Blood transfusion

- Blood transfusion frequently are lifesaving in many situation in pediatrics. However, transfusions are usually associated with risks and they should be given only when true benifits are likely.

Whole Blood transfusion:

- The main indications are:
- Massive hemorrhage.
- Exchange transfusion in newborn. The initial dose is 10-15 ml/Kg.

Packed red blood cells:

- The main indications are:
- Chronic anemias
- Renal & liver diseases
- *The usual dose is 15 ml/Kg infused slowly*

Leukocytes depleted blood:

- By use of leukocytes filters
- The main indications are :-
- Chronic hemolytic anemia
- Bone marrow transplantation
- immune deficiency states
- Chronic renal failure.
- ***Neocytes transfus*ion:-**
- Used for multitransfused patients as Chronic hemolytic anemia

Platelets transfusion:

- *The indication of platlet transfusion*
- Thrombocytopenia due to inadequate B. M production like (pancytopenia, leukemia)
- Platelet dysfunction disorders
- Platelets prepared as form of: -
- Fresh platelet rich plasma.
- Pooled platelets (from multiple donors)
- Platelets concentrate by platelet-phersis.
- One unit of platelets concentrate contain platelets extracted from 500 ml whole blood.

Granulocyte transfusion:

- Indications:-
- Neutrophils < 500/m3 with bacterial infection unresponsive to appropriate antimicrobial therapy.
- Qualtitative neutrophil defect
- Granulocytes prepared from normal donors by leuka pheresis
- Alternative therapies include intravenous immunoglobulins and recombinant myeloid growth factors.

Fresh Frozen plasma transfusion:

- Indications:-
- Sever coagulation factors deficiency.
- Acute dehydration and burns to restore blood volume and renal flow.

Complication of blood transfusion

The complications can be broadly classified into two categories:

- Immune Complications
- Non-immune Complications

Immune complications

- **Immune complications can further be classified into two categories:**
- Hemolytic (acute and delayed)
- Non-Hemolytic (includes febrile, urticarial, anaphylactic, purpura, etc.)
- These are primarily due to the sensitization of the recipient to donor blood cells (either red or white), platelets or plasma proteins

Acute hemolytic reactions
are usually due to ABO blood type incompatibilityThis type of reaction has been reported to occur approximately 1 in 25,000 transfusions –

it is often very severe and accounts for over 50% of reported deaths related to transfusion. The severity of the reaction often depends in the amount of blood given.

Symptoms of acute hemolytic reactions

include chills, fever, nausea, chest pain and flank pain in awake patients. In anesthetized patients, you should look hemoglobinuria, oozing in the surgical field, DIC, shock and renal shutdown for rise in temperature, unexplained tachycardia, hypotension,.

Management of acute hemolytic

reactions mandates that the transfusion be stopped immediately. The unit should be re-checked., repeat compatibility testing and coagulation tests. A foley catheter should be placed to check for hemoglobin in the urine. Osmotic diuresis with mannitol and fluids should be utilized (low-dose dopamine may help renal function and support blood pressure). With rapid blood loss, platelets and fresh frozen plasma may be indicated.

Delayed hemolytic reactions are generally mild in comparison. These are caused by antibodies to non-D antigens of the Rh system or to foreign alleles in other systems such as the Kell, Duffy or Kidd antigens. Following a normal, compatible transfusion there is a 1-1.6% chance of developing antibodies to these foreign antibodies. This takes weeks or months to happen - and by that time, the original transfused cells have already been cleared.

Symptoms are generally mild and include malaise, jaundice, fever, a fall in hematocrit despite transfusion, and an increase in unconjugated bilirubin. Diagnosis may be facilitated by the direct Coombs test which can detect the presence of antibodies on the membranes of red cells.

Treatment is generally supportive.

Febrile reactions

are typically due to white cell or platelet sensitization. This reaction is relatively common occurring in 1-3% of all transfusions. The presenting symptom is a rise in body temperature without evidence of hemolysis. Patients with a history of this reaction that require additional transfusions should receive leukocyte poor transfusions. Use of a filter traps most contaminants.

Urticarial reactions are characterized by erythema, hives and itching without fever. Again, this is a relatively common reaction and occurs in about 1% of all transfusions. It is thought to be due to sensitization against plasma proteins. The use of packed red blood cells rather than whole blood has decreased the likelihood of this problem. Treatment is with antihistamines for symptomatic relief.

Anaphylactic reactions

. These are severe reactions that can occur with very small amounts of blood (a few milliliters). These antibodies react to transfusions containing IgA. Treatment is with epinephrine, fluids, corticosteroids and supportive measures.

Some patients can develop **pulmonary edema** and present with a picture that looks like adult respiratory distress .

Graft versus Host disease is seen exclusively in immunocompromised patients where cellular blood products containing lymphocytes are given. These lymphocytes can mount an immune response against the compromised recipient. Irradiation of transfusions can be utilized to inactivate the lymphocytes prior to transfusion.

Post-transfusion purpura is common with the development of platelet antibodies. The external purpura signal a reaction that may lead to profound thrombocytopenia which usually occurs about one week post transfusion. Plasmapheresis is the recommended treatment.

Immune suppression

is a debatable complication. The transfusion of leukocyte-containing blood products appears to be immunosuppressive causing a decrease in Natural Killer cell function, decreased phagocytosis and decreased helper to suppressor cell ratios.

- **Non-Hemolytic reactions**are due to sensitization of the recipient to donor white cells, platelets or plasma proteins. These reactions include:
- Febrile
- Urticarial
- Anaphylactic
- Pulmonary Edema (non-cardiogenic)
- Graft vs. Host
- Purpura

Risks of blood transfusion:

- **1- Transfusion reaction:-**
  - *i Hemolytic reaction:*
- *ii. Febrile reaction: -*
- iii. *Allergic reaction :*

- **2- Transmission of diseases:-**
- Virus transmition like HBV, HCV, CMV, HIV, EBV,. Bacterial infection, parasitic infection
- **3- Iron over load and hemosiderosis** :in multitransfused patient.
- **4- Circulatory over load**:- due to rapid administration of large volumes of blood.
- **5- Depletion of Labile factors:-**
- Storage of blood is associated with loss of platelets and coagulation factors.
- **6- Graft versus Host disease (GVHD).**
- **7- Air embolism.**

BLOOD TRANSFUSION REACTION

Non immunological

Non immunological transfusion reaction

1. Bacterial contamination reactions.
2. Circulatory overload.
3. Transfusion haemosiderosis.
4. Complications of massive transfusion.
5. Non immune hemolytic reaction
6. Disease transmission.

1. Bacterial contamination reaction.

- Although uncommon,but this type of specific reaction can have a rapid onset and high mortality in recipients.
- The presence of bacteria in transfused blood may lead either to febrile reactions in the recipient (due to pyrogens) or serious manifestations of septic or endotoxic shock.
- Commonly caused by endotoxin produced by bacteria capable of growing in cold temperatures such as *Pseudomonas species, E. coli, Yersinia enterocolitica*.

Source of infection.

- Infection of stored blood is extremely rare.
- **Skin contaminants** are not infrequently present in freshly donated blood but these organisms (predominantly staphylococci) do not survive storage at 4 º C although they will grow profusely in platelet concentrates stored at 22 º C.
- Healthy donor who are **bacteremic at the time of donation**. The majority are due to *Yersinia enterocolitica*, which grows well in red cell components due to its dependence on citrate and Iron.
- Gram negative, endotoxin – producing contaminants found in dirt, soil and faeces may rarely grow in the storage condition of blood.

- According to CDC , most are caused by blood components contaminated by *Yersinia enterocolitica.*
- Since 1987, from 20 cases reported to CDC, 12 are caused by this organism.

Clinical manifestation

- Usually appear rapidly during transfusion or within about 30 minutes after transfusion with dryness, flushing of skin.
- Fever, Hypotension, Chills, Muscle pain, vomiting, Abdominal cramps, Bloody diarrhoea, Hemoglobinuria, Shock, Renal failure, DIC.

Management.

- Rapid recognition is essential
- Immediately stop the transfusion.
- Therapy of shock, steroids, vassopressors, fluid support, respiratory ventilation and maintenance of renal function.
- Broad spectrum IV antibiotics
- The blood component unit and any associated fluids and transfusion equipment should be sent immediately to blood bank for investigation ie: gram stain and culture.
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Prevention

- Strict adherence to policies & procedures regarding blood component collection, storage, handling,and preparation is essential to reduce the risk.
- Visual Inspection of components before release from the transfusion service include any discolouration, visible clots, or hemolysis.
- Ensure the blood components are infused within standard time limits (4 hours).

Prevention

- Blood packs should never be opened for sampling, if any open method of preparation has been used, the unit should be transfused within 24 hours.
- Blood should always be kept in accurately controlled refrigerators (with alarms), maintained strictly at 2 – 6 º C, the blood should never be removed and taken to the ward or OT until it is recquired.

2. Circulatory overload

- All patient will experience a temporary rise in blood volume and venous pressure following the transfusion of blood or plasma except for those who are actively bleeding. However, young people with normal cardiovascular function will tolerate this changes provided it is not excessive.

Clinical manifestation

- Frequently due to transfusion of a unit at too fast rate.
- Signs of cardiac failure – raised JVP, basal crepitations in both lungs, dry cough, breathlessness.

Management

- Stop the transfusion immediately.
- Oxygen therapy
- Intravenous diuretics should be used appropriately.
- If more rapid volume reduction is needed, therapeutic phlebotomy can be used.

Prevention

- Packed cell should be used instead of whole blood.
- Packed cells should be given slowly over 4.
- Diuretics should be given at the start of the transfusion and only one or two units of concentrated red cells should be transfused in any 24 hour period.
- Blood transfusion should be given during the daytime, Overnight transfusion should be avoided wherever possible.

3. Transfusion haemosiderosis

- A complication of repeated long term blood transfusion.
- Most commonly seen in thalassaemic patient.
- Each unit of blood has about 200 mg of iron, while the daily excretion rate is about 1 mg. The body has no way of excreting the excess unless the patient is bleeding.

The use of Iron chelating agent, Desferrioxamine does not completely overcome the Iron load, but has delayed the onset of problems due to haemosiderosis.

4. Complication of massive transfusion

- Massive transfusion is defined as the replacement of total blood volume within a 24 hour period.
- This will inevitably lead to :

1. Dilution of platelets.

   Blood effectively has no functional platelets after 48 hours storage

2. Dilution of coagulation factors.

Stored Whole blood < 14 days has adequate levels of most coagulation factors for haemostasis.
If stored blood of more than 14 days, or plasma reduced blood or red cells in optimal additive solution is used, replacement of coagulation factors with FFP is necessary.

3. Hypothermia (defined as core body temperature less than 35 c) is associated with large volumes of cold fluid transfusion. This may results in cardiac irregularities in particular VF. Therefore the use of blood warmer is important.

4. Excess citrate can act on the patient's plasma free ionized calsium and results in hypocalcaemia (transient).

Citrate toxicity occur with extremely rapid transfusion , in premature infant having ET with blood stored in citrate for longer than 5 days.

5. Hyperkalemia

Can be caused by **intracellular loss** of potassium from

RBC during storage

The most important consideration in massive blood transfusion is to replace blood loss quickly and adequately. Too little blood , too late has more serious consequences than massive blood transfusion itself.

5.Non immune hemolytic reaction

- Mechanical – heat damage from blood warmer, cold, small gauge needle.
- Environment – hypotonic or hypertonic solution.

6. Disease transmission.

- Hepatitis
- Syphilis
- Malaria
- Cytomegalovirus
- Human immunodeficiency virus
- Human T cell leukaemia viruses.

Donor selection criteria and subsequent screening of all donations are designed to prevent disease transmission, but these do not completely eliminate the hazards.

Hepatitis

- **Hepatitis A** is rarely transmitted by transfusion. Any donor who has been in close contact with Hepatitis A patient or develops hepatitis A is deffered for 12 months.

- **Hepatitis B** is a frequent sequel to blood transfusion. Currently all blood donations are tested for HBsAg by very sensitive third generation techniques (eg; ELISA), able to detect at least 0.5 iu of HBsAg per ml of serum.

  In HUSM, EIA method is used with 99.9 % sensitivity.

  HBsAg positive subjects are permanently excluded from donations.