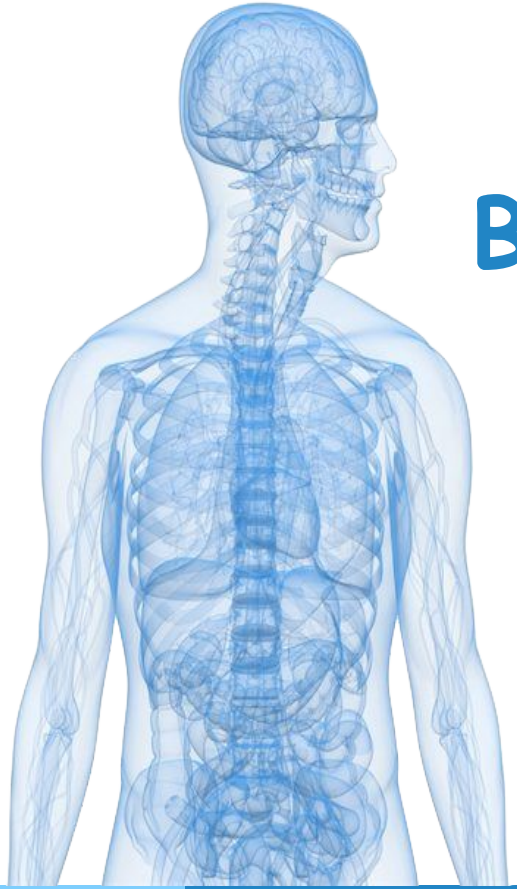


Blood Groups & Transfusion

Team Leaders:
Haya Alenazi
Abdulrahman Alswat

Red: Important
Black: In Male & Female slides
Blue: In male slides
Pink: In female slides
Green: Notes & extra information

Objectives

Describe:

- The ABO and Rhesus blood group systems.
- Grouping, cross-matching & typing with anti-sera.
- The hazards of incompatible blood transfusion reactions.

Recognize:

- Agglutinogens on the surface of the RBCs.
- Agglutinins in the plasma.

Define:

- Blood transfusion and list its uses.
- Hemolytic disease of newborn, describe its pathophysiology and outline its prevention.
- List precautions taken in preparing blood for transfusion and storage.

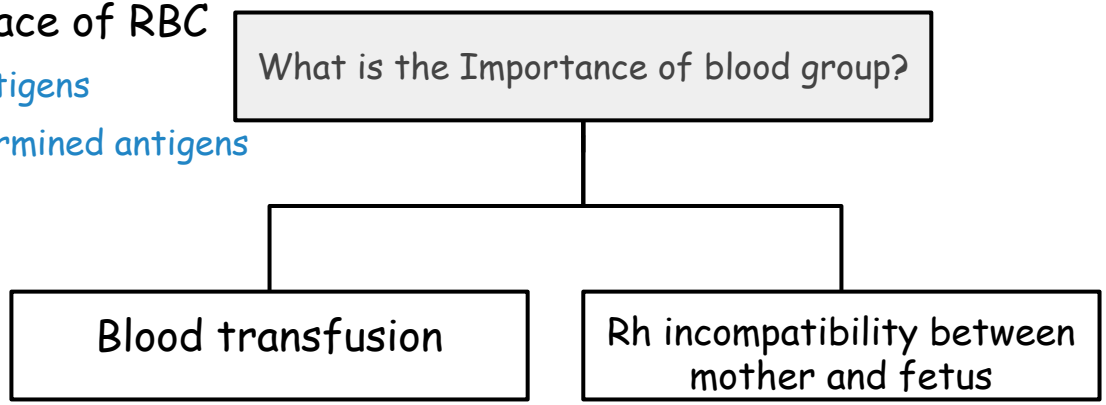
Blood group

Determine by:

Antigens: (glycoprotein) on the surface of RBC

Blood is typed (grouped) based on surface antigens

RBC surfaces are marked by genetically determined antigens (Agglutinogens).



The chief blood groups are:

(Clinically most significant)

1- A-B-O System

2-Rh (Rhesus) System

The ABO and Rhesus (Rh) systems of antigens are of major clinical importance as they are associated with transfusion reactions when mismatched

A-B-O System

Depends on whether the red cells contain one, both or neither of the two blood antigens:
A and B.
•there are four main ABO groups:
A, B, AB, O

A & B antigens
(on the surface of RBCs):

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

Antibodies
(in the plasma"serum"):
naturally occurring antibodies
-Anti-A and Anti-B
Present few months after birth (appear 2-8/12 month)
-Triggered by A and B antigens in food or bacteria
مكتسب، يتكون نتيجة تحفيز جهاز المناعة في عمر مبكر نتيجة التعرض لبعض أنواع المخلوقات الدقيقة أو الأطعمة (اللحوم) التي تحتوي على النوع الآخر (المضاد لما هو موجود لدى الطفل) و نتيجة لذلك يتكون Antibody واضح ولا أعيد ؟؟

Rh (Rhesus) System

تم اكتشافه في نوع القردة وهو يشبه الي في الإنسان لذلك تمت تسميته بناء على هذه العائلة من القردة ، معلومة حلوة صح؟

Rh factor D (antigen-D)

Rhesus antigens:

Dd, Cc, Ee **Clinically most important is D**

Rh factor (antigen) was first discovered in blood of Rhesus monkey. Rh factors only detectable on RBCs

Determined by:

- Presence or absence of the Rhesus antigen (D) on the surface of RBC
- **RBCs with antigen-D = Rh+**
- **RBCs without antigen-D = Rh-**

Rh Anti-D antibody (agglutinin):

(explained more in the next slide)

Is not naturally-occurring

-Can be acquired by:

-Transfusion of Rh-ve individual with Rh+ve blood

-Rh-ve pregnancy with Rh+ve fetus

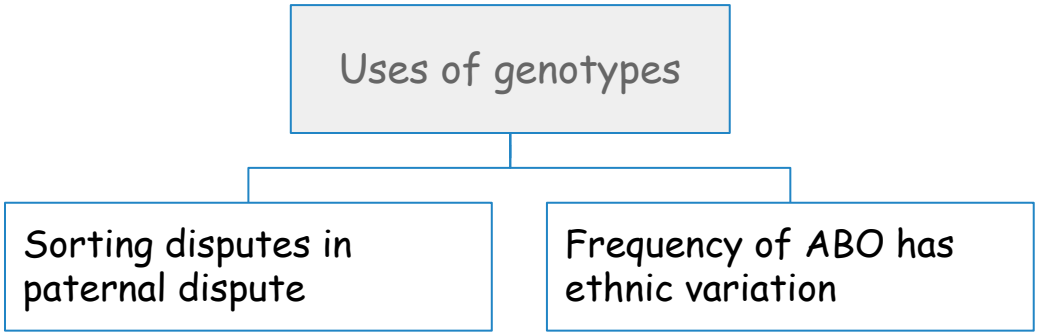
majority of pure races are Rh+ eg.85% of caucasian,95% of black americans,100% of black african,99% of Chinese

Locus of alleles responsible of ABO system is on long arm of chromosome 9 while Rh locus is on chromosome 1

Genetic Determination of ABO Antigens

Genotype	Blood type (phenotype)
OO	O
AA / AO	A
BB / BO	B
AB	AB

- Two genes (one maternal and one paternal in origin), one on each of the two paired chromosomes number 9, determine theO-A-B blood type.
- These genes can be any one of three types but only one type on each of the two chromosomes number 9: type O,type A, or type B.
- The type O gene (zero gens) is either functionless or almost functionless, so that it causes no significant type O agglutinogen on the cells. Conversely, the type A and type B genes do cause strong agglutinogens on the cells.
- The type A and type B genes are co-dominant This meant that if a person inherited one type A gene and one type B gene, their red cells would possess both the A and B antigens



Definitions

Agglutinogens

Blood group antigens on RBC membrane (A and B) .

Agglutinin

The respective antibody to the antigen

Agglutination

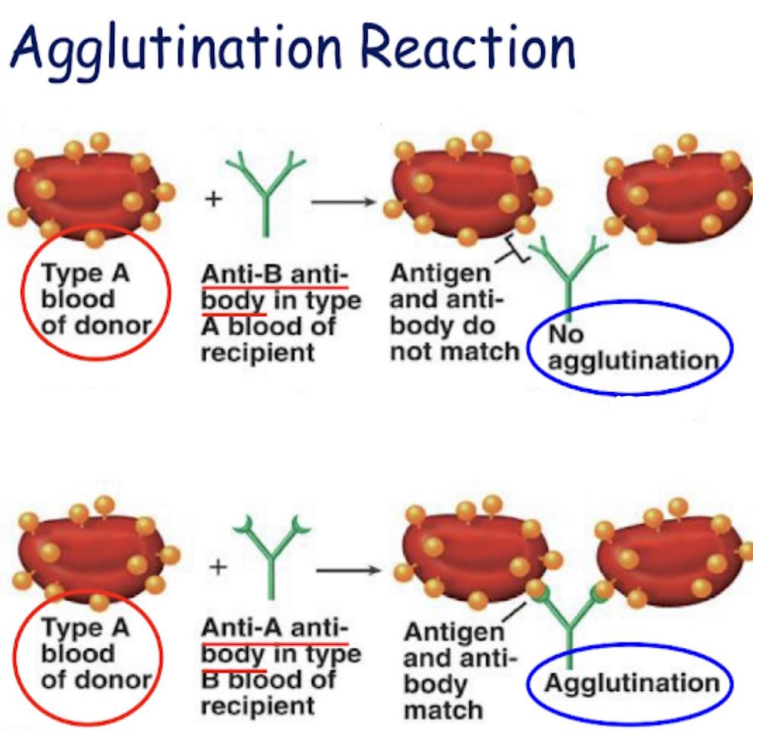
Reaction between agglutinogen on RBC and the respective Ab.

Agglutination in transfusion reaction :
If a patient of blood group A transfused with blood of group B The anti-B in plasma will agglutinate the transfused group B cells

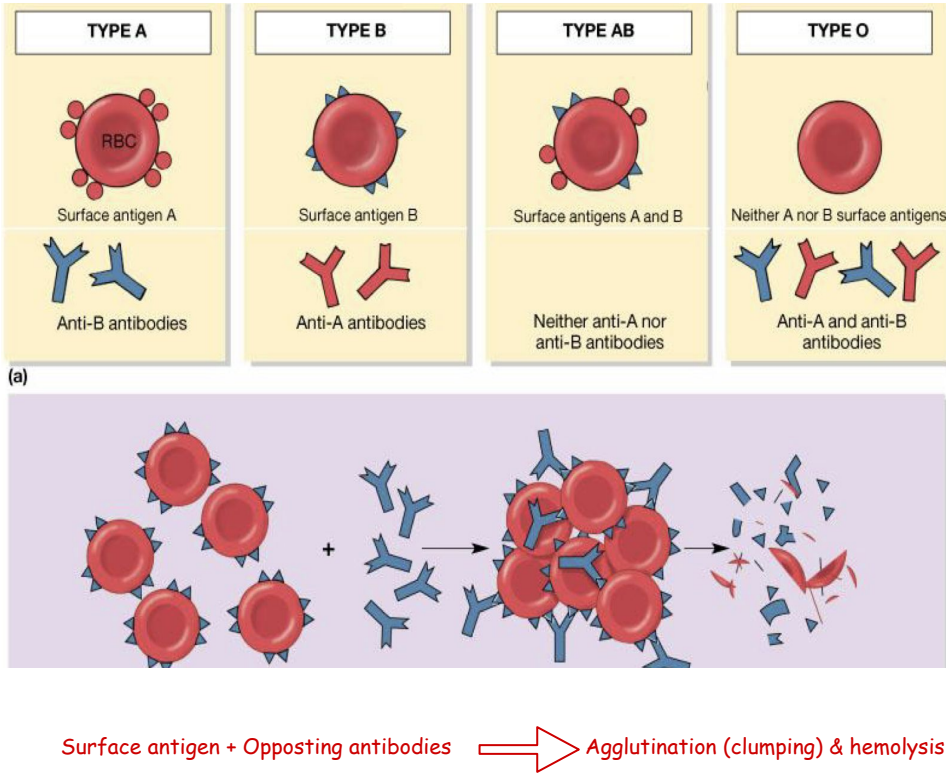
Outcome:

- The clumped cells plug small blood vessels (kidney shut down)
- Sometimes immediate hemolysis

Agglutination reaction



This picture only found in females slides



Surface antigen + Opposting antibodies ⇨ Agglutination (clumping) & hemolysis

Rh Anti-D antibody (agglutinin):

Anti-Rh antibodies (IgG) :
develop only in Rh-blood type and only with exposure to the antigen:
– transfusion of positive blood.
– during a pregnancy with a positive blood type fetus.

Anti-Rh antibodies are not spontaneously formed in Rh- individuals, However, if an Rh–individual receives Rh+blood, anti-Rh antibodies form (Sensitization).

Anti-Rh agglutinins develop slowly (2-4 months). Once produced they persist for years and can produce serious transfusion reaction during 2nd transfusion.

This immune response occurs to a much greater extent in some people than in others, With multiple exposures to the Rh factor, an Rh-negative person eventually becomes strongly "sensitized" to Rh factor.

Paternity

- Blood types can't be used to prove paternity.
- Blood types can disprove paternity

لا يمكنها أن تثبت النسب لكن يمكنها أن تنفي في بعض الحالات ، وهي وسيلة قديمة جدًا في إثبات النسب وغير دقيقة

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

Possible Blood group Genotypes :

Parent allele	A	B	O
A	AA	AB	AO
B	AB	BB	BO
O	AO	BO	OO

Phenotype	Possible genotype
Noura: A	AA or AO
Ahmad: B	BB or BO
Baby: O	OO

Yes, he can

Blood group

Important slide

Note: this table is applied only in blood transfusion of packed RBCs without plasma.

Genotype	Blood type	Agglutinogens (Antigens)	Agglutinins (Antibodies)	May Receive blood from	May Give blood to	Rh Factor
OO	O	Null	Anti-A & B	O	A,B,AB,O Universal donor	Present or absent (O+,O-)
AA / AO	A	A	Anti-B	A / O	A / AB	Present or absent (A+,A-)
BB / BO	B	B	Anti-A	B / O	B / AB	Present or absent (B+,B-)
AB	AB	A & B	Null	A,B,AB,O Universal recipient	AB	Present or absent (AB+,AB-)

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 –

People with type AB blood are called "universal recipients" since have no antibodies in plasma.

Blood group O, Rh negative.
-May be given in emergency to patients with either A, B, AB and Rh negative or positive blood groups.
- Antibody concentrations may be high, so may not be suitable if large volume of plasma is required.

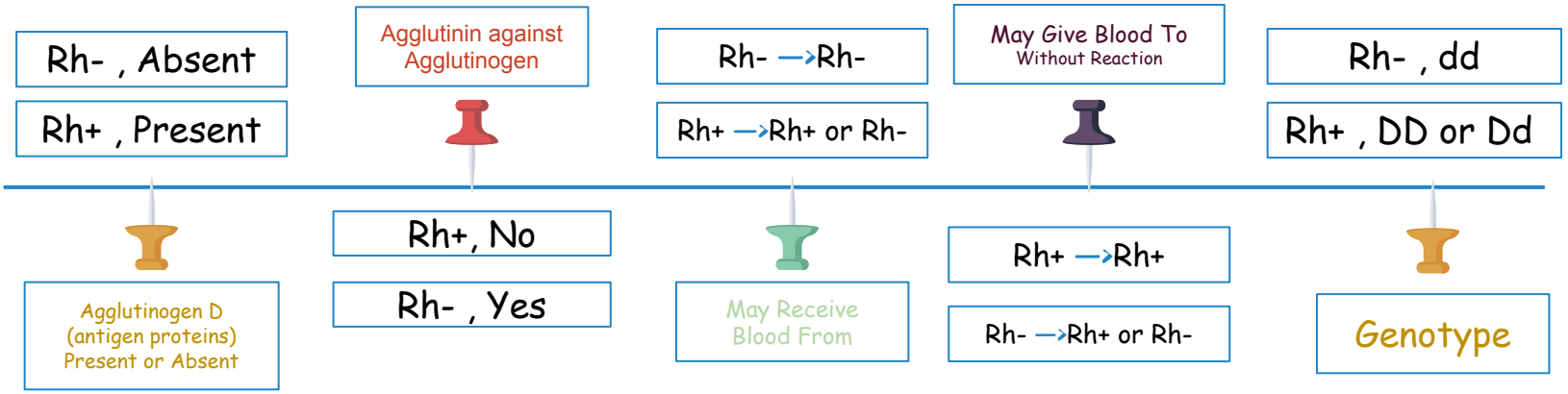
Plasma compatibility table				
Recipient	Donor			
	O	A	B	AB
O	OK	OK	OK	OK
A		OK		OK
B			OK	OK
AB				OK

When considering a plasma transfusion, keep in mind that plasma carries antibodies and no antigens. For example you can't give type O plasma to a type A, B or AB, because a person with type O blood has A and B antibodies and the recipient would have an immune response. On the other hand an AB donor could give plasma to anyone, since they have no antibodies.

Only found in boys slides

Blood Typing

Rh Blood Type



Indication and complications of blood transfusion

Indication(boys slides):

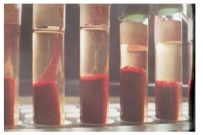
- Acute hemorrhage.
- Severe anemia (if Hb decreased below 7 g/dL).
- Erythroblastosis fetalis: in this case exchange transfusion is done.
- To supply a necessary elements e.g. platelets, packed RBCs, and some clotting factors.

Complication(Girls slides):

- Immune reaction: Incompatible blood transfusion leading to immediate or delayed reaction, fever, haemolysis, allergic reaction.
- Transmission of diseases (e.g.malaria, syphilis, viral hepatitis, AIDS virus).
- Acute kidney failure (reaction to mismatched transfusions).
- Iron overload due to multi-transfusion in case of sickle cell anemia and thalassemia.

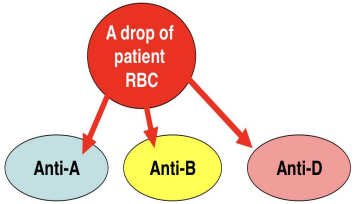
Blood transfusion

Blood tests before transfusion

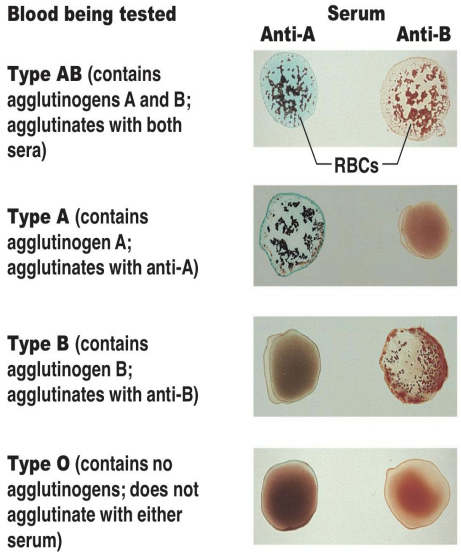


Blood group type of patient (recipient)

Typing involves testing blood with known antisera that contain antibodies anti-A, anti-B or anti-Rh.



Group	Anti-A	Anti-B
A	Agglutination	Nil
B	Nil	Agglutination
AB	Agglutination	Agglutination
O	Nil	Nil



ABO Blood Grouping (Typing) in Laboratory Using Anti-sera

Cross-matching

•donor cells + recipients (patient) serum

note: يتم دمج العينتين في المختبر وإذا حدث تكتل لا ننقل دم المتبرع لجسم المريض

•Mixing of incompatible blood causes agglutination (visible clumping):
-formation of antigen-antibody complex that sticks cells together (agglutination reaction).
-Leading to renal obstruction (shutdown) and hemolysis.

Disease Screening:
- Hepatitis B and C virus
- Antibody to HIV
- HIV Antigens
- Syphilis
- Cytomegalovirus

Rh incompatibility between mother and fetus

Mother(Rh-ve) first (Rh+ve) baby

inherited the trait from its father:

- At delivery :

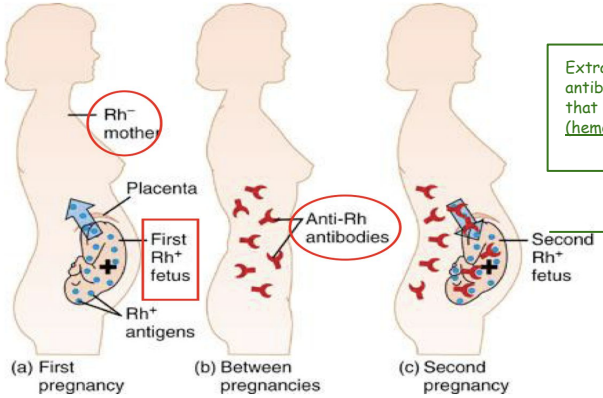
- Fetal Rh+ RBC cross to maternal blood

-The mother will develop Anti-D after delivery

(IgG class)

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

-First child escapes & is safe



Extra Note : the mother's antibodies attack baby's RBC that leads to RBC explosion (hemoglobins is out)

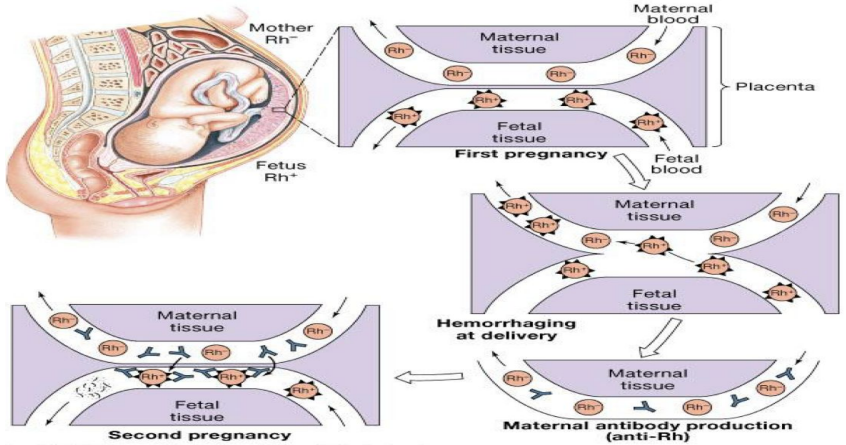
Mother (Rh-ve) second (Rh+ve) baby

In females slides: Anti-D crosses placenta and destroys fetal Rh+ RBC .

In males slides: hemolytic disease of the newborn may develop causing
hemolysis of the fetal RBCs → anemia and jaundice.

- Outcome?

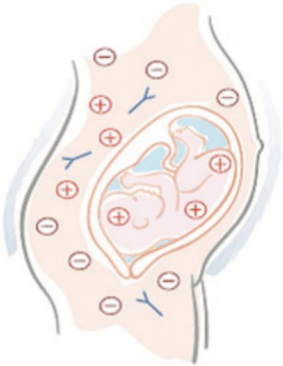
Hemolytic Disease of the newborn



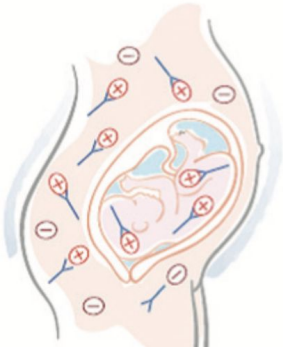
How red cell antibodies are formed during pregnancy

⊖ Mother's red blood cells
⊕ Baby's red blood cells
Y Mother's antibody

A. This baby has a different blood group from its mother. You can see this from the ⊖ in the mother and the ⊕ in the baby.



B. A baby's blood can cross through the placenta into its mother's blood. In this picture the baby's ⊕ blood is now in the mother, along with her own ⊖ blood. In rare cases, her body recognises these ⊕ cells are different and makes antibodies Y to fight them.



C. Antibodies can move across the mother's placenta into the baby's blood. The baby's blood cells can be damaged if they have the matching blood group.

Hemolytic Disease of the newborn

1. Hemolytic anemia:

- If severe: treated with exchange transfusion, Replace baby blood with Rh-ve RBC (several times)

2.Kernicterus (mental retardation due to bilirubin deposition in the brain).

3. Hydrops fetalis (death in utero)

Hydrops fetalis

Prevention:

Formation of the anti-D antibody can be prevented by giving the mother an:

- Injecting the mother with anti-D immediately after 1st childbirth (prophylactic anti-D or anti-D immunoglobulin)
- Antenatal (before birth, during pregnancy) prophylaxis (Prophylaxis is the word given to a medicine that is used to prevent something happening, Inhibits the formation of antibodies)

Rh immune globulin (RhIg) or Rhogam or anti-D:

- Shortly after each birth of an Rh-positive baby, the mother is given an injection of anti-Rh antibodies.
- These antibodies destroy any Rh+ fetal cells that got into the maternal circulation before they can stimulate an active immune response in the mother.
- The routine administration of such treatment to Rh -ve mothers after the delivery of Rh+ve baby has reduced the incidence of disease by >90%.

Treatment: Phototherapy or exchange blood transfusion.

Fetal Incompatibility

-Most anti-A or anti-B antibodies are of the IgM class and these do not cross the placenta.

-Thus, an Rh−/type O mother carrying an Rh+/type A, B, or AB foetus is resistant to sensitization to the Rh antigen.

-Her anti-A and anti-B antibodies destroy any fetal cells
that enter her blood before they can stimulate anti-Rh antibodies in her.

QUIZ!

MCQs

Q1: Which blood type is safe to receive in whole blood transfusion from a person who has O blood type:			
A) A	B) B	C) O	D) All of them
Q2: What type of immunoglobulins is Anti-D antibodies:			
A) IgM	B) IgG	C) IgD	D) IgE
Q3: which chromosome determine ABO system:			
A) Chromosome 1	B) Chromosome 12	C) Chromosome 9	D) Chromosome 7
Q4 : which one can cause Rh incompatibility between mother and fetus?			
A) Mother(Rh+ve) first (Rh+ve) baby	B) Mother(Rh-ve) second (Rh+ve) baby	C) Mother(Rh-ve) first (Rh+ve) baby	D) Mother(Rh-ve) second (Rh-ve) baby

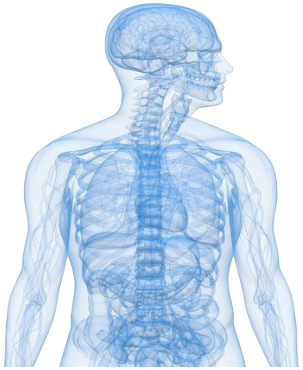
SAQ

Q1: When are antibodies present in plasma ?

Q2: Give me three indication of blood transfusion.

MCQs key answer :
1) D
2) B
3) C
4) B

SAQ answer key :
1) Few month after birth
2)1- acute hemorrhage.
2- severe anemia (if Hb decreased below 7 g/dL).
3- erythroblastosis fetalis.



Thank You

Team members:

- أحمد الخياط
- ماجد العسكر
- مشعل الثنيان
- عبد العزيز الربيعة
- باسل فقيها
- محمد بياري
- محمد السلمان
- عبد الرحمن الدويش
- مرشد الحربي
- منيب الخطيب
- نايف الشهري
- فيصل العمري
- عبد العزيز الغليقة
- عبد العزيز السحيم
- حصة العليان
- شذى الظهير
- سمو الزير
- نورة الشثري
- سارة القحطاني
- ريناد الحميدي
- ياسمين القرني
- يارا الزهراني
- لمى الأحمدي
- آلاء السلمي
- سارة العيدروس
- بدور المبارك
- فرح البكر
- سارة العبيد

Physiology 439

- Made by

Contact info:physiology439@gmail.com

Editing file

Physiology 439 file