RED BLOOD CELLS

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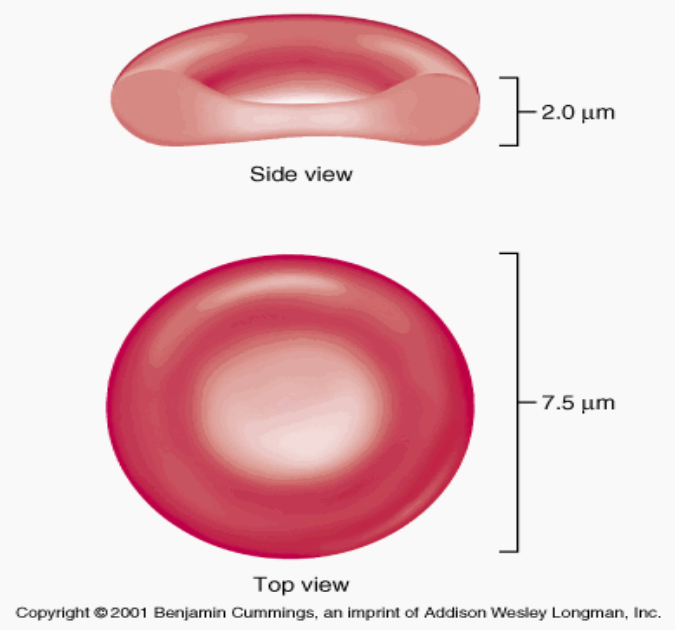

Erythrocytes (red blood cells or RBCs) are anucleate, biconcave cells, filled with hemoglobin, that transport oxygen and carbon dioxide between the lungs and tissues. They are produced in the red bone marrow by a process called erythropoiesis. RBCs don't have mitochondria so only glycolysis take place in these cells. These cells have enzymes required for glycolysis.

BICONCAVE DISK

RBCs have bioconcave structure i.e. periphery is thicker than central part. The biconcave disk provide important functions including:

1. More amount of Hb can bind with more amount of oxygen to transport.
2. Large surface area provide more amount of gas exchange
3. RBC can swell easily and squeeze easily through small capillaries without rupture.

RBC MEMBRANE

RBCs have lipid bilayer membrane. Some peripheral proteins are present under interior surface of RBCs. These peripheral proteins called **spectrins** make a network and these networks are attached with the help of other proteins **ankyrins**, to integral proteins of RBC membrane. These networks hold the RBC membrane tightly to the interior of RBC.

HEREDITARY SPHEROCYTOSIS

If a person inherits defective gene for ankyrins and spectrins, such RBCs with mutant networks lose their membrane and become spherical. This disorder is called hereditary spherocytosis.

If this problem is mild, the disease is called **hereditary elliptocytosis**.

SYNTHESIS OF HEMOGLOBIN

During synthesis of Hb, the first molecule produced from erythroblast is **pyrrole ring**.

Four pyrrole rings assemble to form **protoporphyrin**.

In the center of protoporphyrin ring, iron is placed which is known as **heme**. Next, synthesis of **globin chain** takes place and the molecule is called hemoglobin monomer.

Erythropoietin can produce four types of globin chains (alpha, beta, gamma and delta).

96% of Hb is **Hb-A** which is composed of two alpha globin chains and two beta globin chains

HbA_2 is composed of two alpha globin chains and two delta globin chains.

HbF (fetal hemoglobin) is composed of two alpha globin chains and two gamma globin chains. HbF have stronger affinity for oxygen so it can pull oxygen from maternal circulation to fetal circulation.

THALASSEMIA

The disorder in which there is quantitative problems with production of globin chains is called thalassemia.

ABO BLOOD GROUPS

Antigens are expressed on RBC surface.

BLOOD GROUP	ANTIGEN	ANTIBODY	DONOR
A	A	B	A, O
B	B	A	B, O
AB	A+B	-	A, B, AB, O
O	-	A+B	O

A and B antigens are present in environment as food and microbes. When A antigen enters the body of a person having blood group A, he will recognize it as self and will not make antibodies-A. But when a B antigen enters the body of a person having a blood group B, he will produce antibodies-B. And hence, we can say that a person with blood group A has antibodies-B.

Rh BLOOD GROUPS

Rh+ (having Rh Antigen)

Rh- (lacking Rh Antigen)

Rh antigen is not present in environment or microbes, so they don't normally enter our body.

Person who is Rh- doesnot normally have anti-Rh antibodies but when Rh+ RBCs comes into the body, then that person can make anti-Rh antibodies.

ERYTHROBLASTOSIS FOETALIS

The condition arises when mother is Rh- and the fetus is Rh+. Just after delivery, a small amount of fetal blood goes to maternal blood and mother develops anti-Rh antibodies. The first baby is born without complications but complications arise in later fetuses.

During 2nd pregnancy, if again the baby is Rh+, anti-Rh antibodies can come to fetus and destroy it. When this baby is born, the baby will have severe anemia. After birth of 2nd baby, some more fetal blood reaches maternal blood and more antibodies are made.

In 3rd pregnancy, the Rh+ baby's RBCs are lost severely due to which baby have excessive hematopoiesis and the baby's liver and spleen enlarge. Baby has severe anemia and large amount of bilirubin is produced which goes to the brain and destroy cortex and basal ganglia.

In 4th pregnancy, mother has a lot of anti-Rh antibodies due to which much of baby's RBCs are destroyed. Baby will have the following problems:

- Cardiac failure and edema
- Hepatomegaly, splenomegaly
- Hydrops fetalis
- Baby cannot be delivered normally

Either mother will die or baby will be delivered through C-section.

Hematopoiesis in liver and spleen is different than bone marrow. Bone marrow allows only mature products to go into circulation. The liver and spleen may also allow precursor cells to go into circulation. When this defective baby is born, he will have a lot of erythroblasts in the blood and hence this disease is called erythroblastosis fetalis.

TREATMENT:

Commercially available anti-Rh antibodies injection with the name **RhoGAM** is used to treat Erythroblastosis foetalis. As soon as Rh- mother gives birth, the baby's blood is checked. If the baby is Rh+, the mother is injected with RhoGAM within 72 hours after birth. This injection kill fetal RBCs circulating in maternal blood and second delivery takes place without complications.