in anemic autologous donors.

Emerging strategies to improve the dose-response relationship between Epo therapy and red cell production include low dose Epo and i.v. iron therapy. rhEpo and i.v. iron treatment are increasingly becoming a more valuable therapeutic option in a number of newly defined clinical settings. In circumstances with significant ongoing iron losses or when rapid replacement of iron levels and iron stores is required, oral iron does not provide enough iron to correct the iron deficient erythropoiesis, and i.v. iron therapy should be considered.

The optimal dose of perioperative Epo therapy remains to be established. Recommended Epo dosage to be administered in patients scheduled for elective surgery range from 1800 U/kg to 4200 U/kg total dosage. These regimens remain expensive, and when uncomplicated by autologous blood procurement, are still associated with an allogeneic exposure rate of 16-25%.

Recommended dosage for patients in the PABD program is 600 U/kg twice a week during the period that blood is being collected, with authors recommending iron supplementation should be started at least 1 month before Epo therapy. For anemic patients, i.v. iron therapy may potentiate the erythropoietic response in the setting of Epo therapy by improving iron restricted erythropoiesis induced by Epo therapy.

The usual indications for esophageal replacement in childhood are intractable corrosive esophageal strictures and long-gap esophageal atresia. No randomized trial exist comparing different types of conduits in children. The largest series with long-term outcome are reported for gastric transplantation and colon replacement.

Esophagectomy and esophageal replacement carries high risk of significant intraoperative blood loss and consequently need for blood transfusion. This group of patients are good candidates for PABD.

The patients included in this report successfully donated the three and two blood units in the 30-day and 15-day period prior to operation and covered predicted requirements. The dosing regimens for Epo/iron therapy and the intervals between collections and between last donation and the day of surgery were different. Also, the total volume collected each time was different, 10% (7 mL/kg) versus 12% (9 mL/kg) circulatory volume. However, the total volume collected achieved in 3 and 2 donations respectively, was similar - 20 mL/kg versus 18 mL/kg.

In the first case, at the start of the treatment patient experienced haematological signs of microcytic hypochromic anaemia with depleted serum iron concentration, transferrin saturation and iron storage. She received i.v. iron therapy for three weeks in a total dose of 900 mg, to achieve adequate iron supply for erythropoietic response and assure the efficacy of Epo therapy. Epo was administered in a total dose of 36000 U (1050 U/kg) in a four weeks period prior to operation. Hb level remained constant (119 g/L) during donation period and increased to 122 g/L on the day of surgery. Rbc production above baseline was calculated to average 290 mL over the period of blood donation. The mean rhEpo dose administered was lower than total recommended dose for PABD support that is 3600 U/kg. On the other hand, rhEpo dosing regimen was in accordance with Sonzogni et al. protocol of s.c. administration of Epo at a total dose of 1000 U/kg during the 3 weeks period preceding operation, in the setting of open heart surgery, that allowed the collection of autologous Rbc without reduction in the Hb concentration. These results show that satisfactory Rbc production could be obtained with lower Epo doses. The patient left the hospital with higher Hb and Hct values as well as of MCV and MCHC when she entered the program.

In the second case, prevention of the functional iron deficiency and compensation for the expenditure of ferritin reserves with enhanced erythropoiesis during Epo therapy, was the rationale for iron supplementation. Thus, iron administration during the one week before first donation and after each collection in a total dose of 312.5 mg. Patient received Epo in a total dose of 12000 U (510.6 U/kg) during the two weeks before surgery. During the period of blood collection, Hb level fell from 127 g/L at the at the start of donation to 102 g/L on the day of surgery, representing a fall of about 20%, despite Epo and iron therapy. Rbc production was minimal, 25 mL. Rbc correlated poorly to ini-
tial iron stores. Nevertheless, patient reached the surgery with acceptable hematological status and stable hemodynamic condition, which were the main goals. On discharge, hemogram showed a slight increased of MCV, MCH, MCHC, RDW and serum ferritin level compared to hemogram on admittance, although Hb and Hct levels were lower. Possible explanations for poor erythropoietic response were: too low total Epo dose as well as short duration of Epo treatment and short interval between first and second collection and from the last donation to surgery. Also, it is common finding that compensatory Rbc production during repeated PABD shows marked interindividual variability. There are some data in literature that Hct at baseline and the length of the period between the last donation and time of surgery were the only variables with a significant correlation to net Rbc production.

The net Rbc production was higher with a longer interval from last donation to surgery and a lower initial Hct. The stronger erythropoietic response in patients with a lower initial Hct is likely to be the result of the higher endogenous Epo production associated with lower Hct. In our patients, the first girl showed a higher degree of anemia. In a series by Taguchi et al., the interval between the first and second collection of blood or between the second collection and the operation was more than two weeks, and the Hb and Hct levels at the time of the operation were significantly higher than those at the first collection. They concluded that the hemopoietic activity was considered to be stimulated and highly adapted during the interval between the second collection and the operation, compared with the interval between the first and second collection.

We are not able to differentiate those patients who show a strong erythropoietic response from those who do not, to ensure PABD to be as effective as possible. Our different results are concur with some data in literature that the interval between donations should not be less than 10 days (provided that Hb level remained above 100 g/L) and the interval from last donation to date of surgery should be maximized. The interval between last collection and the operation more than two weeks is considered to allow sufficient time for recovery. Also, the preoperative interval necessary for Epo stimulated erythropoiesis should be estimated to be three to four weeks. In this circumstances, we believe that, in anemic pediatric patients, Epo therapy in low doses (100 U/kg) with concomitant i.v. iron administration could result in maintaining adequate Hb concentrations during repeated blood collections and in shorter return times to baseline levels. This could reduce the high cost of i.v.Epo use, which is the major disadvantage of this therapy.

CONCLUSION

The findings demonstrated PABD to be a safe means of producing blood for elective esophageal surgery in children. Ten days interval between collections (with withdrawn of 10% circulatory volume each time) and between last donation and the operation, with Epo administration in low doses (100U/kg) for four weeks and concomitant i.v. iron therapy, were superior to the collection under standard condition (i.e. one blood unit weekly with the last collection approximately 1 week before the surgery) with shorter duration of Epo therapy, and were shown to be sufficient to allow recovery from autologous blood donation. In specialized institutions for esophageal surgery this regimen enable bloodless esophageal replacement, even in anemic children. We think that this is possible in children and young patients in whom preoperative anemia exist and blood requirements are expected.

SUMMARY

REKONSTRUKCIJNA JEDNJAVA KOD DEVOJČICA SA KOROZIVNOM STENOZOM JEDNJAVA UZ ALOGENU TANSFUZIJU

Uvod. Rekonstrukcija jednava je velika hirurška procedura praćena visokim rizikom za primenu perioperativne transfuzije alogene krvi (TAK), posebno kod dece zbog anemije, male telesne mase i cirkulatornog volumena, kao i nutritivne deficijencije. Primena autologne transfuzije je od posebnog značaja kod devojčica.

Metode. U radu je opisana strategija bežkvenog tretmana, koja je primenjena kod dve devojke starosti 7 i 8 godina, telesne mase 34 i 23,5 kg, a u cilju izbjegavanja primene TAK. Terapijski protokol je baziran na stimulaciji hemopoetnog sistema primenom eritrropoetina i preparata gvožđa, kao i preoperativnoj donaciji autologne krvi (PDAK). Kod prve bolesnice, sa prethodno neuspelom retrosternalnom koloplastikom i ekstrupacijom nekrožnog kolonijalnog grafa, primenjena je kasnija rekonstrukcija - transhijalna subtotalna ezofagektomija i gastroplastika sa cervicalnom ezofagogastričnom anastomozom. Kod druge bolesnice ponavljena neuspela dilatacija korozivne stenoze jednava su bile razlog za izvođenje retrosternalne koloplastike sa ekskluzijom jednava.

Rezultati. U preoperativnom periodu donacije autologne krvi i primene farmakološke terapije, kod bolesnice se ništa ispoljili nepovoljni efekti. U perioperativnom periodu nije primenjena TAK. Takođe, perioperativni tok je pretežko bez hirurških komplikacija.

Zaključak. U institucijama specijalizovanim za ezoafagealnu hirurgiju, PDAK uz primenu eritrropoetina i preparata gvožđa, omogućava izvođenje bezkrvene ezoafagealne rekonstrukcije i u dečijoj uzrastu.

Ključne reči: ezoafagealna hirurgija, autologna donacija krvi, eritrropoetin, gvožđe

REFERENCES


