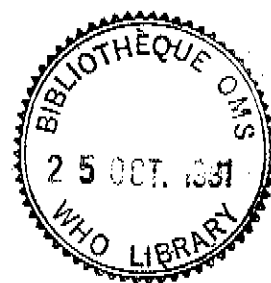

GLOBAL BLOOD SAFETY INITIATIVE

AUTOLOGOUS TRANSFUSION IN DEVELOPING COUNTRIES

GENEVA
10-12 DECEMBER 1990



WORLD
HEALTH
ORGANIZATION

GLOBAL
PROGRAMME
ON AIDS

Health
Laboratory
Technology and
Blood Safety Unit



League of Red Cross
and Red Crescent
Societies

Autologous transfusion in developing countries

The Global Blood Safety Initiative (GBSI) is a cooperative endeavour to support the development of safe and effective blood transfusion services in all countries. Core participants are the World Health Organization's Global Programme on AIDS (GPA) and Unit of Health Laboratory Technology and Blood Safety (LBS), the League of Red Cross and Red Crescent Societies (LRCS), the United Nations Development Programme (UNDP) and the International Society of Blood Transfusion (ISBT). The Initiative is also supported by The World Federation of Hemophilia and other bilateral and multilateral development agencies and nongovernmental organizations.

This document was reviewed and endorsed by the GBSI Consultation on Autologous Transfusion in Developing Countries, held in Geneva from 10 to 12 December, 1990. Seven specialists in blood transfusion medicine and anaesthesia from seven countries participated in the consultation. The participants are listed on the last page.

1. Introduction

- 1.1 Autologous transfusion is the collection and subsequent reinfusion of the patient's own blood or blood components. Recently, interest in autologous transfusion has increased because of concerns of transfusion-transmitted disease from homologous blood - blood collected from donors other than the patient. Autologous transfusion has special relevance for developing countries where the prevalence of markers for human immunodeficiency viruses (HIV-1 and HIV-2) and hepatitis viruses (hepatitis B and C) may be high in blood donor populations, and where appropriate screening techniques may not be generally available.
- 1.2 Autologous transfusion not only prevents transmission of disease but also avoids immunological complications of homologous transfusion such as alloimmunization and transfusion reactions. Autologous transfusion permits greater flexibility in the use of the homologous blood supply, which may be limited in developing countries.
- 1.3 These guidelines are intended to assist national authorities in the development of national programmes for autologous transfusion which take local circumstances into account. They are also intended for physicians and other health professionals who are interested in initiating or expanding programmes for autologous transfusion.
- 1.4 These guidelines address only the collection and storage of liquid autologous whole blood or red blood cells. The need for other autologous blood components, such as autologous plasma, is low. Likewise, the use of frozen autologous red cells in developing countries is limited.
- 1.5 Blood transfusion, whether autologous or homologous, should be used only when clearly indicated. (Guidelines for the Appropriate Use of Blood. WHO document WHO/GPA/INF/89.18; WHO/LAB/89.10). Many patients can tolerate low levels of haemoglobin without transfusion. Whenever possible, techniques to reduce the need for transfusion should be employed. These include meticulous attention to surgical haemostasis and the increased use of crystalloid and/or colloid solutions.
- 1.6 Autologous blood transfusion is most useful in elective or planned surgical procedures. However, most planned surgical procedures do not result in sufficient blood loss to require transfusion. In general, autologous transfusion should be considered if it is anticipated that the surgical procedure will result in sufficient blood loss to require homologous transfusion.

1.7 The principal options for autologous transfusion are:

- Preoperative autologous blood donation
- Acute isovolaemic haemodilution
- Intraoperative blood salvage
- Postoperative blood salvage

These techniques can be used alone or in combination to reduce or eliminate the need for homologous blood. Each of these techniques will be addressed in more detail in these guidelines.

1.8 A programme for autologous transfusion should be incorporated into a comprehensive plan for blood transfusion services. Autologous blood transfusion should complement and extend efforts to recruit safe voluntary donors of homologous blood.

1.8.1 Responsibility for the development and implementation of an autologous blood programme should be with a physician who is familiar with these techniques. The physician responsible for blood transfusion services would normally manage a preoperative donation programme. A surgeon or anaesthetist would normally manage intraoperative and postoperative blood salvage and acute isovolaemic haemodilution.

1.8.2 Health professionals involved in autologous blood donation and salvage programmes should be properly trained in these procedures.

1.8.3 Regional training workshops, audiovisual learning aids and relevant technical literature are all useful training techniques.

1.9 A well organized blood transfusion service will facilitate the introduction of an autologous transfusion programme. These programmes should be designed with appropriate and realistic targets and basic quality assurance indicators. The programmes should be periodically reviewed to determine the degree to which these targets are being achieved.

2. Preoperative autologous blood donation

2.1 Preoperative autologous blood donation (PABD) is an effective procedure for patients undergoing elective surgery. The patient's blood is collected prior to elective surgery so that at operation there are one or more units of either whole blood or red blood cells available for blood replacement if operative blood loss necessitates transfusion. Patients should not be encouraged to donate autologous blood if transfusion is unlikely during surgery.

2.2 A programme for PABD requires precise record-keeping and labelling, and adequate facilities for the collection and storage of blood. A well organized blood transfusion service is therefore essential. Costs of PABD have generally been shown to be higher than those of homologous blood transfusion. These costs must be weighed against those of long-term morbidity and mortality of transfusion-transmitted disease, especially in developing countries with limited health resources.

2.3 The benefits to the patient include reduction of the need for homologous blood transfusion with its attendant risks of transmissible disease and transfusion reactions. In addition, bone marrow erythropoiesis is stimulated, resulting in a more rapid recovery of pre-transfusion haemoglobin levels following surgery. The benefits to the blood transfusion service include the ability to provide blood for surgical procedures in areas where the homologous blood supply may be unpredictable. In addition, unused autologous units may be transferred, or "crossed-over", to the homologous blood supply, provided the autologous donor has met all the criteria for homologous blood donation, including screening for infectious agents.

2.4 Patient eligibility for PABD

- 2.4.1 Most patients who are healthy enough to undergo elective surgery are eligible to donate autologous blood preoperatively. Patients are usually suitable as autologous donors if the haemoglobin exceeds 100 g/l or the packed red cell volume (PCV) exceeds 0.30. Underweight adults (less than 50 kg) should donate no more than 9 ml/kg. This procedure is equally applicable for men and women. There are no age restrictions. However, in paediatric patients over 8 years old, no more than 10% of the patient's blood volume may be taken at each phlebotomy.
- 2.4.2 Patients with bacteraemia, serious cardiac disease (e.g. angina, aortic stenosis) and sickle cell disease should be excluded as autologous blood donors. Information on the suitability of patients with other haemoglobinopathies for autologous donation is insufficient. The risks of PABD are the same as for any blood donation: vasovagal reactions (2-5% of all donations), and a small risk of clerical error in the processing of the unit.
- 2.4.3 PABD should be considered for all surgical procedures where blood replacement is anticipated. Examples include urological surgery (prostate), orthopaedic surgery (joint replacement), cardiovascular surgery (aneurysm), major abdominal surgery (splenectomy) and surgical intervention in high-risk pregnancy (e.g. placenta praevia).

2.5 The procedure for PABD is as follows:

- 2.5.1 The risks and benefits of the procedure should be discussed with the patient and consent obtained to proceed with the autologous donations. The patient should be informed that donating autologous units does not eliminate the possibility that homologous transfusion may be necessary. The patient must meet the minimum criteria for autologous donation at the time of each donation. Every donation must be in accordance with the guidelines of the national blood transfusion service or similar authority.
- 2.5.2 Donations are recommended to be seven days apart, but may be scheduled as frequently as every three days. The minimum interval between the final donation and the scheduled surgery is 72 hours. Oral iron supplementation is necessary. This schedule allows up to five units of blood to be collected in citrate-phosphate-dextrose-adenine (CPD-A1) or a similar anticoagulant/preservative solution.
- 2.5.3 If surgery is delayed or postponed, the oldest autologous units can be serially re-transfused to the donor and fresh units drawn ("leapfrog" technique). Alternatively, the units can be released to the homologous blood supply if all homologous donor criteria have been met, or the units can be discarded.

2.6 Testing requirements

- 2.6.1 The requirements for testing of preoperative autologous donations should comply with established national or local blood policies. If no such policy exists, ABO grouping is required, as a minimum, for patient identification. Tests for transfusion-transmitted disease are desirable and are mandatory if crossover of unused autologous blood is contemplated. Such tests should be performed in accordance with national or local policy.
 - 2.6.2 If the donor is found to have a marker for transfusion-transmitted disease, it is recommended that the collected unit be discarded and that no further donations be made. Exceptions may be made to this recommendation in accordance with local conditions. For example, a community with a high seroprevalence of HBsAg in the population may elect to permit patients who are HBsAg-positive to donate autologous units. A decision to permit infectious units of blood to be drawn and stored must be made with full consideration of all the factors involved.
- 2.7 Autologous units should be stored in a section of the blood bank refrigerator that is separate from the homologous blood inventory. Autologous units should be clearly labelled with the patient's name and with an indication that the unit is for "autologous use only". This information should be removed if the unit is entered into the homologous blood inventory.

- 2.8 On admission to hospital for elective surgery, the patient with stored autologous units should have a fresh venous blood sample taken to ensure ABO compatibility and adequate haemoglobin level. Consensus has not been reached on the indications for the transfusion of autologous units. Some practitioners feel that the indications should be identical for autologous and homologous units; others feel that the criteria for the transfusion of autologous units should be more liberal than for homologous units. National and local transfusion policies and the physician's clinical assessment should guide such decisions.
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3. Acute isovolaemic haemodilution

- 3.1 Acute isovolaemic haemodilution (AIVH) is accomplished by the removal of a predetermined volume of the patient's own blood immediately prior to the commencement of surgery and its simultaneous replacement with sufficient crystalloid or colloid fluid to maintain the circulating blood volume. During surgery, the haemodiluted patient will lose fewer red blood cells for a given blood loss. The autologous blood collected is subsequently reinfused, preferably after surgical bleeding has been controlled. The fresh units of autologous whole blood maintain the patient's haemoglobin concentration and blood volume, and replenish coagulation factors and platelets.
- 3.2 AIVH ensures that fresh autologous blood is immediately available for transfusion. The transmission of disease is avoided and blood compatibility is assured. There is a reduction in the need for homologous blood transfusion, which is of special importance in areas where blood banking facilities are limited or absent and/or where the seroprevalence of markers for infectious disease is high in blood donors. This technique does not require specialized equipment other than standard blood bags and transfusion sets. It can be used in conjunction with other methods of autologous blood transfusion.
- 3.3 A physician should be consulted before AIVH is performed on patients with coronary artery disease, aortic stenosis, significant cardiac arrhythmias, severe hypertension, severe respiratory disease, severe renal impairment, coagulation disorders, severe liver disease or sepsis.
- 3.4 The procedure for conducting AIVH is as follows:
- 3.4.1 The patient's haemoglobin or PCV must be determined and must be adequate to perform AIVH. Venesection should be carried out immediately prior to the start of surgery. Blood must be collected aseptically. Caution should be used when regional anaesthesia is used because of possible hypotension. Blood collection should be from one venous line while simultaneous replacement (with crystalloid/colloid) occurs through a second venous line. If there is only one intravenous line available, then blood collection and replacement must alternate. Replacement should be with crystalloid (3.0 ml for every 1.0 ml blood collected) and/or colloid (1.0 ml for every 1.0 ml blood collected).
- 3.4.2 The PCV after haemodilution is determined by the physician in charge. The haemoglobin and PCV may fall to 90 g/l or 0.27, respectively, without adverse effects, provided that circulating volume is maintained at all times. The volume of blood to be collected for a given haematocrit can be determined by the following formula:
- $$\text{Volume of blood removed} = \frac{\text{Estimated blood volume} \times (\text{Initial PCV} - \text{Desired PCV})}{\text{Mean of initial+desired PCVs}}$$
- Estimated blood volume = body weight (kgs) x 70 (adults)
= body weight (kgs) x 80 (children)
- 3.4.3 The total volume of blood collected should not exceed 40% of the patient's estimated blood volume. The blood should be collected into standard plastic blood packs containing citrate-phosphate-dextrose (CPD) or similar anticoagulant and should be adequately mixed. The volume of collected blood should be monitored by weighing the blood packs as they are filled. The procedure should be completed within 10 to 30 minutes.
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- 3.4.4 The blood packs should be clearly labelled with the patient's name and the date and time of collection. They should be numbered in the order of collection. They should remain with the patient until transfused. If the interval from collection to use exceeds six hours, the blood should be stored in a refrigerator at 4°C.
- 3.4.5 Reinfusion should take place when major bleeding has been controlled, but the blood may be given earlier if excessive bleeding is encountered. The last unit collected should be the first unit transfused. A blood administration set with a standard filter should be used.
- 3.5 It is essential to carefully monitor surgical blood loss and to avoid risk of poor tissue oxygenation/perfusion. Standard haemodynamic measurements (pulse, blood pressure and urine output and, when available, central venous pressure) must be made during blood collection and continued during surgery to ensure that normovolaemia is maintained. Records of the collection and reinfusion should be entered on the anaesthesia record and fluid balance charts.
- 3.6 Equipment requirements are minimal but include a means to measure PCV or haemoglobin, an apparatus for measuring blood volume by weight (e.g. spring balance) and standard intravenous cannulas, tubing and blood bags.

4. Intraoperative blood salvage

- 4.1 Intraoperative blood salvage is the collection of shed blood from a wound or body cavity during surgery and its subsequent reinfusion into the same patient.
- 4.2 All intraoperative salvage techniques must conform to the following safety requirements.
- 4.2.1 Salvaged blood components must be clearly labeled with a specific patient identifier and with the date and time of the blood collection. Blood should be reinfused within six hours from the start of collection and should remain with the patient until reinfusion.
- 4.2.2 Salvage techniques should be performed in accordance with written standard procedures.
- 4.2.3 A qualified physician should be responsible for the safe conduct of these procedures. This responsibility can be delegated to properly trained health workers.
- 4.2.4 The equipment used in these procedures must conform to accepted standards of sterility.
- 4.3 Intraoperative salvage should be considered when the anticipated blood loss is 20% or more of the patient's estimated blood volume or when the usual transfusion requirement for the procedure exceeds one unit.
- 4.3.1 This procedure is useful in cardiovascular surgery, ruptured ectopic pregnancy, ruptured spleen, selected orthopaedic procedures, and traumatic penetrating injuries.
- 4.3.2 The indications for transfusion of salvaged blood are identical with those for the transfusion of homologous blood.
- 4.4 The contraindications for this procedure are relative and the risk must be balanced against the benefit for each patient. The salvage of blood contaminated with bowel contents, bacteria, malignant cells, amniotic fluid or topical bactericidal irrigants is not recommended. If bacterial contamination of the reinfused blood is suspected, broad-spectrum antibiotics may be necessary.
- 4.5 There are four common methods of intraoperative blood salvage available to the clinician which are appropriate for differing levels of health care:
- gauze filtration
 - reusable suction collection devices
 - disposable suction collection devices
 - semicontinuous-flow centrifugation cellwashing systems

- 4.5.1 Gauze filtration is inexpensive and is suitable for blood salvage from body cavities. The method requires sterile stoppered glass bottles containing a suitable anticoagulant, e.g. acid-citrate-dextrose (ACD). At operation the surgeon collects blood from the body cavity using a ladle or small bowl and transfers it into a larger bowl or kidney dish containing the anticoagulant solution from the bottle. The blood is then filtered back into the sterile bottle through four to six layers of sterile gauze placed in a funnel. The bottle is sealed with the stopper and reinfused through a blood infusion set with a standard filter.
- 4.5.2 A convenient reusable suction collection system employs suction of blood via a wide-bore tube with several large terminal collection openings. This tube should not be unduly long and should be attached to one of two ports in a stoppered glass bottle containing a suitable anticoagulant solution. Suction is applied to a tube attached to the second port in the bottle. To avoid excessive haemolysis, suction pressure should be as low as possible (maximum 100 mm Hg). The salvaged blood is reinfused to the patient through a blood infusion set with a standard filter. Blood salvage may continue by using additional replacement bottles.
- 4.5.3 There are several specifically designed, commercially available disposable suction collection systems, some of which use a rigid reservoir containing a disposable liner and others a single-use, self-contained reservoir. Cardiotomy reservoirs can also be used for this purpose. These devices are effective but costly.
- 4.5.4 Semicontinuous-flow centrifugation cell-washing devices use disposable components and a centrifuge washing device to collect and wash red cells prior to their reinfusion. Washing removes unwanted debris and anticoagulants, but the clinical advantages of washing are not established. These devices are useful in large-volume blood loss surgery. Manufacturers' instructions should be followed. These devices are costly and require a trained, dedicated operator.

5. Postoperative blood salvage

- 5.1 Postoperative blood salvage should be considered whenever the anticipated postoperative blood loss is sufficient to cause anaemia or haemodynamic instability that would require homologous blood transfusion. Blood may be salvaged from body cavities and joint spaces and reinfused with or without cell washing.
- 5.1.1 Postoperative blood salvage is most useful after cardiac surgery. It may also be employed after selected orthopaedic procedures and surgery for penetrating wounds of the chest.
- 5.1.2 Postoperative salvage and reinfusion is unlikely to be necessary if the volume of blood collected over a six-hour period is less than 200 ml (50 ml of red cells) or is less than 5% of the patient's estimated blood volume.
- 5.1.3 The risks of this procedure must be balanced against the benefit for each patient. The salvage of blood contaminated with bacteria is contraindicated. The salvage of blood contaminated with malignant cells or fat is not recommended.
- 5.2 Postoperative blood salvage must conform to the following safety requirements.
- 5.2.1 Salvage should be performed in accordance with written standard procedures.
- 5.2.2 Salvaged blood must be clearly labelled with a specific patient identifier and with the date and time of the initiation of blood collection. The time from initiation of collection to reinfusion should not normally exceed six hours.
- 5.2.3 A qualified physician should be responsible for the safe conduct of this procedure. This responsibility can be delegated to properly trained health workers. Special attention should be given to less experienced ward personnel who may be manipulating the blood prior to reinfusion.
- 5.2.4 The equipment used in these procedures must conform to accepted standards of sterility.

- 5.3 Gravity collection or minimal suction (less than 40 mm Hg for thoracic drainage and less than 100 mm Hg for other closed wounds) may be used. Blood should be reinfused through a standard blood filter.
- 5.4 Anticoagulation is ordinarily not required for blood salvaged from the mediastinum because this blood is usually defibrinated prior to collection. If bleeding is brisk, citrate anticoagulation may be necessary.
- 5.5 Several commercial devices are available that are specifically designed for postoperative blood salvage. These devices are expensive. The cardiotomy reservoir may be used following cardiac surgery. Reusable glass bottles can be considered, but strict adherence to sterile protocol must be ensured.

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