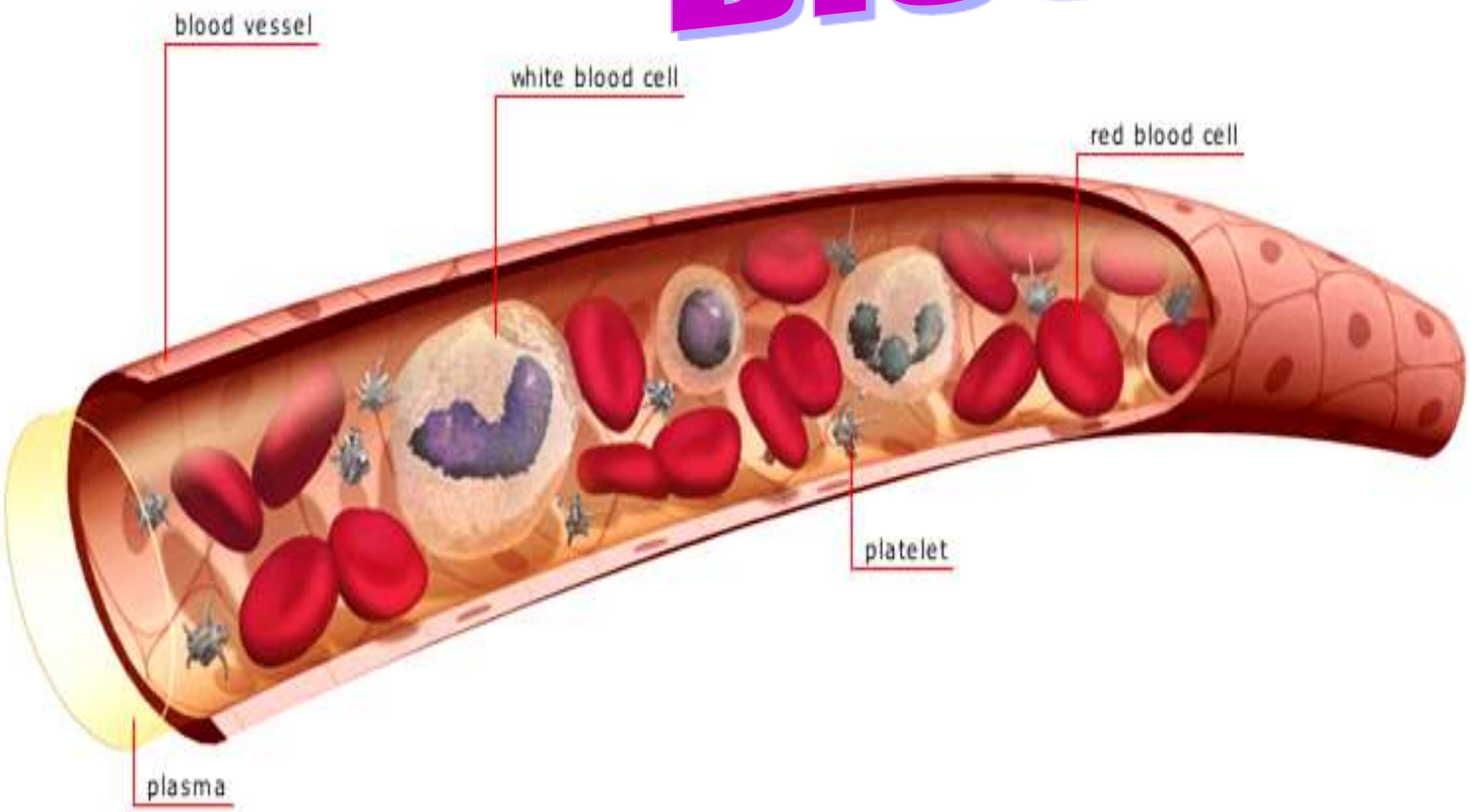
Blood


blood vessel
white blood cell
red blood cell
platelet
plasma

Blood Groups

By

Dr/ Nour A. Mohammed

Mutah school of medicine

ABO system

-The membrane of RBCs contain antigens (agglutinogens) of two types (A) and (B)

These antigens are characterized by :

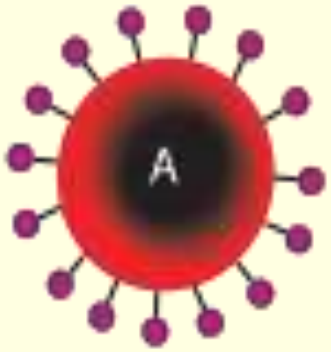
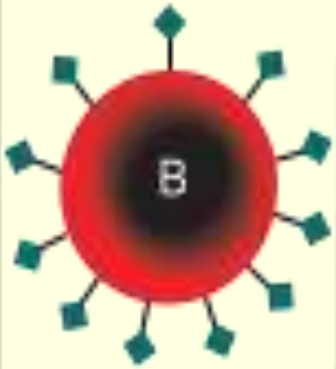
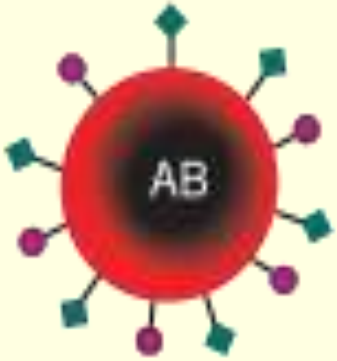
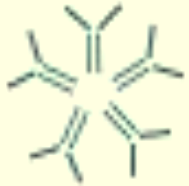
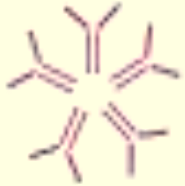
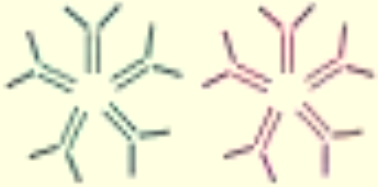
They are inherited according to Mendelian law

They appear in fetal life and persist throughout life.

They may be detected by specific reaction with the corresponding antibodies

In the plasma there are antibodies (agglutinins) against A and against B of gamma globulins type and they also are inherited

According to the types of antigens and antibodies, the blood groups are classified into:

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	No antigens

Inheritance of blood groups

The individual of blood group A may have genotype **AA** (homozygous) or **AO** (heterozygous).

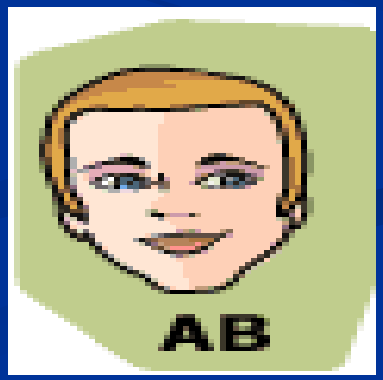
When blood groups of parents are known the possible genotype of their children may be predicted

Antigens & Antibodies

Blood Group	Antigens on RBCs	Antibodies in Serum	Genotypes
A	A	Anti-B	*AA* or *AO*
B	B	Anti-A	BB or BO
AB	A and B	Neither	AB
O	Neither	Anti-A and anti-B	OO

Importance of blood groups:

- (1) Medicolegal importance:
  - In the criminal practice.
  - In disputed paternity (good negative test).



(2) Blood transfusion:

The recipient's plasma should not contain agglutinin against the donor's red cells.

Individuals with group A can receive blood from **A** & **O** and give blood to **A** & **AB**.

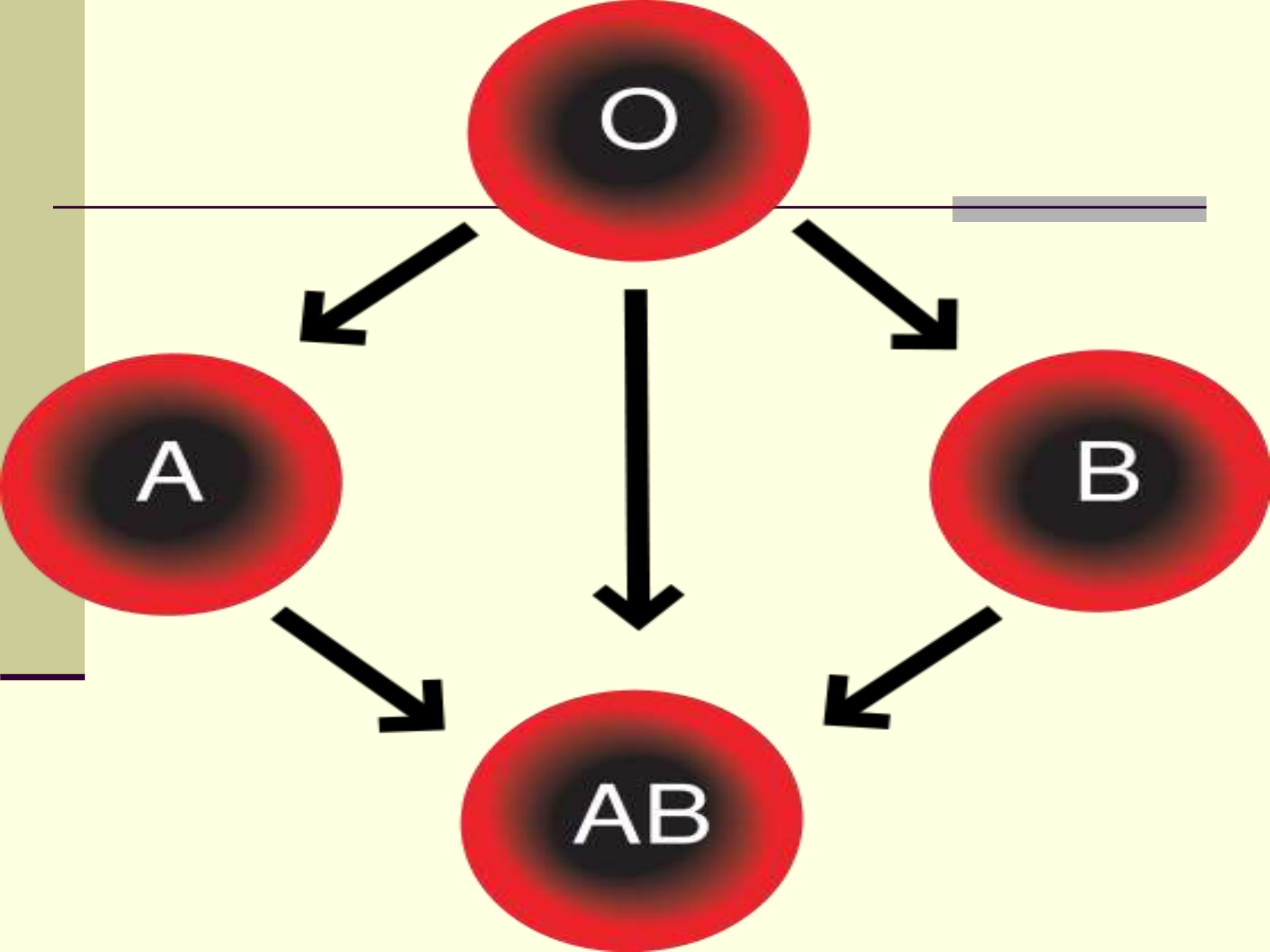
Individuals with group B can receive bl. from B & O and give bl. to B & AB.

Individuals with group AB are called **universal recipients** because they can receive blood from (All) but not give except (**AB**) as they have **no circulating antibodies.**

Individuals with group **O** are called **universal donors** because they receive only from (**O**) but give (All) as they have **no agglutinogens** on their RBCs.

Universal Donor and Recipient

- Universal Donor
- Group O
  - Carries no A or B antigens
  - Has Both anti-A & Anti –B (agglutinin) in plasma
- Universal Recipient
- Group AB
  - Patient has A and B antigens
  - Patient has no anti-A or anti-B


O
A
B
AB

*In incompatible blood transfusion

- The donor's RBCs are agglutinated by recipient plasma

- The donor's serum are diluted by recipient blood so its antibodies are with less or no effect on the recipient RBCs , but in transfusion of large volume → agglutination of recipient RBCs.

Rh system

The Rh(D) Antigen

- RH is the most complex system, with over 45 antigens
- Discovered in 1940 after work on Rhesus monkeys
- *RH* gene located on short arm of chromosome 1

Simple Genetics of Rh(D)

- 85% of population are Rh(D) positive
- Rh-antigens are multiple but
- D-antigen is the most important Rh-antigens
- The *d* gene is recessive:
  - *Dd*, *dD*, *DD*, persons are Rh(D) positive
  - Only *dd* persons are Rh(D) negative.
  - Normally the plasma does not contain anti-D-agglutinin

Distribution of Rh(D) Types

Population	Rh(D) positive	Rh(D) negative
Caucasian	86%	14%
African-American	95%	5%
Oriental	>99%	<1%

Inheritance

- *ABO* & *RH* genes are not linked
- ABO & Rh(D) type are inherited independently

For example:

An A Rh(D) positive mother

and B Rh(D) positive father

could have an O Rh(d) negative child

*Rh-antibodies

They differ from ABO system antibodies

1) They are normally absent but induced by blood transfusion of Rh-positive blood to Rh-negative patient or in pregnancy.

(2) Rh-antibodies are IgG type but ABO-antibodies are IgM type of immunoglobulins

- **IgM has two differences with IgG:**

(a) IgM has specific antigenic sites on RBCs and has the ability to overcome the repellent force of electric charges of RBCs → visible agglutination, but IgG require antihuman globulin to overcome the repellant force and give visible agglutination

(b) IgM has large molecules and cann't cross placenta (IgG has small molecules and can cross placenta).

*Importance of Rh-factor:

(1) Erythroblastosis fetalis:

compensatory ↑ erythroblast in fetus

Rh +ve male + Rh –ve female = Rh +ve fetus

Rh +ve fetal RBCs enter the circulation of the mother and sensitize her immune system to produce anti-D agglutinins

antibodies (IgG) cross the placenta to the Rh +ve 2nd fetus

2nd or 3rd fetus is born anaemic, jaundiced or born dead

1st baby should not be affected except if the mother is sensitized by previous transfusion of Rh +ve bl.

Prevention:

1- Rh –ve female should never receive Rh +ve blood

Anti-D antibodies are given to the mother during 48 hours after each delivery

to neutralize the D-antigen of fetal RBCs transmitted to her, so prevent formation of antibodies

Treatment:

Gradual replacement of baby' blood with Rh –ve group O.

(2) Repeated blood transfusion:

If Rh –ve person is transfused with Rh +ve blood

he will produce antibodies against Rh-factor

if this person re-transfused with Rh + ve blood

$\rightarrow$ agglutination

*Determination of blood group:

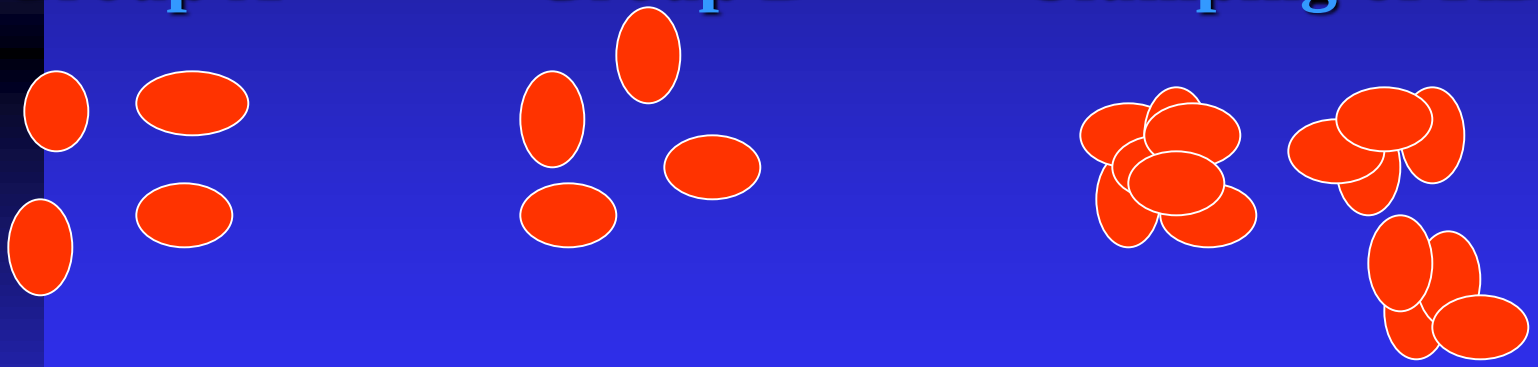
- By slide technique

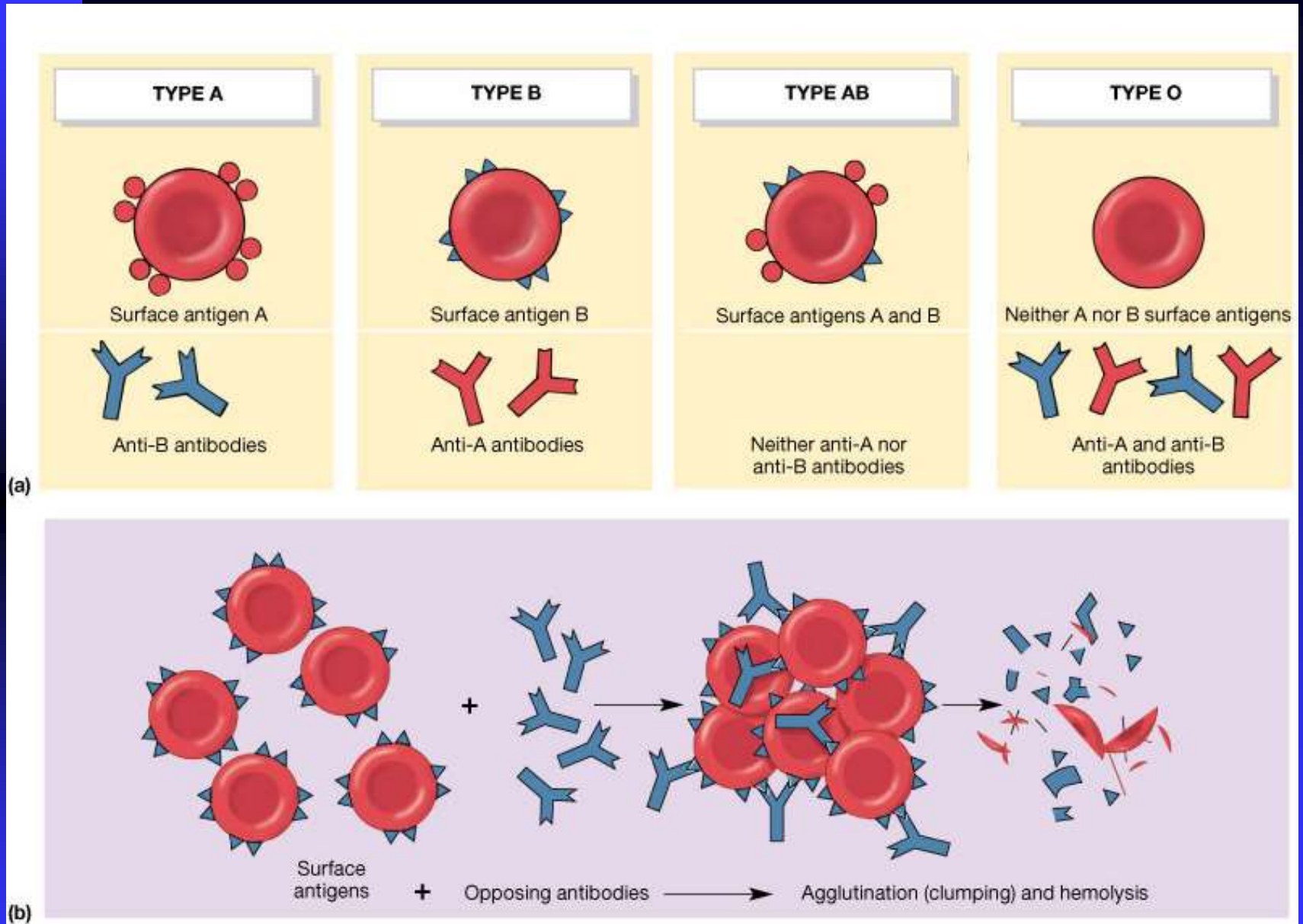
Cross matching

between recipient and donor blood

MISMATCHED TRANSFUSION

Group A + Group B = Clumping of RBCs




TYPE A
TYPE B
TYPE AB
TYPE O
Surface antigen A
Surface antigen B
Surface antigens A and B
Neither A nor B surface antigens
Anti-B antibodies
Anti-A antibodies
Neither anti-A nor anti-B antibodies
Anti-A and anti-B antibodies
(a)
Surface antigens
+
Opposing antibodies
Agglutination (clumping) and hemolysis
(b)


Thanks