ANEMIAS

Anemia is usually a symptom, that is associated with another disease, e.g. with chronic inflammation or with malignancy.

Definition:

Red Blood Cell Count **(RBC)**, or other laboratory parameters **(HGB, PCV)** are lower than normal.

Male:

RBC: < 4.4 T/l
HGB: < 135 g/l
PCV: < 0.40 l/l

Female:

RBC: < 3.8 T/l
HGB: < 120 g/l
PCV: < 0.37 l/l

Classification of Anemias

I. BLOOD LOSS:

a. *acute:* traumatic shock,

b. *chronic:* gynecological or gastrointestinal diseases.

II. HEMOLYTIC ANEMIAS:

a. *intrinsic (intracorpuscular) abnormalities:*

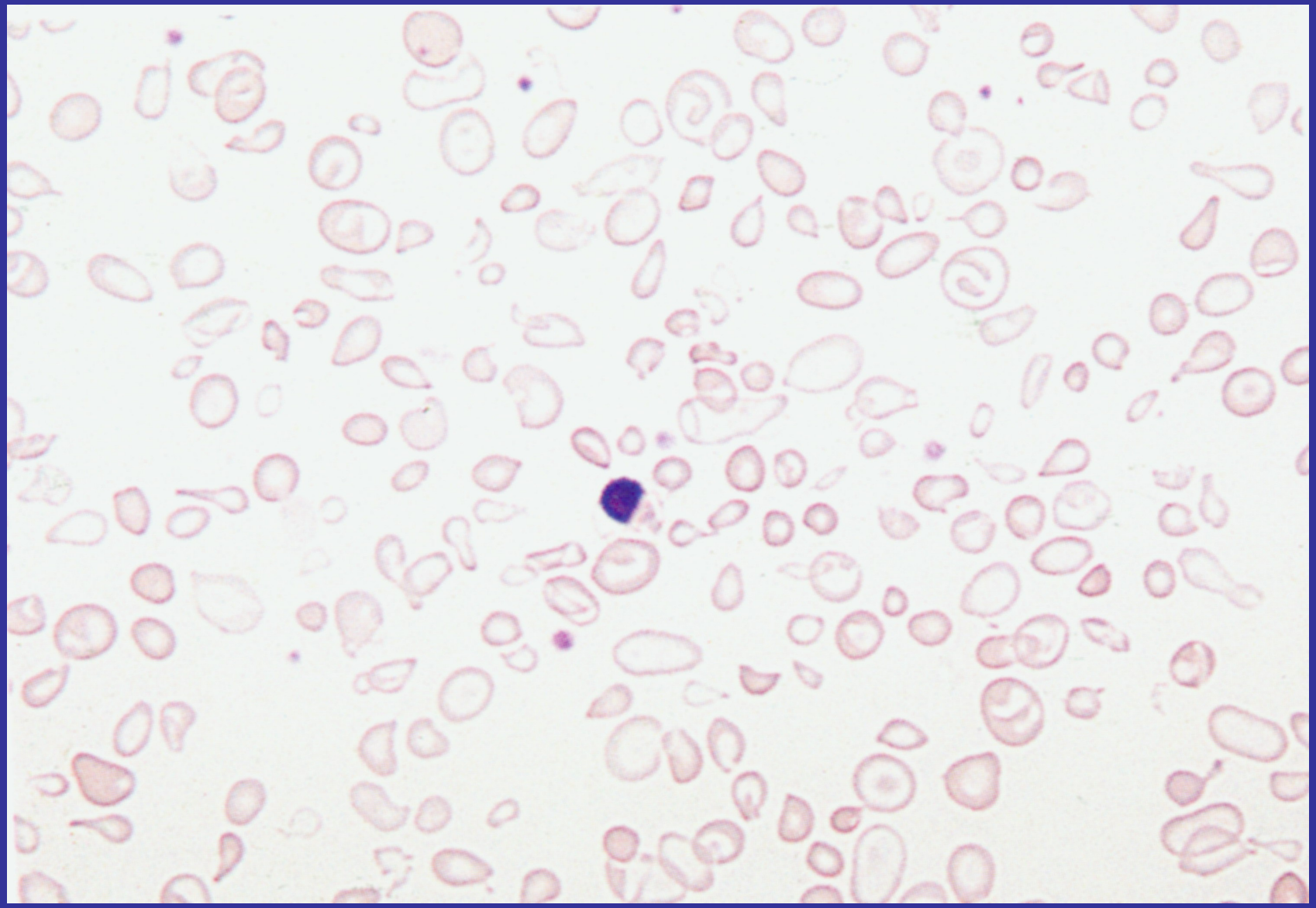
1. abnormalities of cytoskeleton,
2. enzyme deficiencies,
3. disturbances of hemoglobin synthesis.

b. *extrinsic (extracorpuscular) abnormalities:*

1. antibody mediated,
2. mechanic traumas of RBCs,
3. infections.

III. ABNORMAL RBC DEVELOPMENT

Thalassemia Peripheral Blood



Classification of Anemias

Size of RBC (MCV)	**Hb Content of RBC (MCH)**	**Hypo-Aregenerative Anemias**	**Regenerative Anemias**
Normocytic	Normochromic	Aplastic Anemias	Hemolytic anemias Anemia due to Acute Blood Loss
Microcytic	Hypochromic	Iron deficiency Anemia	
Macrocytic	Hyperchromic	Megaloblastic Anemias	

Laboratory Diagnosis of Anemias

RBC: 3.8-5.5 T/l

WBC: 4-10 G/l

MCV: 80-95 fl

PLT: 150-400 G/l

MCH: 28-33 pg

MCHC: 320-360 g/l

HGB: 120-180 g/l

PCV: 0.37-0.52 l/l

Reticulocyte count (relative to RBC): 0.5-2.0 %

Blood Chemistry

Serum Iron: 10-36 µmol/l

TIBC: 45-80 µmol/l

Transferrin saturation: 0.2-0.5

(Quotient of serum iron and TIBC)

Haptoglobin concentration: 6-28 µmol/l

(its level decreases during hemolysis)

Examinations

Medical history, Symptoms and Findings:

a. Medical History: nutritional habits, dyscoloration of urine and stool, gynecological history, previous diseases: chronic inflammation, malignancy.

b. Symtoms: weakness, fatigue, short of breath, palpitation, angina pectoris, headache, sleeping problems, flattened nails, dry skin, hair loss, digestive disorders, motivelessness (DD: depression).

c. Findings: pallor (conjunctiva, nail bed), systolic murmur, tachycardia, jaundice, splenomegaly, paresthesia, glossitis.

Symptoms and findings depend on the type of anemia and its duration.

Laboratory examinations I.

Basic:

- Blood test, thrombocyte- and reticulocyte count, BSR,
- Urine test,
- Serum: creatinine, bilirubin, LDH, iron, ferritin, haptoglobin, hemopexin,
- Blood in stools.

If cause of anemia is not clear:

- Gastroscopy, colonoscopy, gynecological examination,
- Special laboratory tests: Schilling-test, direct and indirect Coombs test, Hgb-electrophoresis in thalassemia and sickle cell anemia,
- Bone marrow smear.

Laboratory examinations II.

In vivo examinations:

1.) Schilling test,

2.) Life span of RBCs .

In vitro examinations:

1.) serum ferritin level,

2.) serum vitamin B_{12} level,

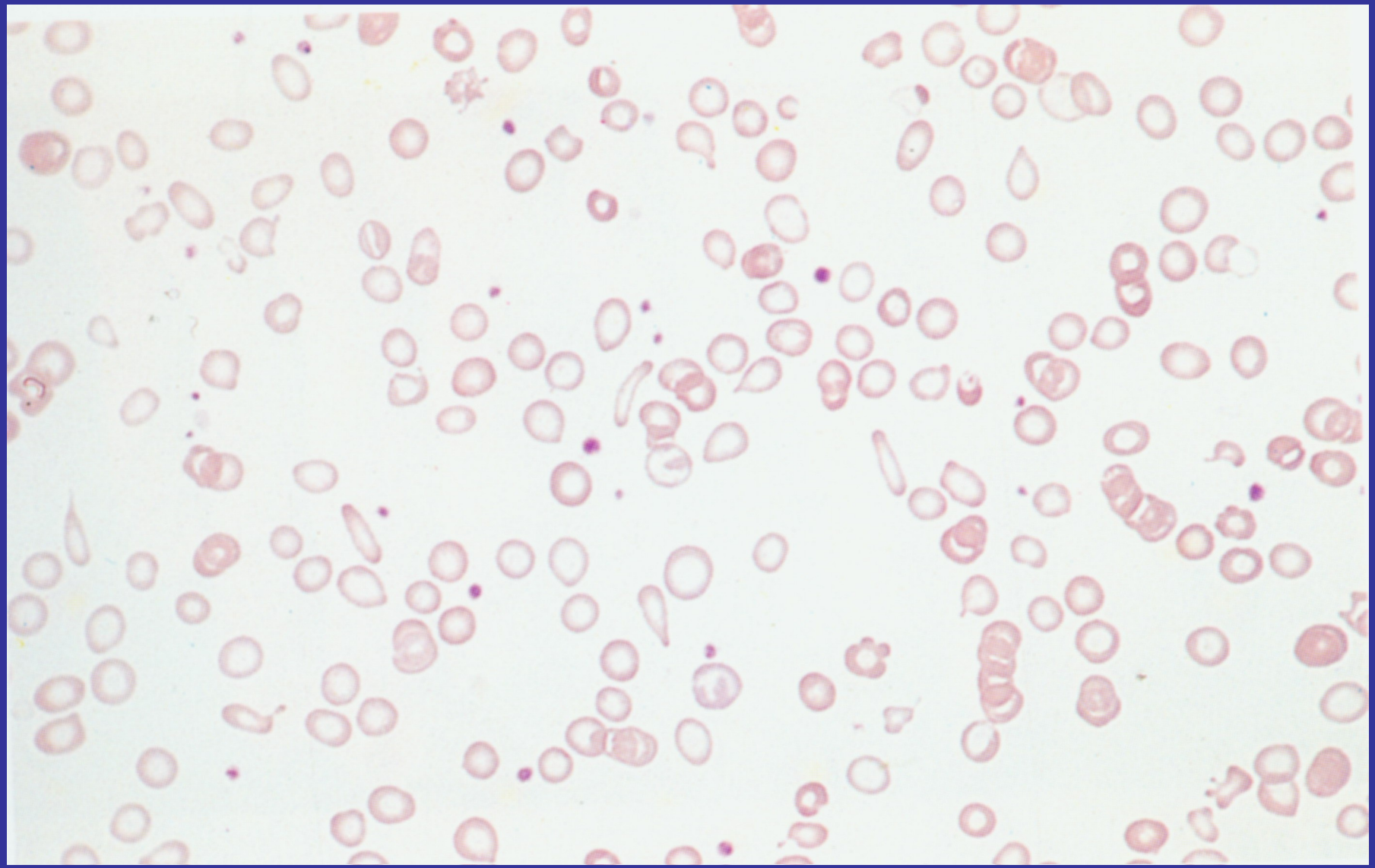
3.) serum and RBC folic acid level,

4.) erythropoietin level.

Laboratory Diagnosis of Hypochromic Anemia

	Iron deficiency Anemia	***Anemia due to Chronic Inflammation or Malignancy***
MCV	Decreased, depending on the severity of anemia	At the lowest level of the normal range or decreased
MCH		
MCHC		
Serum iron	decreased	decreased
TIBC	elevated	decreased
Bone marrow iron storages	empty	normal

Iron Deficiency Anemia Peripheral Blood



Causes of Iron Deficiency Anemia

1. **Chronic Blood Loss**
   gynecological bleeding,
   gastrointestinal bleeding
   rarely hematuria, hemoglobinuria.

6. **Increased Needs**
   preterm neonates,
   puberty,
   pregnancy.

11. **Nutritional Habits**

13. **Malabsorption**
   gastrectomy, celiac disease.

Causes of Vitamin B_{12} Deficiency

1. Nutritional:

vegetarianism

2. Malabsorption:

a. Gastric origin:

lack of IF, pernicious anemia,

gastrectomy.

b. Bowel origin:

diverticulosis, blind loop syndrome, bowel resection, inflammatory bowel diseases.

Folic acid deficiency

1. Nutritional:

alcoholism, starvation, elderly patients, nutritional habits.

2. Malabsorption:

gastrectomy, bowel resection, inflammatory bowel diseases, celiac disease.

3. Increased consumption:

pregnancy, brest feeding, preterm neonates,
inflammatory diseases: rheumatoid arthritis, psoriasis,
hematological diseases,
malignant diseases.

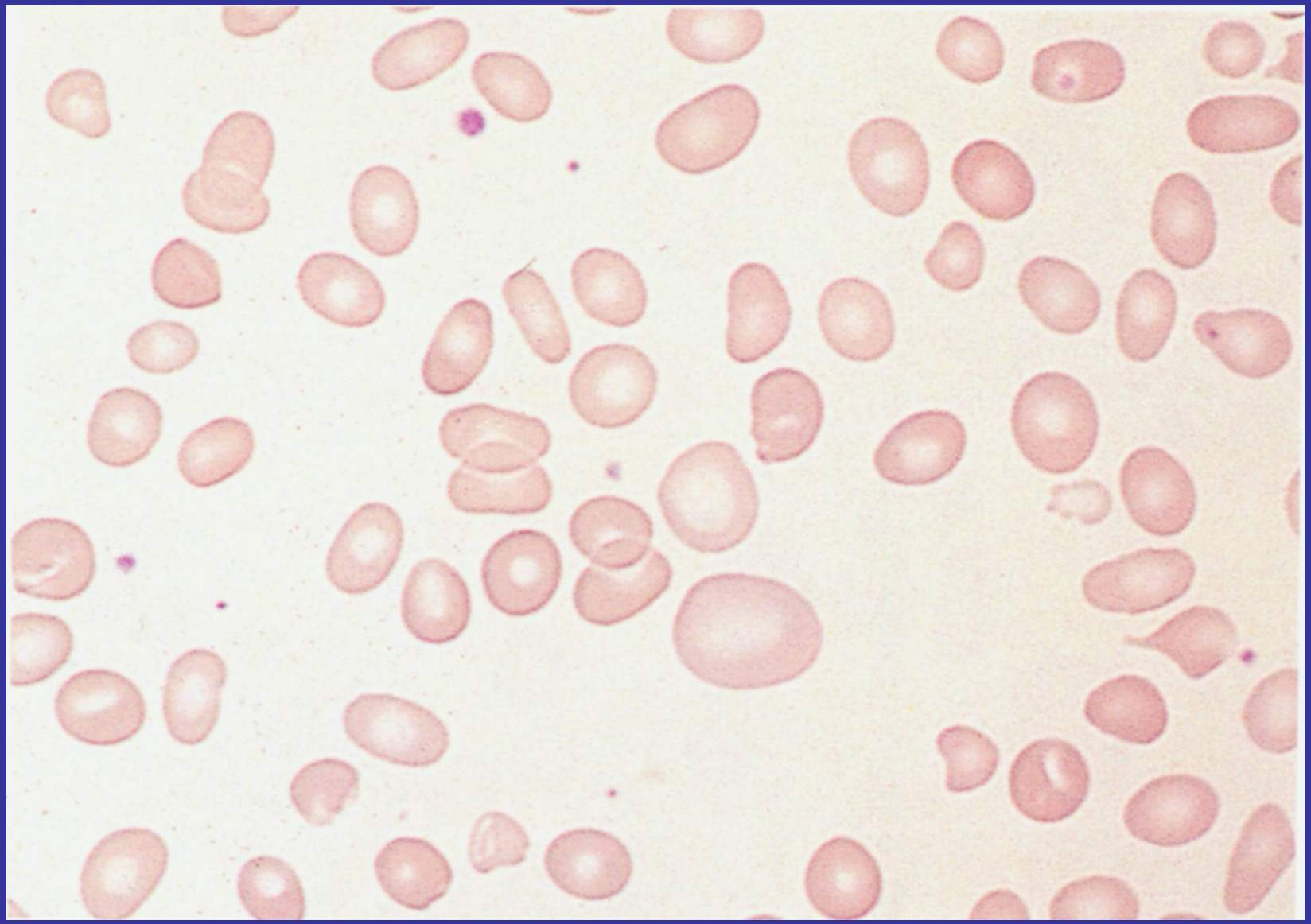
4. Medical treatment

antiepileptics,

5. Others:

active liver disease,
heart failure.

Megaloblastic Anemia Peripheral Blood



Megaloblastic Anemia Bone Marrow