ANEMIA CLASSIFICATION

By
DR. ZAHRAA NAJAH

- **There are several classifications of anemia . Two commonly used are:**

1. **Morphological classification :** based on:

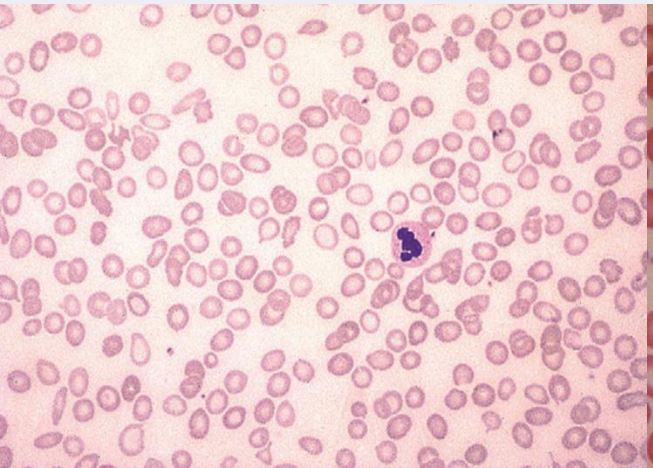
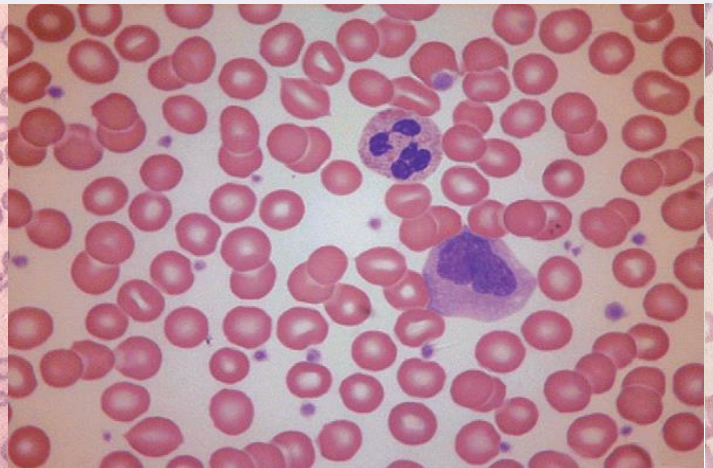
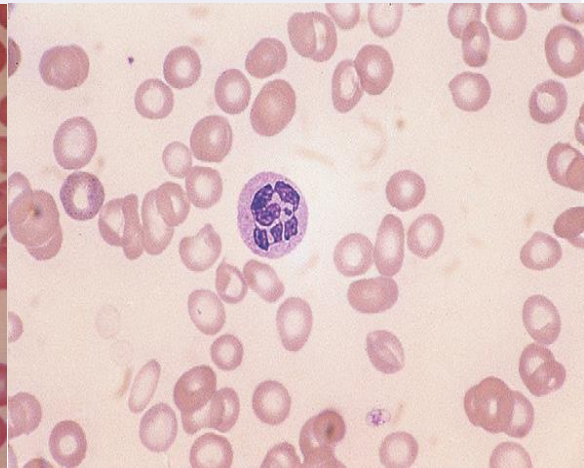
(1) red cell **size** (normocytic, microcytic, or macrocytic), and

(2) degree of **hemoglobinization**, reflected by the color of red cells (normochromic or hypochromic)

2. **Etiological classification**: Based on the underlying mechanisms of production of anemia

Morphological classification

Microcytic, hypochromic	Normocytic, normochromic	Macrocytic
MCV <80 fL MCH <27 pg	MCV 80–95 fL MCH ≥27 pg	MCV >95 fL
Iron deficiency Thalassaemia Anaemia of chronic disease (some cases) Lead poisoning Sideroblastic anaemia (some cases)	Many haemolytic anaemias Anaemia of chronic disease (some cases) After acute blood loss Renal disease Mixed deficiencies Bone marrow failure (e.g. post-chemotherapy, infiltration by carcinoma, etc.)	Megaloblastic: vitamin B_{12} or folate deficiency Non-megaloblastic: alcohol, liver disease, myelodysplasia, aplastic anaemia, etc. (see Table 5.10)

Etiological classification

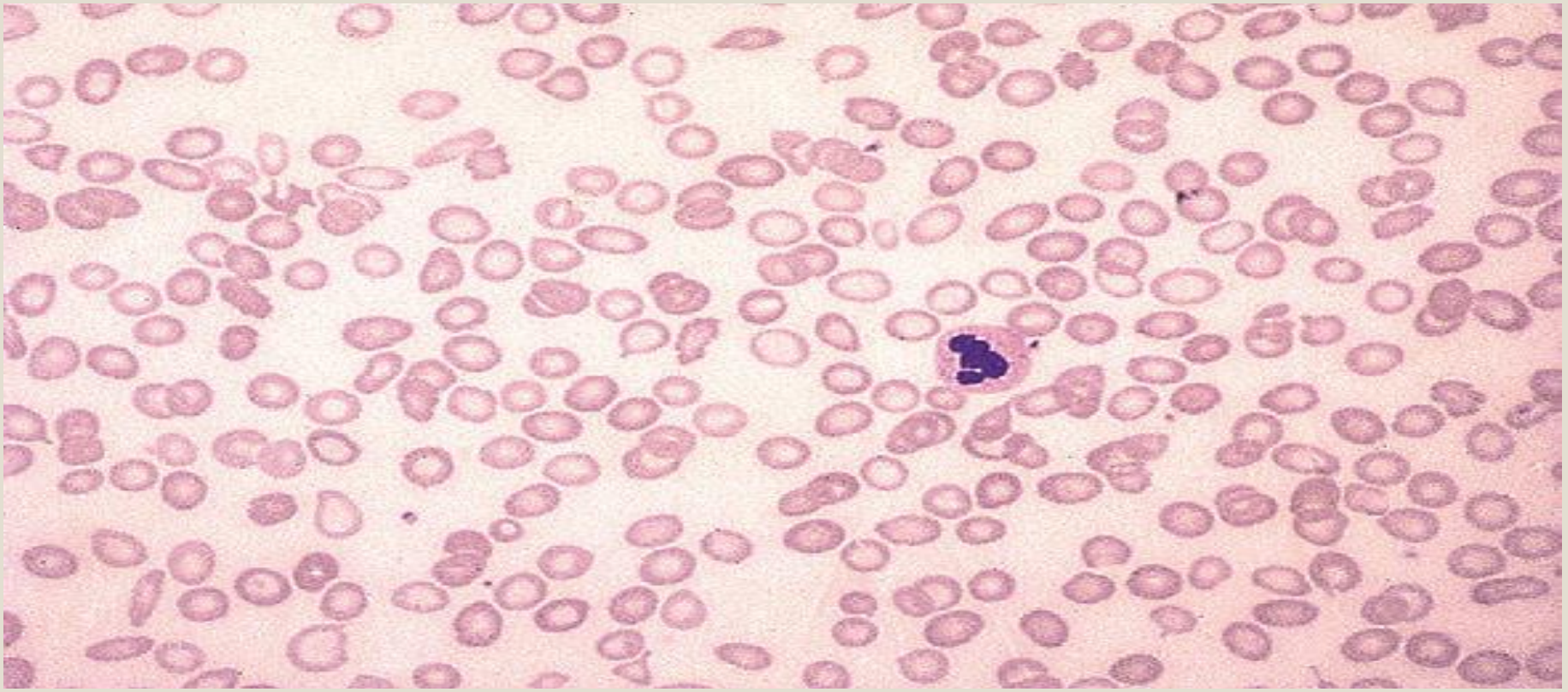
A. **Anemias due to impaired red cell production**

- Nutritional deficiencies
  - Deficiencies affecting hemoglobin synthesis: Iron deficiency
  - Deficiencies affecting DNA synthesis: Vitamin B_{12} and folic acid deficiencies
  - Vitamin C deficiency
- Immune-mediated injury to progenitors
  - Aplastic anemia
  - Pure red cell aplasia
- Primary hematopoietic neoplasms
  - Acute leukemia
  - Myelodysplastic syndromes
  - Myeloproliferative neoplasms
- Miscellaneous
  - Anemia of chronic disorders
  - Marrow suppression due to drugs

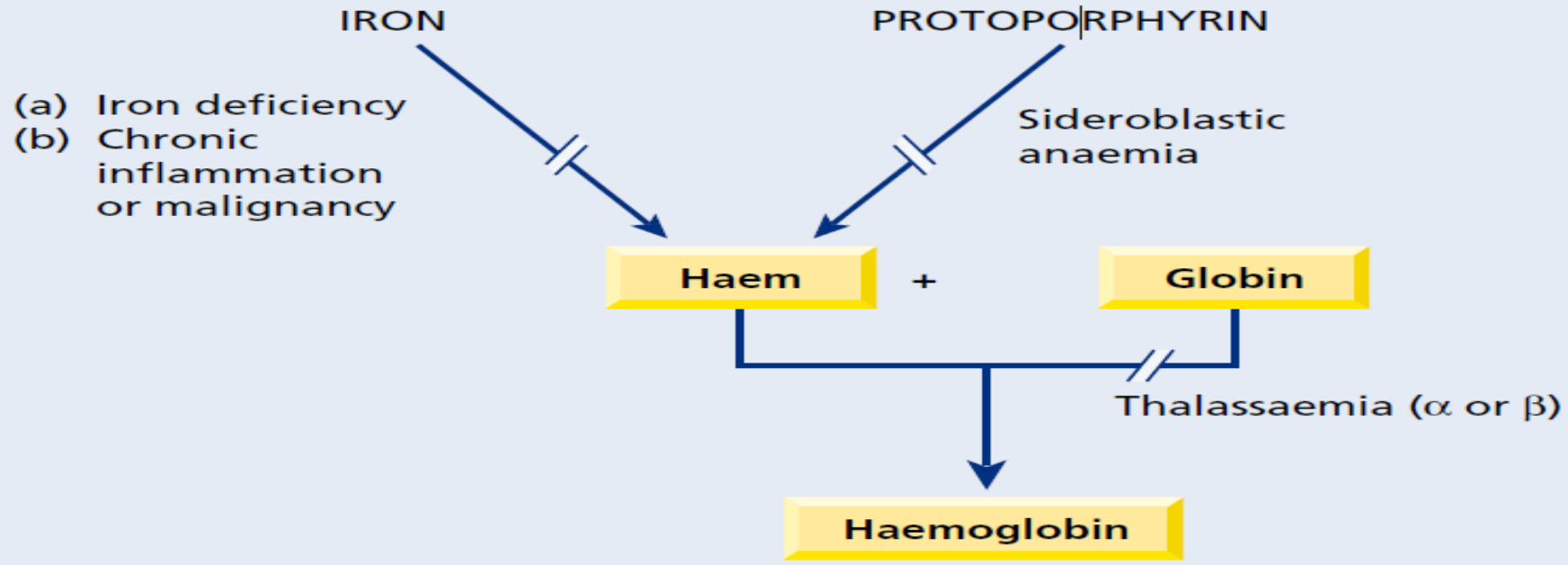
B. **Hemolytic anemias due to increased red cell destruction**
- Intracorpuscular defect
  - Hereditary hemolytic anemias
    - Red cell enzyme deficiencies
      - G6PD deficiency
      - PK deficiency
    - Red cell membrane disorders
      - Hereditary spherocytosis
      - Hereditary elliptocytosis
    - Hemoglobin abnormalities
      - Deficient globin synthesis
        Thalassemia syndrome
      - Structurally abnormal globins (hemoglobinopathies)
        Sickle cell disease
  - Acquired genetic defects: Paroxysmal nocturnal hemoglobinuria
- Extracorpuscular defect
  - Immunohemolytic anemia
  - Fragmentation syndromes
  - Hypersplenism

C. **Anemia due to blood loss**
- Acute blood loss: Trauma
- Chronic blood loss: Bleeding from GI or genitourinary tract

MICROCYTIC, HYPOCHROMIC,ANEMIAS



- An MCV of less than 80 with pale, poorly hemoglobinized red cells on peripheral smear characterizes this group of anemias.
- All result from a disorder in cytoplasmic maturation caused by reduced hemoglobin production.
- Hemoglobin is produced using iron, protoporphyrin and globin chains so the main cause are:



Iron deficiency anemia

- **Main cause:**

1. Inadequate intake of iron as in vegetarian diet ,

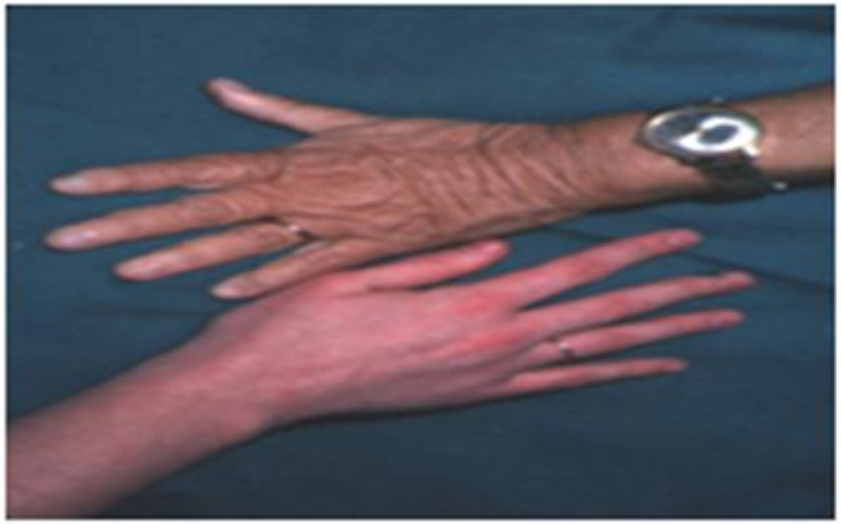
   malabsorption , gastrectomy

2. Blood loss as in menorrhagia, postmenopausal ,esophageal

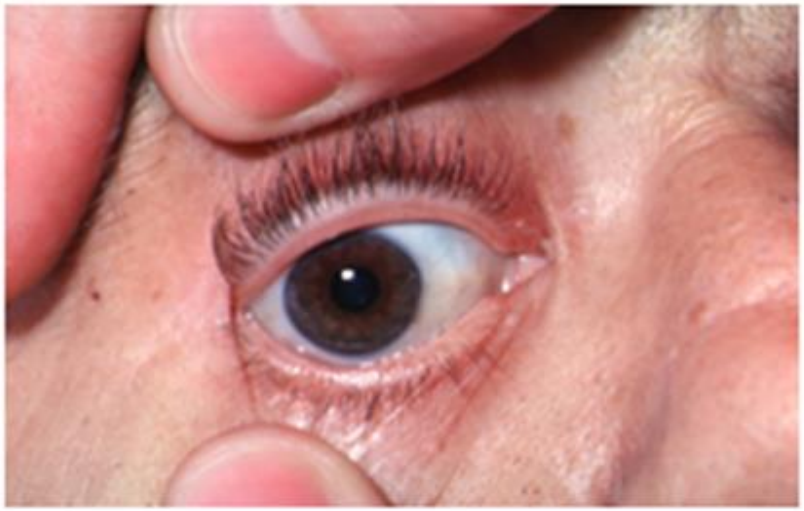
   varices, peptic ulcer, aspirin ingestion.

- **Physical examination** may reveal glossitis, koilonychia (spoon nails), gastritis, and angular stomatitis.
- **Replacement therapy** is Ferrous Sulfate 300mg TID on empty stomach. May give with vitamin C to enhance absorbtion.
- Follow – up in 3-4 weeks hemoglobin should be normalized and the Ferritin should be normal in 8 weeks.

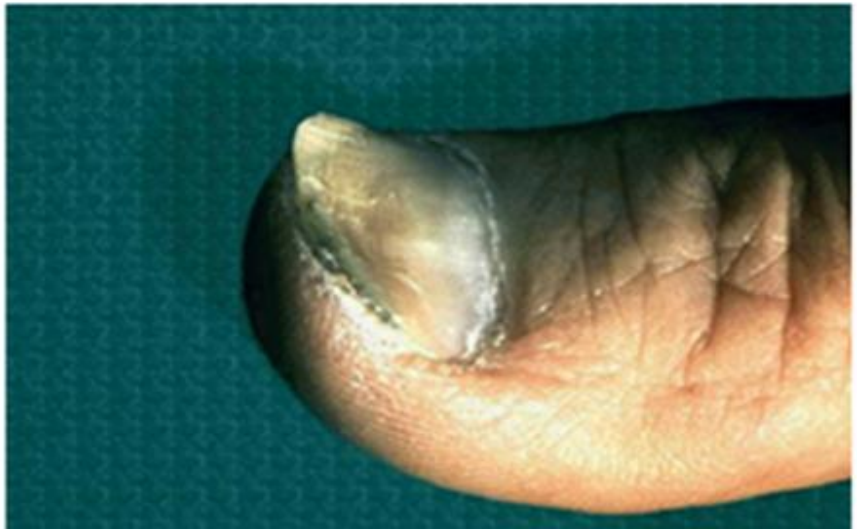
Pallor



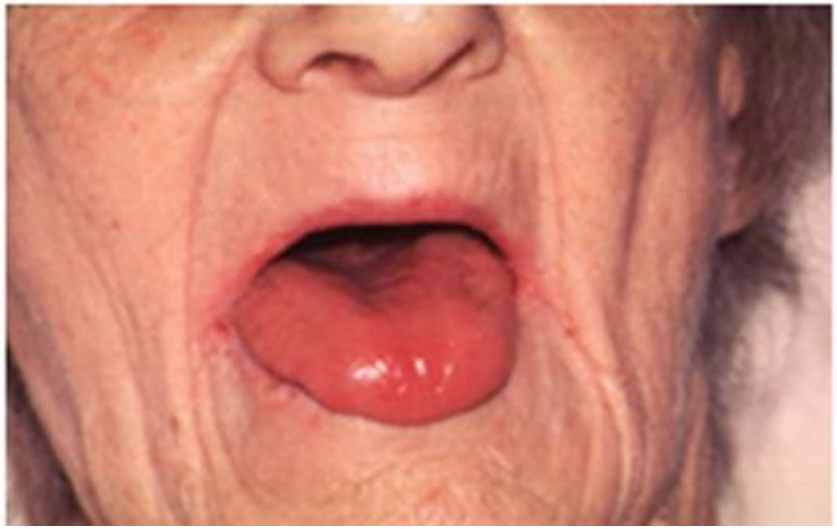
Pale conjunctiva



Koilonychia



Oral changes



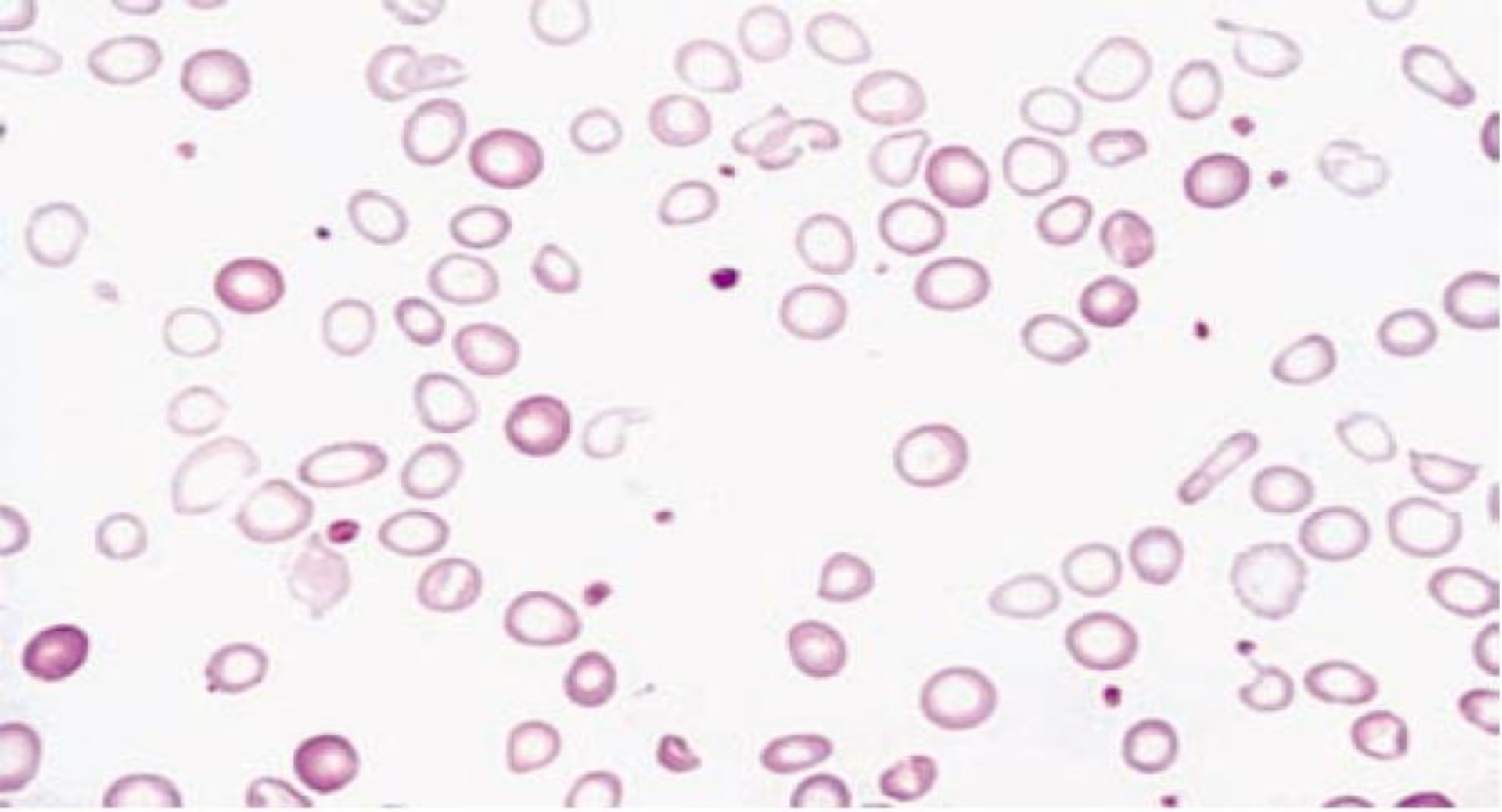


Figure 3.8 The peripheral blood film in severe iron deficiency anaemia. The cells are microcytic and hypochromic with occasional target cells.

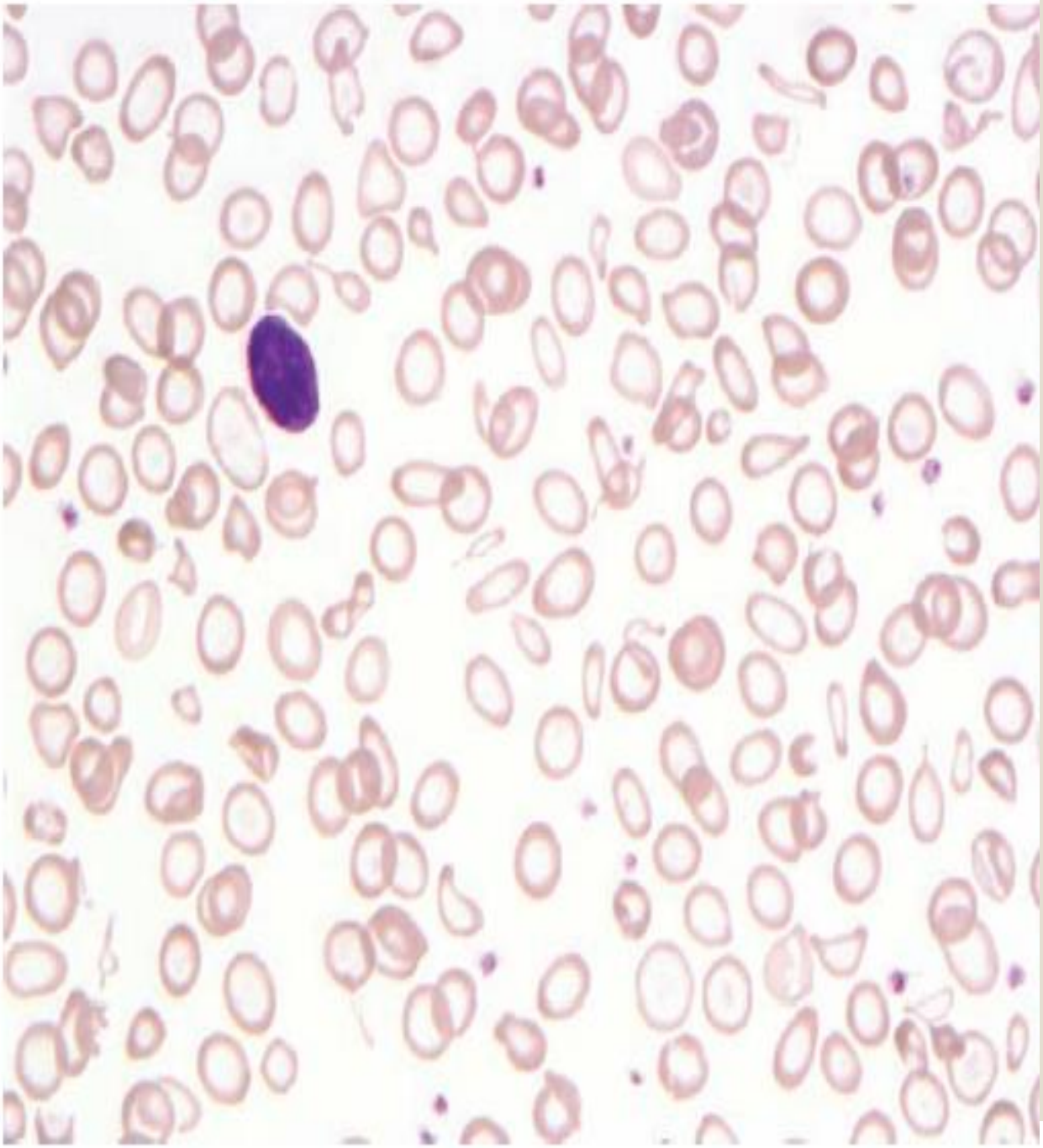
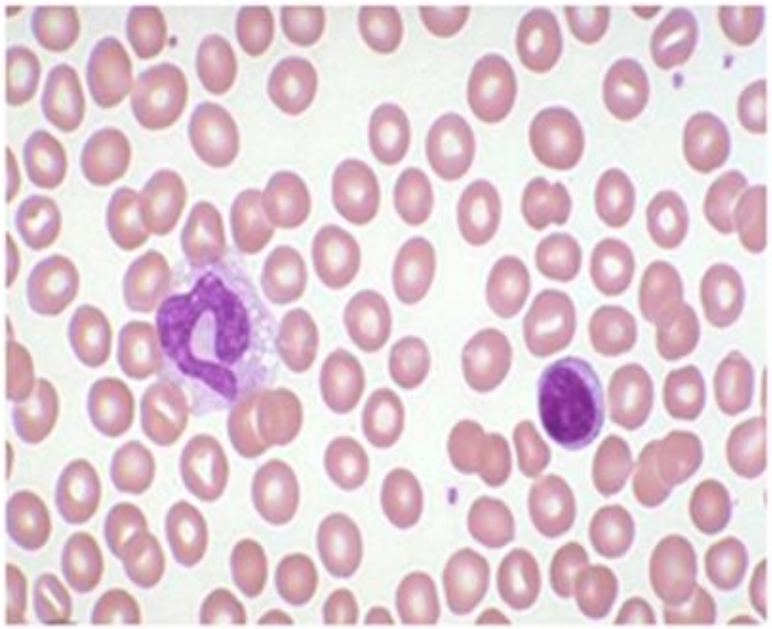
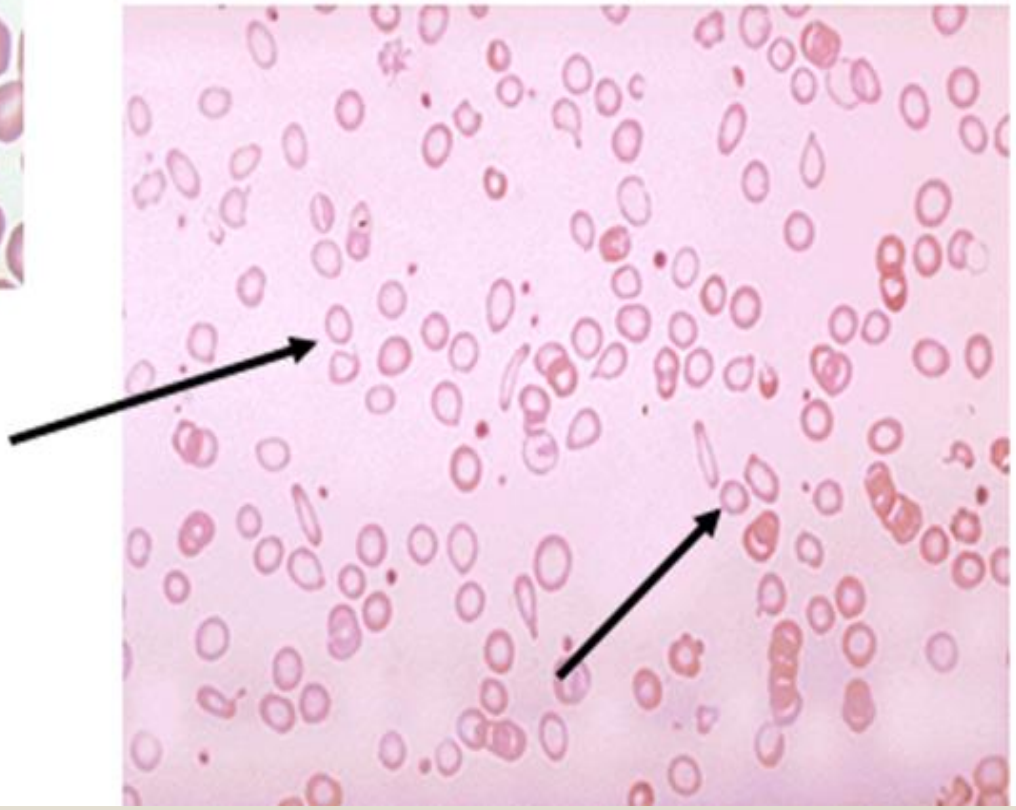


Figure 3.1 Iron deficiency. Severe iron deficiency is evident in this patient whose blood smear shows a predominance of small (microcytic) erythrocytes with markedly increased central pallor (hypochromic) resulting in a low MCHC. RBCs show a wide variation in shape (poikilocytosis) and size (anisocytosis) with frequent pencil cells resulting in an elevated RDW. Polychromatophilic red cells are reduced for the degree of anemia, indicating insufficient new RBC production.

Normochromic Normocytic



Hypochromic microcytic



Thalassemia syndromes

- It is a genetic disorder of **globin production**. There is **decreased or absence** of synthesis of either α or β-globin chain of adult hemoglobin, Hb A (α2 β2),so to the type of globin chain that synthesis in reduced amount can classify to alpha &beta thalassemia
- B-Thalassemia is a hereditary disorder characterized by **diminished synthesis** of structurally normal β-globin chains, associated with unimpaired synthesis of α-chains
- **Types of Beta thalassemia**

Clinical syndromes	*Genotype*	*Clinical features*
β-thalassemia major	Homozygous (β^0/β^0,β^+/β^+) or double heterozygous (β^0/β^+)	Severe form, severe anemia and transfusion dependent High level of HbF in the blood
β-thalassemia intermedia	Variable (β^0/β^+, β^+/β^+, β^0/β, β^+/β)	Moderately severe and not transfusion dependent
β-thalassemia minor/ β-thalassemia trait	Heterozygous (β^0/β, β^+/β)	Mild anemia and asymptomatic

β^0 = Total absence of β-globin synthesis; β^+ = Markedly reduced or diminished β-globin synthesis; β-normal β-globin synthesis

Diagnosis of Beta thalassemia

Clinical

Children born with thalassemia major are normal at birth, but develop severe hemolytic anemia*and related symptoms during first year of birth

- **Fatigue**
- **Failure to thrive**
- **Shortness of breath**
- **Jaundice**
- **Bone deformities**
- ***Hepatomegaly**
- ***Splenomegaly**
- **[all of which were present in our patient]**

Pallor

Poor feeding

Recurrent fever

Laboratory

- Anemia with decrease PCV and increase RBCs count.
- Reduce RBCs indices(MCV,MCH,MCHCH) with normal RDW.
- Increase reticulocyte count
- Blood film
- Special tests (confirmatory test):
  - Hemoglobin electrophoresis.
  - HPLC.
  - DNA analysis.

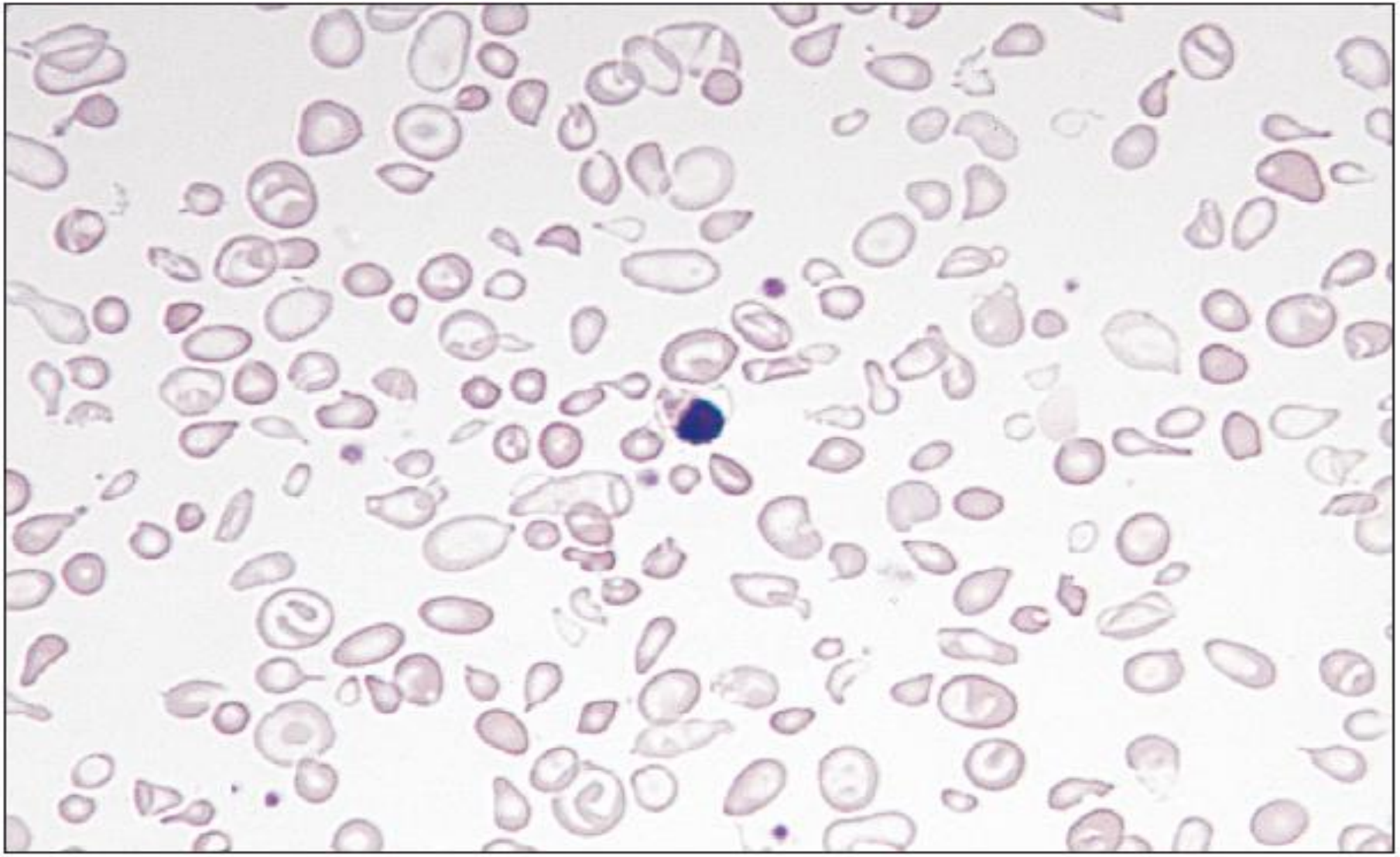


Fig. 9-19. β-Thalassemia major: peripheral blood film showing prominent hypochromic microcytic cells, target cells, and an erythroblast. Some normochromic cells are present from a previous blood transfusion.

Anemia of chronic disease

- Long-standing infections, neoplastic diseases, and chronic inflammatory processes (eg, rheumatoid arthritis, systemic lupus erythematosus) block iron transportation from the storage sites to the bone marrow factory by increase **hepcidine level**.

Sideroblastic anemias

- characterized by the presence of “ringed” sideroblasts in the bone marrow; associated with hypochromic cells on a peripheral smear.
- May be congenital or acquired
- Acquired sideroblastic anemias are associated with use of antituberculous medications (eg, isoniazid, pyrazinamide14), alcohol abuse, lead poisoning, chronic inflammation .

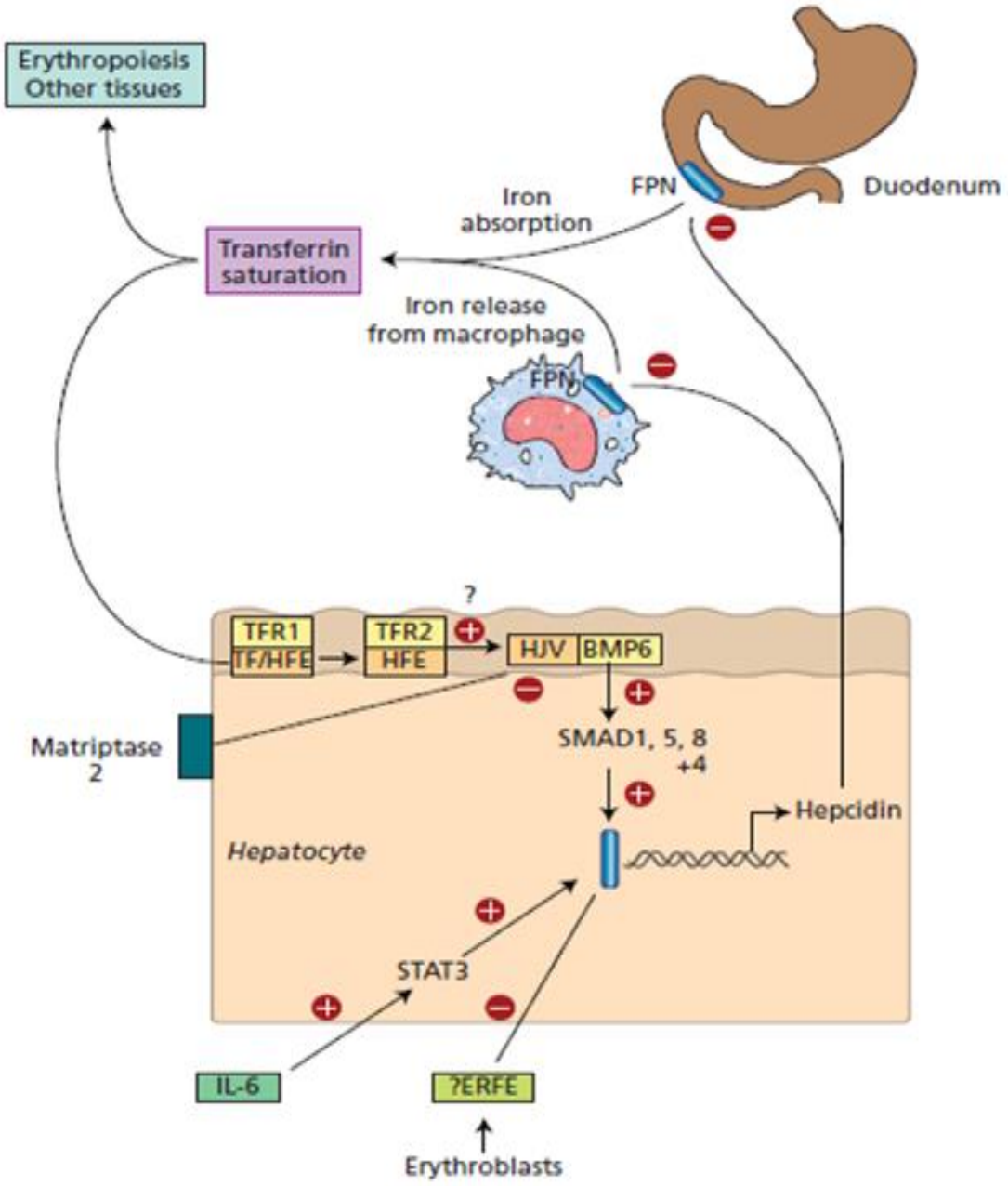
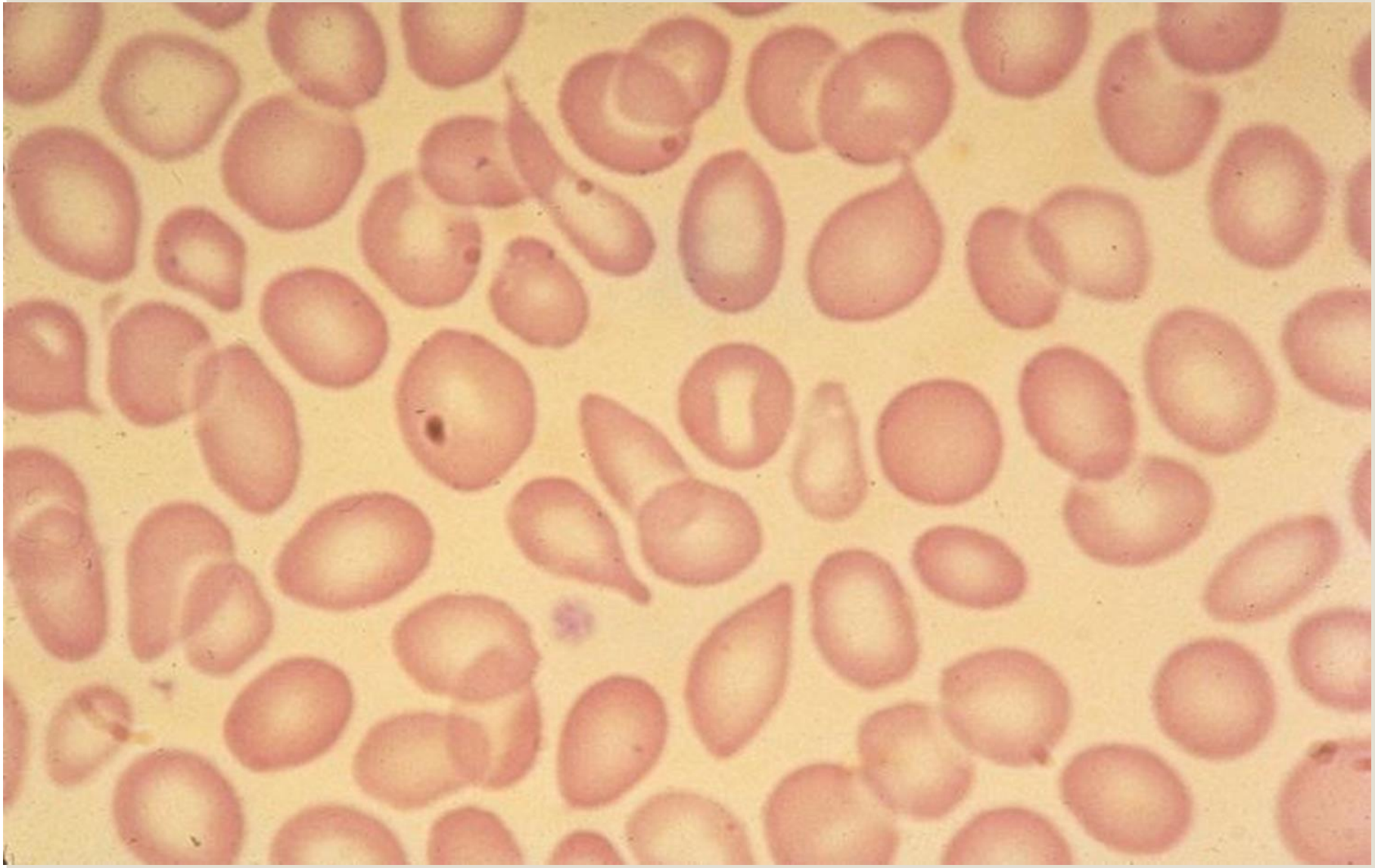
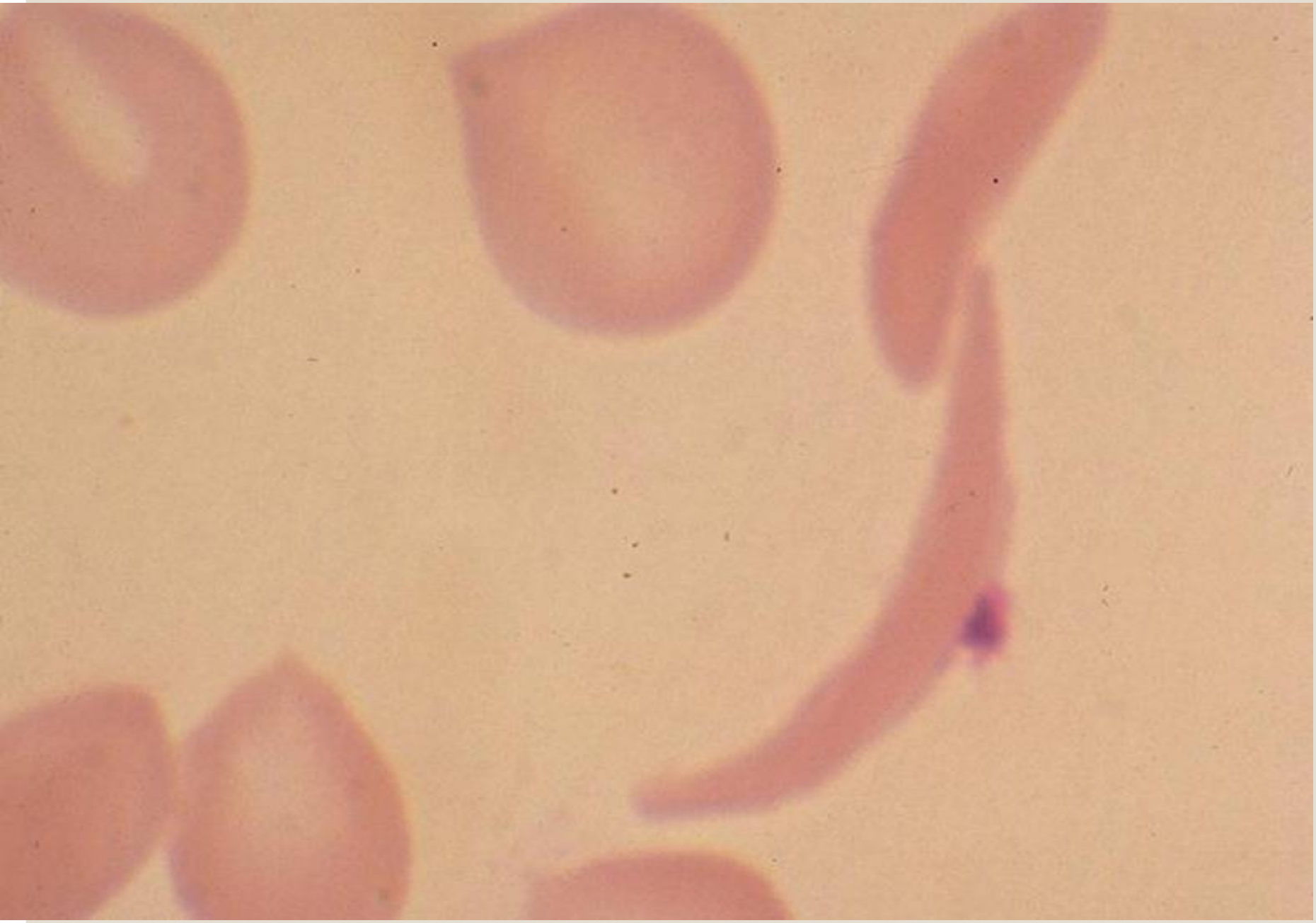


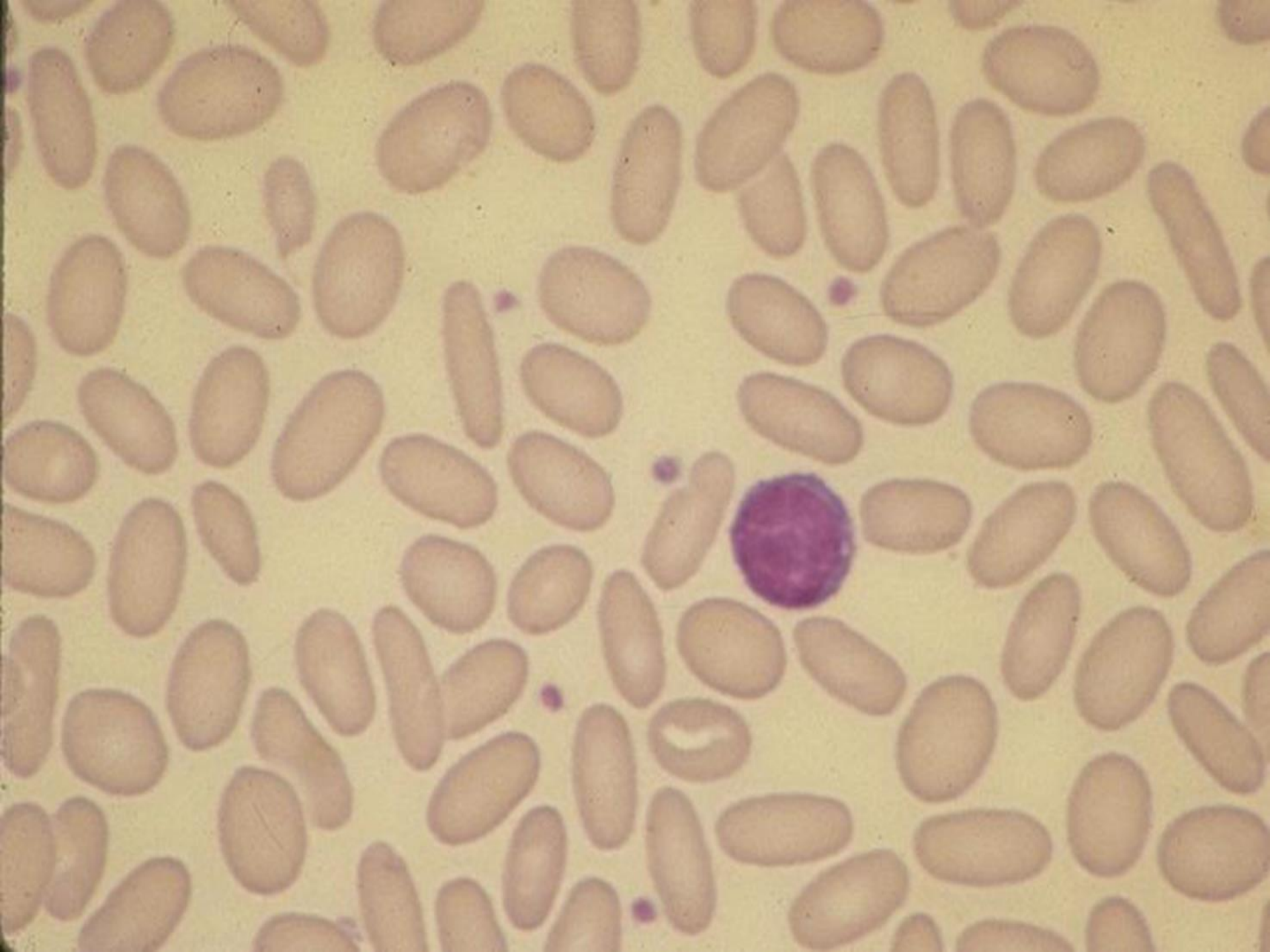
Figure 3.2 Stimulatory and inhibitory signals of hepcidin regulation. Hepcidin, as well as hemojuvelin (HJV), transferrin receptor 2 (TFR2) and HFE, are all produced in the hepatocyte. High plasma iron and inflammation stimulate hepcidin synthesis. This is mediated by SMADs and STAT3, respectively. Conversely, low plasma iron, increased rates of erythropoiesis (including ineffective erythropoiesis) and hypoxia inhibit hepcidin production. This is mediated by matriptase and ERFE. Hepcidin binds ferroportin (FPN), causing its destruction and so inhibits iron absorption and iron release from macrophages into plasma and from intracellular compartments. BMP, bone morphogenetic protein; ERFE, erythroferrone; The ? indicates uncertainty of the ERFE function in humans; GDF-15 may be the human equivalent of ERFE.

Laboratory diagnosis of a hypochromic anaemia.

	Iron deficiency	Chronic inflammation or malignancy	Thalassaemia trait (α or β)	Sideroblastic anaemia
MCV/ MCH	Reduced in relation to severity of anaemia	Normal or mild reduction	Reduced; very low for degree of anaemia	Usually low in congenital type but MCV usually raised in acquired type
Serum iron	Reduced	Reduced	Normal	Raised
TIBC	Raised	Reduced	Normal	Normal
Serum ferritin	Reduced	Normal or raised	Normal	Raised
Bone marrow iron stores	Absent	Present	Present	Present
Erythroblast iron	Absent	Absent	Present	Ring forms
Haemoglobin electrophoresis	Normal	Normal	Hb A_2 raised in β form	Normal








Thank you