اداره کل انتقال خون استان اصفهان

آشنایی با انواع فرآورده های خون نحوه نگهداری، اندیکاسیون ها و علایم اختصاری

دکتر محمدرضا جابری

وظایف سازمان انتقال خون

- انتخاب اهدا کننده سالم
- آزمایشات لازم بر روی خون های اهدایی (بررسی HIV و HBV و HCV و سیفلیس و تعیین گروه خون)
- تهیه فرآورده های مختلف نظیر گلبول قرمز، پلاکت، پلاسما، کرایو و سایر فرآورده ها نظیر گلبول قرمز شسته شده یا اشعه دیده و...
- نگهداری صحیح فرآورده های خونی
- ریلیز و پخش خون

Indications of Blood Therapy

- Low O2 carrying capacity (LOCC)
- LOCC & low blood volume
- Bleeding due to coagulopathy

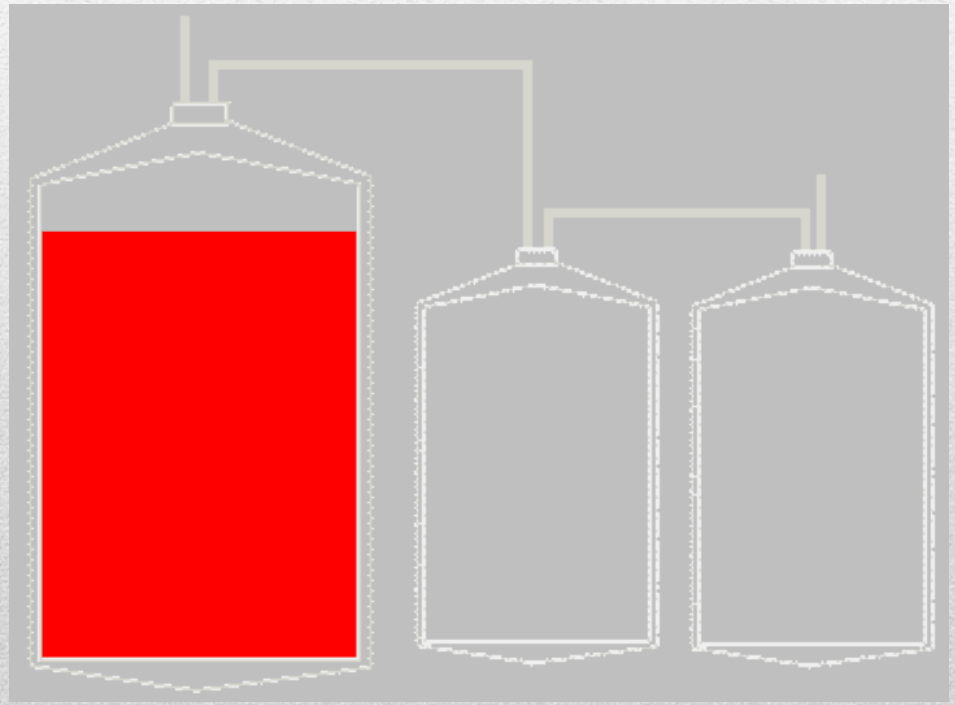
BLOOD PRODUCTS

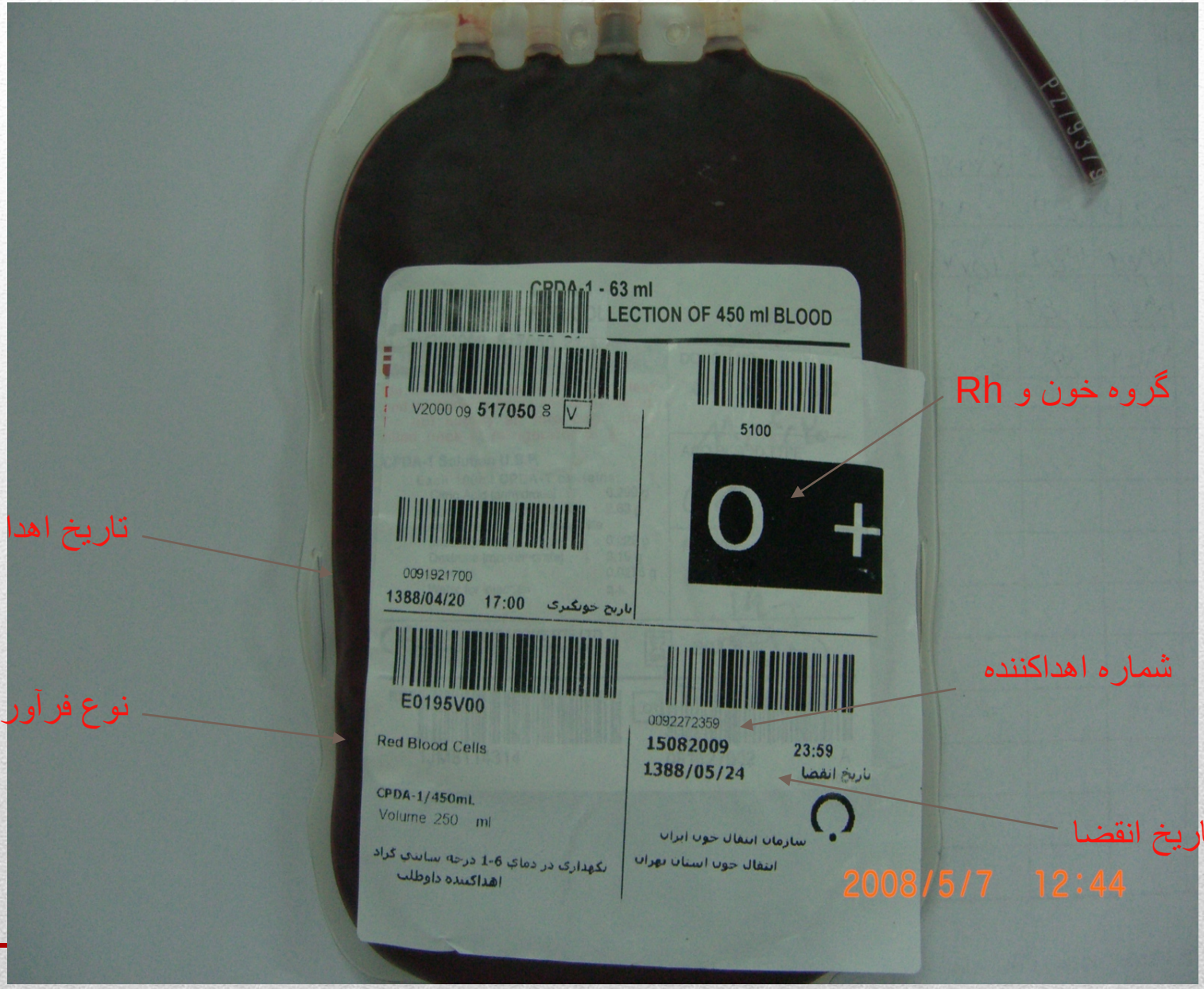
- Blood-cell products
  - whole blood
  - Red blood cells
  - leukocyte-poor (reduced) red cells
  - washed red blood cells
  - random-donor platelets concentrates
  - single-donor platelets concentrates [human leukocyte antigens(HLA)-matched platelets]
  - irradiated blood products (red blood cells and platelets concentrates)- after exposure to 25 Gy
  - Pediatric bag(RBC)

BLOOD PRODUCTS

- Blood-plasma products
  - Fresh Frozen Plasma (FFP)
  - Cryoprecipitate
  - Cryopoor plasma (CPP)

Blood bags




گروه خون و Rh
تاریخ اهدا
شماره اهداکننده
نوع فرآورده
تاریخ انقضا
CPDA-1 - 63 ml
LECTION OF 450 ml BLOOD
V2000 09 517050 8
5100
O +
0091921700
1388/04/20 17:00
E0195V00
0092272359
Red Blood Cells
15082009 23:59
1388/05/24
CPDA-1/450mL
Volume 250 ml
2008/5/7 12:44

Whole Blood

- 450ml +/- 10%
- 63ml CPDA-1
- Hct= 36-44%
- Stored at 2-6 ºC for 35 days
- Contains Normal Levels of WBC and PLT

Whole Blood

- Transfuse same group as patient (ABO & Rh)
- 1 unit: increase Hb level about 1g/dL (10g/L)& Hct by 3%.
- Use blood transfusion set

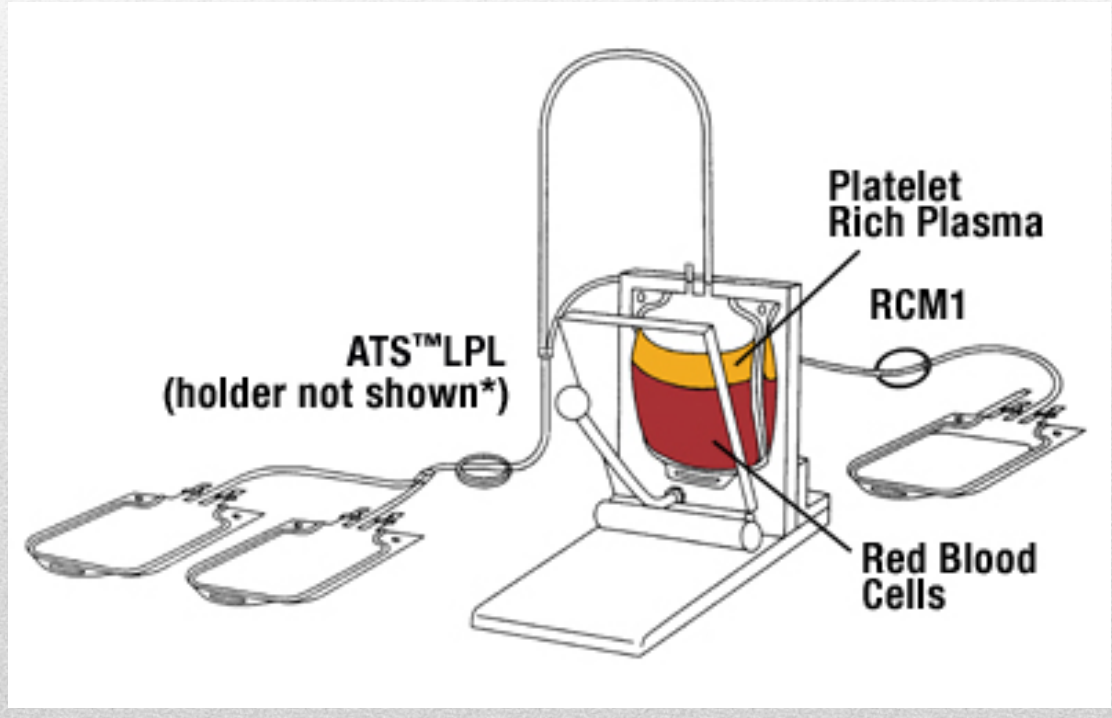
WHOLE BLOOD TRANSFUSION-indications

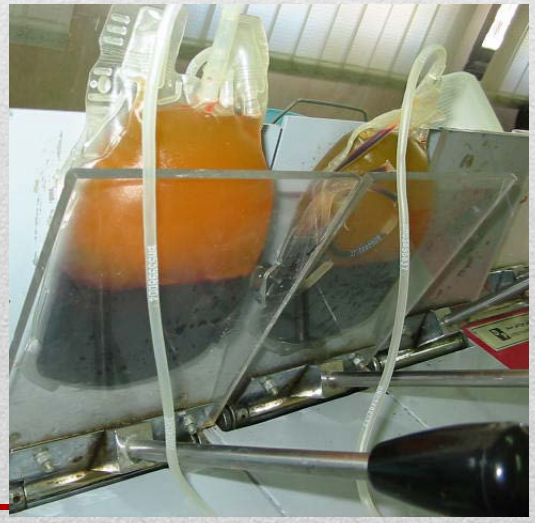
- **Acute hypovolemia (hemorrhagic shock)**
- **Massive transfusion** (>4-5 L/24hr)
- **Exchange transfusion in infants**

Contraindications of Whole Blood

- Congestive heart failure
- Chronic anemia

Blood product preparation





Blood product preparation

Red blood cells

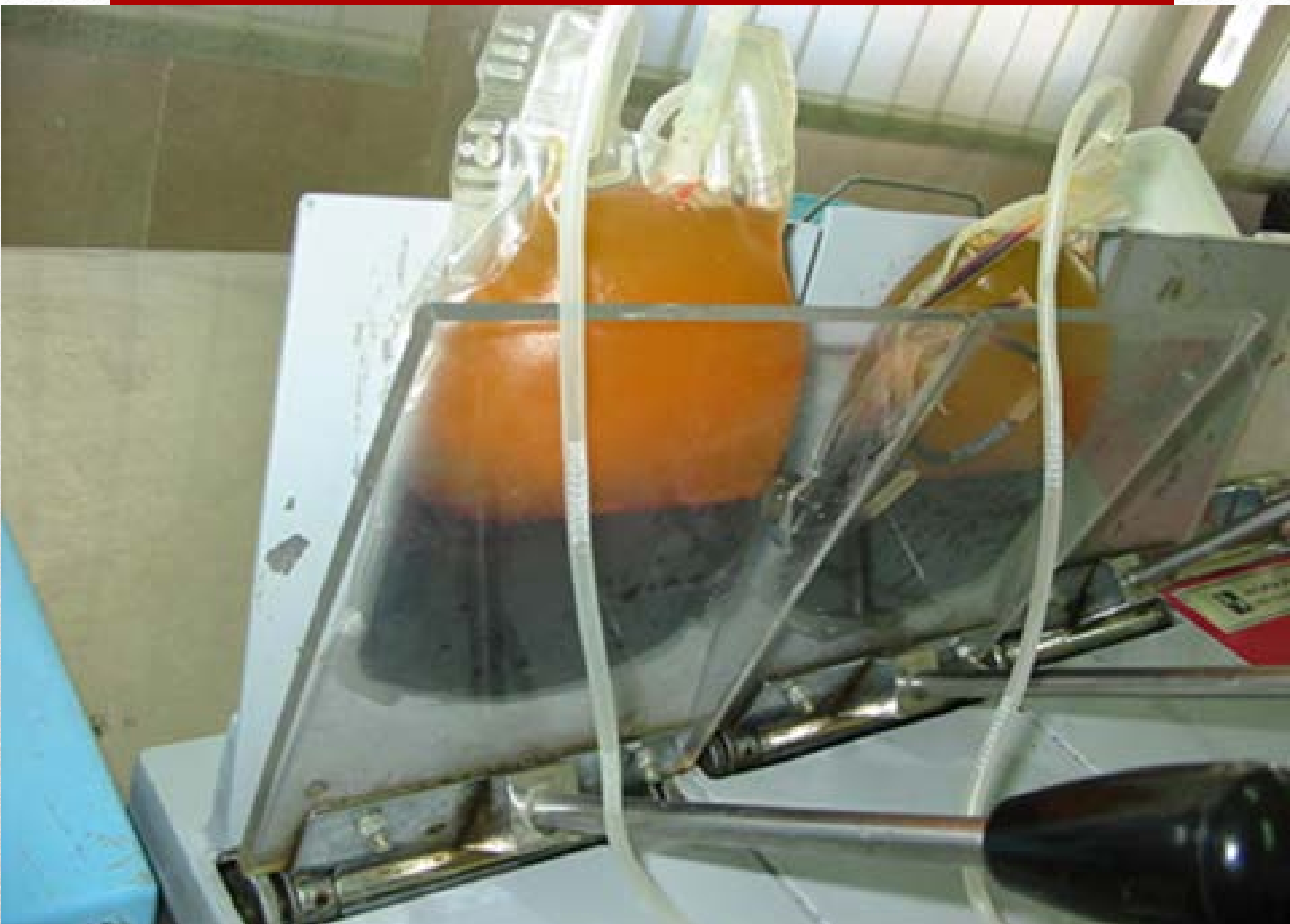
- Prepared by removing 200-250ml of plasma from a unit of W.B.
- 200-300 ml
- Hct= 65-80%
- Stored at 2-6 ºC for 35 days
- Do not contain functional platelets or granulocytes
- Have the same O2 carrying capacity as W.B

Red blood cells

- Injection up to 4 h’s
- Adult rate: 150-300 ml/h
- Child. rate :2-5ml/kg/h
- 1 unit: increase Hb level about 1g/dL (10g/L)& Hct by 3%.
- In child. 8-10ml/kg increase Hb level about 2g/dL (10g/L)& Hct by 6%.
- Consider age, symptoms, Hb level, underl. Dis., acute/chronic, other alternatives

Red blood cells-indications

- **Anemia in patient with normal blood volume**
- **Acute blood loss >15% blood volume**
- **Pre/ Post operative (Hb<9 & blood loss>500ml)**
- **Hb<7 in ill patient**
- **Thalassemia, sickle cell anemia**
- **Neonate Exchange transfusion**
- **Neonate&Pediatric transfusion**
- **Hb<8 in patient with acute coronary syndrome**



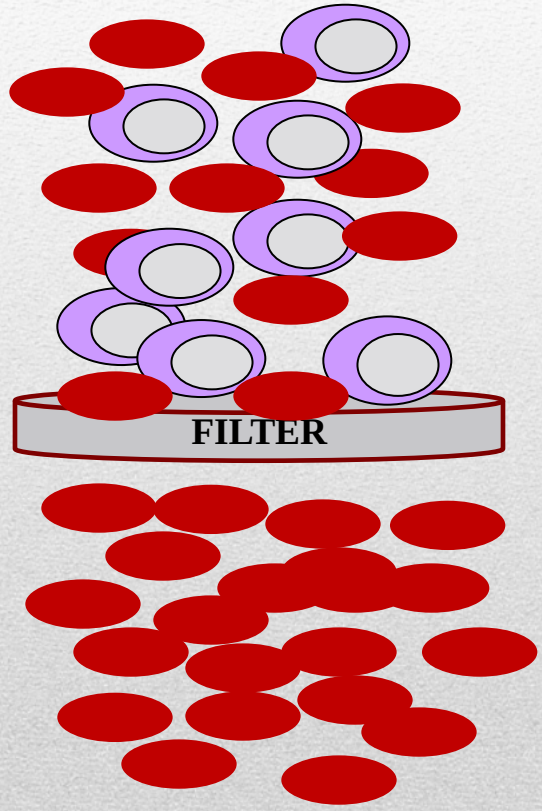
Washed red blood cells - indications

- Severe allergic reactions – 3 times
- IgA deficient patients – 5 times
- Attention: after washing
  - Decrease protein to 98%
  - Decrease WBC to 85%
  - Decrease RBC 10% to 20%
  - Stored at 2-6 ºC for 24hr

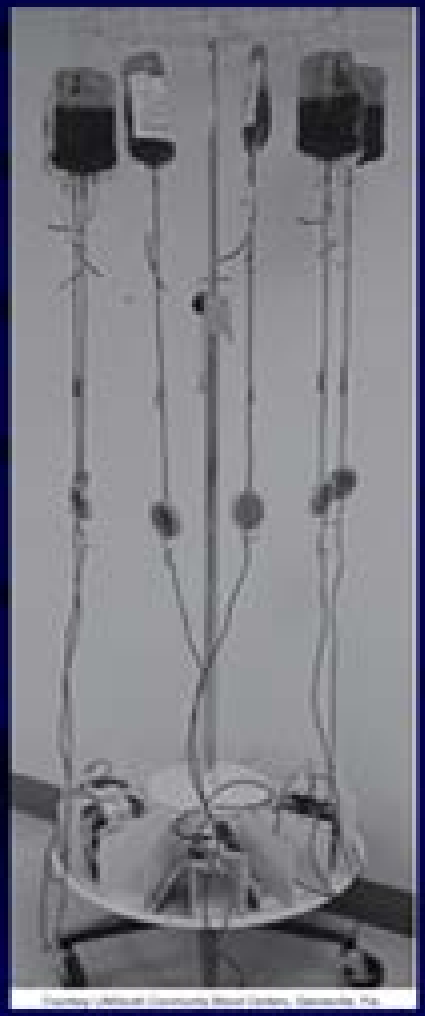
leukocyte-poor (reduced) red cells

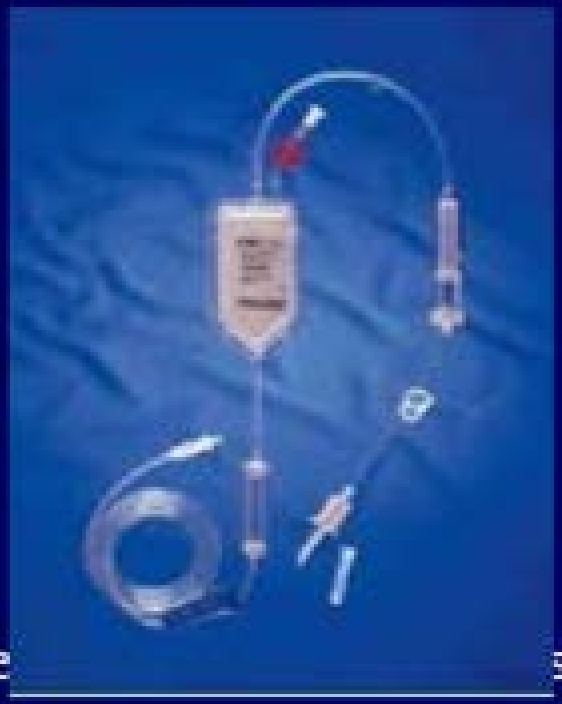
- **Contains : at least 85% of original red cells**
- **WBC < $5x10^6$**
- **to prevent or avoid nonhemolytic febrile reactions (FNHTR) due to antibodies to white cells and platelets in the recipients exposed to previous transfusions or pregnancies**
- **Reduce rate of HLA alloimmunization among hematology-oncology patients**
- **to minimize transmission of viral disease such as CMV**

Leukoreduction



Leukocyte Reduction Filters (maintains closed system)





Irradiated red blood cells

- Gamma irradiation 2500 rad
- Increase potassium level → expired date 28 days
- Changes WBC DNA

Transfusion-Associated Graft versus Host Disease

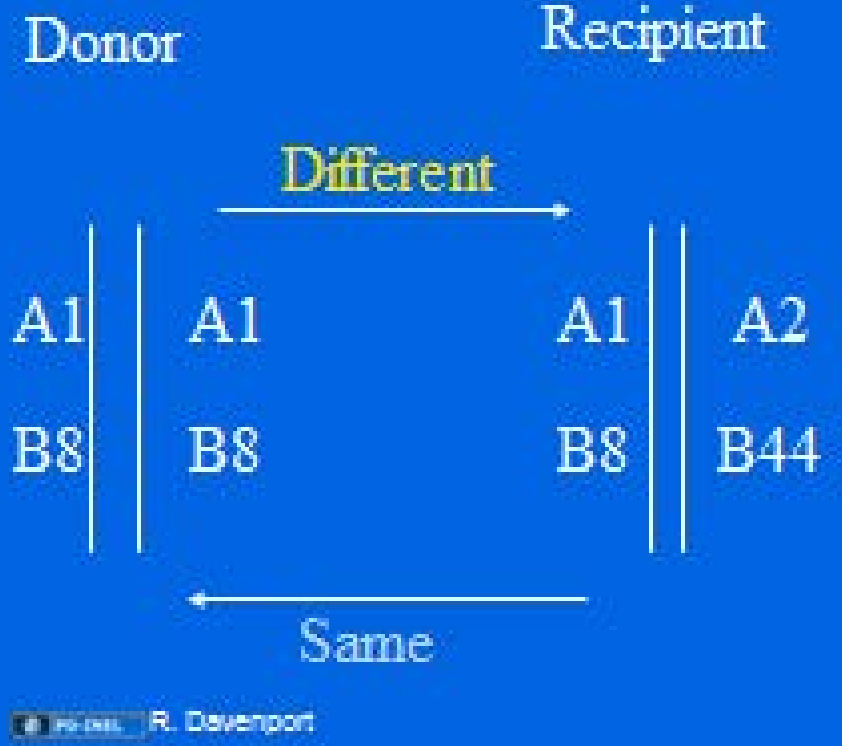
- Incidence: Rare
- Mechanism:
  - Viable donor T-lymphocytes engraft in recipient and mount an immune response against recipient tissues
- Signs & Symptoms
  - Erythroderma
  - Maculopapular rash
  - Anorexia
  - Nausea & vomiting
  - Diarrhea
  - Hepatitis
  - Pancytopenia
  - Fever

Who is at risk for TA-GVHD and needs irradiated blood products?

- Significantly increased risk
  - Congenital immunodeficiency syndromes
  - Bone marrow transplantation (allo & auto)
  - Transfusions from blood relatives
  - Intrauterine Transfusions
  - HLA-matched platelet transfusions/blood components
  - Hodgkin's disease
  - Patients treated with purine analogues
- Minimally increased risk
  - Acute leukemia
  - Non-Hodgkin's lymphoma
  - Solid tumors treated with intensive chemotherapy/radiation
  - Exchange transfusion
  - Premature neonates
  - Neonates on ECMO
  - Solid organ transplant recipient
- Perceived, but no reported risk
  - Healthy newborns
  - Patients with AIDS

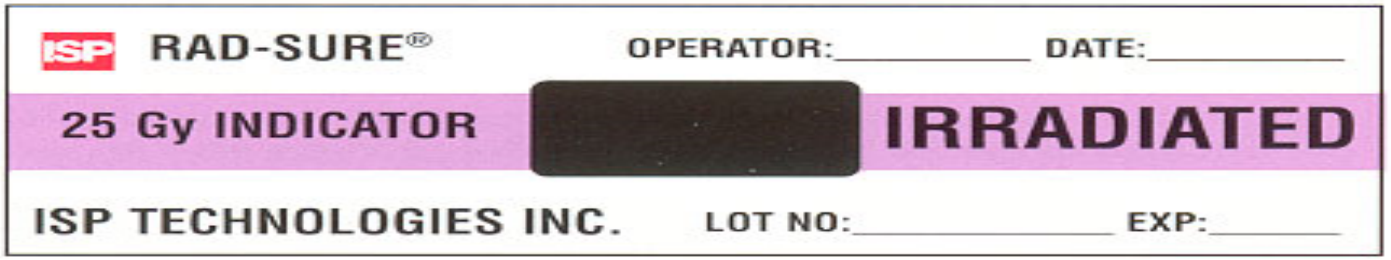
Mechanism of Engraftment in Normal Recipients

- HLA homozygous donor
- HLA heterozygous recipient
- Shared haplotype



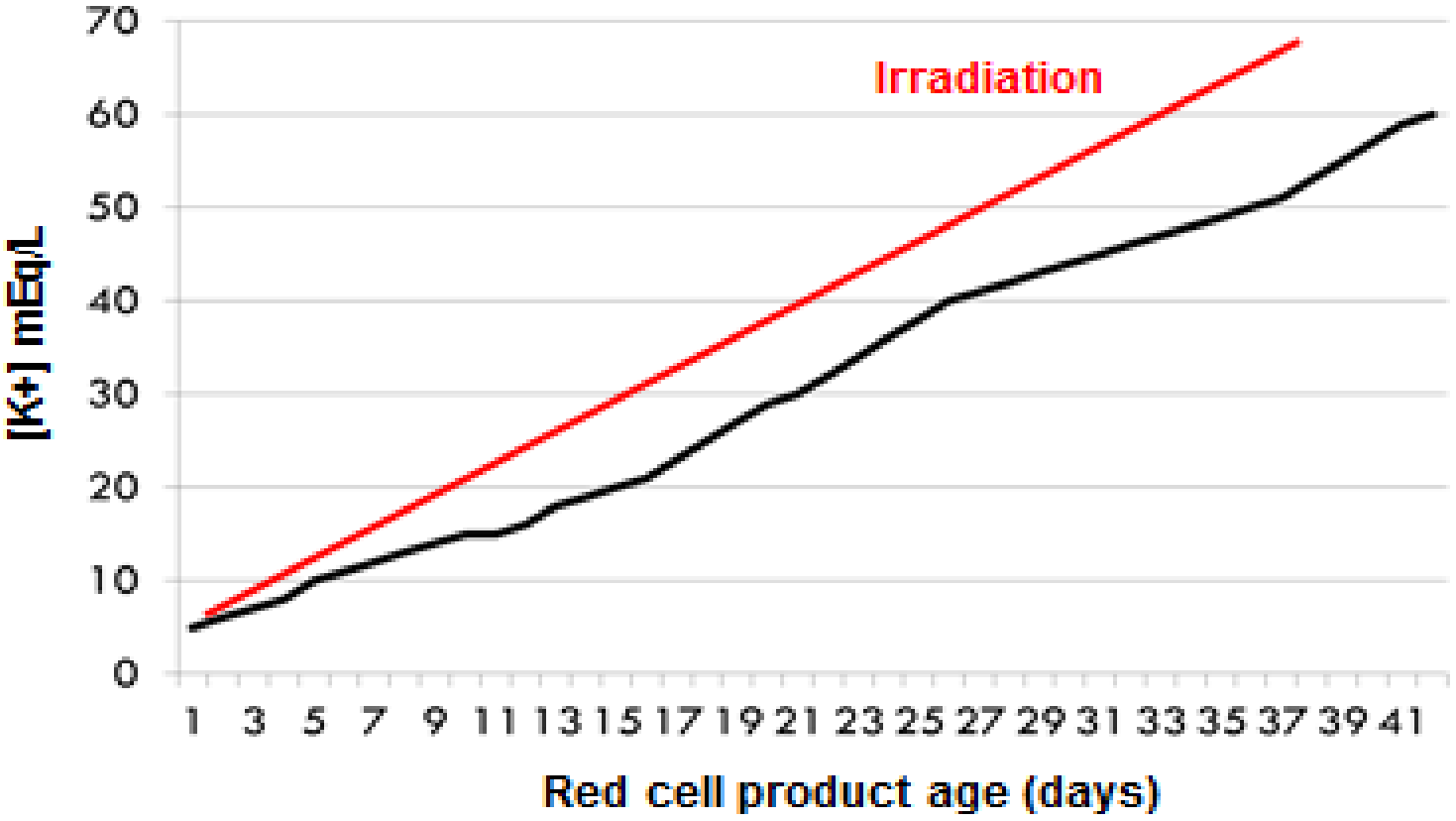
Irradiation of Blood Components

BEFORE IRRADIATION



AFTER IRRADIATION @ 25 Gy

[K+] during storage



BLOOD LOSS- signs, symptoms and indication for transfusion

Volume Lost		Clinical signs	Preparation of choice
mL	% of Total Blood Vol.		
500	10	None;	No transfusion or crystalloid solution
1000	20	tachycardia	crystalloid solution or colloids or RBC if necesssary
1500	30	drop in BP	crystalloid solution plus colloids plus RBC or blood if available
2000	40	shock	crystalloid solution plus colloids plus RBC or blood if available

Patient and donor RBC selection by ABO and Rh type

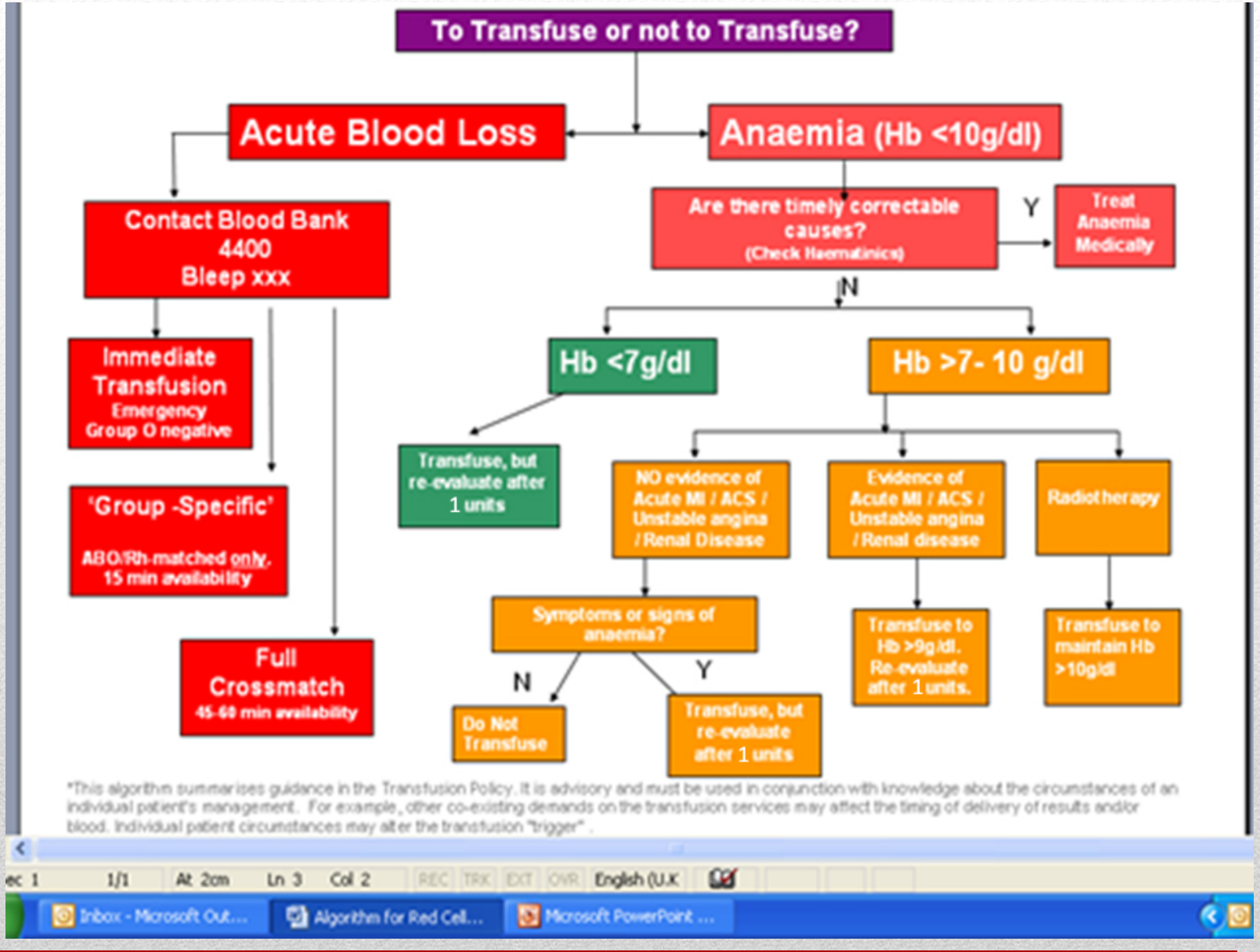
Patient	Donor
A	A, O
B	B, O
AB	A, B, AB, O
O	O
Rh(+)	Rh(+), Rh(-)
Rh(-)	Rh(-)

RBC Changes during storage

- Increase K
- Increase Free Hb
- Decrease ATP
- Decrease 2,3DPG
- Decrease pH
- ……..

INDICATION OF FRESH BLOOD

- Neonate Exchange transfusion
- Neonate transfusion
- Thalassemia
- Intra uterian transfusion
- Hyperkalemic patients
- Massive transfusion


To Transfuse or not to Transfuse?
Acute Blood Loss
Anaemia (Hb <10g/dl)
Contact Blood Bank
4400
Bleep xxx
Are there timely correctable causes?
(Check Haematinics)
Y
Treat Anaemia Medically
N
Immediate Transfusion
Emergency
Group O negative
Hb <7g/dl
Hb >7- 10 g/dl
'Group -Specific'
ABO/Rh-matched only.
15 min availability
Transfuse, but re-evaluate after 1 units
NO evidence of Acute MI / ACS / Unstable angina / Renal Disease
Evidence of Acute MI / ACS / Unstable angina / Renal disease
Radiotherapy
Full Crossmatch
45-60 min availability
Symptoms or signs of anaemia?
Transfuse to Hb >9g/dl. Re-evaluate after 1 units.
Transfuse to maintain Hb >10g/dl
N
Y
Do Not Transfuse
Transfuse, but re-evaluate after 1 units
*This algorithm summarises guidance in the Transfusion Policy. It is advisory and must be used in conjunction with knowledge about the circumstances of an individual patient's management. For example, other co-existing demands on the transfusion services may affect the timing of delivery of results and/or blood. Individual patient circumstances may alter the transfusion "trigger" .
ec 1
1/1
At 2cm
Ln 3
Col 2
REC
TRK
EXT
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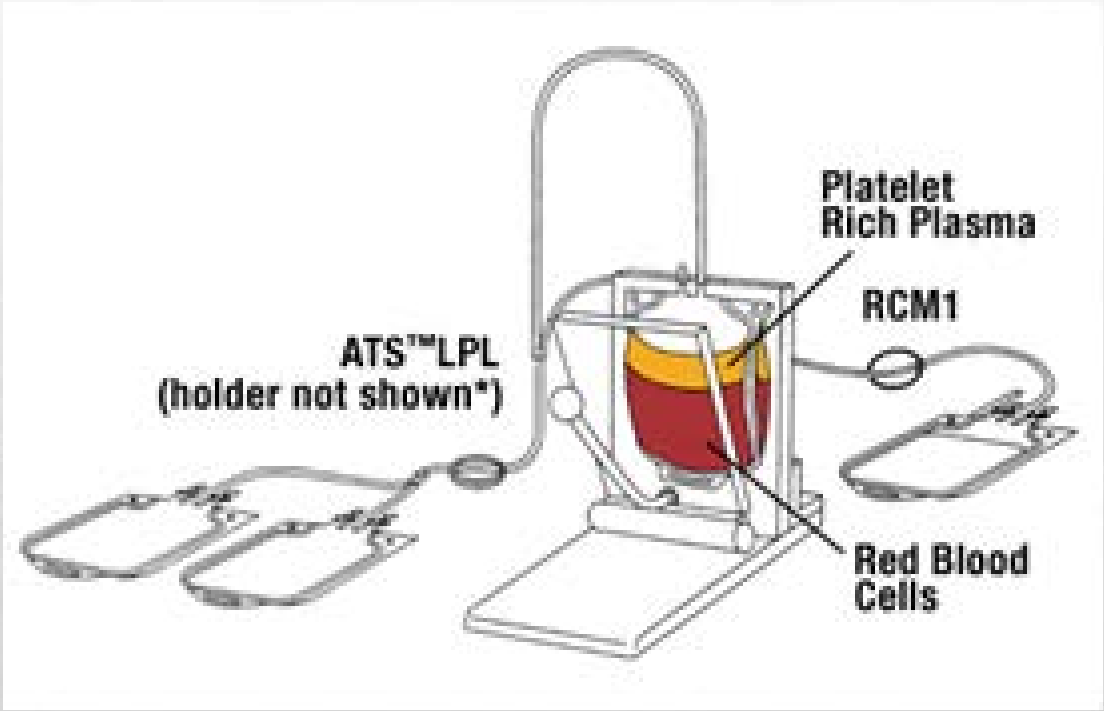
English (U.K
Inbox - Microsoft Out...
Algorithm for Red Cell...
Microsoft PowerPoint ...

FRESH FROZEN PLASMA (FFP)

Blood product preparation



Fresh Frozen Plasma (FFP)

- prepared by removing plasma from W.B within 8h of collection.
- 200-250ml
- Stored at –30ºC or below for 2years / -20 to -25 ºC for 1year
- Contains :

  Water, carbohydrates, fats, minerals

  albumin, clotting factors(all labile & stable clotting fx),

  immunoglobulin, antithrombin
- Each unit of FFP increases the level of each clotting fx by 2-3% in adults.

Fresh Frozen Plasma (FFP)-Indications

- Coagulopathy due to multiple factor deficiencies
- Corrections of known congenital or acquired coagulation factor deficiencies(e.g., factors II, V, VII, X, XI, or XIII) in patients with hemorrhage
- Urgent reversal of warfarin effect
- Treatment of microvascular hemorrhage in the presence of prolonged PT, aPTT (> 1.5 x normal)
- Treatment of microvascular bleeding following massive blood transfusion when timely reporting of laboratory test result is not available
- Plasma exchange for TTP

Fresh Frozen Plasma (FFP)-Contraindications

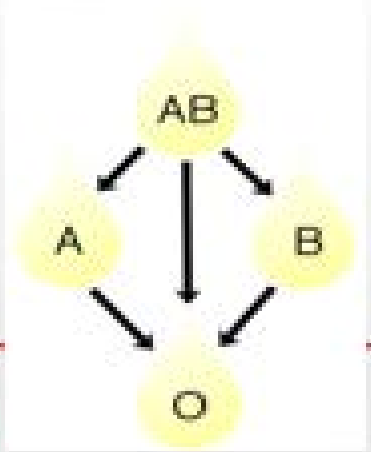
Plasma should not be used:

- as a volume expander or as a nutritional supplement
- as albumin supplementation
- for correction of hypogammaglobulinemia
- for treatment of hemophilia or von Willebrand disease or other congenital procoagulant and anticoagulant factor deficiency where virally inactivated or recombinant factor concentrates are preferred

Fresh Frozen Plasma (FFP)

- Thaw at 37 °C & use within 4 h ,
  if not used keep at 2-6 °C for 24 h
- transfusion rate: adults= 200-300ml/h or 4ml/min
  child.= 60-120ml/h
- Transfuse by filter (170-260 micron)

Patient and donor plasma selection by ABO



Recipient	Donor
O	O, A, B, AB
A	A, AB
B	B, AB
AB	AB

CRYOPRECIPITATE &CPP

Cryoprecipitate

- Vol= 15ml
- The cold-insoluble portion of plasma that remains after FFP has been thawed at 1-6 ° C
- Use as soon as prepared / freeze
- Stored at -30°C or below for 2years /
  -20 to -25 °C for 1year

Cryoprecipitate

- Thaw at 37°C, kept max. 6 h. at room temp.
- Factor VIII decrease: 1st h. 10%
  4h. 20%
  6h. 30%

hence for Factor VIII replacement use within 4 h. of thawing

- Transfusion rate: 5ml/min

Cryoprecipitate

- Contains:
  - Factor VIII:C = 80-120 U
  - Factor VIII:vWF = 70-80 U
  - Factor XIII = 40-60 U
  - Fibrinogen = 150-250 mg
  - Fibronectin = 30-60mg
  - About 10-15ml of plasma

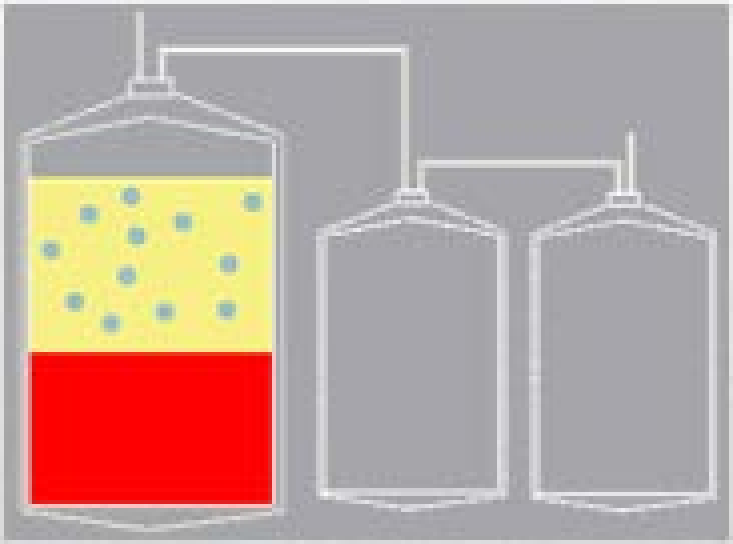
- Dose: 1U/ 5-10kg in hypofibrinogenemia

Cryoprecipitate-Indications

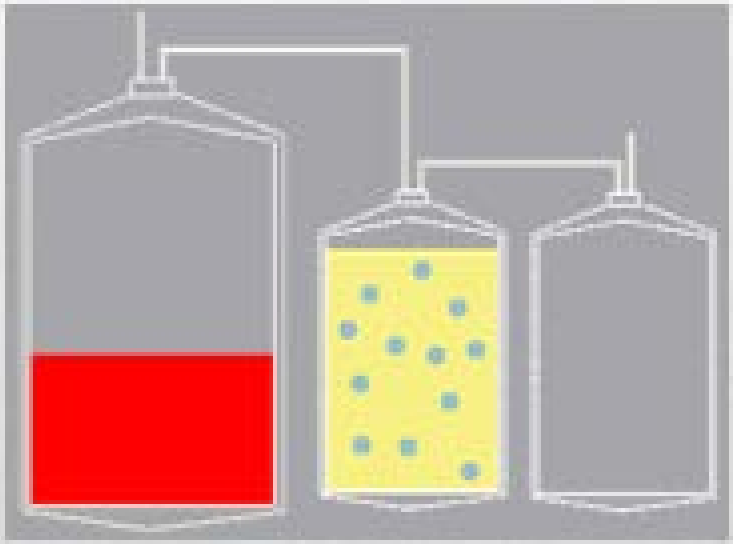
- von Willebrand's disease (if concentrate not available)
- Hemophillia A (if concentrate not available)
- Factor XIII def.
- Cong./acquired fibrinogen def.
- Uremic bleeding (DDAVP prefered)
- fibrin glue

PLATELET PRODUCTION & STORAGE

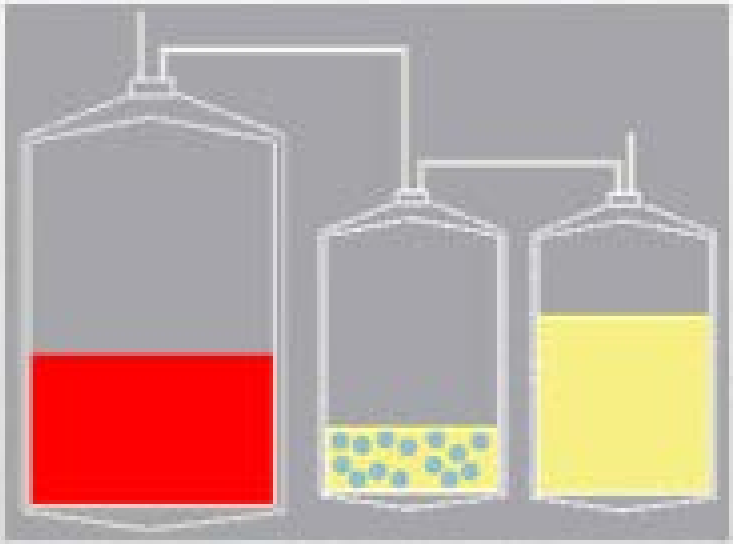
Random donor Platelets



Random donor Platelets

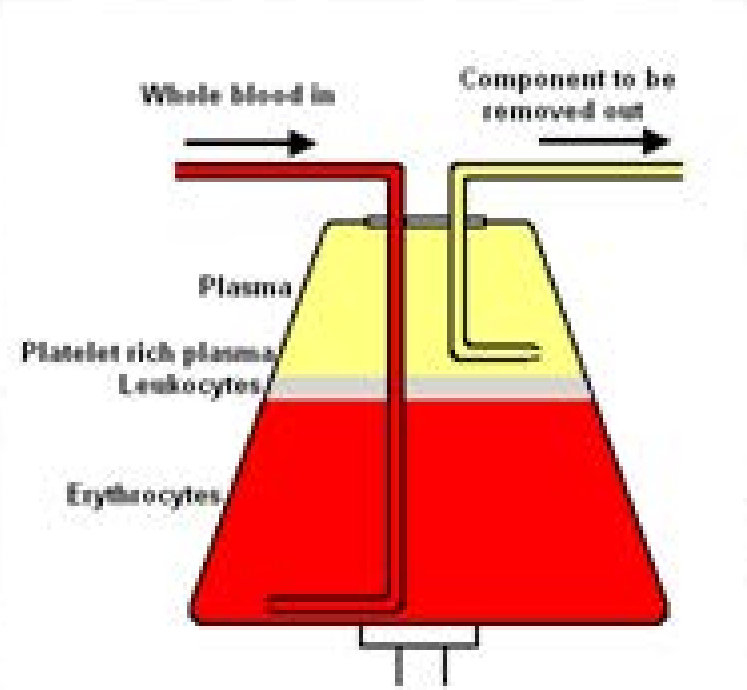


Random donor Platelets



- **$\leq 5.5 \times 10^{10}$ platelet in 50-70ml of plasma**
- Each unit of plt. expected to increase 5000-10000 plt.

Apheresis


Whole blood in
Component to be removed out
Plasma
Platelet rich plasma
Leukocytes
Erythrocytes

Single donor platelet

- Plateletphresis
- ≤$3x10^{11}$ platelet in 300ml of plasma
- Stored at 20-24°C in shaker incubator
- Each unit of plateletphresis unit increase plt. 30000-60000.
  (1 U random plt expected to increase 5000-10000 plt)
- Equals 6 random platelet
- Decrease donor exposure(safety)

تهیه پلاکت به روش پلاکت فرزیس

پلاکت تهیه شده نسبت به روش معمول حجم بیشتری دارد و فرد می تواند سالی ۲۴ بار اهدای پلاکت فرزیس داشته باشد

Pooled leukoreduced platelet

- 5-6 random platelet pooled in a close system
- Stored at 20-24°C for 3 days
- Benefit: leukoreduced
- Implication:
  - prevent alloimmunization
  - to minimize transmission of viral disease such as CMV

Platelet transfusion-indication

- Prophylaxis in otherwise healthy man
- Treatment of patient on Chemotherapy
- Treatment of patient with fever, infection or antiplatelet therapy
- Treatment of patient with mucosal bleeding
- Treatment of surgical patient
- Bleeding in patients with thrombocytopenia or functional platelet abnormality
- After massive transfusion(RBC) and thrombocytopenia
- Cardiac surgery with extracorporeal circulation

TABLE 24-3. Transfusion Guidelines for Platelets in Neonates and Older Children[9,10]

With Thrombocytopenia
1. Platelet count <10,000/μL with failure of platelet production.
2. Platelet count <30,000/μL in neonate with failure of platelet production.
3. Platelet count <50,000/μL in stable premature infant:
a. With active bleeding, or
b. Before an invasive procedure, with failure of platelet production.
4. Platelet count <100,000/μL in sick premature infant:
a. With active bleeding, or
b. Before an invasive procedure in patient with DIC.
Without Thrombocytopenia
1. Active bleeding in association with qualitative platelet defect.
2. Unexplained excessive bleeding in a patient undergoing cardiopulmonary bypass.
3. Patient undergoing ECMO with:
a. A platelet count of <100,000/μL, or
b. Higher platelet counts and bleeding.

DIC = disseminated intravascular coagulation; ECMO = extracorporeal membrane oxygenation.

PLATELET:

- Thrombocytopenia
  - <10,000 in uncomplicated patients
  - <20,000 if febrile or septic
  - <50,000 if bleeding or undergoing major surgery
  - <100,000 for neurosurgery or ophthalmologic procedures
- Thrombocytopathy
  - Congenital defects
  - Drugs (ASA, Plavix)
  - External agents (cardiac bypass or ECMO)

Contraindications

- TTP/HUS
- Heparin-induced thrombocytopenia (HIT)
- ITP (relative contraindication)

Dosage:

- Adult dose: 1 random platelet unit/ 10 kg wt.
  (one dose=5 or more units of random platelets)
- Child: 5-10 ml/kg increases platelet count by 50000-100000

Causes of PLT refractoriness

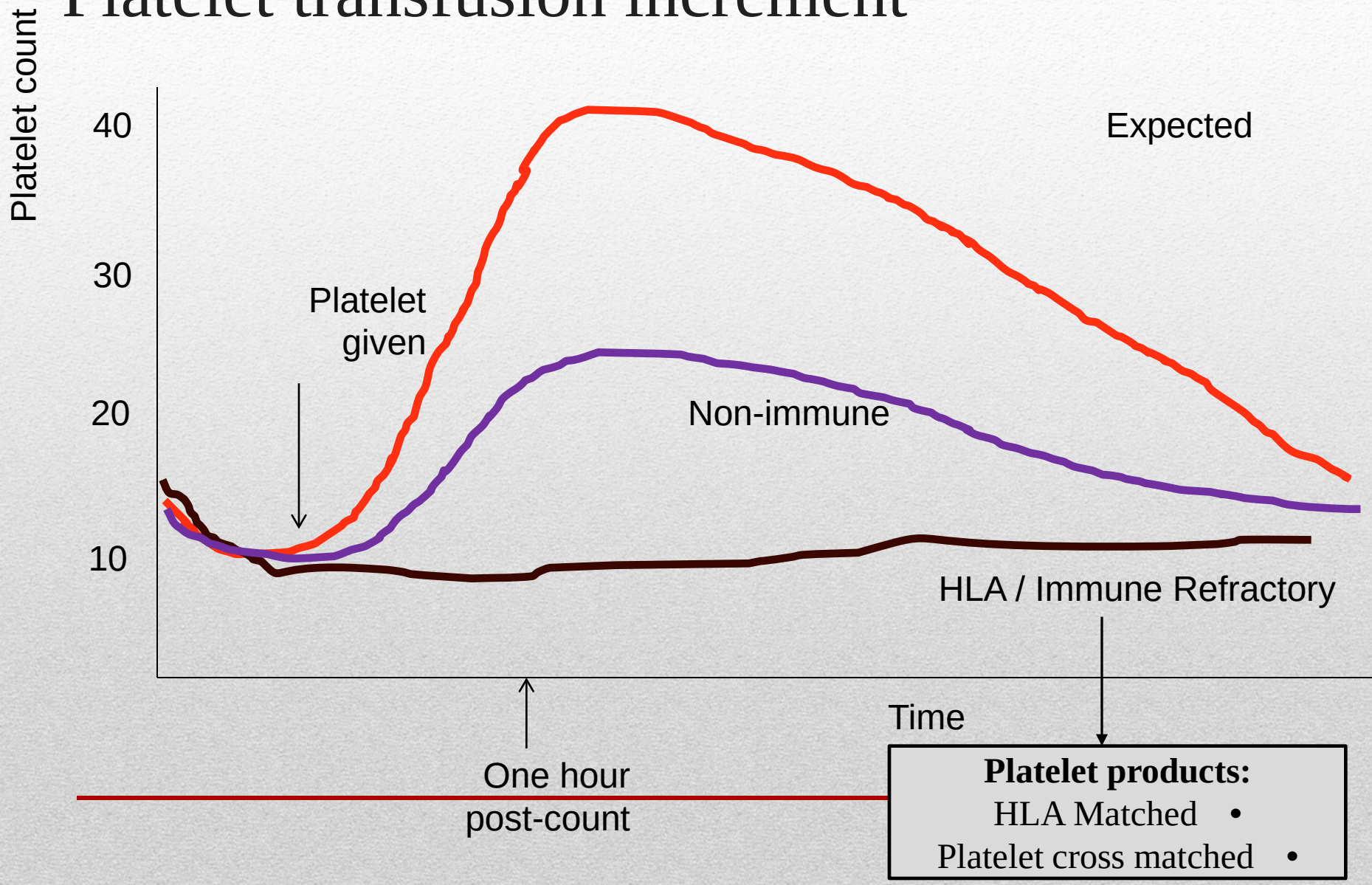
- Nonimmune(80%)
  - Fever
  - Sepsis
  - Splenomegaly
  - DIC
  - GVHD
  - Drug(Amphotricin-Vancomycin)
  - Hemorrhage
  - Prolonged platelet storage
  - Veno-occlusive disease
- Immune(20%)
  - HLA Antibodies
  - ABO mismatch
  - HPA Antibodies
  - Drug dependent autoantibodies

Response evaluation to platelet transfusion:

$$CCI^{*} = \frac{(P1\text{-}P0) \times BSA\ (m^2)}{\text{no. Platelet transfused}} \times 10\ 11$$

*Corrected count increment

Platelet transfusion increment



Modified Platelet Units

- Leukocyte-reduced platelets

- Irradiated

8 Rights of Transfusion Administration

LOYOLA UNIVERSITY HEALTH SYSTEM

ATTENTION

- The most logical approach to reducing the risk of transfusion is only to use blood when it is strictly clinically necessary and there is no alternative
- Ref=ABC of transfusion