Component Preparation & Therapy

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Basic Blood Components

- Red Blood Cells
- Platelets
- Fresh Frozen Plasma (FFP)
- Cryoprecipitated Anti-hemophilic Factor
- Granulocytes
Terms to know:

- **Whole blood**: blood collected before separation into components
- **Components**: parts of whole blood that are separated
- **Closed system**: a sterile system of blood collection
- **Open system**: when the collection is exposed to air, decreasing expiration date
Collection basics

- Blood is collected in a primary bag that contains anticoagulant-preservatives.
- Satellite bags may also be attached, depending on what components are needed.
- Anticoagulant-preservatives minimize biochemical changes and increase shelf life.
Plasma hemoglobin

Plasma K⁺

Viable cells

pH

ATP

2,3-DPG

Plasma Na⁺

Helps release oxygen from hemoglobin (once transfused, ATP & 2,3-DPG return to normal)
Components of whole blood are centrifuged:

- “light spin” – short time, low RPM
- “heavy spin” – longer spin, high RPM

Procedures are in the AABB Technical Manual
Centrifuged blood

- Plasma/serum
- Buffy Coat (WBCs & Platelets)
- Red Blood Cells
Whole blood with satellite bags attached is centrifuged at a light spin.

Platelet-Rich Plasma is expressed off the Red Blood Cells into a satellite bag.

The additive solution is added to the Red Blood Cells.

Red Blood Cells are sealed and cut off.

Platelet-Rich Plasma is centrifuged.

Plasma is expressed off the platelets.

The platelets are sealed and the tubing cut.

The plasma is either frozen to make Fresh Frozen Plasma or frozen and thawed to make Cryoprecipitated Antihemophilic Factor.

A, Courtesy LifeSouth Community Blood Centers, Gainesville, Fla.
Whole Blood

Component Requirements

- Stored: 1-6° C
- Shipping: 1-10° C
- 21 or 35 days depending on preservative (CPD, CP2D, or CPDA-1)
Whole Blood

- Consists of RBCs, WBCs, platelets and plasma (with anticoagulant)
- 1 unit increases Hgb 1 g/dL and Hct 3%
- When is it used?
  - Patients who are \textit{actively bleeding} and lost >25% of blood volume
  - Exchange transfusion
Red Blood Cells

- **RBCs**
  - 1-6°C (stored); 1-10°C (shipped)
  - 21, 35, or 42 days depending on preservative or additive
  - Hematocrit should be ≤80%
  - One unit increases hematocrit 3%
  - Once the unit is “opened” it has a 24 hour expiration date!
Red Blood Cells

- **RBCs (frozen)**
  - $\leq -65^\circ\text{C}$ for 10 years

- **RBCs (deglycerolized or washed)**
  - Good at 1-6$^\circ\text{C}$ for 24 hours

- **RBCs (irradiated)**
  - 1-6$^\circ\text{C}$ for 28 days
Red Blood Cells

- RBCs are usually given because of their hemoglobin content.
- They increase the mass of circulating red blood cells in situations where blood loss occurs.
RBCs

- Conditions include:
  - Oncology patients (chemo/radiation)
  - Trauma victims
  - Cardiac, orthopedic, and other surgery
  - End-stage renal disease
  - Premature infants
  - Sickle cell disease (↑ Hgb A)
RBC Types

- **Leukocyte-Reduced RBCs** are for:
  - patients who receive a lot of transfusions to prevent antibody production toward WBC antigens
  - Patients transfused outside of a hospital
  - Patients who have reacted to leukocytes in the past
Leukocyte Reduction Filters
(maintains closed system)

Final unit must have less than 5 x 10^6 WBCs
RBC Types

- **Frozen RBCs**
  - Glycerol is added to cryoprotect the unit
  - Glycerol prevents cell lysis
  - Why?
    - Freezing RBCs preserves rare units or extends to life of autologous units
RBC Types

- Deglycerolized RBCs
  - RBCs that have had the glycerin removed
  - Thawed at 37°C
  - A blood cell processor washes the cells with varying concentrations of saline
  - Considered “open”, expires in 24 hrs.
Washed RBCs
- Not effective in reducing WBCs
- For patients (with anti-IgA) that may react with plasma proteins containing IgA
- Reactions may be allergic, febrile, or anaphylactic
RBC Types

- **Irradiated RBCs**
  - Prevents T-cell proliferation that may cause transfusion-associated graft versus host disease (GVHD)
  - GVHD is fatal in 90% of those affected
  - Used for:
    - Donor units from a blood relative
    - HLA-matched donor unit
    - Intrauterine transfusion
    - Immunodeficiency
    - Premature newborns
    - Chemotherapy and irradiation
    - Patients who received marrow or stem cells
Platelets

- Important in maintaining hemostasis
- Help stop bleeding and form a platelet plug (primary hemostasis)
- People who need platelets:
  - Cancer patients
  - Bone marrow recipients
  - Postoperative bleeding
How platelets are processed

- Requires 2 spins:
  - **Soft** – separates RBCs and WBCs from plasma and platelets
  - **Heavy**
    - platelets in *platelet rich plasma* (PRP) will be forced to the bottom of a satellite bag
    - 40-60 mL of plasma is expelled into another satellite bag, while the remaining bag contains *platelet concentrate*
Preparation of platelet concentrate
Platelets

- **Storage Temperature**
  - 20-24°C for 5 days (constant agitation)

- Each unit should contain at least $5.5 \times 10^{10}$ platelets (platelet concentrate)

- Each unit should elevate the platelet count by 5-10,000 µL in a 165 lb person
Types of platelets

- **Pooled platelets**
  - Used to reach therapeutic dose
  - An “open system” occurs when pooling platelets, resulting in an expiration of 4 hours

- **Platelet, pheresis** – therapeutic dose (from one donor) without having to pool platelets
  - $3 \times 10^{11}$ minimum
  - HLA matched – for those with HLA antibodies
  - Leukocyte reduced - used to prevent febrile non-hemolytic reactions and HLA alloimmunization
Fresh Frozen Plasma (FFP)

- Plasma that is frozen within 8 hours of donation
  - -18°C or colder for 1 year
- Provides coagulation factors for
  - Bleeding
  - Abnormal clotting due to massive transfusion
  - Patients on warfarin who are bleeding
  - Treatment of TTP and HUS
  - Factor deficiencies
  - ATIII deficiency
  - DIC when fibrinogen is <100 mg/dL
Fresh Frozen Plasma

- FFP is thawed before transfusion
  - 30-37°C waterbath for 30-45 minutes
  - Stored 1-6°C and transfused within 24 hours
  - Needs to be ABO compatible
Cryoprecipitate

Cryoprecipitated antihemophilic factor (AHF) or “Cryo” is the precipitated protein portion that results after thawing FFP.

Contains:
- von Willebrand’s factor (plt. adhesion)
- Fibrinogen
  - 150 mg in each unit
- Factor VIII
  - About 80 IU in each unit
- Fibrinonectin
Cryoprecipitate

- Same storage as FFP (cannot be re-frozen as FFP once it is separated); -18 for 1 year
- If thawed, store at room temp 4 hrs
- The leftover plasma is called cryoprecipitate reduced or plasma cryo
  - Good for thrombocytopenic purpura (TTP)
- CRYO is used for
  - 2° treatment for Factor VIII deficiency (Hemophilia A)
  - 2 ° treatment for von Willebrand’s Disease
  - Congenital or acquired fibrinogen deficiency
  - FXIII deficiency
  - “Fibrin Glue” applied to surgical sites
FFP

Frozen within 8 hours

Thawed FFP

Cryoprecipitate (VIII, vW)

Thaw at 30-37°C
Store at RT 4 hrs

Plasma cryoprecipitate, reduced (TTP, FII, V, VII, IX, X, XI)

Refrozen with 24 hrs of separation
Store at ≤18°C 1 yr
5 day expiration at 1-6°C
Granulocytes

Lymphocyte

Monocyte

Neutrophils

Eosinophils

Basophils
Granulocytes

- Neutrophils are the most numerous, involved in phagocytosis of bacteria/fungi.
- Although rare, it is useful for infants with bacteremia.
- Prepared by hemapheresis.
- \( \geq 1.0 \times 10^{10} \)
- Maintained at room temp for 24 hours.
Labeling of components

- ISBT labeling
  - International Society of Blood Transfusion recommendations regarding the uniform labeling of blood products for international bar code recognition by computers
References