ETIOLOGY AND PATOGENESIS OF DIFFERENT TIPES OF ANEMIAS

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Annotation: *This article discusses anemia, hemolytic anemia and its types, the genetic aspects of the disease development, and methods of treatment. The article also highlights the various manifestations of hemolytic anemia in adults and children*.

Keywords: *anemia, hemolytic anemia, hemolysis, hemoglobin, classification of anemia.*

Currently, anemia is a widespread disease among people, characterized by a decrease in the number of red blood cells and a change in their quality due to a decrease in the amount of hemoglobin. Anemia can be caused by disruption of the process of blood formation, hemolysis, bleeding, and other factors.

Anemia has various forms and is often seen as a manifestation of many diseases. Therefore, several classifications of anemia have been developed for its diagnosis and treatment.

Anemia is classified based on the color index as hypochromic, normochromic, and hyperchromic anemia. The color index indicates the degree of saturation of erythrocytes with hemoglobin. The normal range of the color index is between 0.8 and 1.1.

Hypochromic anemia is the most common form of anemia, where the color index is less than 0.8. Iron deficiency anemia is a type of hypochromic anemia. In this type of anemia, a deficiency of iron microelement in the organism leads to a decrease in hemoglobin synthesis, resulting in a decrease in the number of red blood cells.

Normochromic anemia has a color index within the range of 0.8-1.1. This type of anemia includes:

- Hemolytic anemia - characterized by the rapid destruction of erythrocytes;
- Post-hemorrhagic anemia - occurs due to significant blood loss;
- Anemia caused by a decrease in erythropoietin synthesis; this hormone is synthesized in the kidneys and is involved in the regulation of erythrocyte production;
- Neoplastic anemia - occurs due to the growth of a tumor in the bone marrow;
- Aplastic anemia - caused by a severe disturbance in bone marrow function, leading to a decrease in erythrocyte, leukocyte and platelet production and, in severe cases, death.

Hyperchromic anemia has a color index greater than 1.1. This type of anemia includes:

• Vitamin B_{12} deficiency anemia, also known as Addison-Birmer disease - caused by a deficiency of vitamin B_{12}, which leads to a decrease in blood production, as well as damage to the bone marrow and nervous system;

• Folic acid deficiency anemia - caused by a lack of folic acid in the body, which leads to a slow formation of erythrocytes and the development of megaloblastic anemia;

• Myelodysplastic syndrome (MDS) - a complex hematological disorder that affects the bone marrow's ability to produce normal cells.

Red blood cells live an average of 90-120 days. They are eliminated by the spleen and liver at the end of their life. Red blood cells are of great importance in providing oxygen. The functional activity of red blood cells is determined by the following factors:

1. Structure (composition) of red blood cells;
2. Shape of red blood cells (biconcave disk);
3. Quantity of hemoglobin.

1-table

• The normal level of hemoglobin in children and adults

Age	Gender	Measurement unit - g/l
5-10 Age		134 — 198
10-12 Age		120 — 150
12-15 Age	Females Males	115 — 150 120 — 160
15-18 Age	Females Males	117 — 153 117 — 166
18-45 Age	Females Males	117 — 155 132 — 173
45-65 Age	Females Males	117 — 160 131 — 172
65 after a certain age	Females Males	120 — 161 126 – 174

In the structure of the red blood cell membrane, the presence of integral membrane proteins is of great importance, and their ability to deform is important for its functional activity. Deformation depends on the following:

1. Internal factors. Under optimal conditions, intra-erythrocyte oncotic pressure is equal to the oncotic pressure of plasma with the optimal hemoglobin concentration in the cell. If the external oncotic pressure is high, plasma components penetrate into the erythrocyte and it swells and ruptures. The intra-erythrocyte oncotic composition is determined by the optimal composition of potassium and magnesium, which relate to the tissues and provide strength to the erythrocyte membrane. In addition, the membrane status of red blood cells is determined by the appropriate ratio of phospholipids and ion components in the membrane.

2. External factors (factors outside the erythrocyte). This includes the oncotic pressure of transport isotopes in plasma that provide hemoglobin metabolism,

autoimmune reactions against erythrocytes, jaundice, parasitic infections (malaria), etc.

Thus, the combination of internal and external factors ensures the functional activity of erythrocytes. In hemolytic anemia, red blood cells break down prematurely in the blood. "Hemolysis" refers to the breakdown of red blood cells (hemo - blood, lysis - breakdown). In response to the rapid breakdown of red blood cells, erythropoietin (EPO) is produced, which is an important factor in producing new red blood cells. In some cases, the bone marrow can produce an excess amount of red blood cells due to conditions such as pregnancy, altitude sickness, folate deficiency, or viral infections, which can cause a significant increase in the degree of hemolysis. In hemolytic anemia, most cases involve intravascular hemolysis, which can lead to a shorter life span of erythrocytes, and hemolysis occurs more rapidly. Hemolytic anemia has several types such as hereditary spherocytosis, autoimmune hemolytic anemia, elliptocytosis, etc.

Hereditary and acquired hemolytic anemia are distinguished from each other. Hemolytic anemia is classified based on whether the abnormality is intrinsic within the red blood cells (intracorpuscular) or outside the red blood cells (extracorpuscular).

Intrinsic and intracorpuscular causes may include:

- Hemoglobinopathies (sickle cell anemia, thalassemia, etc.);
- Enzyme defects (glucose-6-phosphate dehydrogenase deficiency, etc.);
- Membrane and cytoskeletal anomalies (hereditary spherocytosis, acanthocytosis, stomatocytosis, etc.).

Sickle cell anemia is a type of anemia where there is a change in the structure of the red blood cells, resulting in the circulation of oxygen-free blood and the formation of clots in the blood vessels. Sickle cell anemia is found in 0.3-1% of black Africans and Americans and is caused by an abnormal type of hemoglobin called hemoglobin S, which is due to a change in the beta chain of hemoglobin where glutamate is replaced by valine amino acid. This results in the formation of long-chain crystals of hemoglobin in low oxygen environments, which can transform the blood cells into sickle-shaped crystals, leading to the formation of clots. Sickle cell anemic patients often experience "crises".

Hemolytic disease of the newborn occurs due to miscarriage and Rh incompatibility during pregnancy. It accounts for 5% of hemolytic anemia cases and 11% of anemia cases. When the fetus is Rh-negative and the mother is Rh-positive, the mother's immune system recognizes the fetus as a foreign object, resulting in the production of antibodies against the fetus's Rh antigen. As a result, the baby's red blood cells are destroyed, leading to hemolytic anemia.

Mechanical hemolytic anemia occurs due to the physical destruction of red blood cell membranes, which can be caused by heart valve replacements, flat feet, high blood pressure or eclampsia during pregnancy.

Chronic disease anemia has long been a relevant issue in the world, as its etiology and pathogenesis are not well studied. One of the etiological factors of anemia is pathology of the thyroid gland, liver, kidneys, digestive system, and others. In diffuse toxic goiter with intensive hyperactivity of the thyroid gland, changes in peripheral blood are observed, such as anemia, lymphocytosis, eosinophilia, hypogranulocytosis, and thrombocytopenia, with a decrease in the osmotic resistance of erythrocytes.

Anemia is a common disease among the population. It is important to realize that there are different types of anemia and that iron supplements are not always the solution. Hemolytic anemia, for example, is a contraindication for iron preparations and can lead to serious consequences.

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