Transfusion medicine

Dr;Golafshan 2023


1 UNIT OF BLOOD
SAVES UP TO 3
LIVES
It's not just blood,
it's liquid life.
Donate today. Save a life.
HealthInsite

درخواست خون و فرآورده های خونی

مسئول تکمیل فرم : - پرستار و پزشک در خواست کننده

- فرد نمونه گیر

قسمت‌های ذیل توسط پزشک و پرستار درخواست کننده تکمیل شود :

مشخصات بیمار:

نام:	نام خانوادگی:	نام پدر:	تاریخ تولد:	کدملی: (در صورت دسترسی)	جنسیت: ☐ مرد ☐ زن

استان :	شهر:	بیمارستان:	بخش:	شماره پرونده:

سابقه:

سابقه تزریق در ۳ماه گذشته :	☐ بلی	☐ خیر	☐ نامشخص
سابقه حاملگی در ۳ماه گذشته :	☐ بلی	☐ خیر	☐ نامشخص
سابقه بروز عوارض حاد مرتبط با تزریق خون :	☐ بلی	☐ خیر	☐ نامشخص
سابقه وجود آنتی بادی غیر منتظره در سرم :	☐ بلی	☐ خیر	☐ نامشخص

آیا نیاز به تجویز دارو قبل از تزریق می باشد؟

☐ بلی ☐ خیر نام دارو :

نحوه تجویز :

علت نیاز به تزریق خون یا فرآورده

تشخیص بیماری : .....

علت نیاز به خون یا فرآورده کدام یک از موارد زیر می باشد.

☐ کم خونی مزمن ☐ کم خونی حاد ☐ نقص در تعداد پلاکت ☐ نقص در عملکرد پلاکت

☐ خونریزی ☐ نقص سیستم انعقاد ☐ عمل جراحی(نوع عمل) ..... سایر علل ذکر شود :

- در صورت درخواست فرآورده‌های گلبول قرمز میزان هموگلوبین: g/dl .....
- در صورت درخواست فرآورده پلاکتی میزان پلاکت /µl.....
- گروه خون و Rh بیمار (در صورت مشخص بودن) :.....

فرم نظارت بر تزریق خون کامل و فرآورده های گلبول قرمز

مسئول تکمیل فرم : پرستار یا پرستاران ناظر بر تزریق

مشخصات بیمار و وضعیت فرآورده ارسالی

توجه : پرستار گرامی بسیار حیاتی است که قبل از تزریق موارد زیر را کنترل نمایید :

آیا هویت دریافت کننده خون (از طریق پرسش از خود بیمار در صورت هوشیاری، اطلاعات مچ بند و شماره پرونده بیمار) با اطلاعات فرم مشخصات خون ارسالی برای بیمار و فرم درخواست خون با یکدیگر مطابقت دارد؟

بلی ☐ خیر ☐ توضیحات :

آیا مشخصات گروه خون وشماره اهداکننده روی کیسه خون با اطلاعات موجود برروی فرم مشخصات خون ارسالی همخوانی دارد ؟ بلی ☐ خیر ☐ توضیحات :

تاریخ انقضای فرآورده : مناسب ☐ نامناسب ☐ توضیحات :

بررسی وضعیت ظاهری کیسه : مناسب ☐ نامناسب ☐

☐ کنترل شد نام و نام خانوادگی تزریق کننده : امضا :

☐ کنترل شد نام و نام خانوادگی شاهد : امضا :

در صورت عدم تائید هر یک از موارد فوق ، به هیچ وجه خون را تزریق ننموده و کیسه خون را به بانک خون عودت دهید و همچنین به پزشک هموویژلانس یا پزشک مشاور انتقال خون گزارش نمایید .

ثبت زمان تحویل فرآورده و چگونگی تزریق

تاریخ تحویل کیسه به بخش: ساعت تحویل کیسه به بخش بیمارستان:

سایز یا رنگ سرسوزن مورد استفاده :

مهم :

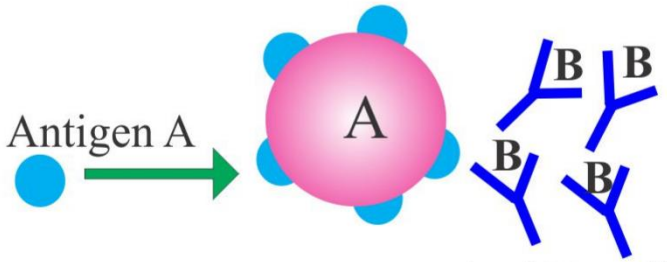
در صورت عدم استفاده از این فرآورده، آن را سریعا به بانک خون عودت دهید. فرآورده RBC حداکثر می تواند ۳۰دقیقه در دمای اتاق ۲۴-۲۰ پس از خروج از بانک خون در بخش نگهداری شود.

Correct Identification

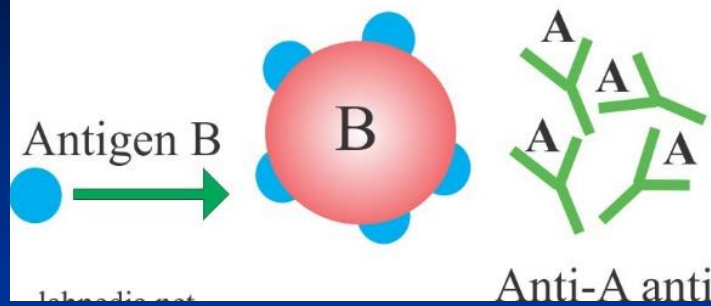
- Phlebotomist (nurse / technician / doctor) must confirm recipient's ID from patient file
  - full patient name and hospital number
  - name of physician
- The sample should have
  - patient name,
  - hospital number
  - date and time of collection
  - phlebotomist's initials
- All of this should be on the request form & the sample

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Sample drawn @ 1 pm	Sample used	Sample used	Sample expires @ midnight	New sample drawn @ 6 am	New sample used	New sample used
Day 0	Day 1	Day 2	Day 3	Day 0	Day 1	Day 2

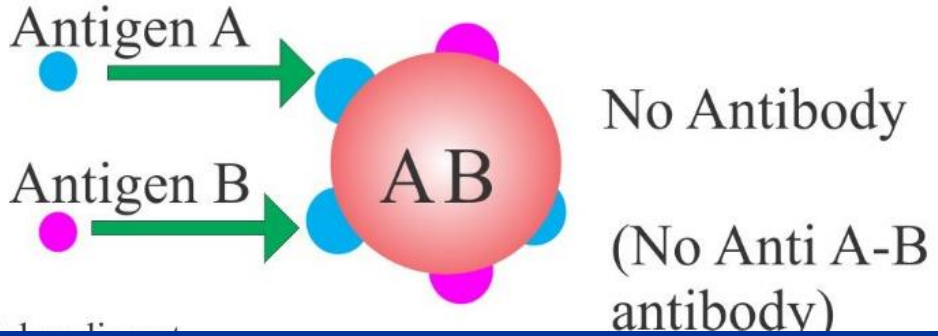
Blood group A



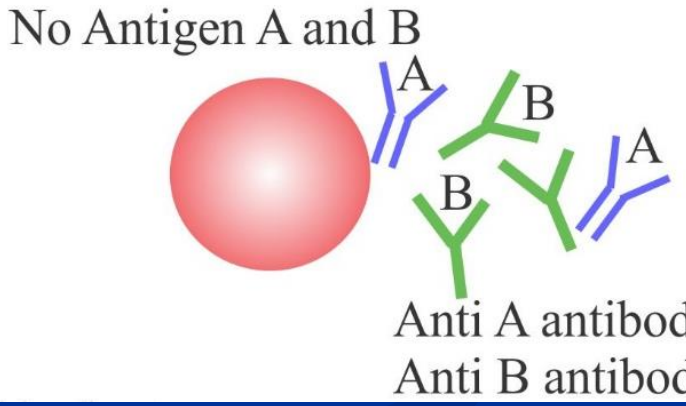
Blood group B



Blood group AB



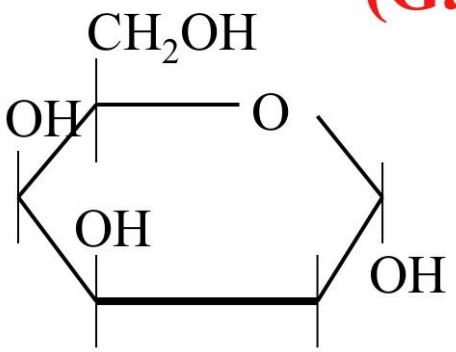
Blood group O



Immunodominant Sugars

A

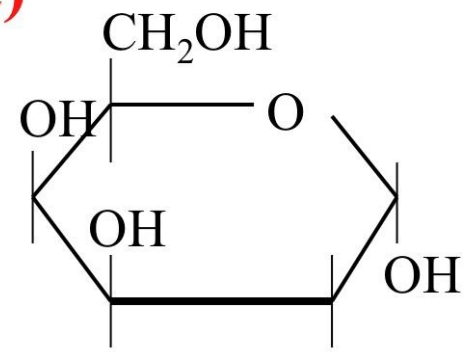
***N*-acetyl-D-galactosamine (GalNAc)**



NHCOCH$_3$

B

D-galactose



OH

Table 1 Ten major blood group systems

ISBT no.	Name of blood group system	Major antigens	Chromosome location no.
001	ABO	A, B, A_1	9
002	MNS	M, N, S, s, U	4
003	P1PK	P1, P^k	22
004	Rh	D, C, E, c, e	1
005	Lutheran	Lu^a, Lu^b	19
006	Kell	K, k, Kp^a, Kp^b, Js^a, Js^b	7
007	Lewis	Le^a, Le^b	19
008	Duffy	Fy^a, Fy^b, Fy3	1
009	Kidd	Jk^a, Jk^b, Jk3	18
027	I	I	6

Immunogenicity of Blood Group Antigens

A, B and D (Rho) – most immunogenic

Kell (K)

Duffy: Fy^a

Fy^b

Kidd: Jk^a

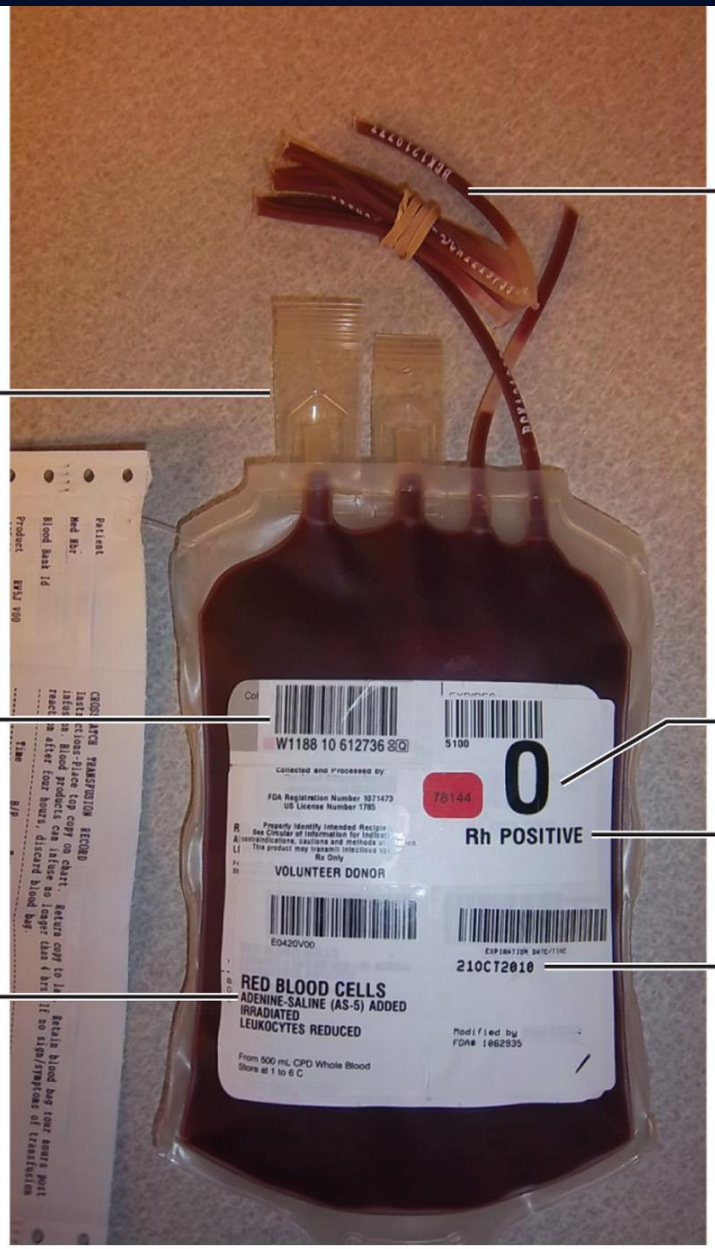
Jk^b

Weak D or Du phenotype

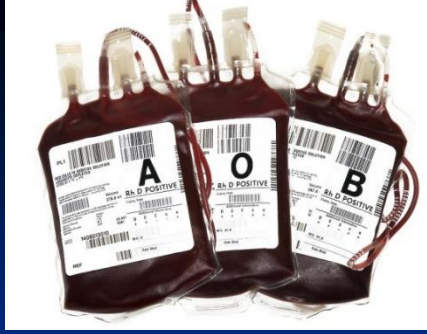
weak Rh gene

D and C in trans position

mosaic or partial D


Sterilely sealed, attached segments
Ports
Component identification number
ABO group
Rh(D) type
Component name
Expiration date
W1188 10 612736
0
Rh POSITIVE
VOLUNTEER DONOR
RED BLOOD CELLS
ADENINE-SALINE (AS-5) ADDED
IRRADIATED
LEUKOCYTES REDUCED
210CT2010

Shelf Life of Red Cell Products



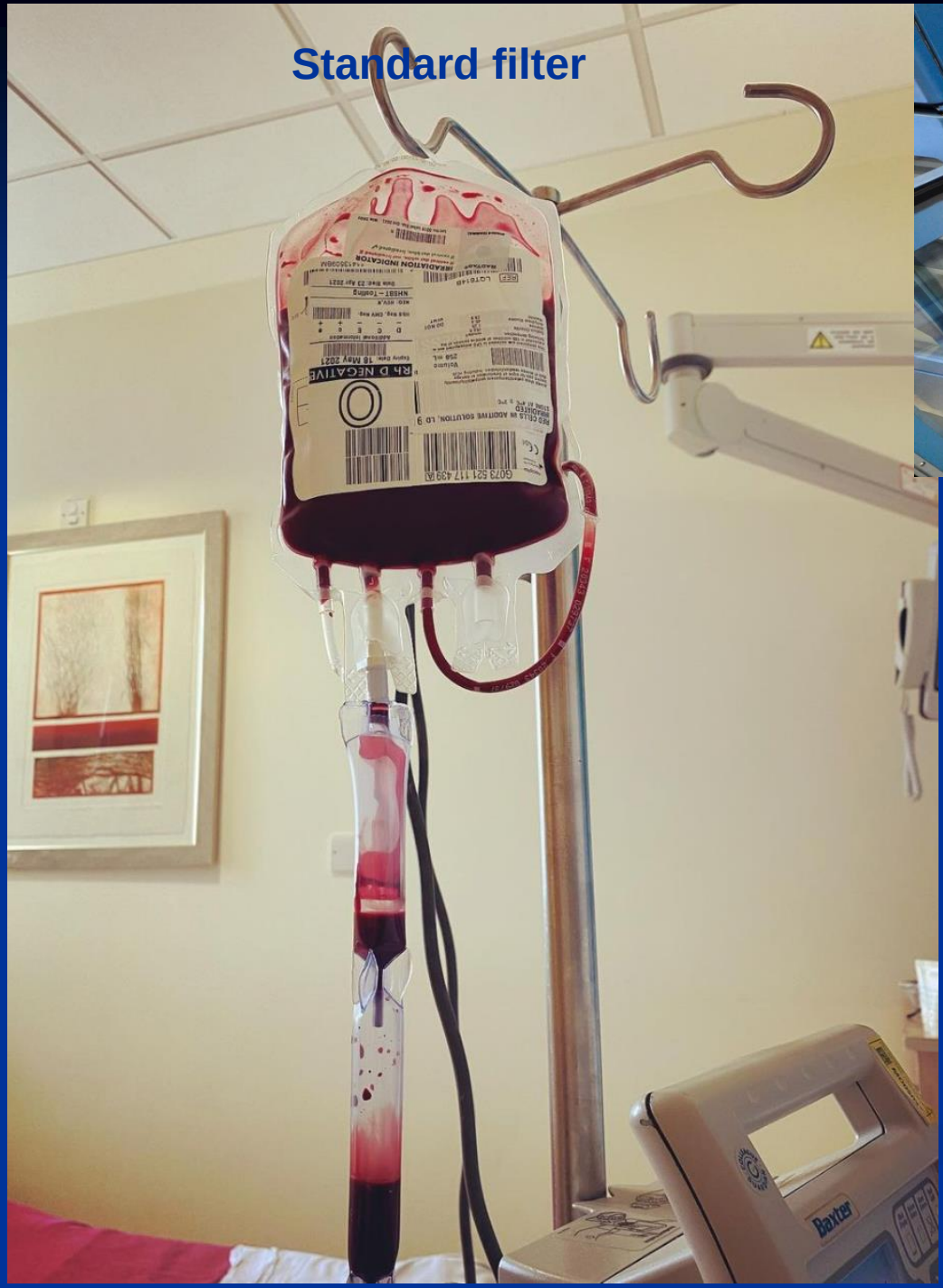
- **CPD:** 21 Days
- **CPD-A:** 35 Days
- **Adsol(AS-1):** 42 Days
- **Nutricel(AS-3):** 42 Days
- **Optisol(AS-5):** 42 Days
- SAGMAN,saline,adenine,manitol,glucose

RED BLOOD CELLS PRODUCT

- Whole blood
- Packed RBC
- Washed RBC
- LR—RBC(leukocyte reduced red blood cells)
- Irradiated blood
- Fresh blood
- Frozen RBC
- Rejuvenated blood (PIPA)

Bacterial Contamination

Component	Appearance
WB/RBC (difficult to see except in separated plasma or segments) 	• Product appears darker than the segments • Unusual color; for example purplish in color • Unusual gas bubbles • A zone of hemolysis above the red cell mass • Plasma or supernatant is murky, purple, brown or red • Clots • Fibrin strands
Plasma	• Clots • Fibrin strands • Murky
Platelets	• Clots • Fibrin strands • Unusual color


Standard filter
RH D NEGATIVE
Baxter


Platelet shaker
HELMER
21.8°C


Blood warmer

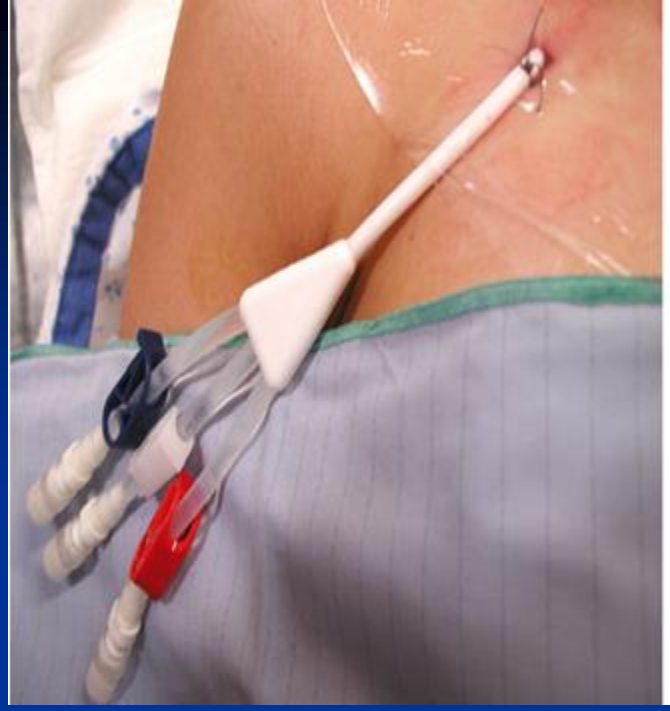
Blood specimen from umbelical cord,wharton jelly

Blood component warmers

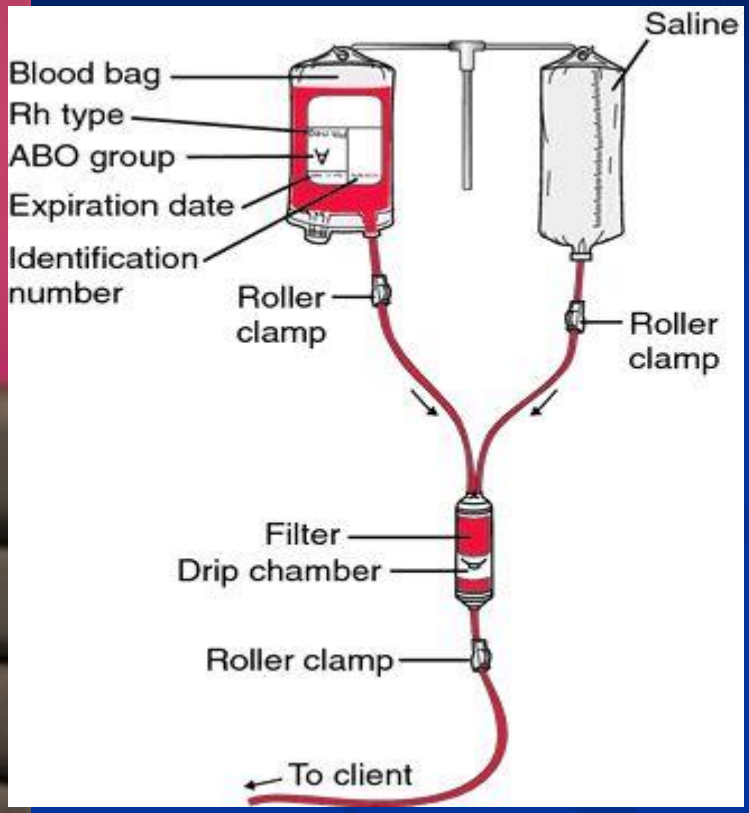
Most patients can receive blood components at the temperature provided from the Transfusion Service Provider.

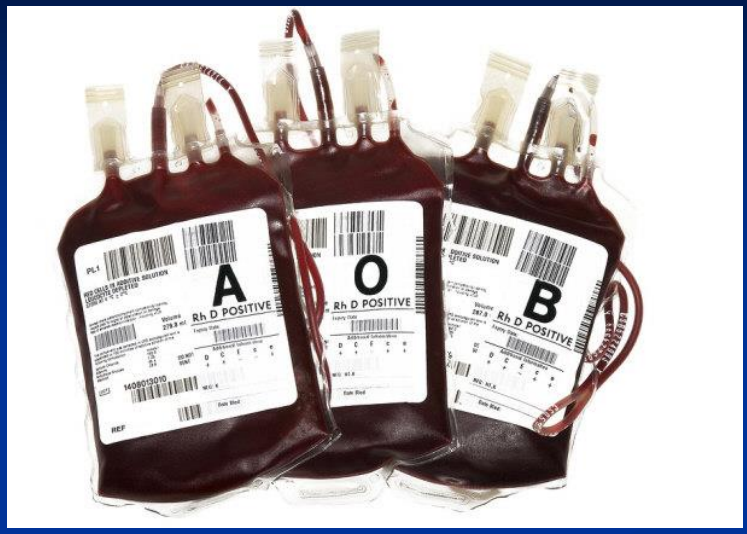
Indications for using blood warmers include:

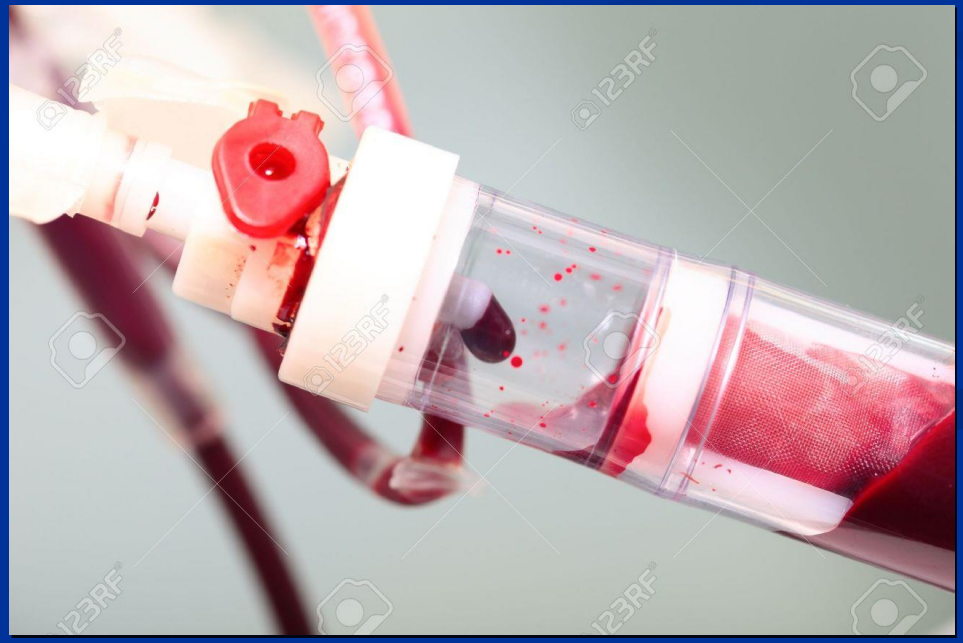
- patients with clinically significant cold auto agglutinins
- large-volume rapid transfusions
- exchange transfusions
- plasma exchange for therapeutic apheresis in adults
- intrauterine transfusions
- trauma situations
- the patient rewarming phase during cardiopulmonary bypass surgical procedur



Increased blood loss (perioperative, in trauma)
Increased mortality in trauma patients
More surgical wound infections
Delayed wound healing
More cardiac events (arrhythmia)
Longer stay in recovery room and in hospital
Higher costs of treatment


Saline
Blood bag
Rh type
ABO group
A
Expiration date
Identification number
Roller clamp
Roller clamp
Filter
Drip chamber
Roller clamp
To client


A
Rh D POSITIVE
O
Rh D POSITIVE
B
Rh D POSITIVE



Red cell 30-minute rules

If you have a delay in starting the transfusion remember:

< 30 minutes out of controlled storage

The pack can be returned to the Transfusion Service Provider or remote blood refrigerator. Complete the return date and time in registers.

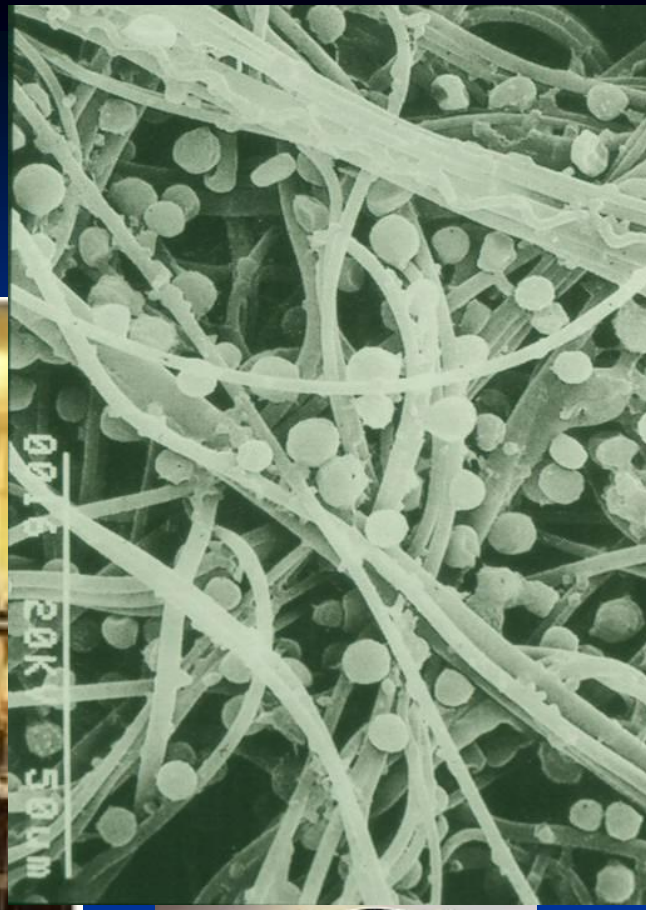
> 30 minutes out of controlled storage

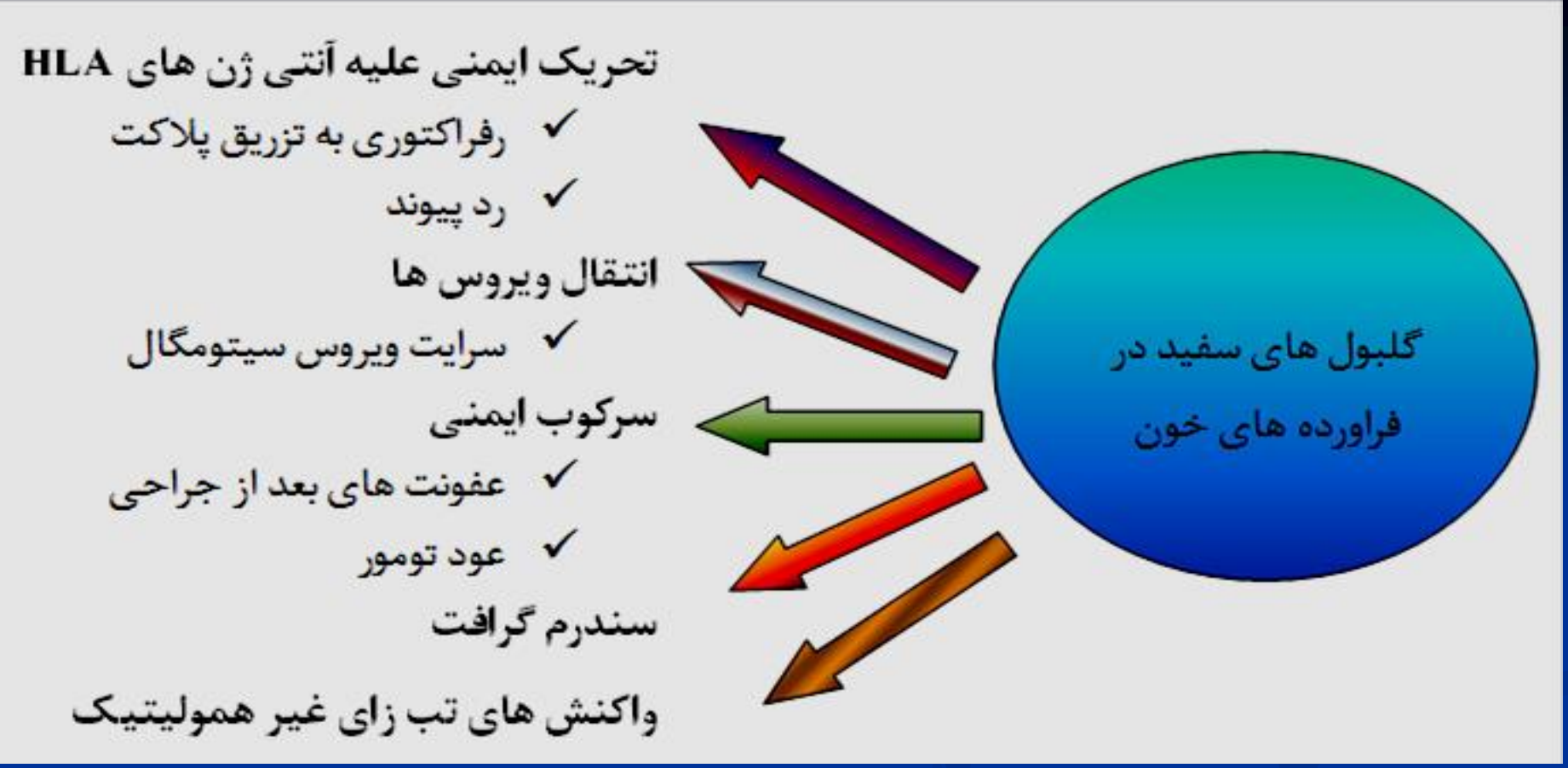
Still wanting to transfuse the patient?

The pack may be kept at the patient's bedside but transfusion must be completed within four hours from the time of removal from storage.

Not wanting to transfuse the patient?

LR-RBC





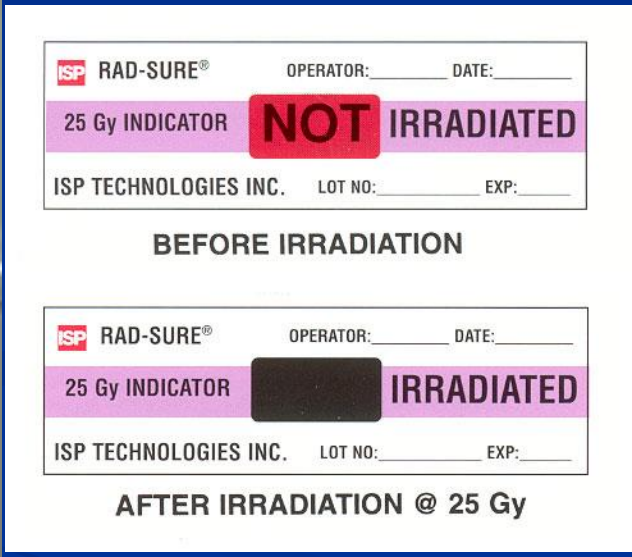
immunomodulation

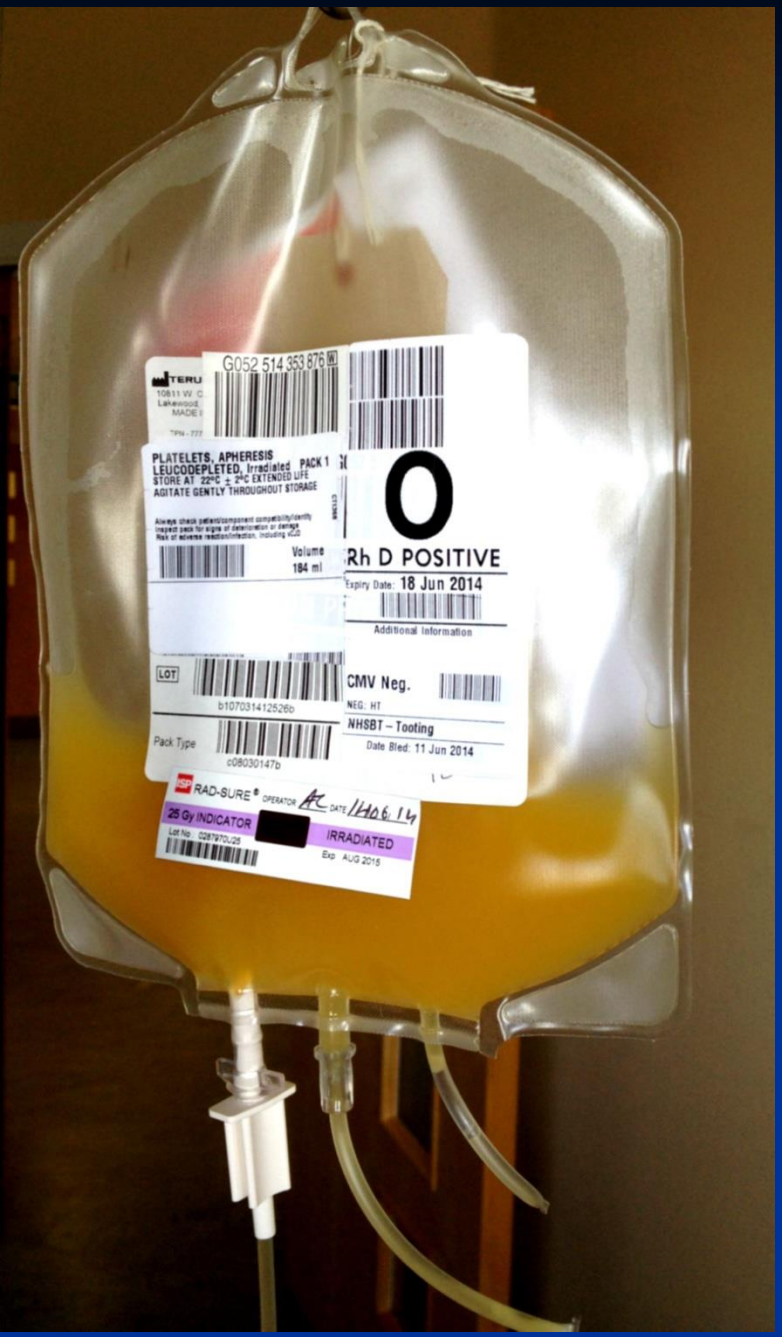
TRIM

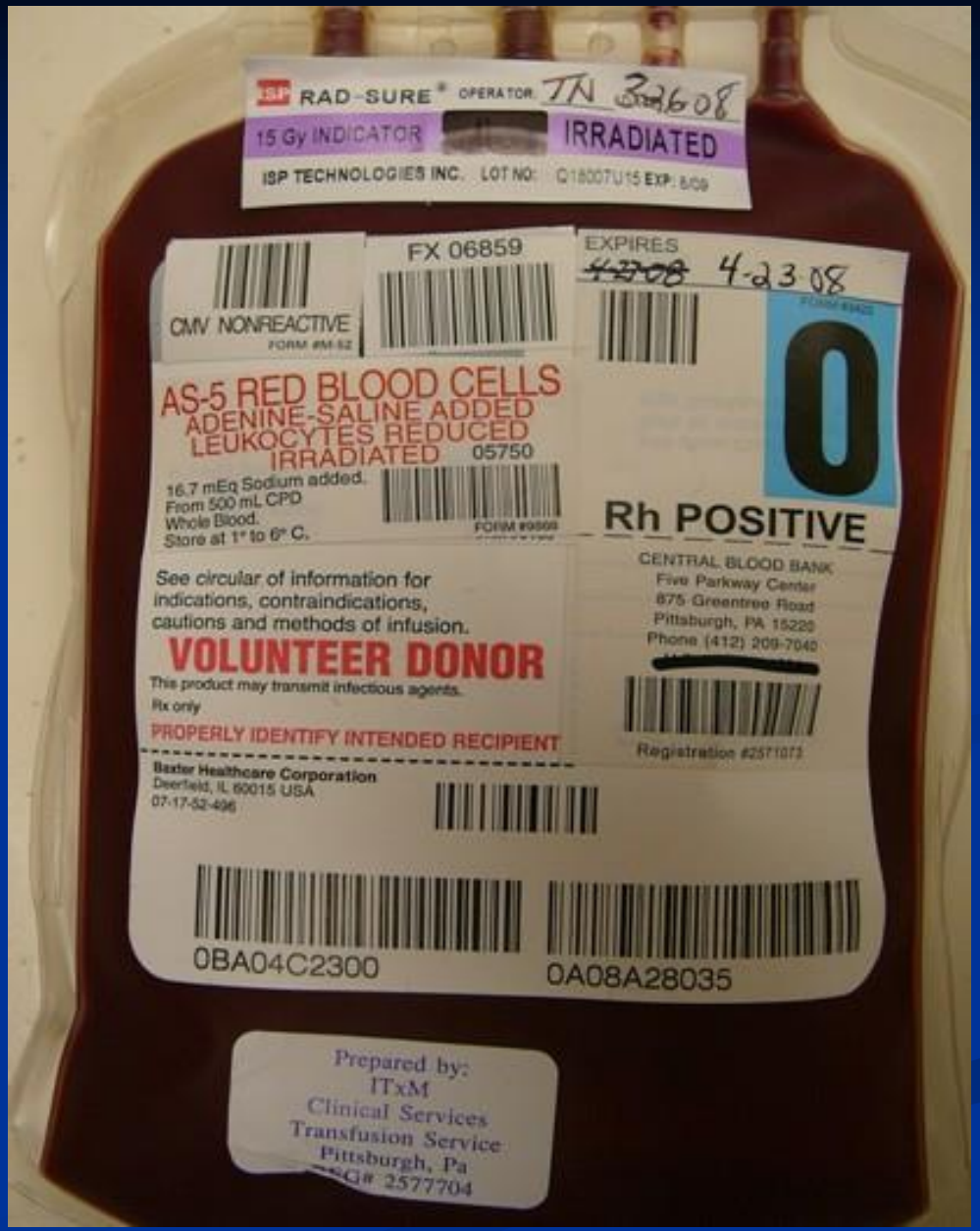
WASHED RED BLOOD CELLS

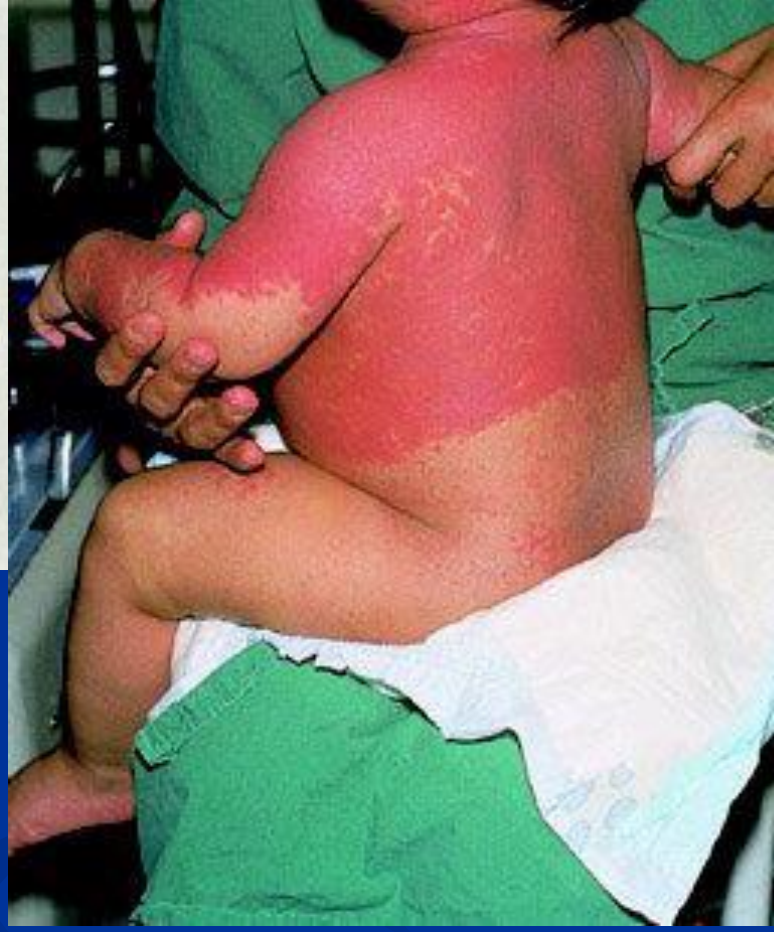
- Washing removes most plasma protein,and cell debris composed of WBC & platelets
- To prevent allergic reaction to plasma proteins
- To prevent anaphylaxic reaction in IgA and Haptoglobin deficient patient
- To prevent febrile non hemolytic reaction
- Safe blood for PNH patient
- Shelf life up to 24 hours in 4C/Closed system

Irradiated blood

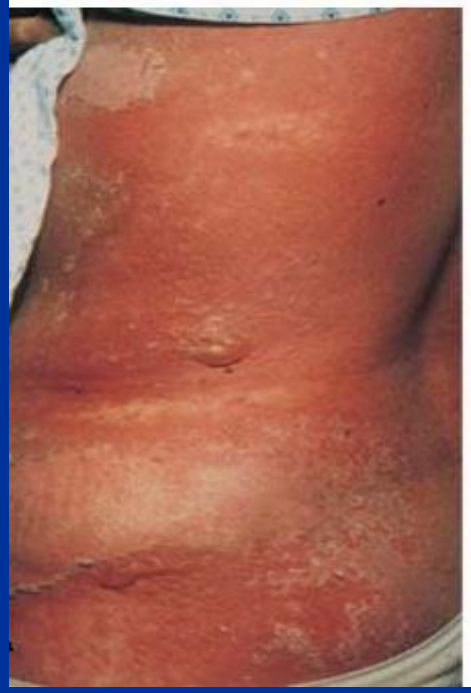


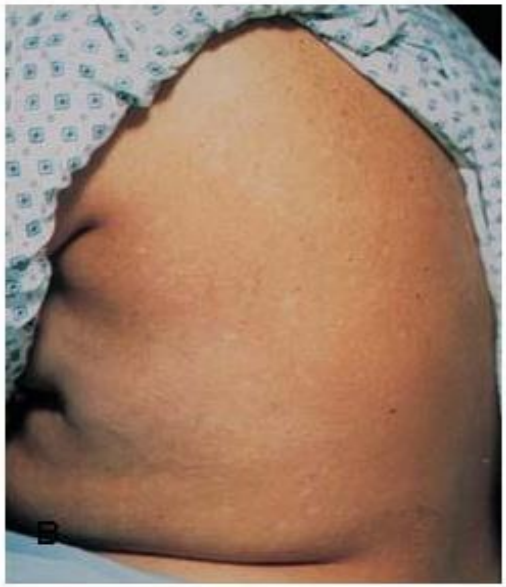

PLATELETS, APHERESIS
LEUCODEPLETED, Irradiated PACK 1
STORE AT 22°C ± 2°C EXTENDED LIFE
AGITATE GENTLY THROUGHOUT STORAGE
Volume
184 ml
O
Rh D POSITIVE
Expiry Date: 18 Jun 2014
Additional Information
CMV Neg.
NEG: HT
NHSBT – Tooting
Date Bled: 11 Jun 2014
Pack Type
RAD-SURE
25 Gy INDICATOR
IRRADIATED
Exp AUG 2015

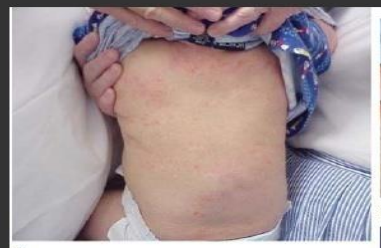

RAD-SURE
15 Gy INDICATOR
IRRADIATED
ISP TECHNOLOGIES INC.
CMV NONREACTIVE
FX 06859
EXPIRES
4-23 08
AS-5 RED BLOOD CELLS
ADENINE-SALINE ADDED
LEUKOCYTES REDUCED
IRRADIATED 05750
16.7 mEq Sodium added.
From 500 mL CPD
Whole Blood.
Store at 1° to 6° C.
O
Rh POSITIVE
See circular of information for
indications, contraindications,
cautions and methods of infusion.
VOLUNTEER DONOR
This product may transmit infectious agents.
Rx only
PROPERLY IDENTIFY INTENDED RECIPIENT
CENTRAL BLOOD BANK
Five Parkway Center
875 Greentree Road
Pittsburgh, PA 15220
Phone (412) 209-7040
Baxter Healthcare Corporation
Deerfield, IL 60015 USA
07-17-52-496
0BA04C2300
0A08A28035
Prepared by:
ITxM
Clinical Services
Transfusion Service
Pittsburgh, Pa

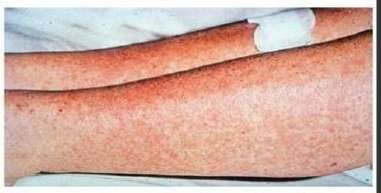


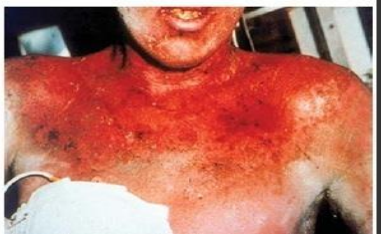
GRAFT VERSUS HOST DISEASE





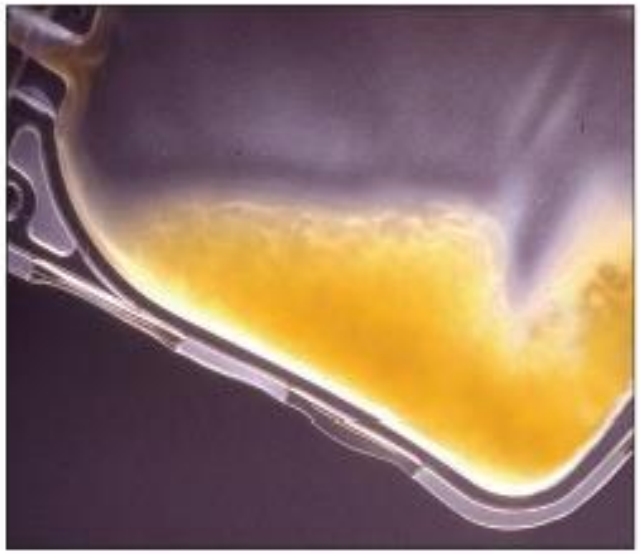






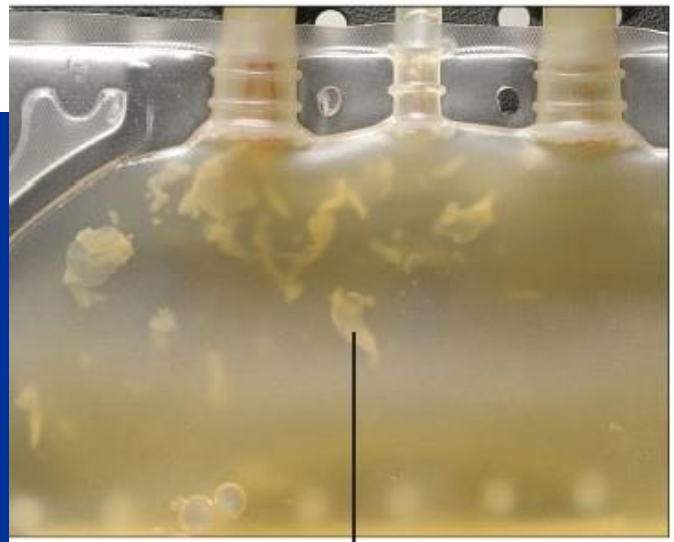
Indications for irradiation	Possible indications
• Hematopoietic stem cell transplant patients • Congenital immunodeficiency affecting T cells • Hodgkin's disease, continued for life • Intrauterine transfusions (IUT) preterm low birth weight neonates • Neonatal exchange transfusions • High-dose chemotherapy or radiotherapy • Purine-analogue drugs (e.g. fludarabine, cladribine, pentostatin, bendamustine, clofarabine) • Alemtuzumab (CamPath) • Antithymoglobulin (ATG) • Granulocyte transfusions • Cellular components from 1st/ 2nd degree relatives	• Solid organ transplant patients • Infants up to 6 months • Healthy premature infants until 6-12 months of age

- HLA-matched, HLA-selected or cross-matched platelet units

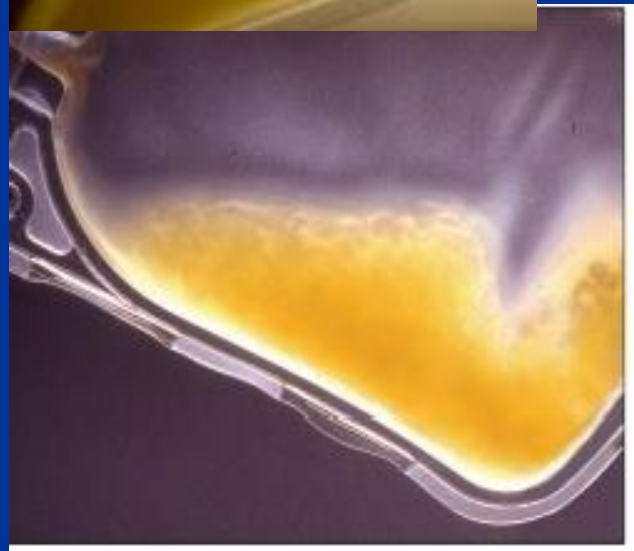


Platelets Swirl*

*Please note: The limitations of photography make it difficult to accurately capture the swirling phenomenon.



means that platelet are alive



Platelets Swirl*

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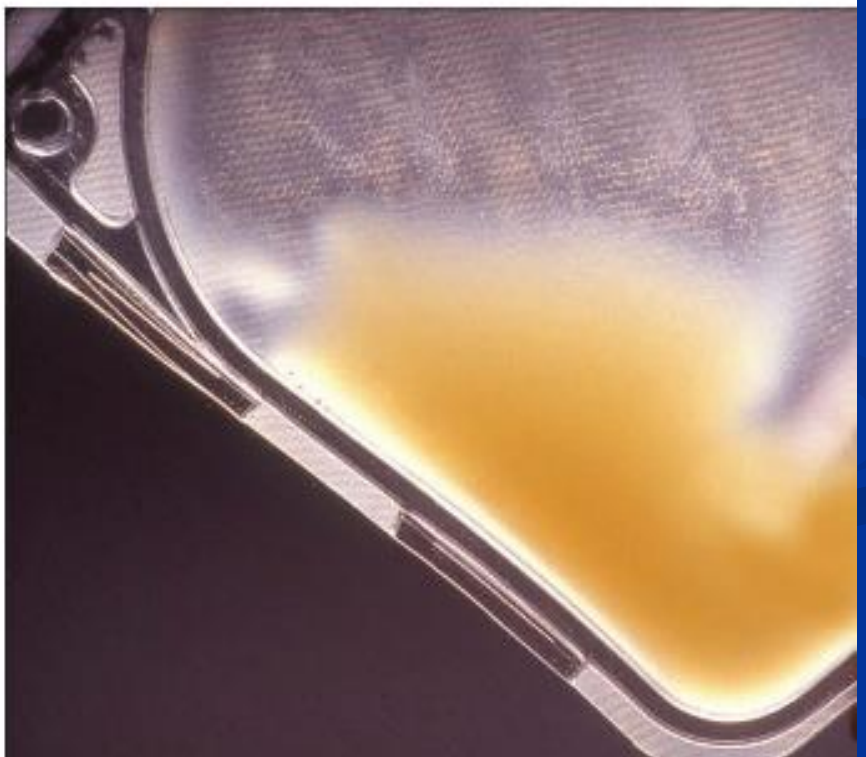
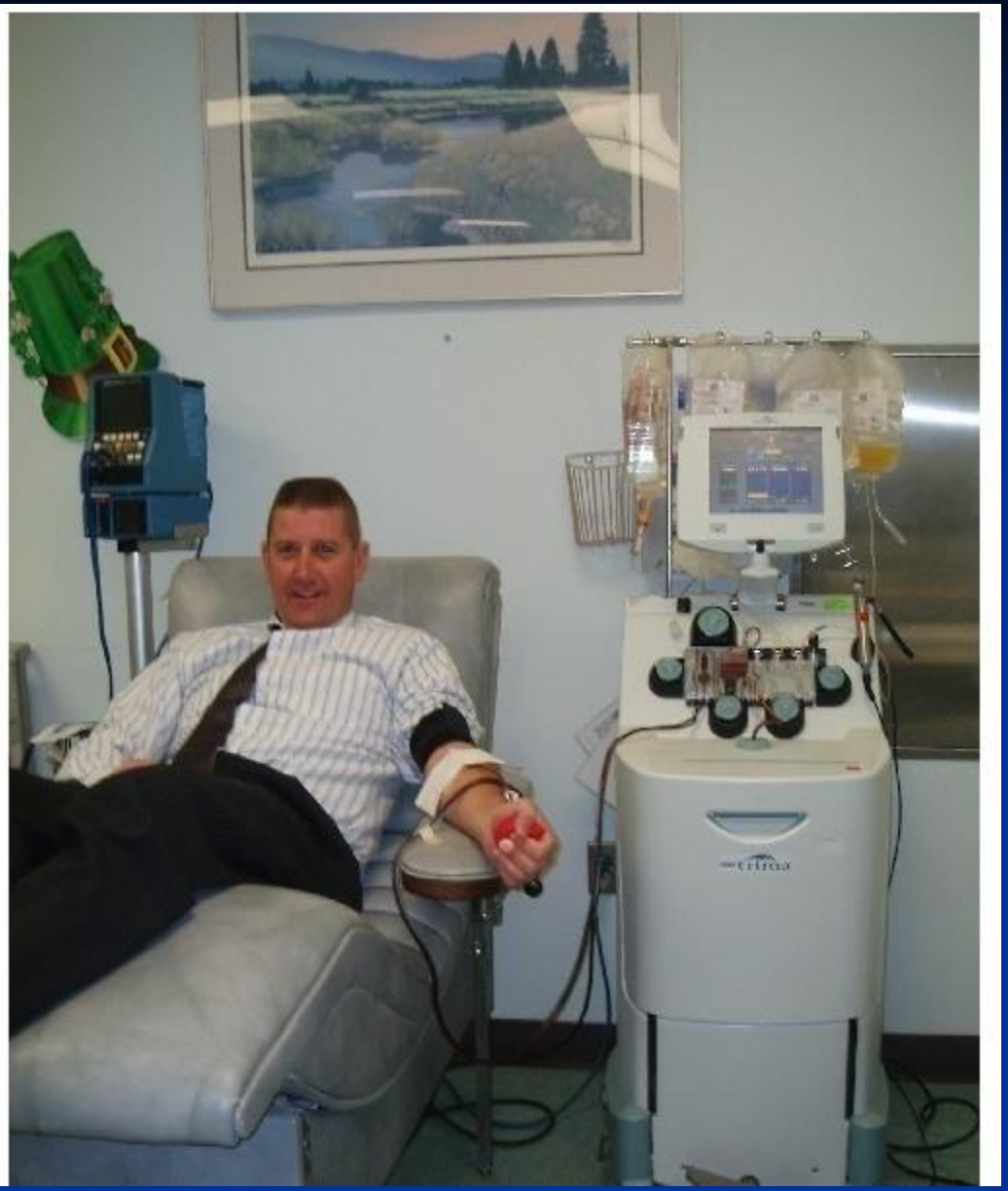




Constituent	Mean Density (g/mL)
Plasma	1.026
Platelets	1.058
Monocytes	1.062
Lymphocytes	1.070
Neutrophils	1.082
Red cells	1.100

Platelet Apheresis

PLATELET APHERESIS

FDA guidelines include a proscription on the collection of apheresis platelets from a donor who has ingested aspirin or piroxicam (Feldene) within 2 days of donation. Standards for Blood Banks and Transfusion
Services (2014) also require that the use of platelets from a donor taking “medications known to irreversibly inhibit platelet function shall be evaluated.” Finally, donors who have taken thienopyridines, such as clopidogrel Plavix) or ticlopidine (Ticlid), are deferred from apheresis platelet donation for 14 days after the last dose (donors must have a platelet count of at least 150,000/μL in order to donate. They can donate as often as twice per week,. A donor cannot donate more than 24 times per year.

Transfusion of One unit of platelet concenterate/10 kg increase platelet by 50000 per cubic millimeter if no bleeding,no sepsis,no ITP,no splenomegally and no fever

Corrected Count Increment (CCI):

$$CCI = \frac{(\text{Post-transfusion count} - \text{Pretransfusion count})\ (\text{BSA } m^2)}{\text{Platelets given } (\times 10^{11})}$$

1 Hour CCI<7,500

1)Alloimmunization
2)Autoimmunization

24 Hour CCI<4,500

1)Sepsis
2)Fever
3)DIC

Corrected Count Increment

$$\text{CCI} = \frac{\text{Platelet count increment} \times \text{BSA}}{\text{Number of platelets transfused} \times \left(10^{11}\right)}$$

where BSA is the body surface area (m^2)

Example

Pretransfusion platelet count = 8000/μL
Posttransfusion platelet count = 36,000/μL
BSA = 1.5 m^2
Platelet dose = 3.0×10^{11}

$$\text{CCI} = \frac{24{,}000 \times 1.5}{3} = 12{,}000$$

If 8 random
bag 5.5 x10*10x8=4.4 x 10*11

فرم درخواست پلاکت فرزیس

مسئول تکمیل فرم: - پزشک درخواست کننده

- مسئول پلاکت فرزیس و پزشک پلاکت فرزیس

این قسمت توسط پزشک درخواست کننده پلاکت فرزیس تکمیل شود :

نام بیمارستان یا مرکز درخواست کننده پلاکت فرزیس: شهر:

برای بیمار زیر نیاز به پلاکت از نوع آفرزیس ☐ پلاکت اشعه داده شده ☐ پلاکت فاقد لکوسیت ☐ می باشد :

نام :	نام خانوادگی :	نام پدر:	تاریخ تولد:	کد ملی : (در صورت دسترسی)	جنسیت : ☐ مرد ☐ زن	
استان :	شهر :	بیمارستان :	بخش :	شماره پرونده :		
تاریخ درخواست :		تاریخ مورد نظر جهت تزریق فرآورده :		بیماری :		

علت درخواست : ..... تشخیص بیماری : .....

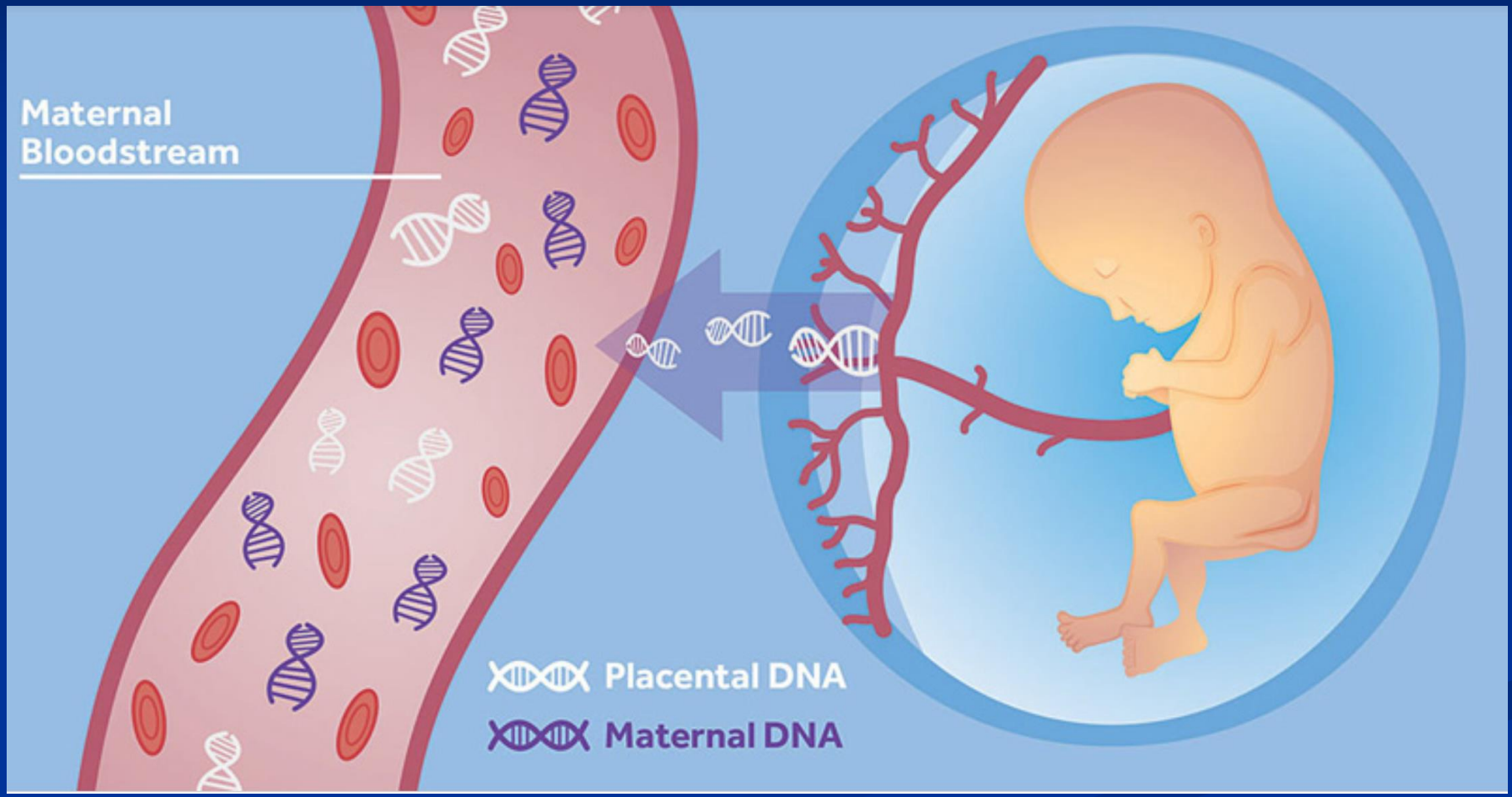
مقدار پلاکت بیمار	گروه خونی و Rh بیمار	HLA بیماردر صورت انجام	میزان پلاکت مورد نیاز (واحد)

لازم به ذکر است هر واحد پلاکت آفرزیس معادل ۶-۵ واحد پلاکت تهیه شده از خون کامل است :

Rogam or anti RH immunoglobulin

- ANTI D or ANTI RH_o(D)
- 300mcg,1500
- ITP,,immunologic thrombocytopenia purpura

FFDNA(free fetal DNA)



Compatible plasma

Plasma components should be compatible with the patient's ABO group. Group AB plasma may be used for all patient ABO groups and may be transfused without regard to RhD .group o patients are universal recipient of all plasma groups. Specialised warming equipment is used for thawing plasma components. Thawing should only be performed by the Transfusion Service Provider and typically takes around 30 minutes.

FRESH FROZEN PLASMA

Shelf life at -18C is 12 months

After thawing it is fresh for 24 h at 4C

Infusion of 10-15 cc/kg to stop bleeding by increasing 20% factors level

To stop bleeding in liver disease

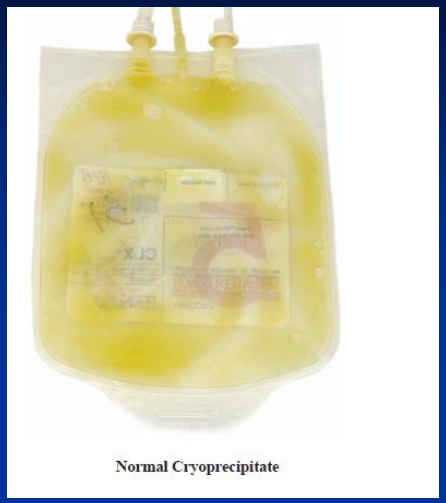
Rapid reversal of warfarin effect

Blood grouping

Glass point

Cryoprecipitate Transfusion

Factor VIII deficiency, factor concentrate unavailable, and bleeding or prior to surgery von Willebrand disease, factor concentrate unavailable, and bleeding or prior to surgery
Hypofibrinogenemia (fibrinogen <100 mg/dL) and bleeding or prior to surgery
Factor XIII deficiency and bleeding or prior to surgery
Uremic bleeding (DDAVP preferre
Topical fibrin sealant (commercial .Thawed cryoprecipitate is stored at 20 to 24 C and expires within 4 hours of pooling if it is pooled in an open system, or within 6 hours for single units.


Normal Cryoprecipitate

Cryo dosage for factor 8

one unit factor 8/kg=2% increase level

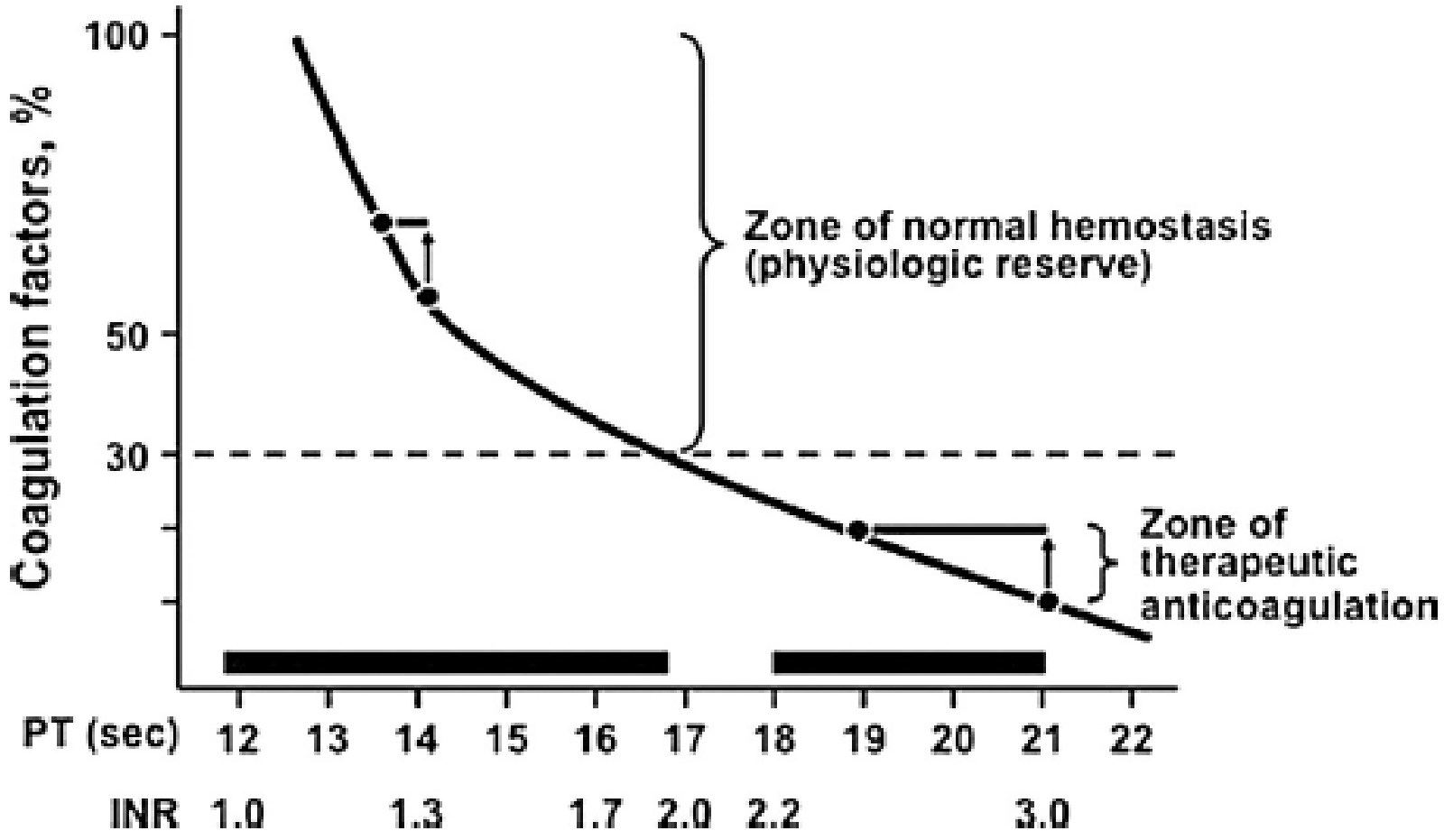
for example 70kg hemophilic patient needs to increase level from 10% to 50%

20U/kg=40%,,70x20=1400

1400÷100=14 cryo bags

Each unit of cryo contain 100 U fantor 8 and 250 mg fibrinogen

Fibrin sealant


Coagulation factors, %
100
50
30
Zone of normal hemostasis
(physiologic reserve)
Zone of
therapeutic
anticoagulation
PT (sec) 12 13 14 15 16 17 18 19 20 21 22
INR 1.0 1.3 1.7 2.0 2.2 3.0

Defined Adverse Reactions

- Transfusion-associated circulatory overload (TACO)
- Transfusion-related acute lung injury (TRALI)
- Transfusion-associated dyspnea (TAD)
- Allergic reaction (where severity = severe, life threatening, or death)
- Hypotensive transfusion reaction
- Febrile non-hemolytic transfusion reaction (FNHTR)
- Acute hemolytic transfusion reaction (AHTR)
- Delayed hemolytic transfusion reaction (DHTR)
- Delayed serologic transfusion reaction (DSTR)
- Transfusion-associated graft vs. host disease (TAGVHD)
- Post-transfusion purpura (PTP)
- Transfusion-transmitted infection (TTI)

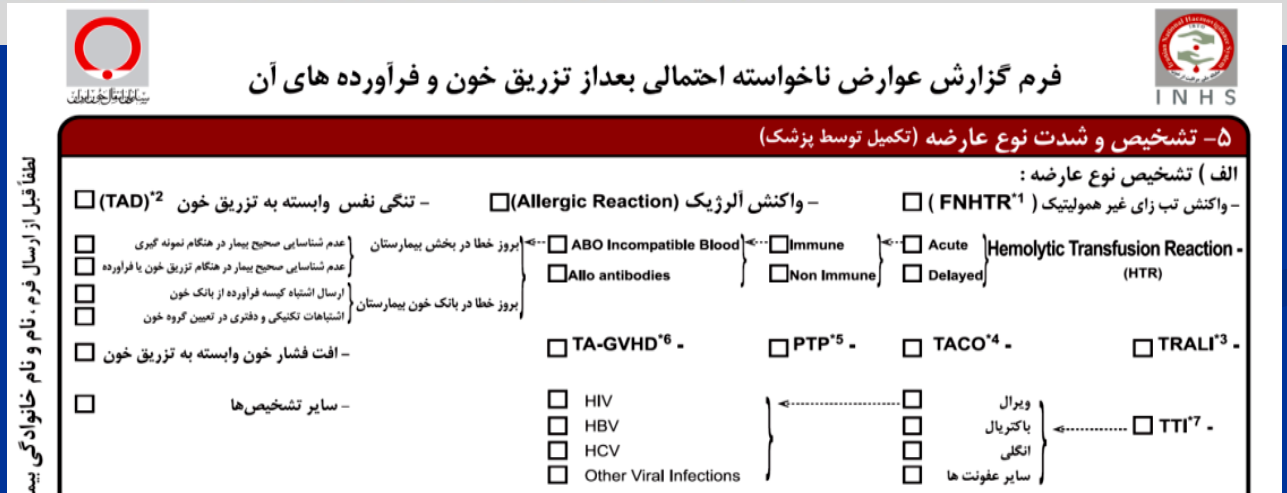


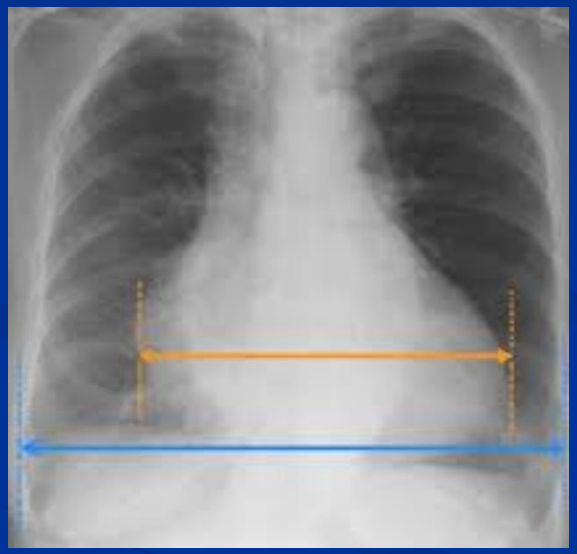
TABLE 10-10 Case Definition Criteria for Hemovigilance Reporting

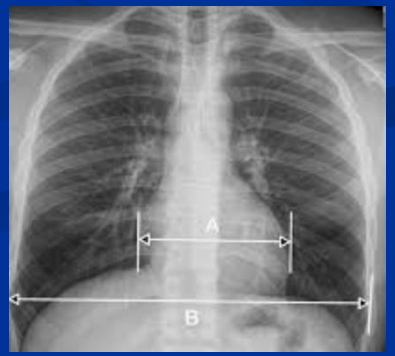
CRITERIA	DEFINITIONS
Signs and symptoms	*Definitive*: Conclusive *Probable*: Evidence in favor *Possible*: Evidence indeterminate
Laboratory/radiology	*Definitive*: Conclusive *Probable*: Evidence in favor *Possible*: Evidence indeterminate
Severity (graded)	*Grade 1*: Nonsevere *Grade 2*: Severe—requires medical intervention or prolongation of hospitalization or both *Grade 3*: Life-threatening; major intervention needed to prevent death *Grade 4*: Death as a result of adverse transfusion reaction
Relationship to transfusion (imputability)	*Definitive*: Conclusive *Probable*: Evidence in favor *Possible*: Evidence indeterminate

Data from NHSN manual: biovigilance component protocol hemovigilance module, June 2011. *Guidelines and procedures for monitoring hemovigilance*. http://www.cdc.gov/nhsn/bio.html.

TACO

It is well known that transfusion can precipitate acute pulmonary edema caused by volume overload. Patients >70 years and infants are at greatest risk, as well as patients with compromised ability.to regulate fluid balance (eg, those with congestive heart failure and end-stage renal disease. S3 gallop, jugular venous distension, elevated central venous pressure, dyspnea,· orthopnea, new St-segment and T-wave changes on electro-cardiogram, elevated serum troponin, .and elevated brain natriuretic peptide (BNP). Radiographs may show a widened cardiothoracic ratio inaddition to pulmonary edema. A posttransfusion-to-pretransfusion BNP ratio of 1.5 yields a sensitivity and specificity >80% in TACO

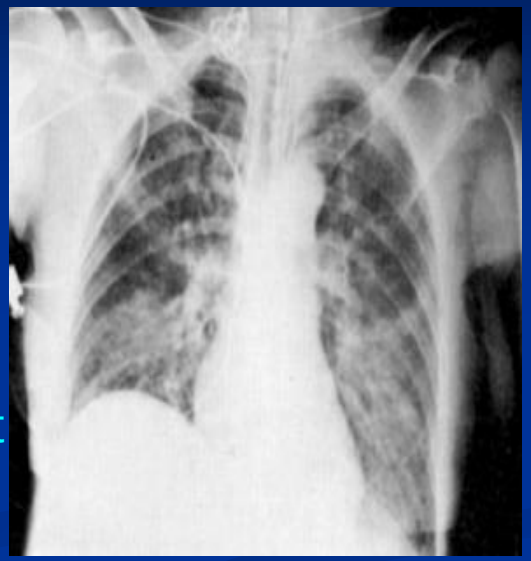




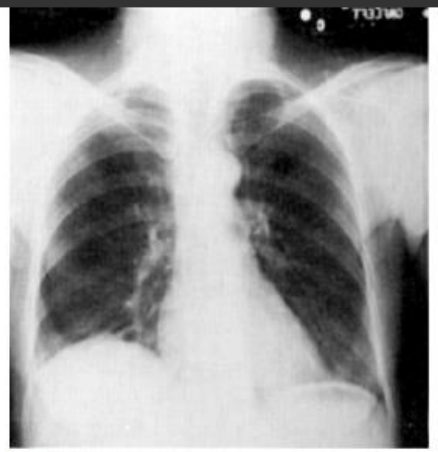
Definition

The clinical syndrome of transfusion-related acute lung injury (TRALI) is characterised by the acute onset of respiratory distress during or within six hours of transfusion, associated with oxygen desaturation (hypoxaemia) and bilateral lung infiltrates, without evidence for left atrial hypertension or circulatory overload [1].

Transfusion-Related Acute Lung Injury(TRALI)



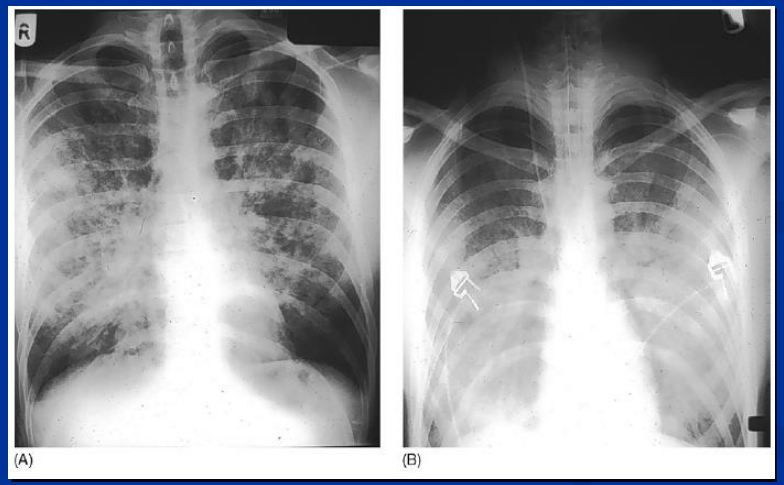
TRALI is clinically similar to acute respiratory distress syndrome (ARDS) but usually resolves within 96 hours. Clinical signs and symptoms of TRALIi include fever, chills, dyspnea, cyanosis, hypotension, hypoxia, and new-onset or worsening bilateral pulmonary edema." A dramatic transient neutropenia or leukopenia may also be observed." Symptoms arise within 6 hours of transfusion, with most cases becoming evident within 1 to 2 hours. All plasma-containing components, including whole blood, RBCs, platelets, cryoprecipitate,
and Fresh Frozen Plasma (FFP),have been implicated in TRALI' Transfusion volumes as small as 15 mL have led to TRALI'There is no method to predict which patients will develop **TRALI.Donors whose collections are linked to cases of TRALI are permanently deferred**

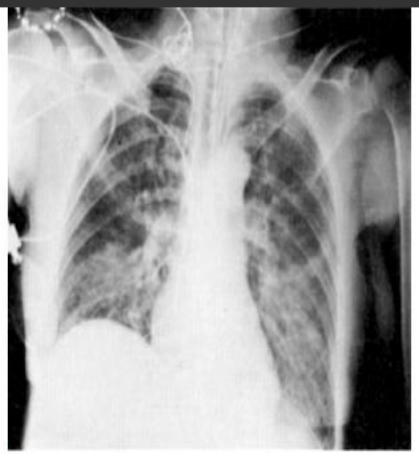


C

Figure 99-4C. Transfusion-related acute lung injury. ***A,*** This patient had a normal chest radiograph prior to transfusion. ***B,*** Pulmonary edema in a chest radiograph taken 2 hours after a transfusion. ***C,*** Pulmonary edema was markedly improved 48 hours later.

Symptoms and signs may be muted in patients under general anaesthesia. In such cases, the first indication of TRALI might be the appearance of copious amounts of pink frothy sputum from the endotracheal tube, although this finding is not specific for TRALI.





B

Figure 99-4B. Transfusion-related acute lung injury. ***A,*** This patient had a normal chest radiograph prior to transfusion. ***B,*** Pulmonary edema in a chest radiograph taken 2 hours after a transfusion. ***C,*** Pulmonary edema was markedly improved 48 hours later.

Parameter	TRALI	TACO
Clinical findings		
Body temperature	fever may be present	unchanged
Blood pressure	hypotension	hypertension, posttransfusion systolic blood pressure elevation > 30 mm Hg
Pulse	+/–	tachycardia
Respiration	acute dyspnea	acute dyspnea
Neck veins	unchanged	distension may be present
Auscultation of the lung (heart)	crackles, paucity of findings	crackles, rales (S3 gallop may be present)
Fluid balance	+/–	positive
Response to diuretic	minimal, sometimes deterioration	significant
Additional findings		
Chest radiograph	new bilateral infiltrates	new bilateral (central) infiltrates, enlarged cardiac silhouette, Kerley's B lines
Echocardiography	normal or decreased ejection fraction	decreased ejection fraction
Pulmonary artery occlusion pressure	< 18 mm Hg	> 18 mm Hg
Central venous pressure	normal/unchanged	increased
Edema fluid	exudate	transudate
Laboratory findings		
WBC	transient leukopenia may be present	unchanged
BNP	< 100–200 pg/ml	> 500–1,200 pg/ml

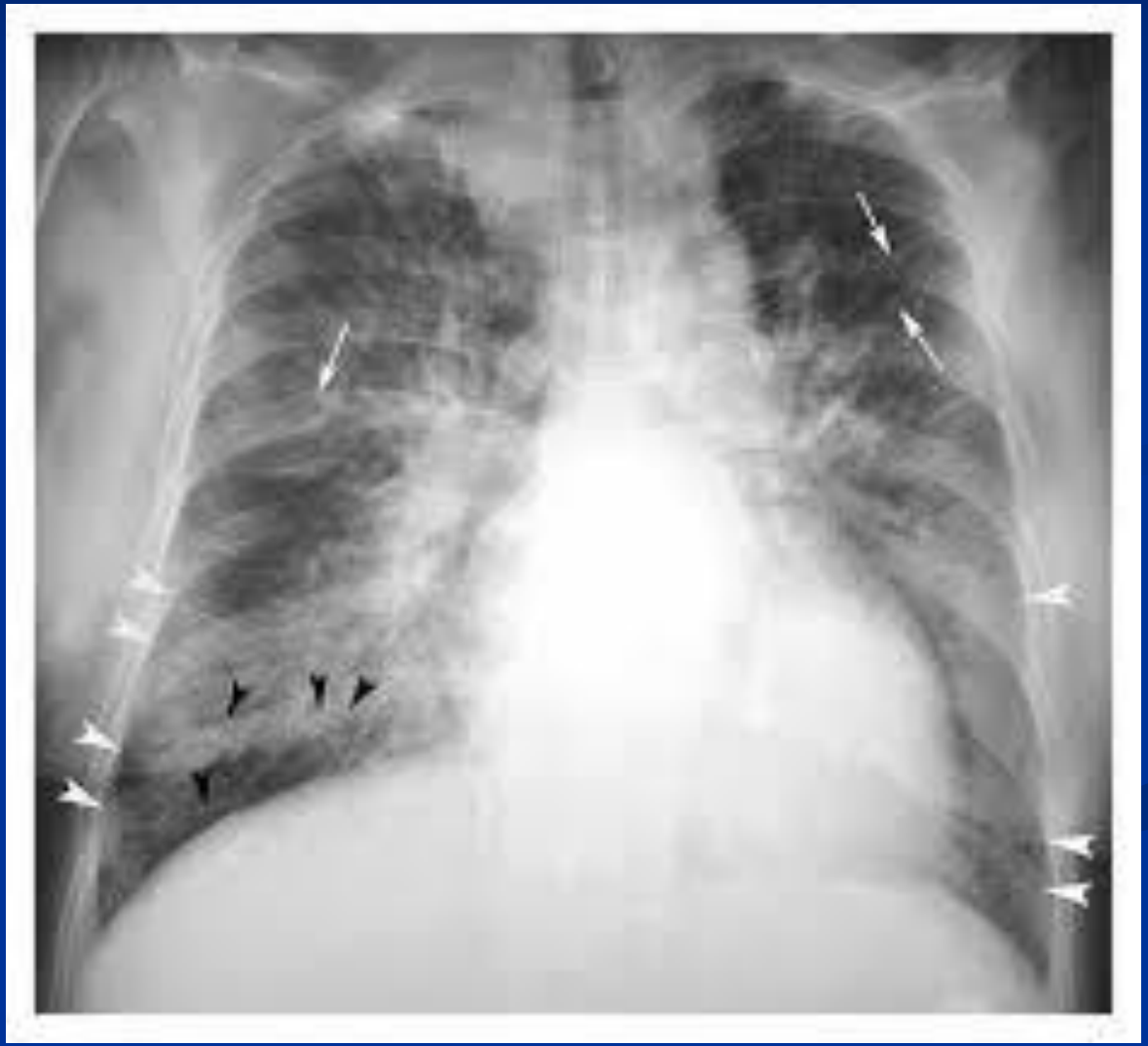
arterial blood gas

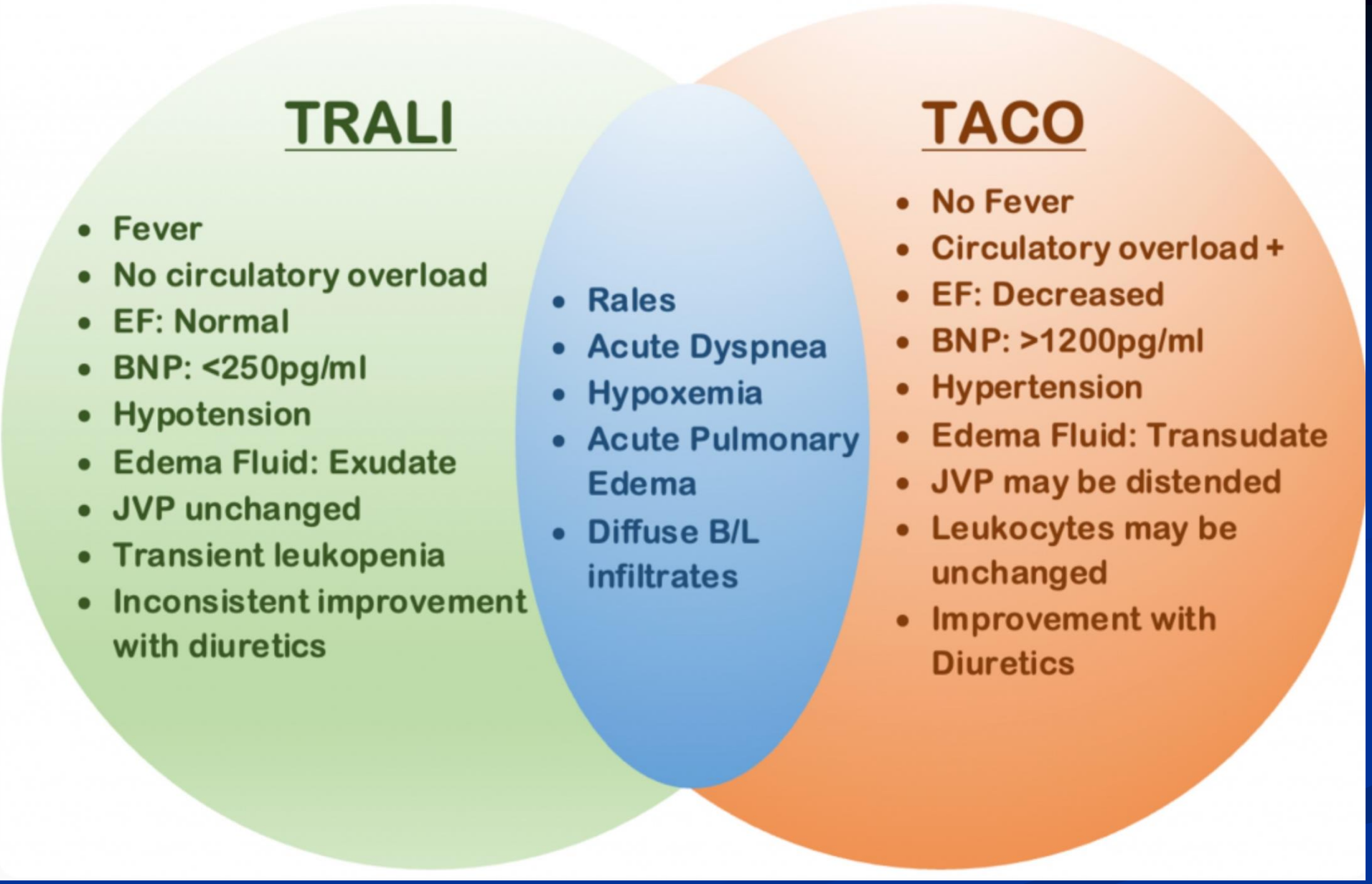
- As demonstrated by PaO2/FIO2 <300 mmHg.

may show hypoxaemia in transfusion-related acute lung injury (TRALI)

Kerley B lines

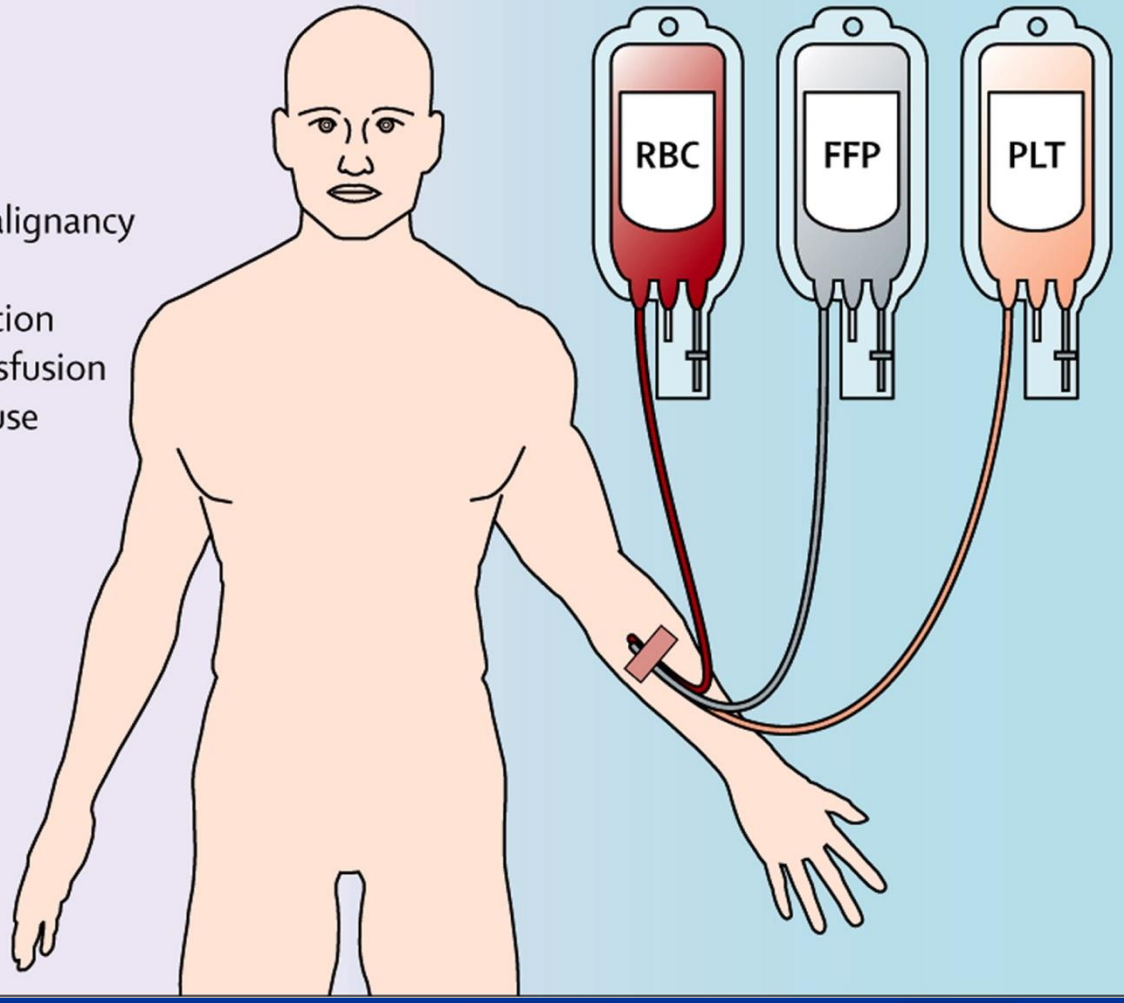
appearing as short, horizontal lines in the lung periphery, perpendicular to the pleural surface. They represent thickened, edematous interlobular septa, often seen in conditions like pulmonary edema due to heart failure.




TRALI
Fever
No circulatory overload
EF: Normal
BNP: <250pg/ml
Hypotension
Edema Fluid: Exudate
JVP unchanged
Transient leukopenia
Inconsistent improvement with diuretics
Rales
Acute Dyspnea
Hypoxemia
Acute Pulmonary Edema
Diffuse B/L infiltrates
TACO
No Fever
Circulatory overload +
EF: Decreased
BNP: >1200pg/ml
Hypertension
Edema Fluid: Transudate
JVP may be distended
Leukocytes may be unchanged
Improvement with Diuretics

First hit
(patient factors)

- Sepsis
- Haematological malignancy
- Heart surgery
- Mechanical ventilation
- Massive blood transfusion
- Chronic alcohol abuse
- Age of patient
- Shock
- Acute renal failure
- Severe liver disease
- Spine surgery
- Liver surgery



Second hit
(transfusion factors)

RBC
- HLA or HNA
- Bioactive lipids
- sCD40L
- Aged erythrocyte

FFP
- HLA or HNA

PLT
- HLA or HNA
- Bioactive lipids
- sCD40L

Immediate Blood Transfusion Reactions:

Acute Intra-vascular Haemolytic Transfusion Reactions

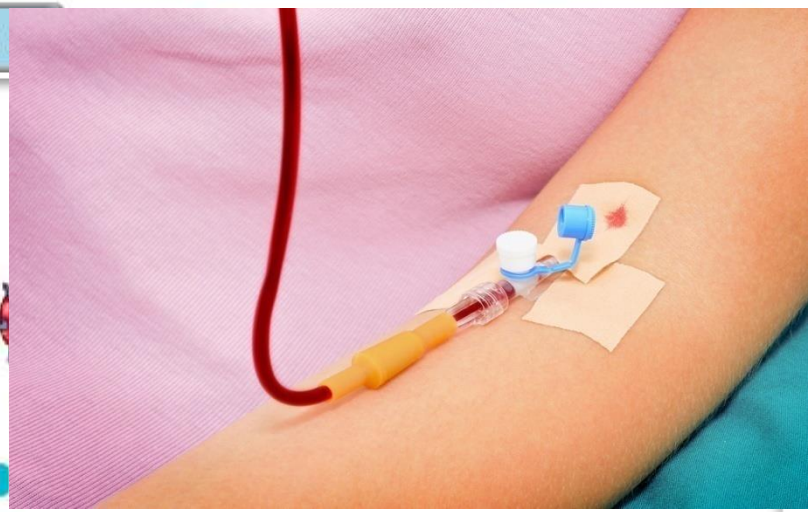
Clinical Picture

- Fever, Flushing, Rigors
- Headache
- Heat or pain at cannulated vein
- Restlessness
- Bronchospasm
- Hypotension
- Back or loin pain
- Oozing in the surgical field
- Red urine (haemoglobinuria)
- Oliguria or anuria

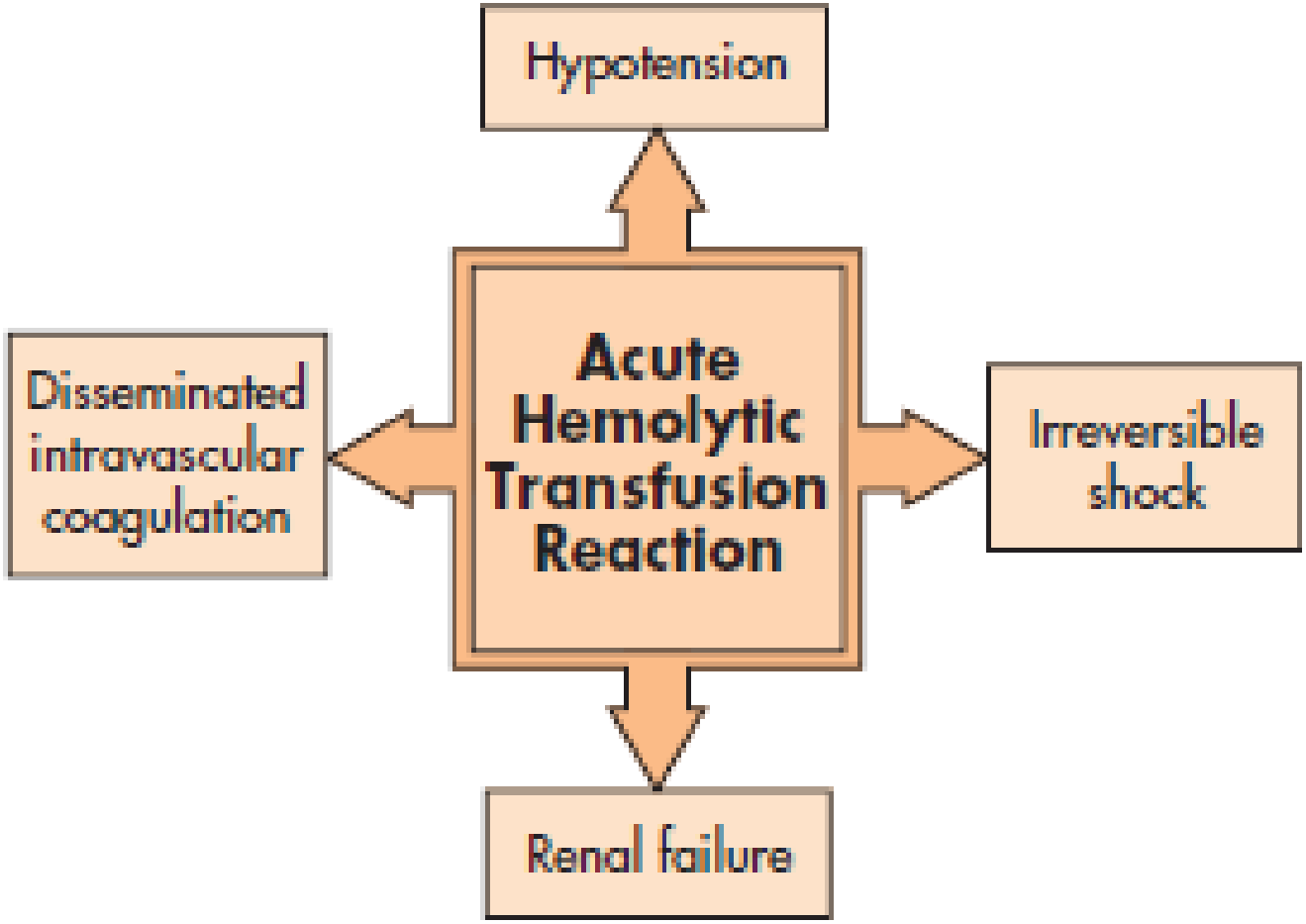
Identify the major processes of a transfusion reaction leading to hemolysis.

Drag the appropriate labels to their respective targets.

A antigens on patient red blood cells | Anti-B antibody | Complement | Agglutination and complement binding | Hemolysis | B antigen on donated red blood cells | Hemoglobin



reset | help


Hypotension
Disseminated intravascular coagulation
Acute Hemolytic Transfusion Reaction
Irreversible shock
Renal failure

Hemolytic transfusion reaction

Specific signs/symptoms:

a) Fever and chills

• Most common presenting symptom (> 80%)

b) Back or infusion site pain

c) Hypotension/shock

d) Hemoglobinuria (may be first indication of hemolysis in anesthetized patients)

e) DIC/increased bleeding (also important in anesthetized patients)

f) Sense of “impending doom”

Clinical: AHTR *vs.* Sepsis

AHTR

- Fever
- Chills/rigor
- Pain-IV, flank, chest
- Hypotension
- Tachycardia
- Shock
- GI-N/V/diarrhea
- Renal failure
- DIC

Sepsis (Endotoxemia)

- Fever
- Chills/rigors
- Chest pain
- Hypotension
- Tachycardia
- Shock
- GI-N/V/diarrhea
- Renal failure
- DIC

Systemic Inflammatio

Acute immune-mediated reactions

These occur within 24 hours of transfusion, and often during the transfusion itself.

- Pain along the infused extremity
- Abdominal, chest, or back pain, which can accompany generalised symptoms
- Haemoglobinuria, which can manifest as red urine
- Progression to hypotension, renal failure, and DIC in severe cases
- Positive direct antiglobulin test
- Evidence of haemolysis upon visual inspection of the plasma.

Signs of hemolytic transfusion reaction

Color serum in hemoglobinemia.

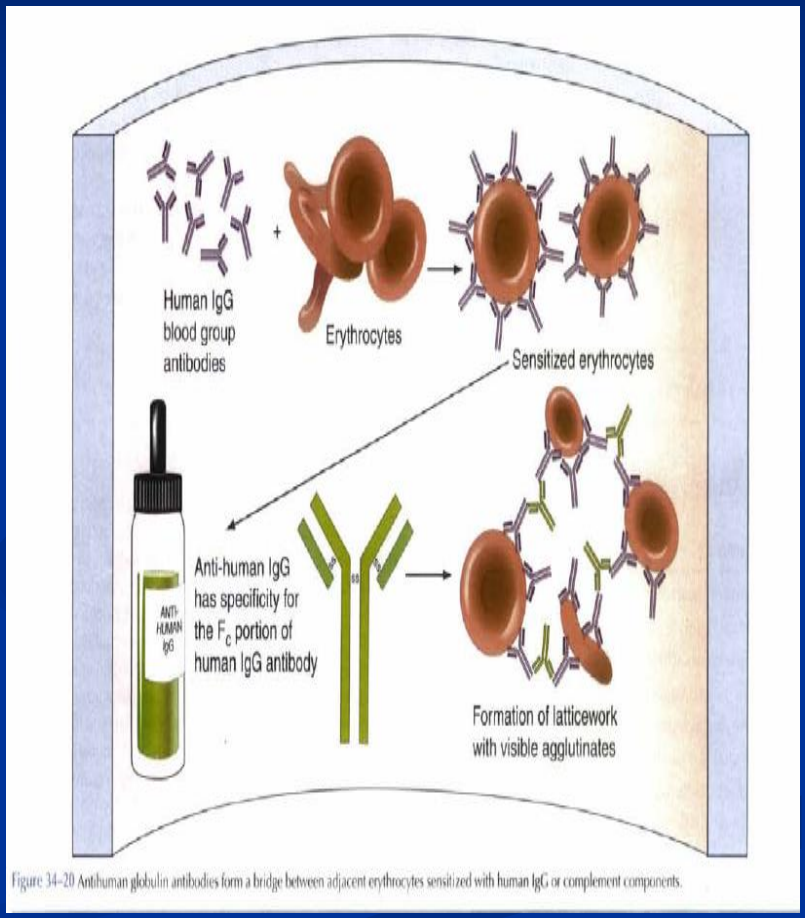
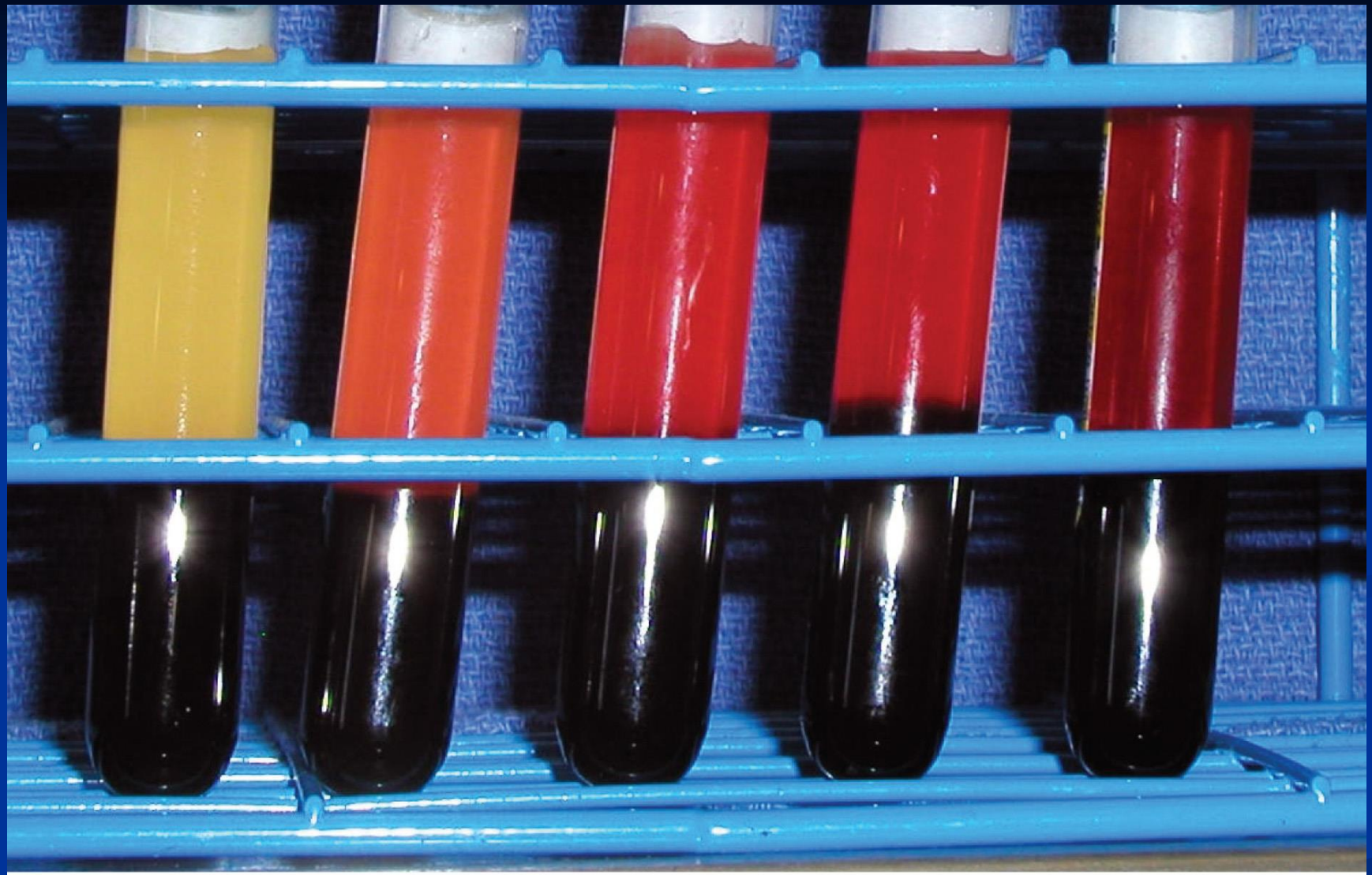


Figure 34–20 Antihuman globulin antibodies form a bridge between adjacent erythrocytes sensitized with human IgG or complement components.



Normal | Slight hemolysis | Moderate hemolysis | Moderate hemolysis | Gross hemolysis

ISTH Diagnostic Scoring System for DIC

Risk assessment: Does the patient have an underlying disorder known to be associated with overt DIC?

- If yes, proceed.
- If not, do not use this algorithm.

Order global coagulation tests (PT, platelet count, fibrinogen, D-dimer)

Score the test results:

- Platelet count (>100 k/μL = 0, <100 k/μL = 1, <50 k/μL = 2)
- Elevated D-dimer (<0.4 μg/mL = 0, 0.4–4.0 μg/mL = 2, >4.0 μg/mL = 3)
- Prolonged PT (<3 sec = 0, >3 sec but <6 sec = 1, >6 sec = 2)
- Fibrinogen level (>100 mg/dL = 0, <100 mg/dL = 1)

Calculate score:

- If ≥5, compatible with overt DIC: Repeat score daily.
- If <5, suggestive (not affirmative) for nonovert DIC: Repeat next 1–2 days.

Treatment of Hemolytic Transfusion Reactions

MANAGEMENT OF ACUTE HEMOLYTIC TRANSFUSION REACTION

- 1-Stop the transfusion and maintain intravenous access.
- 2-make initial rapid assessment of patient and requirements for basic and advanced support.
- 3-notify transfusion service,collect transfused units(full or partially),tubing,etc.,and return them to blood bank.
- 4-Reconfirm identity of blood units and patient.
- 5-collect appropriate patient blood specimens
- 6-pending results of initial evaluation,consider the following supportive approches:
- A-IV fluid resuscitation to treat hypotension.
- B-maintenance intravenous fluids at 3000 ml/m2/day with adminstration of sodium bicarbonate to keep PH>7.0

Continue….

- C-diuretics:mannitol(20%),100 ml/m2 give over 30-60 min,then 30 ml/m2/hr for text 12 hours;furosemide(adults 20-80 mg;infants and children 1-2 mg/ kg to an adult dose)
- D-low-dose dopamine,1-5 mcg/kg/min.
- E-replacement of procoagulant factors and fibrinogen with fresh frozen plasma and cryoprecipitate and platelets with platelet concentrate.
- F-heparin:50-100 u/kg,(unfractionated heparin)and infusion 15-25 u/kg/hr to keep heparin level 0.4-0.7 u/ml.

Febrile non-Hemolytic Transfusion Reaction

Management

The management of FNHTRs consists of the following steps:

-Stopping the transfusion and determining that a hemolytic reaction is not taking place .

-Administration of antipyretics (aspirin should be avoided in thrombocytopenic patients) .

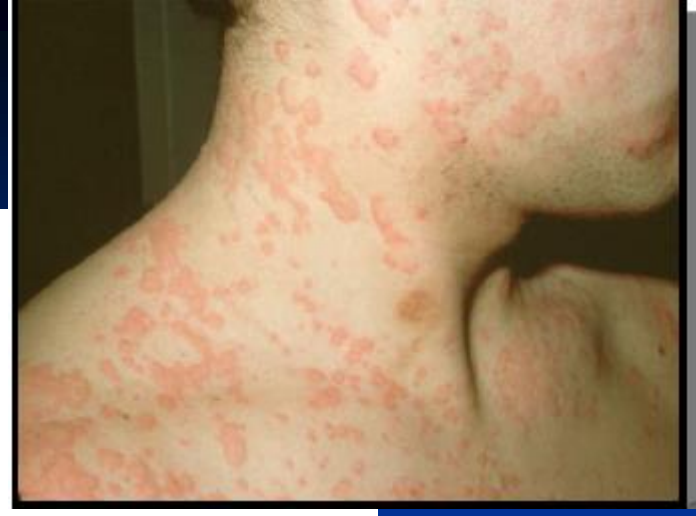
moderate doses of meperidine in patients with severe chills and rigors.

HYPOTENSIVE REACTIONS

If hypotension occurs, the transfusion should be discontinued and intravenous access maintained. The patient should be positioned with head down and feet elevated (Trendelenburg position), and isotonic fluids should be administered. Pressor support is indicated only if the hypotension is severe and refractory to intravenous fluids.

The cause of transfusion-associated hypotension has not been established definitively. However, the condition is most likely due to the release of bradykinin through activation of the contact pathway of coagulation. Some reactions have been associated with angiotensin-converting enzyme (ACE)–inhibitor drugs in the recipient and/or the use of leukocytereduction filters. ACE is the major enzyme that breaks down bradykinin in the circulation. Some bedside filters, particularly those with a net-negative surface charge, appear to cause activation of kallikrein and cleavage of high-molecular-weight kininogen, which results in the release of bradykinin

Approach to transfusion reactions commonly presenting with rash

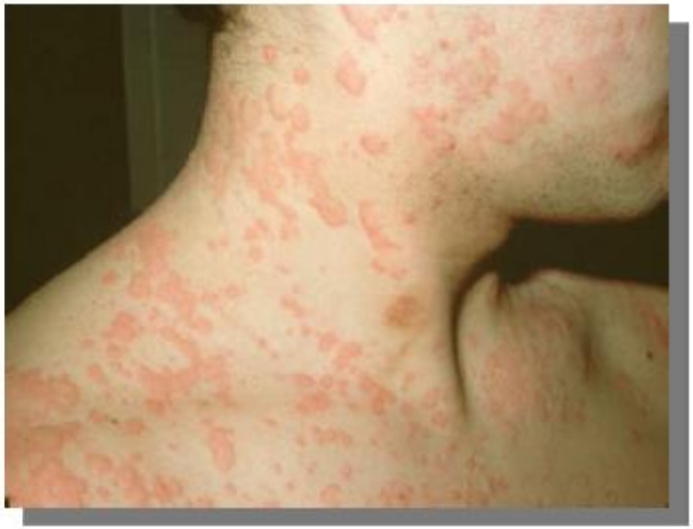


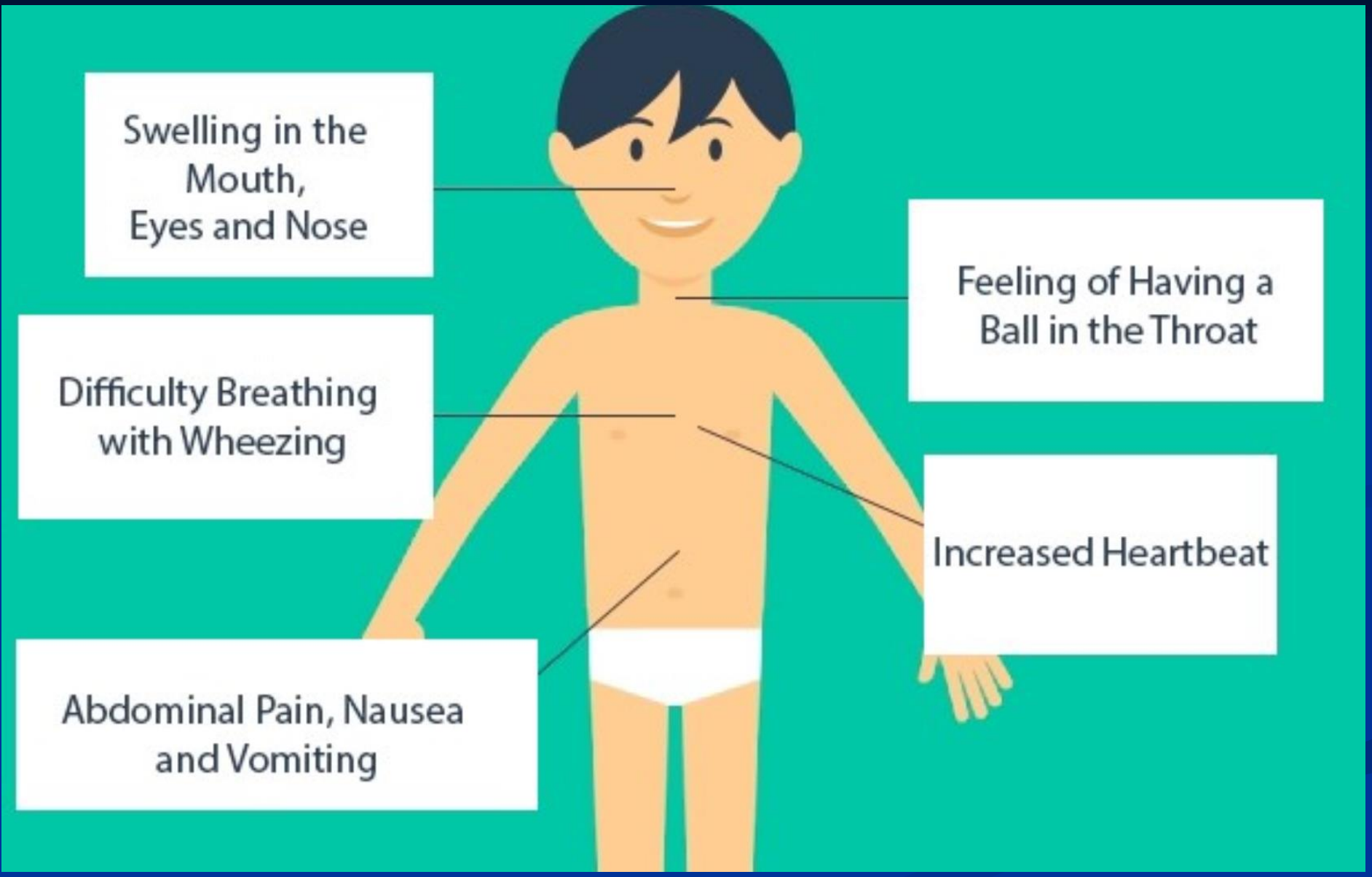
Allergic Reactions—Clinical Presentation

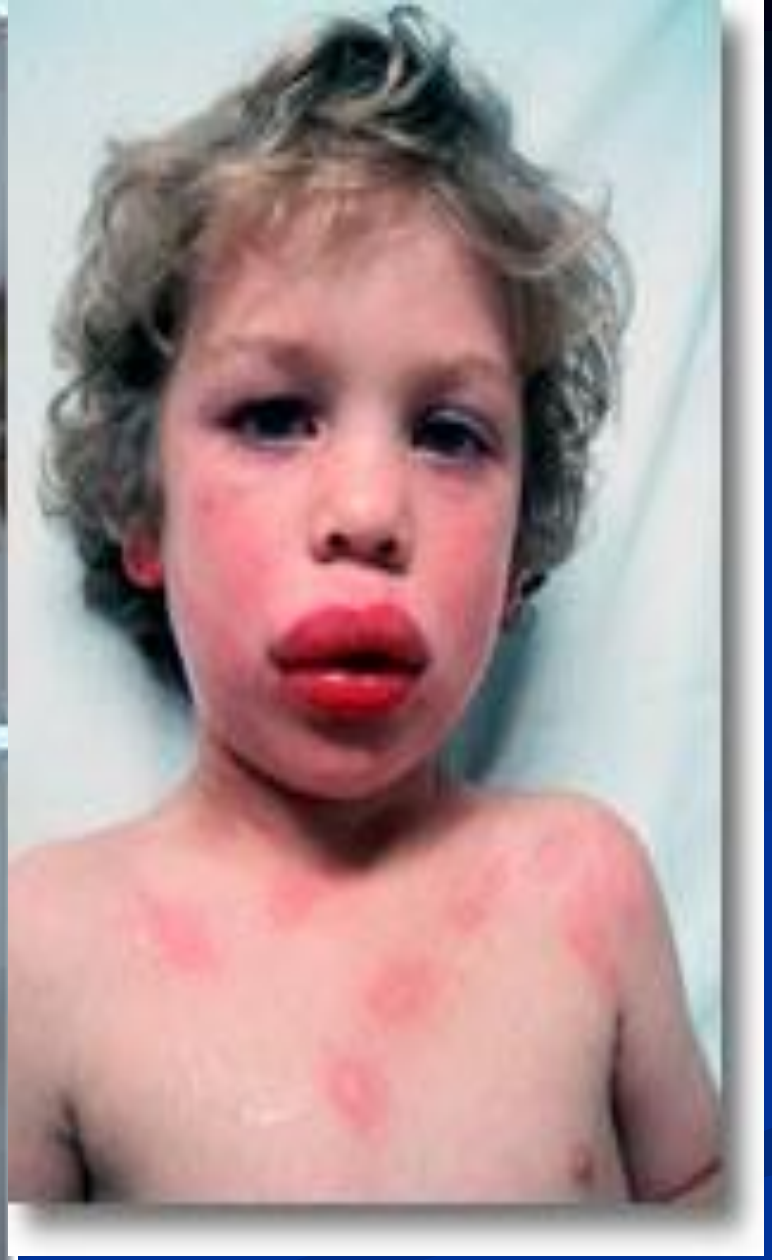
Signs and Symptoms

- Skin lesions (hives)

- May also have
  - Pruritis
  - Angioedema
  - Cough and wheezing
  - Nausea and vomiting
  - Abdominal pain
  - Diarrhea
  - Hypotension
  - Cyanosis
  - Tachycardia




Swelling in the Mouth, Eyes and Nose
Feeling of Having a Ball in the Throat
Difficulty Breathing with Wheezing
Increased Heartbeat
Abdominal Pain, Nausea and Vomiting



1 Life-threatening problems:

Airway:	swelling, hoarseness, stridor
Breathing:	rapid breathing, wheeze, fatigue, cyanosis, SpO_2 < 92%, confusion
Circulation:	pale, clammy, low blood pressure, faintness, drowsy/coma

2 Adrenaline *(give IM unless experienced with IV adrenaline)*

IM doses of 1:1000 adrenaline (repeat after 5 min if no better)

- Adult 500 micrograms IM (0.5 mL)
- Child more than 12 years: 500 micrograms IM (0.5 mL)
- Child 6 -12 years: 300 micrograms IM (0.3 mL)
- Child less than 6 years: 150 micrograms IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**

Titrate: Adults 50 micrograms; Children 1 microgram/kg

3 IV fluid challenge:

Adult - 500 – 1000 mL

Child - crystalloid 20 mL/kg

Stop IV colloid if this might be the cause of anaphylaxis

	4 Chlorphenamine (IM or slow IV)	**5 Hydrocortisone** (IM or slow IV)
Adult or child more than 12 years	10 mg	200 mg
Child 6 - 12 years	5 mg	100 mg
Child 6 months to 6 years	2.5 mg	50 mg
Child less than 6 months	250 micrograms/kg	25 mg

Definition of Massive Transfusion

Massive Blood Transfusuin

- Transfusion of ≥10 red blood cell (RBC) units, which approximates the total blood volume (TBV) of an average adult patient, within 24 h,
- Transfusion of >4 RBC units in 1 h with anticipation of continued need for blood product support
- Replacement of >50% of the TBV by blood products within 3 h.
- Transfusion support to loss of blood >150ml/min

In Paediatric pts

- Transfusion of >100% TBV within 24 h,
- Transfusion support to replace ongoing haemorrhage of >10% TBV /min
- Replacement of>50% TBV by blood products within 3 h.

Massive Transfusion Protocols

- Delaying request for an MTP, increase the risk of morbidity and mortality.
- Assessment of blood consumption (ABC) score: attempt to predict patients likely to require an MTP.
- Four possible variables:
  (1) penetrating injury;
  (2) SBP less than 90 mmHg;
  (3) HR greater than 120 beats per minute;
  (4) positive results of a focused assessment with sonography for trauma (FAST) evaluation.

ABC Score

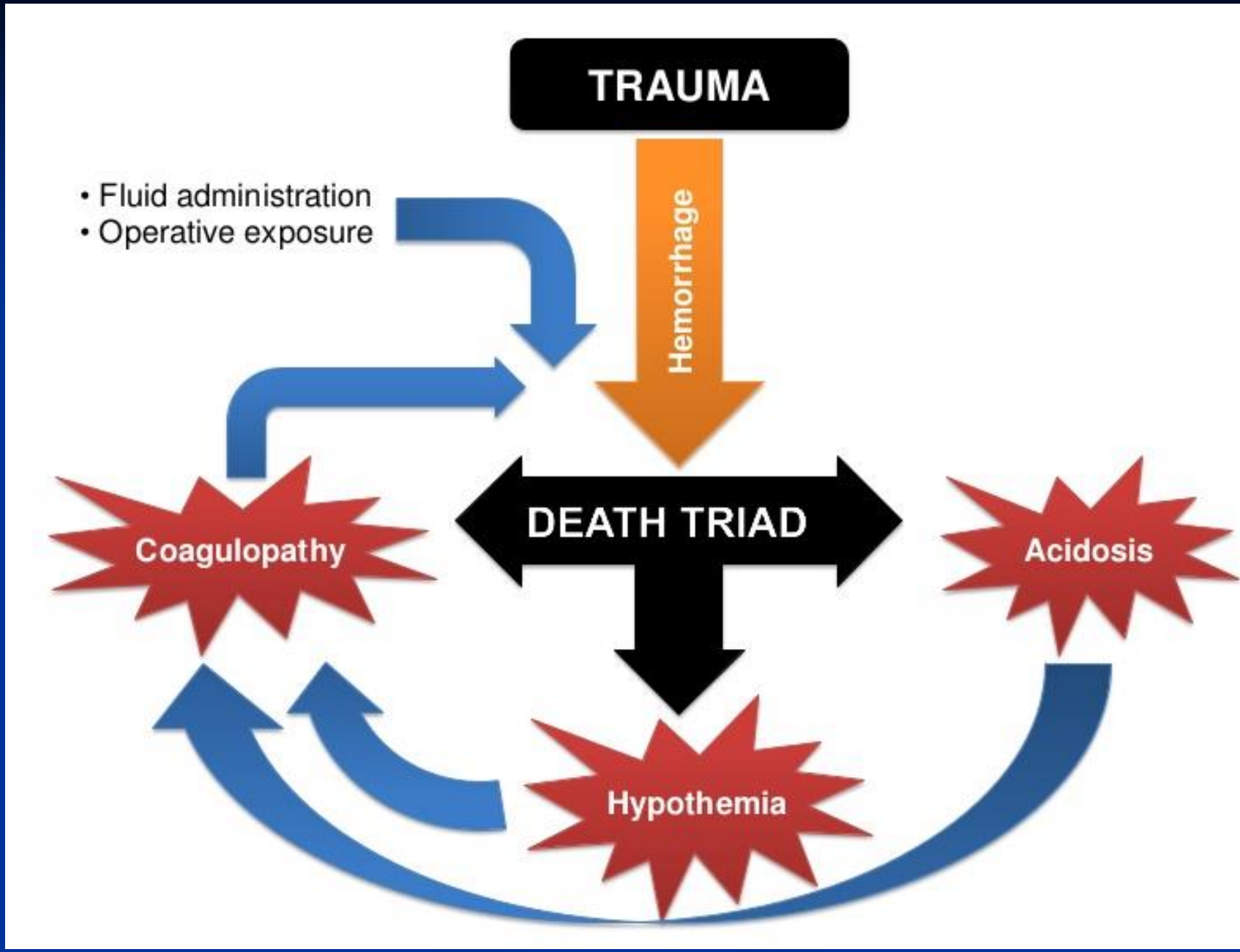
Score < 2 suggests unlikely need for massive transfusi

SBP ≤ 90

HR ≥ 120

+ FAST

Penetrating torso injury


TRAUMA
• Fluid administration
• Operative exposure
Hemorrhage
DEATH TRIAD
Coagulopathy
Acidosis
Hypothemia

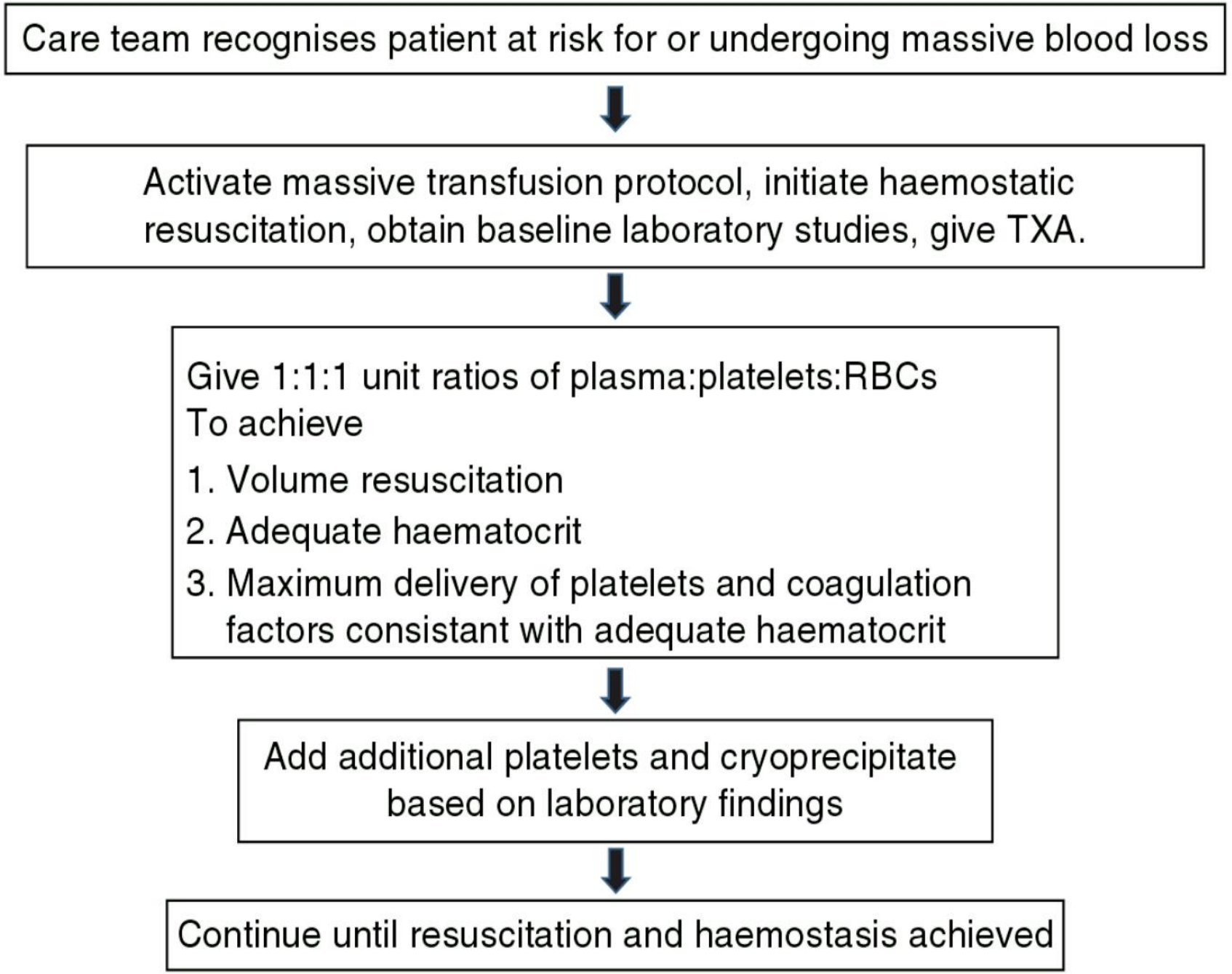
Predictor of massive transfusion

Trauma Associated Severe Hemorrhage (TASH)-score incorporated seven clinical and laboratory variables into a composite score to predict the need for MT.

- Haemoglobin,
- Base excess,
- Systolic arterial pressure,
- Heart rate,
- Presence of free intra-abdominal fluid and/or
- Complex fractures, and
- Gender

Nunez and colleagues demonstrated that simple parameters also appears to be as good as other more complex scoring systems to predict MT.

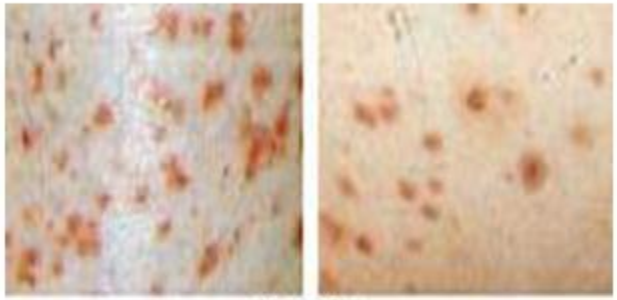
- Presence of penetrating trauma,
- Systolic arterial pressure <90 mm Hg,
- Heart rate >120 beats min, and
- a positive focused abdominal sonography for trauma,
- If any two of the above four parameters are positive, the patient is likely going to require MT.


Care team recognises patient at risk for or undergoing massive blood loss
Activate massive transfusion protocol, initiate haemostatic resuscitation, obtain baseline laboratory studies, give TXA.
Give 1:1:1 unit ratios of plasma:platelets:RBCs
To achieve
1. Volume resuscitation
2. Adequate haematocrit
3. Maximum delivery of platelets and coagulation factors consistant with adequate haematocrit
Add additional platelets and cryoprecipitate based on laboratory findings
Continue until resuscitation and haemostasis achieved

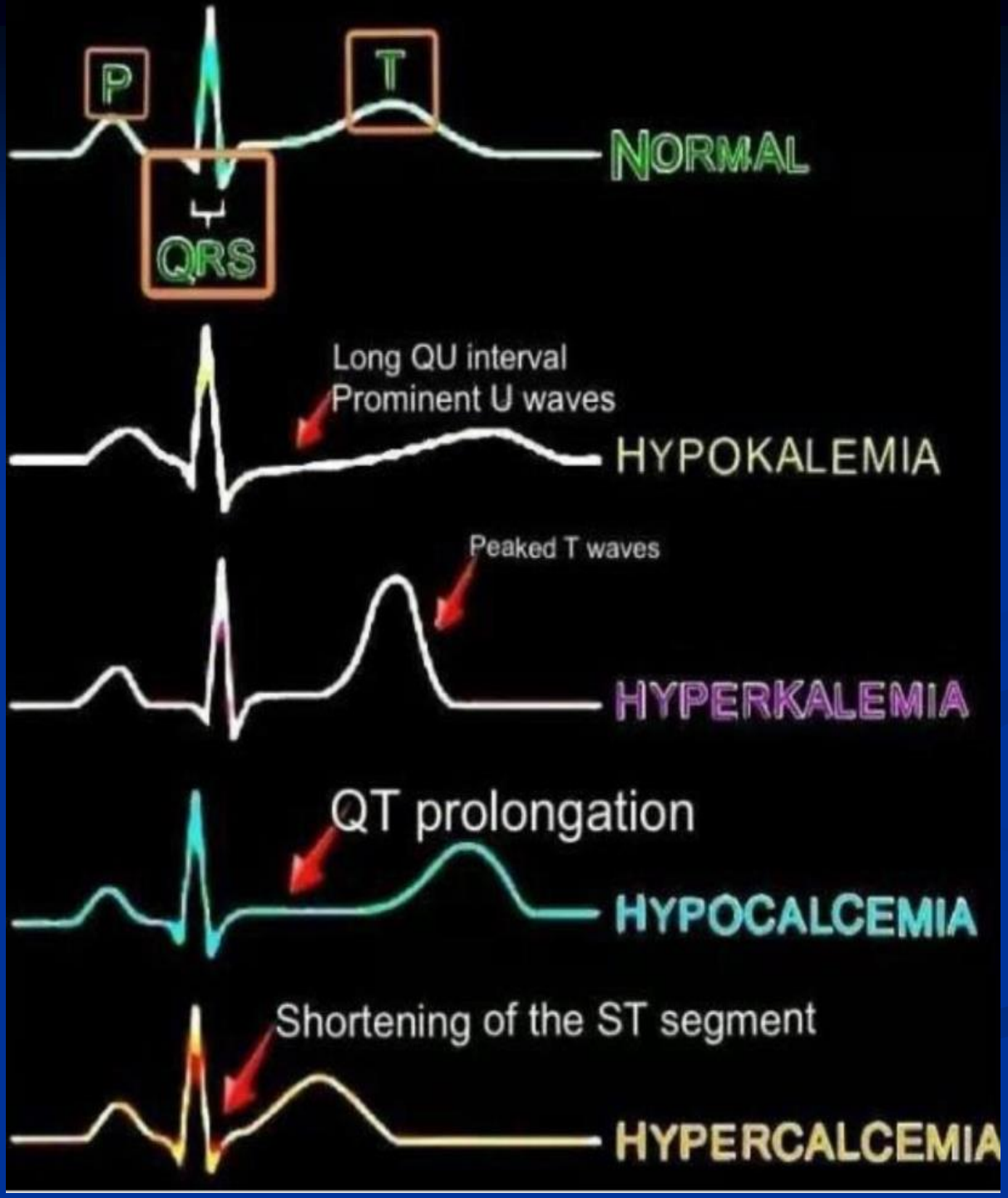
Weight of Child			
< 15kg	15 – 30kg	30 – 50kg	> 50kg
1 unit PRBC+	2 unit PRBC	3 unit PRBC	4 unit PRBC
1 unit FFP*	2 unit FFP	3 unit FFP	4 unit FFP
1 unit pooled platelets	1 unit pooled platelets	1 unit pooled platelets	1 unit pooled platelets

- **Tranexamic acid (TXA), were demonstrated to reduce mortality in trauma patients in both civilian and military settings, especially if given early in the resuscitation process (<3 h from injury to treatment, preferably within 1 h from injury).**
- **In the military setting, the MATTERs study, mortality in the TXA group was lower than in the group not receiving TXA.**

Post-Transfusion Purpura (PTP)



- Incidence: Rare (>250 cases in literature)
  - Female-to-male ratio is 26:1
- Etiology: Recipient platelet antibodies destroys autologous and transfused platelets
- Presentation: Thrombocytopenic purpura, bleeding, 8-10 days following transfusion
- The typical patient is a multiparous woman or a patient with history of previous transfusions
- Thrombocytopenia is usually severe with platelet counts below 10,000
- Can be associated with significant hemorrhage


P
T
QRS
NORMAL
Long QU interval
Prominent U waves
HYPOKALEMIA
Peaked T waves
HYPERKALEMIA
QT prolongation
HYPOCALCEMIA
Shortening of the ST segment
HYPERCALCEMIA

ABO type	n	*VWF:Ag geometric mean*	*VWF:Ag geometric mean ± 2SD*
O	456	74.8	35.6–157.0
A	340	105.9	48.0–233.9
B	196	116.9	56.8–241.0
AB	109	123.3	63.8–238.2

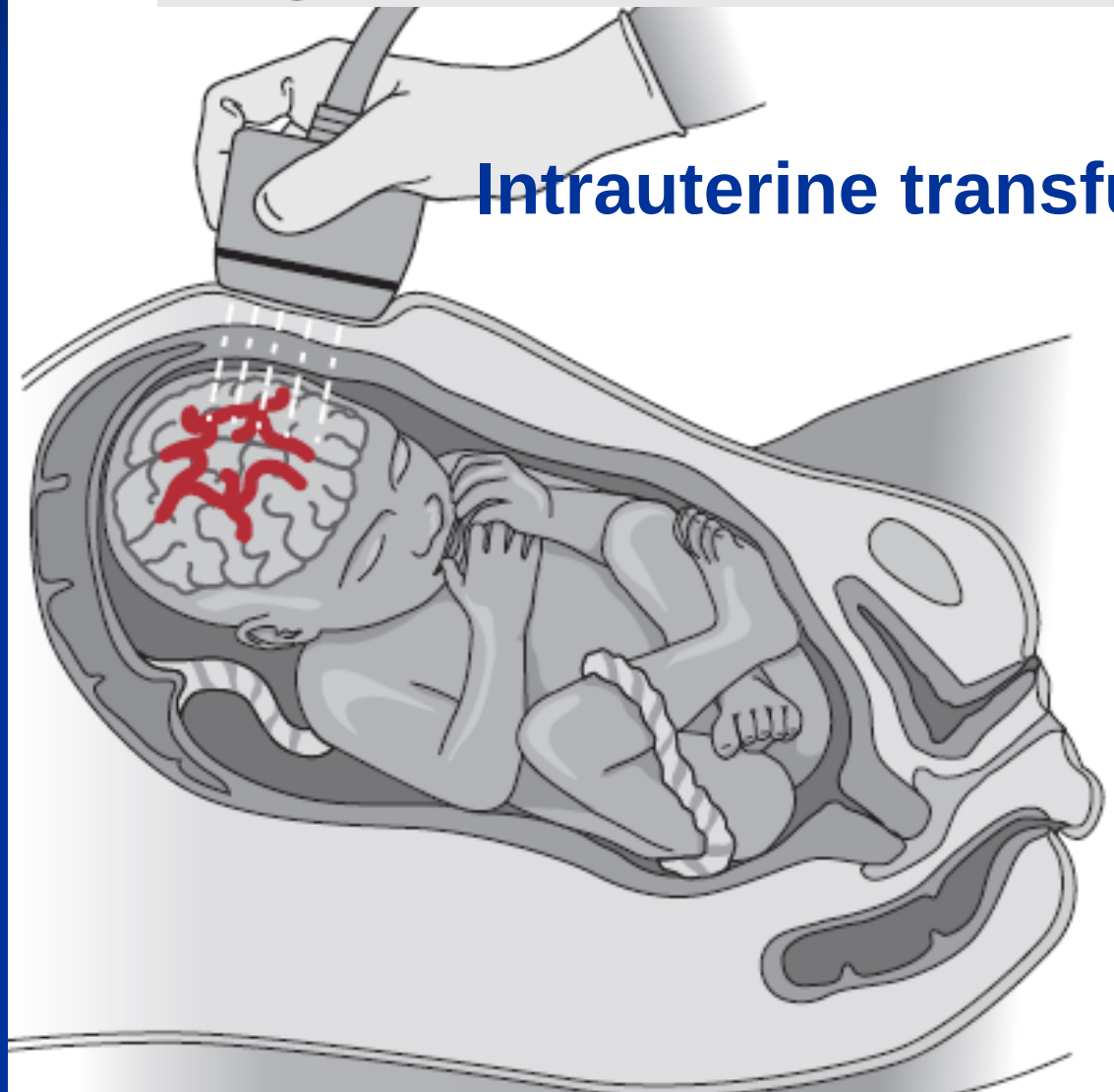
Pretransfusion testing

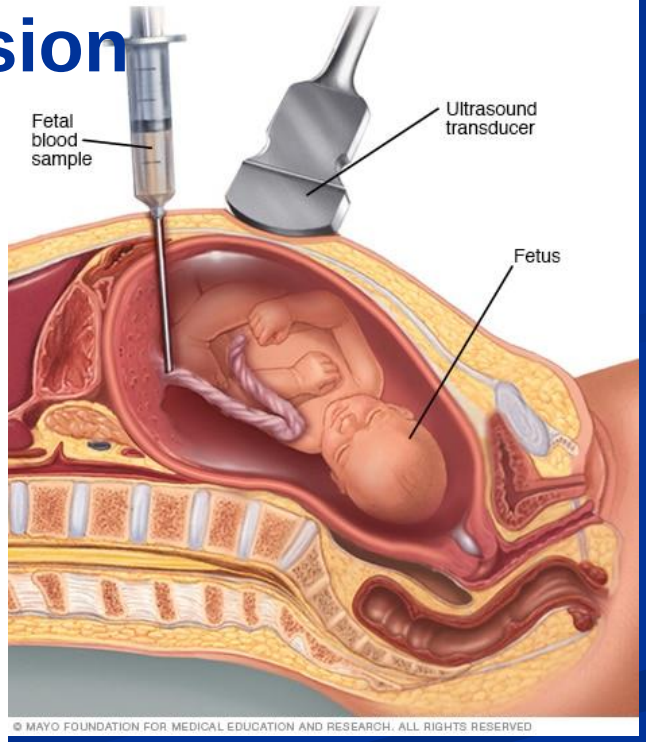
Pretransfusion compatibility testing prior to transfusion is extremely important and involves the following;

- Blood Sampling and Clerical Checking
- Blood Grouping
- Antibody Detection Tests
- Crossmatching Tests
- Computerized Crossmatching
- "Type and Screen" Policy

- Group O (or ABO-compatible) D-negative blood
- RBCs <7 days old, resuspended in group AB FFP
- CMV-reduced-risk components: CMV-seronegative donors or leukocyte reduced
- Irradiated blood
- Hemoglobin S–negative blood
- Blood lacks antigen corresponding to maternal antibody
- Compatible crossmatch with maternal serum or eluate prepared from newborn's red cells

Intrauterine transfusion





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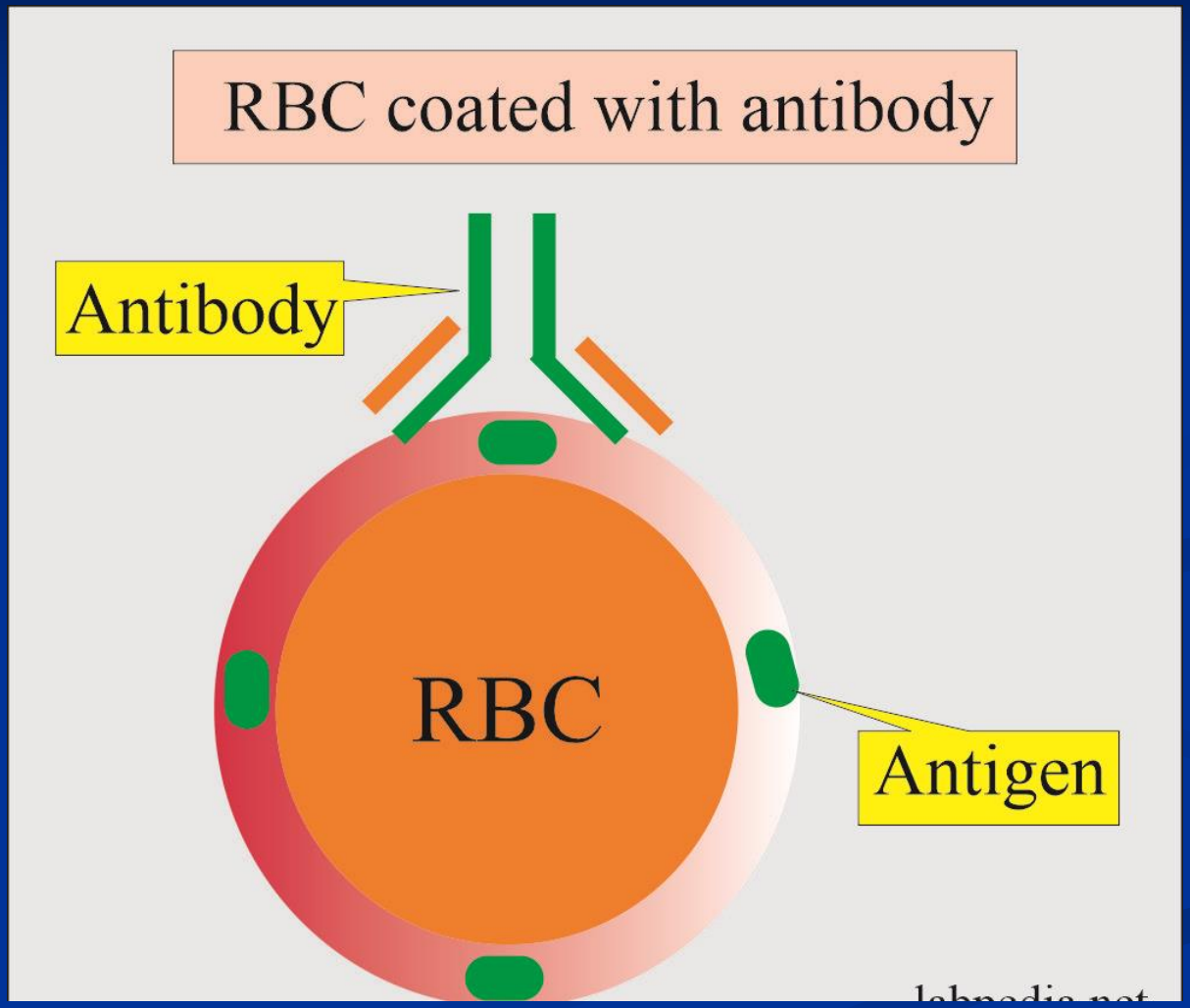
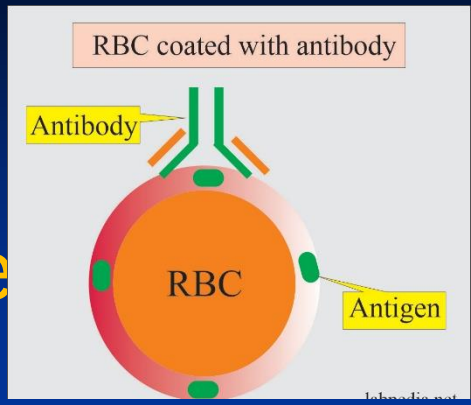


Direct coomb,s test



DATs are useful in workup of:

a) Transfusion reactions

b) Autoantibodies and autoimmune hemolytic anemia

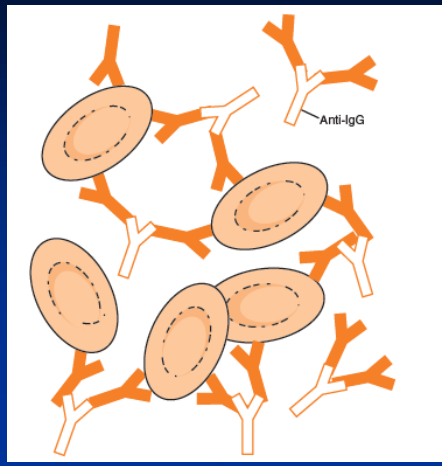
c) Hemolytic disease of the fetus/newborn

d) Drug-related hemolytic anemia

e) Antibodies vs. recently transfused antigens

f. Positive DATs, however, are nonspecific, and are seen in up to 15% of hospitalized patients

Direct coomb,s test



DATs are useful in workup of:

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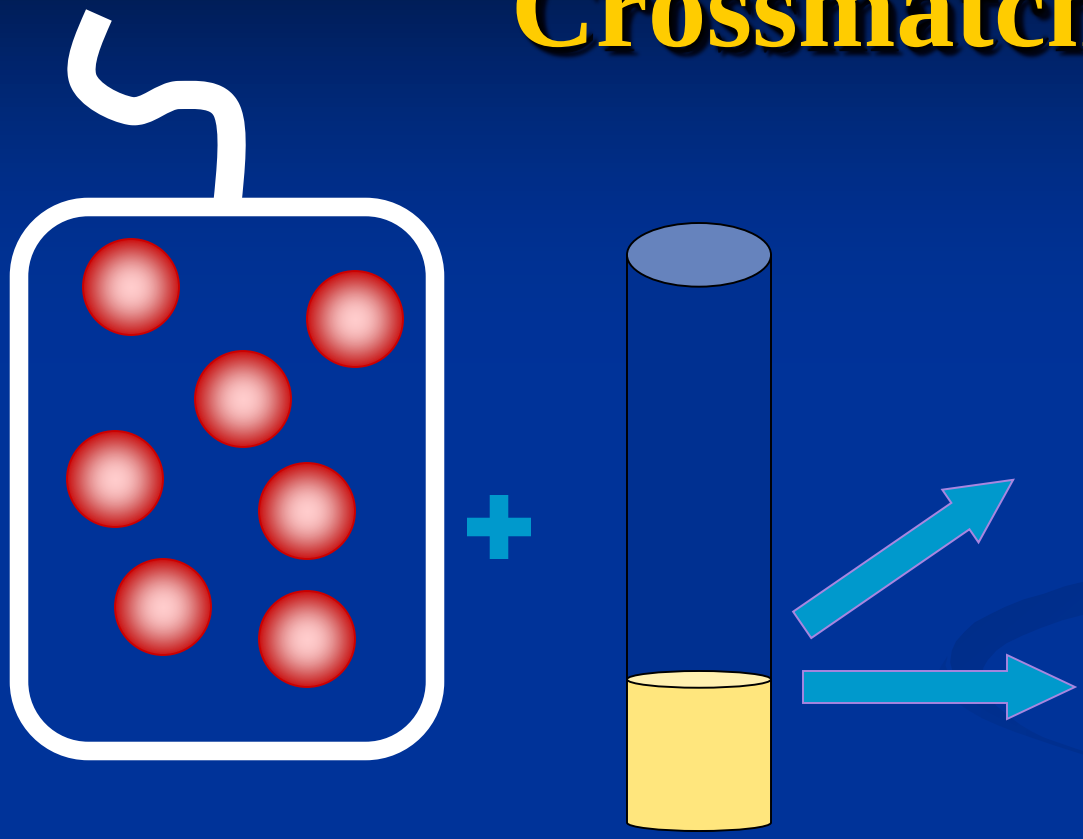
c) Hemolytic disease of the fetus/newborn

d) Drug-related hemolytic anemia

Positive DATs, however, are nonspecific, and are seen in up to 15% of hospitalized patients,IVIg infusion

Crossmatch



Donor RBCs
(washed)

Patient serum

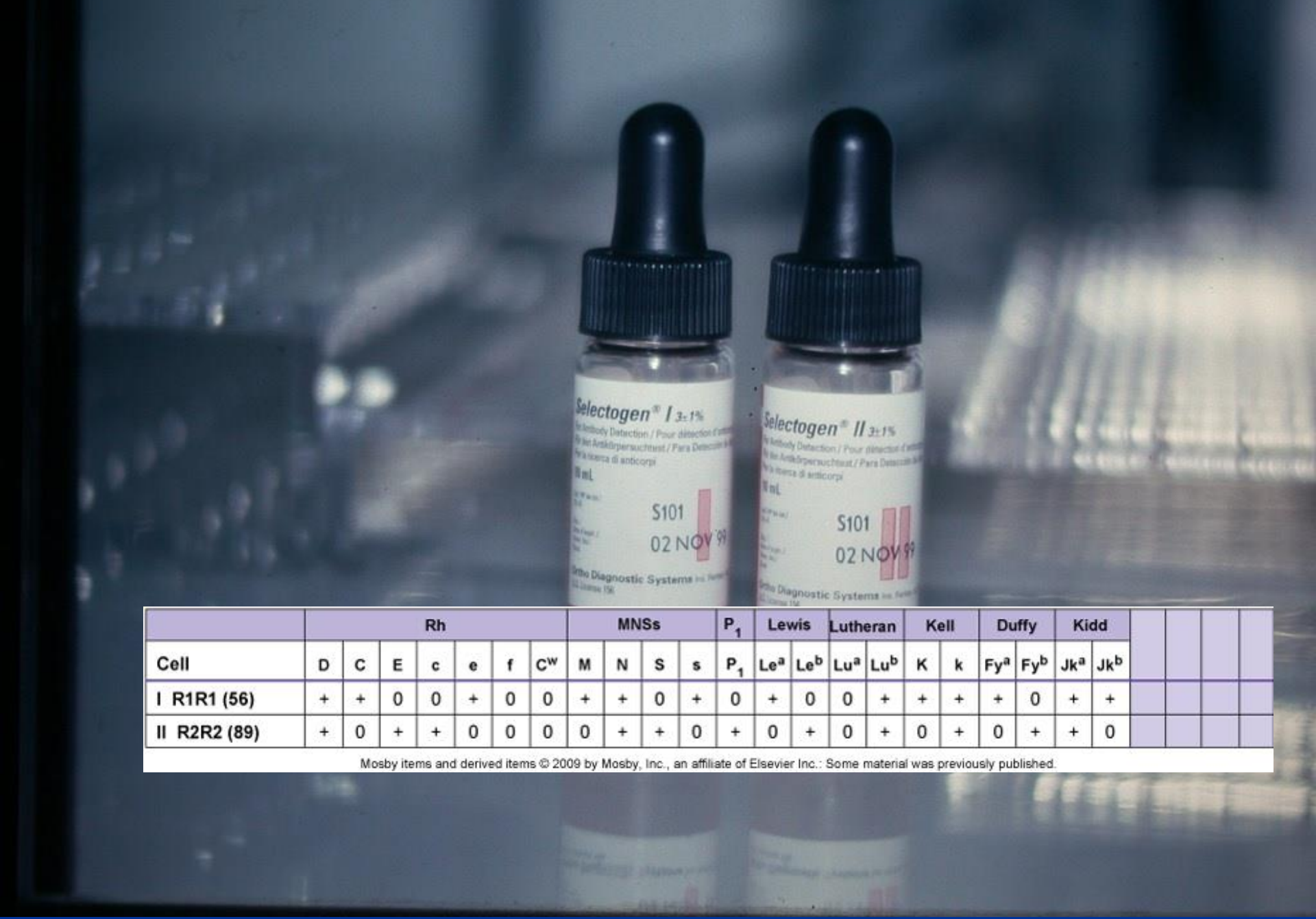
No agglutination ~ compatible

Agglutination ~ incompatible

Type and Screen

- Blood is ABO-Rh typed & screened for common antibodies
- 99.8% chance of compatibility for type
- 99.94% with antibody screen
- 99.95% with crossmatch
- Many institutions do not X-match blood
- Type specific blood available < 10 minutes!

Criteria of blood transfusion for Autoimmune hemolytic anemia



	Rh							MNSs				P_1	Lewis		Lutheran		Kell		Duffy		Kidd					
Cell	D	C	E	c	e	f	C^w	M	N	S	s	P_1	Le^a	Le^b	Lu^a	Lu^b	K	k	Fy^a	Fy^b	Jk^a	Jk^b				
I R1R1 (56)	+	+	0	0	+	0	0	+	+	0	+	0	+	0	0	+	+	+	+	0	+	+				
II R2R2 (89)	+	0	+	+	0	0	0	0	+	+	0	+	0	+	0	+	0	+	0	+	+	0				

Selection of blood for exchange transfusion:

- Group o(or ABO-compatible)
- Fresh(less than 7 days old)RBCs resuspended in fresh frozen plasma
- CMV negative
- Irradiate blood
- HbS negative
- Blood lack of Ag corresponding to maternal Ab
- Compatible crossmatch with maternal serum

Blood volume for exchange transfusion

TBV = 100 ml/kg premature infant
= 85 ml/kg term infant

$$\text{Volume of RBC product (ml)} = \frac{\text{Exchange volume} \times \text{reconstituted Hct}}{\text{Hct of RBC product}}$$

Volume of FFP (ml) = Exchange volume − volume of RBC product


Albumin (Human), USP, 5% Solution
Buminate 5%
5%

Albumin in cirrhotic ascites

- **Large paracentesis > 5 L**

  8 g albumin/liter of ascites removed

- **SBP with renal impairement**

  First six hours 1.5 g albumin / kg bw

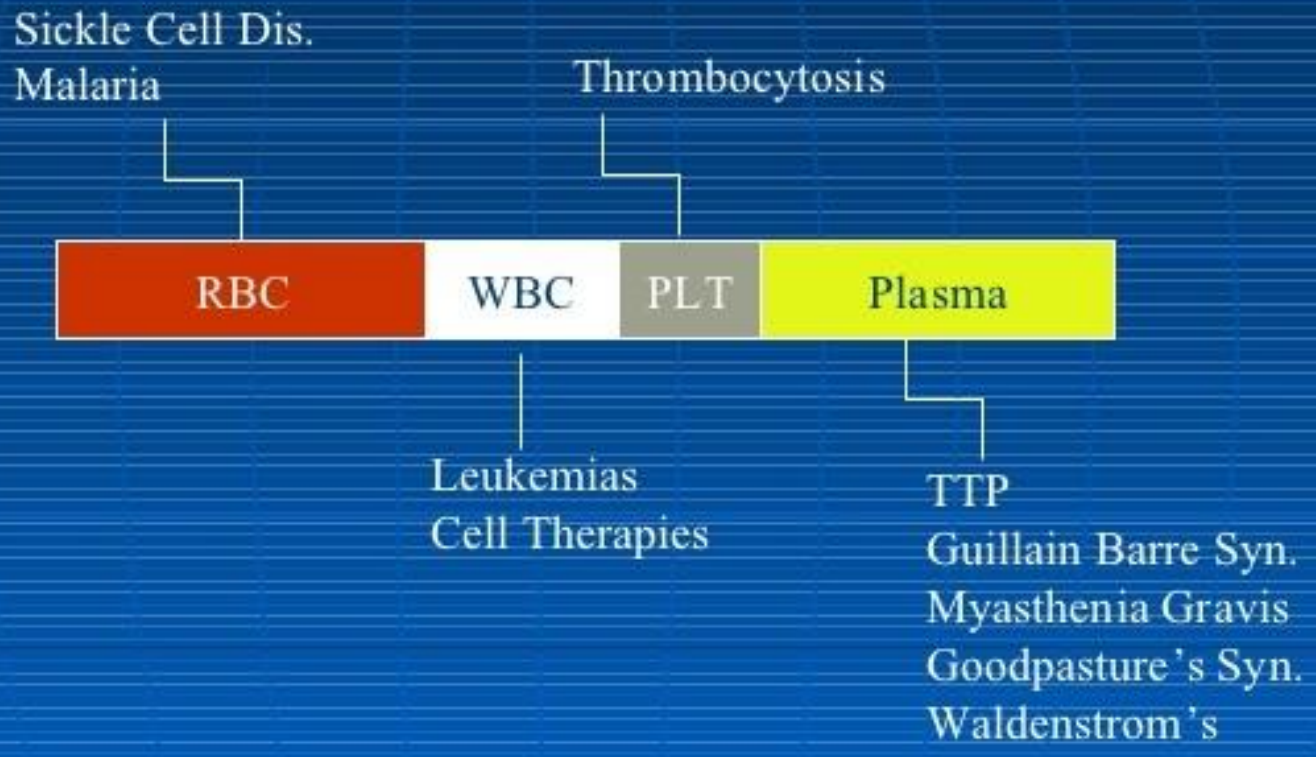
  Day 3 1g albumin / kg bw

- **HRS-I**

  First day 1 g / kg bw (maximum 100 g)

  Following days 20 – 40 g / day

Apheresis in Clinical Practice



Applications

1. Component collections

- Plateletpheresis
- Leucopheresis
- Erythrocytapheresis
- Plasmapheresis
- Stem cell collection

ASFA Guidelines 2010

Category	Description	Example
I	As first-line therapy, either as a primary standalone treatment or in conjunction with other modes of treatment	Guillain-Barre' syndrome; myasthenia gravis
II	As second-line therapy, either as a standalone treatment or in conjunction with other modes of treatment	Acute disseminated encephalomyelitis after high-dose IV corticosteroid failure
III	Optimum role of apheresis therapy is not established	In patients with sepsis and multiorgan failure
IV	Apheresis might be ineffective or harmful	Active rheumatoid arthritis

Guidelines for Therapeutic Plasmapheresis

Category I	Category II
Thrombotic Thrombocytopenic Purpra (TTP). Coagulation factor inhibitors Cryoglobulinemia Goodpasture's syndrome Guillain-Barre syndrome Homozygous familial hypercholesterolemia Hyperviscosity syndrome Myasthenia gravis Postransfusion purpura Refsum's disease	Rapidly progressive glomerulonephritis Chronic inflammatory demyelinating polyneuropathy Cold agglutinin Drug overdose and poisoning (protein-bound toxins) HUS Pemphigus vulgaris Systemic vasculitis (primary or secondary to rheumatoid Arthritis or systemic lupus Erythematosus)

Category III	Category IV
ABO-incompatible organ or marrow transplantation	**AIDS (for symptoms of immunodeficiency)**
Maternal treatment of Maternal-fetal incompatibility (HDN)	**Amyotrophic lateral sclerosis**
Thyroid storm, Multiple sclerosis	**Aplastic anemia**
Progressive systemic sclerosis	**Fulminant hepatic failure**
Pure RBC aplasia , Transfusion refractorines	**ITP (chronic) , Lupus nephritis**
due to Alloantibodies (RBC, platelet, HLA)	**Polymyositis / dermatomyositis**
Warm autoimmune hemolytic anemia	**Psoriasis , Renal transplant rejection**
	Rheumatoid arthritis

Thrombotic Thrombocytopenic Purpura (TTP)

- Pentad: Thrombocytopenia, microhemangiopathic hemolytic anemia, renal dysfunction, CNS symptoms, fever
- Etiology: Platelet activation by unusually large multimers of von Willebrand factor (vWF). vWF cannot be cleaved due to the absence of cleaving enzyme, metalloprotease = ADAMTS 13 (a disintegrin and metalloprotease, with thrombospondin-1-like domains).

Replacement Fluid

- Fresh frozen plasma – TTP, liver failure, coagulopathy with inhibitors, patients with coagulopathy, immediate post surgery.
- Cryopoor plasma – TTP
- 5% albumin – Most cases.


Thank you