BLOOD TRANSFUSION

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INTRODUCTION

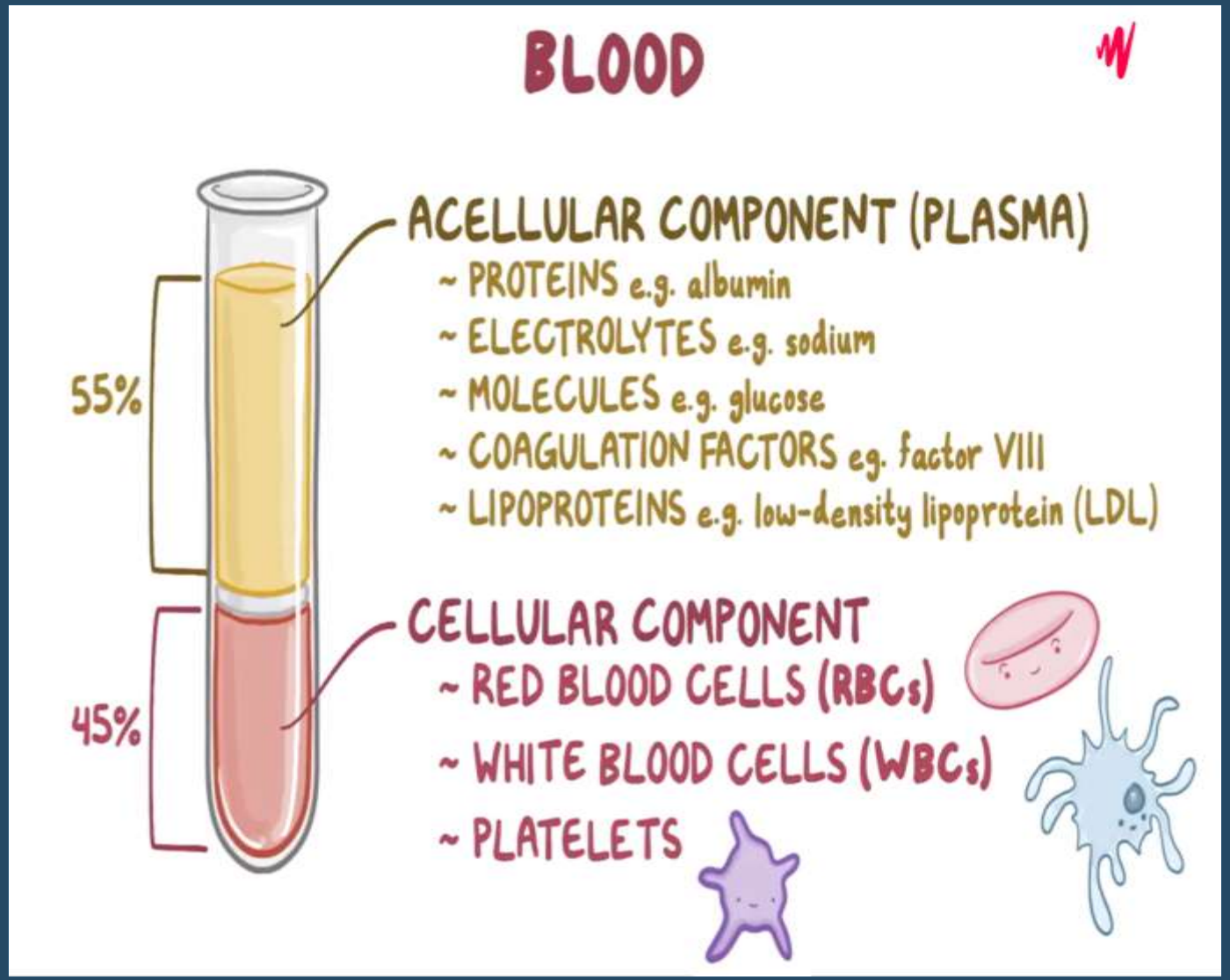
Blood: fluid that transports oxygen and nutrients to the cells and carries away carbon dioxide and other waste products.

Synthesis → bone marrow

Storge and destruction → liver and spleen

A Simple Method To Estimate Circulating Blood Volume

AGE	ESTIMATED BLOOD VOLUME (ml/kg)
Preterm Neonate	100
Full-Term Infant	**90**
Infant	80
Child	75
Teenagers & Adults	70



A NORMAL HEALTHY NON-SMOKER ADULT MALE HAS ABOUT 4–6 LITRES OF BLOOD , CONSISTS OF :

BLOOD TRANSFUSION

- The process of transferring blood or blood products from one person to the circulatory system of an-other.
- Types of transfusion :

❑ Homologous transfusions :from an anonymous donor

❑ Autologous transfusion:for patients undergoing elective surgery to predonate their own blood up to 3 weeks before surgery for retransfusion during the operation

WHAT ARE THE DIFFERENT BLOOD GROUPS?

The differences in human blood are due to the presence or absence of certain protein molecules called antigens and antibodies.

Antigens are located on the surface of the RBCs and antibodies are in the blood plasma.

The blood group you belong to depends on what you have inherited from your parents.

Human red cell membranes are estimated to contain at least 300 different antigenic determinants, and at least 20 separate blood group antigen systems are known. Fortunately, only the ABO and the Rh systems are important in the majority of blood transfusions.

The purpose of compatibility testing is to predict and to prevent antigen–antibody reactions as a result of red cell transfusions.

CLASSICAL ABO BLOOD GROUPING SYSTEM

- The most important in assuring a safe blood transfusion.
- Is based on presence or absence of A and B Antigens **(agglutinogens)** on red cell membrane.
- There are 4 blood groups according to this system: A,B,AB,O group.

- These antigens are characterized by:

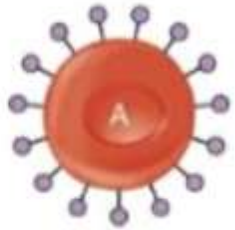
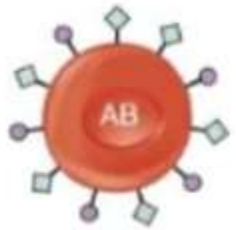
1. They are inherited according **Mendelian law**.
2. They appear in **fetal life** and persist throughout life.
3. They may detected by **speciefic reaction** with the corresponding antibodies.

DIFFERENT BLOOD GROUP

- If an **antigen/agglutinogen** is present on the red cell membrane ,the corresponding **antibody/agglutinin** will be absent in the plasma.
- If an **antigen /agglutinogen** is absent on the red cell membrane ,the corresponding **antibody/agglutinin** will be present in the plasma.

- individuals with **group A** can receive from A ,O and give blood to AB ,A.
- Individuals with **group B** can receive from B,O and give blood to AB,B.
- Individuals with **group AB** are called universal recipients bc they can receive blood from (All) but not give except AB as they have no circulating antibodies.
- Individuals with **group O** are called universal donors bc they receive only from(O)but give (All) as they have no agglutinogens on their RBC

ABO BLOOD GROUP ANTIGENS PRESENT ON RED BLOOD CELL

	Blood Type			
	A	B	AB	O
Red Blood Cell Type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red blood Cell	 A antigen	 B antigen	 A and B antigens	None
Blood Types Compatible in an Emergency	A, O	B, O	A, B, AB, O (AB+ is the universal recipient)	O (O is the universal donor)

RH BLOOD GROUPING STSTEM

- ☆ Rhesus Factor (RH):
- Is a type of protein found on the surface of RBC.
- ☆ The protein is genetically inherited (passed down from your parents).

❑ If protein (D antigen) is present on the surface of RBC, the blood will be termed as D-positive.(Majority of people ,about 85%)

❑ If protein (D antigen) is absent on the surface of RBC the blood is termed as D-Negative.

- Rh factor is very important ,specially in pregnency.
- RH Antibodies:

No natural antibodies like ABO group system.

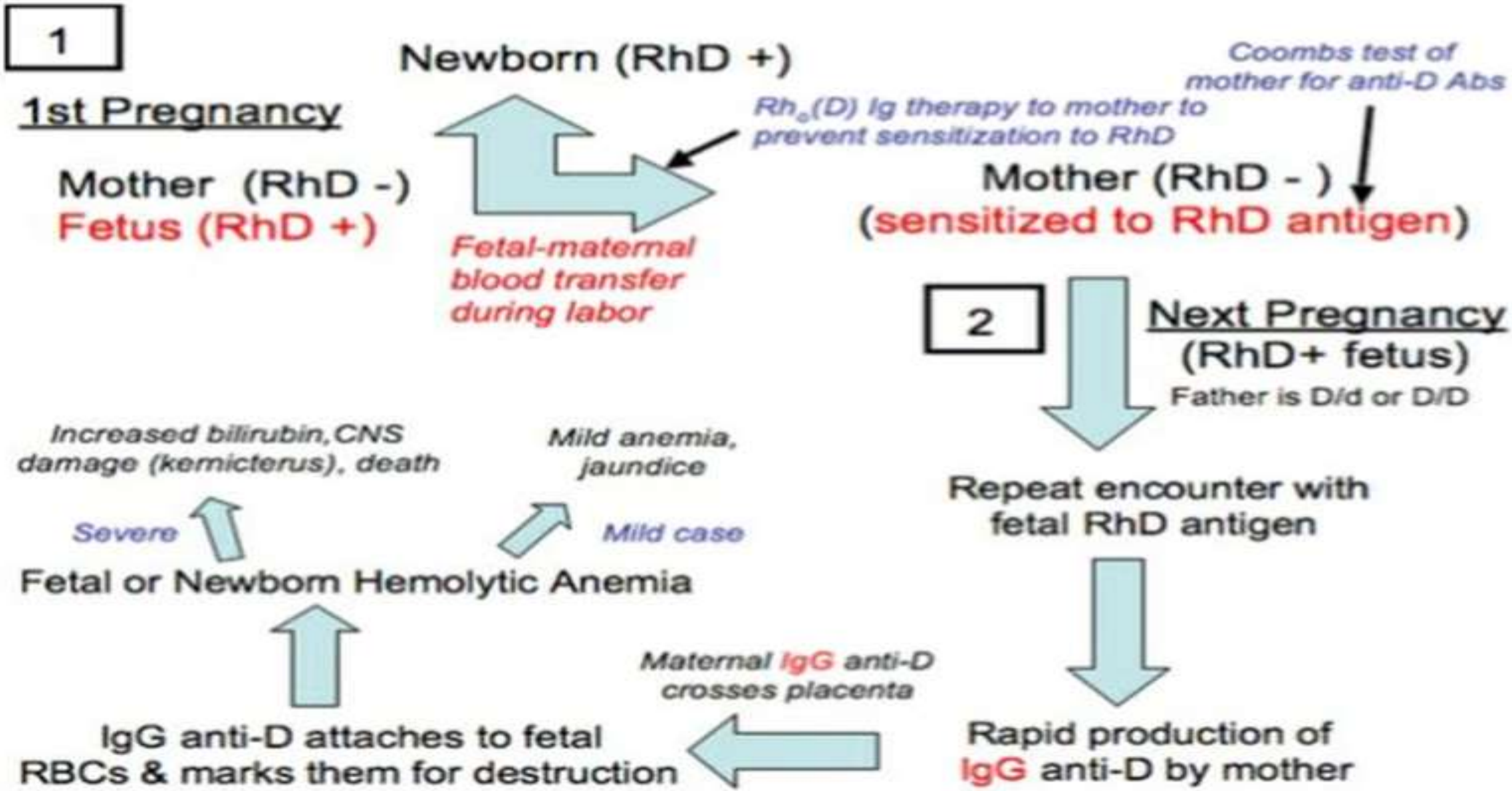
Rh antibodies are produced when Rh negative individual is transfused with Rh positive blood.

These are IgG type and crosses placenta.

ERYTHROBLASTOSIS FETALIS

- Is a disease of the fetus and newborn child characterized by agglutination and phagocytosis of the fetus ‘s red blood cells.
- In most instances of the erythroblastosis fetalis ,the mother is Rh-ve and the father Rh+ve.
- The baby has inherited the Rh+ve antigen from the father, the mother develops anti-RH agglutinins from exposure to the fetus’s Rh –antigen.

- In turn , the mother’s agglutinins diffuse through the placenta into the fetus and cause RBC agglutination and hemolysis.
- So in the subsequent pregnencies, the fetus is born anaemic, jaundiced (excessive formation of bilirubin which may cross the BBB of the fetus cause brain damage(kernicterus)or born dead .


1
Newborn (RhD +)
1st Pregnancy
Mother (RhD -)
Fetus (RhD +)
Fetal-maternal blood transfer during labor
Rh$_o$(D) Ig therapy to mother to prevent sensitization to RhD
Coombs test of mother for anti-D Abs
Mother (RhD -)
(sensitized to RhD antigen)
2
Next Pregnancy
(RhD+ fetus)
Father is D/d or D/D
Repeat encounter with fetal RhD antigen
Rapid production of IgG anti-D by mother
Maternal IgG anti-D crosses placenta
IgG anti-D attaches to fetal RBCs & marks them for destruction
Fetal or Newborn Hemolytic Anemia
Severe
Increased bilirubin, CNS damage (kernicterus), death
Mild case
Mild anemia, jaundice

PREVENTION AND TREATMENT

- Prevention of hemolytic disease of newborn:
- Injecting single dose of RH-antibodies (anti –D) to mother soon after child birth. So active antibodies will not be formed by mother.

Treatment of hemolytic disease of newborn:

Replacement of baby's Rh+ve blood by Rh-ve blood this is called **exchange transfusion.**

TYPES OF BLOOD TRANSFUSION:

Whole blood	Packed RBC	FFP
Cryoprecipitate	platelets	Prothrombin Complex Concentrate

PACKED RED BLOOD CELLS TRANSFUSION (PRBC)

- Centrifugation of blood removes virtually all of the associated plasma, and a solution saline, adenine, glucose, and mannitol (SAGM) is added to provide optimal red cell preservation
- Each unit is approximately 330 mL and has a haematocrit of 50–70 per cent. RBCs are stored in a Blood Bank refrigerator at a temp of **1-6ºC** until issue. The shelf life is 42 days from the date of collection
- This type of transfusion increases a patient's haemoglobin by 1 g/dl and haematocrit by 3% and iron levels.
- <u>Indications:</u>
- 1- A patient suffering from an iron deficiency anemia or symptomatic anemia(causing shortness of breath ,dizziness , congestive heart frailer and decrease exercise tolerance),or when the hemoglobin level is 7 g/dl or less
- 2- sickle cell crisis
- 3- acute blood loss more than 30% of blood volume

WHOLE BLOOD TRANSFUSION

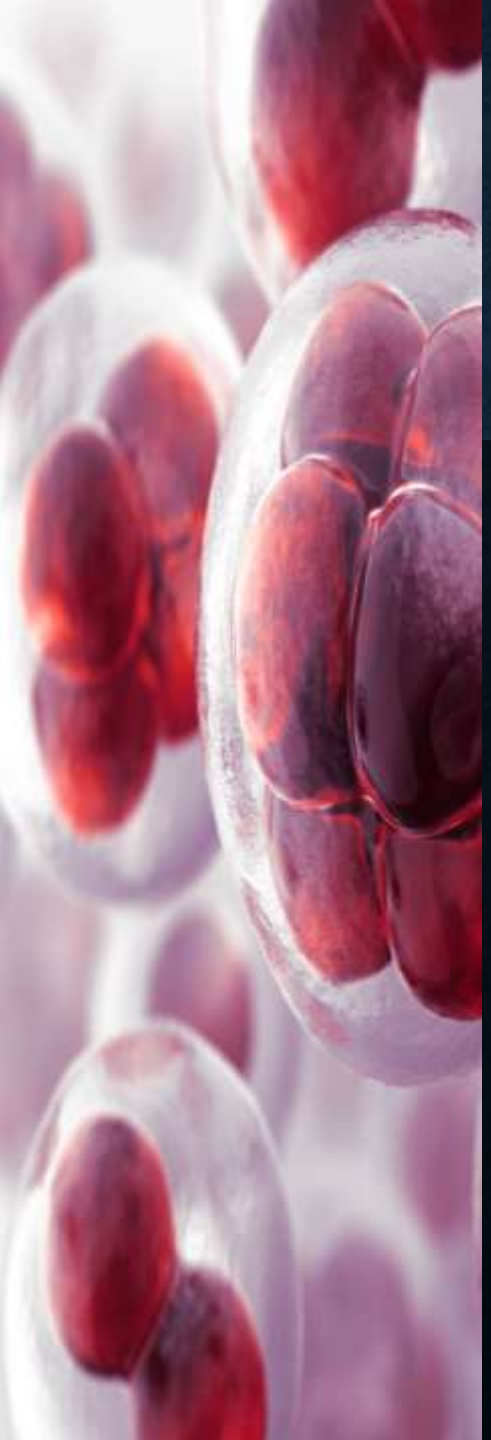
- Rarely available. whole blood transfusion has significant advantages over packed cells as it is coagulation factor rich and, if fresh, more metabolically active than stored blood
- One unit of whole blood contain :

❑450 ml of donor blood

❑50 ml of anticoagulant-preservative solution

❑Hb about 12g/dl and haematocrit 35-45%

❑No functional platelets



- **Indications :**
- 1- Erythroblastosis fetalis by exchange transfusion OF WHOLE BLOOD
- 2- A person may receive a whole blood transfusion if they have experienced a sever traumatic haemorrhage with severe bleeding

- **Precautions :**
- (1) Blood is obtained from healthy donors:
- - Age =18-60 y. -Weight: more than 55 kg.
- - Blood pressure within normal range.
- - Hb% is not less than 90% (13g/dl).
- - Haematocrit value at least 40%.
- -Free from infectious diseases as AIDS, viral hepatitis.
- (2) Blood used is stored at 4°C not more than 21 days.
- (3) Blood groups are compatible by double cross matching test
- (4)The blood is warmed before transfusion to restore the Na-K pump

FRESH FROZEN PLASMA (FFP)

- is rich in coagulation factors and is removed from fresh blood and stored at −40 to −50°C with a two-year shelf life. It is the first-line therapy in the treatment of coagulopathic haemorrhage
- made from the liquid portion of whole blood.it is used to treat conditions in which there are low blood clotting factor(INR>1.5) or low level of other blood proteins.
- <u>Indications:</u>

❑ Non-life-threatening warfarin-induced bleeding

❑ Vitamin K deficiency

❑ DIC

❑ in patient with liver disease ,major hepatic resection and sever liver injuries

❑ TTP

PLATELET TRANSFUSION

- Platelets are supplied as a pooled platelet concentrate and contain about 250 × 109/L. Platelets are stored on a special agitator at 20–24°C and have a shelf life of only 5 days. Platelet transfusions are given to patients with thrombocytopenia or with platelet dysfunction who are bleeding or undergoing surgery (e.g. lumbar puncture) , carried out at less than 50 x 109/L
- <u>indications:</u>

❑ chemotherapy ,radiotherapy for leukemia and multiple myeloma

❑ aplastic anemia

❑ hypersplenism

❑ AIDS

❑ ITP

CRYOPRECIPITATE

- A concentrate of cold and insoluble high-molecular weight plasma proteins.
- is a supernatant precipitate of FFP and is rich in factor VIII and fibrinogen. It is stored at −30°C with a year shelf life. It is given in low fibrinogen states or factor VIII deficiency.
- Contain fibrinogen , von willebrand factor , factor VIII , XIII
- <u>Indication :</u>

❑ DIC : to replace fibrinogen

❑ Factor VIII deficiency

❑ Hemophilia A

❑ Von Willebrand disease

PROTHROMBIN COMPLEX CONCENTRATES

- are highly purified concentrates prepared from pooled plasma. They contain factors II, IX and X. Factor VII may be included or produced separately. It is indicated for the emergency reversal of anticoagulant (warfarin) therapy in uncontrolled haemorrhage

COMPLICATIONS

INCOMPATIBILITY:

RBCs (received from the donor) are agglutinated in clumps and block small blood vessels → ischemic pain in chest and back. If the amount of the blood is less than 350 ml, death does not occur.

(The most severe transfusion reactions are due to ABO incompatibility)

ALLERGIC (ANAPHYLACTIC):

- Type 1 hypersensitivity reaction
- occur when a soluble substance in the plasma of the donated blood product reacts with pre-existing IgE antibodies in the recipient
- Symptoms; pruritis , urticaria , respiratory depression
- Occurs in 2-3 hours after transfusion
- Treatment :stop transfusion, intramuscular epinephrine(vasoconstrictor effects), antihistamine, vasopressor(dopamine)

FEBRILE NON-HEMOLYTIC REACTION:

- The most common of all transfusion reactions .
- Type 2 hypersensitivity reaction due to sensitization of the recipient to the donor's white cells, platelets, or plasma proteins
- Symptoms; fever, chills, headache, flushing
- Occurs in 1-6 hour
- Treatment : stop the transfusion , acetaminophen for the fever

HEMOLYTIC REACTION:

- Type 2 hypersensitivity reaction
- Symptoms: flank pain , jaundice , hemoglobinuria
- Occurs in 1 hour
- Treatment : stop the transfusion , IV fluids to boost the urine output

TRANSFUSION-RELATED ACUTE LUNG INJURY (TRALI):

- Number one cause of death among transfusion reactios
- Donor antileukocytes antibodies vs recipient endothelial cells
- The antibodies activate the leukocytes, which bind to the endothelium in the lungs, causing endothelial injury and edema
- Symptoms : respiratory collapse, acute hypoxia , noncardiac pulmonary edema
- Occurs within 6 hours of transfusion of any blood component
- Treatment; stop the transfusion, mechanical ventilation

TRANSFUSION-ASSOCIATED CIRCULATORY OVERLOAD (TACO) :

- associated with transfusion of a large volume of blood or a high rate of infusion
- Symptoms; including dyspnea, orthopnea, tachycardia, hypertension.
- Occurs in 1-6 hours
- treatment : Patients deemed to be at risk for volume overload (such as those with impaired cardiac function) can be transfused at a slower rate and diuretic therapy

INFECTIONS :

- All donated blood is extensively screened for transfusion-transmitted infections; as a result, the risk of acquiring infection is extremely low
- Each unit of blood administered in the United States is screened for a number of infections, including HIV, hepatitis B and C viruses, human T-cell leukemia virus, West Nile virus, Zika virus, Trypanosoma cruzi, and Treponema pallidum.
- The risk of bacterial contamination of blood products is much greater than the risk of viral transmission.
- Signs , symptoms: Temperature elevation, hypotension, or other signs of sepsis


THANK YOU