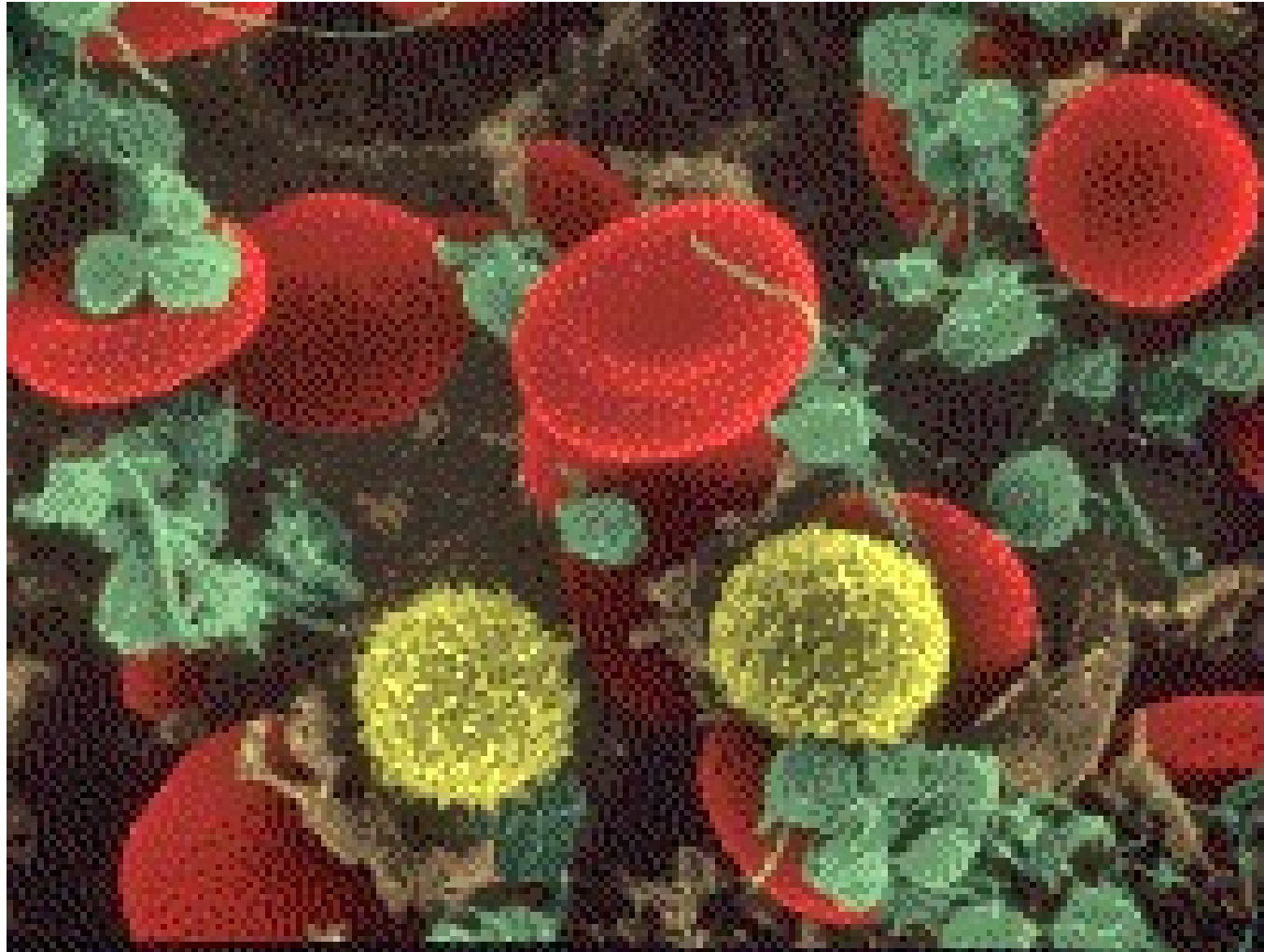
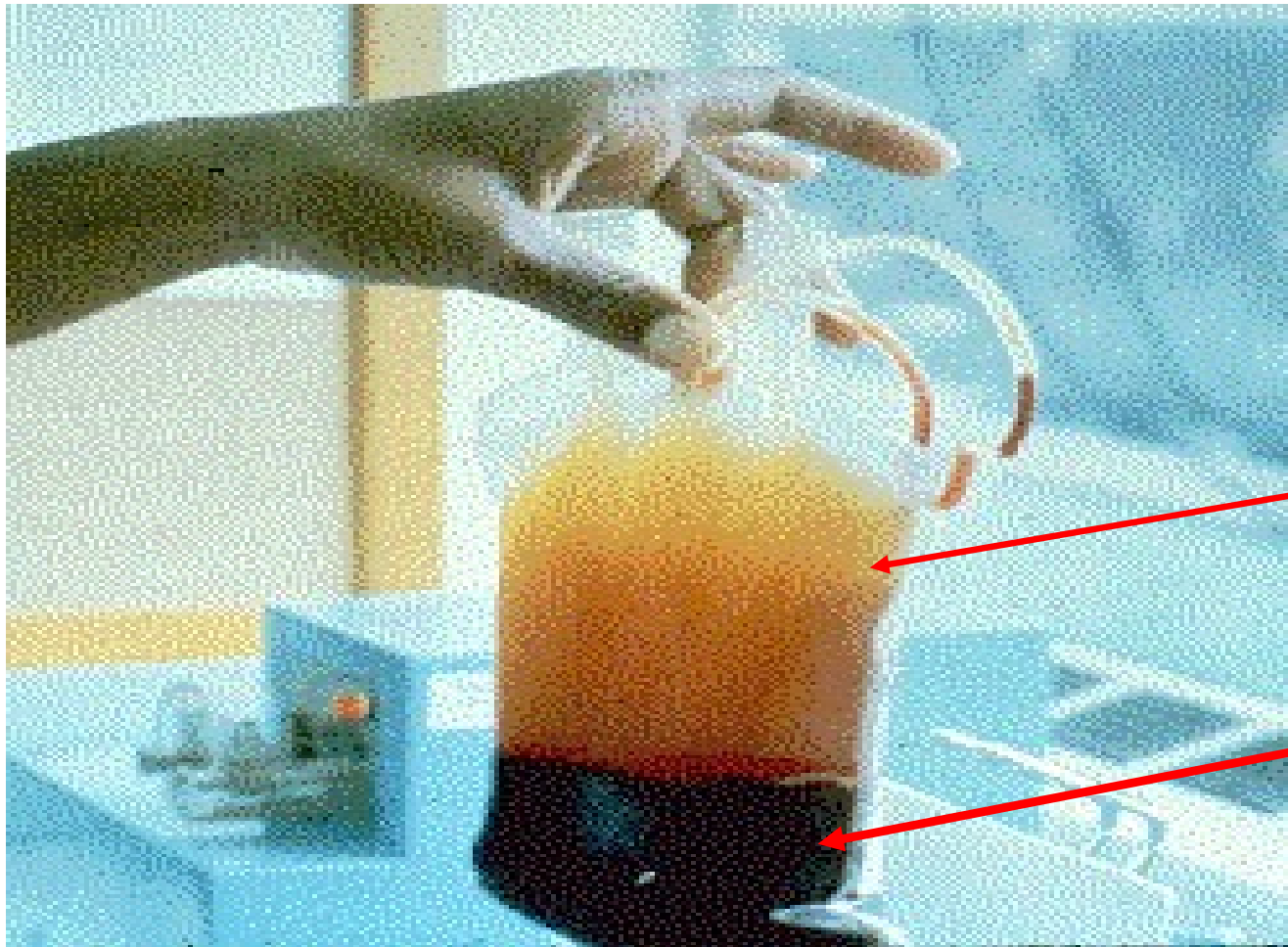


# Blood Components and Therapeutic Utilization



# Whole Blood Unit

(۴۵۰ cc blood+۶۳cc anticoagulant+ preservative)



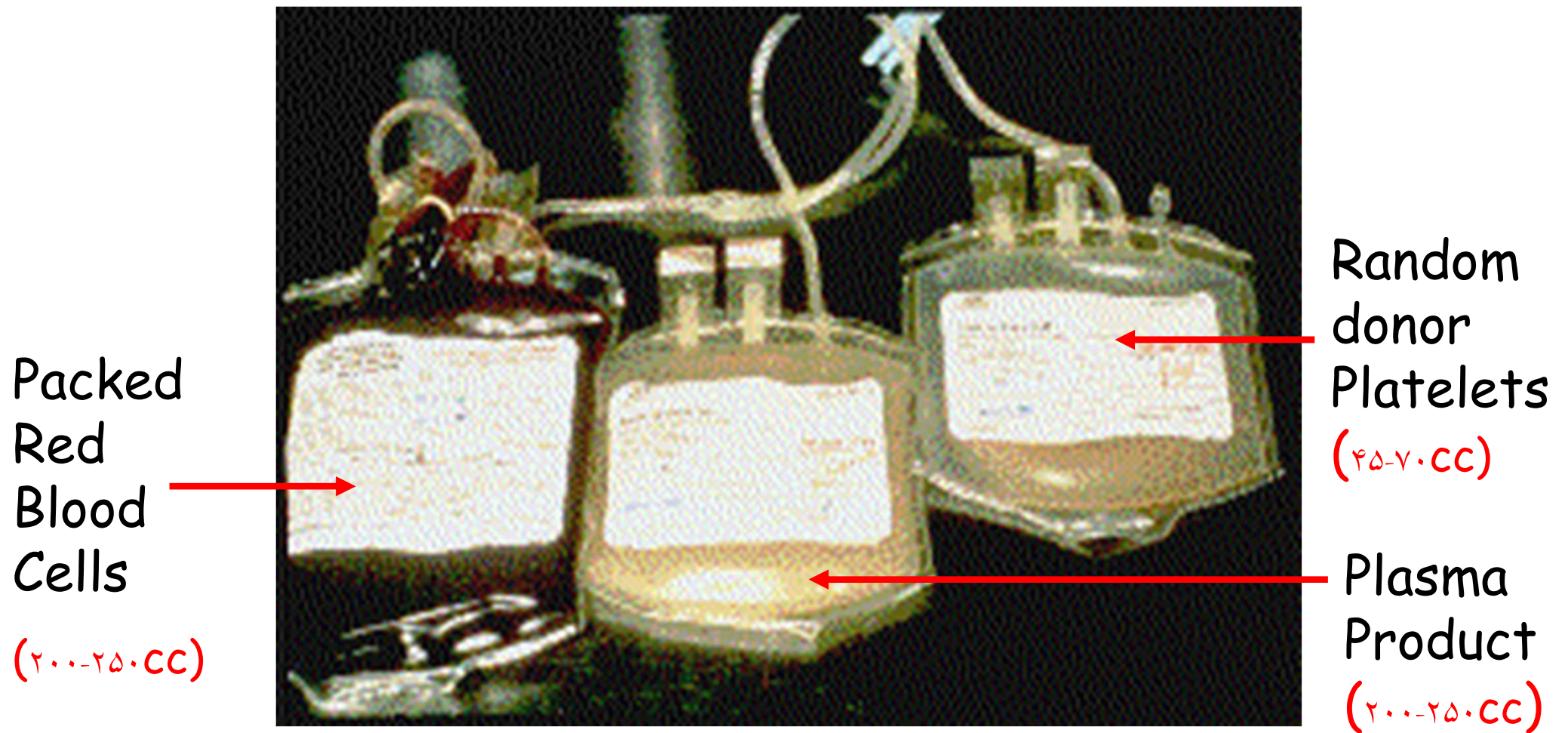
After centrifugation whole blood separates into the plasma and platelets on top and packed red blood cells on the bottom.

A **plasma expresser** is used to squeeze the plasma and platelets off the top and leave only the red blood cells in the original bag.

# plasma expresser





# Blood Components





When whole blood is separated into it's  
component parts we now have  
**Blood Components!!**



Collection Date <b>3/5/93</b>	EXPIRES MCH-29347
<b>CPDA-1 WHOLE BLOOD</b>	 <b>ANTICOAGULANT CITRATE PHOSPHATE DEXTROSE ADENINE-1 SOLUTION</b> 63 ml Anticoagulant Citrate Phosphate Dextrose Adenine-1 Solution for collection of 450 ml of blood.  Affix group label here after all required testing has been completed.
Approx. 450 ml plus 63 ml CPDA-1. Store at 1° to 6°C.  	
See circular of information for indications, contra-indications, cautions and methods of infusion.  <b>VOLUNTEER DONOR</b> This product may transmit infectious agents. <b>CAUTION:</b> Federal law prohibits dispensing without a prescription.  PROPERLY IDENTIFY INTENDED RECIPIENT	<b>MARYLAND GENERAL HOSPITAL BLOOD BANK</b> 827 LINDEN AVE. BALTIMORE, MD. 21201 U.S. LICENSE NO. 375

Base label on bag at time of collection.

Blood Bag label when testing is complete.

Collection Date <b>3/5/93</b>	EXPIRES <b>4/9/93</b>
<b>CPDA-1 RED BLOOD CELLS</b>	 Non-reactive for syphilis by STS. Non-reactive for HBsAg and Anti-HIV by FDA required test. No unexpected antibodies detected. <b>0</b> <b>Rh POSITIVE</b> TESTED FOR Rh <sub>0</sub> (D)  Affix group label here after all required testing has been completed.
From 450 ml CPDA-1 whole blood. Store at 1° to 6°C.  	
See circular of information for indications, contra-indications, cautions and methods of infusion.  <b>VOLUNTEER DONOR</b> This product may transmit infectious agents. <b>CAUTION:</b> Federal law prohibits dispensing without a prescription.  PROPERLY IDENTIFY INTENDED RECIPIENT	<b>MARYLAND GENERAL HOSPITAL BLOOD BANK</b> 827 LINDEN AVE. BALTIMORE, MD. 21201 U.S. LICENSE NO. 375

# RBC Components



# Packed RBCs

- *Approx. half the volume of Whole Blood*
  - Same RBC mass therefore same oxygen carrying capacity
- *Total Volume: 200-250 ml*
- *Hematocrit < 80% for CPDA-1 anticoagulant/preservative.*
- *Expiration Date: depends on sterility and anticoagulant/preservative*
  - **CPDA 1 - 35 days closed system**
  - **AS-1 - 42 days closed system**
  - **Open System - 24 hours**

# RBC:Anticoagulant/Preservative Solutions

## Purpose of RBC Preservation

Designed to prevent clotting and maintain red cell viability and function during storage.

## Anticoagulant-Preservative Contents

**Citrate:** anticoagulant (chelates calcium)

**Dextrose:** ATP generation *via* glycolytic pathway

**Adenine:** Acts as a substrate for RBC synthesis of ATP

**Sodium diphosphate:** Buffer to control decrease of pH expected from generation of lactic acid over time.



# Cold Temperature

- RBC components are kept at  $-6^{\circ}\text{C}$  in a **monitored** refrigerator
- **Inhibits bacterial growth**
- **Slows glycolytic activity:** But RBCs continue metabolic activity during storage consuming nutrients and depleting intracellular energy sources.

# Indications for Transfusion of Packed Red Blood Cells

- **Need** for blood depends on patients:
  - Symptoms & Signs
  - Underlying disease (heart, lung, vascular, CNS)
  - Cause & Course of anemia
  - Alternative therapies (Iron, EPO)
  - Haemoglobin concentration

**Table 497.1**

**Guidelines for Pediatric Red Blood Cell Transfusions<sup>\*†</sup>**

**CHILDREN AND ADOLESCENTS**

1. Maintain stable status with acute loss of >25% of circulating blood volume.
2. Maintain hemoglobin >7.0 g/dL<sup>†</sup> in the perioperative period.
3. Maintain hemoglobin >12.0 g/dL with severe cardiopulmonary disease.
4. Maintain hemoglobin >12.0 g/dL during extracorporeal membrane oxygenation.
5. Maintain hemoglobin >7.0 g/dL and *symptomatic* chronic anemia.
6. Maintain hemoglobin >7.0 g/dL and *marrow failure*.

**INFANTS ≤4 MO OLD**

1. Maintain hemoglobin >12.0 g/dL and severe pulmonary disease.
2. Maintain hemoglobin >12.0 g/dL during extracorporeal membrane oxygenation.
3. Maintain hemoglobin >10.0 g/dL and *moderate* pulmonary disease.
4. Maintain hemoglobin >12.0 g/dL and severe cardiac disease.
5. Maintain hemoglobin >10.0 g/dL preoperatively and during *major* surgery.
6. Maintain hemoglobin >7.0 g/dL postoperatively.
7. Maintain hemoglobin >7.0 g/dL and *symptomatic* anemia.

# Red Blood Cells

- Fresh Red Blood Cells (< 7 days old)
- Leukocyte reduced RBC
- Frozen, Deglycerolized RBC
- Irradiated RBC

# Fresh Red Blood Cells (< 5 days old)

- Neonatal transfusion
- **Massive Transfusion** is defined as replacing the patients entire blood volume or  $8 \times \text{cc/kg}$  *within 24 hours*.
- **Sickle Cell anemia**
- Why would we want to transfuse fresh blood in this situation?
  - **2,3-DPG** levels drop within 1 to 5 days of collection to levels that will **NOT** adequately oxygenate the tissues.
  - Also want to avoid transfusion of excess  $\text{K}^+$ , ammonia and haemolysis.

**Leukocyte reduced RBC:** to a level of  $< 5 \times 10^6$  per unit

- **Leukocyte filtration:** removes WBCs (Pre storage or post storage)
- **Washing-** removes WBCs, not efficiently, 24 hour outdate
- **Freezing/Deglycerolization:** Frozen RBC unit is thawed and washed to remove both glycerol and WBCs



# Indications for Transfusion of Leukocyte Reduced RBCs

- Febrile non haemolytic transfusion reactions
  - Patient history of febrile transfusion reactions
- HLA allo-immunization: antibody to HLA antigens
- Transfusion related acute lung injury (TRALI)
- Transfusion associated Graft vs. Host disease (TA-GvHD).
- Transfusion related immune suppression:
  - Reduces risk of transmission of CMV and HIV.

# Frozen, Deglycerolized RBC

- Freezing RBCs in glycerol gives minimal damage to the cell.
- >10 years Shelf life, while in frozen, for 'rare' blood types
- Free (almost) of WBCs, Platelets & Plasma
- Indicated for patient with anti-IgA;  
Intra-uterine transfusion (as lacks WBCs)

# Irradiated Blood Components

- Gamma irradiation (25 Gy) of component
- Purpose: Inactivate donor lymphocytes to prevent Graft Vs. Host disease (GVHD). Only accepted method.
- Expiration date: 28 days (RBCs) from irradiation or original outdate - whichever comes first.

# Indications for Transfusion of Irradiated Blood Products

١. Intrauterine Transfusion
٢. Neonate, (Exchange transfusion: Recommended)
٣. Premature Neonate, neonate with  $BW \leq 1500g$
٤. Congenital Immunodeficiency's
٥. Hematologic Malignancies
٦. Hodgkin Lymphoma, Solid Tumors
٧. Bone Marrow Transplant
٨. Transfusion of first degree relative
٩. Aplastic Anemia
١٠. Direct donation

- RBC product of Choice in:

- Neonates
- Infants
- Children, and
- Adolescents is

Prestorage leukocyte- reduced RBCs with  
HCT: 60-70% and storage time: 35-42 days.

- For neonate with BW  $\leq$  1500g irradiation is recommended.

- Usual dose 10-15cc/kg/ over 2-4 hr

# Platelet Components



Includes  
Random donor  
platelets,  
Single donor  
platelets and  
Pooled  
Platelets.



# Platelet Components

## Random Donor Platelet

- At least  $5.5 \times 10^{11}$  platelets/unit
- Store at  $20$  to  $24^{\circ}\text{C}$  with continuous agitation
- Suspended in  $55$ - $65$  ml plasma
- Shelf life of  $5$  days

## Single Donor Platelet - Apheresis

- At least  $3.0 \times 10^{11}$  platelets/unit
- Store at  $22$  to  $24^{\circ}\text{C}$  with agitation
- Suspended in  $300$  ml plasma (equivalent to  $4$ - $8$  random donor platelets)
- Shelf life of  $5$  days

# Platelet and Plateletpheresis

- **Platelet Increment (desired):** Patient platelet count should increase by  $5-10 \times 10^9 / \text{random donor platelet transfusion}$  and  $30-60 \times 10^9 / \text{per single donor platelet}$ .

## ABO and Rh Compatibility

- **Paediatric:**
  - **Transfuse ABO/Rh compatible units**
    - Adults: Use ABO compatible with adults but it is NOT necessary
    - No cross match is necessary.

# Indications for Transfusion of Platelets

- **Causes:**

- **Decreased Platelet production:** chemotherapy, malignancy, etc.
- **Increased Platelet destruction:** DIC
- **Decrease by dilution:** Massive transfusion

Table 498.1

Guidelines for Pediatric Platelet (PLT) Transfusion\*

**CHILDREN AND ADOLESCENTS**

1. Maintain PLT count  $>50 \times 10^9/L$  with bleeding.
2. Maintain PLT count  $>50 \times 10^9/L$  with *major invasive procedure*  $>25 \times 10^9/L$  with minor.
3. Maintain PLT count  $>20 \times 10^9/L$  and *marrow failure* WITH hemorrhagic risk factors.
4. Maintain PLT count  $>10 \times 10^9/L$  and *marrow failure* WITHOUT hemorrhagic risk factors.
5. Maintain PLT count at any level with PLT dysfunction PLUS bleeding or invasive procedure.

**INFANTS  $\leq 4$  MO OLD**

1. Maintain PLT count  $>100 \times 10^9/L$  with bleeding or during extracorporeal membrane oxygenation.
2. Maintain PLT count  $>50 \times 10^9/L$  and an invasive procedure.
3. Maintain PLT count  $>20 \times 10^9/L$  and *clinically stable*.
4. Maintain PLT count  $>50 \times 10^9/L$  and *clinically unstable and/or bleeding or not when on indomethacin, nitric oxide, antibiotics etc., affecting PLT function*.
5. Maintain PLT count at any level with PLT dysfunction PLUS bleeding invasive procedure.

Words in *italics* must be defined for local transfusion guidelines.

# Plasma Components

## Fresh Frozen Plasma (FFP)

- Plasma expressed from Whole Blood, frozen within 8 hours of collection for CPDA-1 anticoagulant (6 hrs for ACD).
- Frozen at  $-18^{\circ}\text{C}$ : 1 year expiration date
- Frozen at  $-65^{\circ}\text{C}$ : 7 year expiration date
- Thawed: 24 hour kept at  $1-6^{\circ}\text{C}$
- 200-250 ml total volume
- Contains all clotting factors

# Indications for Transfusion of FFP

- Not recommended for: Severe haemophilia A&B, VWD and Factor VII deficiency.
- Treat **multiple coagulation factor deficiencies** such as DIC, liver failure (+bleeding or an invasive procedure), vitamin K deficiency (+bleeding or urgent conditions), or massive transfusion
- Good for factor deficiency where there is no suitable clotting factor concentrate: **Factor XI deficiency**
- **NEED** to be ABO compatible. No cross-match needed
- **Contraindicated for volume expansion and protein replacement.**



Initial dose: 15cc/kg

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Table 500.1

Guidelines for Children and Infants for Plasma Transfusions\*

1. Severe clotting factor deficiency AND bleeding.
2. Severe clotting factor deficiency AND an invasive procedure.
3. *Emergency reversal* of warfarin effects.
4. Dilutional coagulopathy and bleeding (e.g., massive transfusion).
5. Anticoagulant protein (antithrombin III, proteins C and S) replacement.
6. Plasma exchange replacement fluid for thrombotic thrombocytopenic purpura or for disorders with overt bleeding or in which there is risk of bleeding because of clotting protein abnormalities (e.g., liver failure).

\*Words in *italics* must be defined for local transfusion guidelines.

# Cryoprecipitated Antihemophilic Factor (Cryo)

- Cold insoluble portion of Plasma
- Preparation Procedure
- Take FFP and thaw at 1 to 6°C until it becomes slushy (12-16 hours)
  - centrifuged using Hard Spin (5-7 min at 3500 rpm).
  - Remove cryo-poor plasma leaving about 10-15 ml of plasma with Cryo-precipitates.
  - Freeze Cryo at -18°C for 12 months

# Cryoprecipitated Antihemophilic Factor (Cryo)

- Contains at least 8 units of AHF and 150-250 mg Fibrinogen
- Also contains Factor XIII and von Willebrands factor
- Must be transfused within 6 hours of thawing
- Once thawed store at room temperature until transfusion
- 1 bag/ 5kg Wt of patient

# Indications for Transfusion of Cryoprecipitated AHF

- **Primary use:** intravenous supplementation of **Factor XIII** and **fibrinogen**
- **Topical Use:** Fibrin sealant (glue) in surgery
- **Factor concentrates** (i.e. Factor VIII) have replaced CRYO in many situations because of reduced risk of transmission of disease.

**ALL BLOOD COMPONENTS ARE  
ADMINISTERED THROUGH A  
FILTER!**

- Necessary to remove any accumulated debris that may be present in the blood component such small clots, fibrin, etc.

# Autologous Blood Transfusion

- Donation from the recipient,
- Rare blood type
- Having antibody to high frequency antigen
- Having a presence of multiple CSA
- Useful in planned surgery