Organisation of the blood transfusion service in the University Hospital

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1. Donor recruitment
2. Documentation
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 derivatives
"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
- 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)

- primary collection pack
- leucocyte filter
- buffy coat
- red blood cells
- plasma
Transfer of blood components from primary pack
Components obtained by different apheresis procedures

- erythrocytapheresis
- plasmapheresis
- trombocytapheresis
- granulocypheresis
- collection of PBSC

-components can be separated in several units
## Storage

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

- 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

- 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 erythropoietin

INDICATIONS
Indications for Transfusion of Red Cells

**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 - \( \text{Hb} < 70 \, \text{g/l} \)
- patients with cardiovascular disease or respiratory disease - \( \text{Hb} < 90 \, \text{g/l} \)

\( \rightarrow \) 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
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 trombocytopenia or platelet dysfunction

TREATMENT OF BLEEDING
- patients with trombocytopenia 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 $>50\times10^9/l$
- patients with trombocytopenia or platelet dysfunction
- massive transfusion
- DIC

bleeding $>100\times10^9/l$
- brain injury

autoimmune trombocytopenia - ITP
- only for patients with life-threatening bleeding $\Rightarrow$ the cause of trombocytopenia 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 trombotic trombocytopenic purpura or hemolytic uremic syndrome (plasma exchange)
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 < 0,5x10^9/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 rush, 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

**transfusson-transmitted infections**
- viral (HBV, HVC, HIV), bacterial (syphilis), parasites

**cardiovascular and metabolic complications**
- transfusion-associated circulatory overload, hypothermia, hyperkalemia, hypokalcemia, 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

- Production of immunoglobulins
- Binding antibody to antigen
- Fagocytosis
- Hemolysis

"Foreign antigen"
Immune complications - pictures

- **hemolysis**
- **antibody**
- **complement**
Immune complications

acute hemolytic transfusion reaction (AB0 incompatibility)

- fever, chills or both, pain, hypotension, tachycardia or both, agitation and confusion, particularly in the elderly, nausea or vomiting, dyspnoe, 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)
Anaphylaxis and anaphylactoid reactions

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

anaphylactoid reactions
- IgE independent and can occur on first exposure

mild allergic reactions
- common
- local cutaneus reactions or chest tightness
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 y-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 trombocytopenia 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
co-operation: transfusion service

- surgery
- resuscitation
- pediatry
- hematology
- gynecology and obstetric
Thank you for your attention