
بسم الله الرحمن الرحيم

Blood Components & Plasma derivatives

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GUMS

Introduction
Whole Blood (WB)

- **Collected directly from donors into blood transfusion bag containing anticoagulant**
- **500 ml transfusion bag is used (contains 63 ml of anticoagulant + 450 ml blood)**

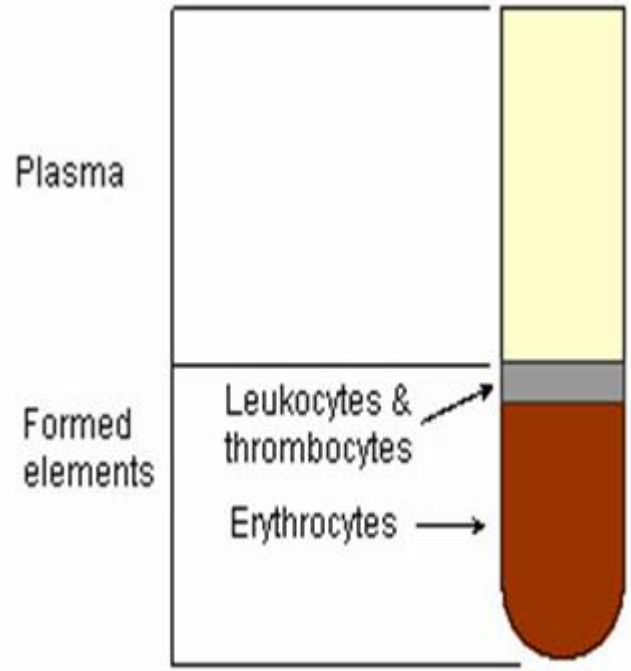
Anticoagulants Used for WB?

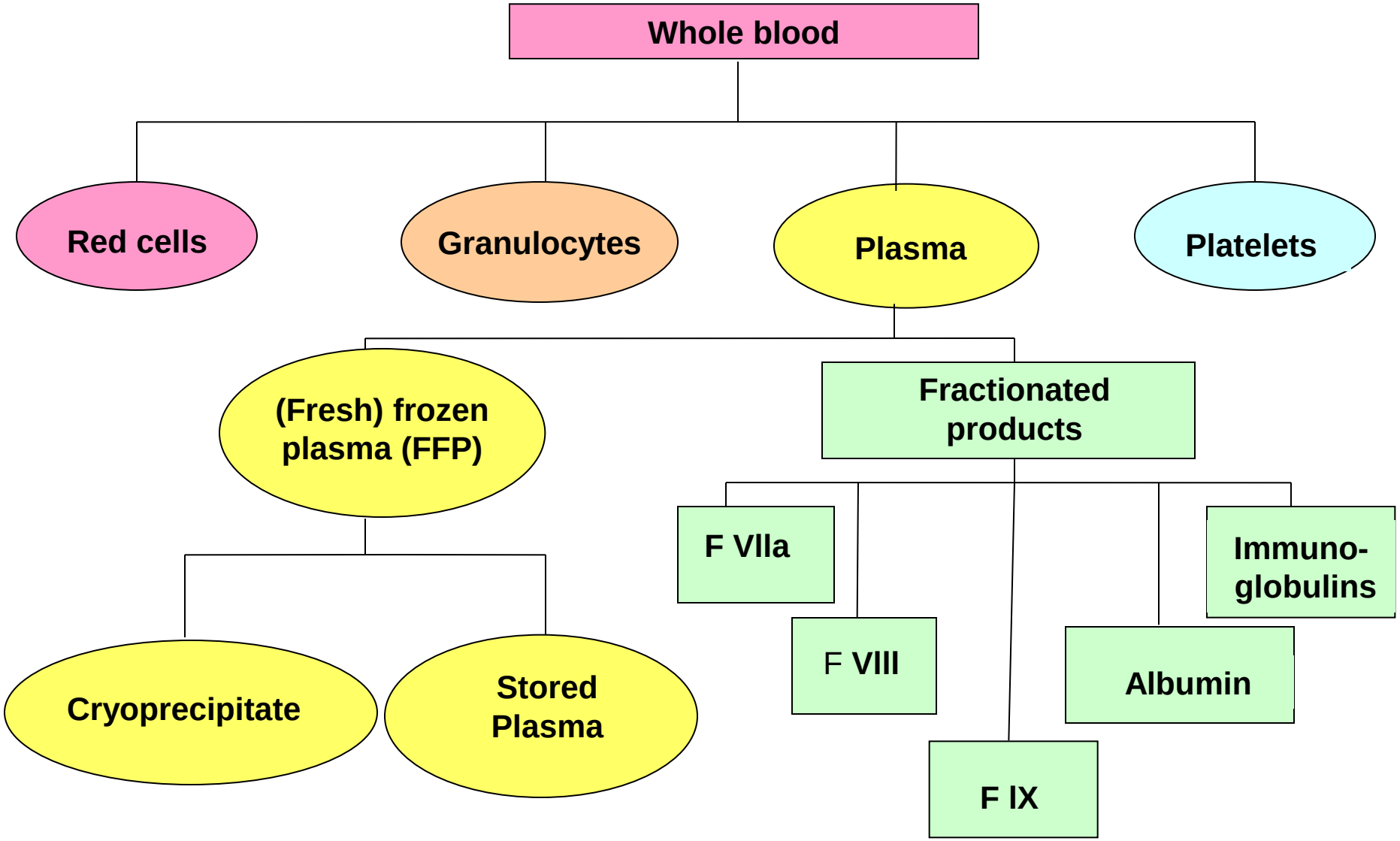
- **ACD & CPD preserve the unit for 21 days at 2-6ºC.**
- **CPDA-1 (anticoagulant/preservative for 35 days).**
- **C = Citrate→ to prevent clotting**
- **P = Phosphate→ to maintain pH**
- **D = Dextrose→ ATP generation**
- **A = Adenine-1→ substrate from which RBC produce ATP**

Anticoagulant ratio is 1.4 ml:10ml blood (63ml / 450ml)

Blood Components

- Human blood consists of plasma, in which cells are suspended
- The plasma also contains other specialised substances, which are important for blood clot formation (e.g. clotting factors)
- Whole blood can be separated at the blood bank into various components




Whole blood
Red cells
Granulocytes
Plasma
Platelets
(Fresh) frozen plasma (FFP)
Fractionated products
Cryoprecipitate
Stored Plasma
F VIIa
F VIII
F IX
Albumin
Immuno-globulins

Blood Components Separation Goals

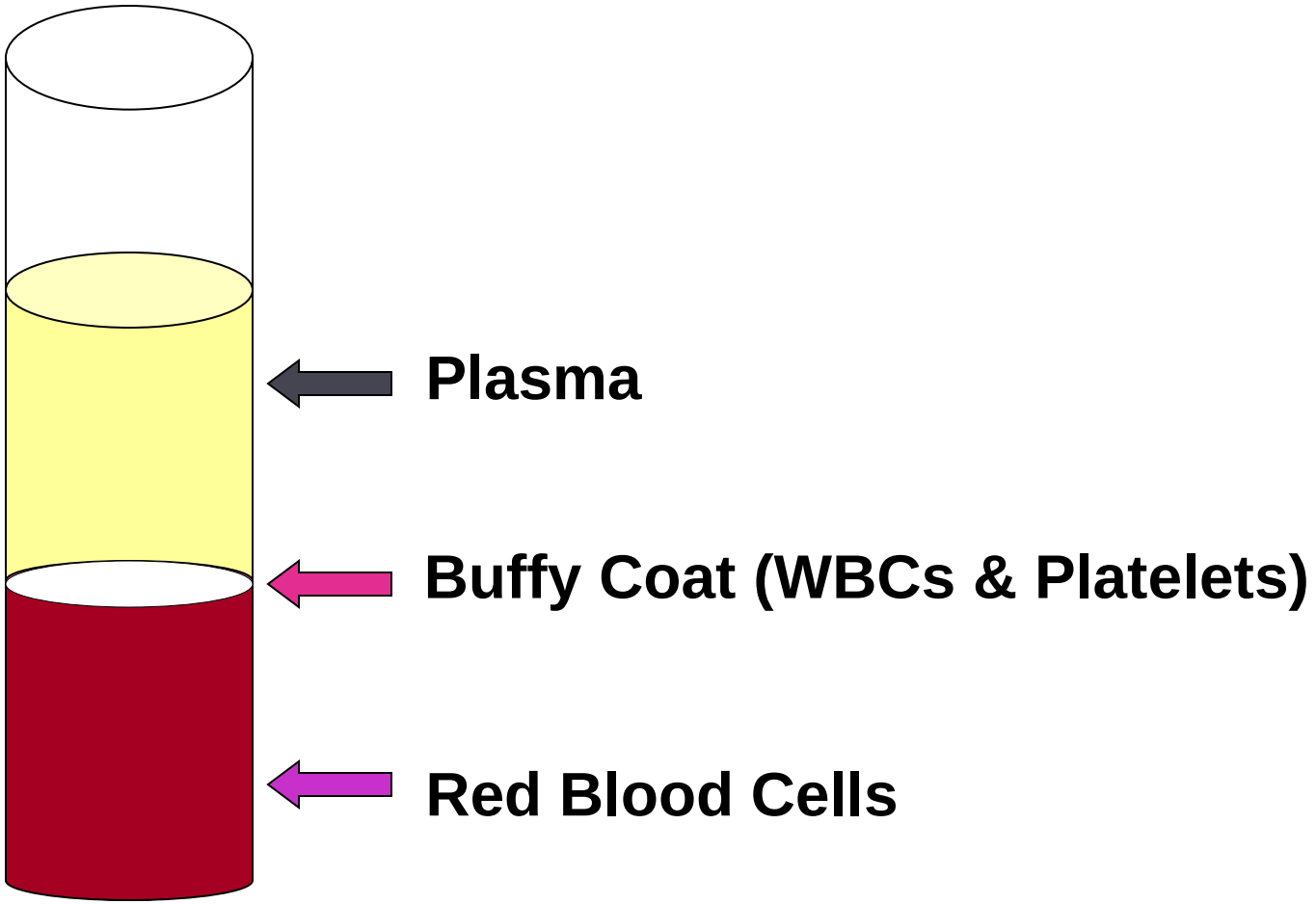
- Decrease harmful effects of blood transfusion.
- Giving patients specific component needed.
- Allow a longer survival for components.
- More than one patient will use the unit.

Centrifugation Types?

There are two types of centrifugation:-

- **Light spin; (2000 rpm at 20ºC for 11 min)**
- **Heavy spin; (3500 rpm at 20ºC for 11 min)**

Centrifuged blood



Blood Components

- Blood components
  - Oxygen carrying components
    - Red cell concentrates (RCC)
    - Leukocyte poor blood
    - Frozen-thawed red cells
  - Platelet products
    - Platelet rich plasma (PRP)
    - Platelet concentrates (PC)
  - Plasma products
    - Fresh frozen plasma (FFP)
    - Frozen plasma (FP)
    - Cryoprecipitate
    - Stored plasma

- Plasma Derivatives
  - Coagulation Factor concentrates
    - Factor VIII concentrates
    - Factor IX complex concentrates & others
  - Oncotic agents
    - Albumin
    - Plasma protein fraction (PPF)
  - Immune serum Globulin
    - Hepatitis B Ig (HBIG)
    - Varicella-zoster Ig (VZIG)
    - Rh Ig (RhIG)
    - Tetanus Ig (TIG)

1- PRBCs

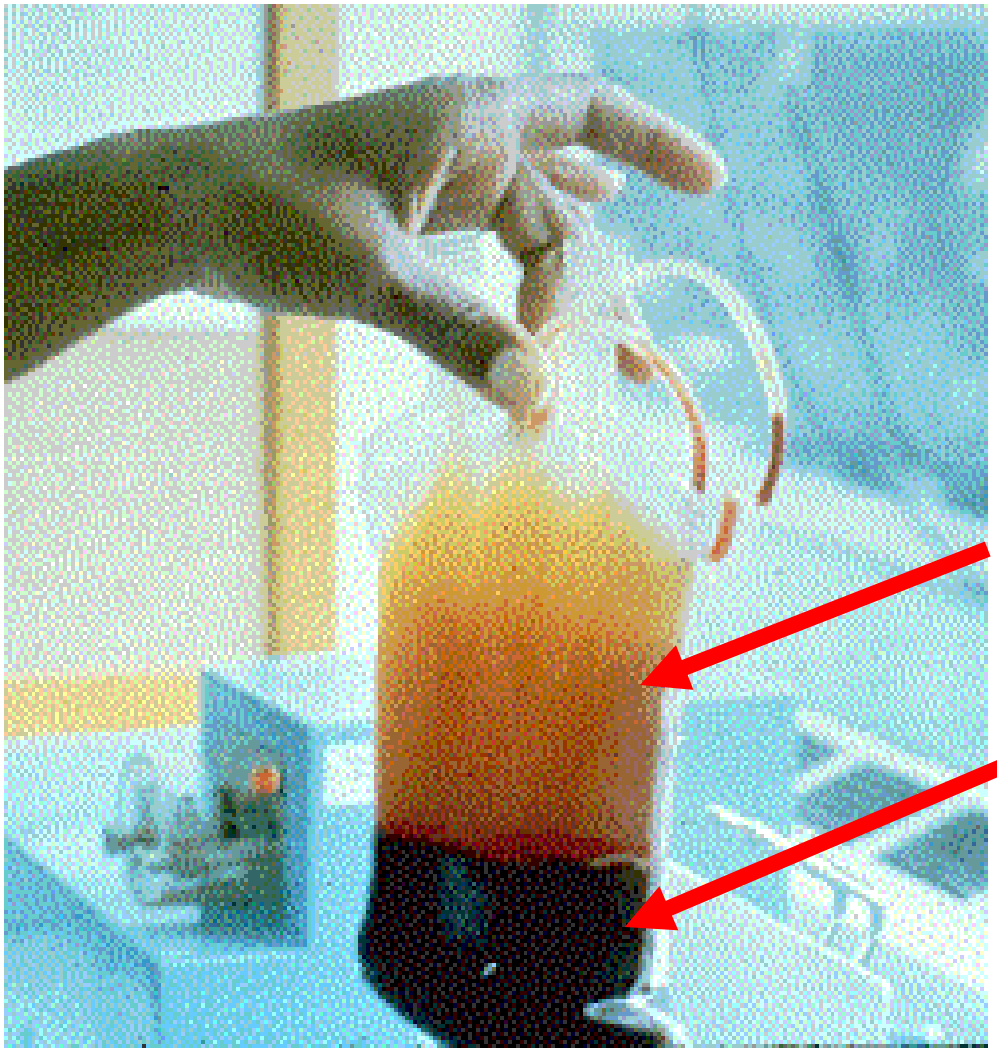
How to make (PRBCs)?

- **RBCs have higher specific gravity than plasma, it moves to lower portion of the bag by centrifugation**
- **WB (Light spin) → Two products:**

  1) PRBCs

  2) Platelet Rich Plasma (PRP)

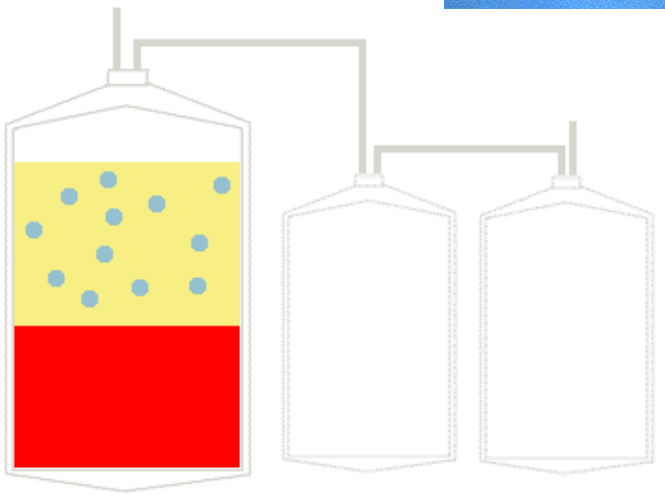
Whole Blood Unit

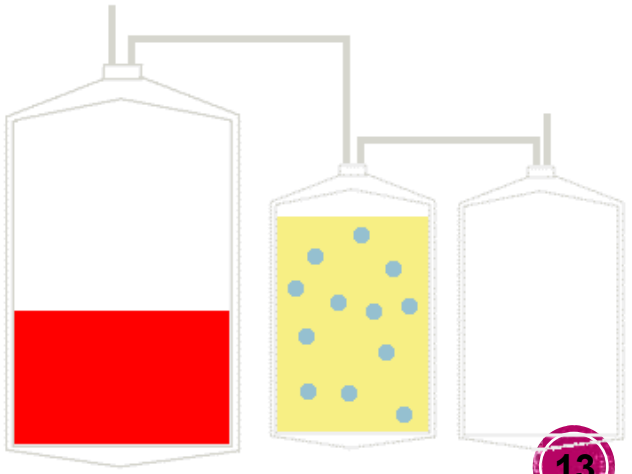


After centrifugation WB separates **into plasma & platelets** & **PRBCS**

1- Red blood cell concentrates

- Prepared by removing approx. 200 ml of plasma from whole blood after centrifugation
- RBCs plus 100 ml of residual plasma
- In CPD-A can be stored for 35 days at 4^{o}C



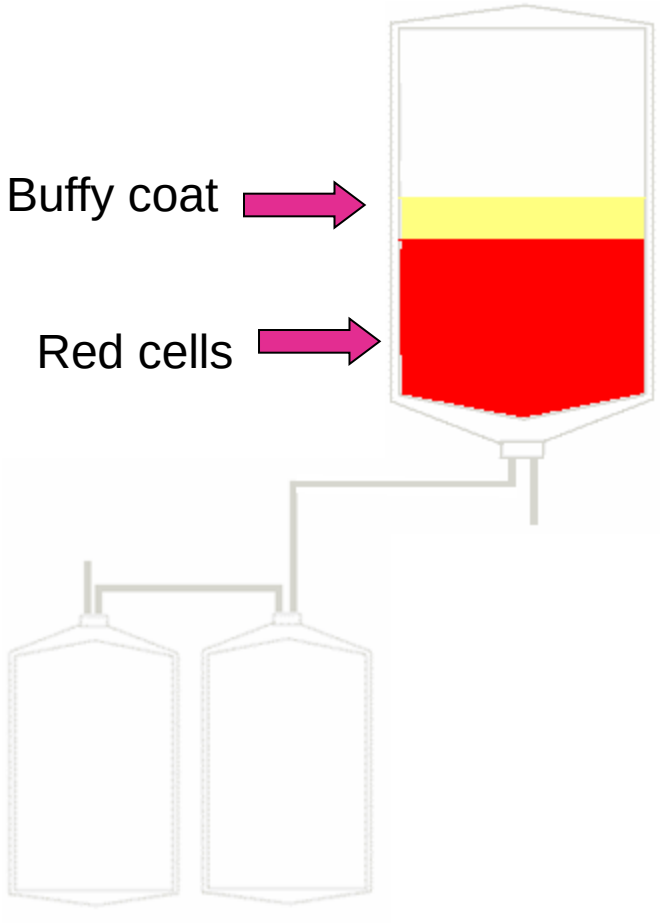


1- Red blood cell concentrates

	Whole Blood	Red cell concentrate
Total Volume	500 ml	300 ml
Volume of red cells	200 ml	200 ml
Volume of plasma	300 ml	100 ml
Hematocrit	40 %	70 %

2- Leukocyte poor blood

- No viable leukocytes
- WBCs are of no consequence
- In some patients cause febrile transfusion reaction
- Should receive leukocytes poor-blood
- WBCs can be removed by discarding the buffy coat (inverted centrifugation)
- Or by washing RBCs or by using filters



Courtesy LifeSouth Community Blood Centers, Gainesville, Fla.

Leukocyte Reduction Filters
(maintains closed system)

http://www.pall.com/39378_39479.asp

Final unit must have less than 5×10^6 WBCs

4- Washed RBCs

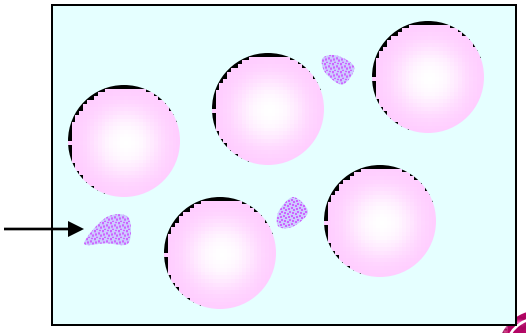
- **Washed RBCs**
  - Not effective in reducing WBCs
  - For patients (with anti-IgA) that may react with plasma proteins containing IgA
  - Reactions may be allergic, febrile, or anaphylactic

5- Irradiated RBCs

- **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

B- Platelets

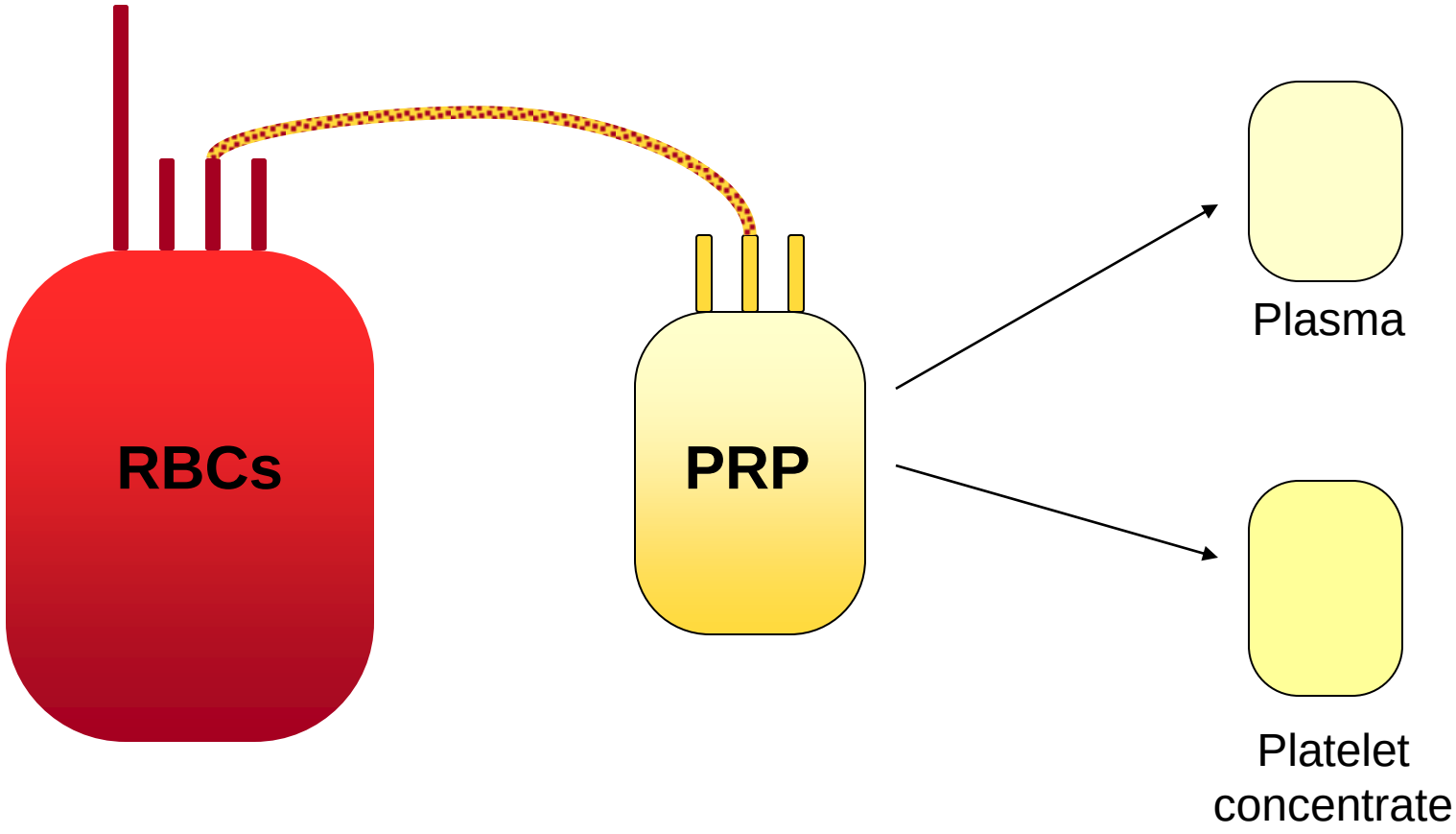
- Important in maintaining hemostasis
- Help stop bleeding and form a platelet plug (primary hemostasis)
- People who need platelets:
  - Cancer patients
  - Bone marrow recipients
  - Postoperative bleeding



How platelets are processed

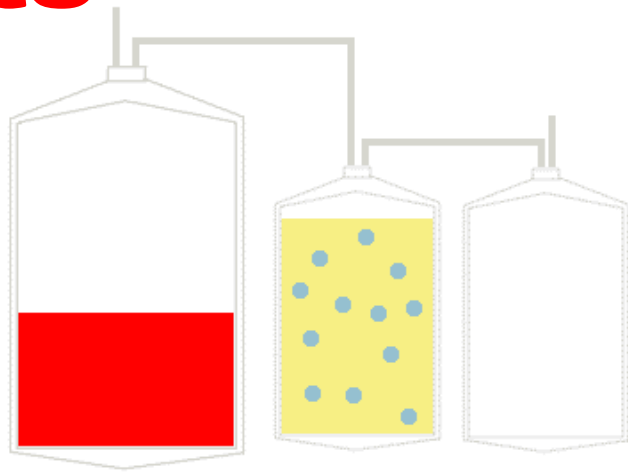
- REMEMBER!!!
- Requires 2 spins:
  - Soft – separates RBCs and WBCs from plasma and platelets
  - Heavy
    - platelets in **platelet rich plasma** (PRP) will be forced to the bottom of a satellite bag
    - 40-60 mL of plasma is expelled into another satellite bag, while the remaining bag contains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

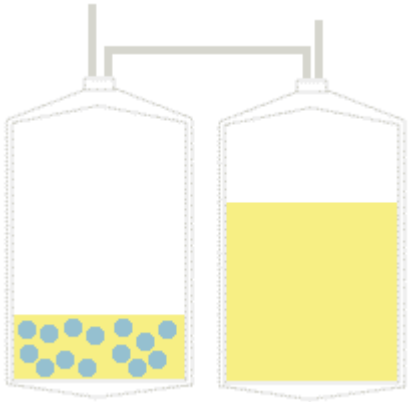
Preparation of platelet concentrate



B- Platelet Products

- Platelet Rich Plasma (PRP)
  - Gentle centrifugation of whole blood
  - Supernatant transferred to the 2nd bag
- Platelet Concentrates
  - Prepared from PRP by a 2nd centrifugation
  - Removal of all but 50 ml of plasma
  - Contain approx. $6X10^{10}$ platelets
  - 60 – 80% Plts present in whole blood unit
  - Remain 5 days
  - Longer at 22°C with continuous agitation





B- Platelet Products

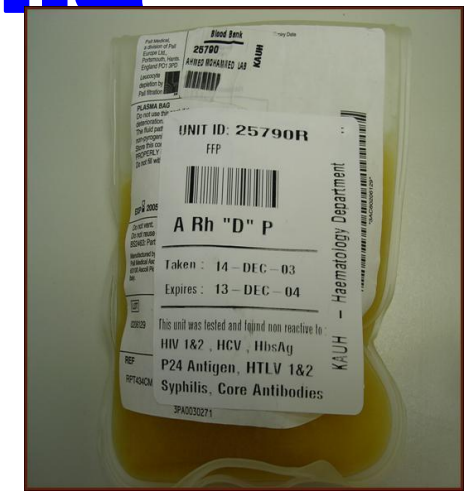
- Contamination by WBCs & RBCs is usually small
- But there is enough to induce alloimmunization
- Plt concentrates from Rh +ve should not be administered to Rh –ve women
- Storage at 22^{o}C, therefore care to prevent contamination

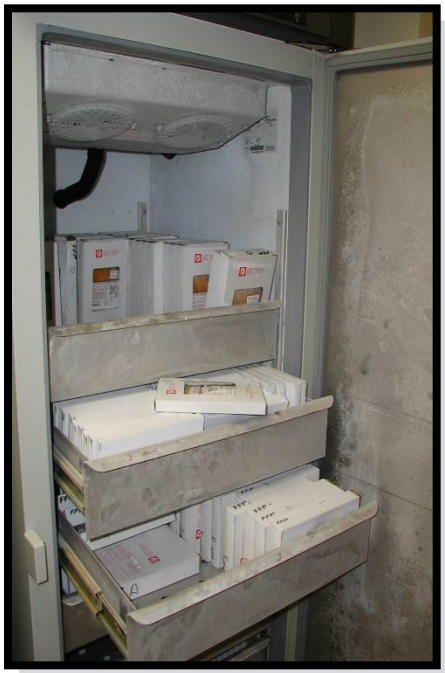
C- Plasma Products

- Plt poor plasma can be separated into a number of products
  - Fresh frozen plasma
  - Platelet concentrate
  - Frozen plasma
  - Cryoprecipitate
  - Stored plasma

1- Fresh frozen plasma (FFP)

- Prepared from whole blood within 6 hours of collection
- Rapid freezing of plasma preserves the labile coagulation factors at maximum levels
- Don't contain cellular elements
- 200 ml volume





1- Fresh frozen plasma (FFP)

- Freeze at -18ºC for 1 year from collection date.
- Or freeze at -70ºC for up to 7 yrs
- Cross match is not required, but of coarse should be ABO compatible.

Indications of FFP

- Liver disease
- Severe burns
- 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
Rh NEGATIVE
VOLUNTEER DONOR

2- Platelets Concentrate (PC)

How to prepare PC?

- **Platelet Rich Plasma (PRP) centrifuged using (heavy spin), this will produce:**

  1) **Fresh frozen plasma (FFP)**
  2) **Platelets concentrate (PC)**

- **PC are stored at room temperature on platelet agitator (prevent platelets clumping)**
- **PC stored for 5 days at** 20-24°C.
- Each unit should elevate the platelet count by 5000/µL

2- Platelets concentrate

- **Indications:**

1. To prevent bleeding due to thrombocytopenia or platelet dysfunction
2. To a patient undergoing an operation, if the platelet count is less than 20,000/µL

Platelet concentrate

3- Frozen Plasma (FP)

- Separated from whole blood within 24 hours of collection
- Contains at least 50 % of original factor VIII & factor V frozen plasma
- Adequate source for treatment of mild to moderate coagulation factor deficiencies
- 200 ml volume
- Storage at -30^{o}C for up to 12 months

4- Cryoprecipitate

- Produced from freshly separated plasma by freezing at -70^{o}C followed by thawing at 4^{o}C
- Flocculent precipitate is rich in factor VIII, fibrinogen and fibronectin
- Once thawed, mixture is centrifuged to sediment the cryoprecipitate & all but 5 to 10 ml of supernatant plasma is removed
- Contains 250 mg fibrinogen
- 80 clotting units of factor VIII
- Stored at -30^{o}C for 12 months

4- Cryoprecipitate

- Increase of 2% of factor VIII level for each bag of cryoprecipitate infused
- Supernatant plasma removed is called stored plasma
  - Must be used within 5 weeks if stored at 4^{o}C
  - Lasts for 2 years at -30^{o}C

Cryo..

Indications:

- Hemophilia A
- Von Willebrand disease (VWD)
- Congenital or acquired fibrinogen defects (i.e., dysfibrinogenemia)

Summary
Blood Components

Blood Component	Centrifugation	Storage		Indication
		Temp	Time	
1) PRBCs	WB Light spin= 2000rpm-20ºC -11min. → PRBCs + PRP	2-6ºC	**+SAGM 42d**	•Anemia •Newborn exchange transfusion
2) PC	PRP heavy spin= 3500rpm-20ºC -11min. → PC + FFP	R.T	3-5 d	•Bleeding •Operation if plt. Less than 20000/µl
3) FFP		-18ºC -65ºC	→ 1year → 7 years	•Clotting factor deficiencies •Severe burns

Summary
Blood Components

Blood Comp	Centrifugation	Storage		indication
		Temp	Time	
4) Cryo	a. **WB special heavy spin= 3500rpm at 4ºC - 11min. → RBC + Plasma** b. **Plasma → store at -18 ºC then thaw at 4 ºC then heavy spin at 4ºC**	-30ºC	1 **year**	• **Hemophilia A** • **Von Willebrand disease**

Plasma Derivatives

Plasma Derivatives

Plasma Derivatives	Preparation avaliable
Coagulation Factors	Factor VIII concentrates
	Factor IX concentrates
	Anti-thrombin III
Albumin	Albumin
	Plasma protein fraction
Immune globulins	Non-specific immune serum globulin (ISG)
	Rh immune globulin (RhIG)
	Hepatitis B immune globulin (HBIG)
	Varicella-Zoster immune globulin (VZIG)
	Tetanus immune globulin (TIG)

Blood products & treatment of specific clotting factor deficiencies

Deficiency	Blood product Indicated
Fibrinogen	Cryoprecipitate
	Stored plasma
Factor V	Fresh frozen plasma
	Frozen plasma
Factor VII	Factor IX concentrate
	Stored plasma
Factor VIII	Factor VIII concentrate
	Cryoprecipitate
Von Willebrand's Disease	Cryoprecipitate
	Fresh frozen plasma
	Frozen plasma
Factor IX	Factor IX concentrate
Factor X	Stored plasma
Factor XI	Stored plasma
Factor XIII	Stored plasma