

# Anaemia

**Anemia** (anaemia) is a decrease in the level of hemoglobin in the blood. We follow the set limits for the specified age and gender. For men, the hemoglobin standard is **136-176 g/l** and for women this value is **120-168 g/l**. Anemia is often associated with decreased erythrocyte and hematocrit levels. It can also be a symptom that occurs in some pathological conditions. <sup>[1]</sup>

## Causes of anemia

1. **Increased erythrocyte losses** (hemolysis, bleeding).
2. **Decreased erythrocyte production** (stem cell disorders; lack of erythropoietin, vitamin B12, folic acid).
3. **Increase in plasma volume** – so-called relative (dilution) anemia.

## Anemic syndrome

- Set of symptoms accompanying anemia:
  - pale skin and mucous membranes;
  - fatigue, decreased physical performance;
  - shortness of breath during exertion;
  - tachycardia, circulatory insufficiency (from myocardial hypoxia).
- In addition, in hemolytic anemias, manifestations of hemolysis – hemoglobinemia, hemoglobinuria (up to hemoglobinuric nephrosis), decrease in haptoglobin levels, hemosiderosis, ikterus, formation of pigmented gallstones.

## Classification of anemias

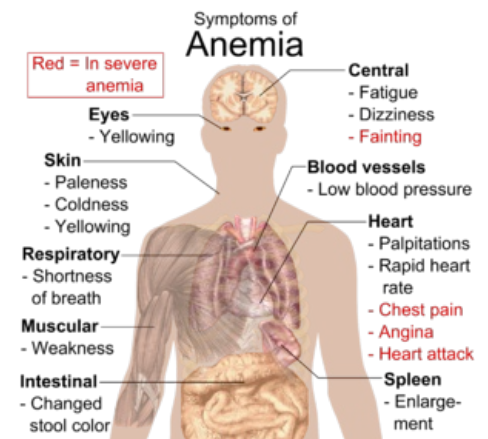
### Morphological

- **Normocytic** (MCV 80–95 fl, or erythrocyte diameter 7–8  $\mu\text{m}$ ) – after acute bleeding, aplastic anemia, some hemolytic anemia;
- **Macrocytic** (MCV over 95 fl, or erythrocyte diameter over 8  $\mu\text{m}$ ) – lack of vit. B12 or folic acid;;
- **Microcytic** (MCV below 80 fl, or erythrocyte diameter below 7  $\mu\text{m}$ ) – Fe deficiency, spherocytosis, thalassemia, after chronic bleeding;
- **Normochromic** (MCHC 300–350 g/l) – after acute bleeding;
- **Hypochromic** (MCHC below 300 g/l) – Fe deficiency, thalassemia;;
- **Hyperchromic** (MCHC over 350 g/l) – lack of vit. B12.

### Patogenetic

#### Anemia from increased erythrocyte loss

- **Posthemorrhagic anemia;**
- **Hemolytic anemia;**
  - **intracorpuseular:**
    - *Congenital:*
      - erythrocyte structure disorders (hereditary spherocytosis);
      - enzymopathy (Glc-6- $\beta$ -dehydrogenase, pyruvate kinase, hexokinase deficiency);
      - hemoglobinopathy (sickle cell disease, thalassemia);
    - *Acquired ::*
      - paroxysmal nocturnal hemoglobinuria.
  - **extracorpuseular:**
    - mechanical causes;
    - toxic hemolysis;
    - osmotic hemolysis;
    - production of antibodies or autoantibodies;
    - hypersplenism.



Symptoms of anemia

#### Anemia from decreased erythrocyte production

- erythropoietin deficiency;
- lack of factors necessary for erythropoiesis (proteins, iron – sideropenic anemia, vitamin B12, folic acid);
- hematopoietic tissue disorder;
- anemia of chronic diseases

## Microcytic anemia investigation algorithm

- serum ferritin level decreased → **iron deficiency anemia**
- serum ferritin level normal or elevated → LDH and haptoglobin
  - *normal* → anamnesis, clinic, inflammatory indicators
    - *positive* → **anemia of chronic diseases**
    - *negative* → bone marrow puncture
      - *positive* → **myelodysplastic syndrome, subtype of refractory anemia with annular sideroblasts**
      - *negative* → **anemia of chronic diseases**
  - *pathologica* → hemoglobin electrophoresis, molecular genetic testing, blood smear → **alpha-thalassemia, beta-thalassemia**

## Algorithm for distinguish iron deficiency anemia from chronic disease anemia

biochemical and clinical signs of inflammation → transferrin saturation <20%

- *serum ferritin* < 30 µg/l → **iron deficiency anemia**
- serum ferritin 30–100 µg/l → soluble transferrin receptor (sTfR)
  - *sTfR / log ferritin* > 2 → **iron deficiency anemia with iron deficiency**
  - *sTfR / log ferritin* 1–2 → ?
  - *sTfR / log ferritin* < 1 → **anemia of chronic diseases**
- *serum ferritin* > 100 µg/l → **anemia of chronic diseases**

## Algorithm for investigating normocytic anemia

- signs of bleeding → **anemia from bleeding**
- no signs of bleeding → absolute reticulocyte count, reticulocyte index
  - *increased* → LDH and haptoglobin
    - *normal* → examination of the spleen
      - *enlarged* → **hypersplenism**
      - *normal* → **bleeding anemia**
    - *LDH increased and haptoglobin decreased* → **hemolytic anemia**
  - *normal or decreased* → differential blood count, blood smear
    - *pathological* → bone marrow puncture → **leukemia, aplastic anemia, bone marrow infiltration by solid tumor or lymphoma, plasmacytoma, myelodysplastic syndrome, myeloproliferative syndrome**
    - *inconspicuous* → creatinin
      - *increased* → **renal anemia**
      - *normal*
        - anamnesis, clinic, inflammatory indicators → **anemia of chronic diseases**
        - occult bleeding → **bleeding anemia**
        - low or undetectable reticulocytes → serology parvovirus B19
          - *positive* → **parvovirus B19 infection**
          - *negative* → **pure red cell aplasia**
        - bone marrow puncture → **leukemia, aplastic anemia, bone marrow infiltration by solid tumor or lymphoma, plasmacytoma, myelodysplastic syndrome, myeloproliferative syndrome**
        - TSH, calcium, phosphate, endocrinological examinations → **hypothyroidism, hyperthyroidism, hypogonadism, hyperparathyroidism, panhypopituitarism**

## Macrocytic anemia investigation algorithm

anamnesis alcohol, drugs, radiation

- *yes* → **alcoholic-toxic anemias, drug-induced macrocytic anemia, radiation-induced macrocytic anemia**
- *no* → absolute reticulocyte count, reticulocyte index
  - *increased* → **hemolytic anemia, AIHA from cold agglutinins or thermal antibodies, bleeding compensation or bleeding anemia, hypersplenism**
  - *reduced* → vitamin B<sub>12</sub> and folic acid
    - *reduced* → **lack of vitamin B<sub>12</sub> or folic acid**
    - *normal* → blood smear
      - *pathological* → bone marrow puncture → **myelodysplastic syndrome, myeloproliferative**

- **diseases , non-Hodgkin's lymphomas, plasmocytoma, leukemia, aplastic anemia**
- *normal* → liver values, liver sonography
  - *pathological* → **liver cirrhosis, chronic active hepatitis**
- *normal* → TSH, fT<sub>3</sub>, fT<sub>4</sub>
  - *pathological* → **hypothyroidism**
  - *normal* → bone marrow puncture → **myelodysplastic syndrome, myeloproliferative disease, non-Hodgkin's lymphomas, plasmocytoma, leukemia, aplastic anemia**

## Links

### Related articles

- ACD (signspot)
- Blackfan-Diamond anemia
- Antianemics
- hemotherapy

### External links

- Anémia (TECHmED) (<https://www.techmed.sk/anemia-diferencialna-diagnostika/>)

### References

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