Journal of Diagnostic Pathology, 2002-2003, **1**, 12-16
Update

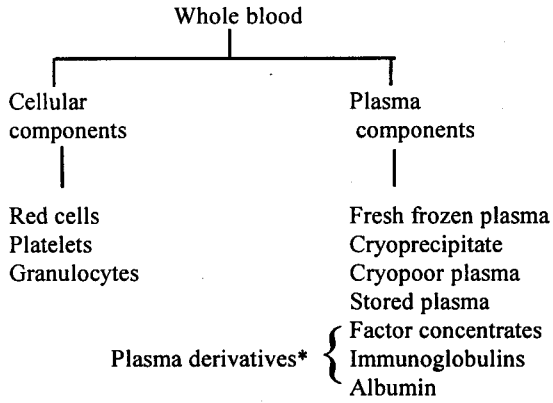
Use of Blood Products

N. Dahanayake[1]

The main objective of blood transfusion therapy is to alleviate clinically problematic symptoms attributed to deficiency or functional failure of blood components by substituting the components concerned. Problems in therapy using blood products include confusion in the indications, choice of blood products, methods of administration and inappropriate use. There is a need to formulate guidelines for the use of blood products in Sri Lanka as in other countries. This will prevent misuse of this limited resource which is not without hazards. Blood transfusion must be avoided when other therapeutic options are available. Whereas whole blood transfusion should be discouraged, component blood transfusion should be encouraged to prevent adverse reactions and complications induced by components other than target component, to minimize volume overload and for the effective use of donated blood.

This article describes various blood components and their uses. The components of blood are summarized in Figure 1.

Figure 1. Blood components



(* Plasma derivatives are synthesized under pharmaceutical manufacturing conditions)

Whole Blood

Whole blood contains no functional platelets, granulocytes or labile clotting factors. The indications are limited. It is used mainly in acute massive blood loss.

The use of fresh blood should be discouraged. One might do more harm by giving fresh blood due to not doing the laboratory markers properly for transfusion transmitted infections. Blood stored for less than 24 hours was used in the past for bleeding disorders when blood components were not available. One unit of fresh blood does not contain enough platelets, coagulation factors and fibrinogen to correct bleeding due to coagulopathies. Platelet concentrates, fresh frozen plasma and cyoprecipitates should be given instead.

For neonatal transfusions, it is advisable to use fresh blood (< 5 days old blood) to prevent hyperkalaemia.

Red cell concentrates

Indications for use

(1) Treatment of chronic anaemias. It is always necessary to investigate the cause for the anaemia and treat appropriately.
eg: deficiency anaemia

(2) Bone marrow failure
eg: Aplastic anaemia, cytotoxic therapy, radiotherapy.

(3) Transfusion dependent anaemias.
eg: refractory amaenias

(4) Suppression of endogenous haemoglobin production.
eg: Sickle cell anaemia, Thalassaemia

Consultant Pathologist, Teaching Hospital – Karapitiya, Galle.
***Corresspondence:** Dr. N. Dahanayake, Teaching Hospital - Karapitiya, Galle.*

In sickle cell anaemia, sickling of red cells occur in the microvasculature causing infarcts, especially in hypoxic conditions like general anaesthesia. In these circumstances blood transfusions are given to reduce the proportion of haemoglobin S. Blood transfusions are also indicated in sickle cell anaemia to prevent recurrent strokes.

(5) Surgery

(a)Preoperative –

Each patient should be assessed individually by the surgeon and the anaesthetist. Factors such as the clinical condition of the patient, associated illnesses, type of surgery and probability of blood loss should be taken into consideration. In general, preoperative haemoglobin is maintained at or above 8.0 gm%. In the elderly and patients with impairment of cardiac and respiratory function, it is advisable to maintain haemoglobin around 9 - 10 gm%.

(b) During surgery if the blood loss is more than 20% of the patients blood volume, blood transfusions are indicated (blood volume = 70 ml/kg body weight)

(c)Post operative haemoglobin should be maintained at or above 8.0 gm%. It is unnecessary to transfuse postoperatively to correct mild compensated anaemia.

Special red cell preparations

1) Washed red cells

(a) Washed red cells are indicated for patients with allergic reactions to previous transfusions.

eg: Anaphylactic reactions in patients who are IgA deficient.

In most cases, the exact cause cannot be found for the previous allergic reactions to transfusions. In these patients washed red cells are indicated to avoid transfusion of plasma proteins.

(b)Paroxysmal nocturnal haemoglobinuria In this condition washed red cells are indicated to prevent transfusion of complement component in the plasma.

2) Leukocyte depleted blood

Leukocyte depleted blood can be prepared by removing the buffy coat and by using filters. More than 98% of the leukocytes are removed by filtration. Therefore filtered blood is preferred although this is a costly procedure.

3) Phenotyped red cells

Appropriate phenotyped red cells are used for patients who have developed blood group antibodies in addition to ABO group antibodies. Phenotyped red cells are preferred for those who are on regular transfusions such as thalassaemic patients to prevent alloimmunisation.

4) Frozen red cells

Frozen red cells with selected antigenic components are useful in providing blood for patients with rare blood groups (*eg: Bombay group*) and patients with multiple red cell antibodies.

5) Irradiated blood

Irradiated blood is indicated for the patients who are at risk of developing transfusion associated graft versus host disease (GVHD), caused by the interaction between donor T lymphocytes and recipient cells carrying HLA class I and II antigens. Therefore irradiated blood is used for immunodeficient patients, although this is not practiced in HIV patients. There is a particular risk of GVHD when the donor and recipient share an HLA haplotype. Therefore irradiated blood is recommended when the donor blood is from a first degree relative.

Platelet concentrates

Platelets for transfusions are prepared as single donor platelets, pooled platelets and from platelet aphaeresis. ABO specificity is preferred when transfusing platelets. Transfusion of ABO incompatible platelets is associated with a decreased platelet increment.

Rh negative females with child bearing potential should be given platelets from Rh negative donors. Total dose of platelet transfusion depends not only on the platelet count but also on the clinical condition and the presence of risk factors such as fever, sepsis and splenomegaly.

Indications for use

1) Conditions with decreased platelet production such as in bone marrow failure, prophylactic platelet transfusions are generally considered when the platelet count is less than 10,000/µl. With the associated risk factors mentioned above, the lower limit of platelet count should be 20,000/µl. Some consider this as 30,000/µl.

2) Prophylactic platelet transfusions before surgery.
For bone marrow aspirations and biopsy platelet transfusions are not indicated. Firm pressure is enough to arrest bleeding. For minor surgical procedures like lumbar puncture, epidural anaesthesia, liver biopsy and insertion of indwelling lines, platelets should be given, if the platelet count is less than 50,000/µl. In major surgery and surgery at critical sites such as the brain and the eye, the platelet count should be maintained above 100,000/µl.

3) Massive blood transfusion
Platelets should not given routinely for a predetermined number of transfusions. Decision to administer platelets should be based on the clinical assessment and the platelet count. If the platelet count is below 50,000/µl platelet transfusions are generally indicated.

4) Immune thrombocytopenias
Platelets are not very effective in immune thrombocytopenias. Platelets are indicated only for patients with major haemorrhage. In neonatal alloimmune thrombocytopenia platelets transfusions are generally given when the platelet count is less than 30,000/µl. For sick babies and for premature babies this limit is 50,000/µl.

5) Disseminated intravascular coagulation (DIC).
The platelet count in acute DIC is an unreliable indicator and platelets should be infused in any patient with a platelet count below 80,000/µl.

6) Thrombotic thrombocytopenic purpura **(TTP)**
Platelets may aggravate TTP because there is pathological activation of platelets in this condition. Unless there is a life threatening bleed not responding to other measures, platelets should not be given.

7) Platelet function defects
(a) Congenital
eg: Glanzmann thrombasthenia and Bernard Soulier Disease
When there is bleeding during or before surgical procedures platelet transfusions are indicated in these conditions.
(b) Acquired
In cardiopulmonary by-pass, platelets are activated by contact with artificial surfaces of the by-pass machine. Activation of platelets leads to degranulation. Platelet function is also impaired by loss of their glycoprotein receptors by binding them to the artificial surfaces. Prophylactic use of platelets are ineffective. Platelet transfusions are indicated when there is bleeding which is not due to a surgically correctable cause or not due to heparin.

Granulocyte concentrates

Granulocyte concentrates are obtained by single donor buffy coat preparation (1×10^9 granulocytes) and by leukophaeresis (1×10^{10} granulocytes). It is almost impossible to achieve an adequate dose of granulocytes by giving buffy coat preparations. ABO compatible cross matched compatible blood should be given.

Indications for use

1) Febrile patients with an absolute neutrophil count less than 500/µl, with documented sepsis, not responding to antibiotics for 48 hours. Leukocytes have to be given for at least four days .This is important in patients who are on chemotherapy.

2) Neonates have neutrophils with impaired chemotaxis and phagocytosis. There is some beneficial effect in tranfusing granulocytes in neonates with sepsis.

There is a high chance of alloimmunisation and transmission of infections by transfusion of granulocytes. Therefore other options such as growth factors and broad spectrum antibiotics should be considered first.

Fresh frozen plasma (FFP)

Only a few clear cut indications are present for the use of FFP, but it is the most abused blood product. Group compatible FFP should be given. For group AB recipients, only the plasma of AB group donors can be given and for group O recipients plasma from any group is compatible since they do not have A and B antigens.

Indications for use

1) Clotting factor deficiency when factor concentrates are not available.
   eg: Factor IX deficiency.

2) Multiple factor deficiencies
   (a) Severe liver disease
   When there is bleeding or before an invasive procedure such as liver biopsy or surgery.
   (b) Warfarin reversal
   In severe haemorrhage due to overdose of warfarin and when urgent correction of prothrombin time is necessary before an emergency surgery FFP is given.
   (c) Massive transfusions
   Early laboratory assessment is needed when a large amount of blood is transfused and if the prothrombin time and activated partial thromboplastin time are prolonged.
   (d) Disseminated intravascular coagulation.

3) Thrombotic thrombocytopaenic purpura / Haemolytic uraemic syndrome.
   FFP may be given along with plasma exchange in this condition.

4) Special paediatric indications.
   FFP not only contains coagulation factors, but also contains complement, fibronectin and protease inhibitors. Therefore FFP is beneficial in sepsis.

5) Protein C, S and antithrombin deficiency

FFP should not be used to correct hypovolaemia or as a source of nutrition or as treatment of immunodeficiency states. It is also not indicated in factor deficiency which can be corrected with specific factor concentrates.

Cryoprecipitate

Cryoprecipitate contains factor VIII, Von Willebrand factor and fibrinogen.

Indications for use

1) Factor VIII deficiency, when factor concentrates are not available.

2) Von Willebrand disease

3) Hypofibrinogenaemia, *eg: advanced liver disease and D.I.C.*

Cryopoor plasma

Cryopoor plasma contains all the clotting factors except factor V and VIII. It also contains albumin and globulin.

Indications for use

1) Use in place of albumin in hypoproteinaemia.
2) Cryopoor plasma is more effective than FFP in some cases of TTP.
3) In plasma exchange as a replacement fluid.
   eg: Guillain Barre syndrome, Myasthenia gravis.

Stored plasma

Stored plasma is plasma separated after 6 hours of collection of blood. FFP which is stored for more than one year also can be used as stored plasma. The shelf life of stored plasma is five years. Indications for stored plasma are the same as cryopoor plasma.

Factor VIII concentrates

Factor VIII concentrates are prepared from large pools of donor blood (available as vials of freeze dried plasma.) Factor VIII is also prepared by recombinant DNA technology.

Indications for use

1) Treatment of haemophilia A
2) Treatment of Von Willebrand disease (severe type III)

Human Albumin

Human albumin carries no risk of infection, but it is very expensive.

Indications for use

1) Hypoproteinaemic oedema
   eg: Nephrotic syndrome
2) Intractable ascites in hepatic cirrhosis.
3) Severe burns
4) Therapeutic plasma exchange as a replacement fluid

Since albumin in expensive, stored plasma can be used instead although there is a risk of transmission of infections.

Immunoglobulins

Immunoglobulins are prepared from pooled plasma. Normal human immunoglobulins are available as intravenous and intramuscular preperations and specific immunoglobulins.

1) Normal human immunoglobulins contain a broad spectrum of antibodies naturally present in the donor populations.

Indications for use

(i) Congenital immunodeficiencies
(ii) Acquired immunodeficiencies
Small doses are repeatedly given as a prophylactic measure.
(iii) Immune cytopenias
eg: ITP, autoimmune haemolytic anaemia
Massive doses of intravenous immunoglobulines inhibit antibody synthesis and block reticuloendothelial function.

2) Intra muscular (IM) preparations are specific immunoglobulins prepared from hyperimmune donors populations.

Indications for use

a) Anti D immunoglobulin
   (i) IM preparation is used for prevention of haemolytic disease of the newborn.
   (ii) Intravenous (IV) preparations (*eg:WinRho*)
   IV preparations are used in the treatment of ITP and following transfusion of large of volume of Rh D positive blood to a Rh D negative recipient.

b) Hepatitis B IgG
c) Varicella zoster IgG
d) Rabies Ig
e) Tetanus Ig

Transfusion of blood components can be life saving if used correctly. Prescribing decisions should be based on guidelines on the clinical use of blood, taking individual patient's needs into consideration.

Further reading

1. Michael T.Murphy, Derwood.H.Pamphilon. Practical Transfusion Medicine.1st edn. Blackwell Science. United Kingdom. 2001.
2. Thomas G.De Loughery.. Haemostasis and Thrombosis. Vademecum Landes Bioscience. USA.1999.
3. Richard Lee, John Foerster ,John Lukens, John Greer, George Rodgers. Wintrobes Clinical Haematology 10th edn. Williams & Wilkins. USA. 1998; 822-847.
4. The Clinical use of blood in Medicine , Obstetrics, Paediatrics,Surgery and Anaesthesia, Trauma and Burns, Publication of World Health Organisation 2001.