Chapter 6

Blood Transfusion

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Blood transfusion is essential when level of functional haemoglobin decreases to a level where oxygen delivery to tissues is compromised. Therefore blood transfusion saves lives. Blood products and blood components are used to mainly correct the associated coagulation disorders due to deficiency of components required in blood coagulation. Blood transfusion can be associated with serious hazards and these are mainly due to human errors resulting in transfusion of wrong blood to the patient. Hence all precautions should be taken to prevent errors related to blood transfusion.

Blood groups

Blood groups are inherited and are determined by the antigens carried on the surface of red blood cells. There are as many as 30 different blood groups, but the main ones are the ABO and Rhesus groups. ABO is the most important system, and is named for the A and B antigens carried on the surface of the red blood cells. Persons with blood group A have the A antigen, blood group B have the B antigen, and blood group AB have both antigens. Blood Group O has neither antigen. The ABO system has associated anti-A and anti-B antibodies that are found in the plasma. Since blood group A has the A antigen, it recognises the B antigen as foreign and forms anti-B antibodies. Similarly, blood group B recognises the A antigen as foreign and can make anti-A antibodies. Group AB has both the A and B antigens so this group makes no antibodies. Group O has neither A nor B antigen so can form both anti-A and anti-B antibodies if exposed to these antigens. Human beings develop plasma antibodies against the A and B antigens very early on in life.

Rhesus status

The second most important blood group system is the 'Rhesus Group' named for its similarity to blood groups in rhesus monkeys. A *blood type* is most frequently defined both by the ABO and rhesus (RhD) systems, where the letter stands for the ABO type, and the sign (+) or (-) indicates the rhesus status. If the D antigen is present the person is said to be

positive (+), and if it is absent the person is negative (-). In the UK approximately 85% of people are positive and 15% negative. The rhesus blood group is particularly important in the context of pregnancy because a D positive baby can cause a D negative mother to develop antibodies, which can cross the placenta and affect future D positive babies. In the Far East the D negative group is less common and so there are fewer problems associated with pregnancy and the D blood group.

In summary, those individuals who are O (-) are universal donors: blood can be given to any blood group recipient, whereas individuals who are AB(+) are universal recipients: they can receive any blood group.

Patient Group	Red Blood Cells	Platelets	FFP	Cryoprecipitate
O				
1st choice	**O only**	**O**	**O**	**O**
2nd choice		**A**	**A**	**A**
3rd choice		**B or AB**	**B**	
A				
1st choice	**A**	**A**	**A**	**A**
2nd choice	**O**	**AB**	**AB**	
3rd choice		**B or O**		
B				
1st choice	**B**	**B**	**B**	**A**
2nd choice	**O**	**AB**	**AB**	
3rd choice		**A or O**		
AB				
1st choice	**AB**	**AB**	**AB**	**AB**
2nd choice	**A or B**	**B**	**A**	**A**
3rd choice	**O**	**A or O**		
Rhesus D +				
1st choice	**D +**	**D +**	**N/A**	**N/A**
2nd choice	**D -**	**D -**		

Donor Testing

Every donation is tested for hepatitis B surface antigen, hepatitis C antibody and RNA, HIV antibody, HTLV antibody, and syphilis antibody.
Tests for antibodies to malaria, T. cruzi and for West Nile virus RNA may be used when travel may have exposed a donor to risk of these infections.

Physiology of blood loss:

Acute Blood loss:

- Acute haemorrhage from wound;

- Acute haemorrhage from surgery: Orthopaedic, General, Obstetrics
- Acute haemorrhage from Vascular malformations: Gastric varices, AV Malformations, Ruptured aneurysms
- Acute haemorrhage from malignancy;

Chronic Blood loss

- Anaemia of Chronic disease;
- Ongoing Menorrhagia;
- Anaemia resistant to medical management: Pernicious anaemia, Iron deficiency anaemia, Sickle cell disease/trait, Thallassaemia;
- Anaemia secondary to malignancy/haematological malignancy;

Indications for Blood transfusion:

For chronic anaemia:

- If asymptomatic with a Haemoglobin < 70 g/l;
- If Symptomatic and Haemoglobin < 80 g/l;

Acute blood loss:

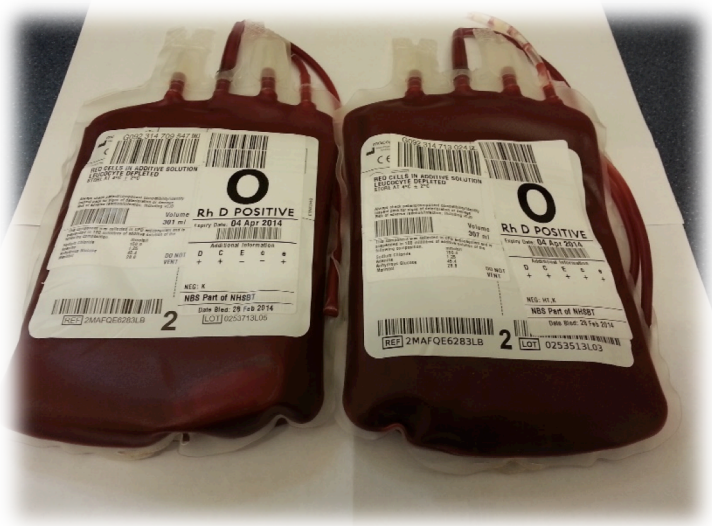
- Massive acute haemorrhage;
- Acute blood loss with evidence of hypovolaemic shock;
- Insidious haemorrhage.

Components of Blood:

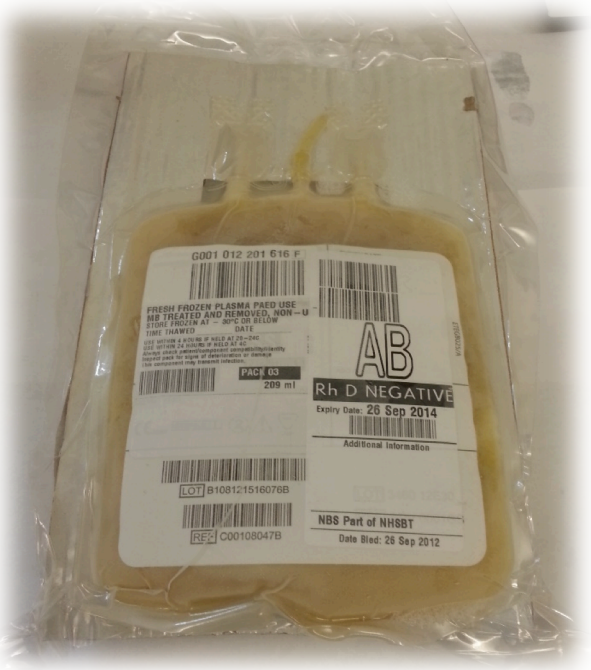
Whole blood: No longer used in the UK, due to increased risk of complications and transfusion reactions;

All blood and blood products in the UK are now Leucocyte depleted to help prevent the transmission of vCJD (Variant Creutzfeldt-Jakob Disease).
Some blood products can be irradiated to prevent transmission of CMV (Cytomegalovirus), which is used in immunocompromised patients (Chemotherapy, Immunotherapy, HIV/AIDs).

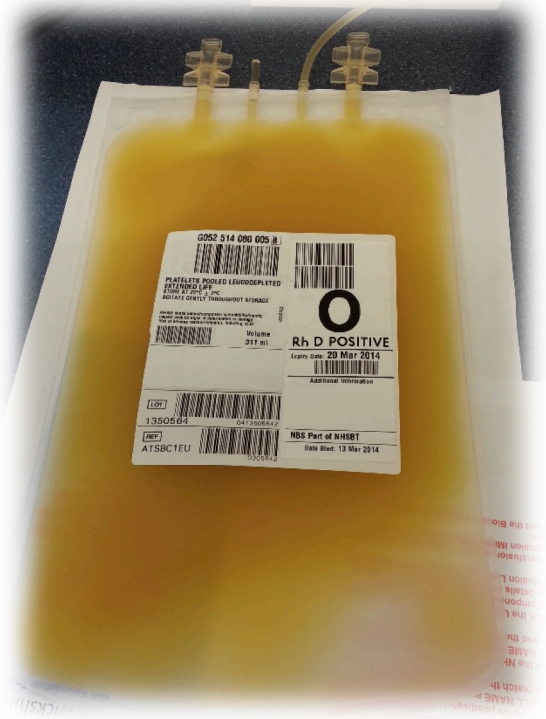
Packed Red Cells: 1 Donor



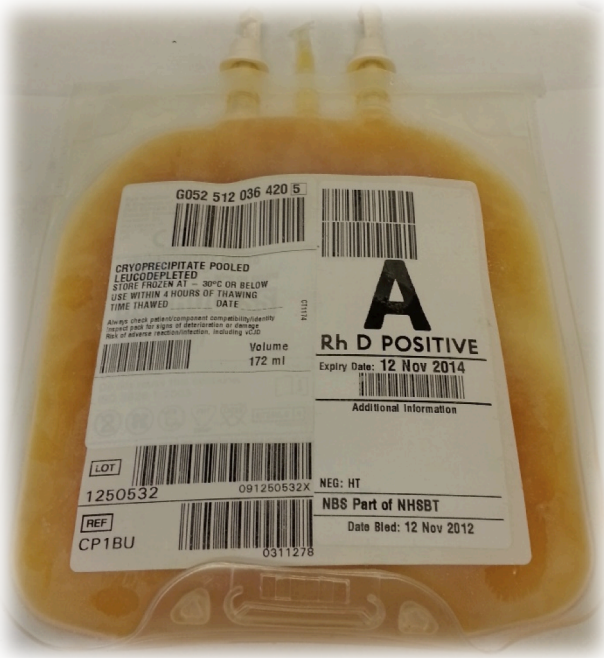
Fresh Frozen Plasma: 1 Donor



Platelets: Pooled donors



Cryoprecipitate: Pooled donors.



Human Albumin Solution: Either 4% or 20% Human Albumin, used as temporary protein replacement.

Contraindications for blood transfusion

Patient refuses as informed consent.

<u>Complications</u>

Classified into early and delayed reactions:
Early Reactions: within 24 hours:

- Acute haemolytic reactions: ABO or Rhesus incompatibility;
- Anaphylaxis;
- Hypersensitivity reaction: Itch, urticarial, mild fever;
- Bacterial contamination + infection (Sepsis);
- Mild transfusion reaction/Febrile reaction: From HLA incompatibility;
- Pulmonary Oedema;
- Transfusion Related Acute Lung Injury (TRALI): Due to anti-leucocyte antibodies within the donor plasma;

Delayed reactions: After 24 hours:

- Infections: Viral infections (HepB, C, HIV, CMV), Bacterial, Protozoa, Prions (vCJD);
- Graft vs Host disease;
- Post-transfusion thrombocytopaenia purpura: Potentially lethal drop in platelet count 5 – 7 days post-transfusion.

Practical Procedure of transfusion

Decision making

Prescribing blood-a checklist for clinicians. Always ask yourself the following questions before prescribing blood or blood products for a patient:

What improvement in the patient's clinical condition am I aiming to achieve?

I. Can I minimize blood loss to reduce this patient's need for transfusion?
II. Are there any other treatments I should give before making the decision to transfuse, such as intravenous replacement fluids or oxygen?
III. What are the specific clinical or laboratory indications for transfusion for this patient?
IV. What are the risks of transmitting HIV, hepatitis, syphilis or other infectious agents through the blood products that are available for this patient?
V. Do the benefits of transfusion outweigh the risks for this particular patient?
VI. What other options are there if no blood is available in time?
VII. Will a trained person monitor this patient and respond immediately if any acute transfusion reactions occur?
VIII. Have I recorded my decision and reasons for transfusion on the patient's chart and the blood request form?

Sample Collection

Information required when taking a blood sample:
Minimum patient identifiers "Baby" is acceptable as a first name for neonates awaiting naming.

- ✓ Gender (important for component selection purposes in Blood Transfusion Laboratory);
- ✓ Location of patient;
- ✓ Number (exact volume in mL for paediatrics) and type of blood components needed, including any special Requirements;
- ✓ Date and time blood component required;
- ✓ Transfusion and obstetric history;
- ✓ Diagnosis (including any significant co-morbidities relevant to transfusion);
- ✓ A clear unambiguous reason for transfusion;
- ✓ Type of surgical procedure when blood component required prior to operation;
- ✓ Printed name of requester with a contact telephone number and date of request;
- ✓ Taking a blood sample for Group and Save and/or Crossmatch

Group and save:

- Patient sample is tested for ABO and Rhesus compatibility.
- Sample is valid for 3 days.

Crossmatch:

- Patient sample is tested against current blood products and compatibility performed.
- Specified number of units of blood products allocated to the patient.
- Allocated blood products become de-reserved after 7 days.

Safe steps in obtaining a successful blood sample:

Ensuring the correct blood sample is taken from the correct patient:

- bleeding one patient at a time
- completing all documentation throughout the sampling process at patient bedside
- completing all checks throughout the sampling process at patient bedside
- Did you ask the patient to state their:
  - Full name?
  - Date of birth?
- Did you check:
  - Details on the wristband?
  - The information on the wristband against that on the prescription or transfusion request form?
- Did you label the venous blood sample as soon as it was taken?
- Does the label on the sample include the following information:
  - Full name, spelt correctly?
  - Date of birth?
  - Hospital number with all digits?
  - Gender?
  - Date?
  - Correctly sign and leave contact details?

Performing blood sampling:

Personal:

Wash hands, wear personal protective equipment and adhere to infection control guidelines at all times.

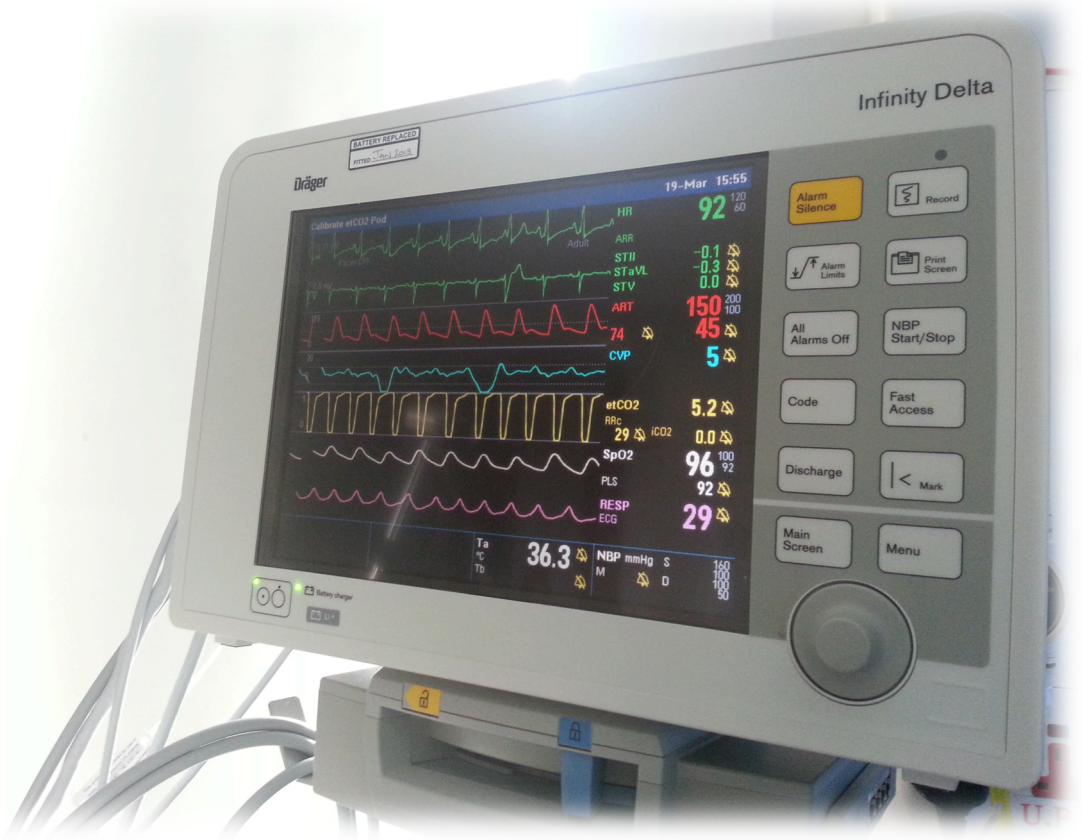
Equipment:

Check that all equipment is clean and available (i.e. Needles (Vacuette + Vacutainer), Tourniquet, Sharps bin, skin cleaning equipment, giving set, disposable bags and a trolley.

Equipment setup

- All blood components must be transfused through a blood component administration set with an integral mesh filter (170-200 micron).
- The administration set must be changed at least every 12 hours, this is intended to reduce the risk of bacterial growth occurring.
- All details on the patient's identification band (full name, date of birth and NHS &PID/UR number) must match exactly the details on the Patient Transfusion Record and the compatibility label attached to the blood component.
- Check the expiry date of the component - unless a specific expiry time is stated, the component expires at midnight of the date shown.
- The unique 14 digit component donation number which always starts with 'G', and the blood group on the blood component label must be the same as on the compatibility label attached to the blood component.

- Check the blood component label to ensure that any clinical special requirements have been met e.g. irradiated, CMV-seronegative.
- Inspect the blood component for any signs of leakage or damaged packaging.
- Inspect the blood component for unusual colour, turbidity or clumping of the contents.
- If any defect is suspected contact the Blood Transfusion Laboratory for advice before starting the transfusion.



Monitoring

Patient should be monitored so that both early and delayed transfusion reactions can be identified.
Standard monitoring includes Pulse, BP, RR and Temperature to be monitored:

- Prior to transfusion;
- At initiation of transfusion;
- During transfusion:
  - Pulse rate, BP, temperature and respiratory rate must be taken 15 minutes after the start of each component transfusion;

- Post transfusion:
  - Pulse rate, blood pressure, temperature and respiratory rate must be taken and recorded not more than 60 minutes after the end of the component transfusion.

Post procedure

Was:

- The blood transfusion within 4hours of it leaving the fridge or;
- The platelet infusion completed within 30 minutes?
- The patient's vital signs recorded prior to starting the transfusion?

- The patient's vital signs 15 minutes after starting the transfusion?
- The equipment disposed of appropriately?
- The patient's vital signs documented on completion of the blood transfusion?

There needs to be documentation in the patient records, on electronic documentation (e-discharge) and communication with blood bank.
The minimum documentation must include:

- The need for blood/blood product transfusion;
- The specific reason why;
- The therapeutic goal;
- and any adverse events;

Inform the patient at the time (if conscious) or the next of kin if unconscious;
Inform the GP in the discharge paperwork.

Electronic documentation: Most blood banks now have electronic data base through which blood transfusion can be traced for quality improvement purposes. Each blood or blood product bag is identified with a specific code. Prior to transfusion the blood form the blood bank or storage fridge bar code should be scanned. Following transfusion, again the electronic record should be completed by scanning the bar code again.

Complications

Acute Haemolytic Reaction:

- Incidence: 1/250,000 – 1/1,000,000;
- Features: Agitation, patient may feel 'something wrong', chest pain, abdominal pain, back pain, skin rash;
- Signs: Rapid Temperature rise, Hypotension, Tachycardia, Oozing from venepuncture site(s);
- Problems: DIC, up to 50% Mortality;
- Management:
  - ***Stop Transfusion immediately;***
  - Re-check name, identity on patient and transfusion unit;
  - Call haematologist;
  - Take a FBC, Clotting, Blood cultures and urine sample from the patient and send it to haematology/blood bank with the unit;
  - Flush IV Cannula with Hartmanns 1000 ml or 0.9% Saline 1000 ml + treat hypotension;

Anaphylaxis:

- Features: Difficulty breathing, flushing, facial + Tongue swelling
- Signs: Bronchospasm, +/- rash, Hypotension, Tachycardia, Angio-oedema
- Management:
  - ***Stop transfusion immediately;***
  - Follow ALS protocol: Oxygen, IV fluids, Adrenaline, Call Anaesthetist;
  - Re-check patient identity and Unit against patient
  - Take FBC + Clotting from patient + contact Haematologist/Blood bank;

Bacterial contamination:

- Features: Feeling unwell, feverish

- Signs: Rapid rise in Temperature, Hypotension, Tachycardia, Rigors, Sweating
- Management:
    - ***Stop Transfusion;***
    - Re-check patient identity against unit;
    - Take blood for FBC, Clotting, Blood cultures and Urine sample and send to Haematology/blood bank with the unit;
    - Start broad-spectrum IV antibiotics;
    - Treat hypotension with IV fluids: Hartmann's 1000mls.

TRALI:

- Where donor antibodies form the plasma react with recipient leucocyte antigens and disrupt capillary wall membranes, increasing permeability to water.
- Incidence: 1/5000 – 1/10,000;
- Features: Difficulty breathing;
- Signs: Dyspnoea, Cough, Decreased saturations, Cyanosis
- Management:
    - ***Stop Transfusion;***
    - Take FBC + Clotting + send samples with unit to Haematology/Blood bank;
    - Administer 100 % Oxygen;
    - Sit patient up to 45°;
    - CXR;
    - Call Senior support/ITU

Metabolic:

- Hyperkalaemia; increased risk with rapid transfusion
- Citrate toxicity; increased risk with rapid transfusion , in association with alkalosis
- Hypervolaemia + Pulmonary oedema
- Hypothermia: If blood is not warmed appropriately during transfusion;
- Impaired coagulation

Further Reading

[1] Blood Transfusion Service: www.transfusionguidelines.org.uk

[2] www.blood.co.uk

[3] WHO, 2006 www.WHO.int/bloodsafety

[4] Yentis S. M, Hirsch N. P, Smith G. B. *Anaesthesia and Intensive Care A-Z: An Encyclopaedia of Principles and Practice*. 3rd Edition. Elsevier. 2004. Pg 66 – 67.

[5] *Administration of Blood Components Guideline SWH 00523*. South Warwickshire NHS Foundation Trust. October 2012.