

Topic of the lesson: PATHOPHYSIOLOGY OF RED BLOOD SYSTEM

Aim: To be able to make pathophysiologic analysis of the situations associated with the development of anemia

Main questions to the topic of the lesson:

1. Definition of anemia, classification.
2. Pathological changes of erythrocytes (quality and quantity).
3. Etiology and pathogenesis of acute and chronic posthemorrhagic anemia. Blood picture.
4. Definition, classification, etiology and pathogenesis of acquired hemolytic anemia. Blood picture.
5. Etiology, pathogenesis, classification of hereditary hemolytic anemia. Blood picture.
6. Etiology, pathogenesis, classification, hematological characteristic of asiderotic [iron-deficiency] anemia, folic-deficient anemia and B₁₂ anemia.
7. Etiology, pathogenesis, classification, hematological characteristic of aplastic anemia, hypoplastic anemia, metaplastic anemia.

Literature:

1. General and clinical pathophysiology/Gozhenko A.I. - Odessa National Medical University. - 2002. - p. 124-143
2. Pathophysiology/Gozhenko A.I., Gurkalova I.P. - Odessa National Medical University. - 2003. - p. 186-201

CONTROL QUESTIONS

№	Instructions to the execution of the task	Answers of the students with complements at the lessons
1.	Anemia is-...	
2.	Classification of anemias -by etiology (a, b)	

	-by pathogenesis (a, b, c) -by abilities of the bone marrow to regenerate (a, b, c, d, e) -by color index (a, b, c) -by type of hemopoiesis (a, b) -by clinical course (a, b)	
3.	What quality changes of erythrocytes are characteristic features of red blood -regenerative forms (a, b, c) -degenerative forms (a, b, c, d) -cells of pathological regeneration (a, b, c, d)	
4.	Posthemorrhagic anemia –is types (a, b)	
5.	Blood picture of posthemorrhagic anemia according to periods of development -few hours of loss of blood (a, b, c, d) -few days (a, b, c, d) - up to 1-2 weeks (a, b, c, d)	
6.	Sign the place of acute and chronicle posthemorrhagic anemia in classification (a, b, c, d, e)	

7.	Give the definition of hemolytic anemias Name causes of them (a, b, c, d) and mechanisms of vascular hemolysis (a, b, c, d, e)	
8.	What is endocellular hemolysis of erythrocytes? What caused it? (a, b, c)	
9.	Classification of acquired hemolytic anemia according to origin (a, b, c, d, e)	
10.	Name mechanisms of development of hereditary hemolytic anemia (a, b, c)	
11.	Give the definition of megaloblastic anemia Types (a, b, c)	
12.	Describe the blood picture by B ₁₂ anemia. (a, b, c, d, e)	
13.	Give the definition of asiderotic [iron-deficiency] anemia, name factors that cause it (a, b, c, d, e) and syndromes (a, b, c, d, e)	

TASK 1. *Mark main pathogenetic factors, which cause anemias?*

- a) Insufficient production of erythrocytes.
- b) Raised destruction of erythrocytes.
- c) Raised production of erythrocytes.
- d) Insufficient destruction of erythrocytes
- e) Disorder of outcome of erythrocytes out of the bone marrow.

TASK 2. *What anemias are inherited?*

- a) congenital anemia of newborn
- b) microcytic anemia
- c). thalassemia
- d) sicklemlia
- e) hypoplastic anemia

TASK 3. *Fill in the table of B12 anemia classification*

by etiology	
by pathogenesis	
by abilities of the bone marrow to regenerate	
by color index	
by type of haemopoiesis	
by clinical course	

TASK 4. Write down the syndromes which characterize B12 anemia. Explain its origin.

A- _____

B- _____

C- _____

D- _____

E- _____

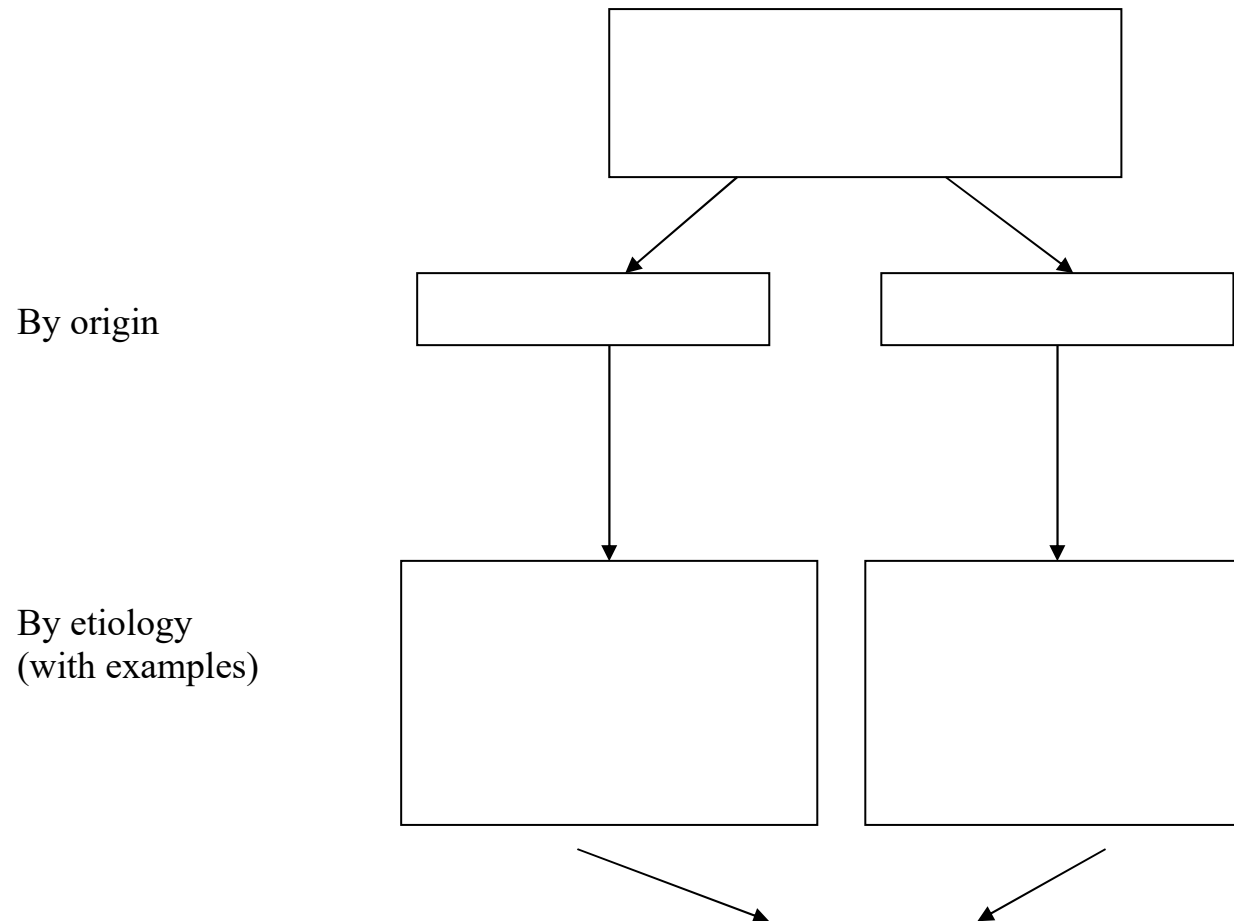
TASK 5. Fill in the table, compare hematological changes with types of anemias, and mark with “+”

	posthemorrhagic anemia	hereditary hemolytic anemia	acquired hemolytic anemia	acute asiderotic [iron-deficiency] anemia	B12 anemia	hypoplastic anemia
Red bone marrow						
inhibition of erythroblastic erythropoiesis						
intensification of erythroblastic erythropoiesis						
megaloblastic erythropoiesis						
uneffective						

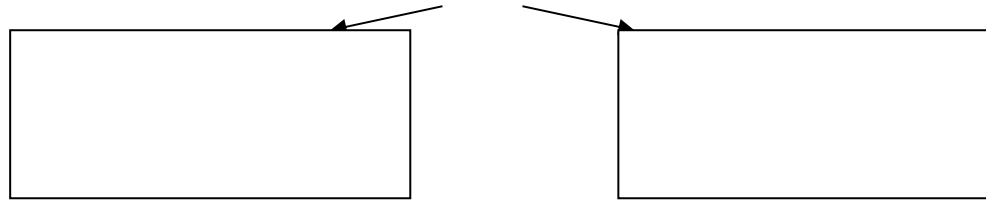
erythropoiesis						
formation of degenerative erythrocytes with anomaly of membrane structure (forms, size)						
Blood						
decrease of physiological regeneration cells quantity						
cells of pathological regeneration						
hemolysis of erythrocytes						
poikilocytosis, anisocytosis						
anomaly Hb						
defects of membrane						
erythrocytes with inclusions						

and nuclear changes						
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TASK 6. Give the characteristic of hypoplastic anemias according to etiology and pathogenesis



By pathogenesis



TASK 7-9. *Solve the clinic-patophysiological tasks*

Task 1. A 3-year- old girl (ethnic Moroccan) was hospitalized to a children's hospital in a very serious condition of pneumonia and hematuria. On examination: the skin and sclera are yellow, the temperature is 39°, superficial tachypnoe, adynamy, right-side croupous pneumonia, hepatomegalia, splenomegalia, dark [black] urine with hemoglobin and hemosiderin. On blood analyze: Hb- 4,2 mmol/l, erythrocytes- $2,3 \times 10^{12}$ in 1 liter, colour index –X, leucocytes- 15×10^9 in 1 liter, neutrocytosis with nuclear shift left, ESR- 25 mm/h. Blood film: poikilocytosis, anisocytosis, erythrocytes with basophilic stippling, solitary drepanocytes, many polychromatophiles. During the electrophoresis of Hb was found HbS and HbA. The test with Natrii metabilsulphate detects the phenomenon of drepanocytes.

Name the pathology of erythrocytes at this child:

Is this disease acquired or hereditary? Name the mode of inheritance if you think that this is the case of a hereditary disease and make the conclusion.

Calculate the color index

Explain the mechanism of hemohlobinuria

Task 2.

Is the rhesus incompatibility possible, if a mother is Rh+ and the child is Rh – and contrariwise? Under which circumstances can the rhesus incompatibility appear?

Task 3.

A 68-year-old patient N. had a total stomach resection in connection with ulcerous disease 7 years ago. He was hospitalized in therapeutics department with complains of general weakness, indisposition, tachycardia and breathlessness, the burning pain in the tongue region, frequent diarrhea, with crawly feeling. On examination: the maize yellow color of skin and sclera, the smooth, lustrous, pimento tongue, slightly enlarged liver, disorder of skin sensitivity.

On blood analysis: Hb- 2 mmol/l, erythrocytes- $0,8 \times 10^{13}$ in 1 liter, colour index-1,1, leucocytes- 3×10^9 in 1 liter, thrombocytes - 90×10^9 , ESR- 14 mm/h.

Blood film: poikilocytosis, anisocytosis, megalocytes with Zholly bodies, and Kebot-rings, hyperchromatism, acidophilous and polychromatophily megaloblasts, giant polysegmental neutrophilic granulocytes. Results of analyze of the red marrow smear: leucoerythroid correlation= 1:3, many acidophilous and polychromatophily megaloblasts (red marrow blood film).

Calculate the color index

What pathology has the patient?

Characterize it according to 5 classifications

What changes in blood film are the most important for diagnostic?

Name regenerative and degenerative forms of erythrocytes in blood film of a patient;

What is the mechanism of this pathology?

Enumerate the physiological systems of organism that are involved.

Why is it a characteristic feature for this pathology?

TASK 10. Solve the tests for self control

1. A 37- year- old woman has in her blood analysis: Hb-60 g/l, erythrocytes- $3,0 \times 10^{12}$ in 1 liter, color index- 0,6. Leukogram unchanged, thrombocytes- 0,3%, ESR- 18 mm/h. Microcytosis, poikilocytosis. What anemia is it?

- A. hemolytic
- B. asiderotic [iron-deficiency] anemia
- C. acute posthemorrhagic
- D. B12 anemia
- E. hypoplastic

2. A 35- year- old woman complained of prolonged (up to 2 weeks) cyclic metrorrhagia during a year, weakness. On examination: paleness, tachypnoe, pulse- 90 in minute. Blood analyze: Hb- 70 g/l, erythrocytes- $3,2 \times 10^{12}$ in 1 liter, color index- 0,6, leucocytes- $6,0 \times 10^9$ in 1 liter, reticulocytes- 1%. Hypochromia of erythrocytes. What pathology has a woman?

- A. chronic posthemorrhagic anemia
- B. hemolytic anemia

- C. aplastic anemia
- D. B12 anemia
- E. asiderotic [iron-deficiency] anemia

3. An infant (parents are healthy, mother has Rh- and father has Rh+) has yellow skin and mycoses. In blood: erythrocytes- $3,7 \times 10^{12}$ g/l, Hb- 105 g/l, the level of unconjugated bilirubin in blood is over the norm. What anemia is it?

- A. hereditary hemolytic anemia
- B. acute posthemorrhagic anemia
- C. acquired hemolytic anemia
- D. hypoplastic anemia
- E. B12 anemia

4. A 35- year-old woman complained of weakness, gingival hemorrhage, and nosebleed. Symptoms appeared after respirator infection that was treated with sulfanilamide. The liver, spleen and lymph nodes are not enlarged.

In blood: hyporegenerator normochromal anemia, leucopenia thrombocytopenia. In the red marrow: decrease of myelocariocytes quantity.

What anemia according to mechanism of development is it?

- A. asiderotic [iron-deficiency] anemia
- B. posthemorrhagic anemia
- C. hemolytic anemia
- D. hypoplastic anemia
- E. B12 anemia

5. A 37 –year- old woman has in her blood analysis: Hb-60 g/l, erythrocytes- $3,0 \times 10^{12}$ in 1 liter, color index- 0,6. Leukogram unchanged, thrombocytes- 200×10^9 in 1 liter ESR- 18 mm/h., reticulocytes 30%. Anisocytosis, poikilocytosis. What anemia is it?

- A. hemolytic anemia
- B. acute posthemorrhagic
- C. asiderotic [iron-deficiency] anemia
- D. hypoplastic anemia
- E. B12 anemia

6. A 35- year-old woman complained of general weakness, aglutition, desire of chalk eating. On examination: temperature is $36,5^{\circ}\text{C}$, respiratory rate- 20 in minute, pulse is 96 in minute, arterial pressure is 110/70 mm. c. m.

The skin and mycoses are pale. Blood analyze: Hb-70 g/l, erythrocytes- $3,4 \times 10^{12}$ in 1 liter, color index-0,7, leucocytes $4,7 \times 10^9$, reticulocytes-2%, eosinophiles- 2 %, segmentonuclear- 64 %, lymphocytes-26%, monocytes- 8 %, ESR- 15 mm/h., serum iron- 7,3 mkmol/l. Deficiency of what factor stimulated the development of disease?

- A. vitamin B12
- B. proteins
- C. folic acid
- D. vitamin B6
- E. iron

7. It has been revealed that a child who stays on artificial feeding has a heavy anemia: Hb- 68 g/l, erythrocytes- 4 T/l, reticulocytes-0%

- A. inherent
- B. siderotic [iron-deficiency] anemia
- C. B12 anemia
- D. sickle cell anemia
- E. hypoplastic anemia

8. A 52-year-old man complains of undue fatigability, weakness. In anamnesis recently was a trauma with

loss of blood. On examination: paleness of skin and visual tunica mycoses, pulse- 90 in one minute/ What sign is obligatory for this type of anemia?

- A. increase of reticulocytes quantity
- B. decrease of blood volume
- C. decrease of color index
- D. B12 anemia
- E. iron refractory anemia

9. A 60-year-old woman complains of straight weakness, short breath, tachycardia, by the little exercise stress and feeling of crawling. Many years suffers of atrophic gastritis. On examination: paleness of skin and visual tunica mycoses, raspberry tongue. Blood analyze: Hb-60 g/l, erythrocytes- $1,5 \times 10^{12}$ in 1 liter, color index- 1,2, massive anisocytosis of erythrocytes, solitary macrocytes.

What chronic anemia has this woman?

- A. chronic posthemorrhagic anemia
- B. acquired hemolytic anemia
- C. siderotic [iron-deficiency] anemia
- D. B12 anemia
- E. iron refractory anemia

10. A 47-year-old man complains of straight weakness, vertigo. Half a year ago he had the operation on stomach with Bilrot method; he had the perforation of the stomach ulcer. On examination: Not high constitution (172 cm and his mass is 60 kg), skin and tunica mucosa are pale, skin is dry. Blood analyze: Hb-80 g/l, erythrocytes- $3,5 \times 10^{12}$ in 1 liter, color index- 0,69, ESR- 15 mm/h. Serum iron – 1 mkmol/l. Hypochromia of erythrocytes. What anemia is it?

- A. chronic posthemorrhagic anemia
- B. hemolytic anemia
- C. siderotic [iron-deficiency] anemia
- D. B12 anemia
- E. iron refractory anemia

11. A newborn, 3 weeks, (parents are healthy, father- Rh+, mother Rh -, icteritiousness of skin; in blood: Hb-105 g/l, erythrocytes- $3,7 \times 10^{12}$ in 1 liter, the free bilirubin is over norm. What is the anemia according to pathogenesis?

- A. posthemorrhagic anemia
- B. hereditary hemolytic anemia
- C. acquired hemolytic anemia

- D. hypoplastic anemia
- E. B12 anemia

12. A 34- year- old woman suffers of general weakness, icteritiousness of skin. On examination: skin and tunica mucosa are icteric, hepatomegalia, splenomegalia. Blood analyze: Hb-80 g/l, erythrocytes- $3,0 \times 10^{12}$ in 1 liter, color index- 0,8, reticulocytes 1,8%, ESR- 19 mm/h., microspherocytosis, hyperbilirubinemia (free bilirubin); in urina- urobilinuria. It was diagnosed the hereditary microspherocytar hemolytic anemia (Minkovsky-Zhiffar disease). What mechanism of caused the hemolysis of erythrocytes?

- A. hemoglobinopathy
- B. enzymopathy
- C. membranopathy
- D. autoimmune aggression
- E. hypoplasia of red marrow

13. At a 36- year- old patient: : Hb-58 g/l, erythrocytes- $1,3 \times 10^{12}$ in 1 liter, color index- 1,3, reticulocytes 2%, ESR- 35mm/h, macropolycytes, Zholly bodies, rings of Kebot. What is this anemia according to mechanism

of development?

- A. posthemorrhagic anemia
- B. hemolytic anemia
- C. asiderotic [iron-deficiency] anemia
- D. hypoplastic anemia
- E. B12 anemia

14. A 37- year -old woman suffers of undue fatigability, chill during 6 months. The condition becomes worse after fish eating. On examination: t° 36,3 C, heart rate- 80 in one minute, arterial pressure 115/70, she has icteric sclera, gloss tongue, signs of sensibility disorders. Liver + 2 sm. In blood: Hb-117 g/l, erythrocytes- $2,7 \times 10^{12}$ in 1 liter, color index- 1,3, megaloblasts, serum iron- 31,5 mkmol/l. From what disease suffers this woman?

- A. hemolytic anemia
- B. B12 anemia
- C. asiderotic [iron-deficiency] anemia
- D. aplastic anemia
- E. metaplastic anemia

15. The blood analysis showed that in patients blood prevails: erythroblasts, normoblasts and megaloblasts. These

cells were found in red marrow. To what anemia can this blood picture be attributed to ?

- A. asiderotic [iron-deficiency] anemia
- B. hemolytic anemia
- C. B12 anemia
- D. posthemorrhagic anemia
- E. aplastic anemia

16. After the application of tourniquet we can observe the point hemorrhages on the forearm (15). With the functional disorder of what blood cells is it connected?

- A. basophiles
- B. macrophages
- C. thrombocytes
- D. erythrocytes
- E. neutrophiles

17. A 35 –year- old man has such blood picture 3 years after stomach resection: Hb-85 g/l, erythrocytes- $2,0 \times 10^{12}$ in 1 liter, color index- 1,27. The disorder of what vitamin absorbtion has a man?

- A. A
- B. B₆
- C. P

D. B12
E. C

18. Women on 7-th month of pregnancy have anemia: Hb-90 g/l, erythrocytes- $2,7 \times 10^{12}$ in 1 liter, anisocytosis, poikilocytosis, solitary megaloblasts, megalocytes, reticulocytes- 0%. What type of anemia is it?

- A. thalassemia
- B. posthemorrhagic
- C. B12 anemia
- D. siderotic [iron-deficiency]
- E. hemolytic

19. It has been revealed that a 40-year- old woman has hemolytic anemia caused with deficiency of ferment glucose-6-phosphatdehydrogenase in erythrocytes. The formation of what matter in pentose-phosphate pathway is disturbed?

- A. dihydroxyacetonephosphate
- B. phosphoenolpyruvic acid
- C. NADPH₂
- D. glucose-6-phosphate
- E. NADPH

20. The woman came to clinic with complaints of weakness, short-breathe, undue fatigability, vertigo; in blood: Hb- 80 g/l, erythrocytes- $1,8 \times 10^{12}$ /l, color index- 1,5, leucocytes- $3,3 \times 10^9$ /l. In the smear: anisocytosis, poikilocytosis, megaloblasts, megalocytes. What is the most probable diagnose?

- A. B12 anemia
- B. posthemorrhagic anemia
- C. acute leucosis
- D. siderotic [iron-deficiency] anemia
- E. immunohemolytic anemia

21. A patient who is the carrier of sickle cell anemia, the pneumonia was accompanied with the hemolytic crisis and with the development of anemia. What is the cause of the hemolytic crisis in this situation?

- A. hyperoxia
- B. heterozygosity with HbS
- C. the mutation of the structural gene
- D. hypoxia pneumonia's origin
- E. change of blood osmolarity

22. A patient had the resection of peripheral part of stomach. After one year he suffers of weakness, periodically dark rings appear behind the eyes. He has short breath. In blood: Hb-70 g/l, erythrocytes- $3,0 \times 10^{12}$ in 1 liter. What changes in peripheral blood smear characterize this disease?

- A. Hyperchrom erythrocytes.
- B. erythrocytes with Cabot rings
- C. Hypochrom erythrocytes
- D. erythrocytes with Howell-Jolly bodies
- E. macrocytes

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For notes
