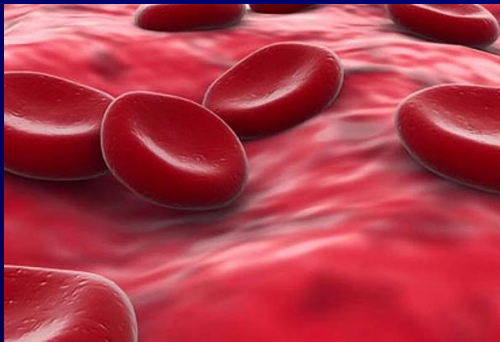


HIGHER STATE EDUCATIONAL
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DEPARTMENT OF GENERAL SURGERY

BLOOD TRANSFUSION-2

Methods & Types of blood transfusion

Lecture for general surgery
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Poltava

LECTURE PLAN

- **Blood Transfusion action mechanism**
- **The indication and contraindication to hemotransfusion.**
- **Methods & Types of blood transfusion.**
- **Doctors Procedure's during hemotransfusion.**

Blood transfusion

- **Ottenberg's rule (1908)** - the donor's red blood cells transfused agglutinates . The holders of group I blood are referred to as universal donors and this blood can transfused to every one.
- But now only same blood typing (on A,B,O) and bloods of the same rhesus transfusion is necessary.
- It is only allowed to transfuse 0.5 Ltr of a donor blood to a different blood group.



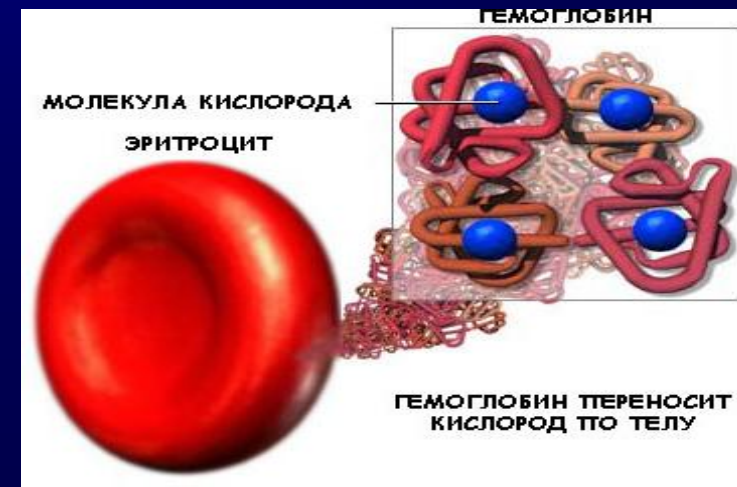
Transfused blood action mechanism

The effect of transfused blood depends upon the amounts, the method, and the speed of transfusion.

- Replacing action.
- Hemostatic reaction
- Immunobyological reaction
- Desintoxical reaction
- Nourishing reaction.
- Stimulating reaction

Transfused blood action mechanism (continued)

- Erythrocytes of the transfused bloods will function for 30 days
- White blood cells - leave at once a bed after transfusion.
- Plasma Proteins from the donor can circulate for 18-36 days.



The indication to hemotransfusion

I. Absolute: Acute, blood loss (more 15% BVC), Traumatic shock, severe operation (with massive impairments to tissue, blood loss e.g. mastectomy, abdominoperineal resection)

II. Relative

1. Anemia (Hb below 80 g/l)
2. Common diseases with intoxication
3. In the case of deep burns a blood transfusion is required as well as initial plasma fluid administration, due to hemolysis of the blood.
4. Preoperatively blood transfusion is required when the patient is anemic and there is limited time for Iron Replacement Therapy before invasive surgery.
5. Also required before malignant disease surgery.

5. A postoperative blood transfusion may be required if the patient has become anemic and debilitated, either due to excessive bleeding during surgery, or as a result of an infection or septicemia.
6. In the case of severe malnutrition and hypoproteinaemia, a blood transfusion may be required before any type of surgery.
7. In certain coagulation disorders like hemophilia, thrombocytopenic purpura, leukemia, aplastic anemia whole blood transfusion's may be required.
8. In treating cases of erythroblastosis foetalis due to Rh incompatibility, an exchange transfusion is often performed through the umbilical vein of the newborn.
9. During chemotherapy for malignant diseases, a blood transfusion is often required if the routine blood test shows considerable diminution of RBC level.

Contraindications to hemotransfusion

Absolute contraindication to hemotransfusion is nonexistent, if the patient suffers massive blood loss!

Then - Contraindications to hemotransfusion are:

Absolute - Acute violation of the function of the liver, kidneys, heart just occurred; (fresh thrombosis and emboli, infarct myocardium, acute nephritis, severe hepatic failure)

Relative

1. Inflammatory diseases of vessels (tromboflebits, phlebitis, embolisms);
2. Allergic conditions, Hypersensitivity;
3. Active tuberculoses process, also inflammation disease of pulmonary tissues.
4. Miocarditis, Septic endocarditis
5. Decompensated cardiac disease.
6. Hypertonic diseases (i.e. with numerous complications)
7. Severe impairment of kidney and liver function
8. Rheumatism
9. Disordered cerebral circulation.
10. Pulmonary edema.
11. Generalized amyloidosis.
12. Bronchial asthma.

METHODS OF BLOOD TRANSFUSION

1. Transfusion of own blood - the autologous blood transfusion

a) a transfusion of earlier prepared blood

б) blood reinfusion

- **during operation**
- **from a postoperative wound**

2. Transfusion of a donor blood

- **1) Direct transfusion**
- **2) Indirect transfusion**
- **3) Exchange transfusion**

I. Transfusion of own blood - the AUTOLOGUS blood transfusion

- I. Transfusion of earlier prepared blood in the case, when a prognosticated hemorrhage 15-20%BVC
 - a) **single method of a blood sampling** (400-500 ml) the day before surgery . Blood transfusion to be carried out at the end of surgery.
 - б) **step method - a stage-by-stage method** (800 ml and more) – during a 1-2 month period prior to surgery.
- From the patient take 200-300 ml of blood, replace with blood substitutes; in 4-5 days pour and again take 300-400ML and so on
- It is possible to prepare 1-1.5 l of an autoblood

2. Blood reinfusion

- 1. Intraoperative** - collecting and transfusing during surgery or as a result of organ damage (vessels).
- 2. Postoperative reinfusion** - collecting and transfusing blood discharged after surgery from drainage points.

Reinfusion methods:

- 1. By means of accumulators.
- 2. By means of collecting and cleaning devices.

Conditions required for reinfusion:

- no later than 8 hours - if the blood poured out in a cavity
- no later than 6 hours - a blood which poured out after operation

Reinfusion technique

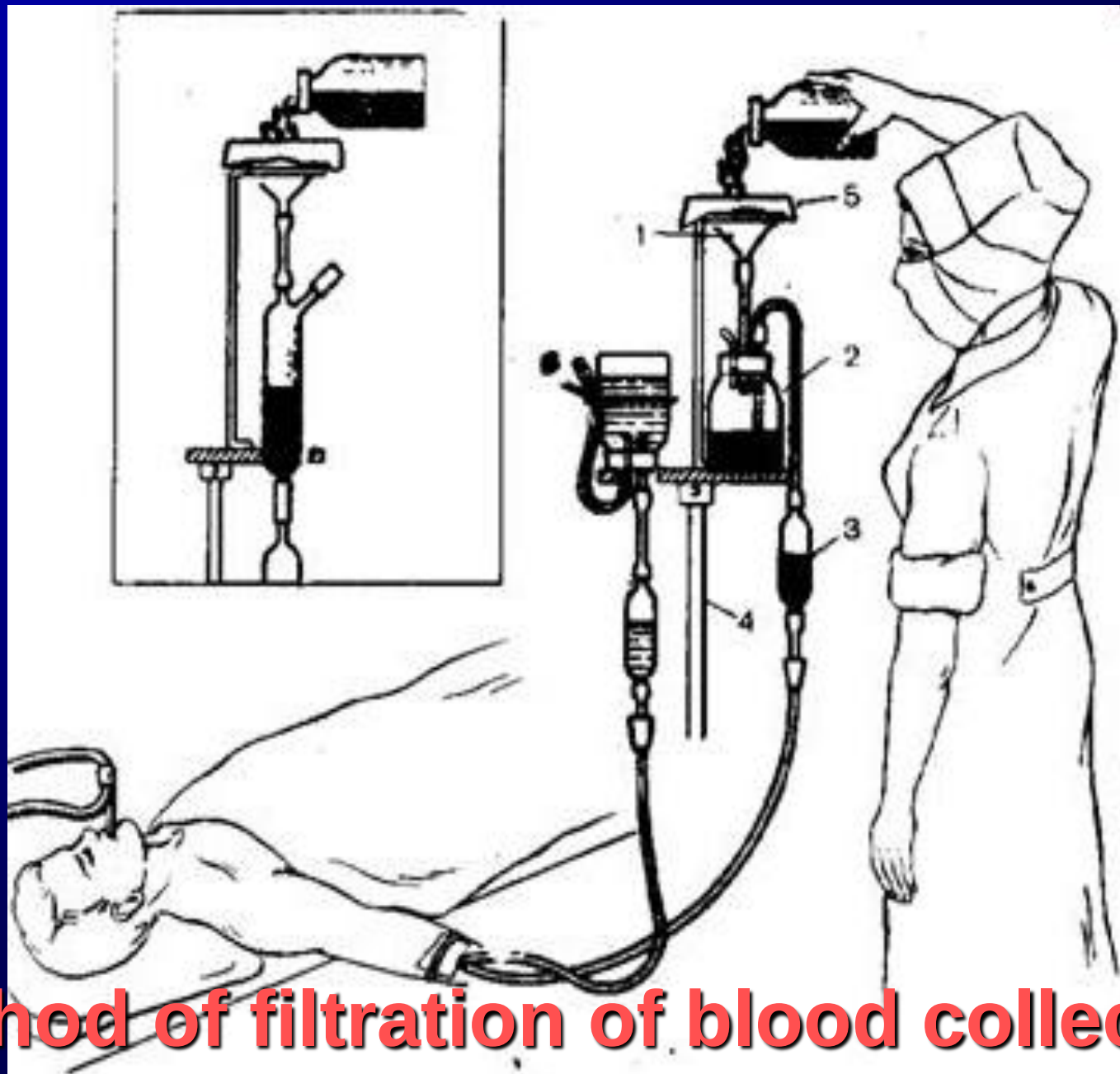
- - own blood from the closed cavities (thoracic, abdominal, a pericardium) - the collecting in sterile glass bottles, packages.
- - from a postoperative wound - transfusions through system with filter.
- - stabilization

Glugjcirum - 50 ml on 200 ml of blood

4 % solution sodium citrate- 10 ml on 100 ml of a blood

Heparin - 1000 UA on 500 ml of a blood

- - filtration (4-6 layers of a gauze or system with filter) - right after stabilization.



**Method of filtration of blood collected
During surgery**

INDICATIONS to the REINFUSION:

- - the broken extrauterine pregnancy
- - rupture of an oothecoma
- - rupture of a lien
- - rupture of a hepar
- - intrapleural bleeding
- - operations on pelvic bones, femurs, a backbone.
- - operations on the main vessels

CONTRAINDICATIONS TO THE REINFUSION:

- if blood was in a cavity for more than 8 hours (a defibrination, infected)
- accompanying damages of hollow organs (stomach, intestine, gall bladder, and bladder)
- operations on malignant diseases
- purulent pollution of blood
- renal failure
- operations on a hysterorrhesis (relative)

II. Transfusion of donors blood

- **I. Direct transfusion** – Directly from the donor to the patient, without stabilizer and conservator.

Ways of direct transfusion:

- a) **direct connection**; via vessels of the donor and recipient connected by plastic tube (**continuous transfusion**)
- b) **intermittent way** - taking blood from the donor by syringe (20 ml) and then fastest introduction to the recipient
- c) **intermittent way** using special devices.

a) direct connection via vessels of the donor and recipient connected by plastic tube (**continuous transfusion**)

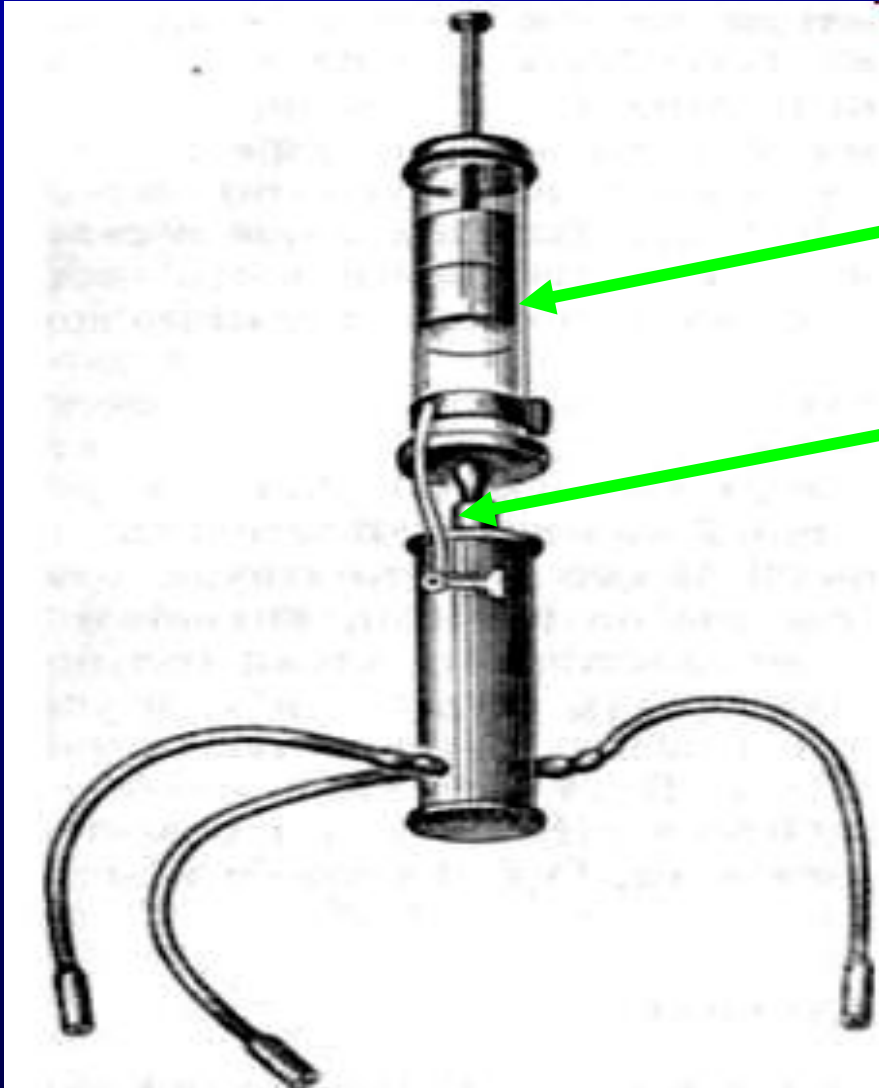


b) intermittent way - taking blood from the donor by a syringe (20 ml) and the fastest introduction it to recipient



- Blood is taken from the Donor , Biologically Tested and then injected into the recipient

c) intermittent way with use of special devices



- Consists of a syringe, a switch and tubes which connect the donor and recipient together a washing solution ensures clean and filtered blood transfer

Anorov's apparatus

Advantages of a direct method:

- - absence of conservators
- - transfusion of a fresh blood

Disadvantages:

- - risk of putting into the vascular system of the recipient small blood clots
- - transfusion not correct type mismatched donor's blood
- - risk of infection of the donor - refusal from direct transfusion

2. Indirect transfusion - the main method of blood transfusiology - preparation in packages, bottles with preservative in a planned regime, stored in blood banks.

3. Exchange transfusion - partial or complete excision of a recipient's blood (exphusion) with simultaneous replacement by its donor blood

INDICATION:

- hemolytic icterus of newborns (conflict)
- hemotransfusion shock
- massive intravascular hemolysis
- serious poisoning.

2. Indirect blood transfusion

Technique of blood transfusion

Operations procedure for the doctor before a hemotransfusion

- 1. To define the indication to a hemotransfusion, to determine contraindication, to ask the transfusiological anamnesis.**
- 2. To determine a blood type and a rhesus factor of the recipient**
- 3. To choose the corresponding blood of the same group and a rhesus and macroscopically to estimate its suitability.**
- 4. To examine a blood type of the donor (from a bottle) on ABO system**
- 5. To carry out test on individual compatibility on ABO system**
- 6. To carry out test on individual compatibility on a Rh factor**
- 7. To carry out biological test**
- 8. To carry out a hemotransfusion**
- 9. To fill documentation**
- 10. To observe for the patient**

1. Transfusiological anamnesis

- Whether the patient knows the blood type and a rhesus
- Whether in the past a blood transfusion was performed and whether there were any complications, (medical history)
- In women - existence of pregnancy and their complications (especially in Rh-negative)

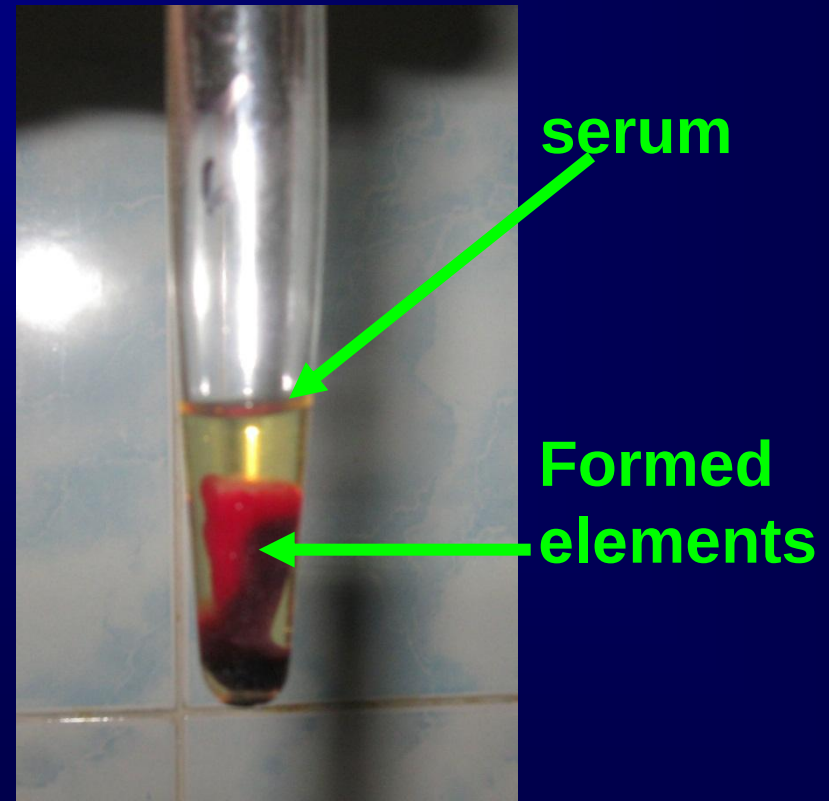


2. To determine a blood type and a rhesus factor of the recipient

For this purpose we take a blood sample from the vein of a patient. The blood sample is centrifuged to define plasma unit and formed elements



centrifuge



3. MACROSCOPICALLY ESTIMATION OF DONORS BLOOD:

1. Correctness of certification - a label with number:

- a) preparation date
- б) group and Rh-factor - indication
- в) name of conservator,
- г) surname and name of the donor
- д) institution supplier
- e) surname and signature of the doctor.

2. Suitability term (Glugjcirum - 21 days from day of preparation).

- 3. Tightness (hermeticity) of packing.



- 4. Layers of an full blood

- а) upper layer - plasma – transparent, yellow.
- б) lower layer - leucocytes , thrombocytes - narrow, gray
- в) dawn - erythrocytes – red color



- 5. Infected blood - plasma opaque, contains membranulas, flake's, clots. A hemolysis - a red coloring. Hilyoz - higher content of fats.

5. Test for individual compatibility **for ABO system**

- 0,1 ml serum of blood of recipient
- T - 15 - 25°C
- 0,01 ml blood of donor blood from storage bottle
- Mix together on a Petri-dish
- After 5 minutes add one drop of 0,9% solution of Sodium chloridum.

Estimation of test:

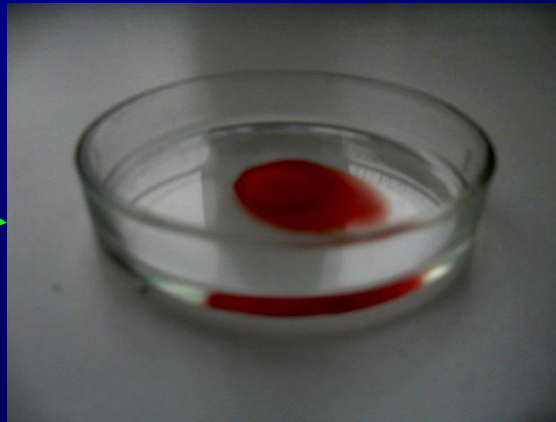
- - absent of agglutination of donor's erythrocyte – blood of donor and recipient compatible for ABO system:
- - there was an agglutination – bloods incompatible

ATTENTION!

**Patients
Blood**



Mixed



Petri Dish

**Donor
Blood**



6. Test for individual compatibility for Rhesus-factor:

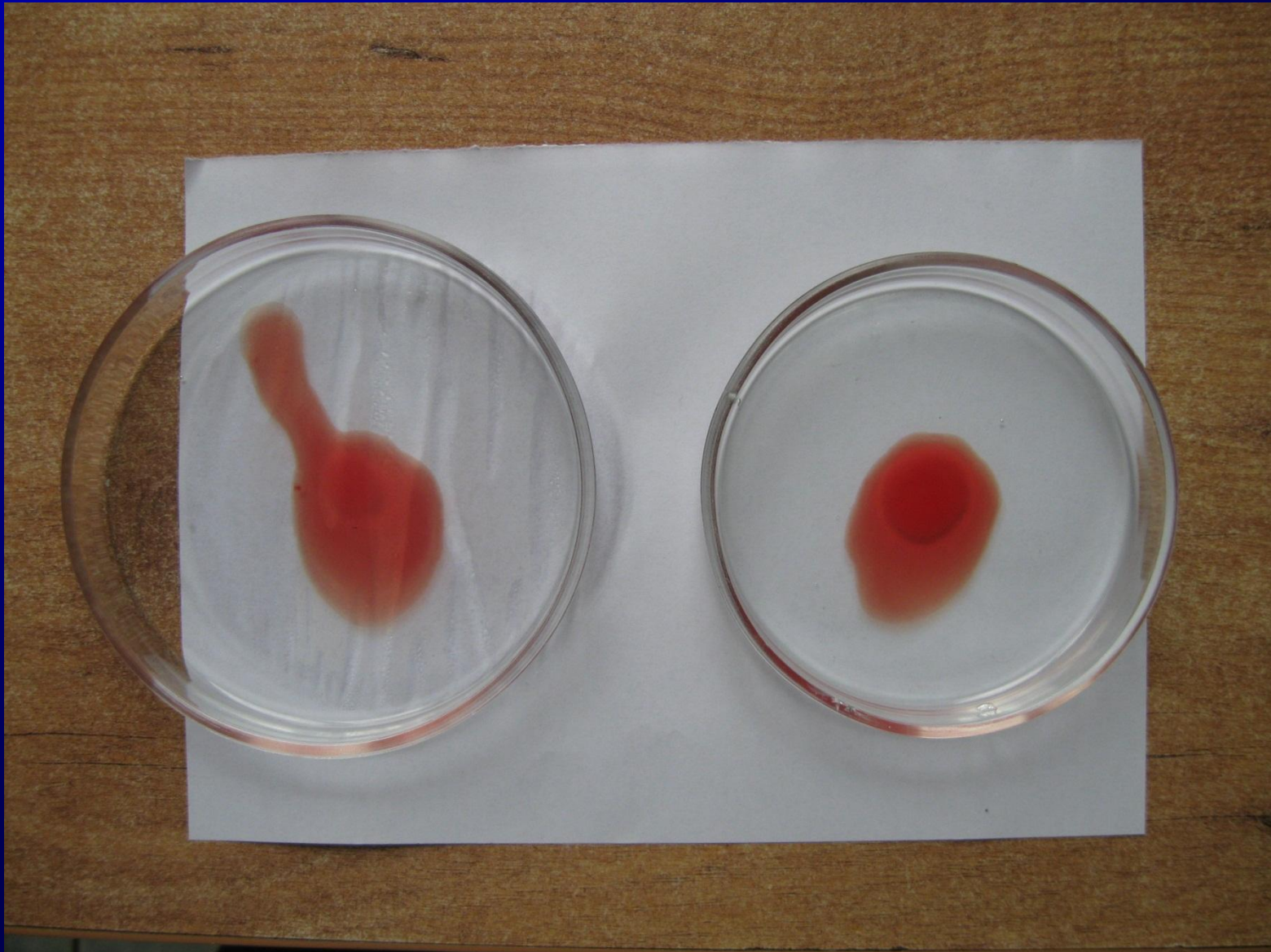
- one drop of Serum of the recipient blood is placed on Petri dish
- add 3-5 times of the smaller size a drop of a donor's blood
- Place Petri dish in water bath-
- T 42 - 45°C on 5 min.



Estimation of test:

- - absence of agglutination of donor's erythrocyte – the donor and recipient blood type is compatible for the Rhesus system:
- - NO agglutination - incompatible.

Test Results of compatibility on ABO system and a Rh factor



7. Biological test:

- 1. Inject / Transfuse 10-15 ml blood
- 2. observe the patient of 3 minutes check pulse rate, respiration, lack of the dyspnea, complicated respiration, hyperemia of the face, fever, pain behind the breast bone, stomach and loin
- 3. Again inject/transfuse 10-15 ml of a blood, monitor patient for 3 minutes.
- Again inject/transfuse 10-15 ml of a blood, monitor patient for 3 minutes.
- 4. **absence of reactions - Blood compatible.**
- 5. Patient reactions if blood is incompatible - restless , tachycardia, dyspnea, hyperemia of the face, fever, pain behind breast bone, stomach and loin (lumbar).

BIOLOGICAL TEST AT THE HEMOTRANSFUSION TO THE PATIENT UNDER GENERAL ANAESTHESIA

- - decreases of arterial pressure
- - erratic pulse
- - hyperemia of a vein
- - hyperemia of the face and trunk
- - brown coloring of urine.

8. Technique of hemotransfusion

- When absence of signs of biological incompatibility the drop hemotransfusion begins
- The blood should have temperature 36-37°C (warm the blood in a water bath)
- Rate of transfusion - 40-60 drops per minute
- During transfusion observe and record pulse, arterial pressure, body temperature .
- After transfusion the container or a vial with the remains of a blood are stored within 2 days

9. Observation for the patient after hemotransfusion

- The recipient must have **2 hours** of bed rest after a transfusion
- Recipient to monitored for **3 hours** after transfusion with Blood Pressure, Pulse and Body Temperature readings being recorded
- General analysis of urine and general analysis of blood to be conducted during the next few days.

10. Filling of medical documentation (Protocol of hemotransfusion):

- Before a hemotransfusion registers short epicrisis with hemotransfusion justification
- After a hemotransfusion the hemotransfusion protocol registers
 - passport data from each vial: name, surname of the donor, blood type, rhesus factor, vial number, date of preparation of a blood
 - blood type and rhesus factor of the recipient

Cont..

- results of test for individual compatibility of a blood of the donor and the recipient on ABO system and a Rh factor
- result of biological test
- existence of reactions and complications
- Date and time transfusion
- Surname, name and the signature of the doctor which carried out transfusion
- Results of triple measurement of temperature, arterial pressure and pulse
- The next days - the diary with the indicating of a state of the recipient after a hemotransfusion

3. Exchange transfusion

DEFINITION: Simultaneous (isovolumetric type) or cyclical (discontinuous type) withdrawal of the recipient's blood and transfusion with the donor's blood. When a recipient's blood is replaced with crystalloids or colloids, partial exchange.

Synonyms:

- *Substitution transfusion
- *Replacement transfusion
- *Exsanguination transfusion

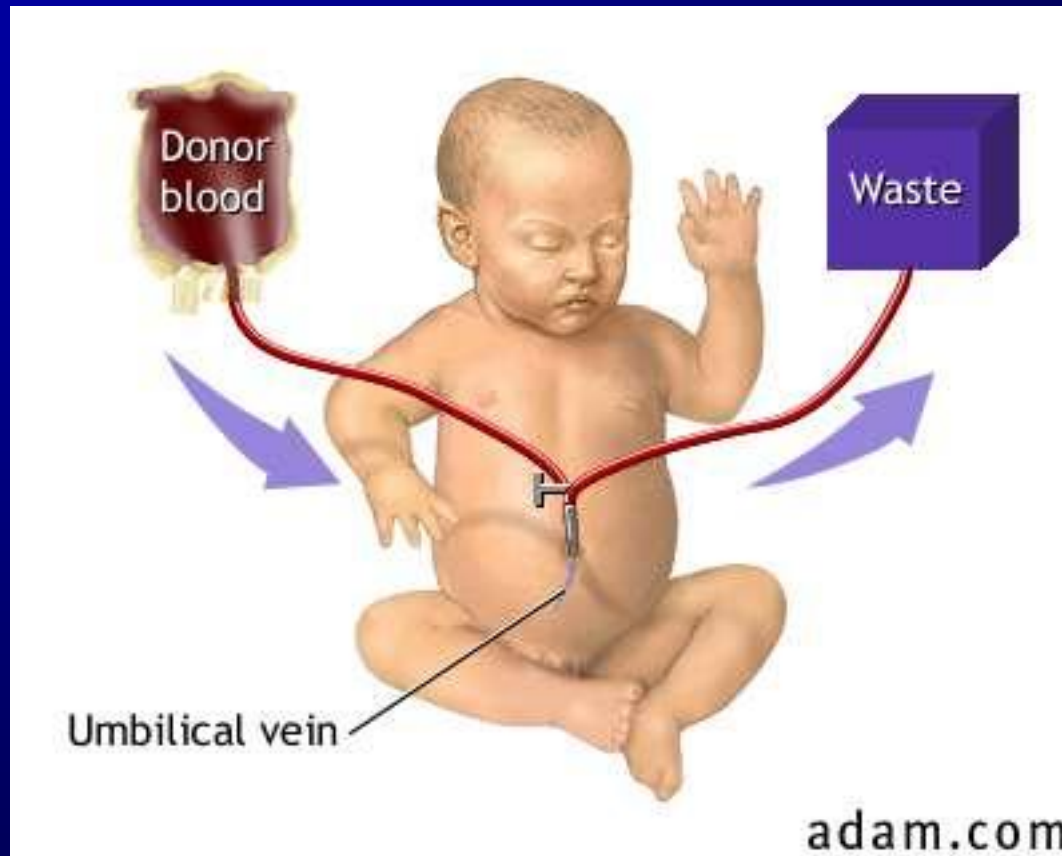
INDICATION:

- hemolytic icterus of newborns (conflict)
- hemotransfusion, shock
- massive intravascular hemolysis
- serious Poisoning – Salicylate, sedatives, theophylline, snake envenomation.
- acute renal failure
- Septicaemia
- Hyperparasitemia , Malaria
- Acute Hepatic Failure
- Leukaemia

Cont..

- During exchange transfusion with an exfused (removed) blood poisons, toxins delete together. The hemotransfusion is carried out with ***replaceable*** purpose..
- Use are fresh preserved blood over short periods of storage.
- Blood transfused in any superficial vein
- Exsphusen carried out from large veins or arteries for the fibrillation prevention of long procedure.
- Excision of a blood and injection of a donor blood carried out at the same time with average speed of 1000 ml in 15-20 minutes.
- For valuable replacement of blood 10-15 l of a donor blood is necessary.

EXCHANGE BLOOD TRANSFUSION



IN-LINE

EXCHANGE TRANSFUSION

ONE CATHETER
PUSH-PULL

Blood

Blood Filter

OUT-LINE

N.B. There is no one way
valve with this set up

This connection
is a tight fit

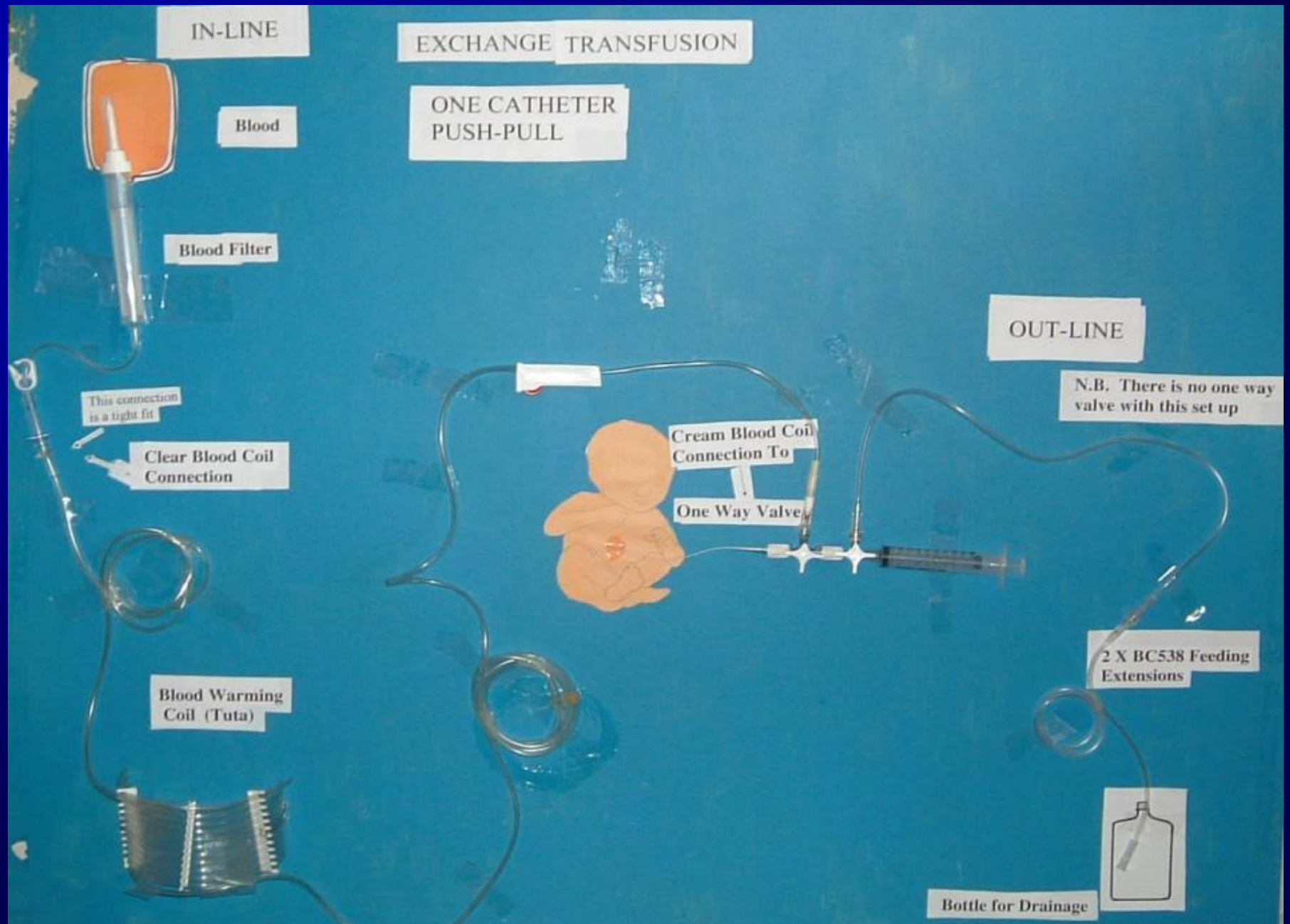
Clear Blood Coil
Connection

Cream Blood Coil
Connection To
One Way Valve

Blood Warming
Coil (Tuta)

2 X BC538 Feeding
Extensions

Bottle for Drainage



Transfusion Complications

- Acute Transfusion Reactions (ATR's)
- Chronic Transfusion Reactions
- Transfusion related infections



Acute Transfusion Reactions

- Hemolytic Reactions (AHTR)
- Febrile Reactions (FNHTR)
- Allergic Reactions
- TRALI
- Coagulopathy with Massive transfusions
- Bacteremia

Acute Hemolytic Transfusion Reactions (AHTR)

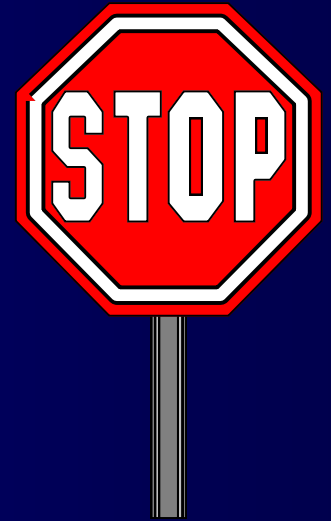
- Occurs when incompatible RBC's are transfused into a recipient who has preformed antibodies (usually ABO or Rh)
- Antibodies activate the complement system, causing intravascular hemolysis
- Symptoms can occur within minutes of starting the transfusion
- This hemolytic reaction can occur with as little as 1-2 cc of RBC's
- Labeling error is most common problem
- **Can be fatal**

Symptoms of AHTR

- High fever/chills
- Hypotension
- Back/abdominal pain
- Oliguria
- Dyspnea
- Dark urine
- Pallor

What to do?

If an AHTR occurs



- **STOP TRANSFUSION**
- **ABC's**
- Maintain IV access and run IVF (NS or LR)
- Monitor and maintain BP/pulse
- Give diuretic
- Obtain blood and urine for transfusion reaction workup
- Send remaining blood back to Blood Bank

Blood Bank Work-up of AHTR

- Check paperwork to assure no errors
- Check plasma for hemoglobin
- DAT
- Repeat crossmatch
- Repeat Blood group typing
- Blood culture



Labs found with AHTR

- Hemoglobinemia
- Hemoglobinuria
- Positive DAT
- Hyperbilirubinemia
- Abnormal DIC panel

Monitoring in AHTR

- Monitor and record patient clinical status and vital signs
- Monitor and record renal status (BUN, creatinine)
- Monitor coagulation status (DIC panel—PT/PTT, fibrinogen, D-dimer/FDP, Plt, Antithrombin-III)
- Monitor for signs of hemolysis (LDH, bili, haptoglobin)

Febrile Nonhemolytic Transfusion Reactions (FNHTR)

Definition -Raise in patient temperature $>1^{\circ}\text{C}$
(associated with transfusion without other fever precipitating factors)

- Occurs with approx 1% of PRBC transfusions and approx 20% of Plt transfusions
- FNHTR caused by alloantibodies directed against HLA antigens
- Need to evaluate for AHTR and infection

What to do?

If an FNHTR occurs

- STOP TRANSFUSION
- Use of Antipyretics—responds to Tylenol
- Use of Corticosteroids for severe reactions
- Use of Narcotics for shaking chills
- Future considerations
 - May prevent reaction with leukocyte filter
 - Use single donor platelets
 - Use fresh platelets
 - Washed RBC's or platelets

Washed Blood Products

- PRBC's or platelets washed with saline
- Removes all but traces of plasma (>98%)
- Indicated to prevent recurrent or severe reactions
- Washed RBC's must be used within 24 hours
- RBC dose may be decreased by 10-20% by washing
- Does not prevent GVHD



Allergic Nonhemolytic Transfusion Reactions

- **Etiology**

- May be due to plasma proteins or blood preservative/anticoagulant
- Best characterized with IgA given to an IgA deficient patients with anti-IgA antibodies

- Present with urticaria and wheezing

- Treatment

- Mild reactions—Can be continued after Benadryl
- Severe reactions—Must STOP transfusion and may require steroids or epinephrine

- Prevention—Premedication (Antihistamines)

TRALI

Transfusion Related Acute Lung Injury

- Clinical syndrome similar to ARDS
- Occurs 1-6 hours after receiving plasma-containing blood products
- Caused by WBC antibodies present in donor blood that result in pulmonary leukostasis
- Treatment is supportive
- High mortality

Massive Transfusions

- Coagulopathy may occur after transfusion of massive amounts of blood (trauma/surgery)
- Coagulopathy is caused by failure to replace plasma
- Electrolyte abnormalities
 - Due to citrate binding of Calcium
 - Also due to breakdown of stored RBC's

Bacterial Contamination

- More common and more severe with platelet transfusion (platelets are stored at room temperature)
- Organisms
 - Platelets—Gram (+) organisms, ie Staph/Strep
 - RBC's—Yersinia, enterobacter
- Risk increases as blood products age (use fresh products for immunocompromised)

Chronic Transfusion Reactions

- Alloimmunization
- Transfusion Associated Graft Verses Host Disease (GVHD)
- Excess Iron
- Transfusion Transmitted Infection



Alloimmunization

- Can occur with erythrocytes or platelets
- Erythrocytes
 - Antigen disparity of minor antigens (Kell, Duffy, Kidd)
 - Minor antigens D, K, E seen in Sickle patients
- Platelets
 - Usually due to HLA antigens
 - May reduce alloimmunization by leukoreduction (since WBC's present the HLA antigens)

Transfusion Associated GVHD

- Mainly seen in infants, BMT patients, SCID

Etiology—Results from engraftment of donor lymphocytes of an immunocompetent donor into an immunocompromised host

Symptoms—Diarrhea, skin rash, pancytopenia

- Usually fatal—no treatment

Prevention—Irradiation of donor cells

Transfusion Associated Infections

- Hepatitis C
- Hepatitis B
- HIV
- CMV
 - CMV can be diminished by leukoreduction, which is indicated for immunocompromised patients



Transfusion Reaction Summary

- AHTR can be fatal
- **Stop the Transfusion**
- Monitor for symptoms and complete evaluation
- FNHTR is a diagnosis of exclusion
- TRALI (ARDS-like reaction)
- Chronic Transfusion reactions
- Prevention methods – using filters, irradiation and premedication

**Thanks for your
attention!**

