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Pre-deposit autologous blood donation in blood conservation: perspective from a resource poor country

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Abstract

Background: The transfusion service in developing countries is bedeviled with the challenges of perennial shortage of allogeneic blood and the need for safe blood. The perceived risk of transfusion-transmitted disease led to the incorporation of autologous blood transfusion (ABT) as an integral component of elective surgical protocol in many institutions in the 1980s. The improvement of viral safety of allogeneic blood products following the introduction of molecular techniques has led to a decline in the use of autologous blood use. Therefore a literature search was performed to examine current evidences and motivate the utilization of autologous blood in developing countries to increase blood availability and safety

Materials and methods: A literature search on autologous blood donation and transfusion was carried out using PubMed, high wire press and google scholar. Article from 1991 to 2016 on the provision of autologous blood with its challenges, merits and demerits were reviewed.

Results: Provision of adequate units of blood is not a major issue in developed countries. With the advent of nucleic acid testing, the risk of HIV, HCV, HBV infections with receiving transfusion of allogeneic blood is considerably small. The cost incurred by the execution of autologous blood transfusion service in the developing countries is less than in the developed countries. The majority of the population in developing countries do not have access to adequate blood supply and the risks of transfusion transmitted viruses is much higher than in developed countries

Conclusion: The Hospital Transfusion Committee should encourage surgeons to offer autologous blood donation/transfusion to patients who are fit. Guideline should also be developed to establish criteria for perioperative blood donation and there should be a policy in place that allows crossover of autologous blood units to homologous blood units which will convert the autologous blood wastage reported from the studies in developed countries to gain for patients in poor resource countries.

Keyword: *Autologous, allogeneic, blood, shortage, developing countries*

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Résumé

Contexte: Le service de transfusion dans les pays en voie de développement est confronté aux défis de la pénurie perpétuelle de sang allogénique et au besoin de sang sain et sauf. Le risque perçu de maladie transmissible par transfusion a conduit à l'incorporation de transfusion sanguine autologue (TSA) en tant que composante intégrale du protocole chirurgical électif dans de nombreuses institutions dans les années 80. L'amélioration de la sécurité virale des produits sanguins allogéniques suite à l'introduction de techniques moléculaires a entraîné une diminution dans l'utilisation de sang autologue. Par conséquent, une recherche documentaire a été effectuée pour examiner les preuves actuelles et motiver l'utilisation du sang autologue dans les pays envoie de développement pour accroître la disponibilité et la sécurité du sang.

Matériaux et méthodes: Une recherche de la littérature sur le don et la transfusion de sang autologue a été effectuée à l'aide de Pub Med, de la presse à fil haut et du GoogleScolaire. Article de 1991 à 2016 sur la fourniture de sang autologue avec ses défis, mérites et démérites ont été examinés.

Résultats: La fourniture d'unités adéquates de sang n'est pas un problème majeur dans les pays développés. Avec l'avènement des tests d'acide nucléique, le risque d'infection par le VIH, VHC, VHB avec transfusion de sang allogénique est considérablement réduit. Le coût engagé par l'exécution du service de transfusion sanguine autologue dans les pays en voie dedéveloppement est inférieur à celui des pays développés. La majorité de la population dans les pays envoie de développement n'a pas accès à un approvisionnement sanguin adéquat et les risques de virus transmissibles par transfusion sont beaucoup plus élevés que dans les pays développés.

Conclusion: Le Comité de Transfusion Hospitalière devrait inciter les chirurgiens à offrir une donation ou transfusion autologue de sang aux patients qui sont en forme. Une ligne directrice devrait également être élaborée selon les critères établis pour le don de sang peropératoire et il devrait y avoir une politique qui permette le passage des unités de sang autologues aux unités de sang homologues qui convertiront le gaspillage de sang autologue rapporté par les études dans les pays développés pour gagner aux patients des pays à ressources appauvrie.

Mot-clé: *Autologue, allogénique, sang, pénurie, pays envoie de développement*

Introduction

Blood transfusion is an important component of an effective health care system. The need for blood continues to increase globally due to improvement in diagnostic and treatment options as well as advances in surgical and medical procedures requiring blood transfusion. Allogeneic blood transfusion is the commonly used approach in transfusion of individuals who need blood transfusion. Allogeneic blood transfusion is the transfusion of blood from a donor to another person who is the recipient. However, two major problems plague the supply of allogeneic blood in sub-Saharan Africa. These include provision of safe blood free from transfusion transmitted infections and adequate amount to overcome the perennial shortage of blood [1]. Whole blood donor rate in low and middle-income countries is 4.6 per 1,000 population and 11.7 donations per 1000 peoples compared with 33.1 donations per 1000 peoples in high income countries [1]. The report for Nigeria in 2010 was 0.2 units/1,000 population [2] while WHO recommends 10/1000 population to meet clinical demand in resource-limited settings [3].

The organisation of Blood Transfusion Service in some developing countries is a combination of centralized, decentralized and informal system [4]. Family replacement donors constitute 75% of the blood donors [4]. It behoves the transfusion services to search for means of reducing the impact of these major challenges on morbidity and mortality. Timely access to the right quantity and quality of blood is an important tool for performance of surgery in many patients. There is increasing concern on availability of blood for surgical patients. Even though, the best practice is to manage any bleeding without blood transfusion or use a blood alternative, there are patients who are best treated with blood transfusion due to the amount of perioperative blood loss. Access to safe and adequate blood for surgery remain a mirage for both surgeons and patients. In developing countries, the patient and blood transfusion services are responsible for maintenance of blood supply. With an average donation rate of 0.37% in developing countries, the balance between the impact of measures to contain known and unknown threats, and the adequacy and accessibility of blood and blood components is not within acceptable limit [5].

In order to expand the sources of blood, it is imperative to seek additional source of blood supply to the allogeneic blood to meet present blood needs. Autologous blood can be rationally considered to provide an alternative source of blood supply to allogeneic blood products for some patients undergoing surgical procedures. In cases of unused blood, where criteria for allogeneic blood collection are met and infectious marker screening is negative, consent of donor could be obtained for the blood to be given to patients in dire need of transfusion. The provision of autologous blood will improve availability, safety and quality of blood for transfusion in some surgical patients. Therefore this review is carried out to improve the supply and safety of blood to surgical patients and promote the utilization of autologous blood transfusion in low income countries in order to conserve the limited allogeneic blood stock.

What is blood conservation?

Blood Conservation is a global concept engulfing all possible strategies aimed at reducing patients' exposure to allogeneic blood products. It is patient blood management by: Correcting preoperative anaemia; Minimizing perioperative blood loss through blood-sparing perfusion and surgical techniques; The administration of agents to diminish blood loss (aprotinin, tranexamic acid, epsilon aminocaproic acid, fibrin sealant) or to promote red blood cell production (erythropoietin); Using minimal haemoglobin-based transfusion triggers and the use of autologous blood. An individualized strategy based on patient specific risk factors, such as preoperative haemoglobin level, anticipated difficulty of the procedure, anticipated blood loss and comorbidities are useful in getting good outcome.

Autologous blood donation as a strategy in blood management can conserve the use of allogeneic blood reducing the pressure on these limited resources. In addition to reducing the demand on allogeniec blood, any unused blood units can be transferred to the homologous pool. While the proportion of such units of blood may be few, the impact on the blood reserve in emergencies could be significant. There are unique sets of challenges pertaining to blood conservation in different surgical procedures and age of patients which determine the strategy to engage. The direction of blood conservation is towards bloodless surgery because of safety and efficacy concerns of allogeneic blood transfusions, their impact on patient outcomes and associated staggering costs. In patient going for

cardiac surgery, blood is certainly required and higher haematocrit will be required for surgery because of cardiopulmonary by pass circuit [6]. Autologous blood donation (ABD) can be carried out in children older than 3 years of age or with weight more than 15 kg in which case a volume of 10 ml/kg may be collected per phlebotomy using femoral vein, while replacing the volume and electrolyte deficit with 0.9% saline or colloid. Supplemental iron, Vitamins (A, C, K), folic acid and B12 may be required [6]. In elective surgical patients who are fit, when multimodal preventive measures are not adequate for a safe surgery, autotransfusion may be explored.

Current status of autologous blood donation and transfusion

Autologous blood donation is the donation of blood for self. Autologous blood transfusion (ABT) is the reinfusion of blood or blood components to the same individual from whom they were taken [7]. It is a process in which the blood donor and recipient are the same. It is the safest type of blood transfusion and is important in the strategy of blood conservation. The perceived risk of transfusion-transmitted disease led to the clamour for ABT in the 1980s [8]. In 1987, Pre-deposit autologous donation (PAD), which is the banking of red cell units from the patient before planned surgery accounted for 11% of the total transfusion volume at Saint Cloud Hospital in Minnesota [9]. In Europe, predeposit autologous blood units collected in year 2000 was 3.3% of the allogeneic units compared to 4.2% in 1997. The predeposit collection was commonest in Italy (7.8%) and Germany (6.4%) [10].

There is dearth of data on its use in developing countries, a study from Kenya reported 5% of patients from general surgery and orthopaedic ward: 98.4% deposited only one unit while 1.6% deposited four units of blood [11]. In an African setting, autologous donation and transfusion have been administered to patients aged 13-80 years. Predeposit haemoglobin was 11.7gm/dl and post operative haemoglobin was 10.2gm/dl a day after surgery [12]. Intra-operative cell salvage was observed to be financially comparable to purchasing an equivalent number of red cell concentrate (RCC) from the South African National Blood Service (SANBS) and have potential benefit by reducing allogeneic blood transfusion [13]. With the development of effective viral screening test, the number of patients offered ABT has steadily declined and pre-operative donation of autologous blood is a practice that is now being abandoned [14]. However, its use is expanding in Japan [15] to improve patient management. Given the current remote risk of viral transfusion-transmitted infection by donor blood in developed countries, the rationale, safety and cost-effectiveness of routine PAD has been severely questioned. In the 1990s, Saint-Louis' Regional Hospital, Senegal introduce the delayed autologous transfusion due to prevailing transfusional risks and blood shortage [16]. The procedure helped to optimize the use of the limited allogeneic blood stock.

Autologous transfusion in Nigeria

Autologous blood accounts for 9% and 0.5% of blood transfused in North Eastern and South Western, Nigeria respectively [17, 18]. A prospective study on obstetric and gynaecological patients at the University of Maiduguri Teaching Hospital, Maiduguri over an 8 year period showed that 20.7% and 22.1% of blood received by obstetrics and gynaecological patients respectively were autologous blood [19]. Induction of labour in 53.9% constitutes the major reason for the autologous blood donation in obstetric while the major indication in gynaecology patients was myomectomy (25.7%). In an audit of spinal surgery in Eastern Nigeria, 3 out of 70 patients were offered autologous transfusion [20] The proportion of patients being offered autologous blood donation in our hospital, University College Hospital Ibadan, Nigeria has reduced from 0.5% in 2008 to 0.2% by 2015 [unpublished data]. Factors responsible for the utilization of the program include donor acceptance, clinician referrals, and perceived lack of conflict with the homologous donation process [9].

In a study conducted in Benue state of Nigeria where HIV prevalence rate was reported as 12.7% according to the 2010 sentinel survey, 85.1% patients were willing to have autologous transfusion in the event of an elective Surgery [21]. Another study conducted in south western Nigeria with a lower HIV seroprevalence showed that knowledge of ABT among patients for surgery was poor, 69% of elective surgical patients have never heard of ABT; 74% were willing to participate in ABT if offered by their physician [22]. The challenges identified are lack of information about ABT and patients are not being offered the option [21,22]. Autologous blood donation was mainly carried out for orthopaedic, otorhinolargnngological and gynaecological procedures [23]. A study showed that allogeneic blood transfusion in a Nigerian hospital is significantly more expensive than autologous transfusion mainly due to greater infective morbidity

in homologous blood recipients [24]. Autologous blood can be used to make blood available to patients within the context of available resources to reduce morbidity and mortality.

Types of autologous blood donation

Four types of autologous blood donation and transfusion are available to patients. These are predeposit / preoperative autologous blood donation (PABD), acute normovolemic hemodilution, intraoperative blood salvage, postoperative blood salvage. Predeposit (pre-operative) blood donation (PAD) is the process in which the patient donates blood prior to surgery and the blood is stored for an anticipated need during or after surgery. In acute normovolemic hemodilution (ANH), blood is collected immediately prior to surgery in the operating room and the patient's blood volume is maintained by the simultaneous infusion of crystalloid or colloid fluids. The blood is stored in the operating theatre at room temperature and reinfused at the end of surgery or if significant bleeding occurs. ANH is most often used in cardiac bypass surgery where the immediate postoperative transfusion of 'fresh whole blood' containing platelets and clotting factors is seen as an advantage. Reported hazards of ANH include fluid overload, cardiac ischemia and wrong blood into patient.

Intraoperative blood salvage is the process in which blood is collected from the surgical field and is reinfused after being washed. Blood lost into the surgical field is filtered to remove particulate matter and aspirated into a collection reservoir where it is anticoagulated with heparin or citrate. If sufficient blood is collected and the patient loses sufficient blood to require transfusion, the salvaged blood can be centrifuged and washed in a closed, automated system. Red cells suspended in sterile saline solution are produced, which must be transfused to the patient within 4 hours of processing. It is not recommended when bowel contents contaminate the operation site and in patients with malignancies. Automated devices are available for elective and emergency surgery. Postoperative blood salvage is the process in which shed blood is collected from surgical drains and reinfused to the patient [8]. It is mainly used in orthopaedic procedures, especially after knee or hip replacement and in correction of scoliosis. The simple filtration systems for reinfusion of unwashed red cells are mainly used when expected blood losses are between 500 and 1000 ml. Automate devices are available. It remains unclear whether it adds significantly to a comprehensive blood conservation programme

When there is a potential requirement for transfusion in elective surgical procedures, pre-deposit autologous donation can be used in selected cases to conserve blood for the blood transfusion services and reduce the potential complications of allogeneic blood transfusion. Despite this advantages it is underutilized for medically eligible patients undergoing elective operation [25].

Benefit of autologous blood transfusion over allogeneic transfusion

The inherent risks in allogeneic transfusions persists despite all efforts to ensure safety in recipients. The well-known risks are the transmission of infections and immunological complications. Even though the risk of transfusion transmissible infections have reduced significantly in the developed countries as shown in table 1[26]. The risk in developing countries is of major concern because of high seroprevalence (Table 2). In developed countries, transfusion of blood products is now very safe with respect to viral transfusion-transmissible infections (TTIs). This is due to the combined effect of careful selection of donors on the basis of their history and clinical information and increased sensitivity of pathogen testing, which reduces infectious window periods with high transfusion standard. The estimated residual transfusion risk for human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) were 1, 4.5, and 2.5 infections per 1000 transfused units, respectively in sub Saharan Africa [35]. The presence of paid and replacement blood donors is compounded by inadequate pathogen testing, inconsistent testing strategies and suboptimal quality assurance. Therefore, high level of blood safety is not guaranteed. Autologous blood transfusion would eliminate the risk of these infections and also emerging pathogens while reducing patient anxiety about TTIs. Autologous blood donation stimulates erythropoiesis, though the red blood cell (RBC) mass regenerated by PABD is smaller than the RBC mass pre-deposited [36].

Report on the incidence of immunological complications are sparse due to poor documentation and lack of haemovigilance in most developing countries. The immunological complications include ABO incompatibility, febrile transfusion reaction, transfusion-related acute lung injury, allergy, urticarial, alloimmunization and immunomodulation. A study from Nigeria reported an incidence of 8.7%. [37]. In Norway, Denmark and United Kingdom immunological transfusion reactions occurred 96.7 times per 100 000 red cell transfusion [38]. Febrile

Table 1: Risk of Transfusion Transmitted Viruses for Mandatory Screening in Selected Countries

Viruses	Country	Rate (100,000 units)
Hepatitis B Virus	UK	1:2.8 million
	USA	1:300,000
	Canada	1:1.7million
	Australia	1:720,000
	Netherland	<1:620,000
Hepatitis C	UK	<1:2.8million
	USA	1:1.1million
	Canada	1:6.7million
	Australia	1:1million
	Netherland	<1:620,000
HIV	UK	1:2.8million
	USA	1:1.5million
	Canada	1:8million
	Australia	<1:1million
	Netherland	<1:620,000c

Adapted from Rogers M.A.M., Rohde J.M. and Blumberg N. Haemovigilance of reactions associated with red blood cell transfusion: comparison across 17 countries. 2015 ISBT International Society of Blood Transfusion. 2015 Doi:10.1111/ vox.12367.

Table 2: Prevalence of transfusion transmitted viruses for mandatory screening in selected developing countries

Viruses	Country	Prevalence (References)
Hepatitis B Virus	Nigeria	10-20% [27,28,29]
	Burkina Faso	13.4% [30]
	Ghana	9.6 – 21% [31,32]
	Cameroon	12.6% [33]
	Mozambique	10.6 % [34]
Hepatitis C	Nigeria	0.5-6% [27,28,29]
	Burkina Faso	6.3% [30]
	Ghana	5.6% [31, 32]
	Cameroon	3.6% [33]
	Mozambique	0% [34]
HIV	Nigeria	3.0-7.2% [27,28,29]
	Burkina Faso	1.8% [30]
	Ghana	4.9% [31, 32]
	Cameroon	3.3% [33]
	Mozambique	8.5% [34]

non-haemolytic (FNHTR) and delayed serologic transfusion reactions were the most frequent adverse events reported after RBC transfusion, occurring in 26 patients per 100 000 RBC units and 25 patients per 100 000 RBC units administered, respectively (26). Febrile non-haemolytic transfusion (FNHTR) is not life-threatening but could be distressful. The study from Nigeria showed that 5.6% of 462 transfusions had FNHTR. [37]. Leukocyte-depleted blood products may minimize this problem but leucoreduction of RBC units is not carried out in the developing countries. Most delayed haemolytic transfusion reactions (DHTR) are unpreventable because the blood is serologically compatible at the time of transfusion, but some cases are due to antibodies to minor red cell antigens that were simply not detected by the routine pre-transfusion antibody screening assay. The incidence of DHTR is likely to be higher in transfusion practice without facility to screen for antibodies outside the routine ABO and Rhesus D blood group which is the situation in many developing countries.

In a tertiary care hospital in Ohio, USA, allergic transfusion reactions accounted for 17% of the transfusion reactions [39]. Severe allergic reactions (anaphylaxis, anaphylactoid signs and symptoms, and/or hypotension) were observed in 7.7% of allergic reactions, or 1.3% of all transfusion reactions [39]. Immunomodulation is unusual in autologous blood transfusion. It is an allogeneic blood transfusion related immunosuppression, which is thought to increase the incidence of postoperative infections (up to six times), delay healing of postoperative wounds, and thereby prolong hospitalization. Newman *et al* reported that re-operation for infection was higher in cases with allogeneic blood exposure (1.67%) than in patients without blood transfusion (0.72) (p=0.013) and autologous –only transfusion [40].

Disadvantages of autologous blood transfusion

Even though ABT is a useful procedure to reduce most of the complications of blood transfusion, it is not without risks. Record-keeping, collection, and transfusion errors are occasional risks of autologous transfusions [41]. The risk of bacterial contamination and clerical error must be taken into account for both autologous and homologous blood. There is a 1-2% risk of possible clerical errors in labelling of unit and identifying patient [9]. The risks associated with any blood donation is not eliminated in ABT. This include bruising and tenderness at venipuncture site, syncope attack, [1,16], 783 risk of a complication requiring hospitalization [8]. Anaemia that may compromise the patients' health is another disadvantage because the patients provide safe blood for themselves at the expense of the risk of developing iron deficiency anaemia [42]. Time commitment by patient is required from the patient to donate. A donated unit of blood may be discarded if there is complication during storage such as clots in blood or leakage of blood bag. In hospitals, where surgery is scheduled 3-5 weeks in advance, blood may go out of date if surgery is postponed.

Although ABT donation reduces the risk of receiving allogeneic transfusion by 43%, but it increases the overall risk of receiving any blood transfusion (allogeneic and/or autologous) [43]. The increased rate of exposure to any transfusion was attributed to two factors: (1) patients who donate autologous blood in general have lower preoperative haemoglobin levels than those patients who do not predonate autologous blood, and therefore have an increased probability of requiring an intra-operative and/or postoperative blood transfusion; (2) the availability of predonated autologous blood engenders a more liberal transfusion policy. ABT donors are vulnerable to being over- transfused or re-transfused due to less conservative transfusion threshold than allogeneic since microbiological safety is not an issue. Autologous blood is more costly than homologous blood [14] largely due to collection of units not subsequently transfused. The wastage of unused PAD units varies from 18% to greater 50% [14]. In cases of unused blood, where the circumstances of blood collection and infectious marker screening meet the criteria for allogeneic blood collection, consent of donor could be obtained for the blood to be given to patients in dire need of transfusion. This wastage may be converted to an advantage in developing countries particularly sub Saharan Africa where the blood donor rate is low. It should also be borne in mind that patients may not be able to pre-donate all the blood they require for surgery because the complete donor criteria must be met.

Since PABD is not without potential risks to the donor, who is also the patient, the supposed benefit of PABD has to be weighed against the risks of donation and re-transfusion of autologous blood on one hand and against the risk of allogeneic transfusion on the other hand [44].

Cost of autologous blood transfusion

The cost implication of ABT is an issue of concern and varies from country to country depending on guidelines for the implementation of the ABT. The post donation cost is determined by the extent of processing that the guideline requires. The increased protection afforded by donating autologous blood is no longer seen as an advantage that justifies the increased cost given the improved safety of allogeneic transfusions in countries incorporating stringent criteria and sophisticated technique to select blood donors. [45]. In our hospital, University College Hospital, Ibadan, Nigeria, an autologous blood unit costs $8 while an allogeneic blood unit costs $30. The cost of labour or input of the managing physician is not often included in the cost of autologous blood in our hospital as it is donated at the hospital based blood bank. The cost for autologous blood is exclusive of the search for replacement donors. The cost incurred by patients who choose to predonate blood (e.g., inconvenience, time, travel costs, expense of additional medication) [46] may be comparable to the stress and cost of getting two or more replacement donors.

The costs associated with administering the preoperative autologous donation program by the hospital, physician fees for conducting assessments of prospective autologous donors, and the procurement, processing and storage of the blood by the Red Cross may not be an issue in an hospital based blood bank. Some people are of the opinion that allogeneic blood transfusions are expensive. Reported cost per unit of packed red cells has varied between $270 and $780, depending on further costs for storage, laboratory analyses (cross match tests, antibody tests, etc.), and other post donation processing. Actual figures in Switzerland show that the cost for one RBC unit in surgery is $500, without taking into consideration transfusion-related complications [47]. Only approximately half of autologous units collected are actually used [48]. Previous report from Nigeria suggested that homologous blood transfusion is significantly more expensive than autologous transfusion and the rate of infection was 85.7% for homologous blood recipients compared to 14.3% for autologous blood recipients [24]. Autologous blood may improve availability of blood without unnecessary burden on family members to source blood and also reduce anxiety about transmission of infections

Indications for pre deposit autologous blood donation

According to Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee and Italian Society of Transfusion Medicine and Immunohaematology [10], the following are the indications for autologous blood donation: patients with rare blood groups for whom it is difficult to obtain allogeneic blood, patients with multiple alloimmunisation for whom it is difficult to obtain compatible allogeneic blood, patients who refuse consent to allogeneic transfusion for personal reasons, scoliosis surgery in children and surgical procedures where blood transfusion is anticipated

Eligibility

There are no generally accepted criteria for predeposit autologous donation [49]. Three categories of patients are considered for PABD:

Patients who meet normal donor health criteria: Patients who are well and ordinarily able to withstand the blood collection procedure but who do not meet normal donor selection criteria and patients who are unwell. The donor should be between 10 and 65 years of age who could be either a male or female and should have a haematocrit greater than 35%. If patient is <50kg, the amount of blood removed at a time should not be more than 8ml/kg of the body weight, and for peadiatric patients, not more than 10% of the blood volume should be removed at a time. The ABT patient must be screened and found negative for HIV, HCV and HBV.

Contraindications

Appropriate donor selection is essential. The incidence of adverse reactions is no greater in properly selected autologous donors than in homologous donors [9]. Administration of oral ferrous sulfate allows many patients to meet all of their perioperative transfusion requirements [9]. In order to avoid wastage, autologous blood donation should not be considered in patients without a definite surgical date. Other conditions in which it is contraindicated include: Current systemic infection which could either be viral, bacterial or fungal, anaemia with haemoglobin <110 g/L or packed cell volume < 33% prior to commencement of autologous collection, disorders such as haemoglobinopathies, pre -eclampsia, chronic obstructive way disease, diabetes mellitus, severe hypertension, psychiatric illness/epilepsy, cerebrovascular disease including transient ischaemic attacks or a stroke, cardiac disease especially ischaemic heart disease, such as angina and myocardial infarction and patient on B brokers or ACE inhibitor (isovolaemic replacement). Blood donors with poor venous access and those who had sustained a delayed faint (weakness or loss of consciousness) several hours after collection, should not be considered.

Procedure

Patients considered suitable for elective surgical procedures and are in good general health to tolerate phlebotomy are generally suitable for autologous blood collection. However, only patients with a reasonable expectation that blood will be transfused should be selected and counselled for the procedure. Therefore, the hospital should have a maximum blood ordering schedule for each surgical procedure to engage in PABD. Patients with any cardiovascular, cerebrovascular or respiratory diseases which will preclude them from allogeneic blood donation should not be considered for autologous blood donation. The doctor with clinical responsibility towards the patient should determine if patient is fit to undergo the PABD. The documentation used to refer a patient for autologous blood collection should be signed by the medical practitioner and be accompanied by a signed patient consent form. The patient must be aware that it may be necessary to transfuse allogeneic blood. A standard questionnaire administered for allogeneic blood donor which include questions about high risk factors for transmission of blood transmissible disease and medical suitability should be completed by the patient at the time of each collection. Patients who weigh less than 50 kg should have 8ml/kg collected and the volume of anticoagulant should also be adjusted accordingly:

The total blood volume of the patient can be calculated using a figure of 80ml/kg.
Example: Weight of patient 35kg
Total blood volume 35kg x 80ml/kg = 2800 ml
Volume of blood to be collected 2800 x 10% = 280ml
To calculate the amount of anticoagulant required for a given volume and hence the amount of excess anticoagulant to be removed, use the following equation:

$$\frac{\text{Volume of blood collection} \times 63}{450} = \text{volume of anticoagulant}$$

Example: volume of blood collection; 280 ml

$$\text{Volume of anticoagulant: } \frac{280 \times 63}{450} = 39 \text{ ml}$$

Excess anticoagulant: 63 - 39 = 24 ml A double collection pack is required so that, transfer the excess anticoagulant into attached plasma bag prior to blood collection without breaching the closed system could be performed.

At least 4-5 units of blood can be collected before surgery. Haemoglobin level must be determined before each donation which should not be less than 110g/l. The blood is collected weekly within the four [4] weeks prior to the date of the operation. Blood should not be drawn more than once a week, the last donation at least 4-7 day before surgery. Occasionally a leap – frog technique can be performed in which the oldest blood unit is returned to patient to allow another unit (fresher unit) to be withdrawn. Intravenous fluids should be considered if systolic blood pressure becomes less than 100mm/hg following blood collection. Traceability of all autologous units must be possible, consequently transfusion records must permit tracking of each unit

from the patient, through all procedures performed on the unit, to transfusion to the patient, or disposal. Autologous collections must be stored and transported in a manner similar to that of allogeneic blood but stored in a different fridge from allogeneic blood.

Pedipack which allows collection of 250mls while containing 35mls of anticoagulant are appropriate for children and adults less than 50kg. Patients who pre-deposit should have oral iron prescribed before the first donation and continue until surgery. Labelled blood bags and sample tubes should not be placed on a shared table or trolley between two adjacent donors to reduce the risk of transposition. The tests of markers for transfusion transmitted infections should be carried out on the first and last donations. Pre-transfusion testing including a group and antibody screen should be performed on the patient prior to surgery, as allogeneic blood may be required in addition to the autologous blood previously collected

The labels on the donated blood unit must clearly state:

1. Autologous Blood
2. Unique blood pack number.
3. Blood group.
4. Collection and expiry date.
5. Place of collection.
6. Patient details (name, date of birth, Hospital number).
7. Patient's signature.
8. Final destination (ward or theatre at which blood will be stored/transfused).
9. Summary of the test results for infectious disease markers
10. The blood group (ABO / Rh D) and any compatibility tests

With a red cell storage-life of 35 days at 4°C, most healthy adult patients can donate up to three red cell units before elective surgery. Patients may be given iron supplements, sometimes with erythropoietin, to prevent anaemia or allow more donations to be collected. Although recombinant human erythropoietin can stimulate red blood cell production before autologous donation and decrease the need for transfusion, it is not clear whether this strategy, which can cost thousands of dollars per patient, will be cost-effective [42]. Its use is generally not recommended. The Blood Safety and Quality Regulations (BSQR, 2005) require that donations for PAD must be performed in a licensed blood establishment, rather than a routine hospital setting. The donations must be processed and tested in the same way as donor blood and are subject to the same requirements for traceability.

A very high level of blood safety is guaranteed by the combined effect of careful selection of donors on the basis of their history and clinical information, serological tests and genomic amplification to screen for transfusion-transmissible infections.

Decision on Unused Autologous Blood unit

The issue of disposition of pre-donated blood which is not transfused to donor-patients remains unresolved. In some transfusion centres, all units are discarded. In others, the blood can be administered to other patients if the donor met all the criteria for homologous donors and the blood tested negative for infectious disease markers [9]. Controversy exists concerning whether the costs and potential risks outweigh the potential benefits of "crossover" use in the general blood supply of unutilized blood that was donated for autologous transfusion. Individuals with high pre-operative haematocrit are able to tolerate more blood loss during surgery and have less need for re-transfusion of PABD units and may be responsible for increased wastage of PABD units [36].

The additional cost of autologous blood is a function of the discarding of units that were donated but not transfused. The first theoretical advantage of ABD is prevention of transfusion-transmitted disease namely viral infections such as HIV or hepatitis virus or emerging virus. Actually, the very low residual risk that remains from allogeneic transfusion after appropriate selection of donors, leuko-reduction and nuclear acid testing in developed countries does not argue for allogeneic blood in developing country. The effectiveness of autologous blood donation and transfusion may not be marked but the difference it make in different contexts may be significant. Autologous donation programs would have the additional advantage of boosting the blood bank stock. There is therefore a need to develop a clinical-organizational protocol to encourage PABD as it may hold promise of increase availability of blood in low income countries.

Conclusion

Considering the tremendous pressure on blood supply in sub-Saharan Africa, there is a need for individual hospital transfusion committees to set up standard guidelines for the use of autologous transfusion that would be synchronized with the transfusion policies to improve availability of safe blood. Once there is an effective collaboration between the blood bank and the attending surgeons, blood donors may be recruited and screened at a hospital-based blood bank in contrast to the

centralized transfusion centre in the developed countries. Patients' families are burdened with the responsibility of finding replacement blood donors and there are concerns about blood safety. The tremendous cost incurred by the execution of autologous blood transfusion service in developed countries may not be replicable in the developing countries.

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