

The Anemias

Anemia means a deficiency of red blood cells, which can be caused either by too rapid loss or too slow production red blood cells. Some types of anemia and their physiological causes are the following:

Blood Loss Anemia:

After rapid hemorrhage the body replaces the plasma within 1 to 3 days, but this leaves a low concentration of red blood cells. If a second hemorrhage does not occur, the red blood cell concentration returns normal within 3 to 4 weeks.

In chronic blood loss, the person frequently cannot adsorb enough iron from the intestines to form hemoglobin as rapidly as it is lost. Therefore, red cells are then produced with too little hemoglobin inside them, giving rise to *microcytic hypochromic anemia*, which is illustrated in Figure (9).

Aplastic Anemia:

Bone marrow aplasia means lack of a functioning bone marrow. For instance, the person exposed to gamma ray radiation from a nuclear bomb blast is likely to sustain complete destruction of bone marrow, followed in a few weeks by lethal anemia. Likewise, excessive x-ray treatment, certain industrial chemicals, and even drugs to which the person might be sensitive can cause the same effect.

Megaloblastic Anemia:

Loss of any one of vitamin B12 and folic acid can lead to very slow reproduction of the erythroblasts in the bone marrow. As a result, these grow too large, with odd shapes, and are called *megaloblasts*. Thus, atrophy of the stomach mucosa, as occurs in *pernicious anemia* or loss of the entire stomach as the result of total gastrectomy can lead to megaloblastic anemia. Also, patients who have intestinal sprue, in which folic acid, B12, and other vitamin B compounds are poorly absorbed, often develop megaloblastic anemia. Because the erythroblasts cannot proliferate rapidly enough to form normal numbers of red blood cells, the cells that are formed are mostly oversized, of bizarre shapes, and have fragile membranes (fig.9). Therefore, these cells rupture easily, leaving the person in dire need of an adequate

number of red cells.

Hemolytic Anemia:

Many different abnormalities of the red blood cells, which are mostly hereditarily acquired, make the cells very fragile, so that they rupture easily as they go through the capillaries. Therefore, even though the number of red blood cells formed is completely normal, the red cell life span is so short that serious anemia results. Some of these types of anemia are the following:

- ***Hereditary spherocytosis***, the red cells are very small in size, and they are *spherical* in shape, rather than being biconcave discs. These cells cannot be compressed, because they do not have the normal cell membrane structure of the biconcave discs. Therefore, on passing through the splenic pulp they are easily ruptured by even slight compression.

- ***Sickle cell anemia***, the cells contain an abnormal type of hemoglobin called *hemoglobin S*, caused by abnormal composition of the beta chains of the hemoglobin. When this hemoglobin is exposed to low concentrations of oxygen, it precipitates into long crystals inside the red blood cell. These crystals elongate the cell and give it the appearance of being a sickle, rather than a biconcave disc. The precipitated hemoglobin also damages the cell membrane so that the cells become highly fragile, leading to serious anemia, in which low oxygen tension in the tissues causes sickling, which causes impediment of blood flow through the tissues, in turn causing still further decrease in oxygen tension, and lead to a serious decrease in red blood cell mass within a few hours and, often, to death.

- ***Erythroblastosis fetalis***, Rh positive red blood cells in the fetus are attacked by antibodies from an Rh negative mother. These antibodies make the cells fragile and cause the child to be born with serious anemia. The extremely rapid formation of new red cells that occurs in erythroblastosis fetalis causes a large number of early *blast* forms of red cells to be released into the blood.

Hemolysis also occasionally results from transfusion reactions, from malaria, from reactions to certain drugs, and as an autoimmune process.

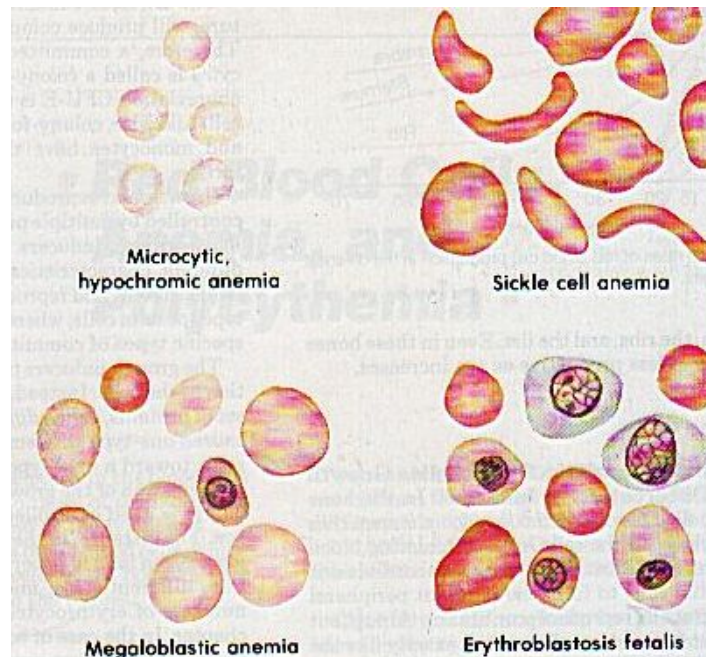


Fig.(9) Red blood cells in different types of anemia

Polycythemia

Secondary Polycythemia:

Whenever the tissues become hypoxic because of too little oxygen in the atmosphere such as at high altitudes, or because of failure of delivery of oxygen to the tissues as occurs in cardiac failure, the blood-forming organs automatically produce large quantities of red blood cells. This condition is called *secondary polycythemia*, and the red cell count commonly arises to as high as 6 to 8 million/mm³.

A very common type of secondary polycythemia, called *physiologic polycythemia*, occurs in natives who live at altitudes of 14,000 to 17,000 feet. The blood count is generally 6 to 8 million/mm³.

Polycythemia Vera (Erythremia):

In addition to those persons who have physiologic polycythemia, others have a condition known as *polycythemia vera*, in which the red blood cell count may be as high as 7 to 8 million and the hematocrit as high as 60 to 70

%. Polycythemia vera is a tumorous condition of the organs that produce blood cells. It causes excess production of red blood cells in the same manner that a tumor of a breast causes excess production of a specific type of breast cell. It usually also causes excess production of white blood cells and platelets. In polycythemia vera not only does the hematocrit increase, but the total blood volume also increases, rarely to almost twice normal. As a result, the entire vascular system becomes intensely engorged. The viscosity of the blood in polycythemia vera sometimes increases from the normal of three times the viscosity of water to ten times that of water.