

Ministry of Health of the Republic of Belarus  
Education Establishment  
"Gomel State Medical University"  
Normal Physiology Department

It was discussed at the department meeting 30.08.16  
The protocol № 8

**METHODICAL INSTRUCTION**

for carrying out classes by teachers with the 2nd course students  
of Faculty for training specialists for foreign countries (teaching in English)  
on normal physiology

**Topic:** Gas exchange in lungs and tissues. Transport of gases by blood

The general time of the class – 4 hours

**1. THE STUDYING AND EDUCATIONAL PURPOSES, MOTIVATION FOR  
ASSIMILATION OF THE TOPIC, REQUIRMENT TO THE INITIAL LEVEL OF  
KNOWLEDGE**

**Purpose of the class**

To study processes of gas exchange in lungs and transport of gases by blood and also factors which provide gas exchange.

**Motivational characteristic**

The research of external respiration is the important diagnostic indicator allowing to determine pulmonary volumes and capacities, and also to compare the received results to norm indicators that it is especially important to know to students of medical and medico-diagnostic faculties.

**Tasks of the class**

In the course of the class students have to master the technique of definition of external respiration indicators by means of the spirometry and give their corresponding assessment.

As a result of the given class the student has to

**To know:**

- structure of an aerohematic barrier;
- essence of processes of gas exchange in lungs and transport of gases by blood;
- analysis of curve dissociation of oxyhemoglobin;
- the basic concepts and terms on the class topic,
- basic physiological constants on the class topic.

**To be able:**

To master a technique of graphic registration of external respiration indicators and to be able to compare the received indicators with norm.

**2. CONTROL QUESTIONS FROM RELATED SUBJECTS:**

1. Structure of an aerohematic barrier.
2. Respiratory enzymes and their role in transport of gases a blood.

**3. CONTROL QUESTIONS ON THE CLASS TOPIC:**

1. Gas exchange in lungs. Partial pressure of oxygen and carbon dioxide in the inhaled, alveolar and exhaled air. Voltage of gases in blood. The factors influencing on process of diffusion of oxygen and carbon dioxide between alveolar air and blood. Ventilation-perfusion coefficient. Diffusion ability of lungs for gases.

2. Oxygen transport by blood. Transport forms of oxygen by blood. Analysis of curve dissociation of oxyhemoglobin. The factors influencing affinity of hemoglobin to oxygen, their physiological value. Oxygen capacity of blood.

3. Transport of carbon dioxide blood. Transport forms of carbon dioxide in blood. Diffusion of carbon dioxide from tissues into blood. Carbonic anhydrase. Interrelation between gas exchange of oxygen and carbon dioxide.

4. Gas exchange between blood and tissues. Efficiency (utilization) of oxygen by tissues at rest and at physical exercise.

#### **Questions for independent studying**

1. The concept about ventilation-perfusion relations in lungs.

2. System of transport of oxygen as unity of functioning of the cardiovascular device and blood. Useful adaptive results and purpose of its functioning.

#### **Report:**

1. The concept about the systemic and regional oxygen capacity of a blood (SOC and ROC). The factors providing optimum SOC and ROC: the minute volume of blood, a gradient of the hydrostatic pressure ( $\Delta P$ ), the oxygen capacity of a blood (OCB), affinity of blood to oxygen, nitrogen oxide role.

#### **4. PRACTICAL PART OF THE CLASS**

Laboratory work 15.1 Spirography.

#### **5. THE COURSE OF THE CLASS**

- *Introduction*: The teacher answers questions of students which caused certain difficulties in the course of independent mastering of educational material;

- *Requirement to the initial level of knowledge*: From sections of the histology and biochemistry students have to know a structure of an aerohematic barrier and what factors take part in transport of gases by blood.

- *Correction of initial level of knowledge*: The teacher checks and supplements the initial level of knowledge of students of theoretical and applied questions on the class topic "Gas exchange in lungs and tissues. Transport of gases by blood". In this section questions of essence of processes of gas exchange in lungs and transport of gases by blood are considered, the curve of dissociation of oxyhemoglobin is analyzed. The teacher corrects answers of students on the considered topic;

- *Statement of problems which will be solved by students*: The teacher sets a task to master at the level of ability technology of determination of respiratory volumes and capacities by spirometry method.

- *Independent performance of tasks by students*:

- students make out the protocol of the class with the subsequent discussion of a technique of performance;

- students perform practical work under control of the teacher or laboratory assistant. For work performance students are provided with methodical guiding, the spirometry. Presentation is provided by tables, drawings;

- students read reports on the class topic with the subsequent their discussion.

- *Assessment of final level of knowledge of the topic of the class*: The teacher specifies the final level of knowledge of students of theoretical and practical questions, the basic concepts and terms, and also knowledge of basic physiological constants of the class topic;

- *Viewing of the video*

- *Fixing of knowledge*: The teacher suggests students to solve several situational problems of a topic of the class and to answer test questions;

- *The conclusion of the teacher and a task for the next class:* At the end of the class the teacher concludes about the carried-out work and offers students home task for independent work. Then summing up the class and signing of protocols of experience, and also assessment of practical skills in an account leaf is carried out.

Note: time of breaks of 15 minutes during the class.

### **Virtual experiment:**

1. Influence of pressure in a pleural cleft on ventilation of the lungs

### **6. QUESTIONS FOR SELF-CHECKING OF KNOWLEDGE**

1. In reanimation not pure oxygen, but carbogenum – an admixture of 93 — 95% of O<sub>2</sub> and 5 — 7% of CO<sub>2</sub> is applied. Why?
2. Why is the respiratory system the effector in the regulation of blood pH?
3. Comparison of the gas structure of inhaled, exhaled and alveolar air. How and why will respiration change at not adapted persons at the lowered atmospheric pressure? List the factors causing acclimatization to oxygen starvation in mountain areas.
4. The pathological states connected with deterioration in diffusion of oxygen through an alveolar-capillary membrane are known. It isn't observed concerning diffusion of carbon dioxide. Why?
5. Oxyhemometry and oxyhaemography. Calculate possible OC for blood with the amount of Hb =150 g/l.
6. At a poisoning with carbon monoxide (CO) the victim felt weakness, fast fatigability. What is the mechanism of such changes and how at the same time will the oxygen capacity of blood change?

### **LITERATURE**

#### **Basic**

1. Human physiology: textbook for overseas students = Физиология человека: учеб. пособие для иностранных студентов, обучающихся на английском языке / А. И. Киеня [и др.]; под ред. проф. Э. С. Питкевича; пер. на англ. яз. Р. А. Карпов, В. А. Мельник. — Гомель: УО ГомМУ, 2009. — 352 с.
2. Text of lectures.

#### **Alternate**

1. Textbook of medical physiology // C. Guyton, 2006. — 1116 p.
2. Human anatomy and physiology // Alexander P., Spence-Elliott B. Masson.
3. Human physiology. The mechanisms of body function // Arthur J. Vander James H Sherman Dorothy S. Luciano, 1986. — 715 p.
4. Lecture notes on human physiology // John J Bray, Patricia A. Cragg, Anthony D.C. Macknight, Roland G. Mills and Douglass W. Taylor.
5. Human anatomy and physiology // Elaine N. Marieb, 1989. — 995 p.
6. Review of medical Physiology, International edition, 2003. — 912 p.