Unit 2 Blood and Blood Components

Part 1

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Goals Of Blood Collection

- Maintain viability and function
- Prevent physical changes
- Minimize bacterial contamination

Anticoagulants Preservative Solutions

- Anticoagulants prevent blood clotting
- Preservatives provide nutrients for cells
- Heparin
  - Rarely if ever used anymore
  - Anticoagulant ONLY
  - Transfuse within 48 hours, preferably 8

Anticoagulants

	CPD or CP2-D	CPD-A1
Storage time	21 days	35 days
Temperature	1-6 C	1-6 C
	Slows glycolytic activity	
Adenine	None	Substrate for ATP synthesis
Volume	450 +/- 10%	
Dextrose	Supports ATP generation by glycolytic pathway	

Additive Solution (AS)

- Primary bag with satellite bags attached.
- One bag has additive solution (AS)
- Unit drawn into CPD anticoagulant



Additive Solution

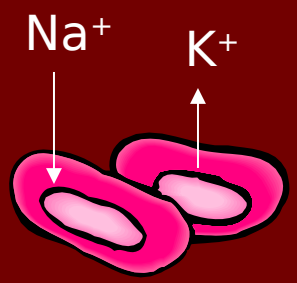
- Remove platelet rich plasma within 72 hours
- Add additive solution to RBCs, ADSOL, which consists of:
  - Saline
  - Adenine
  - Glucose
  - Mannitol
- Extends storage to 42 days
- Final hematocrit approximately 66%

Changes Occur During Storage

- Shelf life = expiration date
  - At end of expiration must have 75% recovery
  - At least 75% of transfused cells remain in circulation 24 hours AFTER transfusion

Storage Lesion

- Biochemical changes which occur at 1-6C
- Affects oxygen dissociation curve, increased affinity of hemoglobin for oxygen.
  - Low 2,3-DPG, increased O_2 affinity, less O_2 released.
  - pH drops causes 2,3-DPG levels to fall
  - Once transfused RBCs regenerate ATP and 2,3-DPG
- Few functional platelets present
- Viable (living) RBCs decrease



Red Blood Cell

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)

Storage Lesion

- Significant for infants and massive transfusion.
- Summary of biochemical changes
  - pH decreases
  - 2,3 DPG decreases
  - ATP decreases
  - Potassium increases
  - Sodium decreases
  - Plasma hemoglobin increases

Preparation of Components

- Collect unit within 15 minutes to prevent activation of coagulation system
- Draw into closed system – primary bag with satellite bags with hermetic seal between.
- If hermetic seal broken transfuse within 24 hours if stored at 1-4C, 4 hours if stored at 20-24C

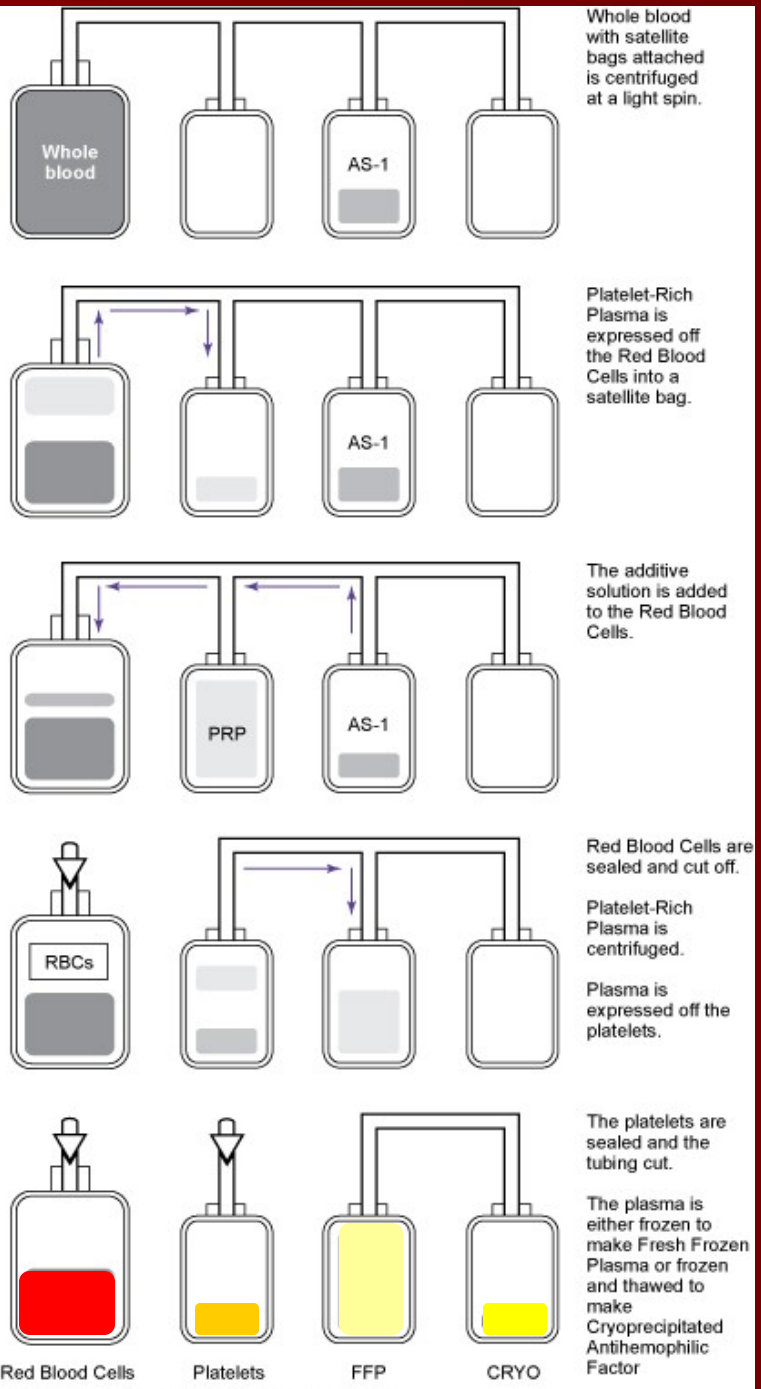


Preparation of Components

- Centrifuge – light spin, platelets suspended
- Remove platelet rich plasma (PRP)
- Centrifuge PRP heavy spin
- Remove platelet poor plasma
- Freeze plasma solid within 8 hours
- Thaw plasma at 1-4C – precipitate forms
- Centrifuge, express plasma leaving cryoprecipitate. Store both at -18C
- RBCs – CPD – 21 days, ADSOL – 42 days – 1-6C

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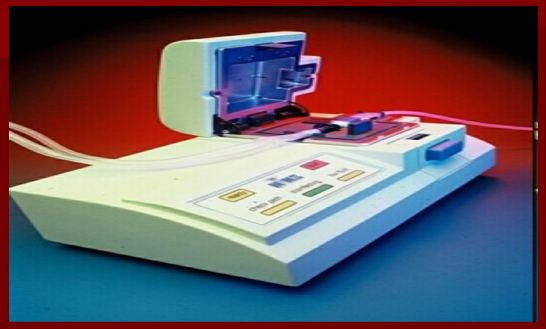


A, Courtesy LifeSouth Community Blood Centers, Gainesville, Fla.

Preparation of Components

- Summary – One unit of whole blood can produce:
  - Packed RBCs
  - Fresh frozen plasma (FFP)
  - Cryoprecipitate (CRYO)
  - Single donor plasma (SDP) – cyro removed
  - Platelets

Preparation of Components





- Sterile docking device joins tubing
  - Used to add satellite bags to maintain original expiration of component
  - May be used to pool components

Quality Control

- Requires certain number of blood products to be tested at regular intervals.
- Usually 4 per month.
- Must ensure product preparation results in a component that meets the regulatory agencies guidelines for number or quantity.

Blood Component General Information

- Blood separated into components to specifically treat patients with product needed
- Advantages of component separation
  - Allow optimum survival of each component
  - Transfuse only component needed

Blood Component General Information

- Transfusion practice
  - Transfusion requires doctor's prescription
  - All components MUST be administered through a filter
  - Infuse quickly, within 4 hours
  - D (Rh) neg require D neg cellular products
  - ABO identical preferred, ABO compatible OK
  - "Universal donor" – RBCs group O, plasma AB

Blood Component General Information

- Fresh Whole Blood
  - Blood not usually available until 12-24 hours
  - Candidates
    - Newborns needing exchange transfusion
    - Patients requiring leukoreduced products – in US products leukoreduced immediately after collection.

Blood Component General Information

- Summary of storage temperatures:
  - Liquid RBCs 1-6C
  - Platelets, Cryo (thawed) and granulocytes 20-24C (room temperature)
  - ANY frozen plasma product ≤ -18C
  - ANY liquid plasma product EXCEPT Cryo 1-6C

Discussion

- Focus on the most commonly used products.
- Components may be altered in many different ways which changes the name and, in some cases, the expiration.

Blood Components

- Cellular
  - Red blood cell products
  - Platelets
  - Granulocytes
- Plasma
  - FFP
  - Cryoprecipitate

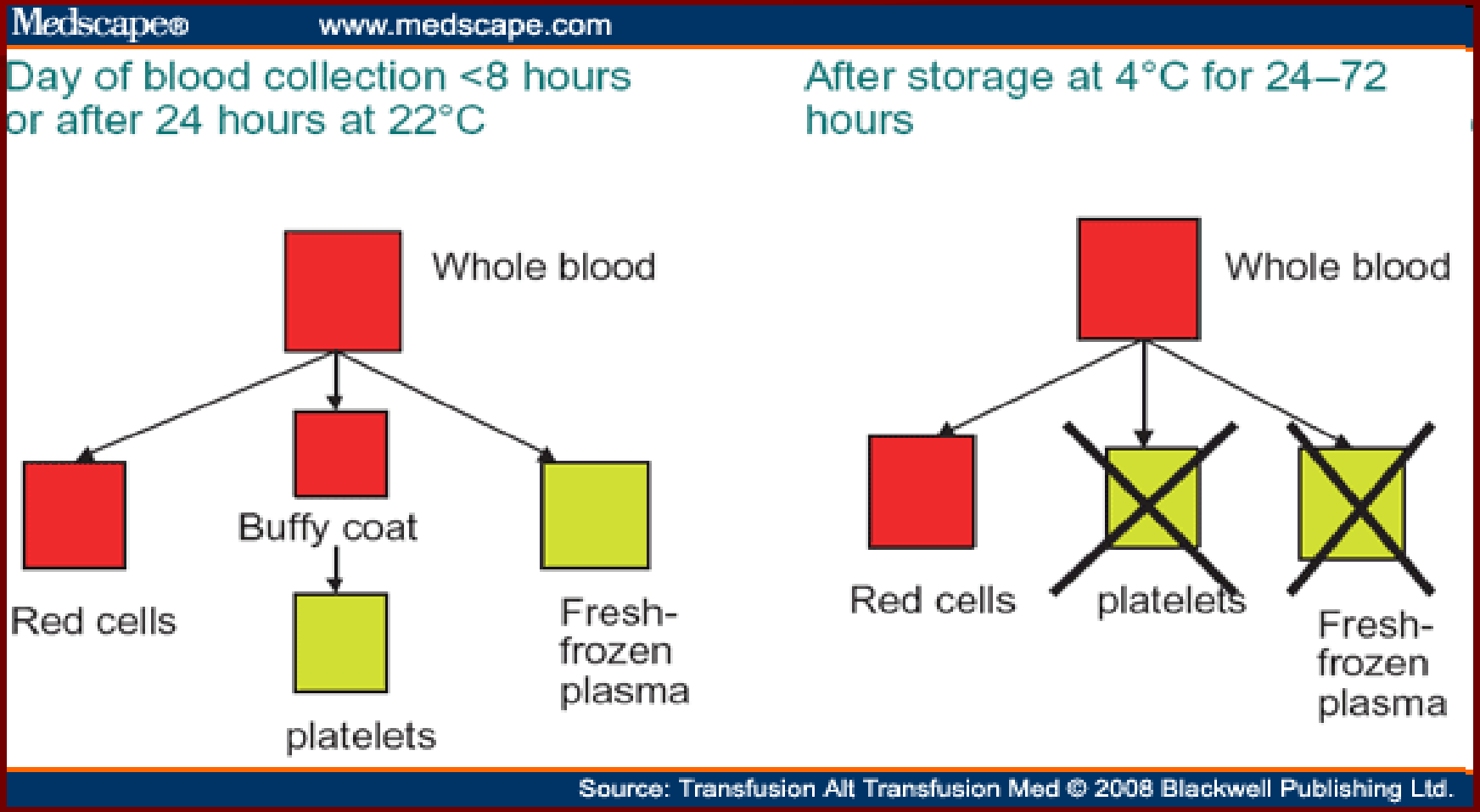
Products With Red Cells

Whole Blood

- Clinical indications for use of WB are **extremely** limited.
- Used for massive transfusion to correct acute hypovolemia such as in trauma and shock, exchange transfusion.
- RARELY used today, platelets non-functional, labile coagulation factors gone.
- **Must** be ABO **identical**.



Changes in Stored Blood



Red Blood Cells (RBC)

- Used to treat symptomatic anemia and routine blood loss during surgery
- Hematocrit is approximately 80% for non-additive (CPD), 60% for additive (ADSOL).
- Allow WB to sediment or centrifuge WB, remove supernatant plasma.



RBCs Leukocyte Reduced

- Leukocytes can induce adverse affects during transfusion, primarily febrile, non-hemolytic reactions.
- Reactions to cytokines produced by leukocytes in transfused units.
- Other explanations to reactions include: immunization of recipient to transfused HLA or granulocyte antigens, micro aggregates and fragmentation of granulocytes.
- Historically, indicated only for patients who had 2 or more febrile transfusion reactions, now a commonly ordered, popular component.
- “CMV” safe blood, since CMV lives in WBCs.
- Most blood centers now leukoreduce blood immediately after collection.
- Bed side filters are available to leukoreduce products during transfusion.

Leukocyte Reduction



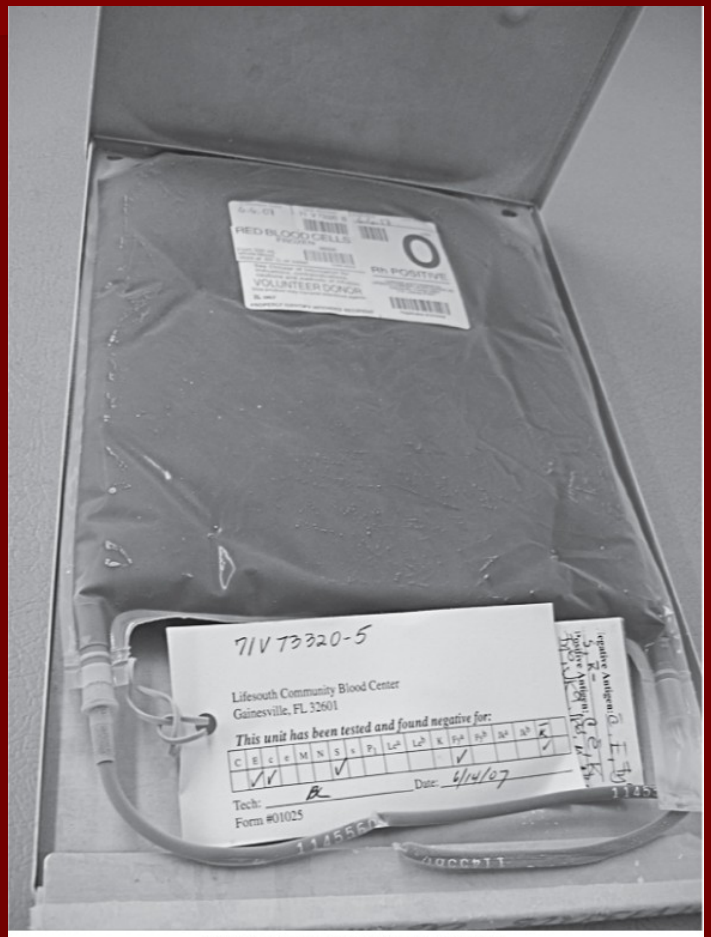
Washed Red Blood Cells (W-RBCs)

- Washing removes plasma proteins, platelets, WBCs and micro aggregates which may cause febrile or urticarial reactions.
- Patient requiring this product is the IgA deficient patient with anti-IgA antibodies.
- Prepared by using a machine which washes the cells 3 times with saline to remove and WBCs.
- Two types of labels:
  - Washed RBCs - do not need to QC for WBCs.
  - Leukocyte Poor WRBCs, QC must be done to guarantee removal of 85% of WBCs. No longer considered effective method for leukoreduction.
- Expires 24 hours after unit is entered.

Cell Washer Prepares Washed Cells



Frozen Blood



Courtesy LifeSouth Community Blood Centers, Gainesville, Fla.

Frozen RBCs; Deglycerolized RBCs

- Blood is frozen to preserve: rare types, for autologous transfusion, stock piling blood for military mobilization and/or civilian natural disasters.
- Blood is drawn into an anticoagulant preservative.
  - Plasma is removed and glycerol is added.
  - After equilibration unit is centrifuged to remove excess glycerol and frozen.
- Expiration
  - If frozen, 10 years.
  - After deglycerolization, 24 hours.
- Storage temperature
  - high glycerol -65 C.
  - low glycerol -120 C, liquid nitrogen.

Frozen RBCs; Deglycerolized RBCs

- Thaw unit at 37C, thawed RBCs will have high concentration of glycerol.
- A solution of glycerol of lesser concentration of the original glycerol is added.
- This causes glycerol to come out of the red blood cells slowly to prevent hemolysis of the RBCs.
- After a period of equilibration the unit is spun, the solution is removed and a solution with a lower glycerol concentration is added.
- This procedure is repeated until all glycerol is removed, more steps are required for the high glycerol stored units.
- The unit is then washed.

Rejuvenated Red Blood Cells

- A special solution is added to expired RBCs up to 3 days after expiration to restore 2,3-DPG and ATP levels to prestorage values.
- Rejuvenated RBCs regain normal characteristics of oxygen transport and delivery and improved post transfusion survival.
- Expiration is 24 hours or, if frozen, 10 years

End of Part 1