Transfusion Complications

Rudiments of Blood Transfusion
for IV. grade medical students

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Problems of Blood Transfusion

Technical problems

Harvay (1628) Circulatory

Devising of instruments, **problems of infections**

Hustin, Lewisohn (1914) Hemostasis

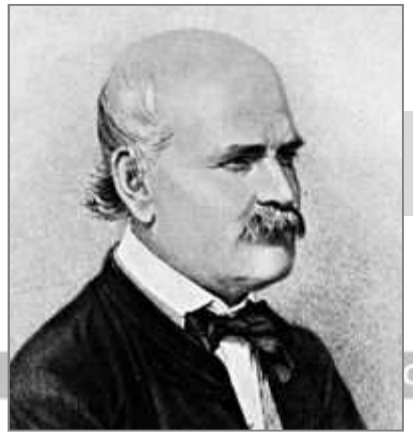
Blood collection in bottle (1940)

Serolgical incompatibility

Landsteiner (1900) **ABO blood group**

Wiener (1940) Rh blood group

Other blood groups



Ignác Fülöp **Semmelweis** (Hungary)

Bacterial and viral contamination

Semmelweis (1847)

Sterile closed blood collection bag system (1963)

Virus inactivation of blood products

Figure 2. Blundell's Gravitator in use. Arguably the most famous image of transfusion's history in nineteenth-century Britain (from James Blundell, "Observations on Transfusion of Blood, with a Description of his Gravitator," The Lancet 2 [1828–29]: 321–24).

The most important symptoms of transfusion complications:

hemolysis, hemoglobinuria
fever, rigor, chills
shortness of breath, dyspnoea
hypotension, hypertension, tachycardia
pain, malaise
skin rash, angioedema
preshock

Transfusion reactions can develop early or late after transfusion

I. Incompatibility

Immunisation, immune reactions

II. Properties of blood products

quality, quantity, administration, technics

III. Pathogen agents

transmission of pathogens (virii, bacteria, protozoa)

I. Immunological Complications

complications	causes

I. *In vivo antigen-antibody reactions*

1. Hemolysis Immediate, intravasal (IgM) Late, majority of extravasal (IgG)	Antibodies against Red Cell antigens
2. Post-transfusion purpura	Antibodies against Platelet antigen / Anti-HPA-1a or HLA class I /
3. TRALI	Antibodies against Granulocyte antigens / HLA or anti-HNA /
4. Allergy, anaphylaxis	Antibodies against Plasma Protein antigens

II. *Immune cells in vivo effects*

5. TA-GVDH	Viable donor lymphocytes
6. Immunomodulation	Difference in white blood cells HLA antigens

1. HAEMOLYTIC TRANSFUSION COMPLICATIONS due to blood group incompatibility

IgM antibodies

I. Intravascular haemolysis (acute within 24 hours)

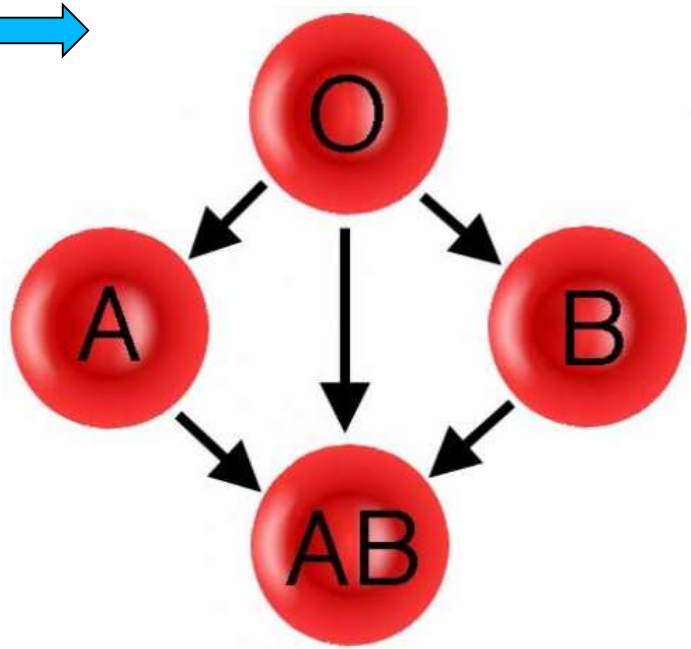
1. Antigen - antibody binding → **complement (C ') activation** - lysis
2. Ag-Ab + C' komplex → activation of phagocytes
3. Release of inflammatory mediators and cytokines

The factors involved in the development of hemolysis:

1 ABO incompatibility - the presence, ti
2 The volume of foreign blood (20 ml)
3 The blood group antigen type
4 Actual Complement level and regene
5 The Ag-Ab-Complenent 'complex forr

Donor	Recipiens	Mortality %
A	**O**	61
B/AB	O	20
A/AB	B	9
B	A	4,6
O plasma	A/AB	4,6
B plasma	AB	0,8

RBC ABO compatibility

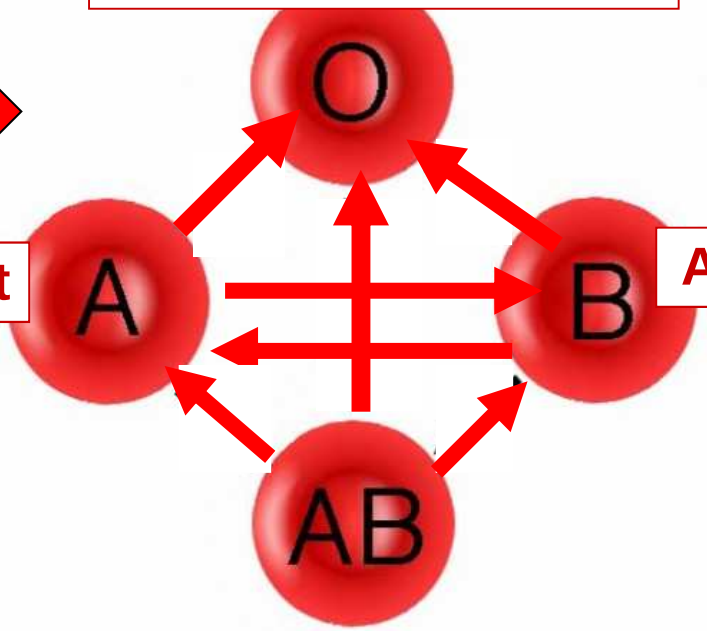


anti-A, anti-B present

ABO incompatibility

!

Anti-B present



Anti-A present

Clerical errors:

Patient identification
ABO testing
Labeling of sample or blood unit

In vivo effects of antigen-antibody reaction:

1. Neuroendocrine response

Immune Complex - activation of factor Hagemann (F XII) - Bradykinin
hypotension - catecholamines, epinephrine
vasoconstriction (kidneys, intestines, lungs, skin)

damage of tissue oxygenation, kidney damage

2. Complement activation

C3-C5 (anaphylatoxins) release - mast cell and basophil degranulation
histamine release - eosinophil degranulation
platelet aggregation, release of hydrolytic enzymes from neutrophils
mast cell and basophil degranulation
cytokine release(TNF, IL-8, MCP, etc.) from monocytes

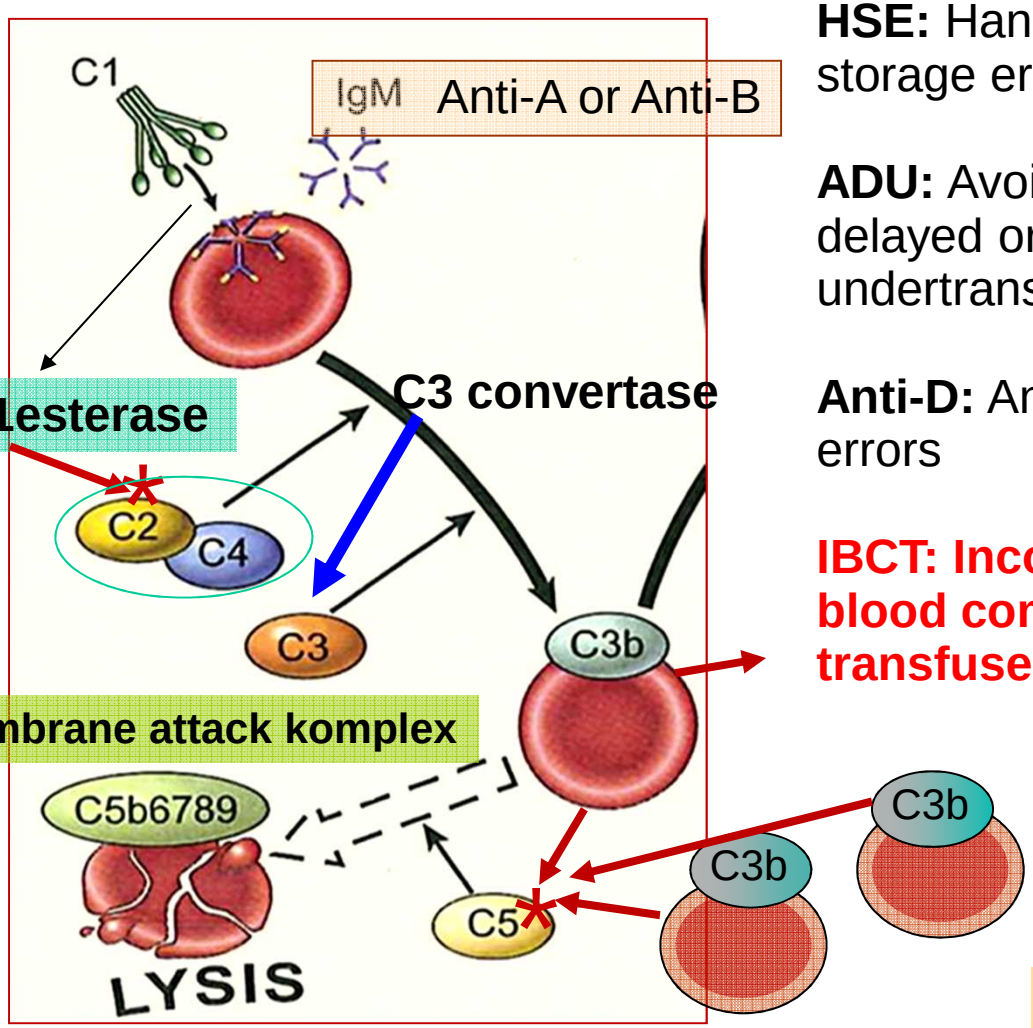
fever, hypotension, bronchospasm

3. Blood coagulation activation

Hageman factor activation due to- Ag-Ab-C ‘ complex and RBC stroma
DIC - intravascular thrombus formation
- utilisation of Clotting factors and platelets
- Increased fibrinolysis

bleeding, shock

Intravascular haemolysis



HSE: Handling & storage errors

ADU: Avoidable, delayed or undertransfusion

Anti-D: Anti-D errors

IBCT: Incorrect blood component transfused

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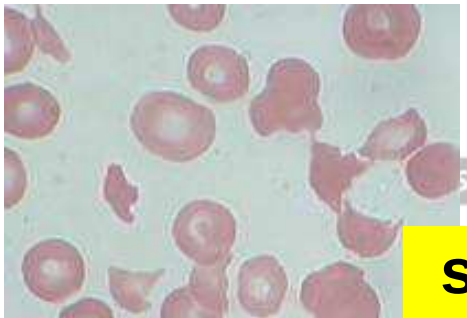
HSE	272	12,7%
ADU	344	16,1%
Anti-D	**59.3 %**	16,6%
IBCT	296	13,9%
TA-GvHD	0	0
TTI	2	0,1%
PTP	1	0.05
CS	20	0.9%
UCT	13	0,6%
TAD	52	2.4%
TACO	**160**	**7.5%**
TRALI	0	0%

ANNUAL SHOT REPORT 2017

HTR	**64.8 %**	2.3%
ATR	296	13.9%
TOTAL	2133	100%



ACUT STAGE

schistocytes

Symptoms:

- Chills and fever
- Hypotension
- Back Pain
- Tight chest pain
- Suffocation, cyanosis
- Fullness of neck veins
- **Burning and itching pain running along in the infused vein**
- Anxiety
- Renal impairment: oliguria, anuria (36%)
- **Unusual bleeding** (DIC!) (10%)
- Shock

Laboratory findings:

1. haemoglobinaemia (Hb binding capacity of haptoglobin!)
2. LDH increase
3. hyperbilirubinemia
4. haptoglobin decrease
5. Urea, creatinine increase in patients with renal impairment
6. haemoglobinuria

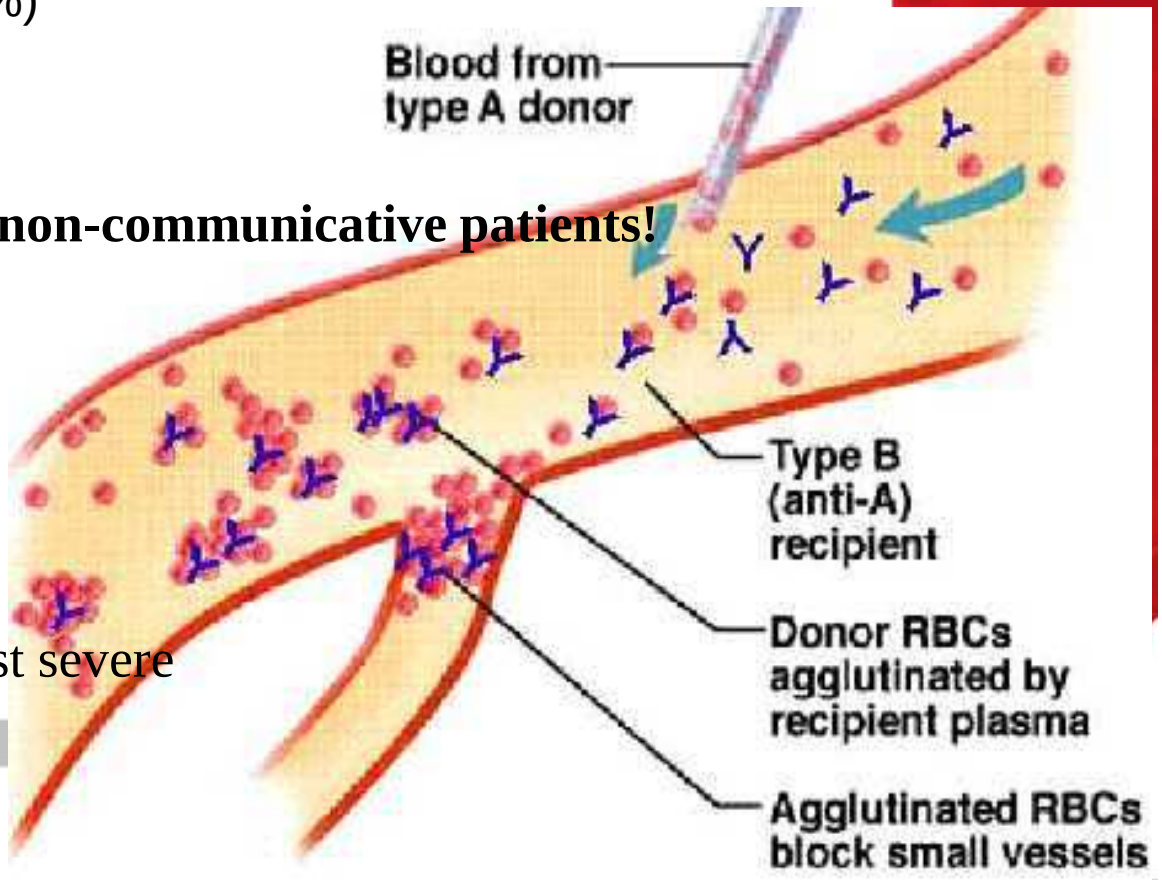
Symptoms in anesthetized, unconscious, non-communicative patients!

- diffuse bleeding in the surgical area
- hypotension

It could be caused by adminisrtation of

5 -15 ml incompatible blood

- ABO incompatibility is usually the most severe



Treatment:

- **transfusion should be stopped immediately**
- At-Ag-reaction should be braked with Steroid
- **antishock terapy** – electrolytes, plasma substitutes - albumin
- restoration of tissue **oxygenation** - selected blood transfusion
- **Renal impairment management** - diuretics - hemodialysis (10-15%)
- **Fluid balance maintenance** – loss and intake rate
- **Metabolism recovery** - hyponatremia, hyperkalemia
- **DIC treatment**
- **Exchange transfusion** (in the first 12-24 hours)

Tasks:

- Check **data**
- **Consultation**
- **Laboratory** tests – blood groups, serological investigation of complications, urinanalysis, free hemoglobin, renal function tests, coagulation tests, LDH, Hp
- **Sepsis** investigation
- Continue **monitoring** of patient

II. Delayed extravascular hemolysis (5-10 days after transfusion)

- mostly occurs as a result of secondary immunization **IgG antibody**

The antigen - antibody reaction consequences:

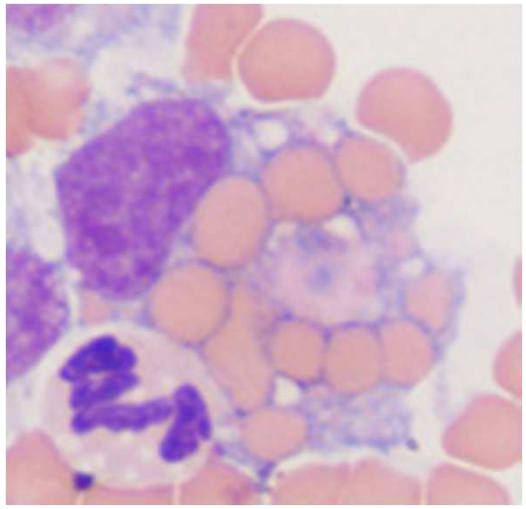
1 **C 'activation-**depends on subclasses of IgG antibody (**IgG3, IgG1,** IgG2, IgG4)
2 **Extravascular lysis** - Immune Complex - macrophage activation
3 Phagocytosis – fragmentation - lysis - **release of cytokines** (IL-1, IL-6,TNF,IL-8)
- ADCC (antibody dependent cellular cytotoxicity)

Influencing factors:

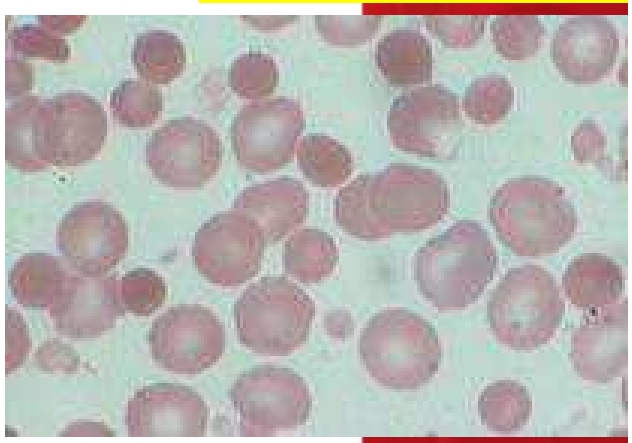
- The actual amount of the antibody
- The individual immunoglobulin synthesis rate
- The current saturation of the phagocytic cell receptors
- The blood group antigen type
- The amount of transfused incompatible blood

rarely fatal

Extravascular haemolysis



spherocytes



Direct Coombs positive cells in circulation

II. Delayed extravascular hemolysis

Symptoms: (from 24 hours to 3 weeks)

- **Fever**
- **Ineffectiveness of transfusion**
- Hemolysis, hemoglobin decrease, mild icterus, hemoglobinuria
- Hypotension
- Renal impairment (6%) - treatment necessary only for these cases

- **May be asymptomatic** - Late serological transfusion reaction

Laboratory findings:

- **Positive Direct Coombs** – antibody-coated red blood cells
- Antibody appearance or sudden increase

A history of previous immunizations

Therapy:

- **generally not necessary**
- close monitoring

The antibodies involved in hemolytic transfusion reactions and types of hemolytic transfusion reactions

Blood group system	AcuteHTR (intravascular)	Delayed HTR (extravascular)	
ABO,H	A,B,H		
Rh		*all types*	34,4%
Kell	K	K,k,Kp^{a+b},Js^{a+b}	13,3%
Kidd	Jk^{a}	Jk^{a+b+3}	30,0%
Duffy		Fy^{a+b}	14,4%
MNS		M,S,s,U	4,4%
Lutheran		Lu^{b}	other 3,3%
Lewis	Le^{a}		
Vel		Vel	
Colton		Co^{a+b}	
Dombrock		Do^{a+b}	

Other acute intravasal hemolysis

Immune hemolysis

- ABO incompatible **plasma** transfusions
- **AIHA** (autoimmune haemolytic anaemia) patients transfusion
- **Cold agglutinin** disease

Non-immune haemolysis

- Red blood cell **enzyme defects (***Glucose-6-phosphate dehydrogenase (G-6-DP) deficiency, Hereditary spherocytosis, Sickle cell anemia)*
- **Infections**
- **Drugs**
- **Diseases associated with hemolysis** (PNH, microangiopathic hemolytic anemia)
- **Haemolytic blood transfusion**

2. FEBRILE REACTIONS

- **Haemolysis** - blood group incompatibility
  - bacterial contamination (endotoxin, cell debris)

- **No Haemolysis - NHFTR – non haemolytic febrile transfusion reactions**
  - **Infection** (malaria, bacterial contamination)
  - **TRALI**
  - **Other transfusion independent reason**

1. Non haemolytic febrile transfusion reactions

(Acute within 4 hours)

Cause: white blood cell content of blood products – **cytokine effect**

Symptoms: fever (during or after transfusion temperature increases ≥**1.5 ℃)**
flushing
tachycardia
shaking, chills

Occurrence: (6.8%) RBC products – to immunized patients
(37.5%) platelet products – to non-immunized patients

common complication - 0,5 - 6%

1. NHFTR – CAUSING FACTORS:

- **antibodies in the recipient serum**
  - Anti-HLA antibodies
  - Anti-granulocyte antibodies
  - Anti-platelet antibodies
- **stored PLT products**
  - destroyed granulocytes

Ag-At-C' complex

↓

macrophag activation in recipient

→ **Release of pyrogens**

(TNF-α, IL-1, IL-6)

Treatment:

- **mild:** interrupt the transfusion - antipyretic –
- **severe:** - antipyretic - differential diagnosis !

Unit causing complications should not be administered.!

Prevention:- removal of white blood cells before blood product storage
(removal buffy coat, **filtration**)

2. PTP – post transfusion purpura

Anti-platelet antibody

acut complication – **one weak after transfusion**

Prior immunization - especially women

Cause: 80-90% **anti-HPA-1a** other: anti- HPA-1b, -3a, -4a, -5b

Symptoms: - bleeding -severe thrombocytopenia -! **Intracranial bleeding**

- fever - NHFTR (+ anti-HLA antibodies)

Differential diagnosis: ITP, drug induced trombocytopenia, TTP, DIC

Treatment: - immediately !

- **high-dose IVIG** (2g/ kg bw for 2-5 days)
- steroid
- plasma exchange
- **blood products (RBC or PLT) only from antigen negative donor!**

After PLT administration both administered and own PLT destruction occur!

Cause: donor HPA-1a antigen or recipient Ag-Ab complex binding to the recipient's platele or cross-reactive antibody production

3. TRALI - transfusion related acut lung injury

severe acute reaction within 6 hours

Anti-granulocyte antibody

Cause: - **anti –granulocyte antibodies** (HLA/HNA)

- often in blood products (***multipara women plasma***)

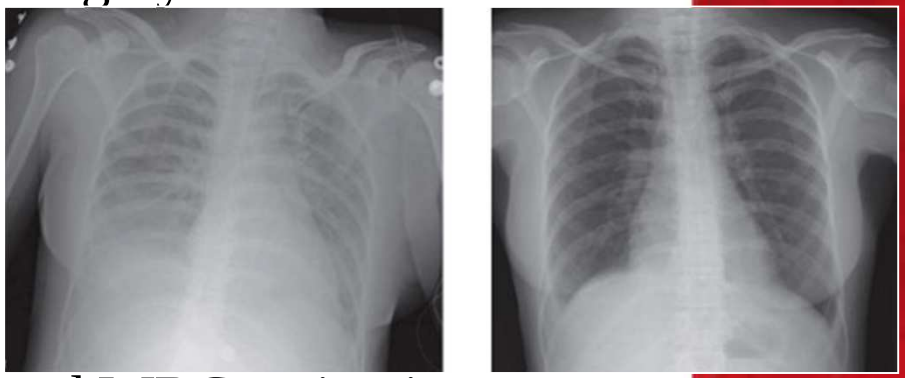
- rarely in recipient's serum

Symptoms:

- Dyspnea (respiratory distress)
- Severe hypoxia, cyanosis, hypotension
- Severe bilateral pulmonary edema
- Fever

Predisposing factors:

- Active infection
- Cytokine therapy
- Surgery or massive transfusion



Factors responsible for developing TRALI

Neutrophyl activation

• Ab-Ag komplex – leucoembolus – C'mediated WBC activation
– pulmonar endothelial damage

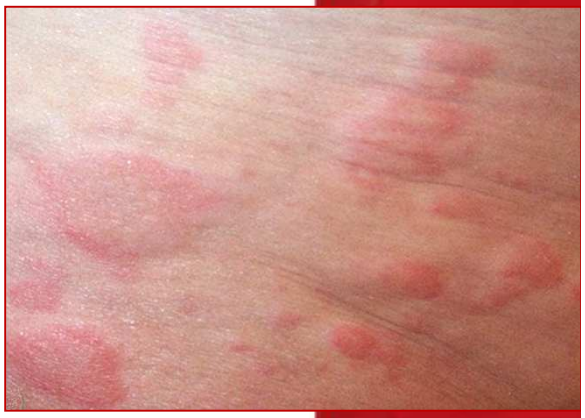
• leukocyte activation in blood components during storage

Therapy: - respiratory support immediately – **mechanical ventilation**

- steroid

4. Allergy, anaphylaxis: - acut reaction /may be life threatening/ within 24 hours

Etiology: **antibody against donor blood proteins** / IgA content!
transfusing of allergens nutrients, drugs (Aspirin, ACE inhibitor)
passive transfer of **IgE** (to drugs, food), or complement

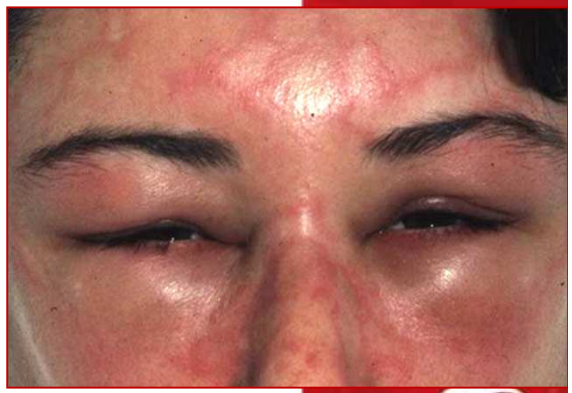


Symptoms:

Mild reactions - malaise
- Itchy, burning red spots / neck, thorax /
- local **urticaria**
- low-grade fever, **fever**

The transfusion can be continued after treatment

Severe reactions - Swollen mucosa / laryngeal edema - shortness of breath
- **Anaphylactic** shock - **no fever**



The transfusion should be stoped

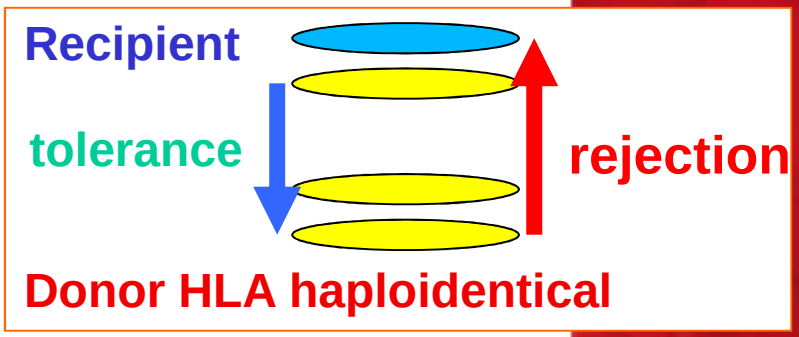
Treatment: - antipyretic, fluid replacement
- **antihistamines**, Ca- preparations
- Steroids (Cortisone, Prednisolone)
- Epinephrine (Adrenaline)

Prophylaxis: - IgA-free blood to IgA deficient patient
- no (or IgA deficient) plasma transfusion
- **washed blood products**

5. TA-Graft versus host reaction

few cases, high mortality >90%

complex immune process which is caused by immunocompetent donor lymphocytes against immunocompromised or immunocompetent recipient



Etiology: transfusion of haploidentical blood products

blood transfusion from relatives

Symptoms: fever, rash, liver dysfunction, diarrhea commencing in 1-2 weeks post-transfusion followed by pancytopenia later

Risk factors: Any condition with impaired cellular immunity, or not developed immunological competence / premature babies and newborns/

- transplantation, leukaemia, lymphoma

- intrauterin transfusion, exchange transfusion, extracorporeal circulation

Therapy: **Largely ineffective**
immunosuppressive therapy, high dose steroids?

Prevention: For patients at risk (e.g., imunocompromised patients), it is critical to **irradiate cellular blood components** (RBC and platelets).

6. Transfusion-related immunomodulation (TRIM)

Transient immunosuppression (delayed (>24 hours) transfusion reaction)

Etiology: **Allogeneic leucocyte-containing RBC transfusions**

the presence of foreign HLA class II. antigens

(the role of HLA DR 3 is suspected)

Cellular effects:

Decreased *T helper reaction*

Increased *T cell suppressor activity*

Increased *B cell antibody production*

Impaired NK cell function

Defective antigen presentation

Clinical signs:

reduced graft rejection

decreased recurrence in Crohn's patients

increased risk of cancer recurrence

increased postoperative infection rate

potential risk of tumorous disease in adult age

Prophylaxis: **leucodepletion of blood products** in question

II. Early non immune complications

Complication	*Etiology*
Heart failure	volume overload / Whole blood, FFP /
High fever and shock	bacterial infection
Hypothermia	Too rapid administration of cold blood / Massive transfusion /
Hemolysis	physical or chemical damage of the the blood administered
Air embolism	Transfusion uder uncontrolled high pressure or priming
Hypocalcemia	**Massive transfusion of citrate-containing blood products / plasma ! /**
Hyperkalemia	massive transfusion of **old blood**

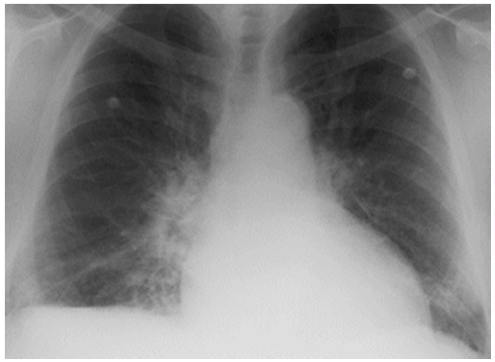
1. Transfusion-related circulatory overload (TACO)

acute - may develop within 1 to 2 hours of transfusion

Symptoms: **acut pulmonary oedema**
(dispnoea, cyanosis, head ache, hypertension, heart failure)

Frequency: about 1% **children and elderly patients**
cardiac and/or pulmonary decompensation
chronic anemia (plasma)
chronic renal failure

Ethiology: - high volume transfusion (whole blood, plasma)
- high (20-25%) concentration albumin infusion
- **rapid or massive transfusion**



Therapy: **Stop transfusion** immediately

Prevention: upright position, diuretics, oxygen

Slow rate transfusion!

Normal urine output 0,5 – 2 ml/min

Transfusion related death

Fatality Complication Breakdown by Imputability

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Figure 3.3: Deaths related to transfusion

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Figure 3.2: Deaths related

Table 3: Transfusion-Associated Fatalities by Complication, FY 2016 – FY 2020

Complication	FY16 No.	FY16 %	FY17 No.	FY17 %	FY18 No.	FY18 %	FY19 No.	FY19 %	FY20 No.	FY20 %	Total No.	Total %
Anaphylaxis	5	12%	3	8%	2	6%	2	5%	6	21%	**18**	**10%**
Contamination	5	12%	7	19%	7	23%	1	2%	4	14%	**24**	**13%**
HTR (ABO)	4	9%	1	3%	2	6%	4	9%	2	7%	**13**	**7%**
HTR (Non-ABO)	1	2%	6	16%	4	13%	11	25%	2	7%	**24**	**13%**
Hypotensive Reaction	1	2%	0	0%	0	0%	0	0%	0	0%	**1**	**0%**
TACO	19	44%	11	30%	12	39%	12	27%	8	27%	**62**	**34%**
TRALI**	8	19%	9	24%	4	13%	12	27%	6	21%	**39**	**21%**
Transfusion Reaction, Type Not Determined	0	0%	0	0%	0	0%	2	5%	1	3%	**3**	**2%**

Note: FY 2016-FY 2020 only includes cases with an imputability of *definite, probable*, or *possible*

**FY 2016-FY 2020 numbers combine both *TRALI* and *Possible TRALI* cases

HTR=haemolytic transfusion reactions; UCT=uncommon complications of transfusion; TACO=transfusion-associated circulatory o

PCC=prothrombin complex concentrates

HTR=haemolytic transfusion reaction; TAD=transfusion-associated dyspnoea; TACO=transfusion-associated circulatory ove

2. Massive transfusion syndrome

Mortality about 60%

Transfusion of severe shock patients
(10-15 U blood in 24 hours or replacement of 1 blood volume(TBV))

Symptoms:

bleeding - **dilution** and consumption of platelets and clotting factors (DIC)
severe hypoxia in tissues

Multiplex complications: Coagulation, biochemistry (hypocalcaemia, hyperkalaemia), acid base abnormality, hypothermia

Therapy: fluid replacement, blood (fresh warmed blood!), cardiac support

3. Cold blood transfusion

Decrease in tissue oxygenation

hypotermia

Symptoms: ventricular arrhythmias
impaired blood coagulation
worsen of hypokalcemia and hyperkalaemia symptoms
peripheral vasoconstriction
increased calorie need

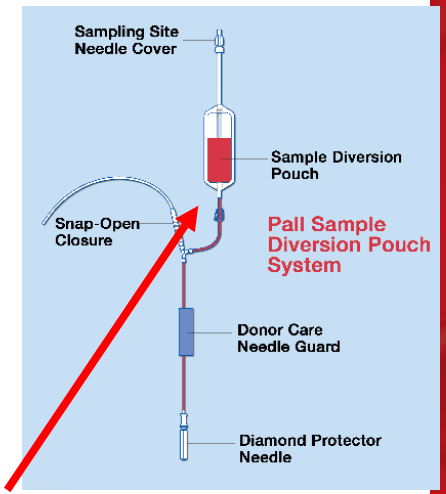
Prevention: Use of blood Warmer

4. Transfusion of infected blood: rare acute

/ mortality of 80-100% /

Sources of infection:

- **donor** arm or donor granulocytes
- poor **venipuncture** technique - foamy blood
- **storage** temperature, inappropriate storage
- **opened** blood bag, not cleaned **water bath**



Signs in blood product:

hemolysis, clots,cloudy plasma - white-gray precipitate, bacterial or fungal colonies on surface

Prevention: donor **skin desinfection**, removal of first aliquot of donor blood
good **product** collecting and manufacturing (**closed system**!)
controlled blood product **storage**
opened products management to appropriate **standards**

Symptoms: fever, chills, RR decrease, **severe rapid shock**, DIC, **intavascular hemolysis**, heart, liver, kidney failure

Treatment: **stop transfusion** immediately
shock therapy, resuscitation
i.v. broad-spectrum antibiotics

Bacteriological examination

blood culture test of blood product and patient blood samples

5. Transfusion of haemolytic blood:

several liters of old stored blood conteins harmful amount of hemoglobin

- large amounts of Hb appears as a cylinder in renal tubular causing **renal failure**
  / Renal disease patients, shock, dehydration /

Reasons for the development of hemolysis in blood product:

- **Expired RBCs**
- **Drugs** or infusion solutions mixing with blood product.
- **Thermal effects** - Heat or freezing (temperature above 38^{o}C)
- **Bacterial** contamination
- **Mechanical** damage - shaking, harsh handling and transport

(Thin needle, artificial heart valves, extracorporeal circulation, high pressure transfusion, etc.).

Prevention: - high quality blood products
- considering of transfusion indication

Treatment: - **remove Hb** / infusions, diuretics /
- Urine alkalinisation
- **desferroxamin**

6. Air embolism: very rare since using plastc blood bags

the foamy blood is transferred into right ventricle

Causes:

- inadequate priming of transfusion set
- transfusion with overpressure

Symptoms: Cough • Dyspnea • Chest pain • .Arrhytmia - Shock

Prevention: the appropriate use of technology

Treatment: : ➢ Laying the patient on the **left side**

- Rhythmic **compression of the chest**
- Aspiration of the frothy blood with catheter
- Resuscitation

7. Citrate intoxication

massive transfusion with plasma

Infants, patients with heart disease or liver disease

Symptoms: - Neuromuscular disorders / **tetany**

- Cardiac arrhythmia

Treatment: **Ca support**

8. Transfusion of hyperkalemic blood:

High risk in hyperkalemic conditions / uremia, heart disease, massive transfusion, acidosis / or in infants

Symptoms: arrhythmia, cardiac arrest

Prevention: - exchange transfusion with blood less than 7 days
- massive blood transfusion with blood less than 10 days
- RBC washing
- use of in-line potassium adsprotion filters

Treatment: - 10% NaCl, $NaHCO_3$ or Ca composition
- Hypertonic glucose / + **insulin**/
- Ion exchange resin / Resonium /
- **Dialysis**, hemofiltration

Potassium adsorption filter

Non immune late transfusion complications

III. Infection transmission

Complications	*Causes*
Hemosiderosis	Politransfusion / > 100 U RBCs /
Hepatitis	HBV /±DELTA/, HCV, HGV/?/, HAV, HEV,CMV
AIDS	HIV-I, HIV -II / after years? /
CLL /adult T-cell/	HTLV -I
TSP tropical spasticus paraparesis	HTLV-II (human T lymphotrope virus)
Zoonosis	Malaria, kala-azar, babesiosis
Syphilis	Treponema Pallida
Aplastic anaemia	Parvovírus B 19
Fetal damage	CMV

1. Hemosiderosis:

accumulation of iron in organs (**> 100 U RBCs**)

1U blood transfusion - 200 mg iron intake

Cause: 50 - 100 U RBC transfusion
transfusion of large amount hemolyzed blood

Symptoms: RES – organs failure - heart, liver, endocrin organs

bronze skin, liver cirrhosis, heart failure

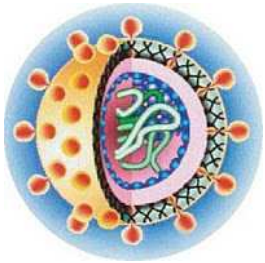
Treatment:

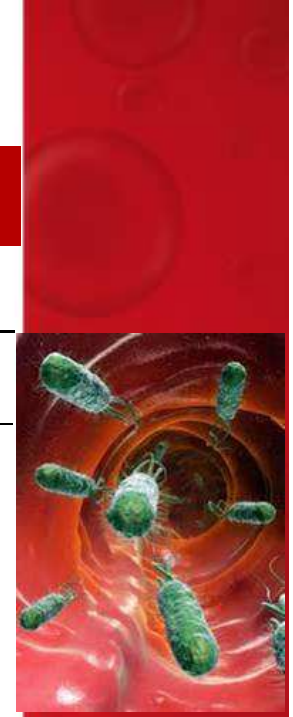
chelation therapy **- iron removal**
desferoxamine, deferiprone, deferasirox

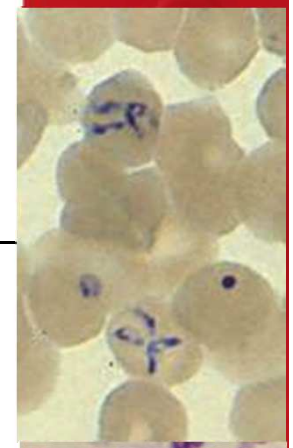
exchange transfusion
phlebotomy

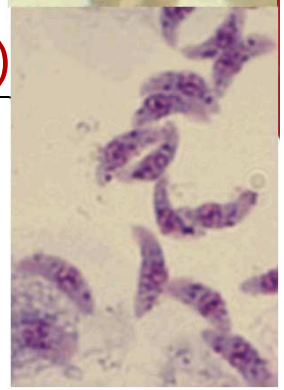
2. Pathogen transmission

Transmissible pathogenic agents with the different blood fractions

Blood Fraction	Pathogens		
	Virus	**Bacteria**	**Protozoa**
Plasma 	Hepatitis A virus Hepatitis B virus Hepatitis C virus Hepatitis D virus Hepatitis G virus[1] HIV Parvovirus B 19 (Prions)	*Treponema pallidum (syphilis)*	
Red blood cells			Plasmodium (malaria) Babesia microti (babesiosis)
White blood cells	HIV I and II Epstein Barr vírus Cytomegalovirus virii as with plasma		Toxoplasma gondii (toxoplasmosis)







Virus transmission

Canadian Blood Services
it's in you to give

Table 2 Estimated residual risk of HIV, HCV and HBV

HIV	HCV	HBV
1 in 21.4 million donations	1 in 12.6 million donations	1 in 7.5 million donations

Australian red cross blood service

Table 10: Residual risk estimates calculated on Blood Service data

Agent and testing standard	Window period	Estimate of residual risk 'per unit' (a)
HIV (antibody/p24Ag + NAT)	5.9 days	Less than 1 in 1 million
HCV (antibody + NAT)	2.6 days	Less than 1 in 1 million
HBV (HBsAg + NAT)	15.1 days	Less than 1 in 1 million
HTLV 1 and 2 (antibody)	51 days	Less than 1 in 1 million
vCJD [No testing]		Possible, not yet reported in Australia
Malaria (antibody)	7–14 days	Less than 1 in 1 million

For infectious diseases where there is no effective testing, donor health screening is important to recognise those at risk and defer donation, for example, Zika virus and travel deferrals.

NZ BLOOD SERVICE 2016

TABLE 26.2 RESIDUAL RISK PER MILLION DONATIONS IN FIVE COUNTRIES

	HIV	Hepatitis C	Hepatitis B
NZ	0.10	0.13	1.18
UK[5]	0.16	0.04	0.63

	HBV	HCV	HIV
Number per million donations	0.81	0.02	0.04
95% confidence interval	*(0.28-1.75)*	*(0.00-0.14)*	*(0.01-0.10)*
At 1.9 million donations per year, testing will miss a potentially infectious window period donation every:	6 months	22 years	14 years

Total mortality	**1.05**

	Mortality	Major morbidity	Total cases
All errors	0.40	0.44	**47.4**
ATR	0.00	3.06	**10.2**
HTR	0.04	0.28	**1.4**
TRALI	0.00	0.00	**0.0**
TACO	0.56	0.72	**3.5**
TAD	0.00	0.24	**0.4**
TA-GvHD	0.00	0.00	**0.0**
PTP	0.00	0.00	**0.0**
CS	0.00	0.08	**0.4**
TTI	0.00	0.04	**0.0**
UCT	0.04	0.04	**0.4**
Paediatrics	0.00	0.72	**5.5**

Table 3.1: Risks per 100,000 components issued

SHOT UK

Transmissible pathogens in the stored donor's blood

Virus transmission:

Problems:

- **new mutants and new virii**
- **expansion of vector-borne diseases –** dengue fever, chikungunya, WNV**,** Zika
- **Screening tests do not detect fresh infection**
- **Virus inactivation procedures are at experimental state for labile blood products or not available for all countries**
- **prions**

Transmissible pathogens in the stored donor's blood

Sepsis by bacteria transfer :

Endotoxin formation is during storage!

RBC transfusion:

Storage temperature : **+ 4C°**

Yersinia enterocolitica (51%)
Pseudomonas fluorescens (26,5%)

Treponema pallidum (4,1%)

Pseudomonas putida (4,1%

PLT transfusion:

Storage temperature : **+20 C°**)

Staphylococcus epidermidis (25%)

Salmonella coholerae-suis (13,5%)

Serratia marcescens (9,6%)

Staphylococcus aureus (5,8%)

Bacillus cereus (5,8%)

Streptococcus viridans (3,8%)

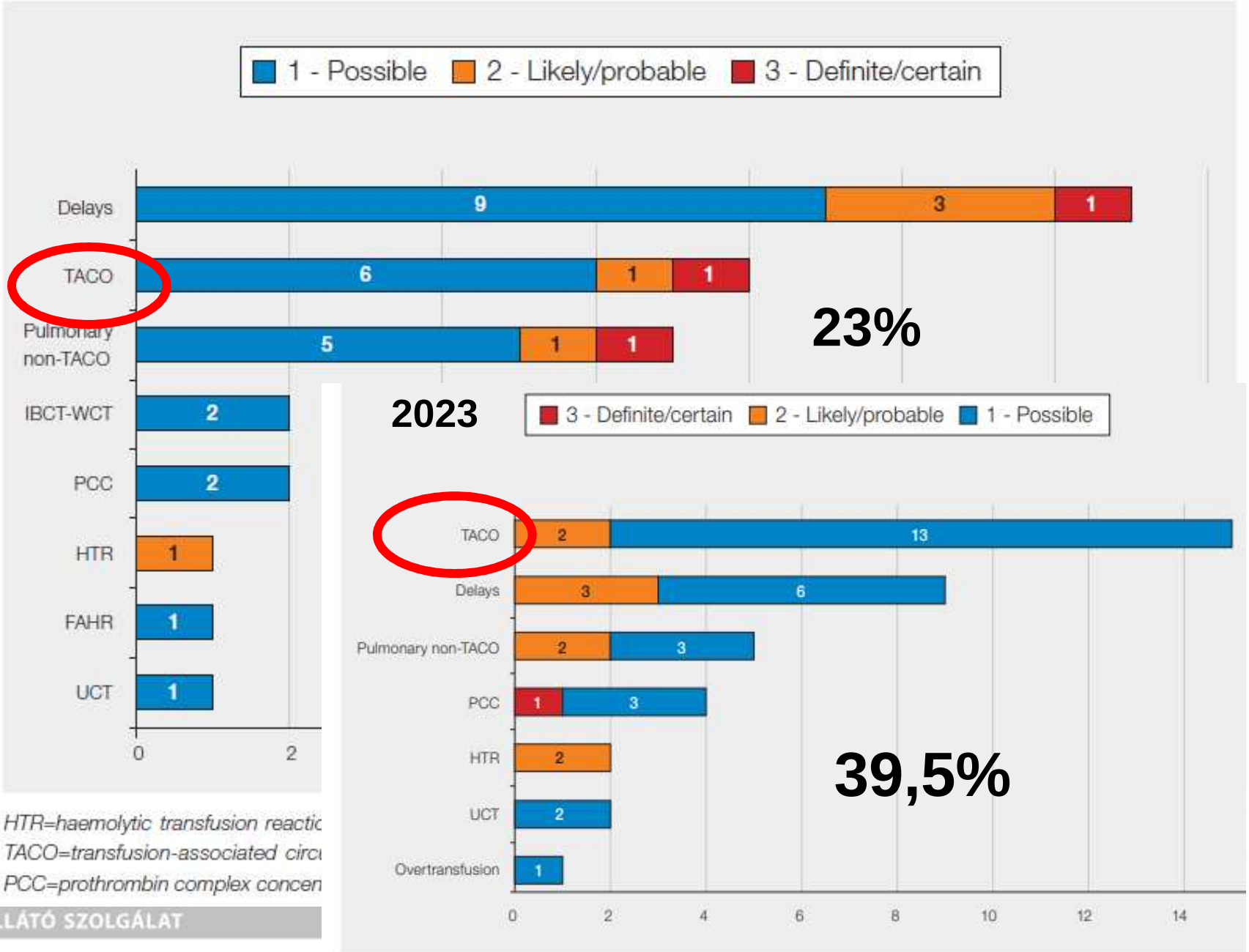
Deaths due to transfusion complications

Hemovigilance is a "quality process" which aims to improve quality and increase safety of blood transfusion, by surveying all activities of the blood transfusion chain, from donors to recipients. Haemovigilance means a set of organised surveillance procedures relating to serious adverse or unexpected events or reactions in donors or recipients, and the epidemiological follow-up of donors incluing obligation of adverse events reporting.

Cause of complications	SHOT (n=169)	RBTC Pécs (n=134)
Wrong blood group	47%	59%
Acut transfusion reaction	13%	18%
Late transfusion reaction	13%	16%
PTP	1%	0,8%
GVHD	1%	0
TRALI (or respiratory symptoms)	7%	6%

Deaths due to transfusion complications

Figure 3.4: Deaths related to transfusion with imputability reported in 2022 (n=35)

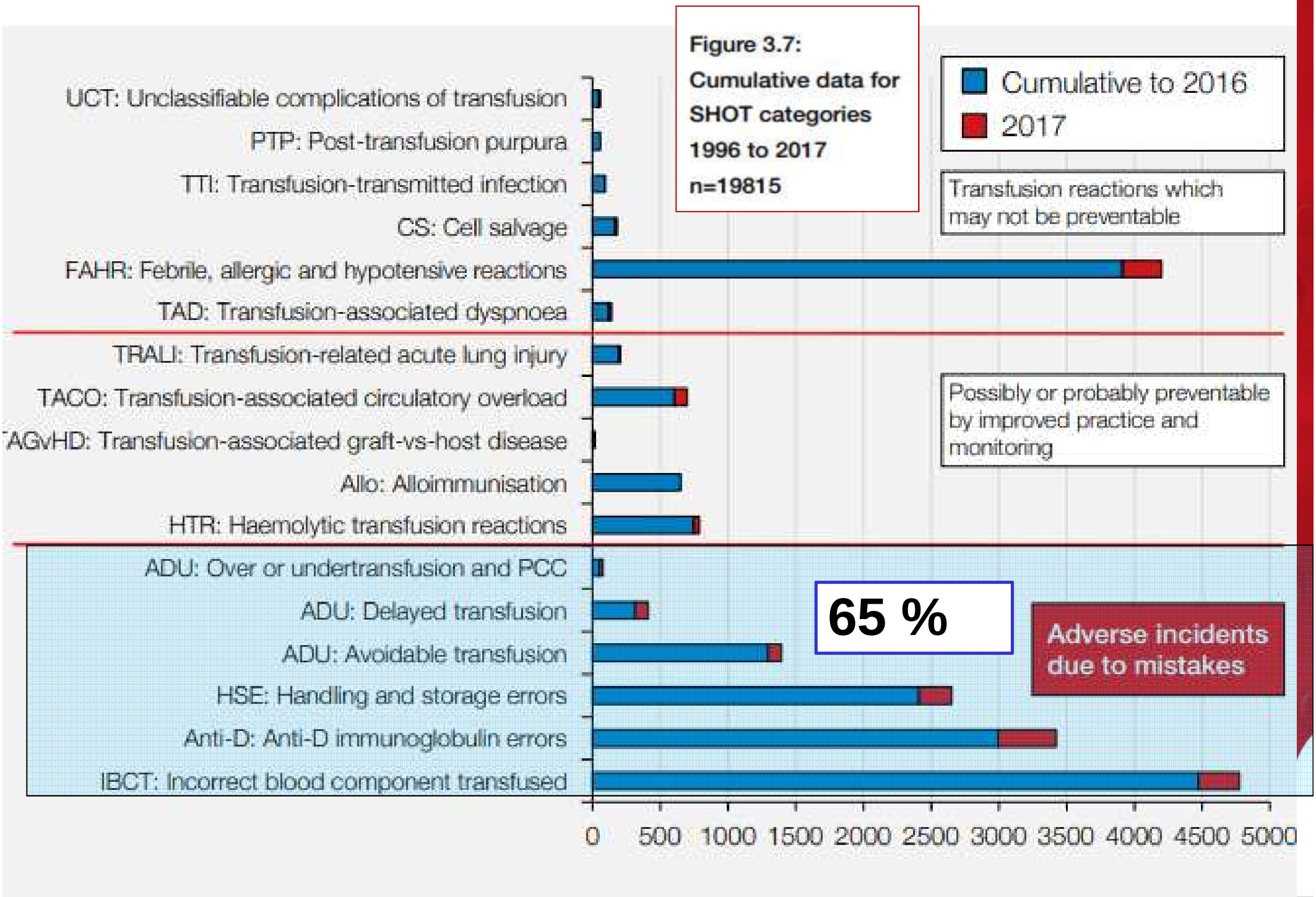


HTR=haemolytic transfusion reactic
TACO=transfusion-associated circu
PCC=prothrombin complex concen

HTR=haemolytic transfusion reactions; UCT=uncommon complications of transfusion; TACO=transfusion-associated circulatory o
PCC=prothrombin complex concentrates

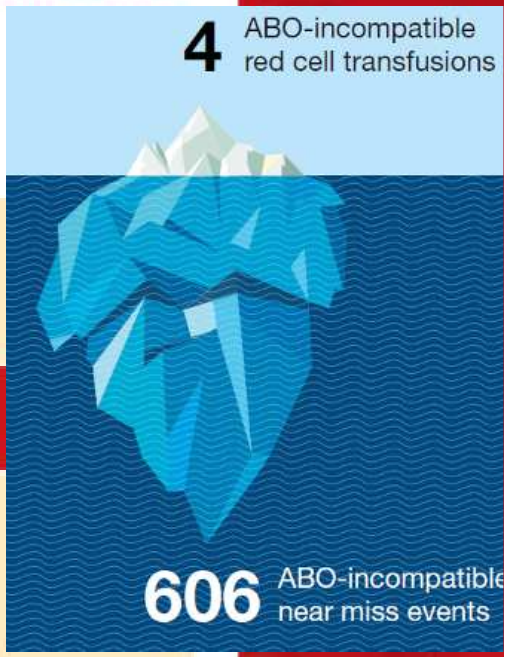
Reported transfusion adverse events

Annual SHOT report UK



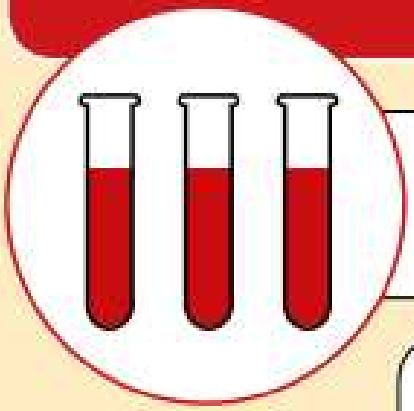
A 'near miss' event refers to any error which, if undetected, could result in the determination of a wrong blood group or transfusion of an incorrect component, but was recognised before the transfusion took place.

Near miss reports continue to increase, n=1243 in 2015 from n=1167 in 2014.



Key SHOT messages

Near Misses 2015 n=1243



Wrong blood in tube (WBIT) is the most common near miss incident, 62.8%

Doctors take 35.0% WBIT samples

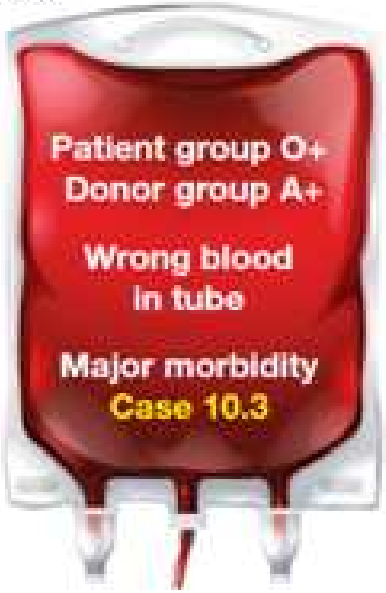
Identify your patient properly
69.6% misidentification near misses

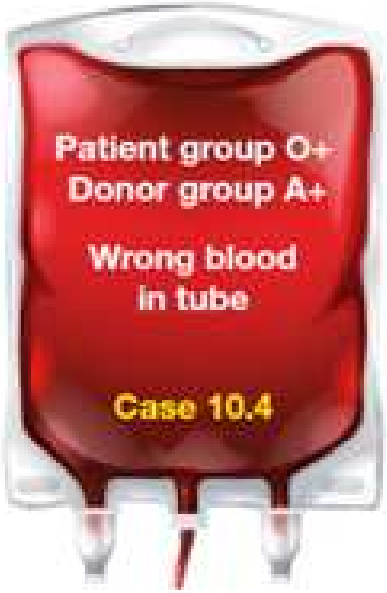
The wrong blood group can kill
23.3% near misses ABO-incompatible
33.3% WBIT ABO-incompatible

ABO-incompatible red cell transfusions n=3 clinical (2 resulting in major morbidity)

ANNUAL SHOT REPORT 2016

IBCT n=331





Case 10.3: Wrong blood in tube leads to ABO-incompatible transfusion and major morbidity

wrong tube labeling
wrong patient identification

both patients had the same forename
wrong patient identification
failure of checks

ANNUAL SHOT REPORT

Incorrect blood component transfused n=307

Case 10.2: Failure to complete the administration check at the bedside correctly leads to an ABO-incompatible red cell transfusion

Summary: Types of transfusion complications

Immediate complications

Within 10 – 15 minutes

ABO – incompatibility

Anaphilaxis

Air embolism

Late complications

1 – 7 after transfusion

Delayed immunohemolysis

Immunisation

Immunodeficiency

TA-Graft versus host disease

Hemosiderosis (months, years)

Early complications

Within 1 – 24 hours

Allergy

Febrile non-hemolytic complications

Haemolytic complications of immunised patients

Haemolytic complication of anesthetized patients

Circulatory overload

Citrate intoxication

Endotoxin shock

Hypothermia

Coagulation disorders

Trombembolia

Transmission of pathogens

Weeks, month, years after transfusion

Hepatitis (B,C stb.) CMV HIV and other **virii** (EBV, Parvovísus B19 ….)

Lues and other **bacteria**

Malaria, babesiosis and other **protozoa**