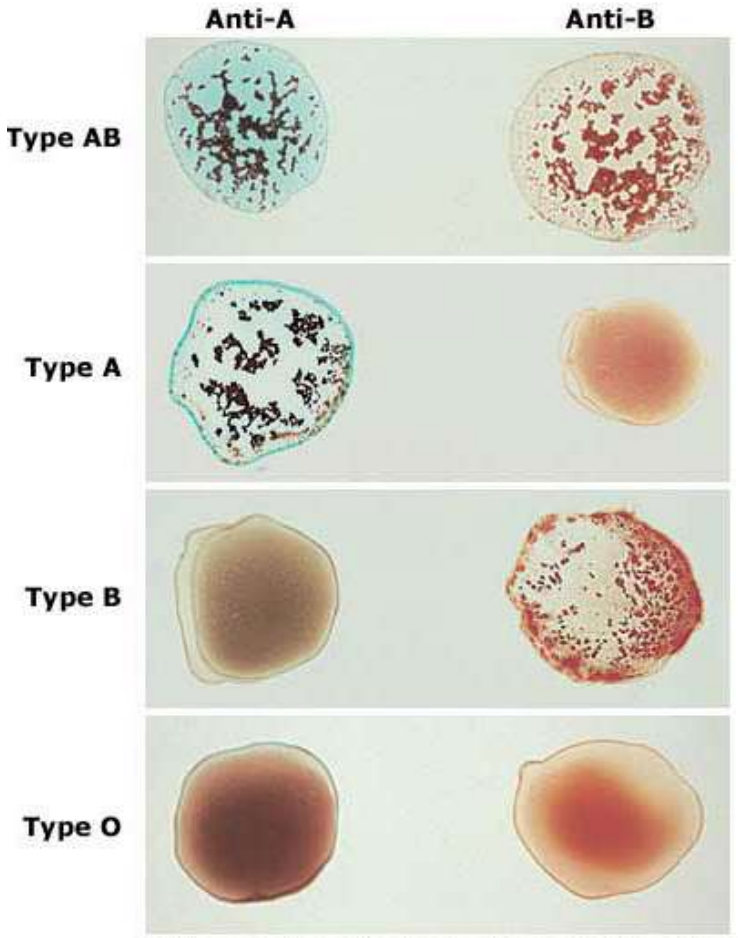
Blood Grouping



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Blood Grouping

- Is the system of typing blood of a specific person into a particular type due to the presence or absence of a specific (inherited) **agglutinogen** on the membrane of RBC of that person

- Before giving a transfusion it is necessary to determine the blood group of the **recipient** and the group of the **donor** blood so, that the blood will be appropriately matched

- **Aim of Blood Grouping---**
  - To identify individuals blood group
  - To identify positive or negative blood group
  - To avoid hazards of mismatch blood transfusion

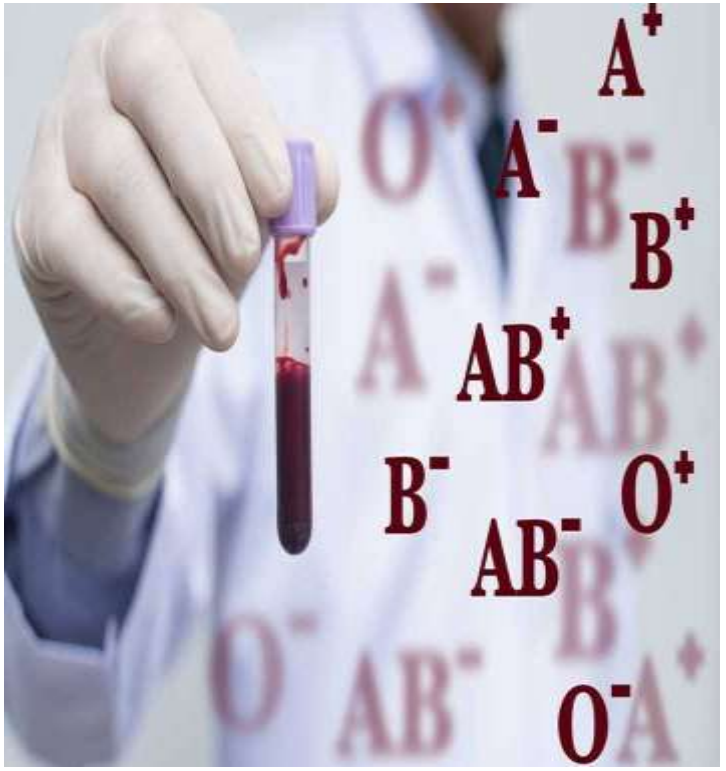
Major Blood Group System

- **ABO Blood Group System:**

  Based upon presence or absence of group specific substance (inherited) or **agglutinogen** or **antigen** on the surface of RBC membrane

- **Rh Blood Group System:**

  Based upon presence or absence of **Rh agglutinogen** or **antigen** on the surface of RBC membrane



Cross Matching

- The donors blood cells and the recipients plasma are directly tested against each other to determine whether **agglutination** occur or not is called cross matching

- **Aim of cross matching----**

  * To screen for antibodies and determine donor-recipient compatibility

Major Blood Groups

- **ABO blood groups:**
  - Discovered by **Karl Landsteiner** in 1900
  - ABO blood group consists of—

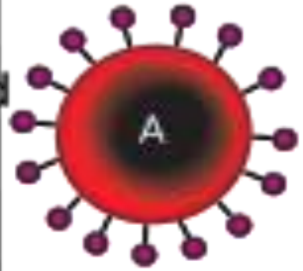
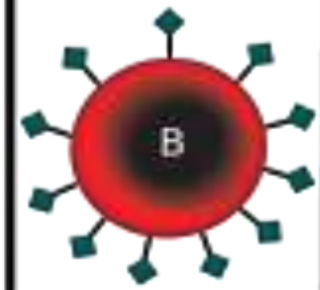
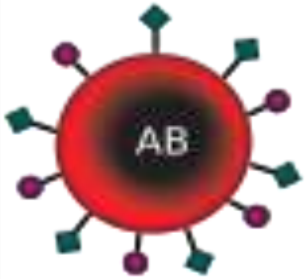
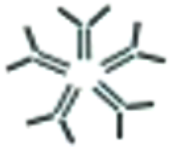
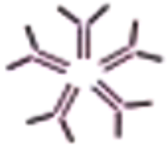
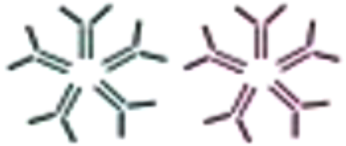
    * two antigens (**A & B**) on the surface of the RBC

    * two antibodies in the plasma (**Anti-A or α & Anti-B or β**)

Reciprocal relationship between ABO antigens and antibodies

Antigen on RBCs	Antibody in plasma	Blood group
A	Anti-B	A (42%)
B	Anti-A	B (9%)
AB	None	AB (3%)
None	Anti-A & Anti-B	O (46%)

ABO Antigens & Corresponding Antibodies

	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	None

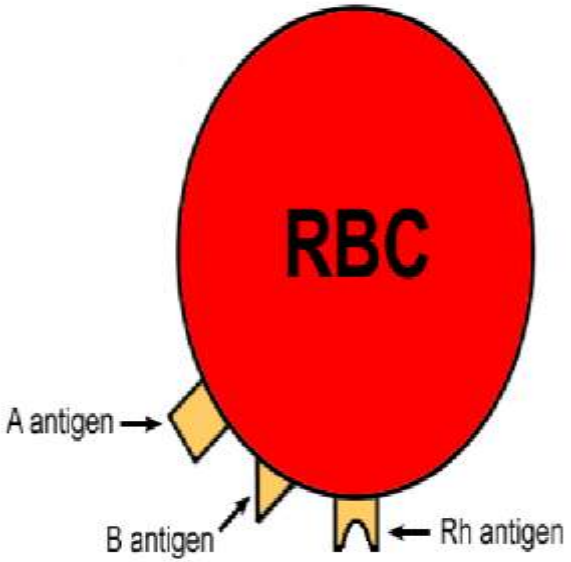
ABO Agglutinogen Or Antigen

- Blood group antigens are actually **sugars** attached to the external surface of red cell membrane
- These antigens are ---

  -- **unique** to individuals

  -- recognized as **foreign** if transfused into another individual

  -- promote **agglutination** of red cells if combine with corresponding antibody
- Individuals inherit a **gene** which codes for specific sugar (S) to be added to the red cell
- The type of sugar added **determines** the blood group

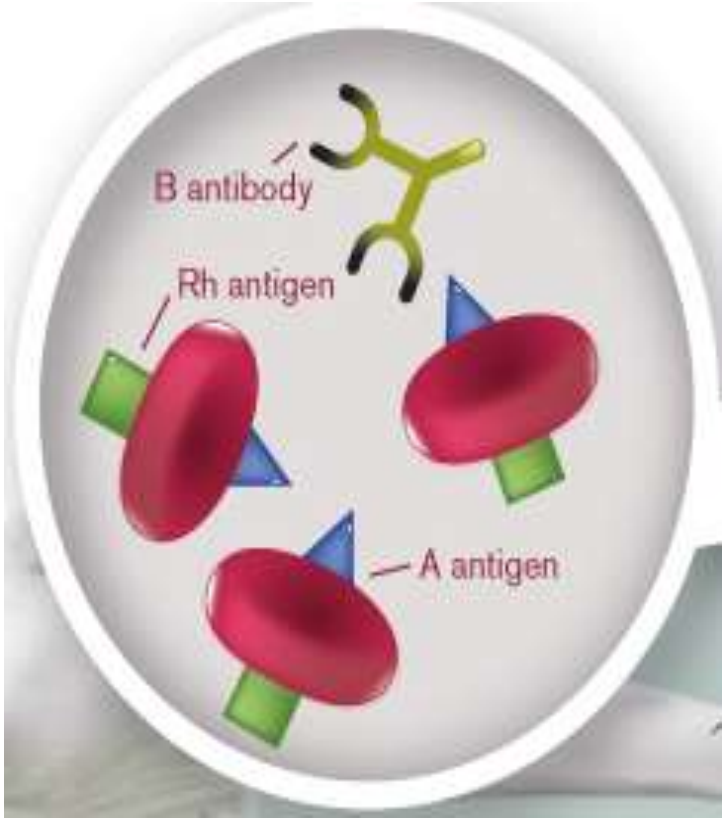


ABO Agglutinogen Or Antigen Cont..

- **Development at birth----**
  - All the ABO antigens develops as early as **6th week** of fetal life
  - Their concentration at birth is one fifth the adult level & it progressively **rises** during puberty and adolescence
  - Red cell of new born carry 25 -50% of number of **antigenic sites** found on adult RBC
  - A or B antigen expression fully developed at **2-4 years** of age & remain **constant** throughout life

ABO Agglutinin Or Antibody

- Anti-A and Anti-B antibodies are not present in **new born**
- Only 50% of new born have demonstrable agglutinin & this has simply **filtered** across the placenta from mother
- The specific agglutinin appear at **10 days**, rise to a peak at **10 years** and then decline



Landsteiner's Law

Consists of two parts-

- **First part:**

  If an agglutinogen is present in the cell membrane of RBC, the corresponding agglutinin must be absent in the plasma

- **Second part:**

  If an agglutinogen is absent in the cell membrane of RBC, the corresponding agglutinin must be present in plasma (exception in case of Rh blood group)

Inheritance Of ABO Blood Groups

- The four classical blood groups depend on **three** genes– A, B & O
- **Two** genes inherited, one from each parent
- Gene **A & B** demonstrated by the use of Anti-A or Anti-B serum
- The presence of O gene is not easily demonstrated
- To Anti-A serum genotype AA (**Homozygous**) & AO (**Heterozygous**) demonstrated
- Similarly, to Anti-B serum genotype BB (**Homozygous**) & BO (**Heterozygous**) demonstrated

Example Of Determining Genotype

Genotype	Phenotype
AA & AO	Group A
BB & BO	Group B

- Phenotype is the actual expression of the genotype
- Genotype are the actual inherited genes which can only be determined by family studies
- A child must receive one of three possible genes (A, B or O) from each parent
- Further, each parent can transfers one or two genes to the child

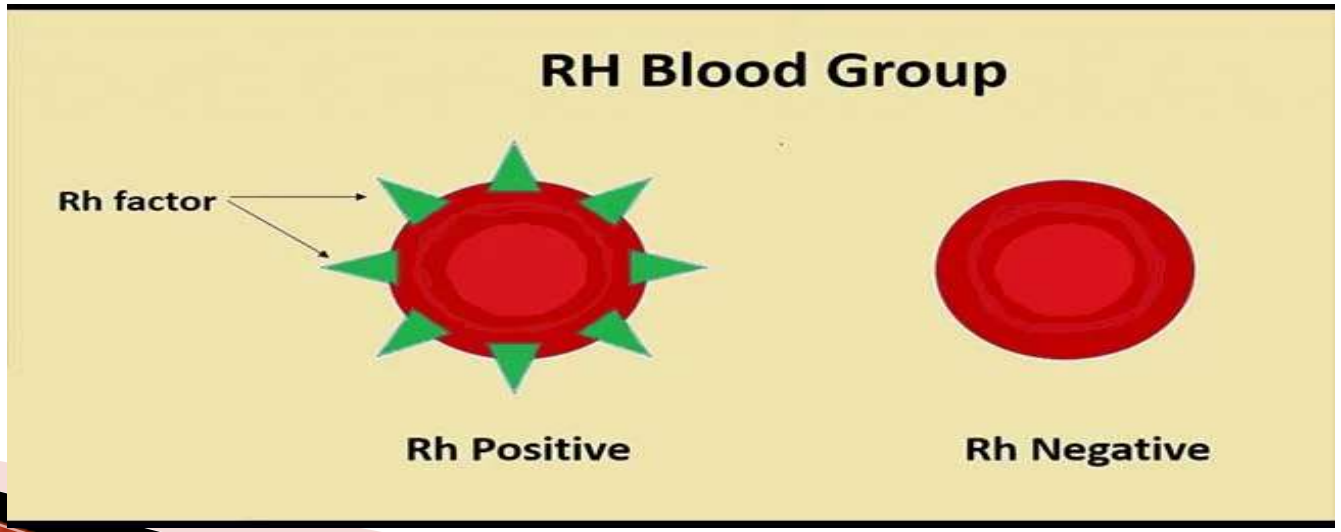
Other Examples

Mother	Father	Offspring Blood Group
AA	BB	100% AB
BO	OO	50% each of B or O
OO	OO	100% O
OO	AO	50% each of A or O

Rh Blood Group System

Rh Blood Group System

- Based upon presence or absence of **Rh antigen** on the RBC membrane
- Consists of –
  - **Rh positive** blood group
  - **Rh negative** blood group
- Rh positive due to **presence** of Rh antigen on the red cell membrane
- Rh negative due to **absence** of Rh antigen on the red cell membrane



Rh Agglutinogen Or Antigen

- Rh-antigen are a group of agglutinogens which are also present on the RBC membrane in addition to classical A & B agglutinogens
- These antigens are usually present in about **85%** of the population & absent in **15%** of the population
- These antigens are C, D, E, c, d, e of which **D** is common & most important

Rh Agglutinogen Or Antigen Cont- - -

- Unlike ABO antigens, Rh antigens are present only on red blood cells
- The D antigen is very immunogenic i.e- individual exposed to it will very likely make an antibody to it.
- Rh-antigen may be of severe problem when a mother with Rh-negative blood is having a fetus with Rh-positive blood.

Rh Antibody OR Anti-D

- All Rh antibodies are immune in nature, developed after immunization event
- Unlike the ABO system, individuals who lack the D antigen do not naturally produce Anti-D
- Production of antibody to D requires exposure to the antigen
- For this reason all individuals are typed for D, if negative must receive Rh (D) negative blood
- Most are IgG in nature and therefore can cross the placenta

Inheritance Of Rh Blood Group

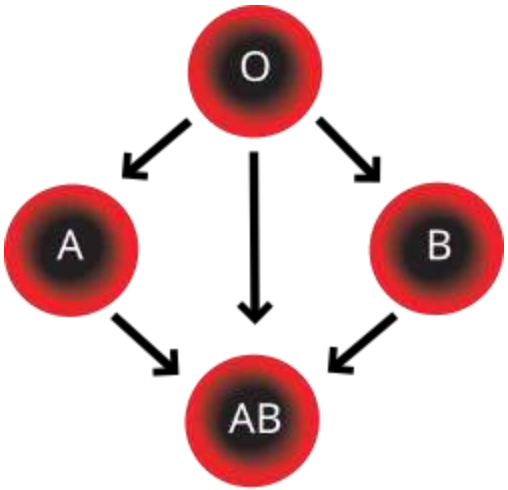
- A Rh gene is inherited from both father & mother
- If gene 'D' is carried by both sperm (male) & ovum (female) the resulting gene composition (Genotype) of the offspring is 'DD'
- If 'D' & 'd' then it will be 'Dd'
- If 'd' & 'd' the it will be 'dd'
- 'DD' (called homozygous) & 'Dd' (called heterozygous) are both called Rh positive
- 'dd' (homozygous) is called Rh negative

Inheritance Of Rh Blood Group Cont- - -

- Homozygous father of genotype ‘DD’ all the sperm contain ‘D’
- Heterozygous father of genotype ‘Dd’ half the sperm contain ‘D’ & half ‘d’
- Same in case of female

Universal Donor & Universal Recipient

- The persons having blood group **"O"** are said to be universal donor as they contains no agglutinogens in their RBC membrane but having both the agglutinins α & β in the plasma



- The persons having blood group **"AB"** are said to be universal receipient as they contains both the agglutinogens A & B in their RBC membrane but no agglutinins in the plasma

Donor & Recipient Interaction

Compatible donor (no hemolysis)	Recipient
Group A & O	Group A
Group B & O	Group B
Group A, B, AB & O	Group AB
Group O	Group O

Bombay Blood group

- Very rare
- Since the first case was detected in Mumbai (then Bombay), the blood group came to be called as Bombay blood group
- H is the precursor of A and B antigen
- These people lack H, along with A and B antigen but plasma contains anti A, anti B and anti H
- Incompatible with all ABO blood groups

Gwada Negative Blood Group

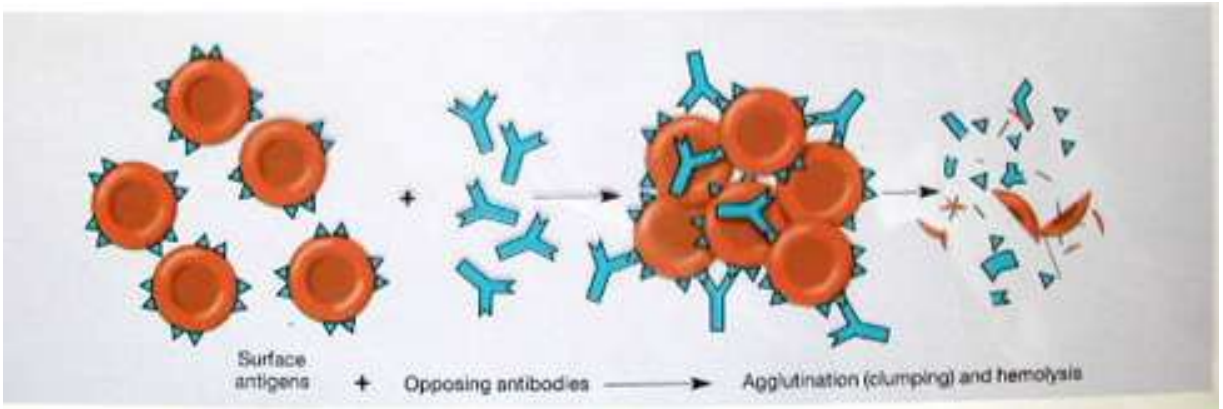
- Newly identified blood type
- Designed as 48th blood group system by the International Society Of Blood Transfusion (ISBT)
- Characterized by the absence of the EMM antigen on RBC
- EMM antigen, a high incidence Ag found on nearly all human RBC
- The unique blood type is result of a genetic mutation in the PIGZ gene which is involved in creating a specific sugar molecule on RBCs

Incompatibility

- Incompatibility means mismatching i.e- a person with a specific blood group is transfused with blood of different group which causes mild to severe problems
- There are two types of incompatibility—

  - ABO incompatibility

  - Rh incompatibility
- Of which Rh incompatibility have much more clinical importance



Rh Incompatibility

- Rh-incompatibility means exposure of Rh-positive blood with Rh-negative blood which may occur either during transfusion or intra-uterinely in case of Rh-positive fetus with a Rh-negative mother
- There are two common menifestation of Rh-incompatibility or hemolytic disease of new born —

  * Hydrops fetalis

  * Erythroblastosis fetalis
- These two conditions occur when mother with Rh-negative blood is pregnant & the fetus is Rh-positive

ABO Incompatibility

- ABO incompatibility between mother & fetus rarely cause problems because Anti-A & Anti-B antibodies are too large to cross the placenta
- ABO incompatibility between mother & fetus always prevents Rhesus immunization of the mother
- Explanation- Rh positive fetal cells cross into the maternal circulation are destroyed by the mothers naturally occurring Anti-A or Anti-B before they have had to stimulate the production of Rh antibody

Hazards Of Blood Transfusion

- **Immediate reaction:**

  * Pyogenic reaction
  * Allergic reaction
  * Anaphylactic reaction
  * Haemolytic transfusion reaction
  * Circulatory over load
  * Biochemical upset following massive transfusion
  * Generalized bleed tendency
  * Air embolism
  * Bacterial contamination of blood

Hazards Of Blood Transfusion Cont- - -

- **Delayed reaction:**

* Transmission of diseases-
  - AIDS
  - Hepatitis
  - Syphilis
  - Malaria etc.
* Sensitization
* Delayed haemolyic reaction
* Multiple micro embolism
* Transfusion of toxic substances from the plastic bag
* Thrombophlebitis

Hazards Of Mismatched Blood Transfusion

- **Immediate effects:**

  * Red blood cells are agglutinated & clumped thus blocking the capillaries leads to violent pain in the back or tightness in the chest, nausea, vomiting, shivering etc.

- **Delayed effects:**

  *** Inapparent haemolysis –** due to agglutination & subsequent phagocytosis of clumped RBC

  *** Post-transfusion jaundice -** due to excessive destruction of RBC, bilirubin concentration increases in blood thus causing jaundice

Hazards Of Mismatched Blood Transfusion Cont- -

*** Acute renal shut down –**

- due to antigen-antibody reaction, toxic substances are released which causes vasoconstriction of renal vessels thus renal shut down occurs
- due to haemolysis of RBC, blockage of renal tubules occur by free haemoglobin which may also cause renal shut down
- due to excessive breakdown of RBC, haemoglobinuria & subsequent renal failure may also occur


Thank You!