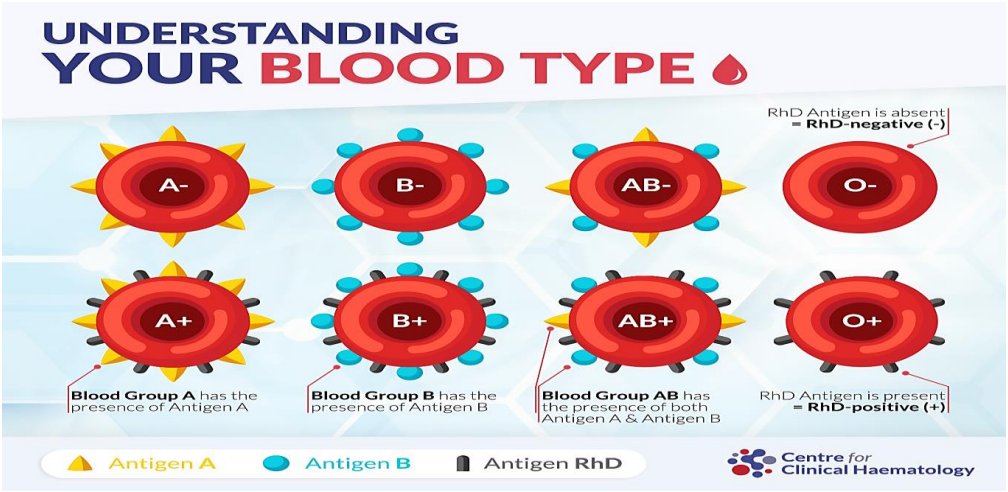
HLS MODULE
PHYSIOLOGY (LECTURE 4)
BLOOD GROUPING



BY

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BLOOD TYPES

Although many blood groups are recognized, the ABO and Rh blood groups are the most important when discussing transfusion reactions.

- There are 2 systems used to determine blood groups:

1. The ABO system.
2. The Rhesus (Rh) system.

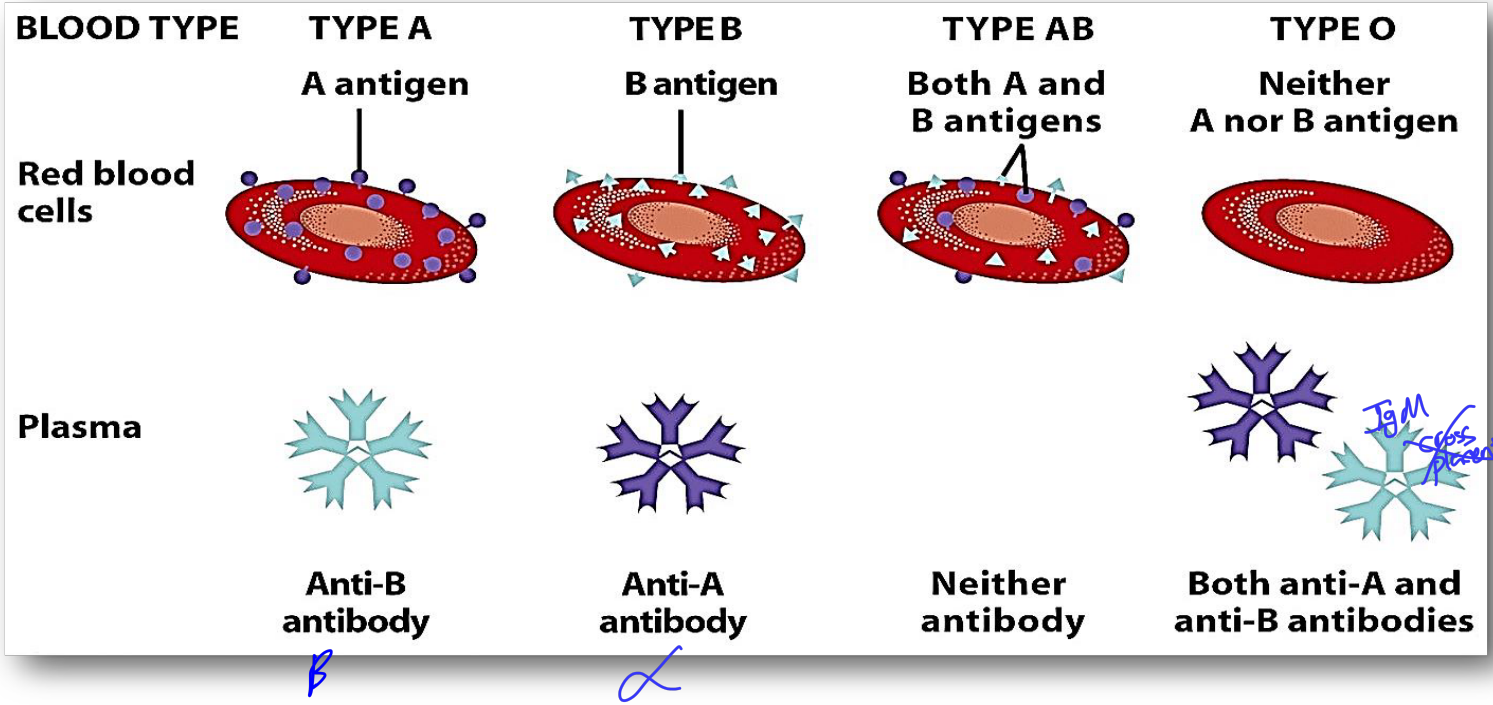
THE ABO SYSTEM

- ✓ **The membranes of human red blood cells** contain a variety of blood group **antigens** which are also called **agglutinogens**.
- ✓ The **most important** and best known of these are the **A and B antigens**.
- ✓ The **A and B antigens are inherited**, and individuals are divided into **four major blood types on this basis**.
- ✓ **Type A individuals have the A antigen, type B have the B, type AB have both, and type O have neither**.
- ✓ **Antibodies against red blood cells agglutinogens are called agglutinins: α (anti-A) and β (anti-B)** (alpha and beta agglutinins); **IgM type, which do not readily cross the placenta**.
- ✓ **The ABO blood types don not exist in equal numbers.** In Caucasians in united states, the distribution is: type O, 47 %; type A, 41 %; type B, 9 %; and type AB, 3 %. Among African Americans, the distribution is type O, 46 %; type A, 27 %; type B, 20 %; and type AB, 7 %.

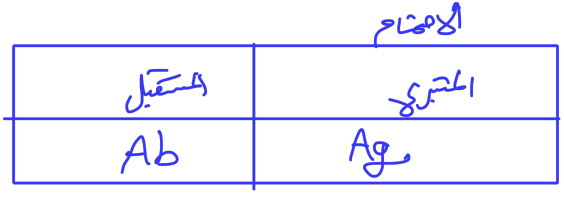
- ✓ **The blood of any person doesn't contain an agglutinogen (e.g A) and its corresponding agglutinin (anti-A; α), otherwise ……. Antigen – antibody reaction occurs which results in agglutination and hemolysis of RBCs.**
- ✓ **Type A individuals have anti-B (β) antibodies in their plasma. Similarly, type B individuals have plasma anti-A antibodies (α). Type AB individuals have neither anti-A nor anti-B antibody, and type O individuals have both anti-A and anti-B antibodies.**
- ✓ The debris formed from ruptured red blood cells can cause severe tissue damage, particularly in the kidneys. Hemoglobin released from lysed red blood cells can damage kidney tissue, reducing its blood-filtering ability. If the damage is extensive, the lack of kidney function could result in death.

- ✓ Normally, the antibodies do not develop against an antigen unless the body is exposed to that antigen.However, the anti-A and/or the anti-B antibodies are present in the blood even without exposure to antigens on foreign red blood cells.
- ✓ One possible explanation for the production of Anti-A /or Anti-B antibodies is that antigens very similar to A and B are common in intestinal bacteria and possibly in foods to which newborn individuals are exposed. Therefore, infants rapidly develop antibodies against the antigens not present in their own cells.
- ✓ Thus, type A individuals develop anti-B antibodies, type B individuals develop anti-A antibodies, type O individuals develop both, and type AB individuals develop neither.
- ✓ In support of that explanation, Anti-A and Anti-B antibodies are not found in the blood until about 2 months after birth.

* المفهم بس مارح تجيب فيها


BLOOD TYPE
TYPE A
TYPE B
TYPE AB
TYPE O
A antigen
B antigen
Both A and B antigens
Neither A nor B antigen
Red blood cells
Plasma
IgM
Anti-B antibody
Anti-A antibody
Neither antibody
Both anti-A and anti-B antibodies

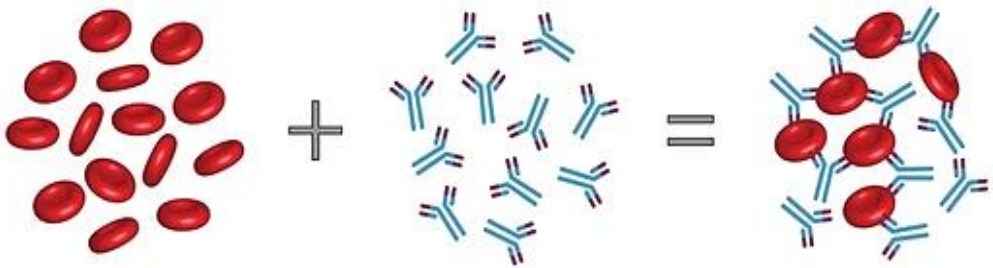
Blood group	Antigens on RBCs membrane (agglutinogens)	Plasma agglutinins (Antibodies)
A	A	Anti-B (β)
B	B	Anti-A (α)
AB	AB	None
O	None	Anti-A & Anti-B (α and β)



- ✓ **Group O is called universal donor because they can usually give blood to the other ABO blood types without causing an ABO transfusion reaction (no agglutinogens and so no agglutination occurs when given).**
- ✓ **Group AB is called universal recipient because they can usually receive blood from other ABO blood types without causing an ABO transfusion reaction (no agglutinins and so no agglutination occurs).**
- ✓ **Agglutination** of RBCs occurs between the **agglutinogens on the RBCs of the donor's blood** and **agglutinins of the recipient's plasma. This is because agglutinins in the donor's plasma are diluted by the large volume of recipient's plasma.**

Donor		Recipient
A		B
A agglutinogen (Ag)	×	B agglutinogen
β agglutinin		α agglutinin (Ab)

Hemagglutination



Red blood cells

Antibodies

THE RH BLOOD GROUP

Rhesus Monkey Dance
C D E
most antigenic

- ✓ **Another important blood group is the Rh blood group.**
- ✓ **So named because it was first studied in the rhesus monkeys.**
- ✓ This system is composed primarily of the C, D, and E antigens, although it actually contains many more.
- ✓ **D is by far the most antigenic component**, and the term **Rh-positive as it is generally used means that the individual has agglutinogen D on the surface of their red blood cells. They are Rh-negative if they do not have these D antigens.**
- ✓ **85 % of whites are D-positive (Rh positive) and 15% are D negative (Rh negative)**; over 99% of Asians are D-positive.
- ✓ **The Rh negative individual has no D antigen and forms the anti-D agglutinin when injected with D-positive cells**.

Ag عنده RBC (D) (RH+)

(d) لا عنده Ag ولا حتى Ab (بالعادي)

- Unlike the antibodies of the ABO system, the Rh system has not been detected in tissues other than red cells.
- **Anti-D antibodies do not develop without exposure of a D-negative individual to D-positive red cells by blood transfusion or entrance of fetal blood (Rh positive) into the maternal circulation (Rh negative).**

- **When an Rh-negative person receives a transfusion of Rh-positive blood, the recipient becomes sensitized to Rh antigens and produces anti-Rh antibodies.** If the Rh-negative person is unfortunate enough to receive a second transfusion of Rh-positive blood after becoming sensitized, a transfusion reaction results.
- The Rh typing serum used in routine blood typing is anti-D serum.
- The ABO blood type and Rh blood type are usually expressed together. For example, a person designated as type A in the ABO blood group and Rh-positive is said to be A positive.

Importance of blood groups

✓ **In blood transfusion ;**

To avoid dangers of incompatibility. عدم توافق

✓ **In marriage ;**

To avoid Rh incompatibility (**erythroblastosis fetalis** or **hemolytic disease of the newborn**).

Transfusion Reactions

- When a blood transfusion is performed, the donor is the person who gives blood and the recipient is the person who receives it.
- Transfusion reaction is the illness caused when erythrocytes are destroyed during blood transfusion, is a special example of tissue rejection.
- Besides antigens of the ABO system, many other erythrocyte antigens and plasma antibodies exist. Therefore, except in a dire emergency, the blood of the donor and recipient must be tested for incompatibilities directly by the procedure called cross-matching.

The possible transfusions among blood groups:

VERY IMPORTANT

- ✓ Group AB is a universal recipient and gives only group AB.
- ✓ Group O is a universal donor and can receive blood only from group O.
- ✓ Group A can receive blood from groups A & O and gives blood to groups A & AB.
- ✓ Group B is can receive blood from groups B & O and gives blood to groups B & AB.

Blood Group	Agglutinogens on RBCs	Agglutinins in plasma	Transfuse with group
A	A	Anti-B	A or O
B	B	Anti-A	B or O
AB	A and B	none	AB, A, B or O
O	None	Anti-A & Anti-B	O

Type and Cross-match

VERY IMPORTANT

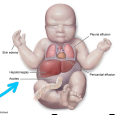
- ✓ **To prevent transfusion reactions, the blood must be typed.** blood grouping
- ✓ **Blood typing determines ABO and Rh blood groups of a blood sample.**
- ✓ **Typically, the cells are separated from the serum and then tested with known antibodies to determine the type of antigen on the cell surface.**
- ✓ **For example, if the patient's blood cells agglutinate when mixed with anti-A antibodies but do not agglutinate when mixed with anti-B antibodies, the cells have type A antigen.**
- ✓ **In a similar fashion, the serum is mixed with known cell types (antigens) to determine the type of antibodies in the serum.**
- ✓ **Normally, donor blood must match the ABO and Rh type of the recipient.**
- ✓ However, because other blood groups can cause a transfusion reaction, a **cross-match is performed**.
- ✓ **In a cross-match, the donor's blood cells are mixed with the recipient's serum, and the donor's serum is mixed with the recipient's cells.** plasma
- ✓ **The donor's blood is considered safe for transfusion only if no agglutination occurs in either match.**

Cross matching

	donor	recipint
①	Ag	Ab
②	Ab	A

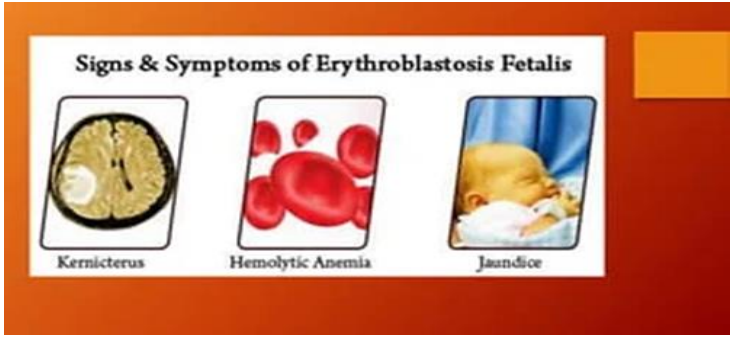
HEMOLYTIC DISEASE OF THE NEWBORN (HDN)

- **Definition:** Another complication due to Rh incompatibility that arises when an Rh-negative mother carries an Rh-positive fetus.
- Small amounts of fetal blood leak into the maternal circulation at the time of delivery, and mothers develop significant titers of anti-Rh agglutinins during the postpartum period.
- In the mother's first pregnancy, there is often no problem. During the next pregnancy, the mother's agglutinins (IgG antibodies) cross the placenta to the fetus. When anti-Rh agglutinins cross the placenta to an Rh-positive fetus, they can cause hemolysis and various forms of hemolytic disease of the newborn (erythroblastosis fetalis).
- If hemolysis in the fetus is severe, the infant may die in utero or may develop anemia (hemolytic anemia), severe jaundice, and edema (hydrops fetalis).

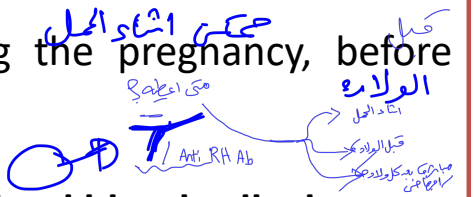


- Kernicterus, a neurologic syndrome in which unconjugated bilirubin is deposited in the brain (specially in the basal ganglia) causing damage, may also develop.

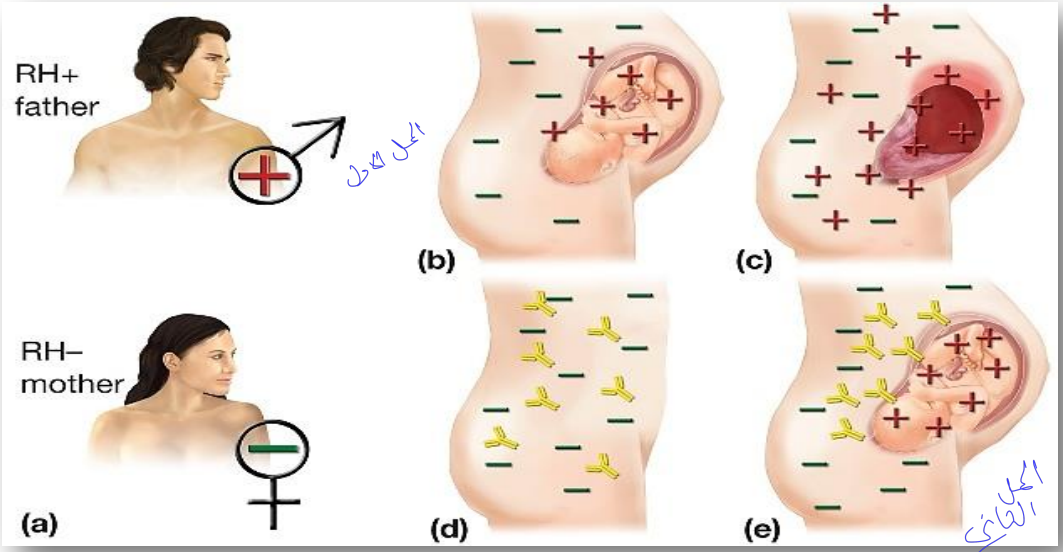
- Bilirubin rarely penetrates the brain in adults, but **it does in infants with erythroblastosis fetalis , possibly in part because the blood-brain barrier is more permeable in infancy.**
- **However, the main reasons that the concentration of unconjugated bilirubin is very high in this condition are that production is increased and the bilirubin-conjugating system is not yet mature.**
- In severe cases, a transfusion to replace lost red blood cells can be performed through the umbilical cord or the baby can be delivered if mature enough.
- **Because sensitization of Rh-negative mothers by carrying an Rh-positive fetus generally occurs at birth, the first child is usually normal.**

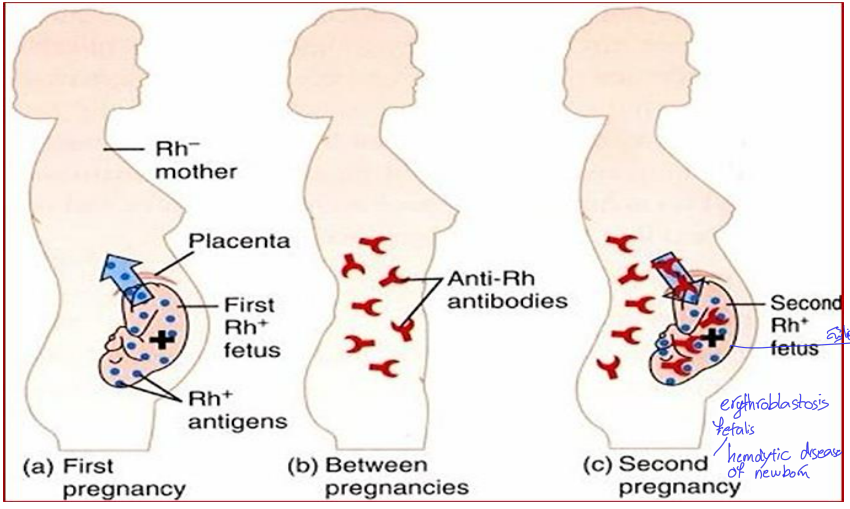


- **Fortunately, it is usually possible to prevent sensitization from occurring the first time by administering a single dose of anti-Rh antibodies in the form of Rh immune globulin.** The injection can be given during the pregnancy, before delivery, or immediately after each delivery or abortion.



- **The injected antibodies bind to Rh antigens of any fetal red blood cells that may have entered the mother's blood. This treatment inactivates the fetal Rh antigens and prevents sensitization of the mother.**
- Such passive immunization does not harm the mother and has been demonstrated to prevent active antibody formation by the mother.
- Fetal Rh typing with material obtained by amniocentesis or chorionic villus sampling is now possible, and treatment with a small dose of Rh immune serum will prevent sensitization during pregnancy.


RH+
father
RH–
mother
(a)
(b)
(c)
(d)
(e)


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

ما توقفش نفسك عند أي محطة فاتت في حياتك مهما كانت صعبة أو مؤلمة.. ما تشوفش النهاردة بعيون امبارح.. ولا بكرة بعيون النهاردة.. اعتبر كل يوم حياة جديدة.. واعتبر نفسك كل يوم في خلق جديد.. وسيبك من الكلام التقليدي بتاع (خلي عندك أمل)، اسمها (طلع الأمل اللى جواك)..لأنه في الحقيقة الأمل موجود جواك بالفعل.. بس محتاج منك تصدقه وتستخدمه..

THANK YOU