Strategies to avoid intraoperative blood transfusion

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Abstract

Anaemia and blood transfusion are risk factors in the perioperative and critical care settings. Effective management begins pre-operatively, should be individualized to the patient and is subject to their own clinical risks. This article addresses the current evidence base for intraoperative strategies to avoid blood transfusion in these settings.

Keywords Anaemia; blood storage; blood transfusion; cell salvage

Royal College of Anaesthetists CPD Matrix: 1A02, 2A05

Learning objectives

After reading this article, you will be able to:

- recognize strategies for minimizing intraoperative blood loss
- employ evidence based restrictive blood transfusion appropriately in theatres and critical care
- implement Intraoperative Cell Salvage into your theatre practice

The reduction in perioperative transfusion may be achieved by implementing the three pillars of patient blood management:

1. Diagnosis and management of preoperative anaemia (reducing the likelihood of a haemoglobin level where transfusion needs to be considered).
2. Minimizing operative blood loss (optimizing surgical and anaesthetic technique, and maintaining normal coagulation).
3. Appropriate usage of a restrictive transfusion policy

This article focuses on the second and third pillar. The first pillar is covered in the article, *Pre-optimization of the Anaemic Patient*, on pages 67–69 of this issue.

Intraoperative strategies

Reduction of intraoperative blood loss requires meticulous surgical technique (which may include collagen or cellulose pads or fibrin glues) and maintenance of appropriate blood pressure. In addition it is important to ensure physiological concentrations of functioning components of coagulation, and inhibition of inappropriate clot lysis. The clinician must therefore ensure coagulation and platelet functions are not pharmacologically inhibited. Hypocalaemia, hypothermia, acidosis and extreme haemodilution should be managed appropriately.

Acute normovolaemic haemodilution (ANH)

This requires a near-normal starting haemoglobin concentration and involves withdrawal of 10–20% of the blood volume while simultaneously infusing crystalloid to maintain normovolaemia, rendering the patient anaemic. Blood loss during surgery will cause less red cell loss which can be restored with the patient's own pre-donated whole blood.

The evidence for this method is limited. Small studies have shown a modest benefit in terms of blood loss and transfusion but widespread employment of this technique has been limited by concerns of increased bleeding due to dilution of clotting factors, iatrogenic induction of low oxygen delivery and ischaemia. The increased requirement of IV crystalloid appears in apposition to evidence of restrictive IV fluids improving outcome in general surgery.

Intrathoracic pressures

PEEP increases intrathoracic pressure and reduces venous return which can increase venous blood loss.

Positioning

Having the operative site above the level of the heart can reduce blood loss by enhancing venous return; however, the risk of venous air embolism must be considered. In the prone position for spinal surgery, avoidance of abdominal compression not only decreases respiratory compromise and risk of organ trauma, but also reduces venous shunting through the epidural veins, lessening venous bleeding.

Regional anaesthesia

Regional anaesthetic techniques have been demonstrated to reduce blood loss in some surgical procedures; neuro-axial blockade reduced blood loss and allogeneic transfusion in hip arthroplasty. In other surgical procedures including hip fracture, peripheral vascular, retropubic prostatectomy, caesarean section and bowel surgery, blood loss were significantly reduced, but did not reduce transfusion as part of a liberal transfusion protocol.[1]

Antifibrinolytic therapies

These inhibit the clot dissolving fibrinolytic pathway and most widely available of these are tranexamic acid and aprotinin.

Tranexamic acid

This lysine derivative blocks the binding site of plasminogen activator, inhibiting fibrinolysis. This has come into vogue as a result of the CRASH-2 trial where early (within 3 hours) administration of tranexamic acid reduced mortality due to bleeding in trauma patients.[2]

Although the reduction in transfusion has been demonstrated, concerns exist on account of pathological coagulation precipitating MI, stroke and other serious complications.[3]

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Aprotinin

A bovine pancreatic trypsin inhibitor is a serine protease inhibitor which, at lower doses acts on plasmin inhibiting fibrinolysis. At higher doses it reduces coagulation via kallikrein inhibition. This drug was commonly used in cardiac surgery, where it had been shown to reduce blood loss; a small evidence base exists for use in orthopaedic and hepatic transplant surgery. Following the 2007 BART study, the drug was voluntarily withdrawn on account of increased mortality and renal failure, however it has been re-licenced for use in myocardial revascularization.[4]

Consideration of a restrictive transfusion strategy

The use of allogeneic transfusion will increase the haemoglobin concentration and hence the oxygen carrying capacity of the blood (except in situations where ongoing bleeding exceeds the rate of transfusion). It does not follow however that use of allogeneic red cells improves outcome in surgical patients. Stored red blood cells (RBCs) do not function as well as circulating RBCs, affect immunological function and may contain significant concentrations of free haemoglobin. The benefits of increased oxygen delivery and other red cell function must be balanced against the all the risks of allogeneic RBC transfusion. Restrictive transfusion, with a threshold of 70 g/L, is considered appropriate in most clinical situations with a number of studies demonstrating no detriment to outcome when comparing liberal to restrictive transfusion triggers. Carson et al. concluded that patients subject to a restrictive transfusion policy do not suffer adverse effects in terms of mobility, myocardial infarction, death and length of stay when compared to their liberally transfusion counterparts.[5]

No difference in outcome has been demonstrated between restrictive and liberal transfusion with fracture neck of femur surgery.

However, not all evidence supports restrictive transfusion, Murphy et al[6]., however, reported that restrictive transfusion resulted in worse outcome when compared to liberal RBC transfusion in cardiac surgical patients. The decision whether or not to transfuse therefore requires the clinician to respond to the individual clinical situation, appreciating that serious adverse effects upon morbidity may not be witnessed immediately; the clinician should consider the risk-benefit for each unit that is administered.

Intraoperative cell salvage (ICS) (Figure 1)

Autologous blood transfusion has become a more common intervention to avoid permissive anaemia, hazards of allogeneic blood transfusion and associated blood storage lesions and may also be compatible with patients refusing allogeneic transfusion.

It involves harvesting blood from the intraoperative site and from wound swabs via a specialized suction device. The suction device has two lumens: one removes blood from the surgical site, the other adds a predetermined volume of anticoagulant to the point of blood collection and avoids adding to the surgical field. Heparin is typically used, but when contraindicated, citrate can be used. Anticoagulant is added to the blood to dilute by around 15%. The mixture is then filtered to remove large debris (e.g. bone and clots and collected in a reservoir). Red cells are separated from the substrate by various techniques, the most common being centrifugation. This removes waste products and red blood cells remain with a high haematocrit. The red cells are then

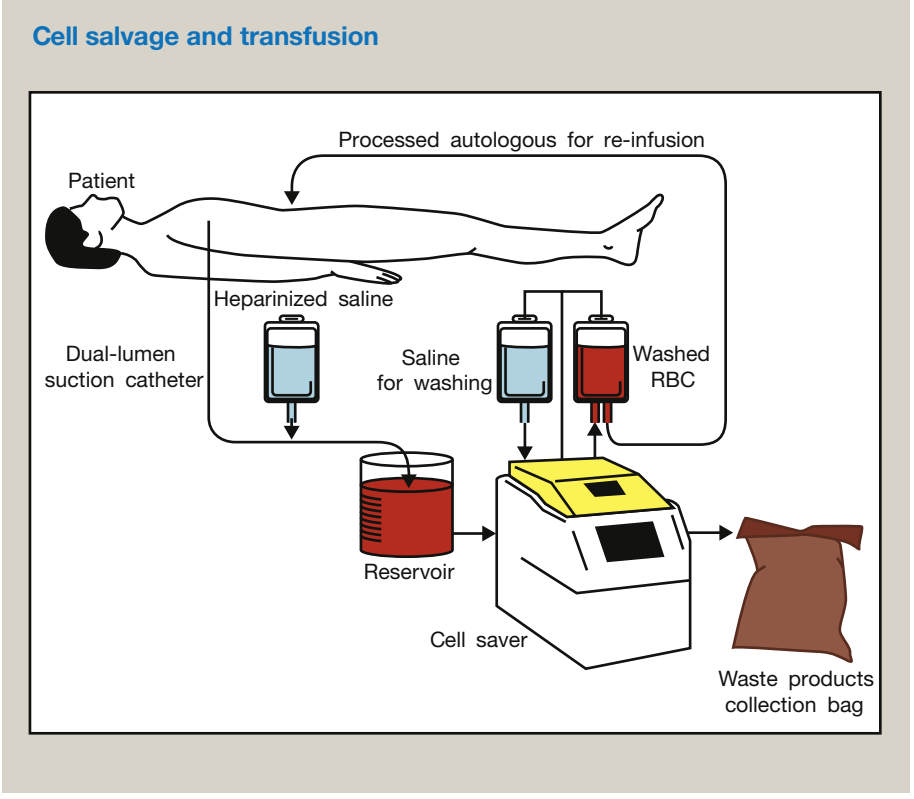

Figure 1