

Surgery in Africa - Monthly Review

Blood Transfusion in Surgery

Introduction

Surgical patients lose blood and surgeons often transfuse blood to restore normal physiology. Despite the increased use of whole blood and products in surgery, there are few publications regarding transfusion in the surgical literature (1). The paucity of research on blood transfusion in surgery is such that The American Society of Anaesthesiology recommends maintaining Hb greater than 6gm/dl whereas The National Institutes of Health recommends a concentration of greater than 7gm/dl for patients who are critically ill (2, 3). Surgical patients are transfused allogenic blood which has significant physiologic sequelae and does not restore normal physiology. Blood transfusion comprises complex biologic products that initiate a systemic inflammatory response, induce a non-specific immuno-suppression and may occlude the microvasculature, causing hypoxaemia.

In addition to the physiologic complexity of transfusions, blood transfusions were also thought to increase cancer growth and recurrence. This perspective has become controversial with maturation of clinical data (4). With regards to renal transplantation, transfusions were once immunosuppressant, but are now considered a significant impediment to successful transplantation (5). Moreover aggressive transfusion of critically ill patients has a significant tradition in surgery, but recent data question this practice as well (6).

Despite all this, there is no doubt that the use of donor (allogenic) blood or blood products has been pivotal to the advancement of modern surgical practice and in order to improve further, it is important that blood transfusion in surgery is undertaken only when necessary and after thorough evaluation of the risks involved.

There are vast differences with regards to transfusion practice between Africa and the western world due to the prevailing economic conditions. Whole blood transfusion remains the norm in Africa, and component therapy is well established in the west (7). Incorrect blood transfusion due to clerical errors is the most common transfusion risk in the west while transmission of infection must be the major risk in Africa.

Africa has one of the highest carrier rates of HIV and hepatitis B. Moreover, the screening facilities are inadequate in most parts and in view of these facts, it is vital that the patients are transfused only when absolutely necessary.

This review intends to evaluate the risks and benefits of transfusion from a surgical perspective in Africa with emphasis on:

[i\) Physiological aspects of transfusion.](#)

[ii\) Risks of Transfusion.](#)

- [iii\) Transfusion in patients with acute blood loss.](#)
- [iv\) Transfusion in the critically ill surgical patients.](#)
- [v\) Transfusion in pre-operative patients.](#)
- [vi\) Transfusion and cancer surgery.](#)
- [vii\) Transfusion to correct anaemia.](#)
- [viii\) Transfusion related Morbidity.](#)
- [ix\) Transfusion Alternatives.](#)
- [x\) Auto Transfusion](#)

Finally [clinical recommendations](#) will also be given.

i) PHYSIOLOGICAL ASPECTS OF TRANSFUSION

Under normal circumstances the oxygen delivery to the tissues is 1000ml/min and the oxygen consumption is 200ml/min. Hence the ratio of oxygen delivery to oxygen consumption is 5:1 and only 20% of the delivered oxygen is extracted leaving behind a mixed venous oxygen saturation of 80%.

In patients with anaemia, hypoxia or myocardial failure in whom the delivery of oxygen cannot be increased and in whom the consumption increased, this 5:1 ratio will fall with the patient using up the inherent oxygen reserves. This scenario persists until the ratio falls to 2:1 up to which level the patient remains stable. Transfusion is only required when oxygen consumption is supply dependant and with aggressive haemodynamic and ventilator management, few patients will reach this critical threshold. Thus the recommendation to transfuse a patient must focus on the compensatory ability of the patient and physiologic parameters and not only on the packed cell volume (pcv) as is the case generally. Transfusion therefore, is only necessary when patients cannot compensate for their anaemia.

Note pcv may be converted to Haemoglobin in gm/dl by dividing by .03.

When the compensatory mechanisms are normal with an adequate oxygen delivery it may not be necessary to transfuse patients until the pcv drops below 16% (Hb 5.3) and in patients with poor compensatory mechanisms may only be advised when the pcv drops below 25% (Hb 8.3) ([8](#), [9](#)).

Thus physiologically, transfusion indications [specific to procedures](#) or [surgical specialties](#) does not make much sense and patients must only be transfused when absolutely necessary.

ii) RISKS OF TRANSFUSION

The major risks include transmission of infections, transfusion reactions and incorrect blood transfusion.

The dictum “The safest transfusion is no transfusion” applies better nowhere else than in Africa in view of the risks of transfusion transmitted infections.

Transmission of infections mainly involves the HIV virus, Hepatitis B and C viruses, the malarial parasite, syphilis and chagas disease.

The WHO guidelines for safe transfusion practice recommends that all donated blood should be screened for HIV, hepatitis B and syphilis and where feasible and appropriate screening should also be done for hepatitis C, malaria and Chagas disease.

With economic hardships and organizational shortcomings, transmission of infection remains the most important risk factor related to blood transfusions and it can't be emphasized enough that only patients who actually require blood be transfused. It is difficult to get a sense of the rate of HIV transmission in the African blood supply but published information indicates that as many as 40% of the units of blood transfused may not have been screened at all (37), and that there remains a serious risk of transfusion transmissible infections (TTIs) (29 - 42). The use of voluntary, non-remunerated donors from low-risk populations combined with pre-donation screening helps reduce both wastage of contaminated blood and the risk of TTIs.(37, 48).

Incorrect blood component transfusion results largely from clerical errors and may account for approximately 66% of all the reported adverse events in the U.K.

Transfusion reactions accounts for about 25% of total reported cases of adverse transfusion reports in the West .

iii) TRANSFUSION IN PATIENTS WITH ACUTE BLOOD LOSS

Acute blood loss is usually due to trauma, gastrointestinal bleeds or operation related.

Few would disagree with transfusion of a patient who is bleeding and unstable despite fluid resuscitation. Transfusion guidelines issued by National Institute of Health, American College of Physicians and the Canadian Medical Association suggests a threshold for a transfusion at a pcv of 21 to 25% (Hb7.0-8.3) (8, 9) Despite clear cut transfusion guidelines and the risks of transfusions, surgeons are frequently too aggressive regards to transfusing patients. There is irrefutable evidence that significant anemia is well tolerated even by elderly and transfusion in a patient with a pcv of 25 or above actually may do more harm than good.

Banked blood is widely available and, until recently, studies had concluded that a pcv of 30 was optimum for shock resuscitation. Recent studies however indicate that blood transfusion in patients with acute blood loss is not necessary and may actually be harmful above a pcv of 21. Transfusion is reported to be a risk factor, independent of shock severity, for poor outcome in patients with trauma (10).

Blood transfusion of banked blood results in provoking neutrophil cytotoxicity which is now regarded as a key mechanism in multiple organ failure (MOF) (11) and early transfusion has been shown to a strong independent risk factor for MOF. The provoking of circulating neutrophils, that are pro-cytotoxicity, are usually found within 6 hours after injury and that result in MOF may be due to the leucocytes and cytokines in the stored blood, or due to the pro-inflammatory lipids generated from cell membranes of degraded red blood cells.

Thus in acute blood loss, with moderate haemorrhagic shock, either normal saline or ringers lactate may be used for volume replacement and in massive haemorrhagic shock ringers lactate may be the fluid of choice (12). Colloids have been largely replaced by crystalloids due to the

propensity of the former to leak from permeable capillary membranes thereby worsening oedema and impairing tissue oxygenation. Large volumes of crystalloids have been implicated in the etiology of adult respiratory distress syndrome and the abdominal compartment syndrome, which colloids may not cause, but overall crystalloids provide the best survival. [\(13\)](#).

Blood transfusion in acute blood loss is advocated when the pcv is less than 21 (in patients without any cardiac pathology) and is generally infused in a ratio of 3 volumes of crystalloid to 1 volume of blood. In severe shock this ratio may increase up to 8:1.

Practical guidelines:

One unit of blood lost is compensated by 3 units of electrolytes. A blood loss of 1500ml is thus compensated by $1500 \times 3 = 4500\text{ml}$ Ringer or NaCl infusion.

Moderate hypovolemia: In most cases a blood loss of 1500 - 2000 ml blood/20-30% is thus compensated for with electrolyte infusions.

Serious hypovolemia: Start volume therapy with Ringer flush infusion through double i.v. lines. If his circulatory state does not stabilize promptly and permanently as a response to 3000 ml NaCl infusion, blood transfusion (or plasma expander) is indicated.

iv) TRANSFUSION IN CRITICALLY ILL SURGICAL PATIENTS

Anaemia is common in intensive care units and its causes include haemorrhage (from trauma or operation), decreased red cell production (from bone marrow depression due to the acute illness), increased destruction of red blood cells (due to intra / extra vascular haemolysis) and sequestration.

Until recently it was felt that anaemia may not be well tolerated in patients in critical care units [\(14\)](#) and some studies actually showed that anaemic patients are at a higher risk of death when critically ill [\(15\)](#). Thus critically ill patients were routinely transfused in the ICU setting if the Hb was around 10.0gm/dl.

Critically ill patients, excluding patients with a cardiac pathology, may however be at an increased risk of the immunosuppressive & microcirculatory complications of blood transfusion and recent studies tend to confirm that the risks of anaemia (pcv <21) may be far less than actually envisaged and that blood transfusion in such patients does more harm than good [\(16\)](#).

Adult critical care units have patients with mainly three primary admitting diagnoses, namely; ischaemic heart disease, post operative management and respiratory insufficiency/failure [\(1\)](#).

In critically ill cardiac patients, the risk of death increases with the presence of anaemia (pcv <30, Hb10.0) and blood transfusion appears to decrease this risk [\(17\)](#).

However critically ill post-operative and respiratory insufficiency/failure patients, who have no primary cardiac pathology, should have a restrictive strategy of blood transfusion (transfusion only if pcv is less than 21) since it is at least as effective and possibly superior to a liberal transfusion strategy (transfusion if pcv <30) [\(16\)](#).

v) TRANSFUSION IN PRE-OPERATIVE PATIENTS

Pre operative transfusion should be done only if haemoglobin level is below 7-8 gm/dl and if the anemia is acute (a few days) in onset and/or giving rise to symptoms.

Generally, blood transfusion in surgery is only indicated if the:

- i) Pre-operative Hb is <7gm/dl with minimal blood loss expected at operation.
- ii) Pre-operative Hb is <9gm/dl if greater than 500ml of surgical blood loss is anticipated.
- iii) Pre-operative Hb is <10gm/dl in patients with cardiac disease, respiratory disease or with uraemia.

vi) TRANSFUSION AND CANCER SURGERY

In 1981 Gantt introduced the concept that pre-operative blood transfusion down-regulated the host's immune surveillance and increased the recurrence and since then numerous reports have supported this view. However, close scrutiny of these publications, with the doctrine of evidence-based medicine, proves no causal relationship between peri-operative blood transfusion and cancer recurrence or death.

vii) TRANSFUSION TO CORRECT ANAEMIA

Recent meta-analysis suggests that correcting anaemia (pcv 30) using donor blood does not necessarily improve outcome [\(16\)](#).

A transfusion trigger of an Hb of <7gm/dl was as safe and possibly superior to a transfusion trigger of <10gm/dl. The only exception was a subgroup of patients with cardiac pathology for whom a transfusion trigger of 10gm/dl should be followed until further studies prove otherwise.

viii) TRANSFUSION RELATED MORBIDITY

Blood transfusion should actually be regarded as a part of transplant surgery since all the disadvantages and advantages of transplantation are applicable.

Transfusion associated immunomodulation is a non specific immunosuppression, the precise cause of which is unknown but postulated to be due to allogenic plasma components, white blood cells, fibrin or accumulators from the storage process [\(1, 17\)](#). Transfusion of banked blood also provokes neutrophil cytotoxicity which is the key mechanism in multiple organ failure (11).

Non immunologic theories of transfusion related morbidity include clogging of the microcirculation with clumped red blood cells, fibrin and cellular debris causing hypoxia and potentially providing an enabling environment for metastatic seeding.

Transfusion of blood stored for long duration has been associated with pneumonia and ICU mortality.

Overall, if fresh autologous blood were readily available every patient would have his pcv maintained at 45 but, in view of the above side effects of homologous blood, blood transfusion must be administered only when absolutely necessary

ix) TRANSFUSION ALTERNATIVES

Since blood has so many potential drawbacks, the search for blood substitutes (oxygen transporting fluids) has been intense but unfortunately blood substitutes are in their infancy showing poor results in the initial clinical trials ([18](#), [19](#)). In animal models, however, they have shown great promise and hopefully these blood substitutes will likely develop into the venous fluid of choice in the critically ill trauma patients.

Albumin has been used in the critically ill patients, but recent evidence shows that administration does not reduce the risk of death in the critically ill patients with hypovolaemia, burns or hypoalbuminemia, but, in fact, there is a strong suggestion that it may increase the risk of death ([20](#)).

X) AUTO-TRANSFUSION

With auto-transfusion there is no risk of transmitted blood-borne diseases or transfusion reaction.

In auto-transfusion blood from the wounds, abdomen, chest or drains of the injured patient is collected, anticoagulated and re infused to the patient. Cases suitable for auto transfusion are:

- Heavy internal bleeding
- Heavy chest tube bleeding
- Dependent drains producing much blood after surgery

The Practical procedure

Blood is collected from the abdominal cavity or chest by a simple sterile mechanical sucker, or a large syringe; or you may collect it with a metal cup or spoon. Leave the blood clots. Filter the blood through a micropore filter or sterile gauze clothes into a sterile bottle. Add 20 ml sodium citrate to each 100 ml blood for anticoagulation. The blood may either be transferred to an ordinary blood pack and transfused or stored in the blood bank as full blood or packed red blood cells. Or it may be directly transfused with syringes as citrate-blood from the bottle.

Re infuse through micropore filters to reduce the risk of complications.

Complications to auto-transfusion

- Precautions in abdominal injury: Blood from the abdominal cavity should not be used in patients with perforations of the large gut. The risk of septicemia is insignificant in cases with minor small gut injuries. As precaution, use broad-spectrum antibiotics as prophylaxis in abdominal cases.
- Coagulation system failure with increased tendency of bleeding is seen after extensive auto-transfusions.
- There is some risk of air embolism if the improvised method is used, but the risk is insignificant compared to the advantages of this method.

CLINICAL RECOMMENDATION

Blood transfusion decision depends on clinical assessment and laboratory test results. No absolute indications and few contraindications exist blood transfusion. However armed with the present knowledge:

i) Safe red blood cell transfusion must replace whole blood transfusion.

ii)

The transfusion trigger must change from a pcv of 30(Hb10) to a pcv of 21(Hb 7) for the majority of adults who do not have cardio-respiratory disease and are planned to undergo minor surgical procedures under general anaesthesia.

iii) Safe, screened blood should be made widely available for those who need blood transfusion.

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