Lecture Notes

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PHYSIOLOGY

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019

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Hemolytic diseases of newborns (HDN)

- There are 3 conditions in which the mother (Rh-negative) my develop antibodies:
  1. Blood transfusion before marriage by blood from Rh+ person (it's either that she develops these antibodies or that she becomes sensitive to developing these antibodies in the future)
  2. Leakage during pregnancy of a small amount of fetal blood (Rh+) into maternal circulation (placental hemorrhage).
  3. During delivery, some blood squeezes back to maternal blood.

- In these 3 aforementioned conditions, one of the following hemolytic diseases may occur:
  1. Erythroblastosis fetalis (mild disease)
     Small amount of RBCs leak into the mother circulation, some mothers develop antibodies against D antigens. These antibodies pass to fetal blood & 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 in this case, we can expose the child to more serious dangers of hemolysis and agglutination).

  2. Icterus Gravis neonatorum (kernicterus - moderate disease)
     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.

  3. Hydrops Fetalis (severe disease – the most severe actually)
     The hemolysis is severe, the infant may die in the uterus or develop severe anemia, jaundice & edema; dies within few hours.

- Fortunately, these diseases can be prevented by giving an Rh-negative mother human gamma globulin against Rh-positive erythrocytes within 72 h after sha has delivered an Rh-positive infant. These antibodies bind to the antigenic sites on any Rh-positive erythrocytes that might have entered the mother's blood during delivery and prevent them from inducing antibody synthesis by the mother. The administered antibodies are eventually catabolized.

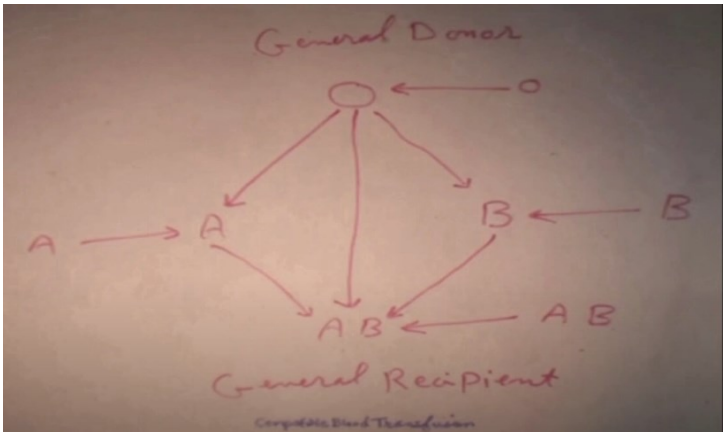
- You may be wondering whether ABO blood types incompatibilities are also a cause of hemolytic diseases of newborns. For example, a woman with type O blood has natural antibodies to both A and B antigens. If her fetus is of type A or B, this theoretically should cause a problem. Fortunately, it usually does not because:
  1. A & B antigens are not strongly expressed in fetal erythrocytes.
  2. The natural antibodies are of the IgM type, which do not readily cross the placenta.

Blood transfusions

- Indications of blood transfusion:

1. To restore Blood Volume, e.g., in haemorrhage
2. To provide RBCs, e.g., anaemias
3. To increase blood coagulability in hemorrhagic diseases, e.g., hemophilia & purpura
4. To replace infant's blood with Rh-ve blood in erythroblastosis fetalis
5. To supply antibodies to raise the general resistance of the body
6. To provide WBCs , e.g., in leukopenia (= decreased WBCs) (this makes no sense btw)
7. To supply plasma proteins in hypoproteinemia

- There are machines now that can separate blood components to provide the patient specifically with what he/she is deprived of.



- This figure shows how blood transfusions work out :

1. Blood type (O) can donate to all other blood types because it has no antigens , it only has natural antibodies (General Donor)
2. Blood type (AB) can receive from all other blood types because it has antigens of both (A) and (B) and no antibodies for these blood groups (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 2-3 bags (1 liter), why is that?
  Because antibodies of the (O) group will attack the recipient's blood type and agglutination will occur.

- This means that (General Donor) OR (General Recipient) terms aren't accurate since there are limitations for blood transfusions from one group to another, though these limitations aren't seen in blood transfusions between individuals with similar blood groups.

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
  6. Hyperkaliemia
  7. Clotting abnormalities (after massive transfusion)

- Late complications:
  1. Transmission of diseases (hepatitis, malaria, syphilis & AIDS)
  2. Transfusional iron overload
  3. Immune sensitization (to the rhesus D antigen)

Blood storage & Use

- When we take blood from individuals to store it in blood banks, we should abide by the following:

  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. Be careful of when the blood is transfused
     a. If there is no time to test, group & cross-match, then donate the (O, Rh-) because it's compatible with all blood groups
     b. In extreme emergencies, we donate (O, Rh+) blood type.

- Blood transfusion is used usually 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 (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).

- Remember that stored blood is not suitable for transfusion of lymphocytes, of platelets.

Blood Genotype

This is an example on blood genotypes and phenotypes
The father has a phenotype of A Rh+ MN, the mother has a phenotype of B Rh- NN
What are the possible genotypes for both parents?

The father:
1. AA RhRh MN
2. AO RhRh MN
3. AA Rhrh MN
4. AO Rhrh MN

The mother:
1. BB rhrh NN
2. BO rhrh NN

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