

Organisation of the blood transfusion service in the University Hospital

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**Markéta Zemanová, Michaela Černá, Dana Galuszková
Transfusion department, University hospital Olomouc**

General organisation of transfusion service

- 1. Donor recruitment**
- 2. Documetation**
- 3. Whole blood, platelets, red cell and plasma collection**
- 4. Preparation of cellular blood products**
- 5. Laboratory testing**
- 6. Quality control of prepared blood products**
- 7. Storage of blood products**
- 8. Distribution of blood and its derivates**

Donor recruitment

"Blood donation shall in all circumstances be voluntary and financial profit must never be a motive for the donor..."

-these statements sum up the attitude of the **World Health Organisation and the International Society of Blood Transfusion** towards the principle of blood donation

-in general, blood donors should be **healthy adults between the age of 18 and 65 years**

-the lower limit is set to take account of high **iron requirements** in adolescence, the upper limit is necessary because of increase problems in **health condition** which might make blood donation more hazardous

-pregnant and lactating women are not accepted as donors again because of high iron requirements

Collection of blood

→ the first step of collection is **reception** and **registration** of donors:

- **very important is** check donor's name, date of birth, the number of current donation, blood group
- every donor get for each donation a unique code **/bar code/**
- everything must be written in our **computer network**



Collecting of blood

→ donors fill in the **questionnaire** before each donation:

-questions are related to the knowledge of donor about diseases, potential risks of infections, general physical condition

-questions are formulated in such a way that is possible to answer by ticking the relevant YES or NO boxes in the questionnaire



Collecting of blood

→ routine physical **examination before every donation:**

- blood count, blood pressure, puls rate and body temperature
- the **donor identification, donor interview and donor assessment** should take place before each donation, an authorised interviewer should sign the donor records
- the donor should be re-identified immediately prior to venepuncture





Blood taking rooms



Processing

- **components production from whole blood** consist of **centrifugation** to **separate out plasma** and **cells** of different density, followed by manual or automated **transfer of components** from primary collection pack to transfer packs

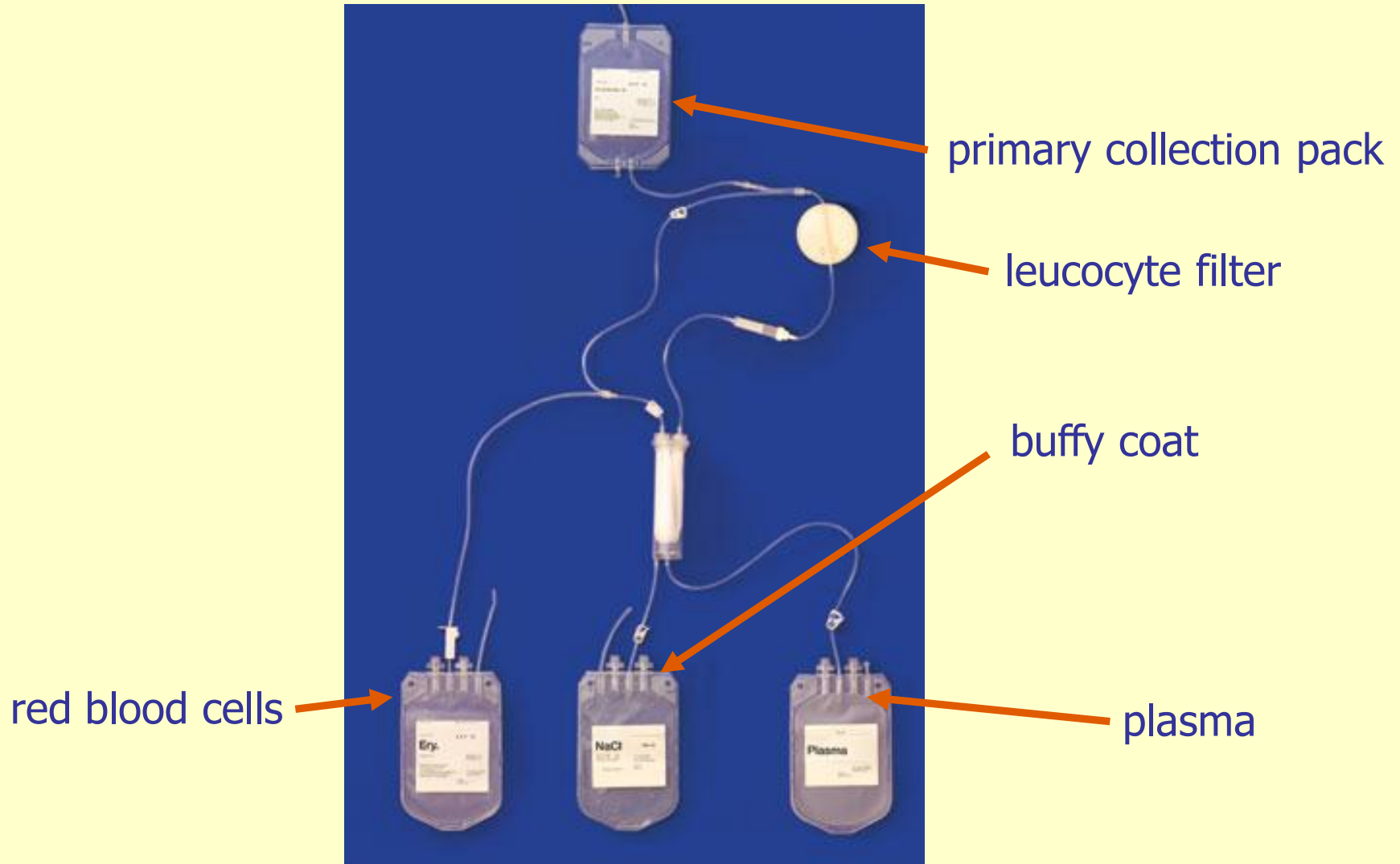
-collection and transfer packs are manufactured as a **single closed unit** to maintain sterility

-the whole-blood donations are held before process at 20-24°C

-usually 1% of components produced are controlled for quality

-for most parameters, 75% of units tested must fall within the specification limits

Collecting of whole blood (cca 450 ml)



Transfer of blood components from primary pack



Components obtained by different apheresis procedures



- erythrocytapheresis
- plasmapheresis
- trombocytapheresis

- granulocypheresis
- collectiong of PBSC

-**components** can be separated in several units

Storage

<i>product</i>	<i>temperature</i>	<i>expiration</i>
EBR	+2 ... +6 °C	42 days
TA	room- temperature (+20 ... +24°C) shake swirling effect	5 days
Plasma	frozen („shock“) -25°C	3 years



-plasma for therapeutical use (FFP)

-plasma for pharmaceutical use: → Human albumin

→ Procoagulators - inhibitors (F VIII/vWF, F IX, Prothrombin complex /F II,VII,IX,X/, F XIII, Fibrinogen, AT, ...)

→ Human immunoglobulins

Testing of blood donations

- include red cell serological testing
- microbiological testing (HBV, HCV, HIV, syphilis)

Pretransfusion testing - patients

- **Blood pressure, temperature**
- **Bed-side test** (EBR - ABO compatibility)
- **observation**
- **complications: blood sample from patient + TU, repeat testing**

Principals of optimal hemotherapy

Appropriate use of blood

purpose

- transfusion just of these blood components which patient really need

treatment

- symptoms of patients - yes
- laboratory results - no

appropriate transfusion in appropriate time

- consider: the risk of not transfuse a patient X



the risk of adverse reaction to a blood transfusion

Effective use of blood components

Decision-making about application of blood

- factors

- patient's symptoms, diagnosis, co-morbidity
- laboratory results
- planned treatment
- possibility of alternatives
- availability of blood components
- recommendation in the institute

Optimal hemotherapy

Quality and safety of blood

- assure

- selection of donors
- the laboratory screening test to identify infected blood
- standard operating procedures for collection, testing, processing and distribution of human blood and blood components
- standard operating procedures for red cell serological testing
- quality system

red blood cells

platelets

fresh frozen plasma

granulocytes

- indications (contraindications)

Transfusion of red cells

INDICATIONS

- increase the circulating red cell mass
- improve oxygen supply to tissues

- the cause of anemia should be established
- treatment of iron deficiency, megaloblastic anemia (B12, folate), autoimmune hemolytic anemia
- use of erythropoetin

Transfusion of red cells

INDICATIONS

Acute blood loss

- blood sample should be sent to the hospital transfusion service or hospital blood bank for compatibility testing
- lost blood volume should be replaced because it is necessary to maintain stable hemodynamics
- crystalloids or colloids for augment intravascular volume
- the transfusion trigger is Hb 80 g/l for young patients and 100 g/l for older patients and patients with co-morbidity

Transfusion of red cells

INDICATIONS

Chronic anemia

- patients without cardiovascular disease - Hb < 70 g/l
- patients with cardiovascular disease or respiratory disease - Hb < 90 g/l

→ rHuEPO

Transfusion of platelets

INDICATIONS

- indicated for prevention and treatment of hemorrhage in patients with trombocytopenia or platelet function defects
- supportive care for patients treated with myeloablative chemotherapy
- possibility of invasive procedures

CAVE! - antiplatelet drugs, surgical reason of bleeding, coagulopathy

Transfusion of platelets

INDICATIONS

PROFYLACTIC PLATELET TRANSFUSION

- risk of bleeding: $< 10 \times 10^9/l$
- other complications (fever, sepsis, coagulopathy)
 $< 20 \times 10^9/l$

INVASIVE PROCEDURES

- patients with thrombocytopenia or platelet dysfunction

TREATMENT OF BLEEDING

- patients with thrombocytopenia or platelet dysfunction

Transfusion of platelets

INDICATIONS

invasive procedures

- teeth extraction: $> 30 \times 10^9/l$
 - insertion of indwelling lines: $> 50 \times 10^9/l$
 - lumbar puncture, epidural anaesthesia, gastroscopy and biopsy, transbronchial biopsy, laparotomy or similar procedures, delivery - Sectio Caesarea: $> 50 \times 10^9/l$
 - operation: $> 70 \times 10^9/l$
 - operation of brain or eyes: $> 100 \times 10^9/l$
- after an operation several days $> 50 \times 10^9/l$

Transfusion of platelets

INDICATIONS

bleeding > 50x10⁹/l

- patients with thrombocytopenia or platelet dysfunction
- massive transfusion
- DIC

bleeding > 100x10⁹/l

- brain injury

autoimmune thrombocytopenia - ITP

- only for patients with life-threatening bleeding ⇒ the cause of thrombocytopenia should be established before a decision about the use of platelet transfusion

Transfusion of FFP

INDICATIONS

- to replace rare clotting factor deficiencies for which no virus-safe fractionated product is available
- when multifactor deficiency due to severe bleeding and disseminated intravascular coagulation
- for correction of clinically important (bleeding, invasive procedure) over-anticoagulation due to warfarin
- in case of thrombotic thrombocytopenic purpura or hemolytic uremic syndrome (plasma exchange)

Transfusion of FFP

CONTRAINDICATIONS

- volume replacement therapy without deficit of coagulation factor
- source of immunoglobulins
- for treatment of factor deficit with availability of virus inactivated product
- intolerance of plasma proteins

Transfusion of granulocytes

INDICATIONS

therapeutic indication

- chemosensitive disease
- neutrophil count $< 0,5 \times 10^9/l$ or neutrophil dysfunction
- sepsis of local infection not responding to adequate antimicrobial therapy (antibiotics, antifungal drugs) at least 48 hours
- no recovery in neutrophil count expected for more than 5 days

prophylactic indication (after allogenic transplantation)

- primary prevention of infection
- secondary prevention - prevention of recurrence of infection

Leucocyte depletion

reasons

- ↓ occurrence of adverse reactions - FNHTRs
- ↓ risk of alloimmunisation
- ↓ risk of transmission of CMV

indication

- repeated adverse reaction – FNHTRs
- presence of anti-HLA antibody
- often transfused patients
- transplanted patients (or other immuno-compromised)
- intrauterine and neonate transfusion, pregnant woman

Irradiation

reason

- ↓ risk of TA-GVHD (skin rash, diarrhoea, liver dysfunction, pancytopenia)
-mainly in imuno-compromised patients

indication

- transplanted patient
- transfusion from relatives or HLA compatible donors
- intrauterine and neonate transfusion
- children with hemato-oncologic diseases

Adverse reactions

immune complications

- hemolytic transfusion reaction
- febrile non-hemolytic transfusion reaction
- transfusion-related acute lung injury (TRALI)
- transfusion-induced graft versus host disease
- anaphylaxis and anaphylactoid reaction
- posttransfusion purpura
- alloimmunization
- transfusion-associated hemolytic anaemia

transfusion-transmitted infections

- viral (HBV, HVC, HIV), bacterial (syphilis), parasites

cardiovascular and metabolic complications

- transfusion-associated circulatory overload, hypothermia, hyperkalemia, hypokalemia, hemosiderosis, hypotension, hypertension

Immune complications

hemolytic transfusion reaction

- the occurrence of lysis or accelerated clearance of red cell in a transfusion recipient
- **Acute = during or within 24 hours after the transfusion**
- **Delayed = 5-7 days following the transfusion**
- **intravascular hemolysis** - gross hemoglobinemia and hemoglobinuria (may cause DIC, renal failure, death)
- **extravascular hemolysis** - fall in hemoglobin

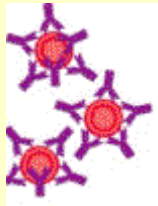
Immune complications - pictures



„foreign antigen“

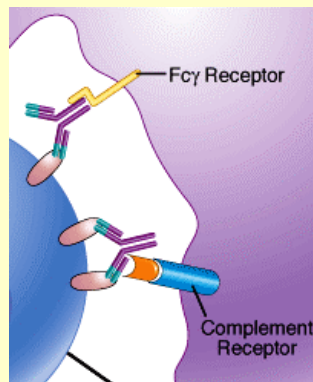


production of immunoglobulins

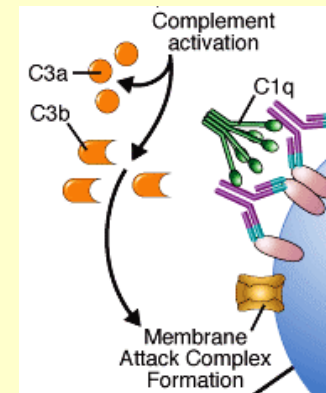


binding antibody to antigen

fagocytosis

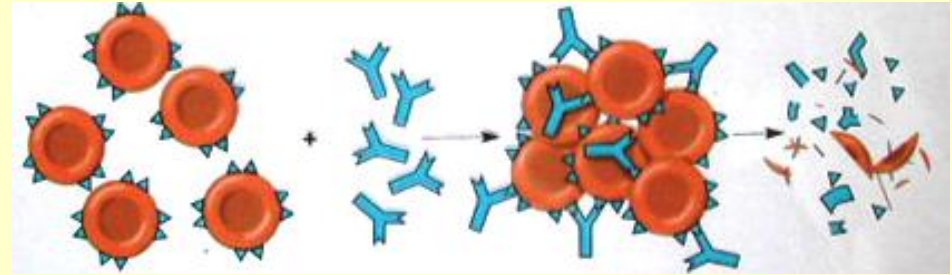


hemolysis



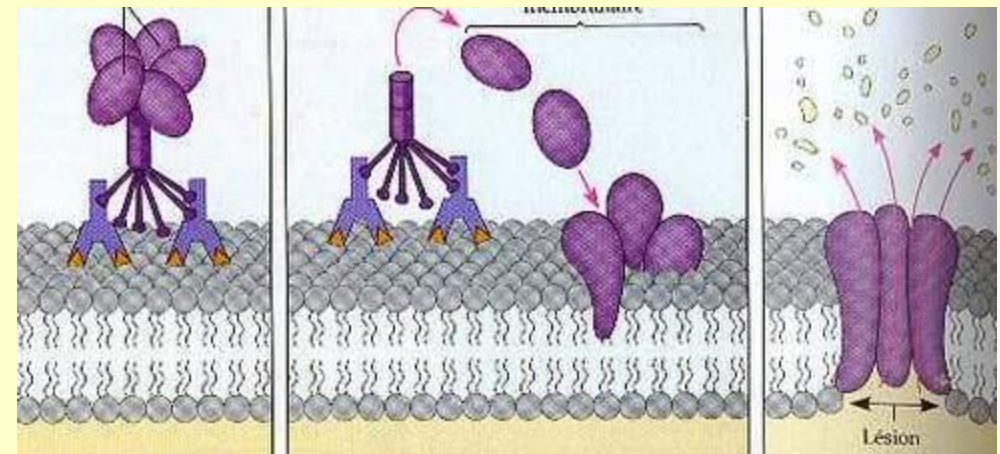
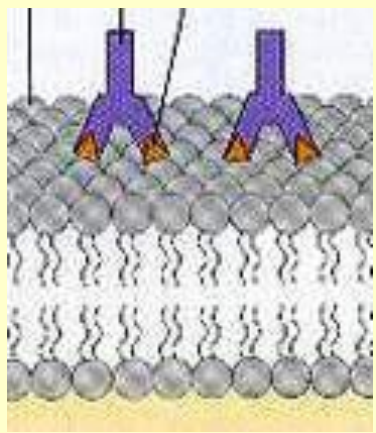
Immune complications - pictures

hemolysis



antibody

complement



Immune complications

acute hemolytic transfusion reaction (ABO incompatibility)

- fever, chills or both, pain, hypotension, tachycardia or both, agitation and confusion, particularly in the elderly, nausea or vomiting, dyspnoea, flushing and hemoglobinuria
- stop the transfusion, call a doctor, check patient identity, monitor pulse, blood pressure and temperature at 15 minutes intervals
- maintain adequate renal perfusion (fluid, furosemid, dopamin) and monitor coagulation tests
- send a blood sample to the Transfusion service

Immune complications

febrile non-hemolytic transfusion reaction (FNHTR)

- a common adverse reaction to blood transfusion
- the importance of **transfused leucocytes** → releasing of pyrogens (IL-1, TNF)
- **leucocyte antibodies are detectable in most patients**
- **leucocyte depletion** of blood components is effective in prevention of FNHTRs

CAVE: differentiate more serious complications, as acute hemolytic reactions or transfusion-transmitted bacterial infection

Immune complications

TRALI (transfusion related acute lung injury)

- a severe pulmonary reaction associated with the transfusion of blood containing donor plasma
 - occurs infrequently, one of the commonest causes of death associated with blood transfusions
 - respiratory distress, hypoxia and pulmonary infiltrates soon after transfusion with no other apparent cause
- **leucocyte antibodies in plasma of donors**
(prevention: plasma only from men)

Immune complications

Anaphylaxis and anaphylactoid reactions

anaphylaxis

- is life threatening allergic reaction
- requires previous sensitisation (specific IgE antibodies)
- severe breathing difficulty, shock, arrhythmias, loss of consciousness

anaphylactoid reactions

- IgE independent and can occur on first exposure

mild allergic reactions

- common
- local cutaneous reactions or chest tightness

Immune complications

TA-GVHD

- the commonest transfusion-related cause of death reported to the UK Serious Hazards of transfusion scheme
- the incidence is low, but treatment is not effective
- the classical features of skin rash, diarrhoea and liver dysfunction are followed by bone marrow hypoplasia, pancytopenia and death from infection within 3-4 weeks of transfusion
- can be prevented by γ -irradiation of cellular blood components to a dose of 25 Gy in high risk situation

Immune complications

Post-transfusion purpura

- an acute episode of severe thrombocytopenia occurring about a week after a blood transfusion
- usually affects HPA-1a negative woman who have been previously alloimmunized by pregnancy
- HD immunoglobulin current treatment of choice (steroid, plasma exchange)

Infection complications

viruses - HAV, HBV, HCV, HIV, CMV, EBV, HHV-8, Parvovirus B19

bacteria - treponema pallidum, borelia burgdorferi, yersinia enterocolica

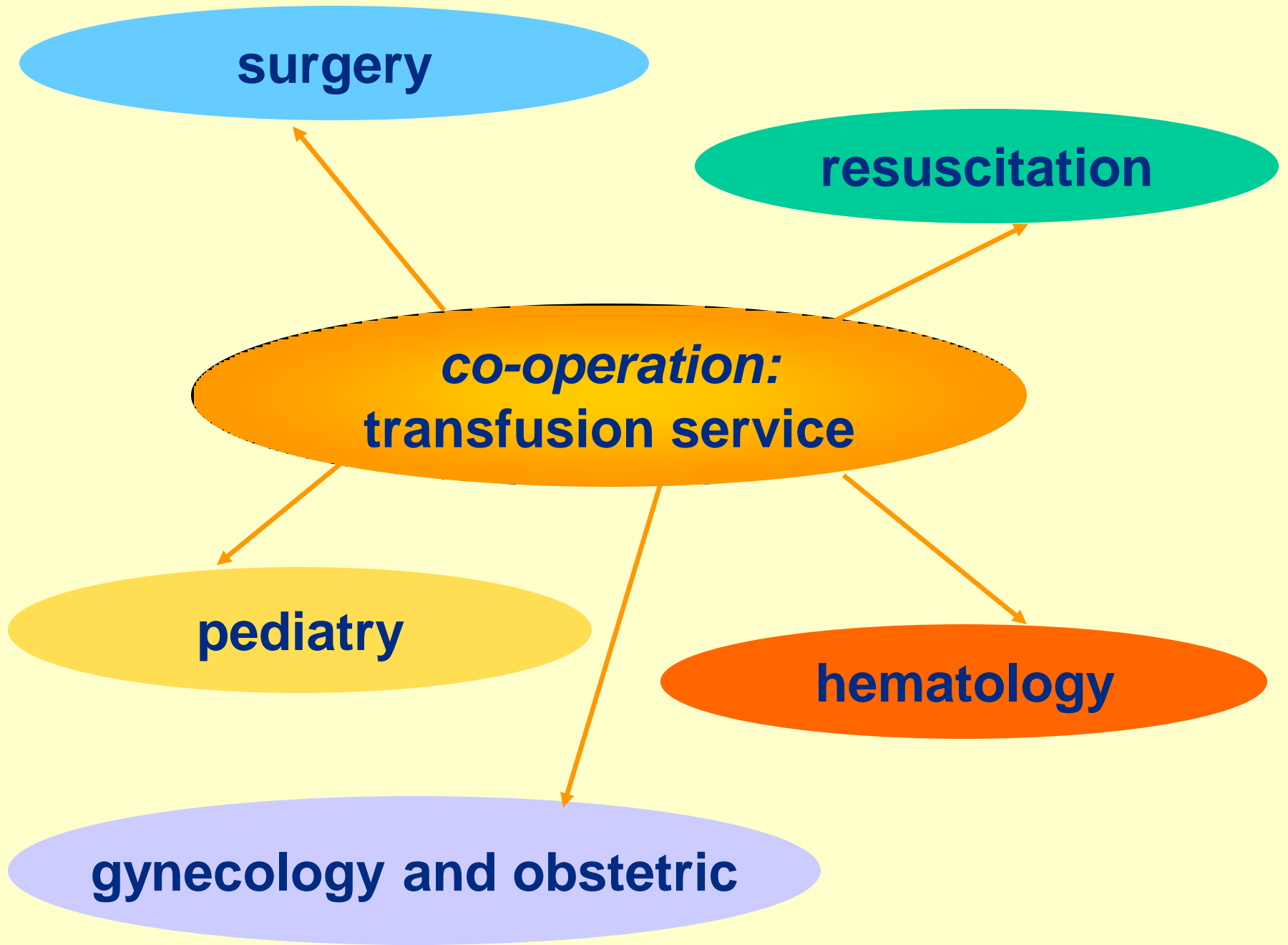
protozoa - plasmodium, trypanosoma, toxoplasma

- blood is screened for HBV, HCV, HIV and syphilis now

- identifying donors potentially carrying transfusion-transmissible infectious

CAVE: Mistakes

- **mistakes in prescription, sampling and request**
- **mistakes in transfusion laboratory**
- **mistakes during application of transfusion**





Thank you for your attention