Blood Banking

INTRODUCTION

- Humans were always interested in blood
- Ancient Egyptians used to bath in blood
- At Renaissance the aristocrats used to drink it…
- In modern society we use blood transfusion, blood products like immunoglobulins, clotting factors etc.

PURMANN -
TRANSFUSION
1705

- At 1492 blood was transfused from three young men to the Pop, unfortunately all *four* died
- At 1901 Karl Landsteiner discovered the blood groups and received a Nobel price of medicine for that at 1930.

Blood group antigens

ABO	'Lewis'	I	P	Rh		MNS		Lutheran	Kell
A	Le^a	I	P_1	D	CE	M	m^v	Lu^a	K
A_2	Le^b	i	P	C	D^w	N	m^A	Lu^b	$\bar{k}$
A_3		I^T	p^k	E	E^T	Hu	Sul	Lu^3	Kp^a
A_x			Luke	$\bar{c}$	Rh26	S	Sj	Lu^6	Kp^b
A_m			$\bar{p}$	e	cE	$\bar{s}$	m'	Lu^8	Kp^c
B				$\bar{f}$	hr^H	He	Kam	Lu^9	Ku
B_3				$C\bar{e}$	Rh29	Mi^a	En^aTS	Lu^{14}	Js^a
B_m				C^w	Go^a	U	En^aFS		Js^b
B_w				C^x	hr^b	M^c	En^aFR	probably	K^w
H				V	Rh32	V^w	Shier	Lu^4	KL
C				E^w	Rh33	Mg	N^A	Lu^5	Ul^a
				G	Rh34	Vr	U^Z	Lu^7	K11
				Rh^A	Rh35	M_1	AY	Lu^{11}	K12
				Rh^B	Be^a	Mur	FR	Lu^{16}	K13
				Rh^C	Rh37	M^e	JL	Lu^{17}	K14
				Rh^D	Rh38	Mt^a	'N'	Singleton	K16
				Hr_o	Rh39	St^a	U^x	Much	WK^a
				Hr	Rh40	Ri^a	S^D	Hughes	K18
				hr^S	Rh41	Cl^a	Can	Anton	K19
				VS	Rh42	Ny^a	Mit	Au^a	K20
				C^G		Tm	Dantu	Wj	K22
						Hut	Wr^b		
						Hil	En^aTK		

Lw	Duffy	Kidd	Xg^a	Diego	Cartwright	Scianna	Dombrock	Colton	Chido/Rogers
Lw^a	Fy^a	JK^a	Xg^a	Di^a	Yt^a	Sc1	Do^a	Co^a	Ch
Lw^b	Fy^b	JK^b		Di^b	Yt^b	Sc2	Do^b	Co^b	Rg
Lw^{ab}	Fy^x	JK^3				Sc3		Co^3	
	Fy^3								
	Fy^4								
	Fy^5								

Fig. 19.1 Red cell antig
those best characterized
assigned to recognized b
group systems. Other
antigens include Hh, Kx,
Gerbich, Cromer, Knops,
Indian, P, P^k, Sd^a, Bg (HL
on red cells). (Modified f
Issett PD. *Applied Blood
Group Serology*. Miami:
Montgomery Scientific
Publications; 1985:612–

.ABO Type Frequencies In U.S

ABO Type	Per Cent
O	45%
A	40%
B	11%
AB	4%

Incidence of different ABO blood groups in the UK population

	Blood group			
	O	A	B	AB
Antigens on red (and other) cells	None	A	B	A+B
Antibody in serum	Anti-AB	Anti-B	Anti-A	None
Approximate percentage in UK population	47	42	8	3

Fig. 19.4 ABO blood groups: incidence in the UK population.

The Rh system

CDE nomenclature	Short symbol	Caucasian frequency (%)	RhD status
cde/cde	rr	15	Negative
CDe/cde	R_1r	32	Positive
CDe/CDe	R_1R_1	17	Positive
cDE/cde	R_2r	13	Positive
CDe/cDE	R_1R_2	14	Positive
cDE/cDE	R_2R_2	4	Positive
Other genotypes		5	Positive (almost all)

Fig. 19.5 The Rh system: genotypes. (Modified from Hoffbrand AV, Pettit JE. *Essential Haematology*, 3rd edn. Oxford: Blackwell Scientific Publications; 1993.)

Structure of ABO Antigens

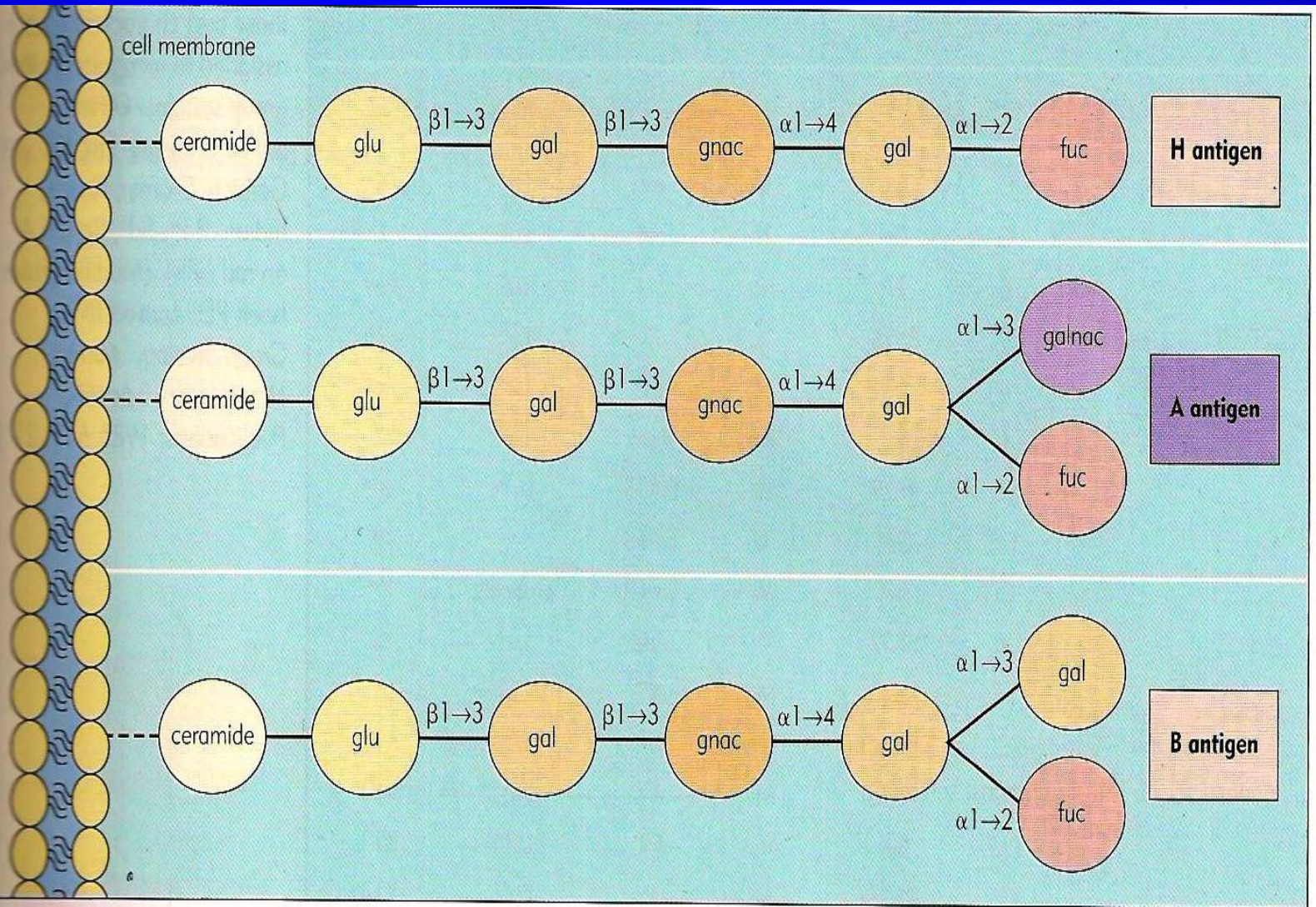


Fig. 19.3 Structure of the ABO blood group antigens: each consists of a chain of sugars, in α or β conformation, linked through different carbon atoms (numbered 1 to 4). The H antigen of the O blood group has a terminal fucose (fuc). The A antigen has an additional *N*-acetylgalactosamine (galnac), whereas the B antigen has an additional galactose (gal). (glu, glucose; gnac, *N*-acetylglucosamine.)

Red cell antibodies causing haemolytic reactions and haemolytic disease of the new-born

Blood group system	Frequency of antibodies	Haemolytic transfusion reactions	Haemolytic disease of the new-born
ABO	Very common	Yes (common)	Yes
Rh	Common	Yes (common)	Yes
Kell	Occasional	Yes (occasional)	May
Duffy	Occasional	Yes (occasional)	May
Kidd	Occasional	Yes (occasional)	May
Lutheran	Rare	Rare	No
Lewis	Common	Rare	No
P	Rare	Rare	No
MNSs	Rare	Rare	No
Ii	Rare	Unlikely	No

Fig. 19.2 Red cell antibodies: those that cause haemolytic reactions and haemolytic disease of the new-born.

Isoimmune haemolytic anaemia		
Blood group system	**Frequency of antibodies**	**Haemolytic disease of newborn**
ABO	Very common	Causal
Rhesus	Common	Causal
Kell	Occasional	Causal
Duffy	Occasional	Causal
Kidd	Occasional	Causal
Lutheran	Rare	Causal
Lewis	Rare	Not causal
P	Rare	Not causal
MNSs	Rare	Not causal
Ii	Rare	Not causal

Fig. 4.45 Isoimmune haemolytic anaemia: the main blood group systems and their association with haemolytic disease in the newborn.

Cross-matching

- Cross-matching tests the match between the serum of the receiver and RBC of the donor
- Non match will cause agglutination

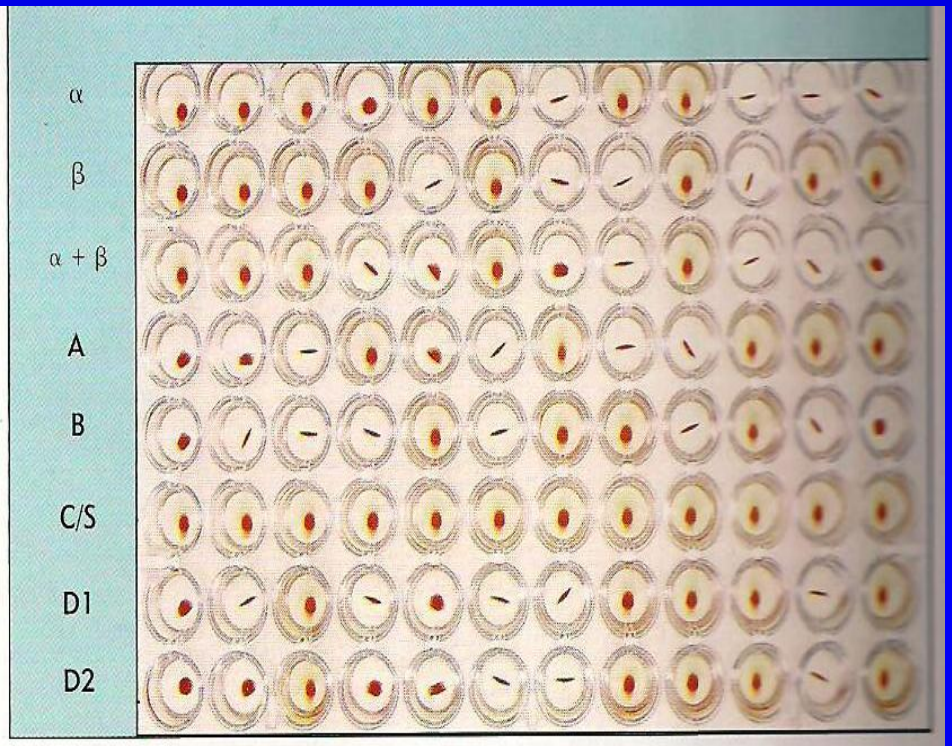


Fig. 19.7 ABO grouping: standard layout for 96-well microplate blood grouping (12 patients grouped on one plate). Symbols along the vertical side are: α, anti-A; β, anti-B; α+β, anti-A+B; A, B, known A or B cells; C/S, patient cells and serum; D1, D2, two sources of anti-D. Sharp agglutination ('comma-like') shows a positive reaction, and no agglutination shows a negative reaction. (Courtesy of Mr G Hazlehurst.)

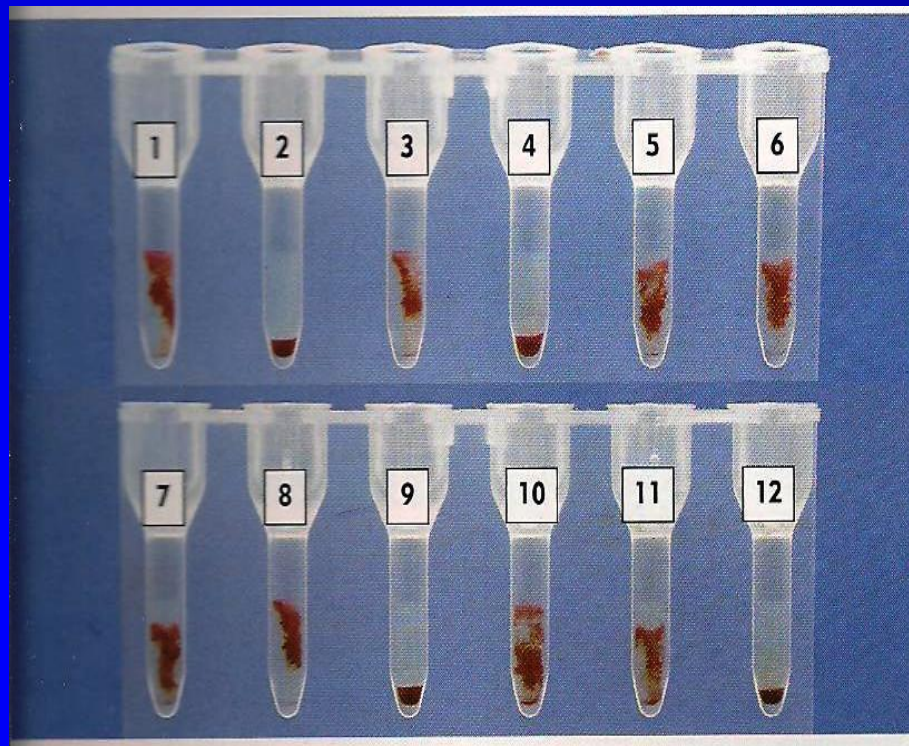


Fig. 19.8 Patient antibody screening using microcolumn (gel) system: ten tests with two controls (tube 11 is the positive control and tube 12 the negative control) are shown. Patient's serum is tested against screening cells with known red cell phenotype. Tubes 1, 3, 5, 6, 7, 8, and 10 show positive results. The patient's serum contained anti-Fy^a. (Courtesy of Mr G Hazlehurst.)

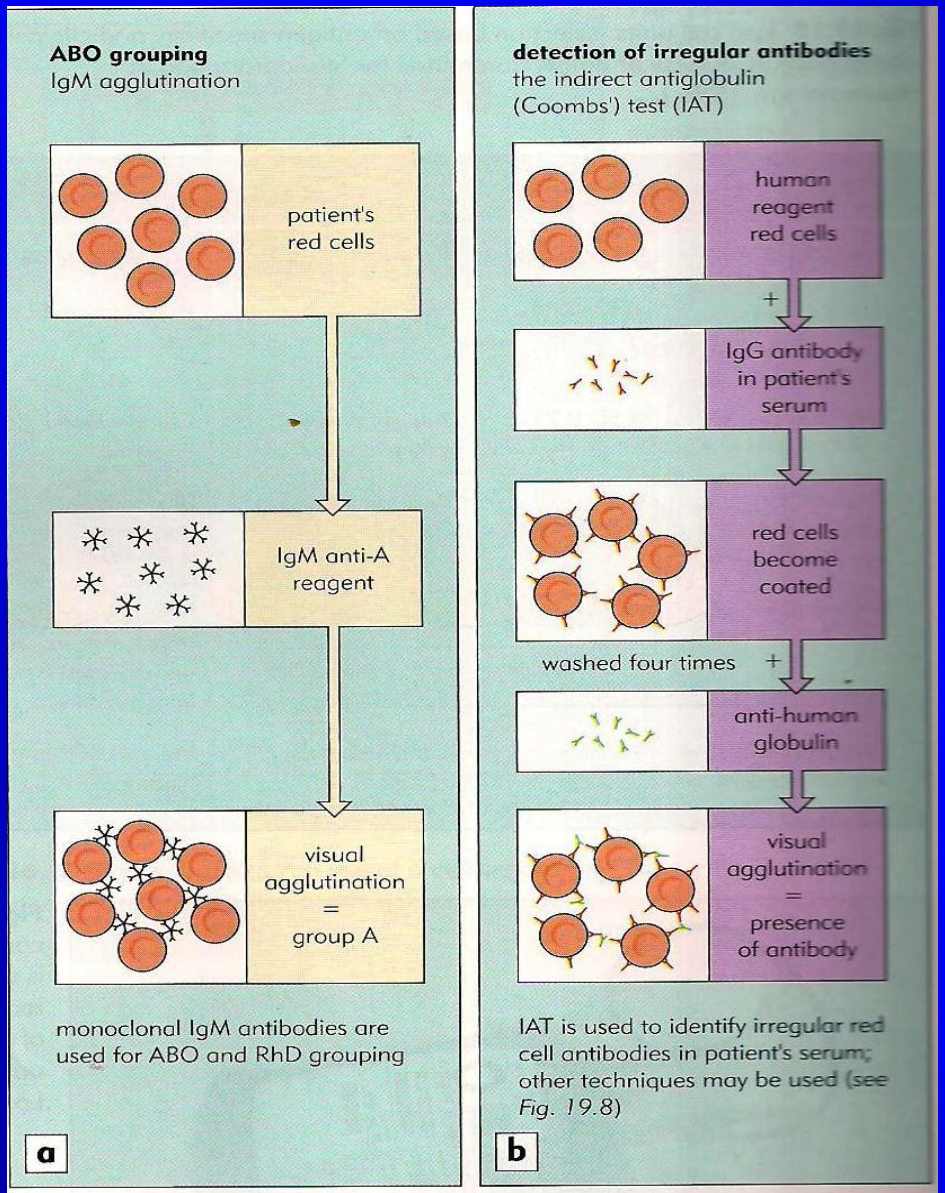


Fig. 19.9a and b ABO grouping: (a) IgM agglutination. Monoclonal IgM antibodies are used for ABO and RhD grouping. (b) The indirect antiglobulin (Coombs') test (IAT). The IAT is used to identify irregular red cell antibodies in the patient's serum. [(a, b) Courtesy of Prof. M Contreras and North London Blood Transfusion Centre.]

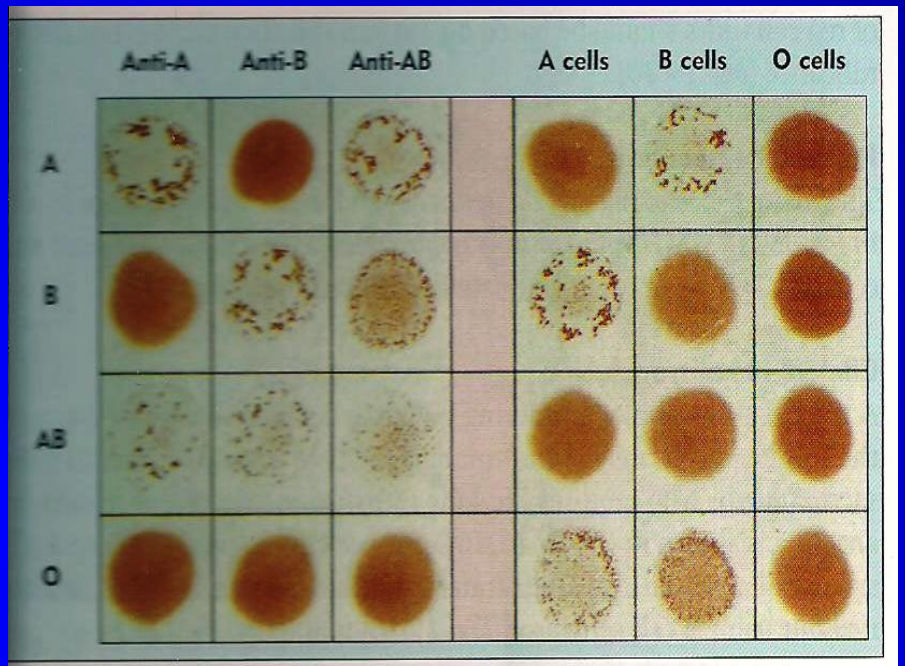


Fig. 19.6 ABO blood group testing: reactions observed. Agglutination denotes reactivity. The left hand three columns denote patient cells (A, B, AB or O) mixed with anti-A, anti-B or anti-AB. The right hand three columns denote plasma from the patients, mixed with A, B or O cells.

Summary of Slide Typing

Anti-A	Anti-B	Blood Group
NEG	NEG	O
POS	NEG	A
NEG	POS	B
POS	POS	AB

Antibody screening

(indirect Coomb's test)

- The aim of the screening is to find out whether the patient has Ab against one or more secondary blood groups of RBC
- Ab like that can be found in people who received blood in the past or in women after pregnancies.
- Performed in every cross-matching

Risks of RBC Transfusion Reactions in USA

- Febrile non-hemolytic reaction: 1/100 tx
- Minor allergic reactions: 1/100-1000 tx
- Bacterial contamination: 1/ 2,500,000
- Viral Hepatitis 1/10,000
- Hemolytic transfusion rxn Fatal: 1/500,000
- Immunosuppression: Unknown
- HIV infection 1/500,000

Donor Screening Tests

Syphilis	1945
HBsAg	1972
Anti-HIV-1	1985
Anti-HBc	1986
HTLV-1	1989
Anti-HCV	1990
Anti-HIV-2	1992
HIV 24 antigen	1996

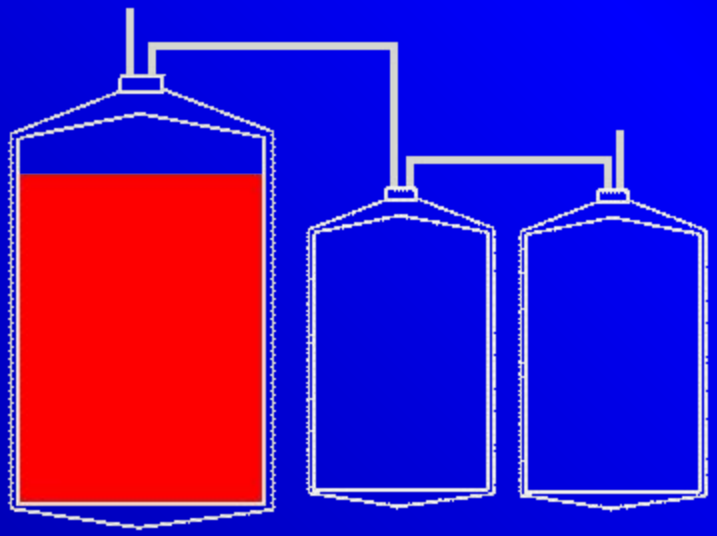
Direct Coomb's Test

- The aim of the Direct Coomb's test (Direct Antiglobulin Test – DAT) is to find antibodies attached to the RBC of the patient
- Performed when immune hemolysis is a suspected cause of anemia, upon request of the physision

Titration of the anti bodies

- Performed in case there is a need to follow up the titer of anti bodies – like in case of anti Rh in pregnancy.

Whole Blood

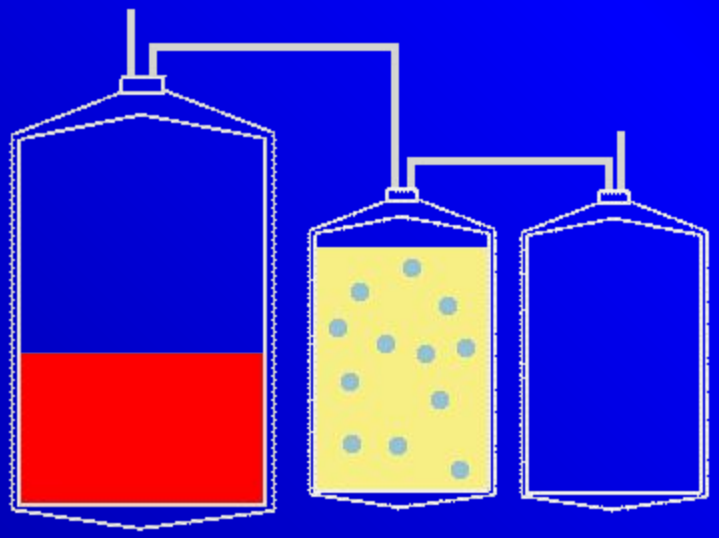


- Includes all blood components
- Is given in case of massive blood loss
- According to blood group and after cross-match
- Stored in refrigerator

Packed Red Blood Cells

- Increases Hb in anemic patients, one unit will increase Hb by ±1gr/dl
- Used in anemia or blood loss
- Is given according to blood group and after cross-match
- If not used should return to refrigeration

Platelets (thrombocytes)



- Increase Plt by ±10000/unit, adult should receive 6 units
- Indicated in cases of Plt<10000, in febrile Plt<20000, or bleeding in thrombopenic patient
- No need in cross-matching
- Stored in room temperature, given within 4 hours from preparation

Relative Contraindications to Plt transfusion

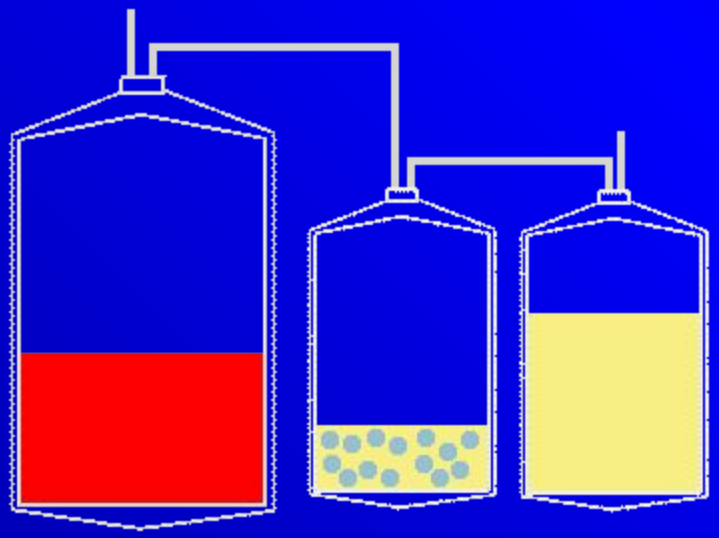
רצוי להמנע מלתת טסיות

Thrombotic thrombocytopenic purpura

Heparin induced thrombocytopenia

Immune thrombocytopenic purpura

Fresh Frozen Plasma- FFP



- Increases clotting factors and volume expansion
- Indicated in massive bleeding or clotting factor deficiency
- According to blood group, no cross-match

Cryoprecipitate

- Contains fibrinogen and Factor VIII
- Produced by speed freezing to -80 ºC
- Indicated in DIC, massive transfusion

Irradiated blood products

- Irradiation inactivates lymphocytes
- Prevention of Transfusion Associated Graft vs. Host Disease
- Indicated in immune suppressed patients – Hodgkin dis., chemotherapy – purine analogs, post bone marrow transplantation, treatment with immune-suppressive agents

Filtered Blood Products

- Filtration by Leukostop, filters WBC from RPC and Plt
- To prevent transfusion reactions
- To prevent CMV transmission

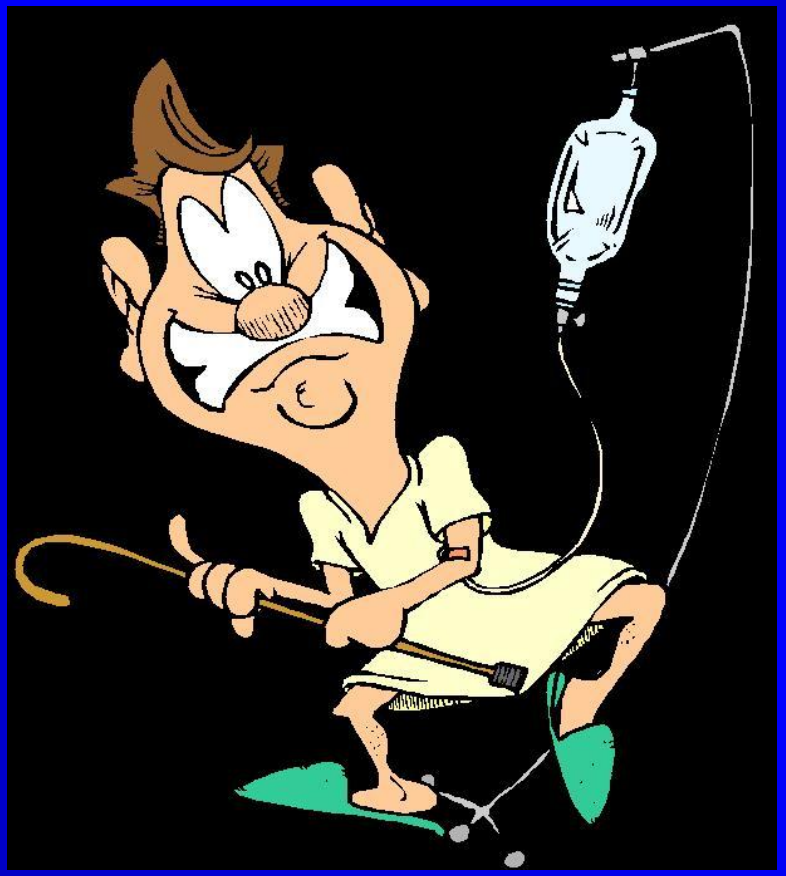
Washed Blood products

- To wash all the plasma components from cellular product
- To prevent allergic reactions
- Should be given within 4 hours

Single Donor Platelets

- Produced by pheresis from one donor
- Indicated in patients that don't have Plt increment after random Plt transfusion or patients that will need multiple Plt doses to prevent alloimmunization

Transfusion reactions



In case of transfusion :reaction

- Stop the transfusion immediately
- Treat the symptoms – steroids, anti histamines etc.
- Return the product to the blood bank, including the transfusion set and patient's blood and description of the reaction

Taking blood specimen prior to transfusion

1. Two nurses will identify the patient
2. The treating nurse will identify the specimen near the patient and sign the specimen tube and the blood bank form
3. Second nurse will identify the patient and the specimen and sign the blood bank form

Transfusion of Blood

1. Start by slow infusion
2. Follow up blood pressure, pulse and any signs of allergic reaction
3. After 15 min. increase the rate of transfusion
4. Must be completed within 4 hours
5. Leave the product documentation in patient's file

Summary

- Blood products can save lives, but non-matched products can cause life threatening complications
- The matching and transfusion of blood products must be according to a blood bank protocol to avoid unnecessary loss of life

Thank you for your attention