

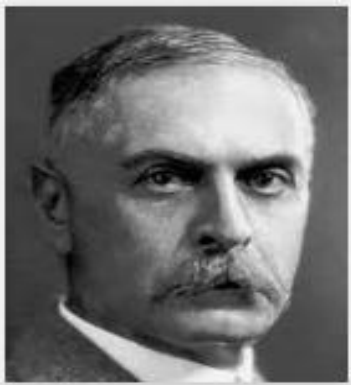
Human blood types & Rh factor

Microbiology V

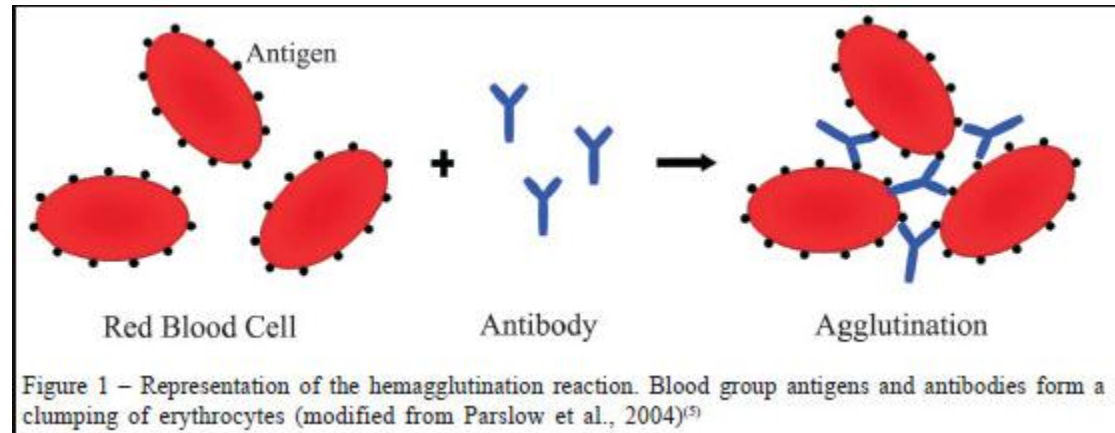


Introduction

- Human blood is not the same—people belong to different blood groups
- Depending upon the surface markers found on the red blood cell.
- **Karl Landsteiner** an Austrian scientist, discovered the **ABO – blood group** types in 20th century, awarded Nobel Prize.
- Showed that the **RBCs** of some individuals were **agglutinated** by the serum from other individuals



Karl Landsteiner



- Landsteiner explained that the reactions between the RBCs and serum were related to the presence of markers (**antigens**) on the **RBCs** and **antibodies** in the **serum**.
- **Agglutination** occurred when the **RBC antigens** were **bound** by the **antibodies** in the **serum**.
- Antigens :A, B, AB
- O – no antigen
- Blood groups: ABO
- Rhesus: Rh – D antigen

Table 26–1. Blood group systems

<i>Blood group system</i>	<i>Antigen</i>	<i>Discovered in</i>
ABO	A, B, AB	1900
Rhesus	C, D, E	1940
Duffy	Fya, Fyb	1950
Kidd	Jk, jk	1951
MN	M, N, S, s, U	1926
Lewis	Lea, Leb	1946
P	P, Pi, p	1926
Kell	K, k, Kp, Js	1946
Xg	Xg	1962
Lutheran	Lu, Lu	1945
Dombrock		1965
Colton		1967

Chemical composition of RBC Ag

- Blood group antigens are either **sugars or proteins**
- attached to various components in the RBC membrane
- **ABO** blood group: antigens – **sugars**
- **Rh** blood group: D antigen – **large protein**
- RhD gene encodes **→** D antigen
- Some people - gene does not produce D antigen
- RhD protein is absent from their RBC **→ RhD^{-ve}**

ABO Blood Group System

- This system consists of **two antigens** which divide humans into **four groups**.
- Antigens: **A and B**
- detected with corresponding antibodies
- Antibodies: **anti-A and anti-B**
- obtained from sera of normal individuals.

Genotypes of ABO groups:

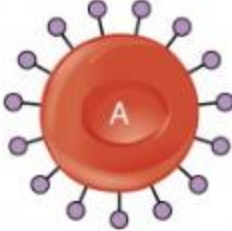

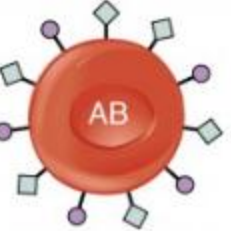







- RBCs antigens are inherited.
- The ABO blood group antigens are encoded by one genetic locus – ABO locus
- It is located on chromosome 9
- 3 alternative (allelic) forms—A, B, and O.

ABO phenotypes:

- The four basic ABO phenotypes are:
- O, A, B, and AB.

- Each human RBC expresses about 2 million ABO blood group antigens.
- Although the ABO blood group antigens are regarded as RBC antigens
- They are actually **expressed** on a wide variety of **human tissues:**
 - Epithelial
 - Endothelial cells.
- **T cells, B cells, and Platelets:**
 - ABO blood group Ags are adsorbed from the plasma.

ABO blood groups

		Blood Type			
		A	B	AB	O
Red Blood Cell Type					
Antibodies in Plasma		 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red blood Cell		 A antigen	 B antigen	 A and B antigens	None
Blood Types Compatible in an Emergency		A, O	B, O	A, B, AB, O (AB ⁺ is the universal recipient)	O (O is the universal donor)

Clinical Significance of ABO Antibodies

- ABO antibodies are of major clinical significance for two reasons:
- they are **naturally occurring** and **found universally**
- they are **highly reactive**.
- If a recipient - blood group O is transfused with non-group O RBCs – anti-A and anti-B in the recipient's serum binds to their corresponding antigens on the transfused RBCs.
- These antibodies **fix complement** and cause rapid intravascular haemolysis
- trigger an **acute hemolytic transfusion reaction** that can cause disseminated intravascular coagulation, shock, acute renal failure, and death.

Rh Blood Group System

- The nomenclature **Rh** to the human blood group system derived from the fact that it was discovered with the aid of rabbit antibody to **rhesus (Rh) monkey** erythrocytes.
- The Rh system consists of antigen C, D and E.
- Of these D is highly immunogenic and of considerable clinical significance.
- Majority of the individuals who lack D antigen shall develop anti D antibody after transfusion of blood having red blood cells that contain D antigen.

Discovery

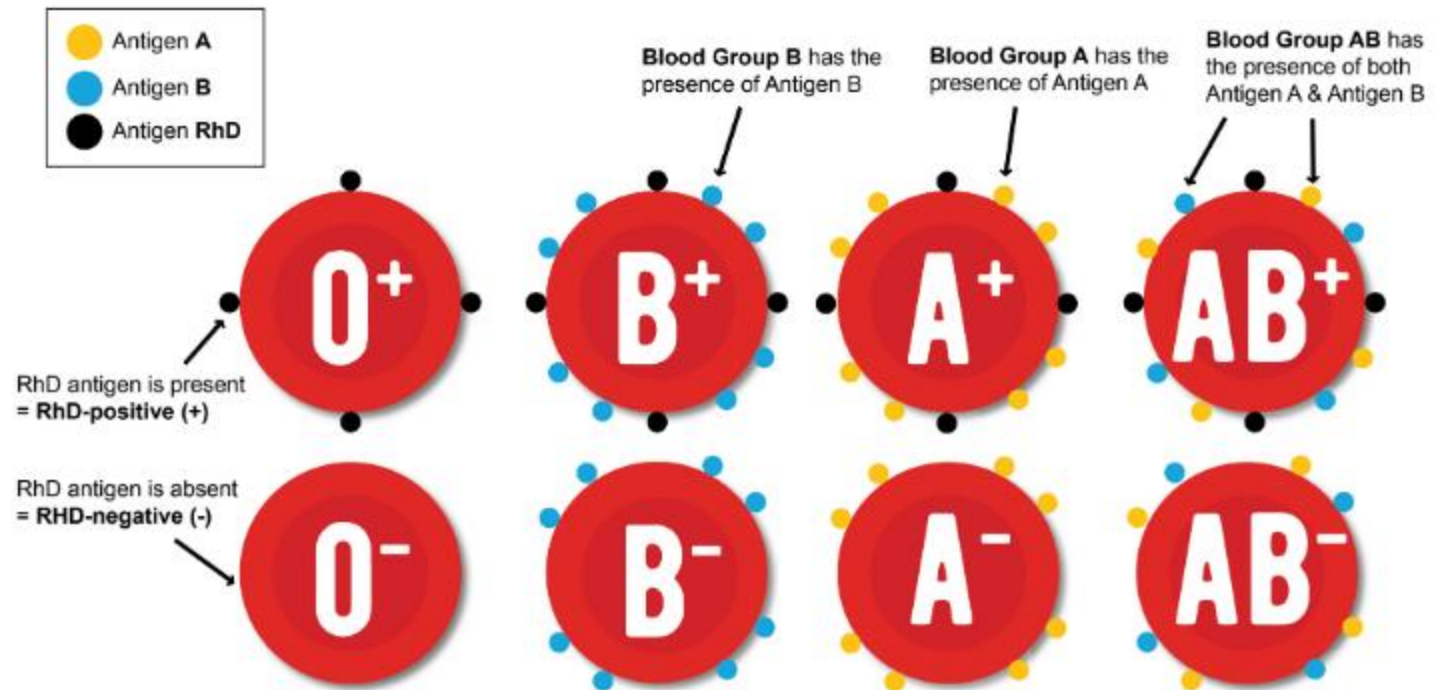
- The rhesus blood type named after the rhesus monkey was first discovered in 1937 by Karl Landsteiner and Alexander S. Wiener.
- The significance of the discovery was not immediately apparent and was only realized in 1940, after subsequent findings by Philip Levine and Rufus Stetson
 - This serum that led to the discovery was produced by immunizing rabbits with red blood cells from a rhesus macaque. The antigen that induced this immunization was designated by them as *Rh factor* to indicate that *rhesus* blood had been used for the production of the serum.



- Therefore, in addition to determining the ABO blood group of the donor and recipient,
- It is also important to type their blood for D antigen.
- Individuals with **D antigen** on their **RBCs** are considered **Rh positive**
- those who lack it are considered **Rh negative**.
- Patients who are **Rh negative** should receive **blood transfusion** only from donors who are **Rh negative**.
- The D antigen is responsible for the haemolytic disease of the newborn, also known as **erythroblastosis foetalis**.

ABO & RhD types

UNDERSTANDING BLOOD TYPES



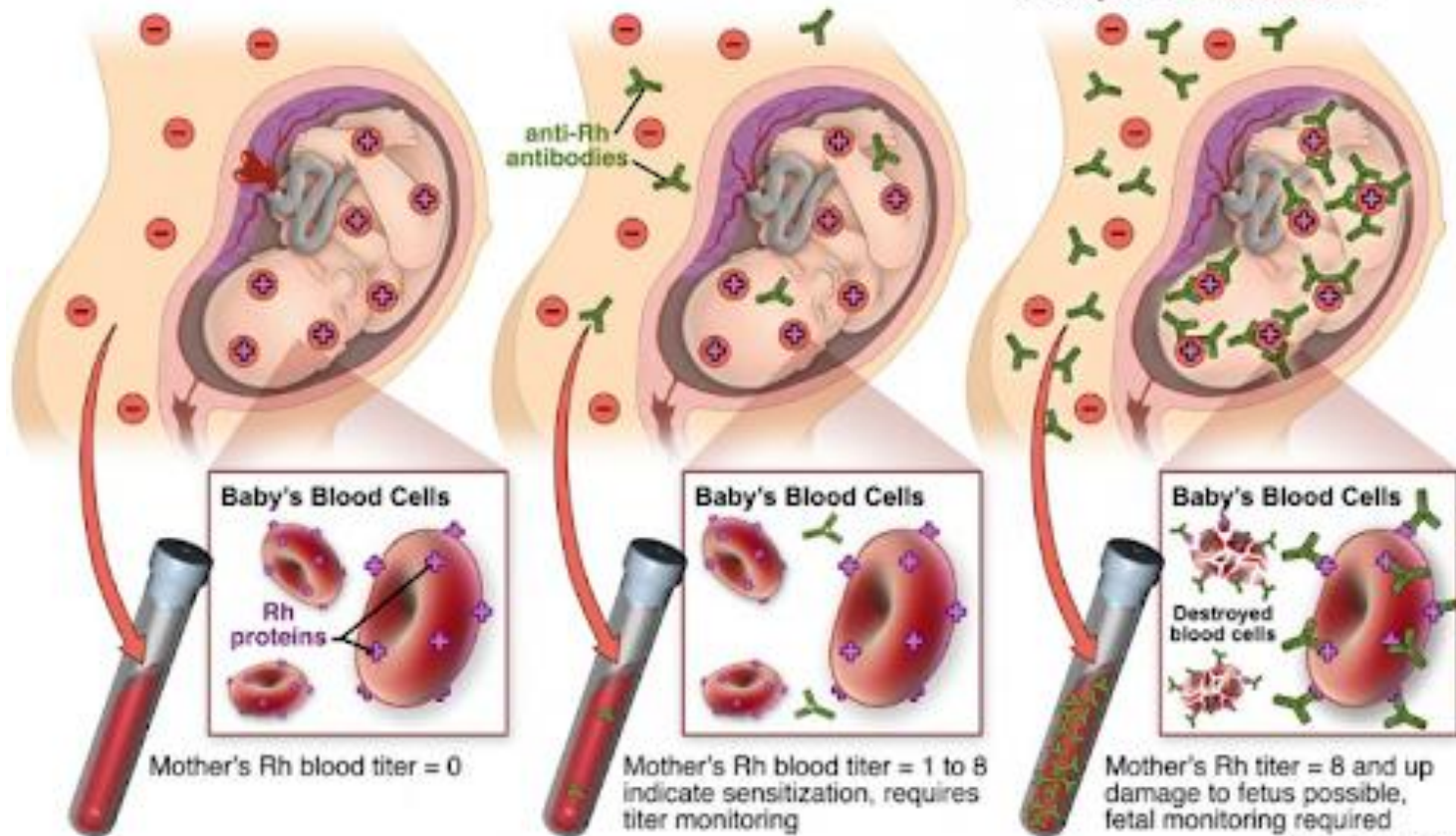
Erythroblastosis Foetalis

Progression of Rh Factor Sensitization

Rh- Mother's and Rh+ Baby's Blood Mix This can occur with previous pregnancy, miscarriage, or with bleeding during a pregnancy.

Mother's Antibodies are Formed **Antibodies** that recognize the **Rh protein** as foreign are formed by the mother, there are not enough **antibodies** to cause significant harm to the baby's **red blood cells**.

































Mother's Antibodies Enter Baby's Blood and Attack Large amounts of **Antibodies** enter the baby's blood, attach to the **red blood cells**, and identify them as foreign due the **Rh protein**. The immune system attacks and destroys the **red blood cells**.



Significance of blood groups

- Clinical significance is attached to only those antigens which are strongly immunogenic – ABO and Rh blood group systems.
- Testing blood group antigen has applications:
 - Transfusion medicine
 - Transplantation
 - Disputed paternity
 - Forensic pathology
 - Anthropology

HOW TO READ YOUR RESULTS

BLOOD TYPE	ANTI-A	ANTI-B	ANTI-D	CONTROL
O-POSITIVE				
O-NEGATIVE				
A-POSITIVE				
A-NEGATIVE				
B-POSITIVE				
B-NEGATIVE				
AB-POSITIVE				
AB-NEGATIVE				
INVALID	