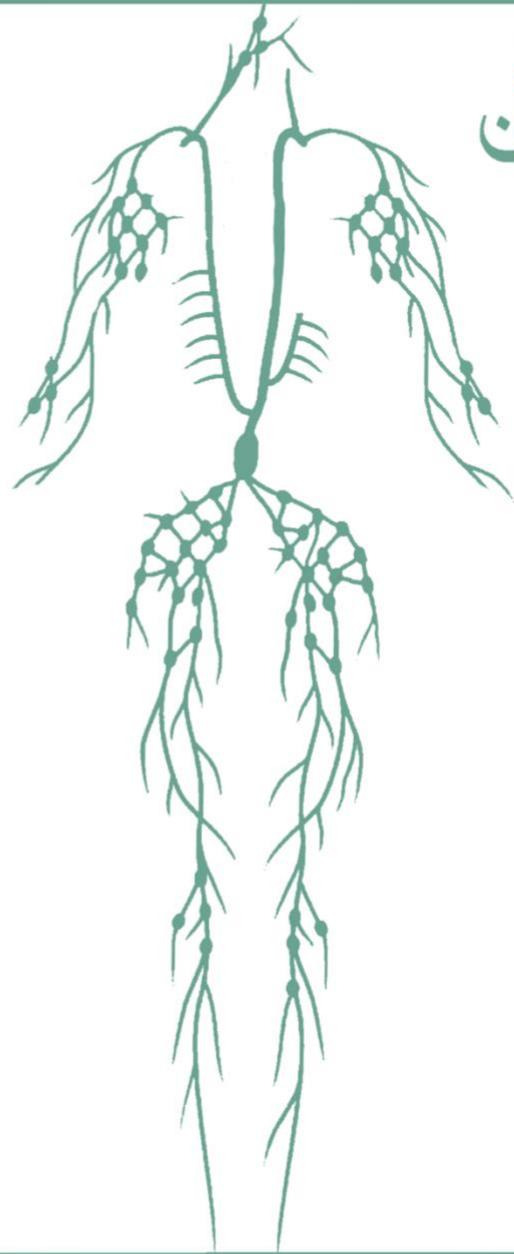
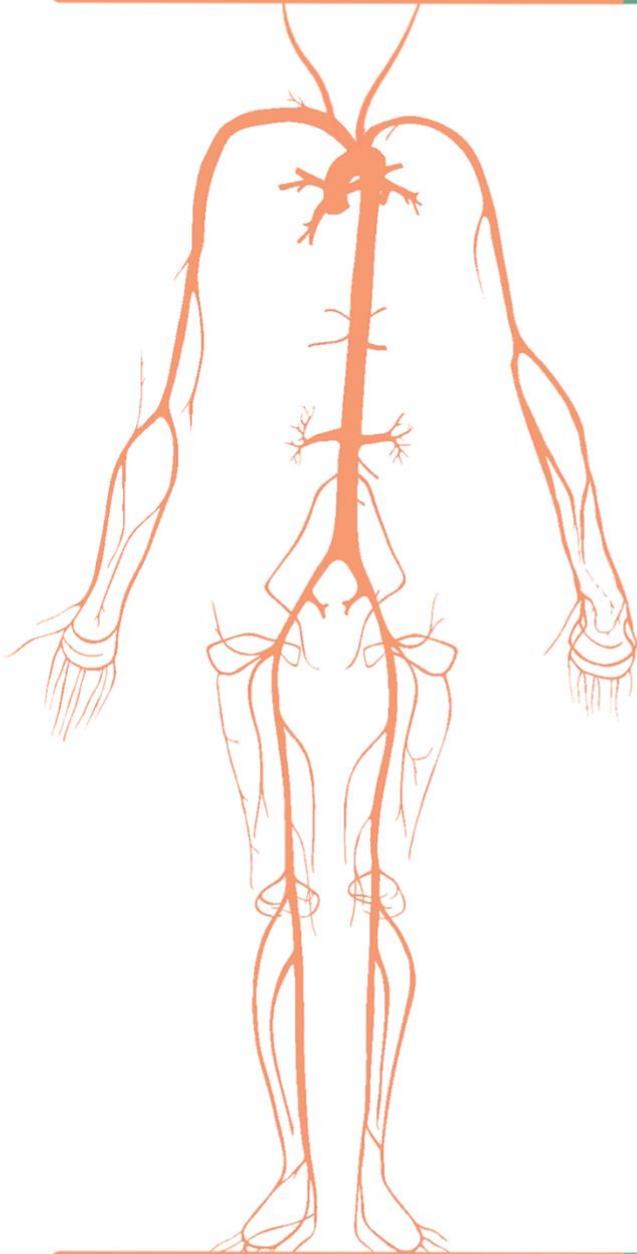


Physiology HematoLymphatic



العلم

Title: Sheet 12- Blood transfusion

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Hemolytic diseases of newborns (HDN)

They are blood problems in newborn babies, their major cause is an incompatibility of the Rh blood group between the mother and fetus.

Pregnancies at risk of HDN are those in which an RhD-negative mother becomes pregnant with an RhD-positive child (the child inherited the D antigen from the father).

There are 3 conditions in which (Rh-) mother can develop Antibodies against Rh+ antigens:

- ❖ Blood transfusion before marriage from Rh+ person: if the (Rh-) mother received blood from an Rh+ donor the mother's immune system would develop Antibodies against Rh+.
- ❖ Placental hemorrhage: means leakage -during pregnancy- of a small amount of fetus blood into the maternal circulation.
- ❖ During delivery, some of the fetal blood is squeezed back to maternal blood.

Example: *a mother is pregnant with her first baby and "her blood group is O-, the father's blood group is O+", she didn't receive any kind of blood transfusion, and let's suppose that the baby is O+ tamam?*

Some of the baby's blood will leak into the mother's circulation and her immune system will recognize it as a foreign antigen, and anti-D antibodies will develop. However, the mother's antibodies can't attack the antigens at the first time of exposure, In other words, the maternal anti-D that is formed at the time of first exposure can not cross the placenta "but the mother becomes sensitized ". Subsequent pregnancies (with RhD+ babies), or repeated encounters with the RhD antigen stimulate the rapid production of anti-D, which can be transported across the placenta and enter the fetal circulation.

In one of these **3 previous conditions** the mother will develop antibodies against RhD+, **and if the attacking occurs** one of these hemolytic diseases may occur:

Erythroblastosis Fetalis (Mild disease):

Once the mother's immune system develops antibodies against Rh antigens these antibodies can pass into the fetal blood and cause Mild Hemolysis of the RBCs of the fetus.

This newborn baby can be rescued by giving him Rh- blood, but not from his mother, Because the mother's blood contains antibodies that will further attack the RBCs of the fetus.

Icterus Gravis neonatorum (kernicterus/moderate disease):

A rare kind of preventable brain damage disease that can happen in newborns, the infant is born at term either jaundiced or will develop jaundice within 24 hours.

There may be severe neurological lesions involving the basal ganglia in which the bile pigments are deposited, because bilirubin crosses the BBB if it rises to critical levels.

Hydrops Fetalis (the most severe disease):

The hemolysis is severe, the infant may die in the uterus or develop severe anemia, jaundice, and edema which leads to death within a few hours.

Okay, Now how to prevent these diseases??

These diseases can be prevented by giving an Rh- mother "Human Gamma Globulins" against Rh+ erythrocytes within 72 hours after she has delivered an Rh+ infant..

How they work??

These Gamma Globulins bind to the antigenic sites on any RhD positive erythrocytes that might have entered into the mother's blood during delivery, preventing Rh+ antigens from inducing antibody synthesis by the mother.

^^ The Adminstrated Antibodies are eventually catabolized.

^^ All the previous diseases are caused by Rh incompatibility

If you are wondering whether ABO blood types incompatibilities will cause hemolytic diseases in newborns or not, theoretically the answer may be yes it causes problems, but actually, it usually does not...

For example, a woman with the blood type (O) has natural antibodies for blood types A and B, if her fetus is of type A or B, there won't be any clinical manifestations, this is because:

- 1) Fetal erythrocytes do not express (A) and (B) antigens strongly.
- 2) Maternal natural antibodies are of the IgM type which does not cross the placenta readily.

BLOOD TRANSFUSION:

First of all, Blood transfusion is the process of transferring blood into one's circulation either the whole blood "whole components" or some products of it.

So we can use technological machines that isolate blood components to provide the patient specifically with what he/she is deprived of.

The indications for blood transfusion

- To restore Blood Volume, in hemorrhage

- To provide red blood cells, in anemias
- To increase blood coagulability in hemorrhagic diseases, Like hemophilia and purpura
- To replace infant's blood with Rh- blood, in Erythroblastosis fetalis
- To supply antibodies to raise the general resistance of the body
- To provide White blood cells, in the case of leukopenia (the doctor said that we provide WBCs in case of leukemia and this is **illogical** and **incorrect**) 🙄
- To supply plasma proteins in hypoproteinemia

Blood transfusion (Donors and recipients) :

Blood type (O) **can donate to every blood type**, since it has **no** antigens but it has natural antibodies for antigen (A) and antigen (B), and we call it **"GENERAL DONOR"**

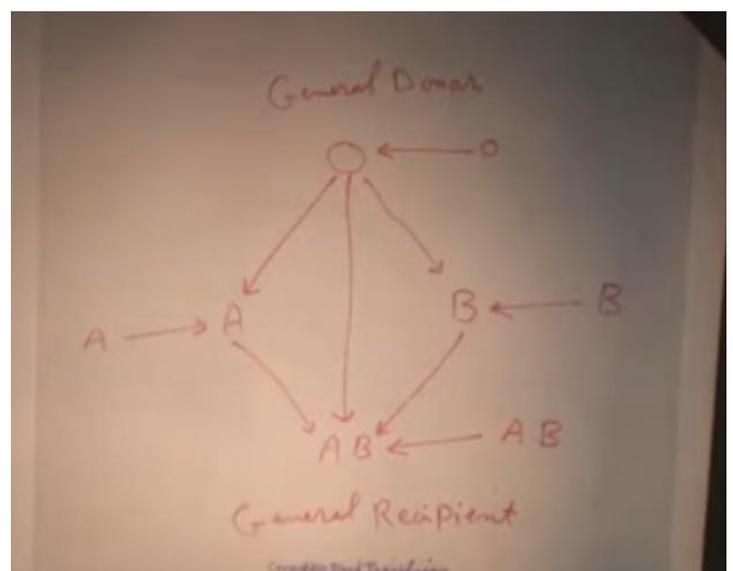
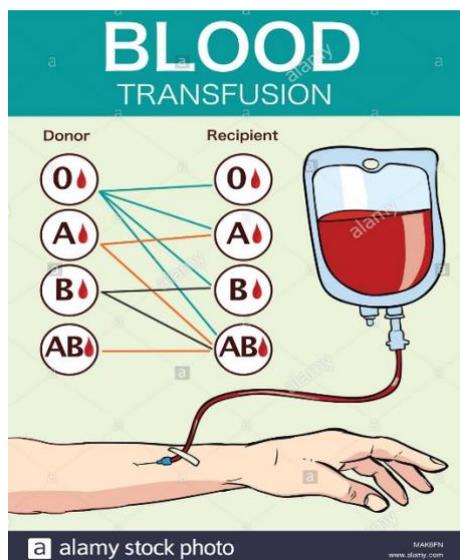
Blood type (AB) **can receive from all blood types**, since it has antigens of both (A) and (B) and **no** antibodies for these blood groups, and we call it **"GENERAL RECIPIENT"**

When the (O) blood group donates to another blood group, the antibodies present in (O) blood group are **diluted** in the blood of the recipient, but the recipient can't tolerate more than 1L which is around 2-3 bags, **why?**

Because antibodies of the (O) group will attack the recipient's blood type and **agglutination occurs**.

SO the term **"general"** donor OR recipient isn't accurate since there are limitations in the amount you are donating or receiving.

By the way, there are no limitations if the patient receives blood from his own blood group like O to O



Complications of blood transfusion :

Early complications:

- 1) Hemolytic reactions; immediate or delayed.
- 2) Reactions due to infected blood:
Allergic reactions to white cells, Platelets, or proteins
- 3) Circulatory overload
- 4) Air embolism
- 5) Citrate toxicity, Hyperkalaemia and Clotting abnormalities (after massive transfusion)

**** extra:** Electrolytes disturbances are the major concerns for patients who receive large amounts of blood via transfusion. Citrate is a compound added to blood products to prevent coagulation prior to administration. In large volumes, Citrate toxicity can lead to hypocalcemia and while blood products are stored, K⁺ leaks out and leads to Hyperkalaemia.

Late complications:

- 1) Transmission of diseases e.g. hepatitis, malaria, syphilis, and AIDS.
- 2) transfusional iron overload
- 3) Immune sensitization, e.g. to the rhesus D antigen

The doctor just read them without explanation

Blood Storage and Use:

When blood is withdrawn, we have to do the following points :

- 1) The blood should be tested, grouped, and cross-matched: determining whether the donor's blood is compatible with the recipient's blood or not.
- 2) Addition of ACD (Acid Citrate dextrose), an anticoagulant
- 3) Storage at a temperature of 4°C
- 4) Take into account the timing of when the blood is transfused
 - If there is no time for the first procedure, then donate the (O, Rh-) because it's compatible with all blood groups
 - In extreme emergencies, we donate (O, Rh+) blood type * I don't know what the doctor exactly did mean but I think if there is no O- stores give the patient an O+ bags until you find O- donor w Allah a3lam*

Blood transfusion is used for donations of RBCs, but not WBCs and platelets, because white blood cells and platelets have a short half-life, so for WBCs and platelets, we need fresh blood samples to transfuse.

By the way, Blood stored for 14 days shows 80% survival of RBCs in the recipient blood 24 hours after the transfusion, then the survived RBCs are destroyed at a rate of 1% per day.

Blood Genotype:

Genotype is the two alleles inherited for a particular gene, while phenotype is the observable characteristics.

There are some rules you must know, such as that A phenotype can either be AA or AO on genotype, as well as B phenotype can either be BB or BO, A and B alleles are dominant, while O phenotype on the other hand is only OO, and AB Phenotype is AB "A and B alleles are codominant"

Another rule is that phenotype Rh+ can be either RhRh (DD) or Rhrh (Dd) in genotype since the Rh+ gene is dominant, while the Rh- is only rhrh (dd)

Let's suppose the mother's phenotype is (A Rh- NN) and the father's phenotype is (B Rh+ MN)

What are the possible genotypes for both??

Phenotype	A Rh- NN	B Rh+ MN
The possible genotypes	AA rhrh NN "dd"	BB RhRh MN "DD"
	AO rhrh NN "dd"	BB Rhrh MN "Dd"
		BO RhRh MN "DD"
		BO Rhrh MN "Dd"

Test yourself 😊 :

A 27-year-old man is brought by an ambulance to the resuscitation room of the Emergency Department after a high-speed road traffic crash. He has major injuries, including a lacerated left arm. He has suffered a massive hemorrhage. Blood transfusion is required immediately. What blood group of red cells should he receive?

- 1) O rh
- 2) AB Rh
- 3) O Rh
- 4) AB rh
- 5) none of the above let him die

Good luck

