Section 4
Blood Conservation

Aim

- To introduce the learner to the basic concepts of blood conservation

Learning Outcomes

- Identify the principles of blood conservation
- Identify the areas where blood conservation can be undertaken in surgical patients
- Describe the main method of blood conservation

Introduction

Allogeneic (donor) blood is a valuable but limited resource and although potentially life-saving, is not without risks e.g. wrong blood incidents, transmission of infection and immunosuppression.

Precautionary measures, introduced due to concerns over the potential risk of variant Creutzfeldt-Jakob Disease (vCJD) transmission through blood transfusion, together with additional testing for a wider range of blood-borne viruses have further improved the safety of donated blood. However, the result has been a significant increase in cost.

In addition, individuals who have received or think they may have received a transfusion after 1st January 1980 are no longer eligible to donate blood. This and other restrictions have reduced the already diminishing blood donor population. The introduction of a possible test for vCJD could impact on the willingness of donors to donate. It is possible that blood shortages may in future result in the restriction of transfusion to treatment of active major bleeding, emergency surgery and life-threatening anaemia.

4.1 Health Service Circular (HSC)

In March 2007, the Chief Medical Officers of England, Northern Ireland, Scotland and Wales participated in a third "Better Blood Transfusion" seminar. In England the publication of Health Service Circular (HSC) 2007/001 – "Safe and Appropriate Use of Blood"[1] followed.

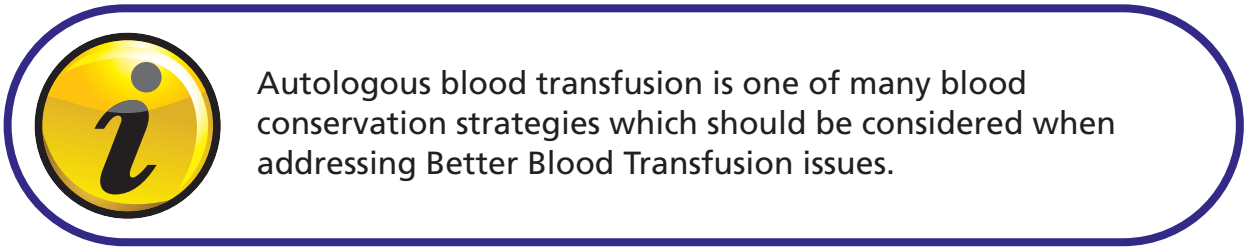
It outlines a new programme of action for NHS Trusts:

- Each NHS Trust should develop a Blood Conservation Plan
- Build on the success of previous *Better Blood Transfusion* initiatives to further improve the safety and effectiveness of transfusion
- Ensure that *Better Blood Transfusion* is an integral part of NHS care
- As part of clinical governance responsibilities, make blood transfusion safer
- Avoid the unnecessary use of blood and blood components (fresh frozen plasma and platelets) in medical and surgical practice
- Avoid unnecessary blood transfusion in obstetric practice and minimise the risk of haemolytic disease of the newborn (HDN)
- Increase patient and public involvement in blood transfusion

A toolkit to assist Trusts in the implementation of *Better Blood Transfusion* is available at *www.transfusionguidelines.org.uk*. It provides access to national guidance, examples of good practice and patient leaflets.

4.2 Reasons for Blood Conservation

Concerns over possible future blood shortages have resulted in increased efforts to manage the blood supply more effectively. This includes efforts to increase the supply and to reduce the demand for blood. Reducing the demand (blood conservation) takes many forms and can occur in both medical and/or surgical patients. This section focuses on surgical patients.

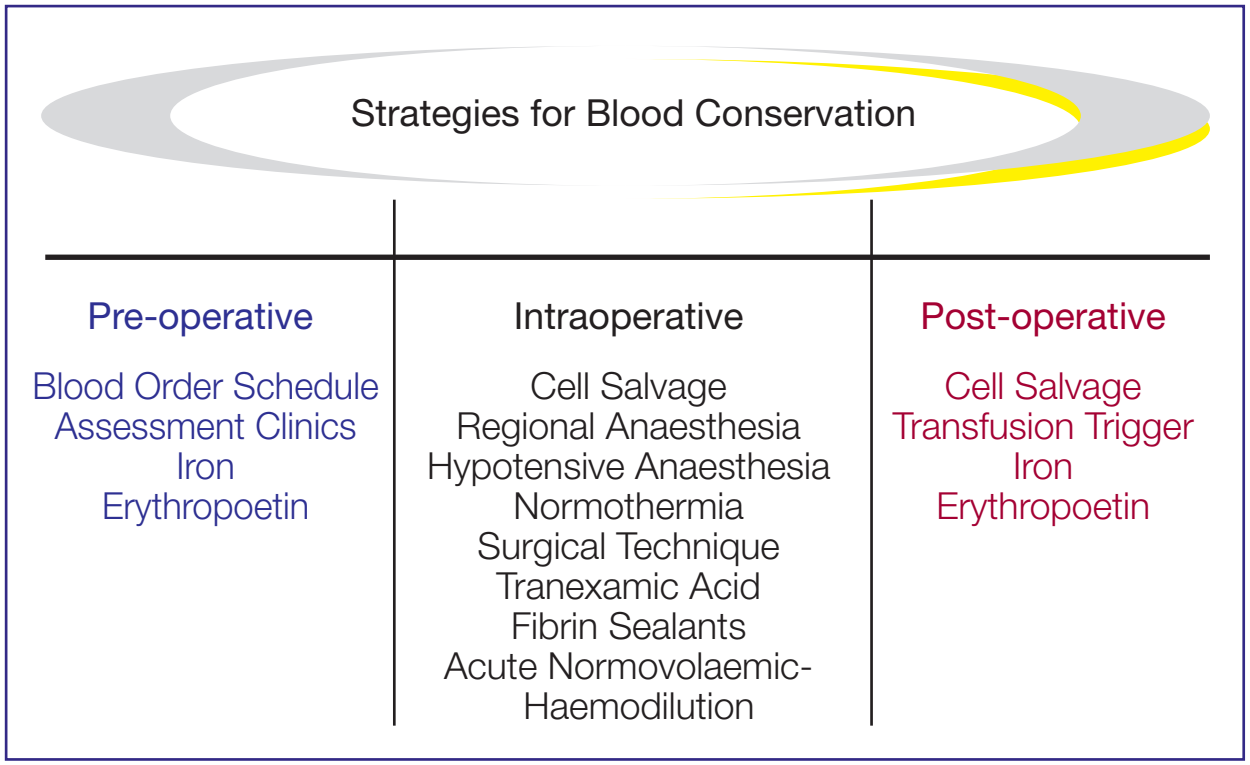


Emergency Plans for Blood Shortages

Blood services and the hospitals across the UK have made plans to manage the supply of blood in the event of a prolonged shortage. The UK blood services and hospitals have a responsibility to develop an integrated Emergency Blood Management Plan to ensure shortages are handled in a fair way and, once implemented, will invoke a controlled response to a shortage situation. For this reason, efforts at better and more appropriate management of the blood supply are being advocated.

4.3 Strategies for Blood Conservation

Figure 4. Strategies for Blood Conservation



- Pre-operative Planning:
  - Manage haemoglobin (Hb) (Manage and correct pre-operative anaemia)
  - Manage haemostasis (detect and manage coagulation disorders, stop anti-coagulants and anti-platelet drugs if safe to do so)
  - Cell salvage (arrange for blood salvage to be available if it is appropriate for the planned surgery)
- During Surgery:
  - Surgical techniques
  - Anaesthetic techniques
  - Normothermia
  - Intraoperative cell salvage (ICS)
  - Check Hb and coagulation using near patient testing
- Post Surgery:
  - Minimise blood loss
  - Transfusion threshold
  - Postoperative cell salvage (PCS)
  - Check Hb

4.4 Pre-operative Optimisation of Haemoglobin

Patients scheduled for elective surgery should have anaemia investigated before presenting for surgery.

Low iron stores define iron deficiency. Iron deficiency anaemia is the presence of low haemoglobin concentration in addition to low iron stores. Iron deficiency anaemia is detectable from routine pre-operative screening and, after investigation, may be corrected using oral or parenteral iron.

Oral Iron

Oral iron is available in a variety of preparations and is the recommended treatment for mild to moderate iron deficiency anaemia. The recommended dose is 80-100mg elemental iron per day but compliance is often poor because of gastrointestinal side effects. Oral iron therapy may fail in the presence of chronic diseases, e.g. Crohn's, ulcerative colitis, coeliac disease, renal failure, parasitic disease, and drugs that inhibit erythropoiesis (red blood cell production).

Parenteral Iron

This is the most important alternative to oral iron and may be required if there is insufficient or no response to oral iron, intolerance of oral iron, severe anaemia or a need for a rapid response. Parenteral iron should only be administered if the patient's iron status is known, to prevent iron overload.

There are three different types of parenteral iron and they may not all be available in every organisation.

Iron dextran has the advantage that it can be administered in a total dose infusion, but it is associated with allergic reactions.

Iron sucrose may be rated as very safe, with anaphylaxis occurring rarely. However, repeat injections are required to achieve the target haemoglobin making this labour intensive and inconvenient for patients.

Iron carboxymaltose is a new parenteral iron compound, which is delivered in a total dose infusion over about 15 minutes. It has a similar safety profile to iron sucrose and has been available in the UK since 2008.

Erythropoietin (EPO)

In normal healthy adults red cells are formed in the bone marrow under the influence of haemopoetic agents (agents that control the formation of the cellular components of blood). Erythropoietin is formed predominantly in the kidneys and is the key regulator of erythropoiesis (red blood cell production). Low Hb concentration is a potent stimulus of erythropoiesis in normal healthy adults. As a result, the new red cells will incorporate iron and form haemoglobin. In the presence of renal disease, critical illness and malignancy, recombinant erythropoietin may be required in addition to intravenous iron, to raise the Hb level.

4.5 Autologous Transfusion Techniques

The following techniques involve the collection and reinfusion of the patient's own blood or blood components.

Preoperative Autologous Donation (PAD)

PAD is a form of autologous transfusion where blood is collected from the patient, stored and reinfused at surgery, if appropriate.

This technique is not currently recommended

Preoperative Autologous Donation prior to planned surgery has been used extensively in the USA. In practice the patient goes to theatre with a lower than normal Hb and there is no evidence that these patients receive any less allogeneic (donor) blood, so this technique is no longer recommended as routine. In rare cases of unusual antibody formation or in a situation of blood shortage, it may be considered but it can only be carried out in premises licensed by the Medicines and Healthcare products Regulatory Agency (MHRA) as a blood establishment. Additional information can be obtained from the British Committee for Standards in Haematology (BCSH) approved document "Guidelines for Policies on Alternatives to Allogeneic Blood Transfusion 1. Predeposit Autologous Blood Donation and Transfusion"[2].

Acute Normovolaemic Haemodilution (ANH)/Isovolaemic Haemodilution

This technique is not currently recommended

This is a procedure where the patient donates their own blood in the anaesthetic room with full monitoring in place. At the same time, a plasma expanding fluid is infused to maintain the circulating volume. The patient's whole blood is collected, labelled and kept by the patient's side, then reinfused when surgical bleeding has ceased.

Adverse events include myocardial ischaemia, pulmonary oedema and mis-identification of blood. A recent meta-analysis[3] suggests only modest benefits and therefore this technique has limited benefit.

Post-operative Cell Salvage (PCS)

Generally used in orthopaedic surgery, blood that is lost from the wound post-operatively is collected into special autologous wound drains where it is filtered before being reinfused to the patient. There are also machines available that extend the intraoperative cell salvage process into the post-operative period providing washed red blood cells for reinfusion.

4.6 Appropriate Use of Blood

Restrictive Transfusion Strategy

A lower Hb level is accepted before an allogeneic (donor) red cell transfusion is considered. The acceptable Hb level varies between patient groups and often between individual patients. Generally however, in young fit patients, a transfusion will not be considered until the Hb is less than 8g/dl or lower. It is not necessary to transfuse to a target Hb of 10g/dl in healthy patients. A restrictive transfusion strategy is not appropriate for patients with ischaemic heart disease or in the presence of ongoing rapid haemorrhage.

Point of Care Testing (PoCT)

Blood samples are drawn from the patient and tested for Hb concentration and coagulation abnormalities. The tests are performed close to the patient, often in the operating theatre. During large blood loss and transfusion the patient's haemoglobin and coagulation status can change considerably. PoCT rapidly provides the clinician with information that permits targeted, appropriate treatment of low Hb and rapid correction of a coagulopathy.

4.7 Haemostatic Products

Tranexamic Acid

This is a synthetic amino acid that inhibits fibrinolysis (breakdown of the clot) by preventing the binding of plasmin to fibrin. It is used as adjuvant therapy in primary menorrhagia, gastrointestinal bleeding and in patients with bleeding disorders. It is sometimes used post-operatively in orthopaedic surgery to decrease bleeding. It should be used with caution in patients who have a high risk of thrombotic disease or myocardial infarction.

Key Points

- Blood conservation requires a team approach if it is to be successful.
- Safe and appropriate use of allogeneic (donor) blood should be a priority for all staff.
- Developing a blood conservation policy for each organisation is essential.

References

1. Health Service Circular 2007/001 – Safe and Appropriate Use of Blood *www.transfusionguidelines.org.uk/bbt*
2. British Committee for Standards in Haematology (BCSH) (2006) Guidelines for policies on Alternatives to Allogeneic Blood Transfusion 1. Predeposit Autologous Blood Donation and Transfusion. *www.bcshguidelines.com*
3. Segal, J. B., Blasco-Colmenares, E., Norris, E.J., Guallar, E. (2004) Preoperative acute normovolaemic haemodilution: A meta-analysis. *Transfusion*, 44(5) 632-644

Further Reading

- Llewellyn CA *et al* (2004) Possible transmission of vCJD by blood transfusion. *Lancet*; 363: 417-421
- A Manual for Blood Conservation *ed Thomas, Thompson and Ridler (ISBN-10: 1903378249)*