

Blood Components Management

13TH – 17TH APRIL 2024



Presentation on:

- Introduction
- Production of Labile Blood Products
- Storage
- Transportation
- QC
- Return of unused Blood components

Introduction

- **Centrifugation:** Spinning blood samples at high speeds to separate its components based on density. For example,
 - red blood cells settle at the bottom,
 - plasma rises to the top, and
 - platelets are found in the middle layer.

Centrifugation is used to prepare packed red blood cells, platelet concentrates, and plasma products.

- **Leukoreduction:** Removing white blood cells from blood components to reduce the risk of transfusion-related reactions and infections.
- **Apheresis:** Allows specific blood components to be selectively collected or removed from a donor or patient while returning the remaining components to the circulation.

This technique is used to collect platelets, plasma, red blood cells, or specific cell populations for therapeutic purposes.

Introduction (Contd)

- **Pathogen inactivation:** Used to reduce the risk of transfusion-transmitted infections by inactivating pathogens, such as viruses, bacteria, and parasites, in blood products.
- **Cryopreservation:** Involves freezing blood components at ultra-low temperatures to extend their shelf life and preserve their viability.
- **Fractionation:** Used to isolate and purify specific blood proteins or factors from plasma, such as albumin, clotting factors, and immunoglobulins.

Cross-matching: A laboratory procedure performed to determine compatibility between donor and recipient blood samples before transfusion.

Quality control: Implemented throughout the blood processing and component preparation process to ensure the safety, purity, and efficacy of blood products. Includes monitoring for contamination, conducting regular testing for blood-borne pathogens, and maintaining proper storage conditions.

Processing of Whole Blood to Components

Whole Blood

Whole Blood donation:

450-500mL ($\pm 10\%$) of blood collected into citrate anticoagulant also containing phosphate and dextrose.

Red Blood Cell Production and Storage:

- *Red cells may be produced either from whole blood donations or by Apheresis*
- *Additive solution (such as Saline-Adenine-Glucose-Mannitol SAGM, or AS-3, to provide nutrients, stabilize pH, and prolong RBC viability during storage)*
 - haematocrit of 50-70% and extend storage from 21-28 days to 35-42 days*
- *Storage temperatures start at 1-2 °C, extending through 6 °C, with allowance during transport up to 10 °C.*
- *Changes occurring during storage:*
 - *progressive extracellular leakage of potassium*
 - *decline in red cell recovery to 75-85% of transfused cells at end-expiration.*

Processing of Whole Blood to Components

Whole Blood

Whole Blood donation:

450-500mL ($\pm 10\%$) of blood collected into citrate anticoagulant also containing phosphate and dextrose.

Platelets Production and Storage:

- *Whole blood donations and subsequently pooled, or collected by Apheresis*
- *An adult therapeutic dose of platelets ($>2.5 \times 10^{11}$) can be consistently manufactured from four or more whole blood donations.*
- *With appropriate selection of donors, 1- 3 adult therapeutic doses ($2.5 - 11 \times 10^{11}$) can be harvested from a single donor during one Apheresis collection procedure.*
- *Platelets are stored under agitation at 20-24 °C for five days, which may be extended to seven days if an approved method to detect or inactivate bacterial pathogens is used.*
- *During storage, platelets undergo a fall in PH due to accumulation of Lactic Acid, show increased surface expression of activation markers and lose their normal shape.*

Processing of Whole Blood to Components

Whole Blood

Whole Blood donation:

450-500mL ($\pm 10\%$) of blood collected into citrate anticoagulant also containing phosphate and dextrose.

Plasma Production and Storage:

- *Fresh Frozen Plasma (FFP) from a whole blood donation must be prepared and frozen as soon after collection as possible.*
- *Usual unit volumes are 200-300mL. FFP can also be derived from Apheresis collections in 300-600mL volumes.*
- *Source of multiple coagulation factor replacement of massive transfusion, disseminated intravascular coagulation, warfarin-induced bleeding and liver disease. Also used for plasma exchange in patients with TTP or serve as a single source of one or more deficient factors for which no concentrates are available.*
- *Permitted shelf-life (three months to seven years) depends on the storage temperature (≤ -18 to ≤ -65 °C).*

Processing of Whole Blood to Components

Whole Blood

Whole Blood donation:

450-500mL ($\pm 10\%$) of blood collected into citrate anticoagulant also containing phosphate and dextrose.

Cryoprecipitate Production and Storage:

- *Slowly thawing single units of FFP at 1- 6 °C.*
- *Cryoprotein precipitates of factors VIII and XIII, vWF, Fibrinogen and Fibronectin are concentrated 2-9-fold compared with plasma.*
- *Cryoprecipitate can be stored for 1-3 years.*
- *Thawed cryoprecipitate has a shelf-life of 4-6 hours.*

NB:

Originally developed for factor VIII deficiency (Haemophilia A), most cryoprecipitate is now prescribed to treat acquired hypofibrinogenaemia, usually in the context of massive transfusion, DIC or Liver disease.

Processing of Whole Blood to Components

Whole Blood

Whole Blood donation:

450-500mL ($\pm 10\%$) of blood collected into citrate anticoagulant also containing phosphate and dextrose.

Granulocytes Production and Storage:

- *Presently indicated only for severely neutropenic patients (count $<0.5 \times 10^9/L$) with bacterial or fungal infections refractory to appropriate antimicrobial therapy..*
- *Primarily collected by Apheresis, with buffy coat separation from whole blood as an alternative source.*
- *Most regulatory agencies require an adult dose of $\geq 1 \times 10^{10}$ granulocytes, which is usually infused daily.*
- *Some countries transfuse buffy coat as a source of granulocytes. A dose of 1×10^{10} can be achieved from 10 buffy coats..*

NB:

- Granulocytes should be transfused as soon as possible after collection due to their 24-hour shelf-life and onset of significant functional deficiency within six hours of collection.
- Granulocytes must be γ -irradiated to prevent TA-GVHD and NEVER Leucocyte reduced. Granulocytes should be kept at 20-24 °C without agitation.

Summary: Storage of Blood Components

Product	Storage temperature	Shelf life
RBCS	2-6°C	42 days if additive solution is added. 21 days with no additive solution.
PLTs	20°C– 24°C: Under continuous gentle agitation using a agitator to preserve platelet function.	5days
FFPs and Cryoprecipitate	≤ -18° C	1 year
Thawed FFPs	1-10°C	24 hrs, thawed FFPs should not be refrozen.
Thawed cryoprecipitate	Use within 6 hrs of thawing, do not refreeze	

N.B

Ensure proper recording of temperature every four(4)hours on temperature monitoring sheet.

Summary: Transportation of Blood Components

pRBC

- +1°C to +10°C
- No contact of ice pack and RBC to avoid freezing and hemolysis (use punched cardboard)
- Ice packs to be used should have been cooled towards -18°C.

Platelets

- 20-24°C

Thawed Plasma

- +1°C to +10°C.

Thawed Cryo

- Must always be transported at ambient temperature

- Cryoprecipitate and FFPs you have to maintain in the frozen state during transportation.
- If Served by Zipline, Pick immediately the package after delivery and make sure the transportation conditions are respected for each component.

QC of Blood Components

pRBC

- **Weekly:** at least 4 pRBC units that are closer to expiry are selected.
- FBC is performed to check hemoglobin and hematocrit level.
Hematocrit: 65% - 75%
Haemoglobin: >45 g/L
- The percentage of hemolysis is also checked to see the quality of the product. *Haemolysis: < 0.8% of red cell mass.*

Platelets

- **Weekly:** at least 4 platelets units that are closer to expiry are selected.
- PH measurement is performed
 - *If the pH is < 6.2, suspect bacterial contamination. Culture should be done*
- Performing FBC
 - *Acceptable count: $\geq 5.5 \times 10^{10}$ PLT/bag for WB derived PLT*
 - *Apheresis is 2.0×10^{11} PLT/bag*

QC of Platelets is not only done for the units closer to expiry, but also at the end of platelets preparation process for each unit to be labelled.

QC of Blood Components (Contd)

- At least 75% of products tested should comply.

- **Reagents**
 - Every morning, reagents are quality controlled before being used.
 - Reagents are not used if the quality control tests fail.

QC of Blood Components (Contd)

Test for sterility:

- Intended to test for sterility (microbiological test) to ensure blood components are free from bacterial contamination.
- Each month, 10 pRBCs and Platelets units are selected for microbiological test.
- Perform culture on blood components.

The blood components are considered as sterile if there is no bacterial growth/turbidity

Returning unused blood components

- ❑ Unused units or units closed to expiry date must be taken back to the nearest RCBT.
- ❑ They should be transported in suitable conditions, at least **7 days** before being expired.
- ❑ The returned blood components should be accompanied by a well filled form for returned blood product.
- ❑ After performing visual inspection, the unit is kept for 48 hours after which is later visually inspected for hemolysis in supernatant.
- ❑ If the blood component meets the acceptance criteria, it will be returned in stock and reissued to the patients as nominative distribution.



THANK YOU
