The clinical value of blood. .
Allowance for doctors'
(Institute of Pediatric Hematology, the drafters of the A.G .Rumyantsev, E.B .Vladimirskaya), Moscow, 1999

Automatical Counting	Units Measure-ment	Normal Level	Short Form
HGB-Hemoglobin	G/Liter	120-160	Hb
RBC - erythrocyte	12 10 /L	3,9-5,9	Er
HCT - Hematocryte	%	36,0-48,0	Ht

MCV- average volume of erythrocyte	3 1 micron = 1 - femtoliter (fl)	80 - 95	
MCH – the average content of Hb in erythrocyte	Pikogram 1 г =1012 pikograms	27,0-31,02	Colour Index (0,85-1,0)
MCHC – average concentration of Hb in erythrocyte	G/dl или g %, less g/l	32,0-36,0	
RDW – width of the distribution curve of erythrocyte by volume	%	11,5-14,5	**anisocytosis**

RETICULOCYTE

Normal values:

- **The relative number of reticulocyte 0,5-1,2%**
- **The absolute number of reticulocyte 30-70 x 10 * 9 / L**
- **In cord blood of newborns 20-60%.**

Anemia – pathologic state,accompanied by decrease in the level of hemoglobin and the quantity of erythrocytes per unit of volume of the blood.

Erythrocytes - less informative index of anemia than the level of hemoglobin therefore, in the general practice the basic criterion of severity is precisely Hb:

- **Light degree of anemia - Hb 110-90 g / l,**
- **The average degree of severity - Hb 90-70 g / l,**
- **Severe anemia - Hb below 70 g / liter**

In terms of number of reticulocyte, anemia are divided into:

- Regenerative- reticulocyte from 1.5 to 5% (or 15 to 50 ppm)
- Hyper-regenerative - reticulocyte more than 5% (or more than 50 ppm)
- Aregenerative- Low reticulocyte (less than 0.5%), not according to the severity of anemia or lack of reticulocyte.

Classification of Anemia

- I. Anemias resulting from acute blood loss
- II. Anemias resulting from a deficit of erythropoesis

1) At the expense of maturation (mainly microcyte):

- violation of absorption and utilization of iron (iron)
- violation of transportation of iron (atransferrinemia)
- violation of recycling iron (thalassemia, sideroblastic anemia)
- violation of reutilization of iron (anemia of chronic disease);

Anemia (continued)

2) At the expense of differentiation (essentially normal):

- aplastic anemia (congenital and acquired)

3) At the expense of proliferation (mainly macrocytes)

- B12-DEFICIENCY anemia
- Folic-DEFICIENCY anemia.

Anemia (continued)

- **Anemias resulting from increased destruction of erythroid series cells - haemolytic:**

- **1) caused by internal defects of erythrocytes membranopathy, enzimopathy, haemoglobinopathies;**

- **2) the external (extracllular) effects:**
- **autoimmune, traumatic, etc.**

- **Classification D. Nathan, F. Oski, 2003, (book «Anemias in children», NA Finogenova et al, 2004.):**

IRON DEFICIENCY ANEMIA (IDA)

- IDA recorded 20% of the world's population.
- 83-90% of all anemia constitute IDA.
- In children the first 2 years of life the frequency of iron deficiency was 73%.
- The second peak IDA development - adolescence.

CAUSES FOR DEVELOPMENT of IDA

- Alimentary iron deficiency as a consequence of an unbalanced diet;
- Increasing demand for iron and the reduction of the deposit (or the frequency of multiple pregnancies, prematurity, lactation periods of rapid growth, sports)
- Chronic blood loss (nasal bleeding, diaphragmatic hernia, and bleeding from GIT and diverticulitis, menorrhagia, renal hemorrhage, idiopathic lung hemosiderosis)
- Reduction of iron absorption (malabsorption, chronic inflammatory diseases GIT, gastrectomy).

The total content of iron in the body - about 4.2 g.
From them:
- 75-80% belongs to the hemoglobin

- 20 - 25% reserve

- 5-10% part of the myoglobin

-1% is part of the enzyme for the tissue respiration

Anemic Syndrome

- - Decrease amount of Hemoglobin

Complaints: General weakness, reduction in the appetite, physical and mental fatigue, shortness of breath, vertigo, noise in the ears, flashing "flies" before the eyes, unconscious states, in heavy cases – leads to coma.

- Symptoms: the pallor of the skin and mucosa, tachycardia, hypotonia, the expansion of the boundaries of heart, muting tones and systolic murmur.
- Laboratory signs: a decrease in the level Hb and a drop in hematocrit (lower than 35% in children, 37% in girls and 42% in youths)

Sideropenic Syndrome (Deficit of Iron)

- dystrophic changes in the skin and its appendages (shedding of hair, the brittleness of nails), the atrophy of the mucous membranes of nose, esophagus and stomach, gingivitis, glossitis, angular stomatitis);
- the distortion of taste and sense of smell
- muscular pain (deficit of myoglobin)
- muscular hypotonia
- alteration in the nervous system: slowing down of conditioned reflexes, decrease attentiveness, worsening of memory, delay of intellectual development.

Laboratory Signs of Iron Deficit Anemia

- A decrease MCV - less than 75
- Reduction in the colored index - less than 0,85
- Increase RDW
- A decrease MCHC - less than 30.
- Morphology of the erythrocytes - hypochromic, anisocytosis and poikilocytosis
- Biochemical - decrease level of serum ferritin
- Decrease level of serum iron
- Increase Total Iron Binding Capacity (TIBC)
- Increase level of serum transferrin

Developmental Stages of Iron Deficiency Anemia (WHO, 1977)

- Pre-latent (exhaustion of tissue reserve of iron; index of the blood within the standard; there are no clinical manifestations)
- Latent (deficit of iron in the tissue and the decrease of its reservoir transport; index of the blood within the standard; clinical picture is caused by the sideropenic syndrome)
- Iron Deficiency Anemia (deviation from the standard index of the blood in dependence on the degree of severity; the clinical manifestations in the form of sideropenic syndrome and general anemic symptoms)

Differential Diagnosis of Iron Deficiency Anemia

it is carried out with other forms of the hypochromic anemias:

- Thalassemia - there are no signs of deficit of iron, the presence of pathologic hemoglobin with the electrophoresis.
- Sideroblastic Anemia - examination of the puncture specimen of bone marrow.
- Chronic poisoning by lead - specific starts in the erythrocytes.
- Against the background chronic infectious and inflammatory diseases - hypochromic normocytic (thinner frequent microcytic) anemia, normal or increased level of ferritin in combination with the lowered content of serum iron and transferrin.

Ferritin

- water-soluble complex of iron hydroxide with the protein apoferritin.
- It is located in cells of the liver, spleen, bone marrow, in the reticulocytes.
- Ferritin is the basic protein in human which deposits iron and concentration of ferritin in the serum reflects the reserve of iron in the organism.

Serum Transferrin
(Beta-globulin).

- Main function - transport of absorbed iron in the depot (liver, spleen), into the medullary erythroid predecessors and into the reticulocytes.
- Basic place of synthesis - liver.
- An increase in the content of transferrin with lowering in the level of iron of serum is characteristic for the iron-deficiency state.
- A decrease in the level of transferrin can be with the damage of the liver (different genesis) and with the loss of protein (for example, in nephrotic syndrome).
- The level of transferrin is increased in the last term of pregnancy.

Transferrin

LIMITATION

- The concentration of TF is subjected to the daily variations
- Acute inflammation contributes to lowering the TF level

CLINICAL SIGNIFICANCE

- Basic clinical index for the differentiation between the iron-deficiency ([TF]↑) and hemolytic anemia ([TF]↓)
- More precise index than total iron binding capacity
- After the liberation of iron from the complex, TF ion of Fe3+ must be restored into Fe2+

Treatment of Iron Deficiency Anemia

- Diet: meat, liver, yeast, fish
- Oral preparations: recovery rate Hb does not differ from parenteral introduction, side effects are less, excessive introduction does not lead to hemosiderosis.

- Dosage : 1 hour prior to the meal

in the evening time (absorption increase in the second-half of a day)

During first 3 days - half dose of the selected preparation.

Possibilities : dark colour of stool and transitory dyspeptic disorders (nausea, diarrhea or watery stool)

Check analysis of the blood: in 7-10 days – reticulocyte reaction; 4 weeks - increase Hb and Ht

During the normalization of the indices of the blood – reduce the dose of preparation

Parenteral Introduction of Iron

- in exceptional cases
- in severe iron deficiency anemia
- rendering to special aid
- intolerance of oral preparations (after repeated replacement and reduction in the dose)
- diseases of gastro-intestinal tract
- syndrome of the disrupted intestinal absorbtion
- after the extensive resection of the small intestine
- continuous blood loss
- not compensated by oral method

Complications of Parenteral Introduction

- Local reactions (pains, phlebitis)
- General reactions (anaphylaxis, fever, head and articulate pains, vomiting, rash, bronchospasm).

Preparations:

Venofer - for the intravenous introduction,

Maltofer, Ferrum-Lek - intramuscular

Overdose of Iron

In the first 6-8 hours - epigastral pains, nausea, vomiting (including with the blood), diarrhea, pallor, sleepiness, acrocyanosis)

For 12-24 hours - metabolic acidosis, leukocytosis, there can be spasms, coma, after 2-4 days - necroses of the liver and kidneys.

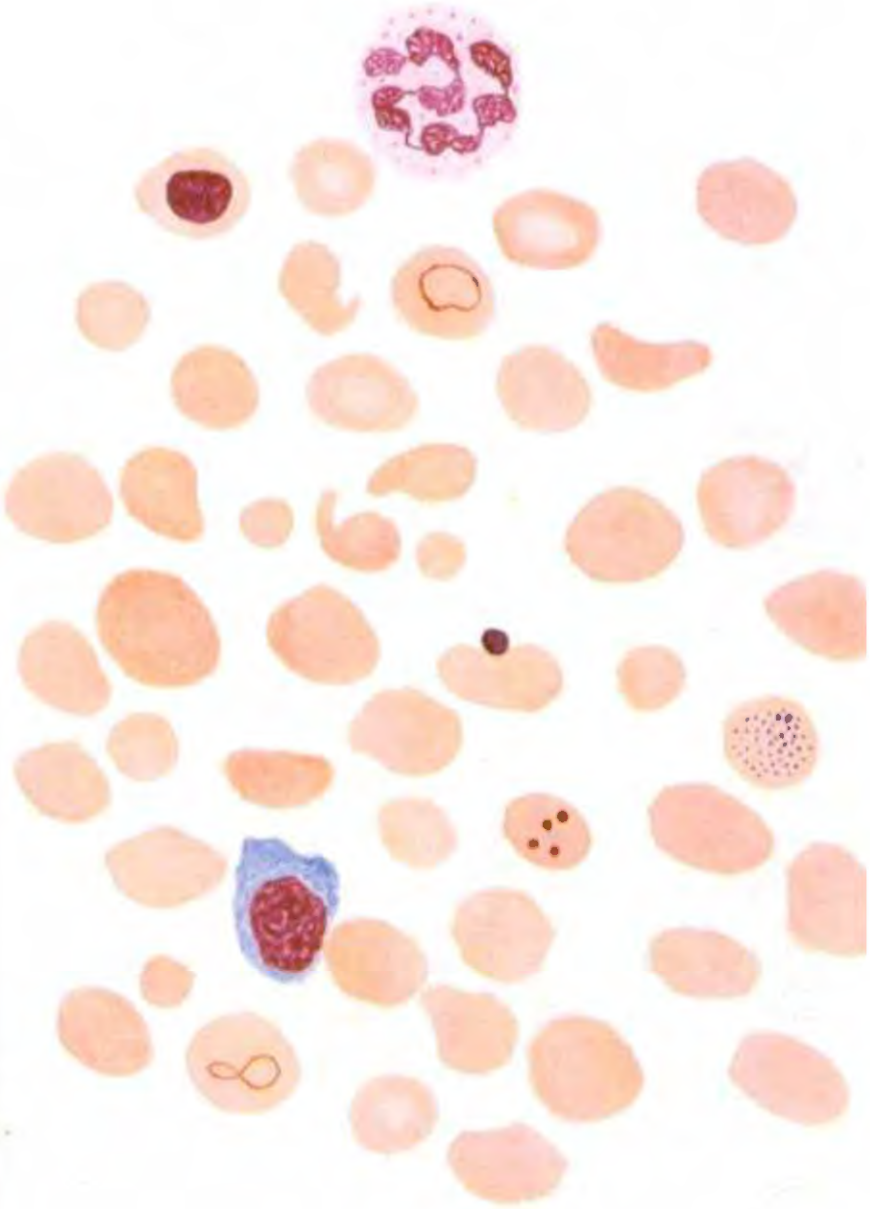
Treatment: emetic means, stomach lavage, the method of milk with the egg white, Deferoksamin, Desferal, symptomatic therapy.

Iron Overload Syndrome

- ! Human does not have special mechanism of the excretion of iron! Its excessive introduction leads to hemosiderosis. Clinical manifestations: Gradual increase of the dimensions of the liver, spleen, cardiopathy, suprarenal insufficiency, diabetes mellitus, eunuchoidism.

Laboratory signs:

- Increase in serum iron (more than 30 mmol/liter), percentage of saturation transferrin by iron it is more than 45%, ferritin of serum it is more than 1000 ng/ml; Test with desferalom; + the specific signs of the defect of internal organs (ECG, level biochemical index of functions of the liver, the level of hormones and others)



54. Картина периферической крови при B_{12}-дефицитной анемии.

Anemia due to the disturbance of the proliferation

- B12 and Folate Deficiency Anemia
- Megaloblastic

Causes of B12 Deficiency Anemia

- Deficiency of the internal factor of Kastla
- Atrophy of the mucous membrane of stomach as the most frequent reason, gastrectomy
- Inflammatory or autoimmune diseases of small intestine, the removal of its specific sections
- Helminthic invasion (tapeworms),insufficiency of the vitamin B12 in the food (it is contained in the meat, bean).

Causes of Folic Acid Deficiency

- Alimentary
- Increase in need (prematurity birth, rapid growth rate, pregnancy)
- Feeding by the goat milk
- Disease of the small intestine
- Comsumtion of folate antagonist with metatreksat
- Anti-convulsant (diphenine),oral contraceptives
- Chronic hemolysis

Clinical

- Anaemic syndrome
- Skin is pale with the lemon shade
- Slight jaundice of the scleras
- Disturbance of the proliferation of the epithelium of gastro-intestinal tract: dry-red tongue, loss of appetite, achylia, diarrhea, erosive and ulcerous changes in the mucous membranes

Only for B12-Deficiency Anemia

- Damage of CNS - funicular myelosis (degeneration and the sclerosis of the posterior and lateral horn of spinal cord), paresthesia, paralyses with the disorder of the function of pelvic organs.

Diagnosis of B12 and Folate Deficiency Anemia

General Analysis of Blood:

- reduction in the quantity of erythrocytes and hemoglobin hyperchromatic (macrocytic)
- anisocytosis of the erythrocytes
- hyper-segmentation of the neutrophils
- Jolly body and Cabbots rings as the microscopical picture of the erythrocytes

Continuation

- Reduced reticulocyte in blood count
- Normoblasts in the smear of the blood
- Leucopenia, thrombocytopenia

Bone marrow:

- Irritation in erythroid growth, megaloblasts, the disintegration of erithrokaryocytes.

Biochemical Analysis of Blood

- an increase in unconjugated bilirubin
- an increase in serum iron

- B12 – decrease or

- Folate status (Folic acid in the blood) – decrease

Criteria of Effective Treatment

- Subjective improvement during the first days of treatment;
- Reticulocytosis, maximally expressed (to 20%) on 5-7th day of treatment;
- Increase in hemoglobin and number of erythrocytes, beginning from the 2nd week of treatment;
- The normalization of the blood index, number of leukocytes and thrombocytes in 3-4 weeks of treatment.