
بسم الله الرحمن الرحيم

# Blood Groups

**Dr. Abeer Al-Ghumlas**

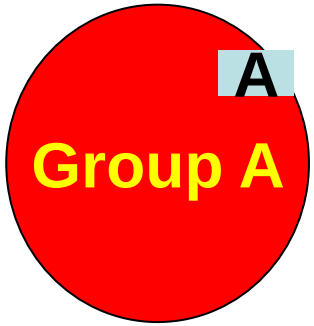
**M.B.B.S., MSc. Physiology**

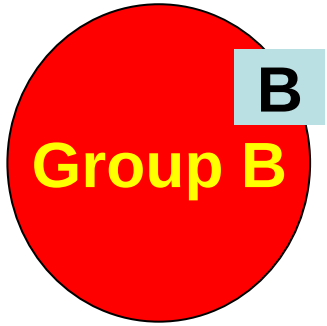
**Ph-D. Physiology**

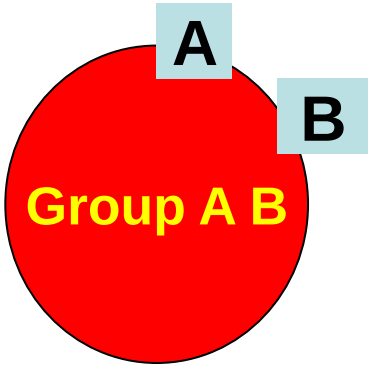
# Objectives

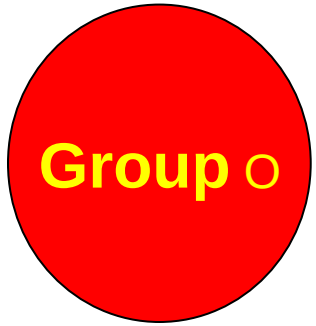
At the end of this lecture student should be able to:

1. Describe ABO blood groups types
2. Recognize Agglutinin in plasma
3. Recognize transfusion reactions
4. Describe Rhesus blood groups.
5. Describe causes of hemolytic disease of the newborn.


A
Group A


B
Group B


A
B
Group A B


Group O

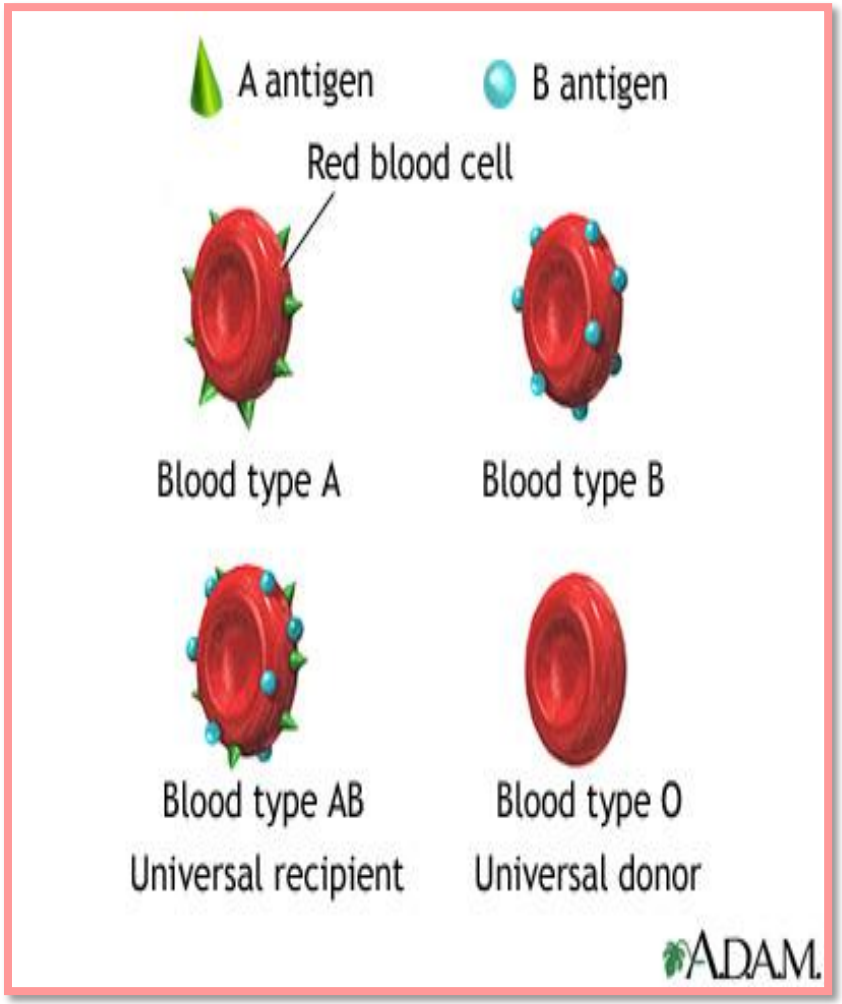
# 1.The ABO system

- Determined by:
- Antigens (glycoprotein) on the surface RBC, whether the red cells contain one, both or neither of the two blood antigens: A and B.
- Four main ABO groups:

  A, B, AB, O
- Clinically most significant:

  A-B-O System

  Rh (Rhesus) System



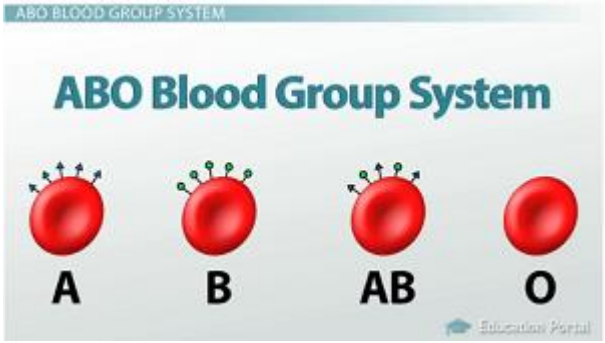
# The ABO Blood groups

| GroupBlood | Agglutinogen | |
|---|---|---|
| A | A | |
| B | B | |
| AB | A & B | |
| O | - | |

# 1.The ABO system

## ❑A & B antigens:

- They are genetically determined
- Appear in the early fetal life and remained unchanged throughout life.




# The ABO Blood groups

| GroupBlood | Agglutinogen | Agglutinin |
|---|---|---|
| A | A | Anti-B |
| B | B | Anti-A |
| AB | A & B | - |
| O | - | Anti A+B |

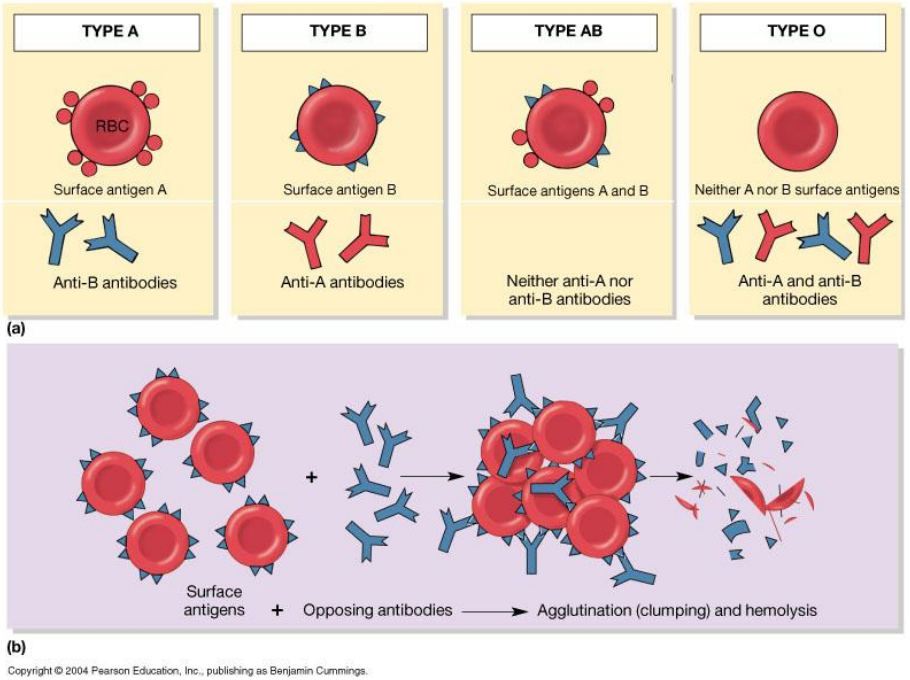
# 1.The ABO system

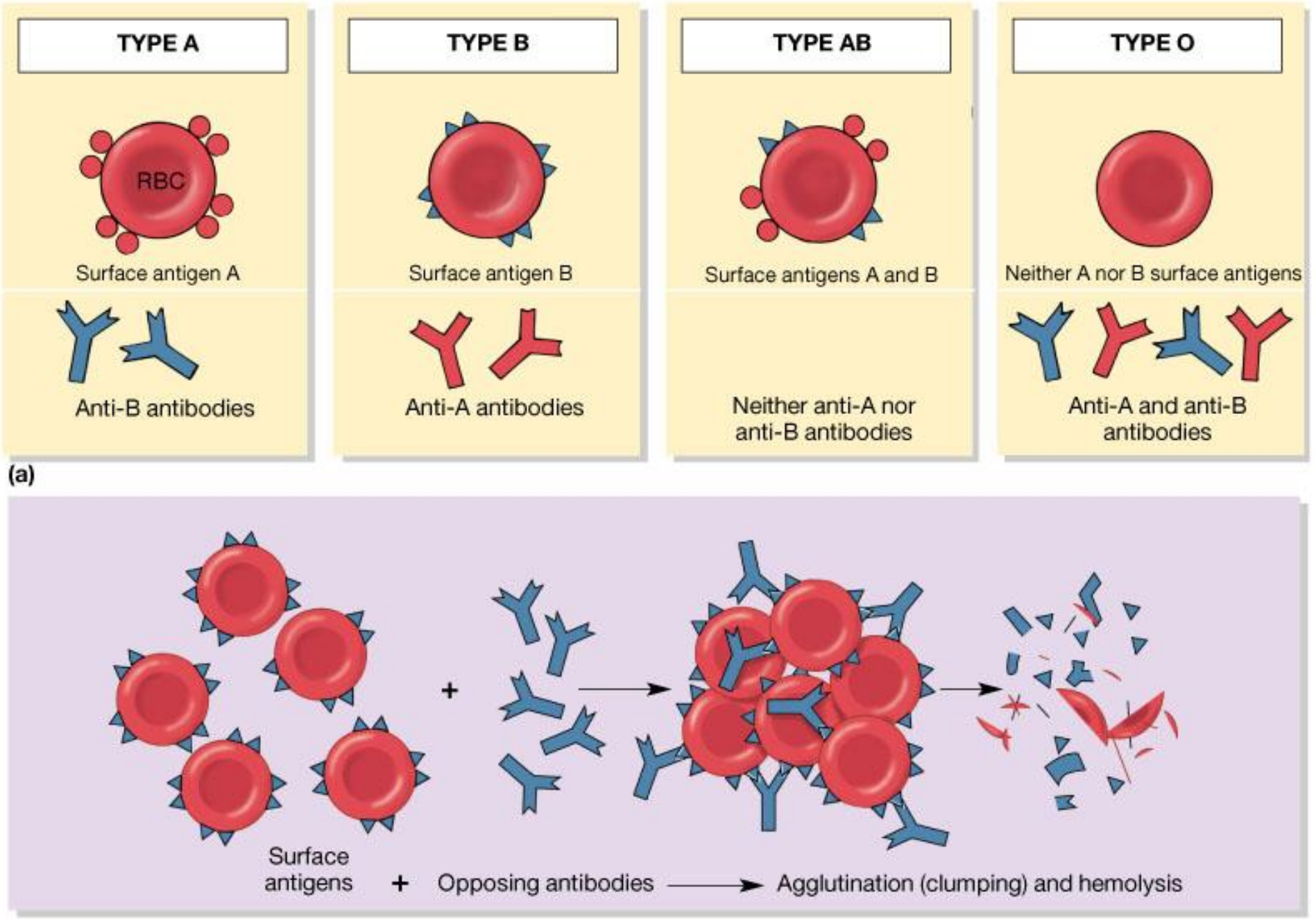
## ➢ Definitions:

- **Agglutinogens:**
  Blood group antigens on RBC membrane (A and B)

- **Agglutinin:**
  The respective antibody to the antigen

- **Agglutination:**
  Reaction between agglutinogen on RBC and the respective Ab.





# 1.The ABO system

➢ Anti-A & Anti-B are:

- They are naturally occurring antibodies.
- Not present at birth, appear 2-8/12
- Triggered by A & B antigens in food and bacteria


Red Gingers Near Arenal Volcano, Costa Rica

# 1.The ABO system

## ➢ Inheritance of blood groups

| allels | Genotypes | Phenotype (Blood group) |
|---|---|---|
| A,B,O | AA, AO | A |
| | BB, BO | B |
| | OO | O |
| | AB | AB |

**Locus of alleles responsible of ABO system is on long arm of chromosome 9**

# 1.The ABO system

## ➢ Inheritance of blood groups

| Blood group | Genotypes |
|---|---|
| A | AA, AO |
| B | BB, BO |
| O | OO |
| AB | AB |

## ➢ Uses of genotypes:

- Frequency of ABO has ethnic variation

- Sorting disputes in paternal dispute

# 1.The ABO system

## The Question of paternity?

- Blood types can not be used to prove paternity
- Blood types can disprove paternity

# 2. The Question of paternity?

Nora blood (type A) and Ahmad blood (type B) Have a baby (blood type O) Can Ahmad be the father?

| Phenotype | Possible genotype |
|---|---|
| Nora:A | AA or AO |
| Ahmad:B | BB or BO |
| Baby: O | OO |

Yes, he can be the father (Cant prove that he is the father but exclude)

# The Question of paternity?

A woman who has blood (type A) gives birth to a daughter blood (type B). The possible father is blood type O. can he be the father?

| | A | O |
|---|---|---|
| O | AO | OO |
| O | AO | OO |

| | A | A |
|---|---|---|
| O | AO | AO |
| O | AO | AO |

# 1.The ABO system

- **Possible Blood group Genotypes**

| Parent Allele | A | B | O |
|---|---|---|---|
| A | **AA** | **AB** | **AO** |
| B | **AB** | **BB** | **BO** |
| O | **AO** | **BO** | **OO** |

# 1.The ABO system

- The table shows the four ABO phenotypes ("blood groups") and the genotypes that give rise to them.

| 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 |

# 2. Rhesus (Rh) Blood Group

# Rh Factors

- While studying Rhesus monkeys, a certain blood protein was discovered. This protein is also present in the blood of some people. Other people, however, do not have the protein.

**A+ A- B+ B-**

**AB+ AB- O+ O-**

- Rh locus is on chromosome 1

# 2. Rhesus (Rh) Blood Group

- Determined by:

Presence or absence of the Rhesus antigen (D) on the surface of RBC:

- Presence of D (individual is Rh+ve)
- Absence of D (individual is Rh-ve)

- Rhesus antigens:

  Dd, Cc, Ee

  Clinically most important is D

# Do you know which blood group you belong to?

According to above blood grouping systems, you can belong to either of following 8 blood groups:

| | | | |
|---|---|---|---|
| A Rh+ | B Rh+ | AB Rh+ | O Rh+ |
| A Rh- | B Rh- | AB Rh- | O Rh- |

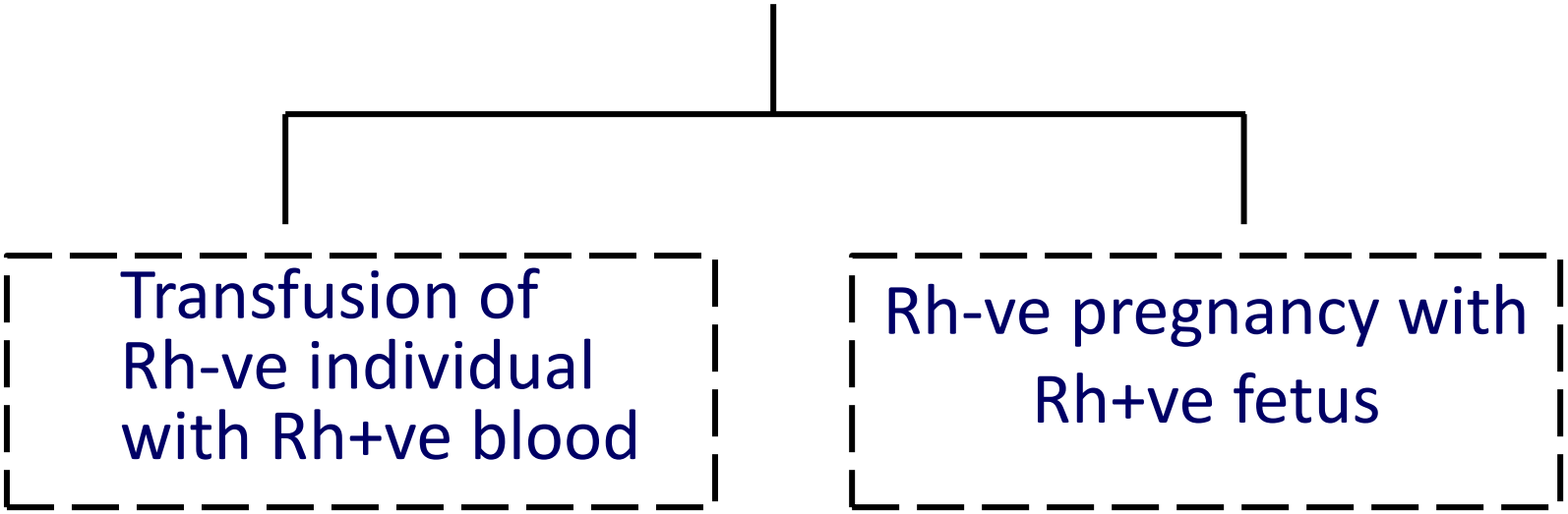
# Antibodies ????

# 2. Rhesus (Rh) Blood Group

## Anti-D antibody (agglutinin):

-Is not naturally-occurring

-Can be acquired by:



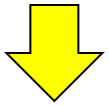
# Importance of blood groups


1. Blood Transfusion.

# Transfusion reactions

(Incompatible Blood transfusion)

- If a person with blood group A transfused with blood of group B (contains anti-A in plasma)
- The anti-B in plasma of recipient blood group A will agglutinate the transfused cell (B)
- Outcome:
- The clumped cells plug small blood vessels
- Sometimes causes immediate hemolysis



Transfusion reaction

| Blood Group | Antigens | Antibodies | Can give blood to | Can receive blood from |
|---|---|---|---|---|
| AB | A and B | None | AB | AB, A, B, O |
| A | A | B | A and AB | A and O |
| B | B | A | B and AB | B and O |
| O | None | A and B | AB, A, B, O | O |

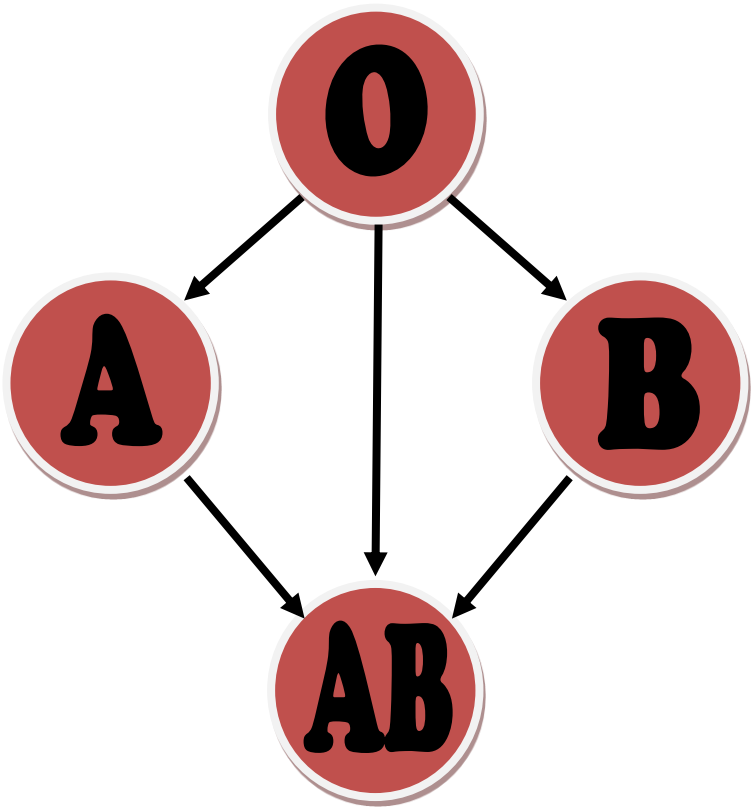
**O-negative: May be given in emergency to patients with either A, B, AB and Rh negative or positive blood groups.**

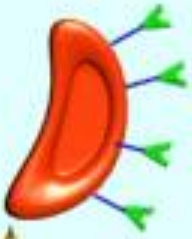
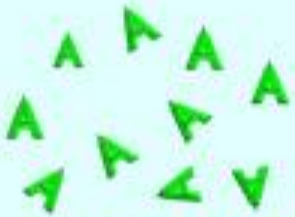
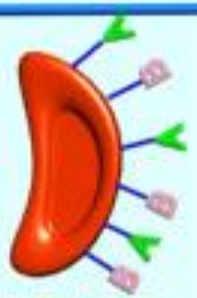
## Who can give you blood?

People with **TYPE O** blood are called **Universal Donors,** because they can give blood to any blood type.

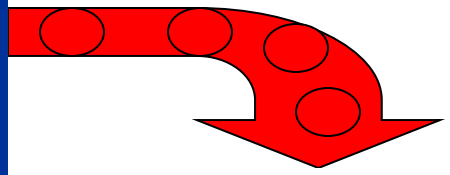
People with TYPE **AB** blood are called **Universal Recipients,** because they can receive any blood type.

Rh + → Can receive + or -
Rh - → Can only receive -



| BLOOD GROUP | ANTIGEN + ANTIBODY PRESENT | AS DONOR, IS | AS RECIPIENT, IS |
|---|---|---|---|
| A |  ANTIGEN-A  MAKES ANTI-B | COMPATIBLE WITH: A AND B | COMPATIBLE WITH: A AND O |
| B |  ANTIGEN-B  MAKES ANTI-A | COMPATIBLE WITH: B AND AB | COMPATIBLE WITH: B AND O |
| AB |  ANTIGENS A & B MAKES NEITHER ANTI-A NOR ANTI-B | COMPATIBLE WITH: AB ONLY | COMPATIBLE WITH ALL GROUPS UNIVERSAL RECIPIENT |
| O |  NEITHER A OR B ANTIGEN  MAKES BOTH ANTI-A AND ANTI-B | COMPATIBLE WITH: ALL GROUPS UNIVERSAL DONOR | COMPATIBLE WITH: O ONLY |

# Blood tests before transfusion



**BLOOD BANK**

**Screening**

**Blood components Prep**

**Storage**

**ISSUE**

**HOSPITAL PATIENTS**

# Blood tests before transfusion

1. **Blood group type of patient (recipient)**

2. **Cross-matching**

3. ***Disease Screening:***

- Hepatitis B and C virus
- HIV
- Syphilis
- Cytomegalovirus

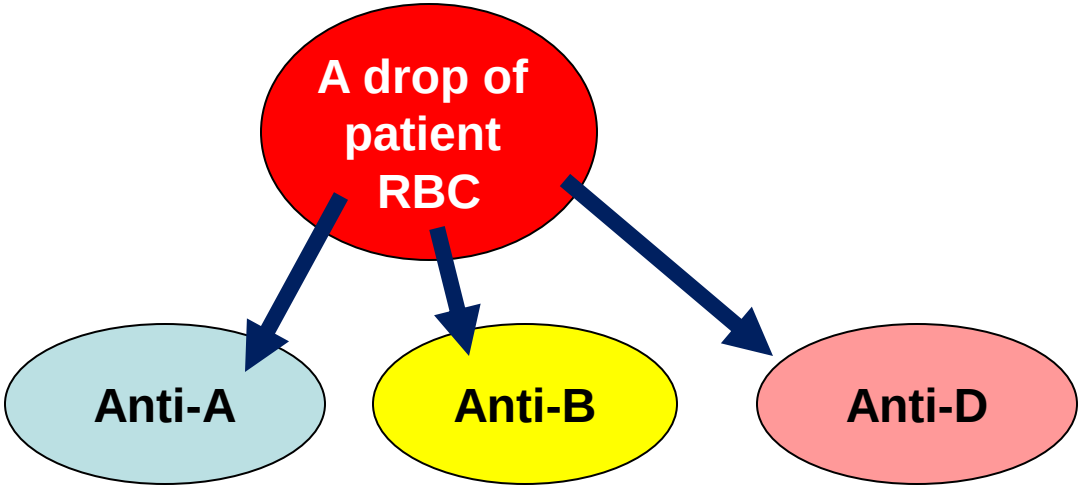
# Blood tests before transfusion

## 1. Blood group type of patient (recipient):

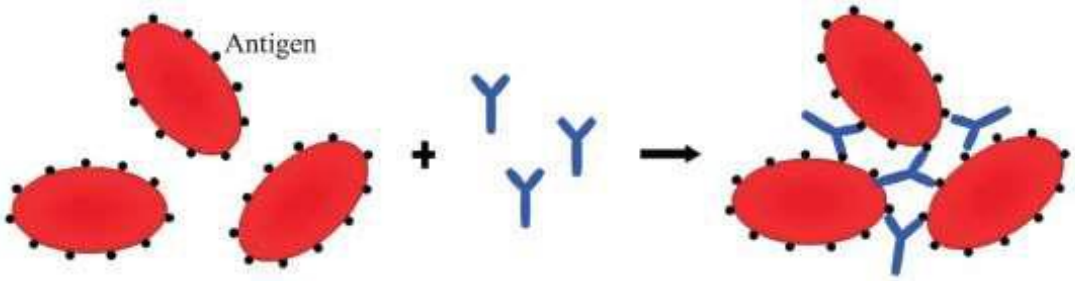
To determine red cell antigens in blood:

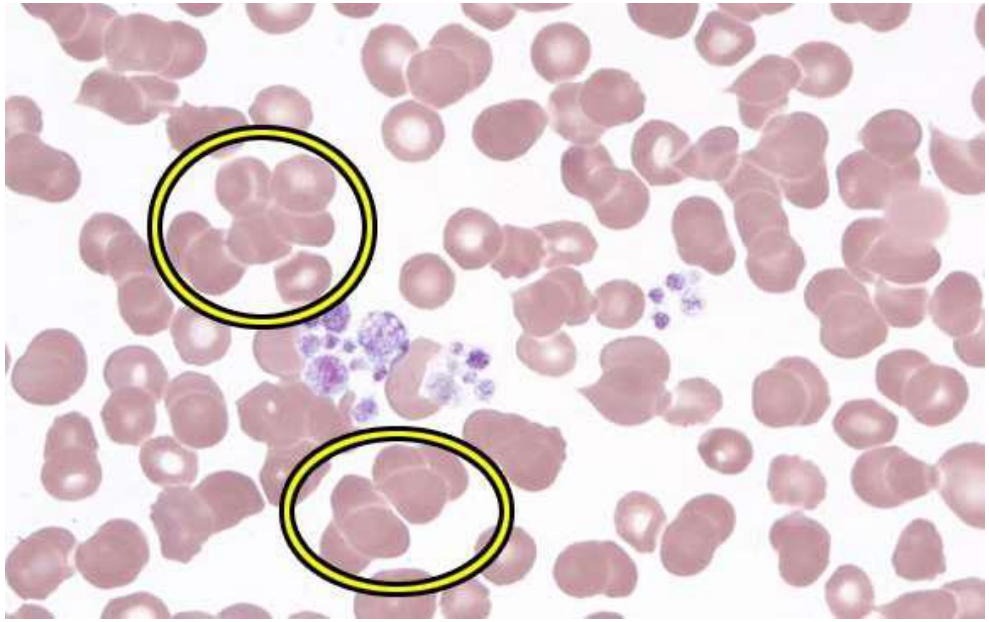
-ABO typing

-Rh typing




**Look for agglutination**


Antigen
Red Blood Cell
Antibody
Agglutination

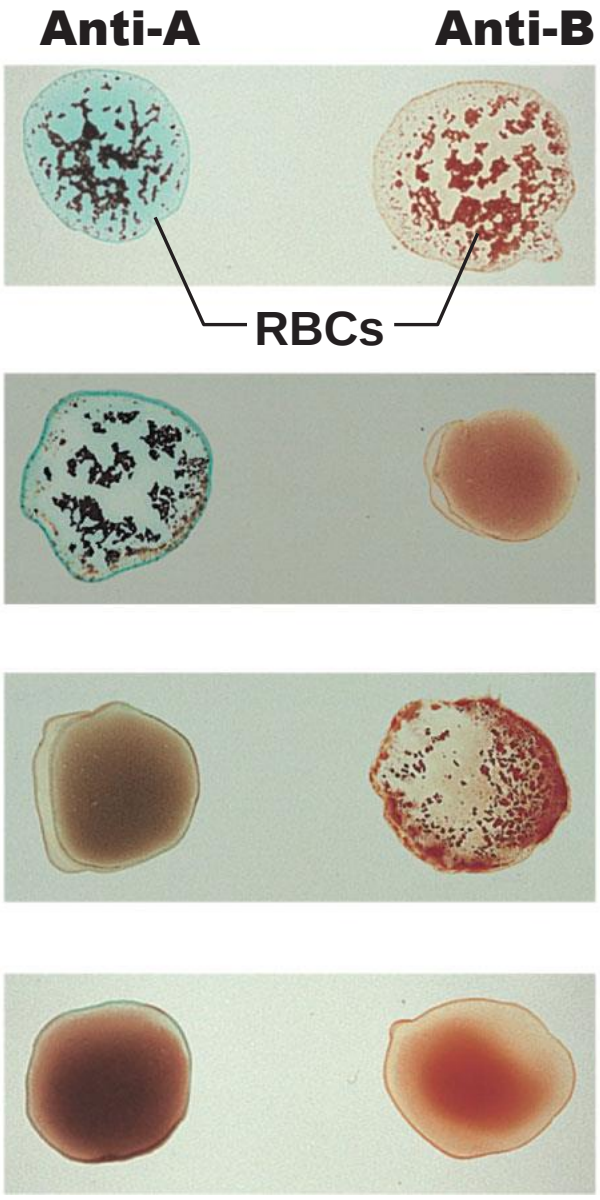


**Type AB** (contains agglutinogens A and B; agglutinates with both sera)

**Type A** (contains agglutinogen A; agglutinates with anti-A)

**Type B** (contains agglutinogen B; agglutinates with anti-B)

**Type O** (contains no agglutinogens; does not agglutinate with either serum)



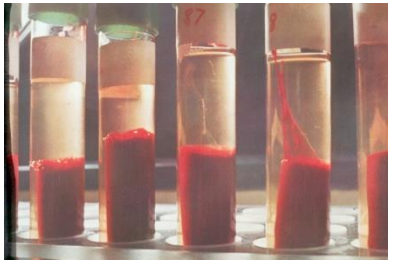
# Blood tests before transfusion

## 2. Cross-matching:

donor cells

+

recipients (patient) Plasma



# Complications of blood transfusion

# Complications of blood transfusion

## 1. Immune reaction:

Incompatible blood transfusion leading to immediate or delayed reaction, fever, hemolysis, allergic reaction

## 2. Transmission of diseases:

Malaria, syphilis, viral hepatitis & Aids

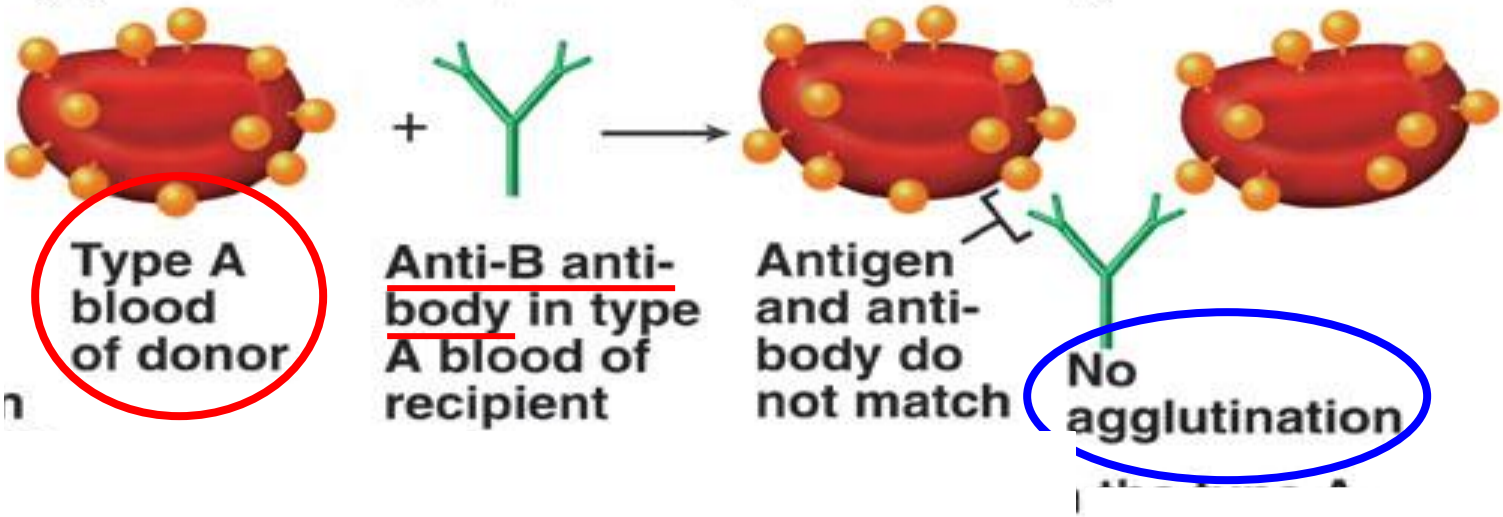
## 3. Iron overload:

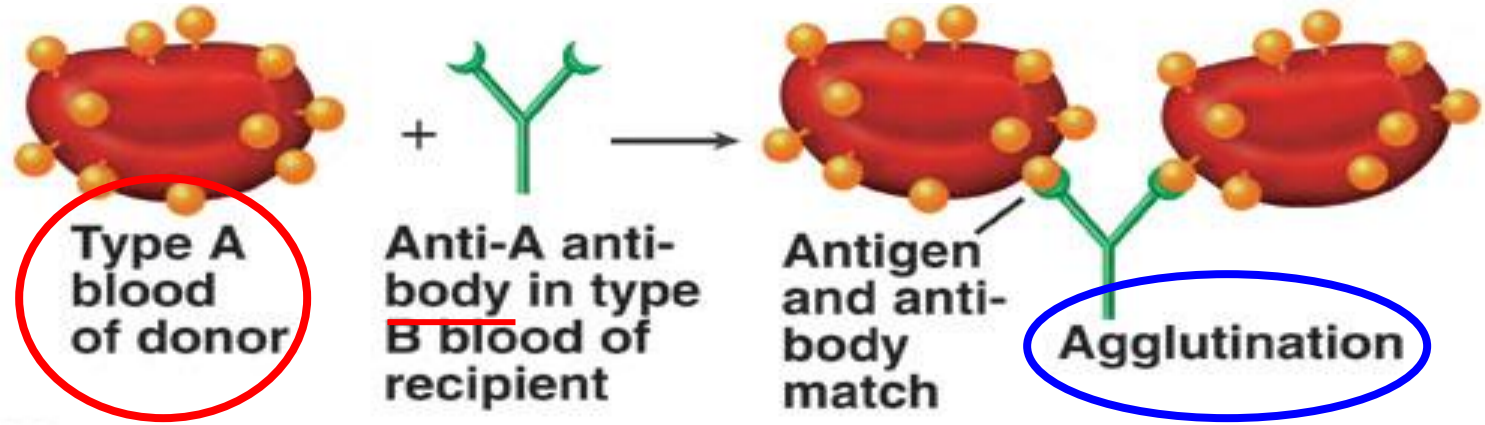
Due to multi-transfusion in case of sickle cell anemia and thalassemia


VOLUNTEER DONOR

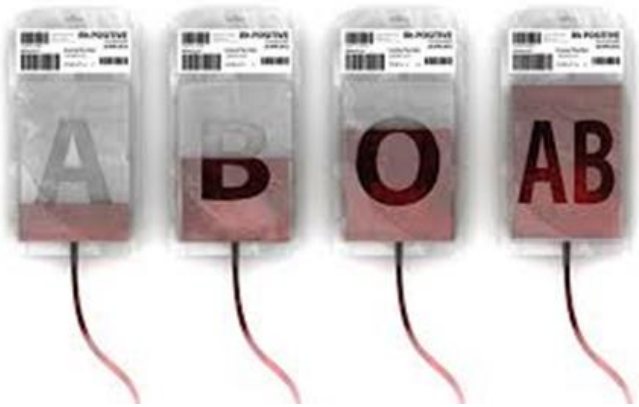
# Agglutination Reaction





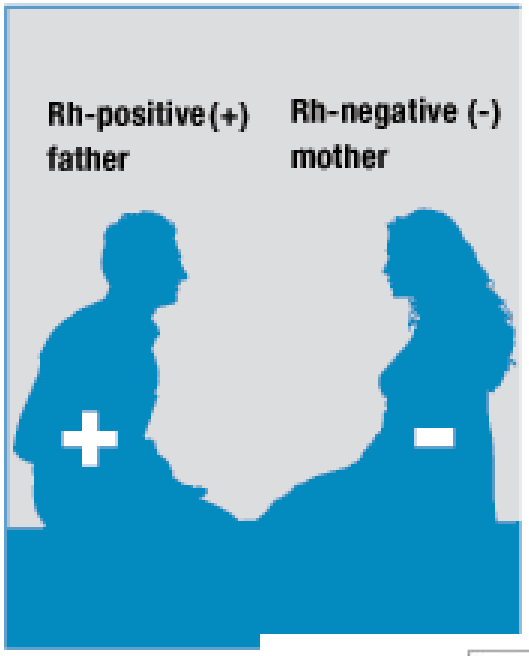
# Importance of blood groups

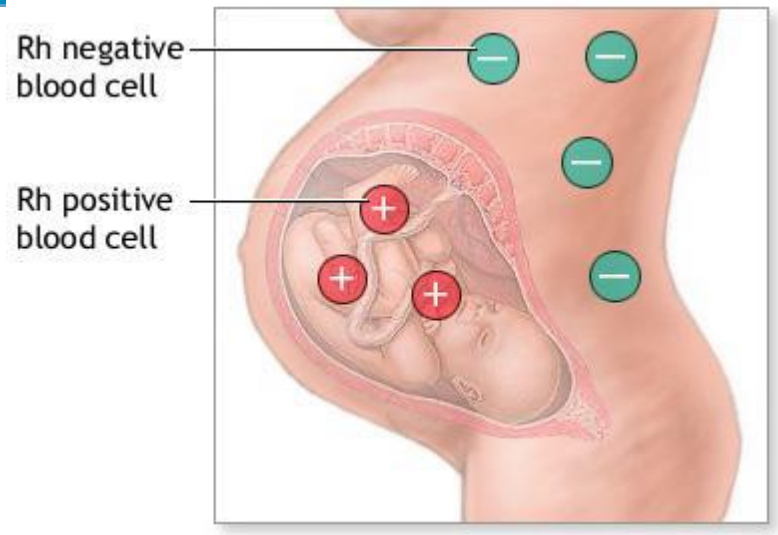


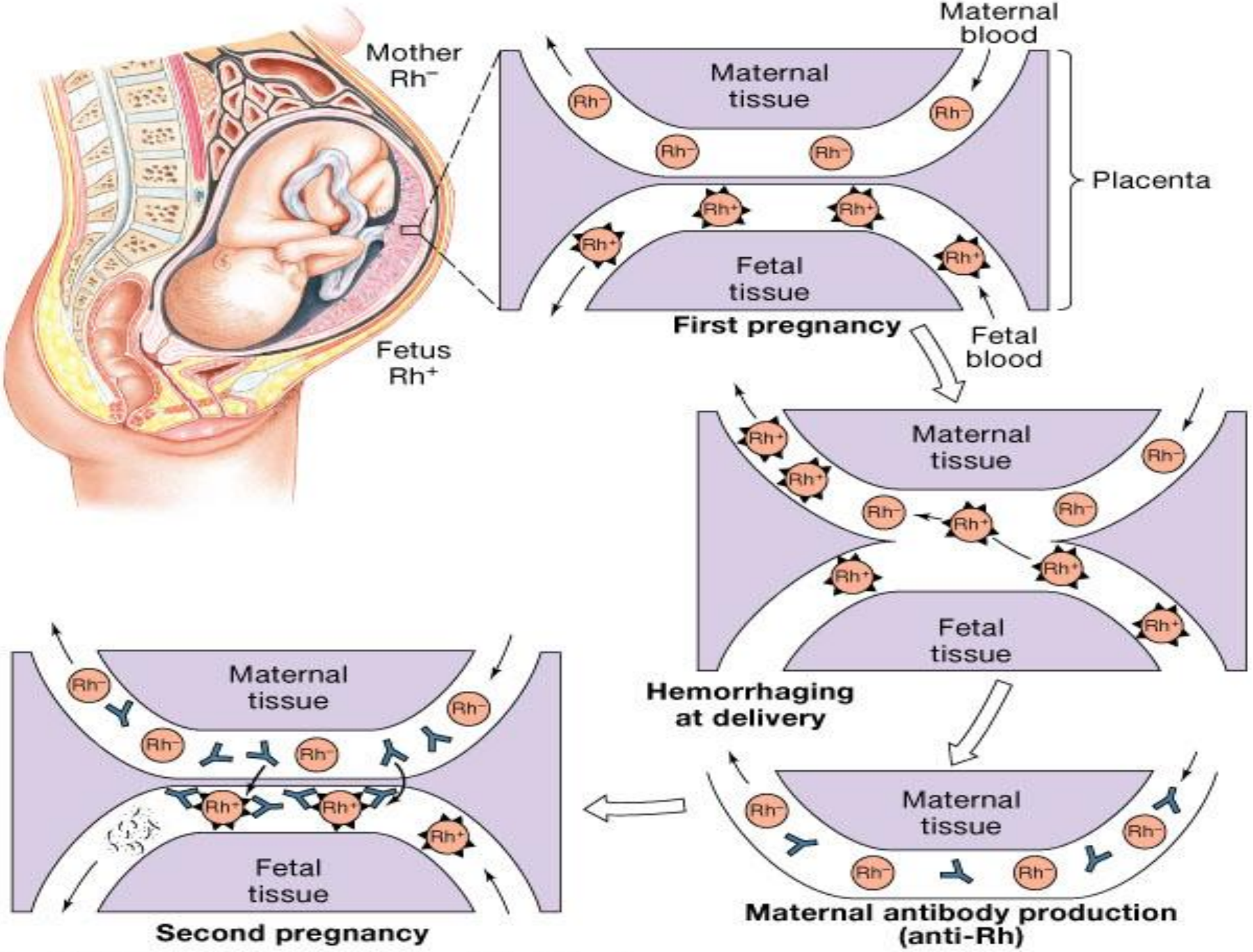

1. Blood Transfusion.
2. Rh incompatibilty between mother and fetus

# Rh incompatibilty between mother and fetus

# Rh incompatibility between mother and fetus

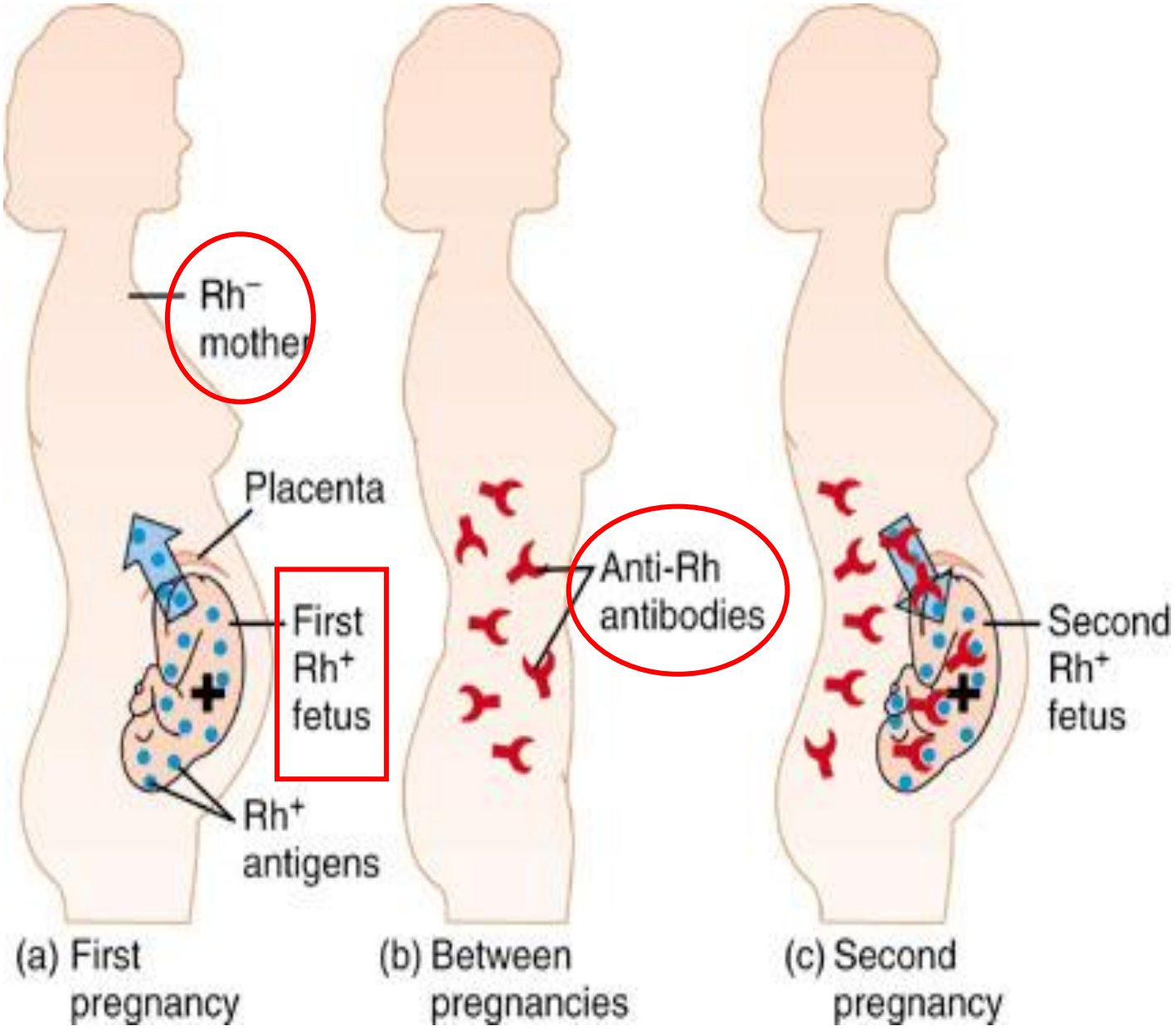




# Hemolytic Disease of the newborn

1. **Hemolytic anemia:**
   - Kernicterus (mental retardation due to bilirubin deposition in the brain).
   - If severe: treated with exchange transfusion: Replace baby blood with Rh-ve RBC (several times)
2. **Hydrobs fetalis (death in utero)**


Rh⁻ mother
Placenta
First Rh⁺ fetus
Rh⁺ antigens
Anti-Rh antibodies
Second Rh⁺ fetus
(a) First pregnancy
(b) Between pregnancies
(c) Second pregnancy

# Rh incompatibilty between mother and fetus

- Mother Rh-ve first Rh+ve baby:
- At delivery
  - Fetal Rh+ RBC cross to maternal blood
- The mother will develop Anti-D after delivery.
- First child escapes & is safe

(If the mother is transfused with Rh+ve blood before, first child will be affected)

# Rh incompatibilty between mother and fetus-cont.

- Second fetus
  - If Rh+ve
  - Anti-D crosses placenta and destroys fetal Rh+ RBC
  - Outcome?

    Hemolytic Disease of the newborn

**Prophylaxis**

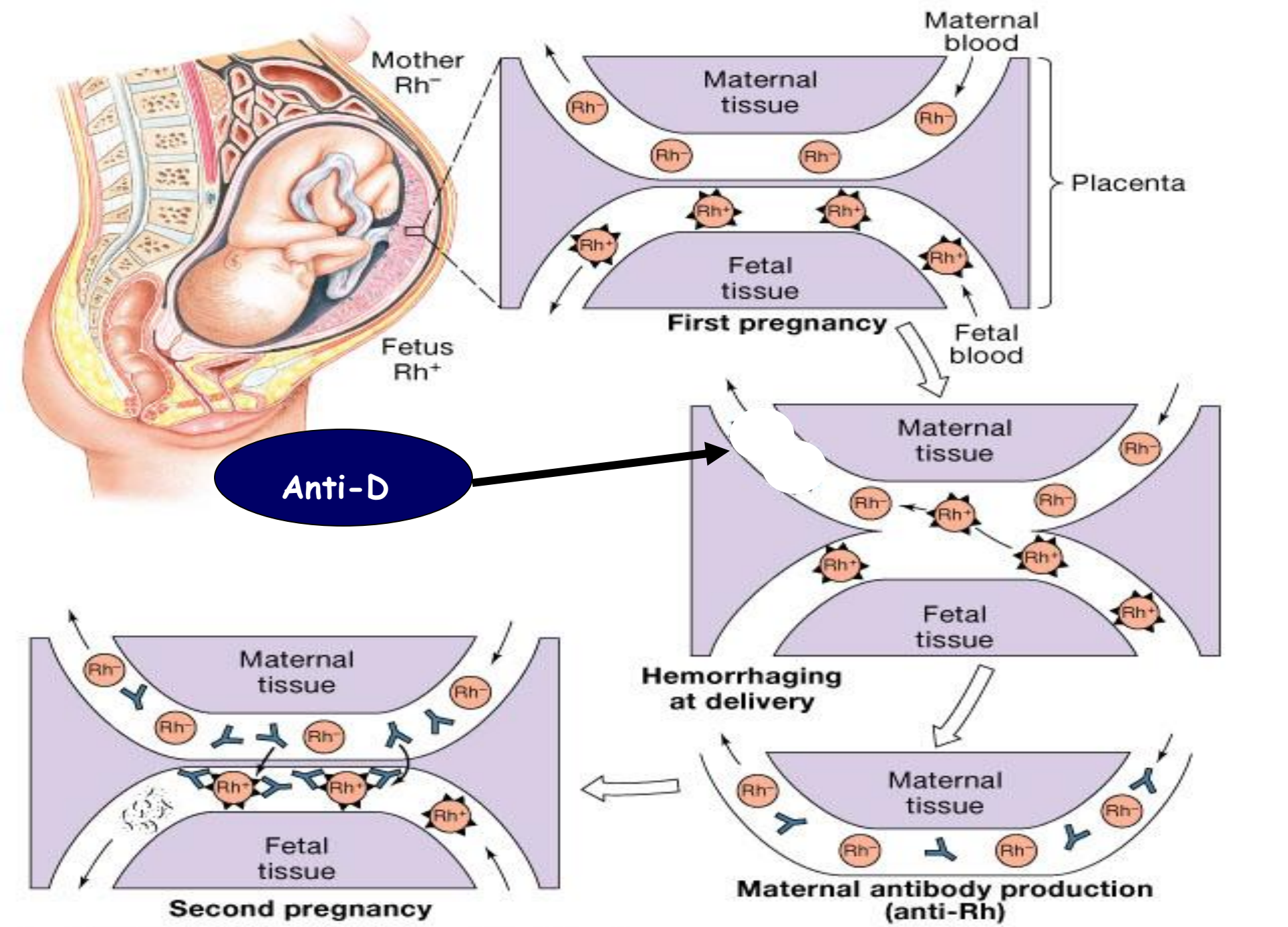
**Treatment??**

# Hemolytic Disease of the newborn

**Prevention:**

- Injecting the mother with **anti-D** immunoglobulin immediately after 1st childbirth

- Antenatal (during pregnancy) prophylaxis



# Summary


Hydrangea Garden, Clermont, Kentucky

وَمَنْ أَحْيَاهَا فَكَأَنَّمَا أَحْيَا النَّاسَ جَمِيعًا


Thimbleberry
THANK YOU