

# Blood groups

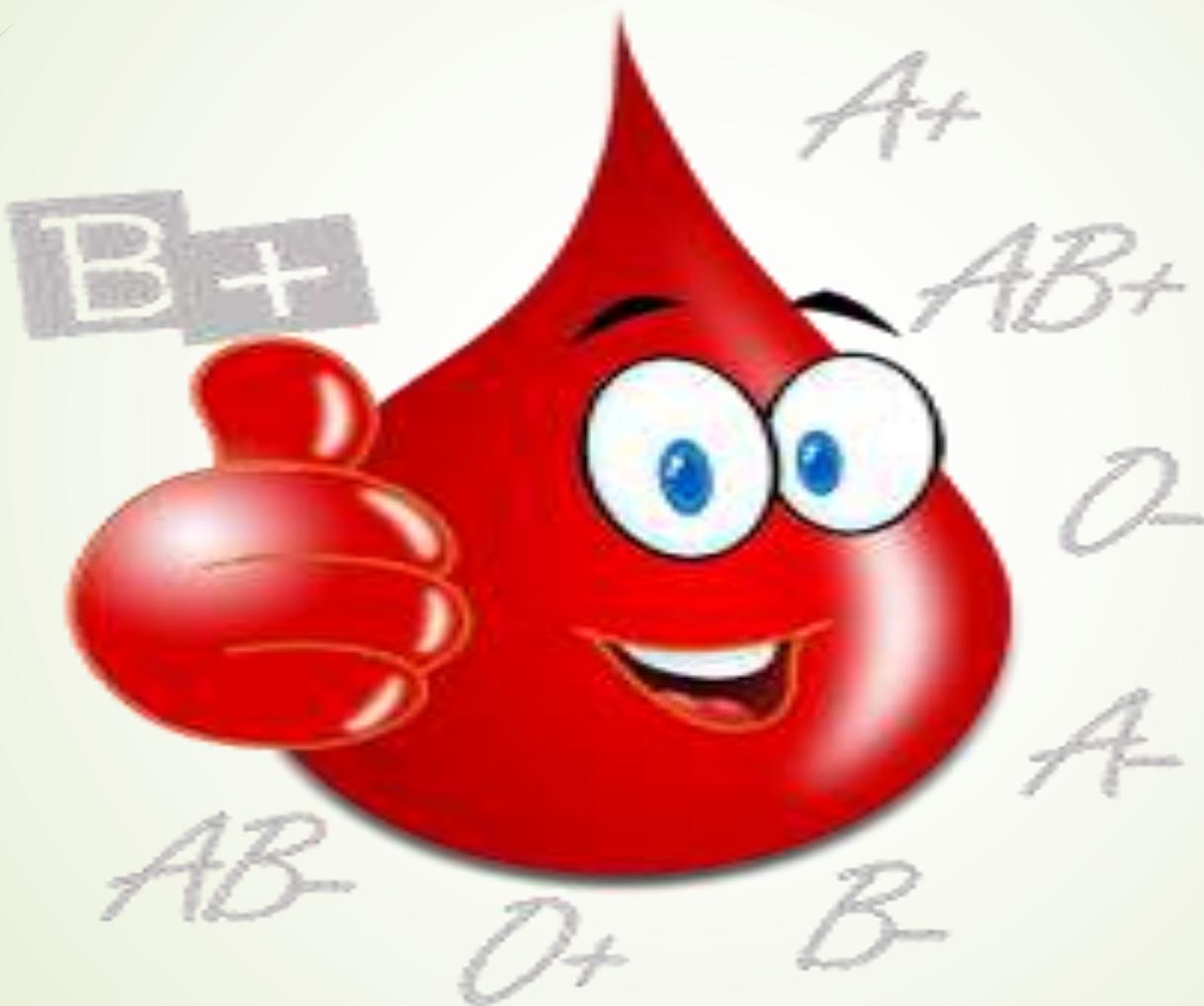
Medical physiology



## ILOs

- ▶ Identify blood types (ABO system and Rh factor)
- ▶ Mention importance of blood groups.
- ▶ Identify complication of incompatible blood transfusion.
- ▶ Mention importance of Rh factor

# BLOOD GROUPS AND YOU





# BLOOD GROUPS



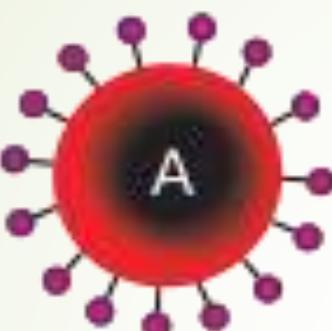
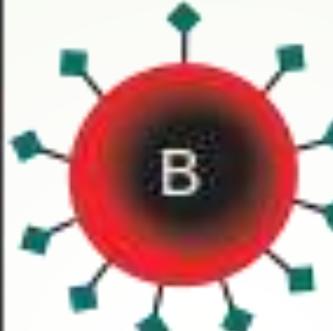
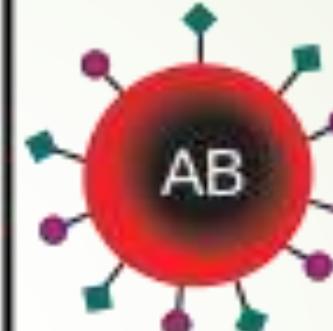
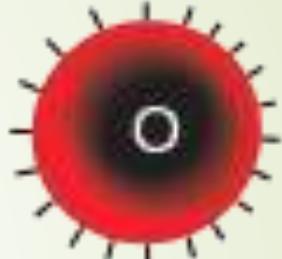
## ABO system:

- The cell membrane of RBCs contains mucopolysaccharide substance called antigens (agglutinogen).
- Two types of antigens are known: A antigen and B antigen.
- People are classified into 4 groups according to antigen on RBC membrane (A, B, AB, O)
  - The plasma contains antibodies (agglutinins) against the absent antigen.



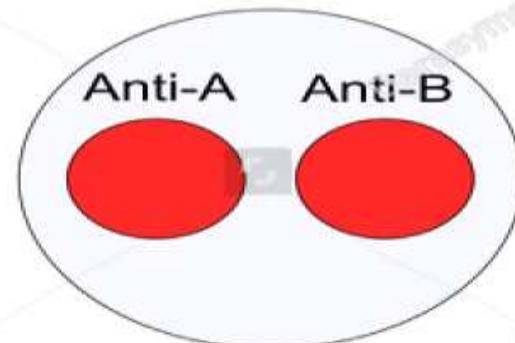
| Group        | A      | B      | AB    | O               |
|--------------|--------|--------|-------|-----------------|
| •% of people | 40 %   | 10%    | 5%    | 45%             |
| •Antigen     | A      | B      | A & B | -----           |
| •Antibody    | Anti-B | Anti-A | ----- | Anti-A & Anti-B |

- If an antigen is present in RBCs and the plasma contains its corresponding antibodies → agglutination → hemolysis.
- The antigens are called **agglutinogen** and the antibodies are called **agglutinins**.

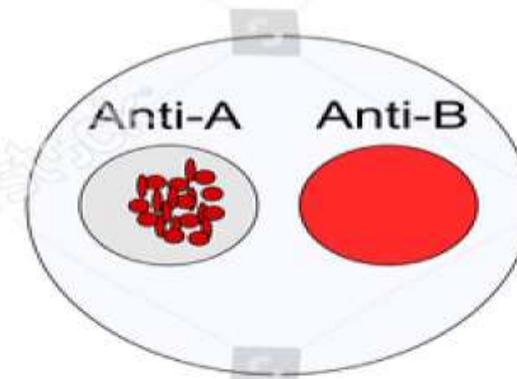
|                            | Group A  | Group B  | Group AB  | Group O  |
|----------------------------|--|--|---|--|
| Red blood cell type        |                |                 |                        |                       |
| Antibodies in Plasma       | <br>Anti-B      | <br>Anti-A      | None  | <br>Anti-A and Anti-B |
| Antigens in Red Blood Cell | <br>A antigen | <br>B antigen | <br>A and B antigens | None   |

# Blood types

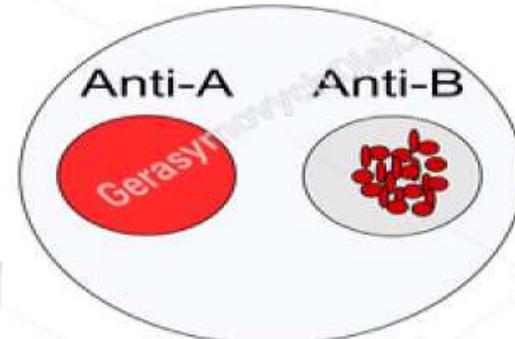
O (I)



A (II)

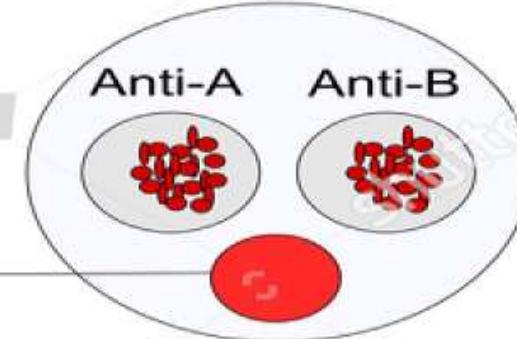


B (III)

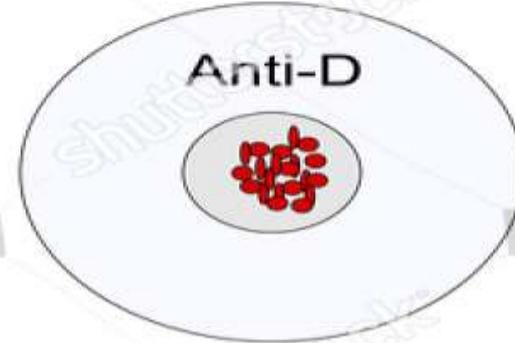


AB (IV)

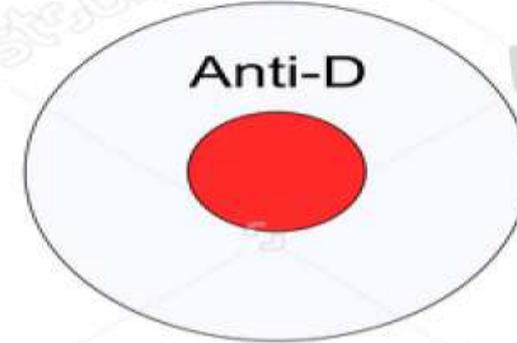
Control with  
saline



D (Rh)<sup>+</sup>



D (Rh)<sup>-</sup>



# Importance of blood groups:

**1-Medicolegal importance**

**2- blood transfusion**

**3- Rh factor during pregnancy**

**1-Medicolegal importance** (Disputed Parenthood):

- Inheritance of blood groups is by 2 antigens from both father & mother
- The A & B antigens are dominant, while the O one is recessive.
- Blood group is a good negative test in disputed parenthood.

|                     |    | Father's Blood Type |                   |                |        |  |  |
|---------------------|----|---------------------|-------------------|----------------|--------|--|--|
|                     |    | A                   | B                 | AB             | O      |  |  |
| Mother's Blood Type | A  | A or O              | A, B, AB,<br>or O | A, B, or<br>AB | A or O |  |  |
|                     | B  | A, B, AB,<br>or O   | B or O            | A, B, or<br>AB | B or O |  |  |
|                     | AB | A, B, or<br>AB      | A, B, or<br>AB    | A, B, or<br>AB | A or B |  |  |
|                     | O  | A or O              | B or O            | A or B         | O      |  |  |
| Child's Blood Type  |    |                     |                   |                |        |  |  |

## **2-Blood transfusion:**

In incompatible blood transfusion, the donor RBCs is agglutinated by recipient plasma, as the donor's plasma is diluted by the recipient blood.

- \*Group O is universal donor, because there is no agglutinogen (antigens).
- \*Group AB is universal recipient, because there is no agglutinin(antibodies)
- \***Cross matching test:** should be done before blood transfusion in  
The recipient plasma is mixed with donor's RBCs, and recipient RBCs is mixed with donor plasma, If no agglutination transfusion is done.

## **Rh factor (D factor):**

- It is a system composed mainly of **D** antigens
  - It is first discovered in blood of Rhesus monkey
  - D is the most antigenic component.
  - 85 % of people are Rh positive i.e. have D antigen.
  - 15 % of people are Rh negative i.e. have no D antigen.
- 
- Normally Rh + Ve & Rh – Ve have no anti-D**
  - Negative Rh persons forms anti D if antigen D is transformed to them.
  - Positive Rh never form anti D, whether receives Rh +Ve or Rh -Ve

# Rh Blood Group System



**present (+)**  
**Rh positive**



**absent (-)**  
**Rh negative**



Rh

Factor Set

Why rh factor  
Blood Test Before  
Marriage ?



|                 |                  |
|-----------------|------------------|
| • O (I) Rh (+)  | • B (III) Rh (+) |
| • O (I) Rh (-)  | • B (III) Rh (-) |
| • A (II) Rh (+) | • AB (IV) Rh (+) |
| • A (II) Rh (-) | • AB (IV) Rh (-) |

Rh

Factor Set

# Importance of Rh

**Before marriage & before blood transfusion**

## 1) Erythroblastosis Foetalis:(Rhesus hemolytic disease of newborn)

The disease occurs if:

- An **Rh negative female** is married from an **Rh positive male**
- She carries an **Rh positive fetus**

**A] The first baby will be born normal, little fetal blood leaks into maternal circulation. & Mother will produce anti-D agglutinins (IgG)**

**B] During next pregnancy, maternal agglutinins (IgG) cross the placenta causing fetal hemolysis:**

- **Anemia** of fetus
- **Jaundice**, increase bile pigments which cross the undeveloped blood BBB and deposit in basal ganglia (Kernicterus).

• **The first baby is affected in case of maternal sensitization by:**

- 1 - Previous Rh + Ve blood transfusion
- 2- Fetal maternal hemorrhage during pregnancy.

• **The disease can be prevented by:**

[1] Avoiding Rh + Ve blood transfusion to Rh – Ve females.

[2] Anti-D antibodies are given to prevent maternal sensitization.

\*If baby is born alive, he would be treated by exchange transfusion with blood group O Rh negative.



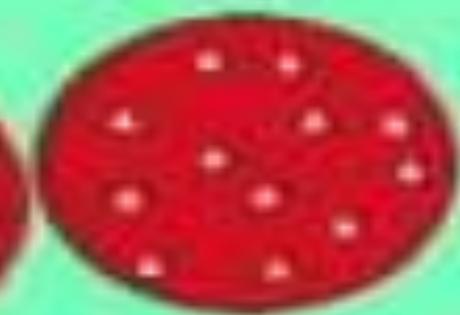
## **2) Repeated blood transfusion:**

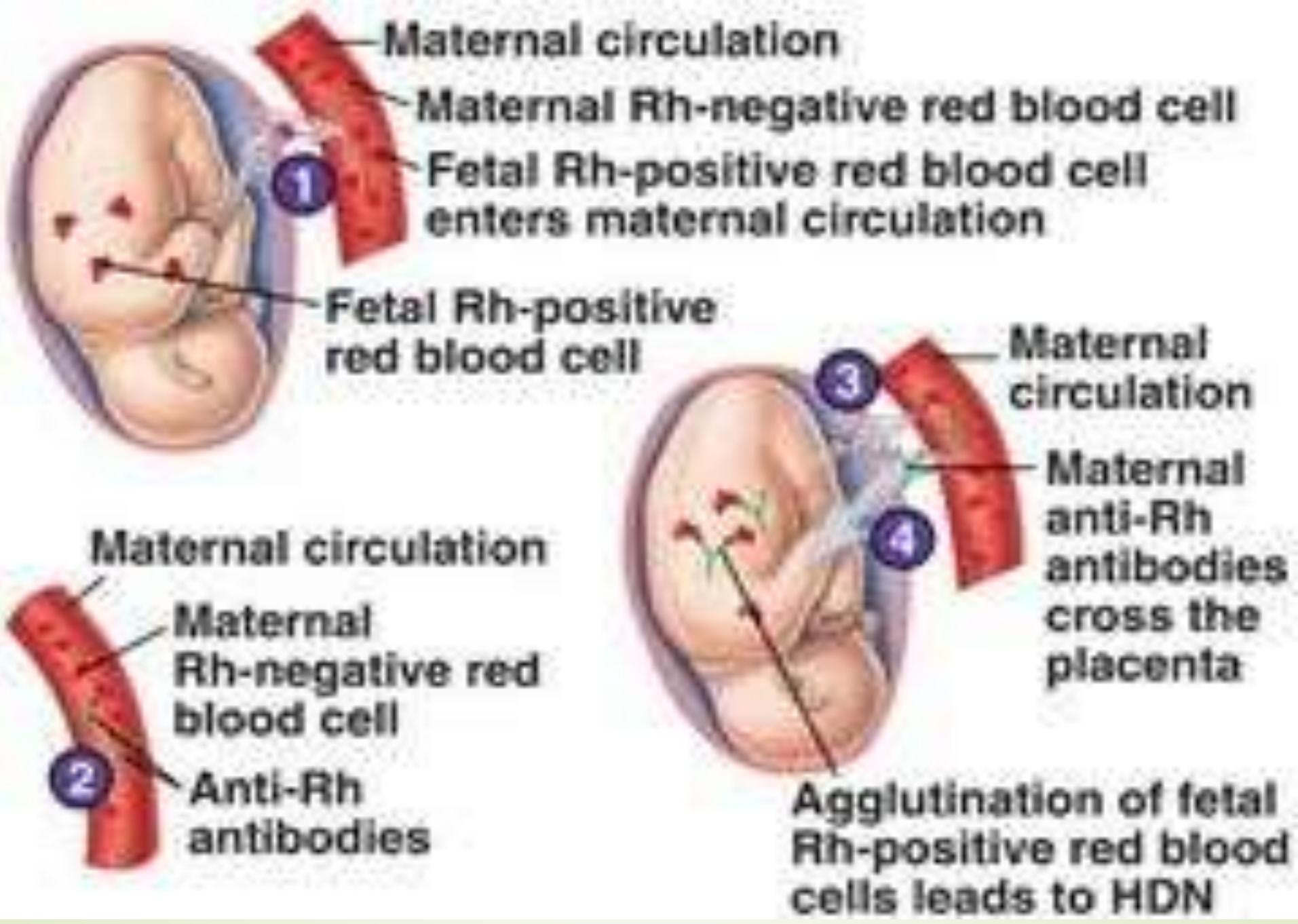
- If **Rh – Ve persons** is transfused with **Rh +Ve blood**, he will produce agglutinins against Rh factor.
- If this person is transfused (later on) with Rh +Ve blood, agglutination occurs.

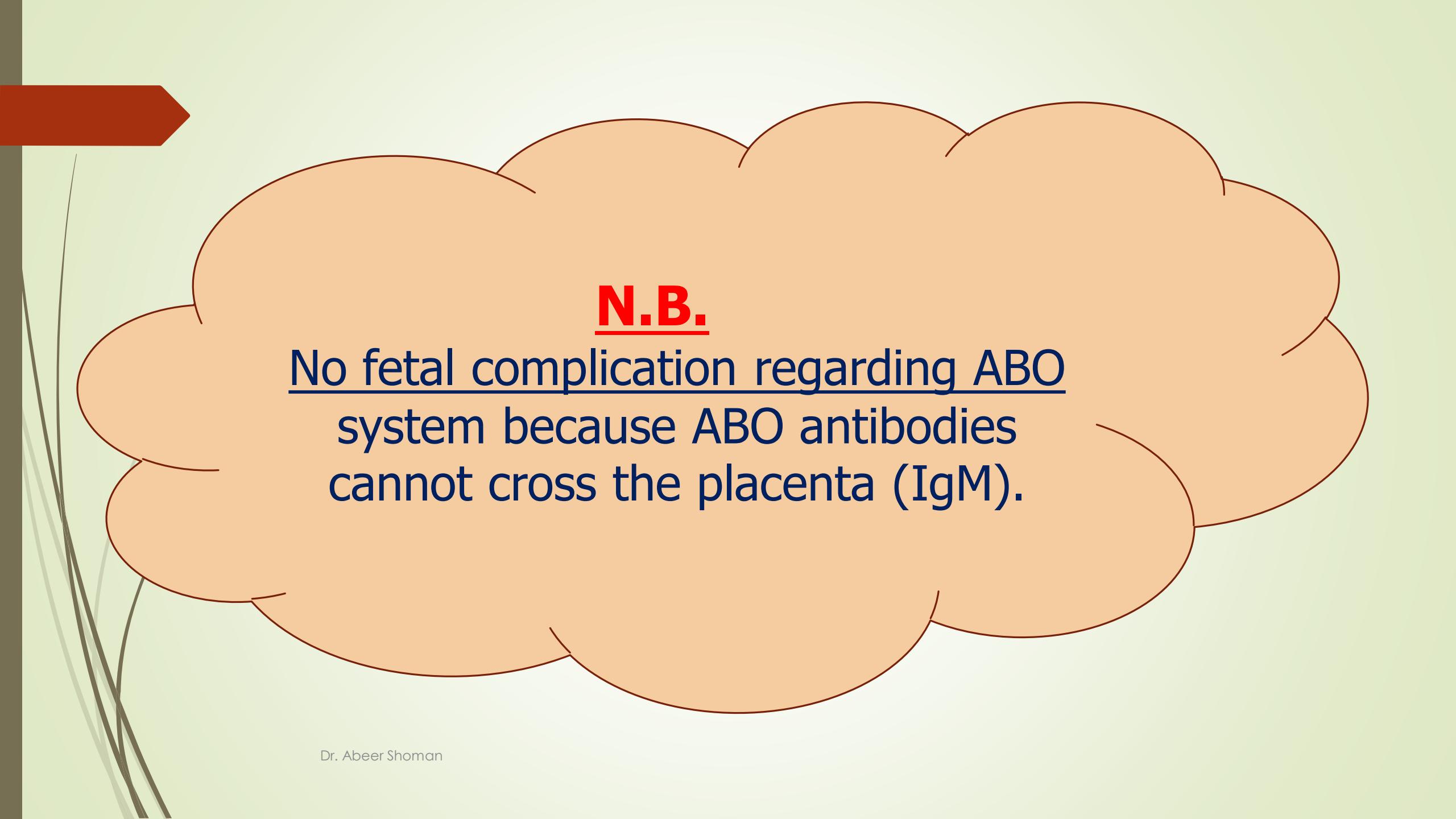
MOTHER  
 $Rh^-$



FETUS  
 $Rh^+$







**N.B.**

No fetal complication regarding ABO  
system because ABO antibodies  
cannot cross the placenta (IgM).



## Indications of blood transfusion:

- 1) To restore whole blood as in haemorrhage.
- 2) To restore one element: RBCs, WBCs & platelets.
- 3) Erythroblastosis foetalis.



## **Precautions before blood transfusion:**

- 1) Compatible blood.
- 2) High Hb content.
- 3) Free from contamination.
- 4) Free from disease.
- 5) Fresh i.e. less than 2 weeks storage.

## Storage:

Blood is stored at  $-4^{\circ}\text{C}$  not more than 2 weeks.

The following is added to it:

- citrate as an anticoagulant
- Dextrose as nutrient for cells
- Citric acid to reduce PH

Storage will lead to: → Decrease platelets

- Decrease dextrose
- Decrease factor 7, 8 & 9
- Increase, potassium & lactic acid

## Complications of blood transfusion:

- 1) **Mechanical:** air or fat embolism
- 2) **Physiological:** excess transfusion → overloading → heart failure.
  - Pyrogenic reaction → fever.
- 3) **Infective:** infective hepatitis, malaria, AIDS.
- 4) **Incompatibility:** Transfusion with incompatible blood leads to clumping & hemolysis of given RBCs leading to:

## Effects of incompatibility:

### a. Blockage of blood capillaries:

This occurs by clumping RBCs leading to →backache and joint pain.

Blocking of coronary vessels leads to → angina pain

### b-Intravascular hemolysis leads to :

1. Shock due to release of histamine and vasodilators-→ drop of arterial blood pressure.
2. Liberation of K+ (hyperkalemia)→ cardiac arrhythmia.
3. Liberation of Hemoglobin which:
  - a. is broken to bilirubin leading to yellow coloration of skin and mucous membrane (jaundice)
  - b. Leads to blockage of renal tubules as it is filtered by renal glomeruli →leading to renal failure.

# Blood Transfusion Reaction



## Allergic

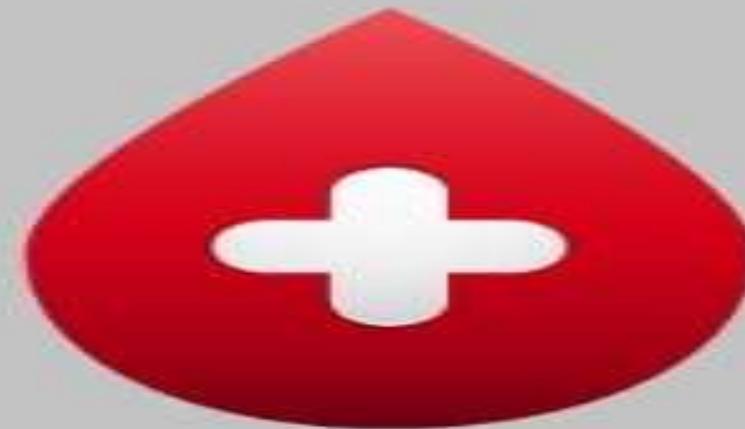
MILD  
Facial Flushing  
Hives/ Rash

SEVERE  
Increased Anxiety  
Wheezing  
Decreased BP



## Febrile

Headache  
Tachycardia  
Tachypnea  
Fever/Chills  
Anxiety



## Hemolytic

Decreased BP  
Increased RR  
Hemoglobinuria  
Chest Pain

Apprehension  
Low Back Pain  
Fever  
Tachycardia  
Chills

# Main symptoms of Acute hemolytic reaction

**Systemic**  
- Chills  
- Fever

**Vascular**  
- Hypotension  
- Uncontrollable bleeding

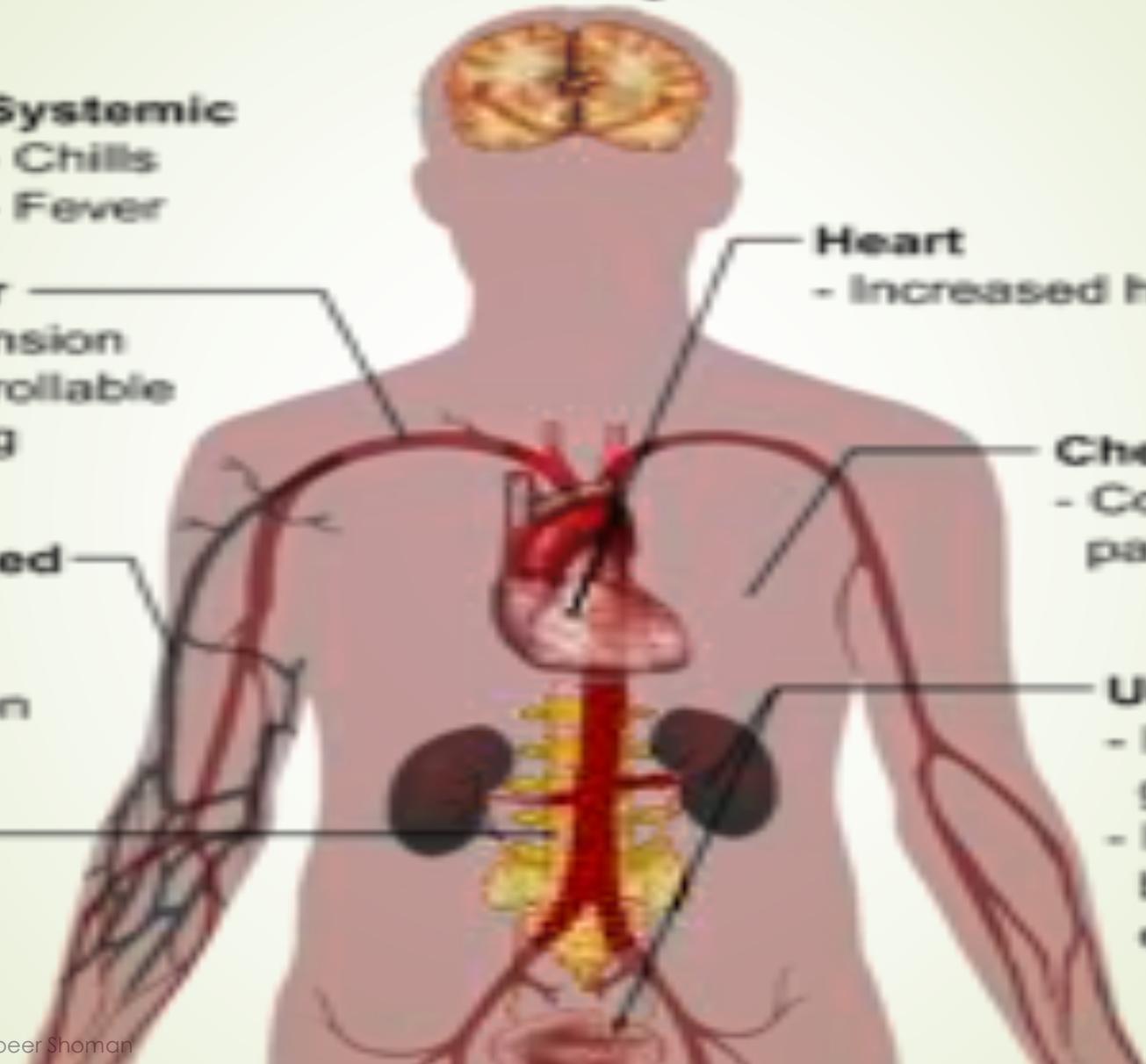
**Transfused vein**  
- Heat sensation

**Lumbar region**  
- Pain

**Heart**  
- Increased heart rate

**Chest**  
- Constricting pain

**Urinary**  
- Hemo-  
globinuria  
- Hyper-  
bilirubin-  
emia





*Thank You*

