Physiology

Different Blood Groups and Clinical Importance of Blood Grouping, Blood Banking, and Transfusion

م.د. أحمد تركي هاني
MBChB. MSc. PhD.

Karl Landsteiner

14 June 1868

26 June 1943

Nobel Prize in Physiology or Medicine (1930)

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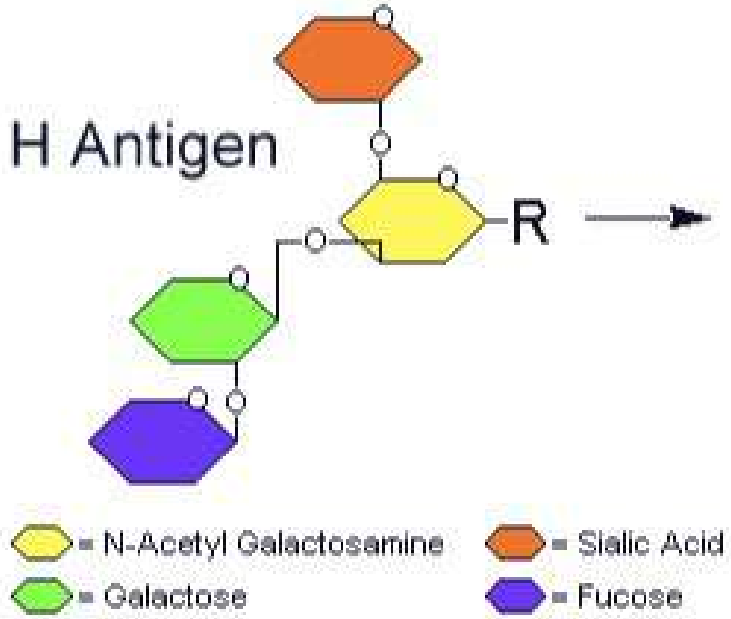
MBChB. MSc. PhD.

The ABO blood group antigens are attached to oligosaccharide chains that project above the RBC surface.



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MBChB. MSc. PhD.

The A and B alleles each encode a glycosyltransferase that catalyzes the final step in the synthesis of the A and B antigen, respectively.

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"O" after the German word "Ohne", which means "without"

ABO genotype in the offspring		ABO alleles inherited from the mother		
		A	B	O
ABO alleles inherited from the father	A	A	AB	A
	B	AB	B	B
	O	A	B	O

The ABO locus is located on chromosome 9

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A person's ABO blood type was used by lawyers in paternity suits, by police in forensic science, and by anthropologists in the study of different populations.

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Disease association

Gastric cancer appears to be more common in group A individuals, whereas gastric and duodenal ulcers occur more often in group O individuals.

Blood group O individuals have about 25% less FVIII and vWF in their plasma.

Non-group O individuals have been shown to be at an increased risk of both arterial and venous disease.

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ABO antibodies in the serum are formed naturally. Their production is stimulated when the immune system encounters the "missing" ABO blood group antigens in foods or in micro-organisms.

This happens at an early age because sugars that are identical to, or very similar to, the ABO blood group antigens are found throughout nature.

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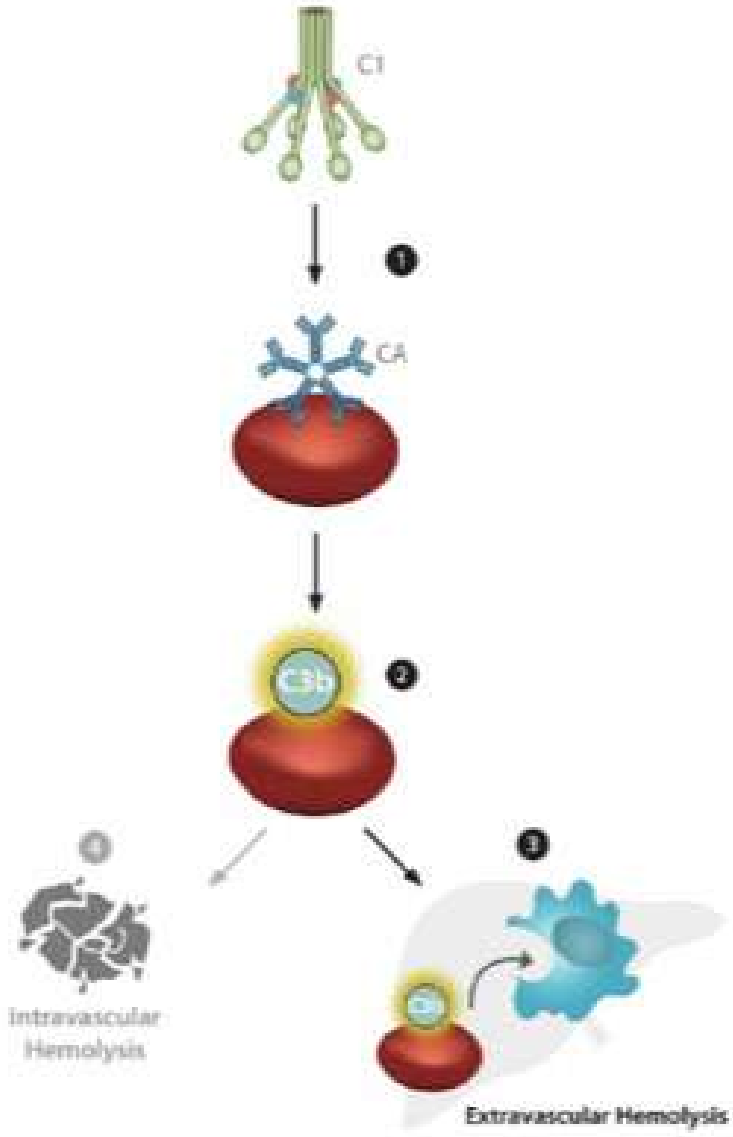
Anti-A and anti-B bind to RBCs and activate the complement cascade, which lyses the RBCs while they are still in the circulation (intravascular hemolysis).



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Introduction to Blood Groups

- Blood groups are determined by specific antigens on red blood cells (RBCs)
- Two major systems:
  - ABO system
  - Rh system
- Critical for safe transfusions, organ transplants, and pregnancy care

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ABO Blood Group System

Blood Type	Antigen on RBC	Antibody in Plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	None
O	None	Anti-A and Anti-B

- O Negative = Universal donor
- AB Positive = Universal recipient

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The ABO Blood System

Blood Type (genotype)	Type A (AA, AO)	Type B (BB, BO)	Type AB (AB)	Type O (OO)
Red Blood Cell Surface Proteins (phenotype)	 A agglutinogens only	 B agglutinogens only	 A and B agglutinogens	 No agglutinogens
Plasma Antibodies (phenotype)	 b agglutinin only	 a agglutinin only	 No agglutinin	 a and b agglutinin

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Rh Blood Group System

- Based on presence of D antigen:
  - Rh Positive (Rh^+): D antigen present
  - Rh Negative (Rh^-): D antigen absent
- Clinical importance in:
  - Transfusions
  - Hemolytic Disease of the Newborn (HDN)

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Importance of Blood Grouping

- Prevents incompatible transfusion reactions
- Ensures safe organ transplantation
- Key for prenatal and antenatal care
- Crucial in mass casualty and surgical planning

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What is Blood Banking?

- The process of:
  - Collection
  - Typing
  - Screening
  - Processing
  - Storage of blood and components
- Ensures a safe and adequate supply

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Blood Products

- Whole Blood
- Packed RBCs – for anemia
- Platelets – for thrombocytopenia
- Fresh Frozen Plasma (FFP) – for coagulopathy
- Cryoprecipitate – for fibrinogen deficiency

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Screening in Blood Banking

- Mandatory infectious disease testing:
  - HIV, Hepatitis B and C, Syphilis, Malaria
- Blood typing: ABO and Rh
- Crossmatching to confirm compatibility

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Clinical Importance of Transfusion

- Indications:
  - Acute blood loss
  - Severe anemia
  - Surgical blood loss
  - Bleeding disorders
- Ensures oxygen delivery & hemostasis

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Complications of Transfusion

- Hemolytic transfusion reactions
- Febrile non-hemolytic reactions
- Allergic reactions
- Transfusion-related acute lung injury (TRALI)
- Infectious disease transmission

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Hemolytic Disease of the Newborn (HDN)

- Rh^- mother with Rh^+ fetus
- Mother's immune system attacks fetal RBCs
- Prevented by giving anti-D immunoglobulin during pregnancy and postpartum

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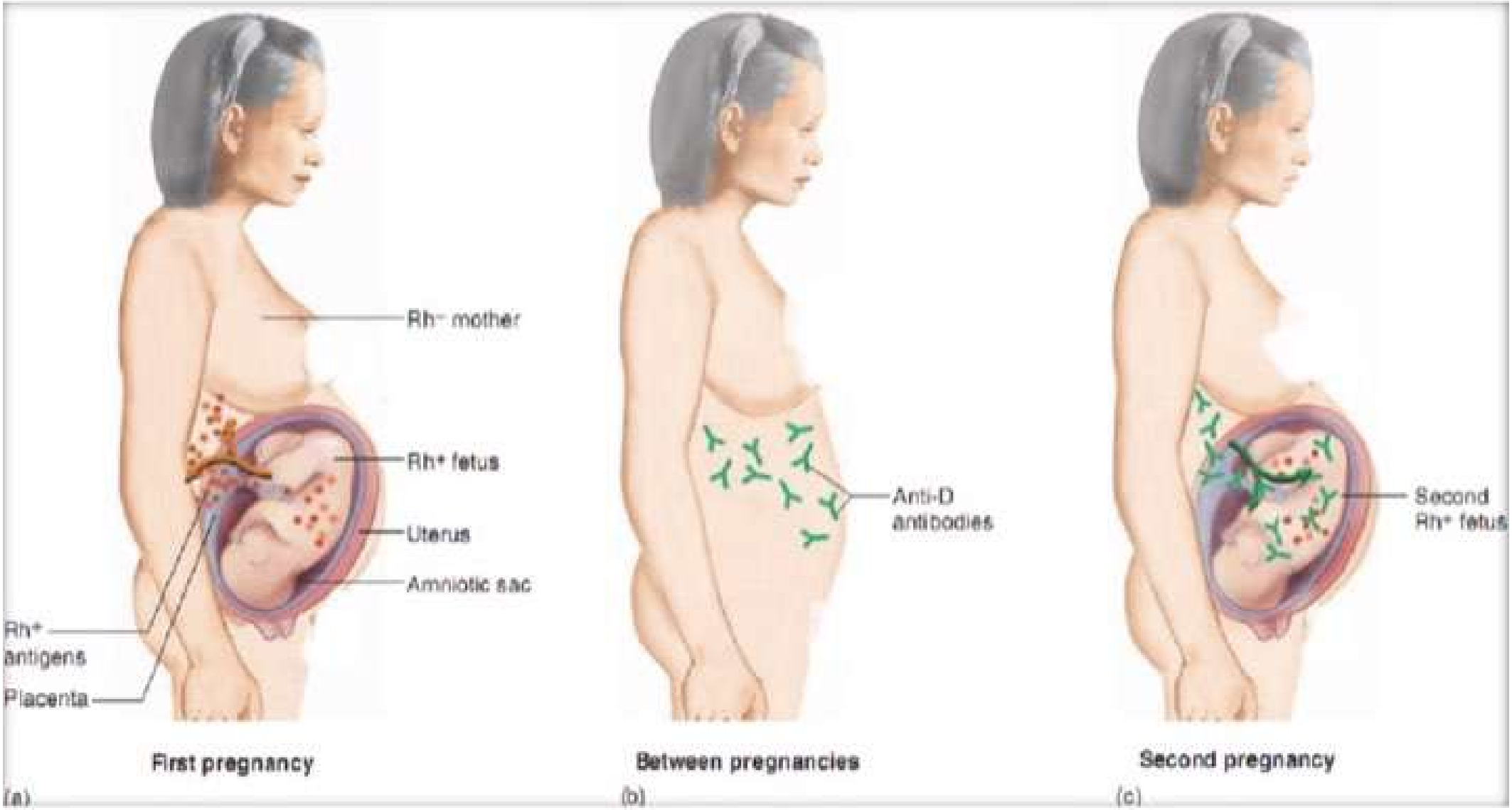
MBChB. MSc. PhD.



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Summary

- Blood grouping is vital for safe medical care
- Blood banking ensures a reliable supply of tested, compatible blood
- Transfusions save lives but require strict protocols to avoid complications

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