AUTOLOGOUS BLOOD DONATION IN HIGH RISK PATIENTS

JAMES G. CORMACK, MD, FRCPC

Department of Anaesthesia,
W.C. MacKenzie Health Sciences Centre,
University of Alberta, Edmonton, Alberta

INTRODUCTION

Autologous blood is defined as blood drawn from one individual to be given back to that individual as the need for transfusion arises. The Canadian Red Cross has provided autologous blood donation to healthy donors for the last decade. To participate in this program, patients must essentially meet regular blood donor criteria, thus excluding patients with cardiovascular, respiratory, metabolic, hepatic or renal disease, and those weighing less than 45 kg.

Autologous blood donation programs for high risk patients have been in existence in the United States for many years in response to concerns associated with post transfusion hepatitis and HIV infection. The percentage of autologous blood transfused annually in the U.S. is almost 10% of all blood transfused compared to less than 1% in Canada. In Canada, hospital-based programs serving high risk donors (adult cardiac patients and children not served by the Red Cross program) have been initiated in many Canadian cities.

Public concern and awareness of the risks of homologous blood transfusion have fueled a demand from patients for autologous blood donation. Justice Horace Krever in his Report of the Commission of Inquiry on the Blood System in Canada has recognized this concern and recommended that autologous blood programs be created in hospitals and autologous blood donation be made available to the maximum number of patients.

ADVANTAGES OF AUTOLOGOUS TRANSFUSION

- Eliminates known complications unique to allogeneic blood, including:
    - Transmission of pathogenic viruses and other infectious agents [overall risk of serious or fatal infection 3:10,000 recipients (1)].
    - Alloimmunization.
    - Febrile and allergic reactions.
    - Graft versus host disease.
    - Potential risk of immunosuppression resulting in increased cancer recurrence and increased postoperative infections.
- Reduces patient anxiety of transfusion-transmitted infection.
- Eliminates risk of possible emerging pathogens such as Chagas disease, Creutzfeld-Jacob disease, Lyme disease and Toxoplasmosis.
- Stimulates erythropoiesis.
- Decreases demand on homologous blood supply.

DISADVANTAGES OF AUTOLOGOUS BLOOD

- Risks of any blood donation - bruising and tenderness at venipuncture site, syncope etc. [1/16,783 risk of a complication requiring hospitalization (2)].

- Possible anemia and hypovolemia.
- Time commitment by patient.
- Possible clerical errors in labeling of unit and identifying patient [1-2% risk(3)].
- Complications during the procedure and storage resulting in loss of the unit.
- Need for surgery to be scheduled 3-5 weeks in advance; blood may outdate if surgery postponed.
- Autologous blood more costly than homologous blood (4) largely due to collection of units not subsequently transfused.

PHARMACOECONOMICS OF AUTOLOGOUS TRANSFUSION

There have been a number of studies attempting to assess the pharmaco- economic consequences of autologous transfusion. No data are available for pediatric autologous donation. To date, studies suggest that for an adult patient undergoing cardiac surgery, the cost of preoperative autologous blood donation is about US$150,000.00 per life saved. Consequently, arguments can be made on an economic basis against the development of an autologous blood transfusion program (5). It is anticipated that autologous programs will become more cost effective with improved management to minimize collection of unnecessary blood and with the rising cost of homologous blood. Despite favorable information concerning the declining risks of homologous blood, patients continue to demand, and judicial commissions continue to recommend the development of autologous blood.

AUTOLOGOUS DONATION TECHNIQUE AND COMPLICATIONS

Indications

- Patient undergoing surgical procedure requiring crossmatched blood.
- Patients with alloantibodies to common antigens.

Contraindications

- Anemia.
- Severe left main coronary artery disease or aortic stenosis.
- Recent MI or unstable angina.
- Hypertrophic cardiomyopathy.
- Active bacterial infection.

Collections should start 5 weeks before surgery. A typical collection schedule is to draw blood once a week for 4 weeks, with the last donation about 3-7 days before surgery. Iron supplementation is recommended, as the minimum acceptable hemoglobin is 11 g/dl. The use of erythropoietin to maximize autologous collections has been shown to improve the ability of patients to donate (6), but is expensive and is not covered by provincial health care plans. Erythropoietin therapy in the preoperative period, especially for patients with a low initial hematocrit level, might obviate the need for autologous blood donation prior to surgery (7).

AUTOLOGOUS DONATION TECHNIQUE AND COMPLICATIONS

Autologous blood is tested for ABO and Rh in the same manner as allogeneic blood. Maintaining routine blood bank procedures for processing and cross- matching of autologous blood helps to prevent potentially catastrophic outcomes in case of a clerical error. Testing for disease markers is not legally required for autologous blood. Crossover of auto- logous blood into the homologous blood supply remains controversial, but is permitted by the Food and Drug Adminis- tration (8).

Donor reactions to the phlebotomy are usually mild vasovagal reactions but more severe reactions may be accompanied by significant hypotension, bradycardia, and clonic movements. The incidence of mild

reactions is estimated to be 1.13-4.8% in volunteer donors (9) and 4.8% in autologous donation patients (10). The incidence of moderate to severe donor reactions is 0.19-1.7% in volunteer donors (11).

BENEFITS AND RISKS OF HIGH RISK AUTOLOGOUS DONATION

Pediatric Population

Autologous blood donation appears safe for children from ages 7-19 years. The lower age limit is determined by the ability of the child to cooperate and the availability of suitable veins. The maximum amount of blood that may be safely withdrawn at one sitting is approximately 12% of the blood volume, and formulae exist to enable the amount of anticoagulant in the blood bags to be adjusted appropriately. In a recent study from Japan (12) 59 children (42 cardiac, 13 orthopedic, and 4 misc.) ranging in age from 3-15 years were scheduled for autologous donation. Only 2 failed to donate because of anxiety. Of the 53 patients undergoing surgery, 50 (94%) avoided homologous transfusion, and none became anemic. There is some suggestion that autologous donation may motivate children to become homo- logous donors as adults.

Adult Cardiac Population

Experience with preoperative autologous blood donations in well compensated adult cardiac patients suggests it is safe and effective in reducing homologous blood requirements. Physical exam and EKG prior to donation are recommended and continuous EKG and blood pressure monitoring during and after donation may be necessary. Donating autologous blood had no demonstrable effect on the presence ischemic EKG episodes in 42 preoperative coronary artery bypass patients (13). Owings studied 107 preoperative cardiac surgery patients who donated autologous blood using saline isovolemic replacement. Exclusion criteria included unstable angina and critical aortic stenosis. There were only 2 reactions among 326 donations, both of which were without long-term sequelae. Thus, isovolemic autologous donation can be safely used in patients scheduled for cardiac surgery based on the absence of subjective complaints, without objective monitoring (14).

Another study of autologous blood donation in a high-risk population assessed hemodynamic function (including blood pressure, heart rate, lead II EKG, pulse oximetry and noninvasive cardiac output monitoring) during and following phlebotomy in 123 patients donating 224 units of blood (15). This patient population included those with a history of angina (25.2%), myocardial infarction (18.7%), poorly controlled hypertension (47.2%), arrhythmias (32.5%), congestive heart failure (6.5%), valvular heart disease (17.1%), and prior CVA (2.4%). Exclusion criteria included unstable angina, critical aortic stenosis, and recent myocardial infarction. Systolic (22%), diastolic (11.2%), and orthostatic (16.1%) hypotension, tachycardia (5.4%), dysrhythmias (3.1%), and syncope (2.2%) occurred. Saline infusion corrected hypotension in most patients yet five patients required administration of ephedrine or atropine. No apparent long-term adverse effects were noted.

ERYTHROPOIETIC RESPONSE TO ANEMIA

Studies have shown that the endogenous erythropoietin response is suboptimal at the level of mild anemia achieved during collection of autologous blood (16,17). Aggressive autologous blood phlebotomy (twice weekly for three weeks, beginning 25-35 days before surgery) has demonstrated that endogenous erythropoietin levels do rise when patients undergo a blood donation (loss) of up to 1000 ml weekly during autologous donation. In a controlled clinical trial of aggressive phlebotomy (18), serial erythropoietin levels showed a logarithmic rise even in the Hb level range of 100 to 140 gm/l. This was accompanied by significant erythropoiesis, in which a RBC volume equivalent to three allogeneic blood

units was generated over a preoperative interval of 28 days (19). The ability of recombinant human erythropoietin to further accelerate the erythropoietic recovery from blood loss during autologous donation has been demonstrated in several placebo-controlled trials (20,21,22). When aggressive autologous phlebotomy was accompanied by simultaneous erythropoietin administration, the equivalent of an additional two blood units (nearly five total) was generated for subsequent blood conservation.

INDICATIONS FOR TRANSFUSION OF AUTOLOGOUS BLOOD

Guidelines for autologous blood transfusion are controversial. Some published guidelines recommend that the same criteria be used for autologous as are used for allogeneic blood units (23). This view is supported by the risks of an immediate transfusion reaction, in which administrative error and bacterial contamination are the two most common etiologies and account for 50% of fatalities from acute transfusion reactions (24). The alternative view holds that the risk/benefit relationship is lower for autologous blood than for allogeneic blood since the risk for disease transmission by autologous blood has been reduced; this viewpoint argues for different standards for transfusion of autologous than for allogeneic blood.

DIRECTED DONATIONS

Directed donations, in which blood is donated for a specific recipient, have become more common in the past decade in the United States. The overall prevalence of positive transmissible disease tests is slightly higher in directed donor populations than in the random volunteer donor blood supply (25). There is considerably more pressure to donate when an individual is asked to donate for a relative or friend as compared to that with a voluntary donation. In addition, transfusion with blood from close relatives carries a higher risk of graft-versus-host disease, thus requiring irradiation of the donor blood (26). There is no reason to use directed donation other than for patient reassurance.

CONCLUSION

The relative risks and benefits of blood transfusion and blood conservation strategies should be discussed with all patients undergoing surgery with a reasonable likelihood of requiring a blood transfusion.

REFERENCES

1. Dodd, NEJM 1992; 327:419
2. Popovsky, Transfusion 1995; 35:73
3. AABB Teleconference March 13, 1996
4. Tretiak, CMAJ 1996; 154:1501
5. Etchason, NEJM 1995; 332:719
6. Biesma, Br J Haemat 1994; 86:30
7. Mercuriali, Transfusion 1993; 33:55
8. Kruskall, Transfusion 1988; 28:286
9. Ogata, Transfusion 1980; 20:679
10. Kruskall, Transfusion 1986; 26:335
11. Kasprisin, Transfusion 1992; 32:23
12. Tasaki, Vox Saniz 1994; 66:188
13. Kasper, Transfusion 1997; 37:829
14. Owings, JAMA 1989; 262:1963
15. Spiess, Transfusion 1992; 32:17
16. Kickler JAMA 1988; 260:65
17. Goodnough Lab Clin Med 1990; 1 15:28
18. Goodnough Br. J. Haematol 1994; 87:695
19. Goodnough Transfusion 1989; 29:821

20. Goodnough Transfusion 1992; 32:441
21. Goodnough N Engl J Med 1989; 321:1163
22. Goodnough Transfusion 1994; 34:66
23. Silberstein, JAMA 1989; 262: 1993
24. Sazama Transfusion 1990; 30:583
25. Williams, Transfusion 1992; 32:455
26. Vogelsang Transfusion 1990; 30: 101