

**May 18<sup>th</sup> -22<sup>th</sup> , 2020**  
**Class 33 “BIOCHEMISTRY OF THE BLOOD”**

**Tasks:**

- I. Prepare at least 6-pages outline of the class, containing answers to the questions listed in the training guidelines.**

**THEORETICAL PART**

1. Blood, general characteristics and functions.
2. Specific features of chemical composition, structure and metabolism of blood cells.
3. Hemoglobin, structure, derivatives. Variants of hemoglobin in ontogenesis. Hemoglobinopathies.
4. Transport of oxygen and carbon dioxide in blood.
5. Metabolism of iron. Transferrin and ferritin. Iron deficiency anemia
6. Plasma proteins: their classification and characteristics.
7. Hemostasis. Blood coagulation factors. Intrinsic and extrinsic pathways of blood coagulation. Scheme of blood coagulation. Role of vitamin K in blood coagulation.
8. Anticoagulant and fibrinolytic system. Disorders of coagulation and anticoagulation systems. Thrombosis and hemophilias.
9. Biochemical analysis of blood, major laboratory results, use for diagnosis.

**LITERATURE FOR TRAINING:**

1. Harper's Illustrated Biochemistry / Robert K. Murray [et. al.]. – 28th ed. – New York [etc]: McGraw-Hill, Medical, 2009. – P. 463, 566-608.
2. Harper's Illustrated Biochemistry / Robert K. Murray [et. al.]. – 29th ed. – New York [etc]: McGraw-Hill, Medical, 2012. – P.629-640, 650-675.
3. Biochemistry: manual for the medical faculty for international students (in English) / Н.Э. Петушок, А.А. Масловская, М.Н. Курбат. – Гродно: ГрГМУ, 2014. – P. 262-271.
4. Harper's Illustrated Biochemistry / Robert K. Murray [et. al.]. – 31st ed. – New York [etc]: McGraw-Hill, Medical, 2018. – P. 627-645, 646-658, 669-679
5. Harper's Illustrated Biochemistry / Robert K. Murray [et. al.]. – 30th ed. – New York [etc]: McGraw-Hill, Medical, 2015. – P. 668-668, 689-698, 700-701, 711-721.
6. Lecture “Biochemistry of the blood”.

- II. In the laboratory work 1 “DETERMINATION OF HEMOGLOBIN CONCENTRATION IN THE BLOOD” use the extinction below to calculate concentration of hemoglobin. Make conclusion according to diagnostic importance.**

**Extinction of the sample = 0,45**

**Calculation is done by the formula:**

$$C = E_s \times 392 = \quad \text{g/l}$$

**CONCLUSION:**

**DIAGNOSTIC IMPORTANCE.**

Normal concentration of hemoglobin in the blood is **115 – 145 g/l (female), 130 – 160 g/l (male).**

- Children: 11 to 16 g/dL (111 to 160 g/L, or 6.83 to 9.93 mmol/L)
- Pregnant women: 11 to 14 g/dL (110 to 140 g/L, or 6.83 to 8.69 mmol/L)

Increased concentration of hemoglobin is observed in **hypohydration, tissue hypoxia, ulcer disease, in newborns within first hours of life.** Dehydration or hyperhydration can greatly influence measured hemoglobin levels. Albumin can indicate hydration status.

Decreased concentration of hemoglobin is observed in **anemias, hemoglobinopathias, deficiency of vitamins B<sub>12</sub>, E and folic acid.**

In the laboratory work 2 “**DETERMINATION OF CALCIUM CONCENTRATION IN THE BLOOD SERUM**” write down values of extinctions, perform calculation, and make conclusion:

$$E_{\text{sample}} = 0,09$$

$$E_{\text{standart}} = 0,12$$

$$\text{CALCULATION: } C_s \text{ in mmol/l} = \frac{E_s}{E_{st}} \times 2,5 =$$

**CONCLUSION:**

**DIAGNOSTIC IMPORTANCE.**

Normal concentration of calcium in the blood is **2,25-2,75 mmol/l.**

**Hypercalcemia** is the term that refers to elevated levels of calcium in the bloodstream.

- Hyperparathyroidism tends to be more common in women over 50.
- It can be the result of all four parathyroid glands producing too much PTH (parathyroid hyperplasia), or one gland specifically producing an excessive amount of hormone (usually the result of a parathyroid adenoma, or benign [tumor](#)).

Hypercalcemia can occur due to other medical conditions. These conditions can vary in severity and chronicity, and may be life-threatening. Malignancy is a common cause of elevated blood calcium. Up to 20% of individuals with [cancer](#) will develop hypercalcemia at some point in their disease.

Other conditions associated with hypercalcemia include:

- Cancers, especially [lung cancer](#) and [breast cancer](#)
- Immobilization over a long period of time
- [Kidney failure](#)
- Overactive thyroid ([hyperthyroidism](#)) or excessive thyroid hormone intake
- Use of certain medications such as the thiazide diuretics
- Inherited kidney or metabolic conditions
- Excessive vitamin D levels from vitamins, excessive dietary calcium, or from diseases that may result in excess vitamin D production.

**Hypocalcemia:** Lower-than-normal level of calcium in the blood, which makes the nervous system highly irritable, as evidenced by tetany (spasms of the hands and feet, [muscle cramps](#), abdominal cramps, and overly active reflexes). Chronic hypocalcemia contributes to poor mineralization of bones, soft bones (osteomalacia), and [osteoporosis](#). In children, hypocalcemia leads to [rickets](#) and impaired growth. Treatment involves increased dietary intake of calcium or calcium supplementation.

Physiologically, blood calcium is tightly regulated within a narrow range for proper cellular processes. Calcium in the blood exists in three primary states: bound to proteins (mainly albumin), bound to anions such as phosphate and citrate, and as free (unbound) ionized calcium. Only the ionized calcium is physiologically active. Normal blood calcium level is between 2.12 to 2.75 mmol/L. Common causes of hypocalcemia include hypoparathyroidism, vitamin D deficiency, and chronic kidney disease. Symptoms of hypocalcemia include neuromuscular irritability (including tetany as manifested by Chvostek's sign or Trousseau's sign, bronchospasm), electrocardiographic changes, and seizures. Treatment is dependent upon the cause, but most commonly includes supplementation of calcium and some form of vitamin D or its analogues.

**The notes and laboratory protocols will be revised by your teacher.**

**Please, report whether you have received this letter.**