BLOOD PRODUCTS: COLLECTION, PROCESSING AND STORAGE

WHOLE HUMAN BLOOD

- Blood is a body fluid in humans and animals that carries Essential constituents like nutritions and oxygen to the cells and allows the metabolic waste aways from cells.
- Any person with good health can be a donor.
- Donor shouldn't suffer from any transmitted disease.
- Haemoglobin content shouldn't less than 12.5g/dl of blood for female and 13.5g/dl of blood for male. Blood is around 7% of whole body weight with total volume of 5-7 L of which comprises of plasma and different kinds of cells.
- Whole blood is combination of cellular components, colloids and crystalloids.

Collection-

- Blood is collected aseptically from *median cubital vein*, in front of the elbow into a sterile container containing anti coagulant.
- During collection the container is gently shaken, to ensure that blood and anti coagulate are mixed well which prevents the formation of Fibrin clots.
- At a time not more than 420mL blood is taken.
- The collected blood is sealed and freezes at 4-6 °C
- Blod clotting factors are:

PROTHROMBIN (INACTIVE ENZYME) $\xrightarrow{\text{THROMBOPLASTIN AND CALCIUM IONS}}$ THROMBIN (ACTIVE ENZYME)

FIBRINOGIN $\xrightarrow{\text{THROMBIN}}$ FIBRIN (BLOOD CLOT)

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- Heparin- naturally occurring anti-coagulant, expensive and looses its anticoagulant activity in in-vitro condition.
- EDTA Di sodium salt- chelating agent and prevents blood coagulation but less stable.
- Citrates-Acid citrate dextrose(ACD) solution is the most commonly used Anti coagulant.

Processing or testing after collection:

- Rh system- it consist of 50 different types of blood group antigens also determine that whether donor's blood is having Rhesus factor or not i.e. Rh+/Rh-
- Rh factor- group of antigen in RBCs. This antigen will cause agglutination when it reacts with antibodies from Individuals without this antigen.
- Determination of ABO grouping and determination of transmitted disease .

Groups	Can donate to	Can receive from	Comments
A	A and AB	A and O	
B	B and AB	B and O	
AB	AB	A, B, AB and O	Universal acceptor
O	A, B, AB and O	O	Universal donor

Table 1.4 Blood grouping

Storage:

- Sterile container/ disposable bag containing anticoagulants.
- At temperature 4-6 °C until required for use. Can be stored for 42days.
- If stored ant room temperature (for 1 day), it may reduce post transfusion survival of Erythrocytes.

Use:

- To be given to treat every haemorrhage, uncontrolled Diarrhoea and vomiting.
- Major surgery etc.

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DRIED HUMAN PLASMA

- In some circumstances , dried human plasma is used as substitute for whole blood.
- The major advantage is , if it is stored properly can be used upto 5 years, if protected from light can be kept at 20 °C from refrigerator, can be given to patients of any blood group.

Collection:

- The whole human citrated blood is used as source and supernatant fluid Is separated by centrifugation.
- Batches of not more than 10 bottles are collected , mixed in correct ratio to neutralise Agglutinins (plasma antibody).
- The mixture is stored at 4-6 °C (sterility testing is also done periodically).

Processing:

- Preliminary freezing- 400 mL mixture is taken in the bottles and sealed with bacteriologically efficient pads and centrifuged at -18 °C. The liquid snap-freezes and become distressed inside the bottle.
- Primary drying- the bottles of frozen material are mounted horizontally in the drying chamber under high vacuum for 2 days after which the moisture content of residual is about 2%.
- Secondary drying- then the bottle are transferred to another chamber by vacuum desiccation over phosphorus peroxide.
- For one day product is left with only 0.5% moisture content.

Storage:

- Dried plasma kept below 20 °C, protected away from light, moisture and oxygen.

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DRIED HUMAN PLASMA

- **Direction of use:** Dried plasma should be reconstituted in
- Water for injection
- Sodium chloride injection
- Solution containing 2.5% dextrose and 0.45% sodium chloride.

Must be used immediately after reconstitution.

- Dried plasma must be soluble in these solvents and form solution within 10min.
- If gel formation took place / incomplete solution is obtained . It indicates dried plasma is deteriorated.

Uses :

- Mostly preferred in the treatment of severe burns where excessive loss of fluid and protein occurs.
- May be given as substitutes of whole human blood (condition- in emergency whole Human blood is not available/ blood group matching tests are not known)

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PLASMA SUBTITUTES

- These are of non human origin , which could be use to restore the blood volume temporary.
- **Properties of such substitutes are**:

- Should have same osmotic pressure as whole blood.
- Should have same viscosity as plasma.
- Should have low rate of excretion but must completely eliminate form the body.
- Free from antigen, pyrogen and must be sterile.
- Stable in liquid form at normal and sterilising temperature.
- Economic and easy to prepare.

- **Examples of Plasma substitutes:**

1. Gum saline- (injection of sodium chloride and Acacia) British Pharmacopeia in 1932 prepared Gum saline by mixing 6% Acacia in 0.9% NaCl solution.
2. PVP- (Polyvinylpyrrolidone) in 1950's century it was used a plasma substitute but has major problem was its Carcinogenic nature.
3. Dextran- It is the most satisfactory plasma substitute.it was discovered by LOUIS PASTEUR as microbial product in wine.

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PLASMA SUBTITUTES

DEXTRAN

- **Inoculum** – *Leuconostoc mesenteroides*. This organism secrets an enzyme Dextran sucrase which converts sucrose into dextran.
- **Medium composition** – Sucrose, peptones, yeast extract, Dipotassium hydrogen phosphate, manganese chloride and calcium chloride.
- **Prepration-**

Fresh culture of *L.mesenteroides* is added to fermentation medium.

↓

Fixed the fermentation at 80 °C and incubate for 20 hours at pH 6-8

↓

fermentation broth is added with equal volume of chilled ethanol for precipitation of dextran

↓

Centrifuged at 10,000rpm for 15min

↓

Discarded Supernatant

Precipitates are dried under in vacuum u in presence of Calcium chloride

↓

The dextran produced may have high molecular weight which cannot be used as plasma substitutes as it may yield very viscous solution which may not be administered parenterally.

It may cause renal damage and allergic reaction. So molecular weight of Dextran can be reduced by following three methods I.e.Acid hydrolysis, Thermal Degradation and Ultra sonication.

Flowchart 1.6 Production of Dextran

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PLASMA SUBTITUTES

Three methods of molecular weight reduction of dextran

Dextran hydrolysis

- pH of Dextran solution is adjusted to 2 at 90 °C. This reduces viscosity of the preparation due to decrease in molecular weight.

Thermal Degradation

- Solution of dextran is heated under pressure at 160 °C in presence of Sodium Sulphate and calcium carbonate.

Ultra Sonication

- Dextran Solution is ultra-sonicated to split the large molecules into smaller one
- Acceptable range of molecules weight of dextran is 10,0000(1 lakh) to 2,50,000 (2lakh 50thousand) daltons.

- **Quality control tests performed-** Pyrogen testing , Sterility testing and Serological testing for determination of antigen. Example: injections like Dextran 110 and Dextran 40.
- **Uses-** in treatment of severe burns and in treatment of acute Peritonitis.