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**Tasks and standard answers**

**for the exam in the discipline Normal Physiology**

**for specialty 31.05.01 – General Medicine**

**full-time education**

TASK 1

A 10-year-old boy with developed swelling of the face 3 weeks after the defeat of the tonsils with an acute infection was diagnosed with glomerulonephritis (inflammation of the glomeruli of the kidneys).

Research RESULTS:

|  |  |  |
| --- | --- | --- |
| Indicators | Patient analysis | Norm |
| Urine volume (ml/day) | 500 | 850-900 |
| Color | Red, muddy | Yellow |
| Protein | ++ |   |
| Erythrocytes | ++ |   |
| Blood Pressure, mm Hg. | 160/95 | 100/60 |
| Protein in blood plasma, g/ l | 50 |   |

Questions:

1) Violation of what processes of urination in kidney disease leads to the appearance of protein in the urine?

2) Describe the possible mechanisms of edema?

3) What is the oncotic blood pressure, its magnitude and role in the development of edema?

4) Does it correspond to the norm of blood pressure? What are the main factors in the norm determine the value of blood pressure? What are the possible reasons for its increase?

5) What causes can lead to a decrease in the level of protein in the blood? Which ones are most likely in this case?

TASK 2

According to medical indications, the patient requires a transfusion of whole blood. When determining the blood group affiliation, agglutination of erythrocytes with antibodies (zoliclon) anti-A, anti-AV and super anti-D was observed, but a negative reaction with anti-B zoliclon.

Questions:

1) To which blood group according to the AB0 system does the patient's blood belong?

2) What is the Rh type of blood?

3) What is the best donor blood for transfusion?

4) Is it possible to transfuse Rh-negative blood to a patient?

TASK 3

The introduction of rabbit serum, previously anemized by bloodletting, to another, intact rabbit, stimulates erythropoiesis in the latter.

Questions:

1) What does this experience show?

2) What is erythropoietin? Where is it produced?

3) What is the point of application of the action of erythropoietin?

4) Under what conditions does its production increase?

5) What other similar substances do you know?

TASK 4

After surgery on the gastrointestinal tract, the patient was on parenteral nutrition for 10 days. He was injected daily with up to 4 liters of liquid - solutions of 0.9% NaC1, Ringer-Locke, 5% glucose, and others. The patient lost 10 kg of body weight in the postoperative period.

|  |  |  |
| --- | --- | --- |
| Analysis  | Sick  | Norm  |
| Plasma proteins  | 47 g/l  |   |
| Albumins  | 20 g/l  | 32-55 g/l  |
| Hemoglobin  | 100 g/l  |   |
| Erythrocytes  | 2х10-12/l  |   |
| Color index  | 0,7  |   |
| Protein in the urine  | 0.27 g/day  | 0.2 g/day  |
| Specific gravity of urine  | 1012  |   |
| Daily diuresis  | 4L  |   |
| Oncotic blood pressure  | 20 mmHg  |   |

Questions:

1) Analyse the blood test, name the norm for each indicator, designate the condition of the patient. What do red blood counts indicate?

2) Analyze the kidney function.

3) Has this patient's hormonal control of kidney activity changed?

4) Why does the patient have a significant loss of body weight?

TASK 5

When analyzing the working conditions in the blacksmith shop, it is established: the air temperature in the work zone is +30 C, there is no air movement. The work consists in moving heated parts weighing 2-3 kg throughout the working day. By the end of the working shift, the decrease in body weight in workers is 2-3 kg. Caloric value of the daily diet is on average about 3500 kcal.

1) What explains the decrease in body weight in workers by the end of the shift?

2) What methods of heat transfer do you know, which ones are effective in these conditions?

3) What changes in water-salt metabolism are possible in the human body under these conditions?

4) Will the composition and physiological properties of the blood of workers change by the end of the shift?

5) Will diuresis change in these conditions? How and why? What are the mechanisms for these changes?

  TASK 6

A 34-year-old patient was sent to the hospital for treatment in connection with severe bleeding after tooth extraction. Blood tests have the following results:

|  |  |  |
| --- | --- | --- |
| Analysis  | Patient  | Norm  |
| Platelets/L  | 175x10\*  |   |
| Hemoglobin (g/L)  | 100  |   |
| Bleeding time (min)  | 9  | 3-6  |
| Leukocytes / l  | 6,5x10\*  |   |
| Ca2+  | 1,5 mMol/L  | 2,2- 2.5 mMol/L  |

Questions:

1) What are the possible causes of bleeding in this patient?

2) What physiological mechanisms ensure the cessation of bleeding (hemostasis)? What is coagulation hemostasis, and what are the main factors involved in it?

3) How is erythropoiesis regulated? What factors are necessary for erythropoiesis?

4) Name and explain the ways of entry of Ca2+ into the body and excretion of Ca2+ from the body?

TASK 7

In a blood test, it was established that the patient's plasma protein content is 50g/l.

Questions:

1) Compare with the norm, designate the state with the appropriate term. List the functions of blood plasma proteins.

2) What causes can lead to such hypoproteinemia? What additional studies need to be done to identify the specific cause?

3) How will the volume of interstitial fluid in the patient change? Explain the reasons for the changes.

4) Has the effective filtration pressure in the nephron capsule changed in this patient? How is the effective filtration pressure calculated?

5) What physiological characteristics of the blood can change?

TASK 8

The patient underwent resection of the pyloric part of the stomach for medical reasons.

Questions:

1) What functions does the stomach perform? What are the functions of each of its departments?

2) What functions of the stomach will be impaired after such an operation? Is it possible to compensate them?

3) Will the patient's digestion of nutrients change?

4) How should I change the diet of this patient?

5) Is it possible to violate the erythropoiesis of this patient and why?

TASK 9

The athlete during the marathon run lost 4 liters of water due to increased sweating.

Questions:

1) What is the mechanism and significance of increased sweating in this case? What are the mechanisms for compensating for decreasing blood circulation capacity (BCC)?

2) Give a classification characteristic of the sweating reflex.

3) How will the activity of the kidneys change at this time?

4) How and why will the concentration of glucose in the blood and hormones that regulate the concentration of glucose change?

5) Will the composition and physiological properties of the blood change during the run?

 TASK 10

As a result of the injury, the patient completely destroyed the anterior roots of all lumbar and three upper sacral segments of the spinal cord on the left.

Questions:

1) What manifestations of motor activity on the affected side will disappear – phase, tonic, arbitrary, involuntary?

2) Will muscle tone on the affected side change? How and why?

3) Which spinal reflexes in case of irritation of the skin of the lower leg and foot on the left will be recorded, and which will not?

4) What function do muscle spindles and Golgi receptors perform?

5) Which part of the brain directly controls the activity of muscle spindles?

6) Will the blood circulation in the muscles of the left lower limb change?

TASK 11

A person habitually chews gum.

Questions:

1) How will salivation change? What is the mechanism of regulation of salivation?

2)What happens to breathing when you swallow saliva? What is the mechanism of this phenomenon?

3) What phase of gastric secretion is activated in this situation? Its mechanism.

4) What hormones are involved in the gastric phase of gastric juice secretion? Are they formed in this case?

5) Why is it not recommended to chew gum with an empty stomach?

6) Will this person salivate at the sight of chewing gum?

TASK 12

In an experiment on a dog with a fistula of the salivary gland, it was found that more saliva is excreted on meat powder than on meat, on crackers - more than on bread; a lot of saliva liquid is released on spraying with the help of a rubber pear of ascorbic acid and at the sight of this pear, the dog actively tries to avoid jumping acid, heart rate and respiratory rate increase.

Questions:

1) Explain the differences in saliva secretion on different foods. What is the name of this ability of the digestive glands? What are the mechanisms of this phenomenon?

2) What functions does saliva perform? How to explain the secretion of saliva on the action of acid?

3) What is the name of the reaction of a dog that occurs at the sight of a pear to spray acid? What is its origin and biological significance?

4) How to explain the changes in heart rate and respiratory rate at the sight of a pear? How are these processes regulated?

TASK 13

Alcoholism is characterized by toxic damage to the neurons of the central nervous system. At the same time, ataxia, nystagmus, asymmetry of tendon reflexes, muscle tone and strength decrease, sexual functions are disturbed, vegetative-vascular dystonia are observed.

Questions:

1) What symptoms indicate a violation of the activity of vegetative centers?

How is vascular tone normally regulated?

2) Describe the features of cerebral circulation and its regulation.

3) Explain the possible origin of motor disorders. Which parts of the brain regulate movements?

4) What is muscle tone? What is its origin and significance?

5) Muscle strength. Give a definition. What does it depend on?

TASK 14

The animal in the experiment was cut the Vagus nervebranches going to the pancreas.

Questions:

1) What reflexes provide the secretory function of the pancreas? Characterize these reflexes.

2) Will the secretory reflex be carried out in this case? Will pancreatic juice be secreted? If so, how is the secretion of pancreatic juice regulated in this case?

3) Will the endocrine function of the pancreas be impaired in this case?

4) What hormones does the endocrine part of the pancreas secrete, what are their functions?

TASK 15

The patient (a heavy smoker) complains of severe pain in the lower limb, which appears only when walking (intermittent claudication). The examination revealed the absence of pulsation on the arteries of the limb, pallor and a decrease in skin temperature. With angiography, it was found that the lumen of the arteries is reduced compared to the norm. The patient underwent an operation to cut the sympathetic nerves innervating the limb. Pain and other listed symptoms disappeared after surgery.

Questions:

1) Which center maintains and regulates the tone of the smooth muscles of the arteries? What condition is it in? What are the mechanisms that support this condition?

2) Give a classification characteristic of the vasomotor reflex.

3) List the links of the reflex arc of this reflex. Which mediator provides the transmission of excitation to the smooth muscles of the vessels? What receptors on the myocyte membrane does it interact with?

4) How did the tone of the vessels change after the operation? What is the reason for these changes?

5) Explain the origin of the above symptoms and the reasons for their elimination after surgery.

6) Will the tone of the skeletal muscles of this limb change after this operation?

TASK 16

The patient has a traumatic rupture of the spinal cord at theTh6-Th7segments.

Questions:

1) What is the name of the state of the nerve centers located below the spot of injury? What are the mechanisms of this phenomenon?

2) What somatic reflexes will be changed? How long?

3) What autonomic reflexes will be changed?

4) Are voluntary movements possible after an injury? What structures of the brain regulate movements?

5) Is it possible to arbitrarily control autonomic functions? Describe the structure of the reflex arc of the autonomic reflex.

6) Will the activity of sensory systems change? Which ones?

TASK 17

During the experiment, the dog was not fed for one day, and then put in a machine where it was usually fed. They used stimulation of the paw with an electric current, causing a weak painful sensation, but instead of a defensive motor reflex, salivation was observed.

Questions:

1) Which sensory systems are excited in a given situation?

2) Explain the physiological mechanism of the observed phenomenon.

3) What is the name of the principle of interaction of nerve centers, in which one center can increase its excitation due to the excitation of other centers? What is its biological role?

4) Give examples of a similar condition in humans.

5) What is the role of salivation in a dog? In human?

TASK 18

In the room where the dog is located, a piece of meat is located at an inaccessible height. The dog has motor anxiety, increased blood pressure, increased heart rate, salivation and dilation of the pupils.

Questions:

1) Explain the physiological mechanisms of changes in heart rate and blood pressure.

2) What mechanisms are used to regulate salivation?

3) Explain the causes and mechanism of the change in the diameter of the pupils.

4) List the departments of the central nervous system involved in the regulation of muscle tone and movements,

5) Which of the centers is in the dominant state and determines the behavior of the dog? What is the essence of the dominant principle?

TASK 19

A person was diagnosed with a spinal injury after a car accident. It has been established that the ulnar (elbow) and upper abdominal reflexes correspond to the norm, and the lower abdominal, as well as the knee and Achilles reflexes are not detected.

Questions:

1) What does the lack of reflexes indicate?

2) Draw a reflex arc of the tendon reflex.

3) Will the functional state of the proprioceptors of the lower extremities change?

4) Analyze the situation and justify the conclusion about the level of spinal cord injury.

5) Is it possible to restore voluntary movements and reflexes of the skeletal muscles of the lower extremities?

6) Is it possible to restore the reflexes of urination and defecation?

TASK 20

Upon admission to the clinic, the patient complains of insomnia, tachycardia, weak involuntary contractions of skeletal muscles. In a blood test, it was found that the concentration of Ca ++ in the blood is 1.7 mmol / l (the norm is 2.2 *-* 2.5 mmol / l).

Questions:

1) What are the possible causes of a decrease in the level of Ca++ in the blood?

2)What hormones regulate the level of Ca++ in the blood?

3)What are the ways of CA++ entry into the body?

4) What is the role of vitamin D in the regulation of calcium homeostasis?

TASK 21

With a strong fright, the following were detected: tachycardia, increased blood pressure, increased respiratory rate, increased blood glucose levels.

Questions:

1) What endocrine changes are usually observed under stress?

2)Explain the mechanisms of changes in heart rate and blood pressure in this case.

3) Describe in detail the mechanisms of regulation of cardiac activity and breathing.

4) Is it possible to change the motility of the intestine?

5) What are emotions? Give a definition. What is their role in the adaptation of the body?

6) What are the mechanisms of increasing blood glucose levels in this case?

TASK 22

Late in the evening, the patient ate 300 g of salted salmon. At night, he had to get out of bed twice and drink water.

Questions:

1) Name the three processes of urination and briefly describe them.

2) How will urination change when consuming salty foods?

3) How will the osmotic pressure of the blood change during the absorption of salts from the gastrointestinal tract?

4) An increase in the production of which hormone reduces the volume of final urine in this situation? Describe its mechanism of action.

5) Draw a reflex arc of the urination reflex. What is the role of the cerebral cortex in the regulation of urination?

TASK 23

The patient complains of constant thirst. It was examined that the daily diuresis is 3 liters.

Questions:

1) Compare to the norm, name it by a special term.

2) What changes in the dietary regime can lead to this situation?

3) What hormonal disorders can lead to this situation?

4) List and explain the possible mechanisms of increased diuresis in hormonal disorders.

5) Why does diuresis increase with sharp rises in blood pressure?

TASK 24

During the examination, it was found that the daily diuresis in the patient is 600 ml.

Questions:

1) Compare the amount of diuresis with the norm, name it by a special term.

2) What physiological situations can lead to a decrease in diuresis?

3) What clinical situations can lead to a decrease in diuresis?

4) Explain the mechanism for reducing diuresis (cessation of diuresis) in severe pain.

5) Describe the mechanisms for reducing diuresis with massive blood loss.

6) What blood constants will change with a prolonged decrease in diuresis?

TASK 25

A young man complains of thirst, loses about 2800 ml of urine daily. The exhaled air of the patient has the smell of acetone, his urine contains glucose. Analyzes showed the following:

|  |  |  |
| --- | --- | --- |
| Analysis | Patient | Norm |
| Daily diuresis | 2800 ml |   |
| Blood glucose | 11 mmol/L |   |
| Glucose in the urine | + |   |
| Acetone in urine | + |   |

Questions:

1) Write a norm for each indicator, give names to the states.

2) Explain what endocrine disorders this patient might have?

3) The absence or lack of which hormone usually leads to an increase in blood glucose levels? How is the production of this hormone regulated?

4) Explain the cause of polyuria in this case.

5) What other hormonal disorders are accompanied by polyuria?

6) Why is glucose contained in the urine of the patient and is absent in the urine of healthy people?

TASK 26

Patient suffers from prolonged diarrhea. In the study of feces, a large amount of neutral fat, undigested food were revealed. He was diagnosed with chronic pancreatitis. In the blood plasma there is:

|  |  |  |
| --- | --- | --- |
| Analysis | Patient | Norm |
| Calcium | 1,8 mmol/l | 2,10-2,55 mmol/l |
| Total protein | 68 g/l |   |

Questions:

1) Explain the excretion of fat and undigested food residues in this patient.

2) Explain why the patient has a low serum Ca++ content.

3) What role does Ca++ play in the body, and what endocrine factors affect the content of Ca++ in the blood? What symptoms can a patient develop due to a low content of Ca ++ in the blood?

4) Will the rate of protein digestion change in this patient?

5) Will the BCC, heart rate, blood pressure change in this patient?

 TASK 27

With artificial breathing with oxygen, for example, in long flights, 5% CO2 is added to the oxygen cylinder.

Questions:

1)What is such a mixture called?

2) For what purpose is this done?

3) What classical experience underlies this phenomenon?

4) What happens if it is not done?

5)How can this problem be solved with surgical interventions?

TASK 28

Patient K., 50 years old, hospitalized due to uncontrollable profuse vomiting within the last 48 hours. He is conscious, the skin is pale, cold to the touch, dry. There is a condition of dehydration of the body. Survey results are as follows:

|  |  |  |
| --- | --- | --- |
| Analysis  | Patient  | Norm  |
| Pulse (beat//min)  | 104  |   |
| Urine volume (%,ml/24 hours)  | 600  |   |
| Urine pH  | 7.4  | 5,5-7.0  |
| Blood pH  | 7.45  |   |
| K+ blood serum (mmol / l)  | 2.0  | 3.5-5,1  |

Questions:

1) Explain the pallor of the skin in the patient.

2) Why does the patient have tachycardia?

3) Explain why the patient has a small volume of urine and an increase in its pH. What hormones are involved in creating this effect?

4) How will the tone of the resistive vessels in the patient be changed? Explain the mechanism of development of these changes.

5) What measures should be taken to normalize the water-salt balance in this patient?

TASK 29

The pH of arterial blood is 7.45. Give an estimate of this value.

Questions:

1) What is the name of this condition?

2) How is a constant blood response maintained?

3) Which buffer systems do you know?

4) Which blood buffer systems are the most important and play a large role in maintaining the constancy of the blood response?

TASK 30

The patient was found on the street unconscious and taken to the hospital. He is exhausted, dehydrated, blood pressure 85/60 mm Hg st., breathing with acetone odor, heart rate - 105 beats per minute. A blood test gave the following picture:

|  |  |  |
| --- | --- | --- |
| Analysis  | Patient  | Norm  |
| blood glucose (mmol/L) | 23,6 |   |
| potassium whey (mmol/L) | 6 | 3-5 |
| glucose in the urine  | +  |   |

Questions:

1) Name the norm for the given indicators, name it by a special term.

2) What endocrine changes can this phenomenon be associated with?

3) Why does the urine of a healthy person not contain glucose?

4) In what case does it appear in the urine?

5) How will diuresis change when glucose appears in the urine?

TASK 31

The patient complains of acute pain in the lower back. Ultrasound showed a 8 mm diameter stone in the right ureter. Blood pressure - 140/100 mmHg.

Questions:

1. Explain the cause of the pain in this case. What is the biological significance of pain?
2. List the elements of the nociceptive sensory system.
3. How and why will the pulse and blood pressure change in the bottom case?
4. How will the activity of the endocrine glands change?
5. Will the secretory function of the digestive tract also change?
6. Has the urination in the left and right kidney changed?

TASK 32

The patient showed a decrease in basal metabolism by 40%.

Questions:

1. What is a basic exchange?
2. What processes in the body consume the energy of the basic metabolism?
3. What changes in the hormonal balance of the body can lead to a decrease in basal metabolism?
4. How does this change the indicators of the activity of the cardiovascular system?
5. How will thermoregulation change?
6. Will the state of the central nervous system change?
7. What changes in GNI can I expect in this patient?

TASK 33

With a strong fright, the heart rate increases, blood pressure rises, and the respiratory rate increases.

Questions:

1. What endocrine changes are observed under stress?
2. Describe the mechanisms of regulation of the heart and respiratory system.
3. Explain possible changes in intestinal motility. Are they similar to sympathicotonics and vagotonics?
4. What are emotions? What is their role in the adaptation of the body?

TASK 34

The patient had a complete traumatic rupture of the spinal cord in the region of the C7-T1 segments.

Questions:

1. Is breathing possible in this case? Is it possible to alternate inhalation and exhalation normally? Will the lung capacity change?
2. Will there be changes in the activity of the cardiovascular system?
3. Will there be changes in the secretory and motor function of the digestive tract?
4. Are urinary and urination disorders possible? Where will they manifest themselves?
5. Are voluntary movements and spinal reflexes possible in such conditions?

TASK 35

Two patients without pathology of the cardiovascular system after a week of bed rest for the first time got out of bed. The results of the survey of each of them are presented below:

|  |  |  |
| --- | --- | --- |
| Physiological indicator | Patient 1 | Patient 2 |
| Heart rate in the "lying" position | 70 per min | 70 per min |
| Heart rate in the "standing" position | 76 per min | 88 per min |
| Blood pressure in the "lying" position | 120/80 mm Hg  | 120/80 mm Hg  |
| Blood pressure in the "standing" position | 125/75 mm Hg  | 110/90 mm Hg  |
| Sensations  | No discomfort detected | Dizziness, weakness, sweating |
| Breath | No change | Dyspnoea |

Questions:

1) What is an orthostatic test?

2) Draw a conclusion about the state of the cardiovascular system in the first and second patient.

3) Explain the mechanism of change in breathing in the second patient.

4) Explain the mechanisms of dizziness and sweating.

5) Draw a reflex arc of self-regulation of blood pressure.

TASK 36

When examining mountain climbers, an increase in the number of red blood cells and the amount of hemoglobin, an increase in hematocrit, an increase in heart rate and blood pressure were found.

Questions:

1) Name the normal content of red blood cells and hemoglobin in men and women.

2) What is the name of the increase in the number of red blood cells? What is the cause of its occurrence?

3) Describe the role of hemoglobin in the transport of blood gases.

4) How will the nature of breathing change at an altitude of 3000 m?

5) How will the gas composition of the blood change at an altitude of 3000 m and what changes in the acid-base state of the blood can this lead to?

6) What are the mechanisms for increasing heart rate and blood pressure?

TASK 37

The number of red blood cells in the blood of the athlete before training was 4.5x1012 per liter, after physical training 5.5x1012, the total peripheral resistance after training decreased. Heart rate and blood pressure increased.

Questions:

1) What are the main blood depots?

2) What is the oxygen capacity of the blood and how to calculate it? Will it change after the training?

3) Does the viscosity of the blood change with prolonged physical exertion? Why?

4) Will the hematocrit change in this case?

5) Will sweating change during exercise and why?

6) Explain the mechanisms for reducing total [peripheral](https://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/peripheral) vascular [resistance](https://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/resistance), increasing heart rate and blood pressure.

TASK 38

The patient was hospitalized with a gunshot wound to the hip, the femoral artery was damaged. Не looks pale, breathing is rapid and shallow, the skin is moist and cold. Pulse-140 beats / min, blood pressure - 90/60 mm Hg.

Questions:

1) Explain the mechanisms of lowering blood pressure and increasing heart rate.

2) What is the mechanism of shortness of breath?

3) What changes in kidney function can be assumed in this patient?

4) Explain the causes of pallor and decreased skin temperature?

TASK 39

In a healthy adult at rest and 10 minutes after the start of physical exercise, the following indicators were recorded (see Table):

|  |  |  |
| --- | --- | --- |
| Index  | Quiescent state  | During exercise  |
| HR  | 70 bpm  | 150bpm  |
| Respiratory rate  | 14 /min  | 40/min  |
| Lung capacity  | 550 ml  | 1000ml  |
| Partial pressure of carbon dioxide in alveolar air  | 40 mmHg  | 40 mmHg  |
| Anatomical dead space  | 150ml  | 150 ml  |
| Minute Blood Volume  | 5,6 l/min  | 15 l/min  |
| Blood pressure  | 120/80 mmHg  | 150/75 mm Hg Art.  |

Questions:

1) Calculate the minute volume of breathing and alveolar ventilation.

2) Make a conclusion about the state of external respiration.

3) Describe the mechanism for maintaining the partial pressure of CO2 in the alveolar air at rest and during exercise?

4) List the mechanisms responsible for increasing ventilation during exercise, the role of peripheral and central chemoreceptors, the role of proprioceptors of skeletal muscle, the role of conditioned reflex regulation.

5) How do blood pressure, minute blood volume, systolic volume and heart rate change during physical work, what is the mechanism of these changes?

TASK 40

The number of red blood cells in the blood of the athlete before training was 4.5x10 12 per liter, after physical training 5.5x10 12, the total peripheral vascular resistance after training decreased. Heart rate and blood pressure increased.

Questions to the task:

1) What are the main blood depots?

2) What is the oxygen capacity of the blood and how to calculate it? Will it change after a workout?

3) Does the viscosity of the blood change with prolonged physical exertion? Why?

4) Will the hematocrit change in this case?

5) Will sweating change during exercise and why?

6) Explain the mechanisms for reducing OPSS, increasing heart rate and PD.

TASK 41

A patient was admitted to the clinic after a car injury. It was established that as a result of the rupture of large vessels, he lost about 1.5 liters of blood.

Questions:

1) What protective mechanisms are included to compensate for blood loss in the body?

2) What will be the dynamics of changes in the volume of circulating blood?

3) Will the patient's kidney function change? How and why?

4) Will this patient's heart rate and blood pressure change?

5) What hormones will be released to maintain blood pressure and regulate water-salt metabolism?

6) Will the patient's breathing pattern change? How and why?

TASK 42

A 48-year-old woman was hospitalized with shortness of breath, swelling of the feet. Blood pressure is 190/120 mmHg. In the past, she was treated for hypertension. The pressure in the jugular vein is 20 cm. water column. The heart and liver are enlarged.

Questions:

1) Comment on the value of arterial and venous pressure in a woman.

2) List the factors on which the level of blood pressure depends.

3) How does the increase in blood pressure affect the work of the heart and breathing, what is the physiological mechanism of this influence?

4) What is the alleged mechanism for the development of edema in this patient?

5) What is the normal pressure in the veins that bring blood to the heart?

TASK 43

|  |  |
| --- | --- |
| Look at the picture and answer the questions. Questions:1) What process does this curve describe? 2) Determine the P50 score.3) What type of hemoglobin is presented here?4) Indicate the рО 2 range that characterizes the ability of hemoglobin to bind O2 and give it to tissues.5) Calculate on the curve how much the % of hemoglobin oxygen saturation decreases with a decrease in O2 voltage by 30 mm Hg. in the zone of high (100-70) and medium voltages (60-30).6) Under what conditions will it be effective to shift the dissociation curve of oxyhemoglobin to the right? |    |

TASK 44

Compare the results of the patient's examination. Give an opinion on the dynamics.

|  |  |  |
| --- | --- | --- |
| Index  | Day 1  | Day 5  |
| Respiratory rate  | 20 per min  | 40 per min  |
| Heart rate  | 90 per min  | 120 per min  |
| Tidal volume  | 250 ml  | 325 ml  |
| Anatomical dead space  | 150 ml  | 150 ml  |
| Oxygen tension in arterial blood | 90 mmHg  | 105 mmHg  |
| Carbon dioxide tension in arterial blood  | 47 mmHg  | 42 mmHg  |

Questions:

1) Calculate the minute volume of breathing for day 1 and 5 and the minute alveolar ventilation. Make a conclusion about the state of external respiration on the 1st and 5th day

2) How does an increase in  рCО 2 and a decrease in blood рО 2 affect the dissociation of oxyhemoglobin?

3) What are the physiological mechanisms for changing the frequency and depth of breathing when рО 2 and рCО 2 change in the blood?

4) Present a modern view of the respiratory center.

5) Will the activity of the central nervous system in this patient change?

6) What are the mechanisms for increasing heart rate?

TASK 45.

The patient underwent an operation, during which he was transfused with 2 liters of canned blood and for the first hour he was connected to a heart-lung machine.

After the operation, bleeding from the wound is observed.

INDICATORS:

|  |  |
| --- | --- |
| Pulse | 96 bpm |
| HELL | 100/70 mm Hg Art.  |
| Blood test: Erythrocytes | 3,5\*1012L  |
| Platelets | 100\*109 l |
| Sa++ | 1.5 mMol/L (norm = 2.2-2.5 mMol/L) |
| Bilirubin | more than normal |

Questions:

1) Evaluate the results of the blood test. What are the reasons for the deviation of indicators from the norm? Name the corresponding states by accepted terms. What actions should be taken to improve biochemical blood indicators?

2) Assess the performance of the cardiovascular system,

3) Name the reasons for the bleeding of this patient.

4) What hormones and biologically active substances regulate the level of Ca++ in the blood?

5) In the process of metabolism of what substance is bilirubin formed in the body and in what form is it excreted from the body?

**STANDARD ANSWERS TO CASE PROBLEMS FOR THE**

 **NORMAL PHYSIOLOGY EXAM (Specialty 31.05.01 - General Medicine)**

Task 1.

1. The processes of filtration and reabsorption in the renal glomeruli.
2. The causes of edema can be the following. Hypervolemia*.* Water, as a solvent, rushes along the concentration gradient in the tissue. Hypoproteinemia*.* A decrease in proteins in the blood plasma leads to a decrease in oncotic pressure created by proteins that are able to retain water. With hypoproteinemia, water goes into the tissues - there are so-called protein-free edemas.
3. Oncotic pressure is 1/200th of the osmotic pressure created by plasma proteins (mainly albumin). Proteins retain fluid in the vessels, when they decrease (hypoproteinemia), water as a result of hydrostatic pressure rushes into the tissues. The norm of oncotic pressure is 25 -30 mm Hg.
4. Blood pressure is high. Systolic pressure is caused by the kinetic energy developed by the heart during systole. Diastolic pressure is caused by the energy of the elastic tension of the arterial walls that maintain blood flow during diastole. Blood pressure can rise reflexively and humorally. In this case, the humoral mechanism of increasing blood pressure is renin - angiotensin system.
5. Causes of hypoproteinemia: a) protein starvation, b) impaired liver function, c) increased protein filtration in the renal glomeruli and reduced protein reabsorption in the tubules of the kidneys. In this case, the third option is likely.

Task 2

1. If agglutination has occurred with anti-A and anti-AB tsoliclones antibodies, but a negative reaction with anti-B, then according to the ABO system, the patient has blood group A (II)).

2. According to the Rh-factor system, the factor is positive, since the D antigen is the most "aggressive" and always causes the production of antibodies.

3. Only the same group blood can be transfused, and with great care.

4. It is possible, since antibodies to the Rh factor will not be formed.

Task 3.

1. The body has adaptive mechanisms that help maintain the constancy of red blood cells. In addition, experience demonstrates the presence of humoral factors that stimulate erythropoiesis.

2. Erythropoietin is a hormone that stimulates erythropoiesis. It is synthesized mainly in the kidneys, but also in the spleen and liver.

3. Red bone marrow.

4. With a decrease in CEK: blood loss, anemia, decreased partial pressure of oxygen, with severe erythrodyeresis. Regulation of erythropoiesis - neuro-humoral. Sympathetic nervous system enhances erythropoiesis, parasympathetic - depresses. A particularly pronounced effect is exerted by the hypothalamus through the pituitary gland and vegetative centers. Endocrine glands: Enhance erythropoiesis hormones of the anterior lobe of the pituitary gland (SТH, АCТH), adrenal glands, thyroid gland, male sex hormones, estrogens to a lesser extent.

5. Differentiation of stem cells in the white row is stimulated by leukopoietin, and thrombopoietin affects the formation of platelets.

Task 4.

1. The total amount of proteins is normally 65 - 83 g/l, the patient has hypoproteinemia, hypoalbuminemia. The amount of hemoglobin in the norm in men is 130 -160 g / l, in the patient - hypohemoglobinemia. The number of erythrocytes is normal in men 4 - 5 \* 10 12 / l, in a patient - erythropenia. Normally, the Colour indicator is 0.75 - 1.0, the patient has hypochromia. Usually, protein in the urine should not be found, so the patient has proteinuria.

Normally, the specific gravity of urine is 1.001 - 1.033, which corresponds to the patient. Daily diuresis is normally 1 - 1.5 liters, in a patient with polyuria. Normally, oncotic pressure is 25 - 30 mm Hg. the patient is reduced. Indicators of the state of red blood indicate hypochromic anemia.

1. Kidney function is enhanced with increased water filtration and salt reabsorption. Corresponds to the water load.
2. Significant weight loss is possible due to protein, lipid and vitamin starvation.
3. To calculate weight, you need to know the sex of the patient, height, age, energy expenditure. Calculation is being done according to special nomograms, tables and formulas.

Task 5.

1. A loss of fluid in the body is associated with massive sweating and evaporation.
2. Heat conduction, convection, heat radiation, evaporation. Under these conditions, evaporation is effective, since the skin is cooled.
3. Water-salt metabolism changes in the direction of hyperchloremia.
4. Yes. Increase in hematocrit index relative leukocytosis, erythrocytosis, thrombocytosis. In plasma, an increase in electrolytes. Physiological properties will change - osmotic pressure will increase, the blood reaction will shift towards acidosis, the viscosity and specific gravity of the blood will increase.
5. Diuresis will decrease. The mechanisms are neuro-reflex and humoral loss of fluid through the skin → a decrease in interstitial fluid → diffusion of fluid from the vessels → thickening of the blood → an increase in osmotic pressure → the anterior lobe of the hypothalamus activates the synthesis of vasopresin (antidiuretic hormone, ADH) → the release of ADH from the posterior lobe of the pituitary gland → an increase in the reabsorption of water in the renal tubules → urine is concentrated and it is small. A decrease in BСС will lead to increased cardiac activity (positive effects are inotropic, chronotropic, batmotropic, dromotropic); to increase vascular resistance.

Task 6.

1. Violation of hemostasis - coagulation system of blood - either vascular-platelet (in small vessels), or coagulation (in vessels with high blood flow rate and large diameter)
2. Neuro-reflex and humoral mechanisms regulate vascular-platelet and coagulation hemostasis. Coagulation hemostasis is an enzymatic cascade system consisting of three phases, the essence of which is the transition of soluble fibrinogen to insoluble fibrin, while plasma, tissue and cellular coagulation factors take part.
3. The ways of entry of Ca ++ into the body are endogenous and exogenous with food (800 - 1000 mg per day for an adult). Ca++ is absorbed in the form of monobasic salts of phosphoric acid. Ca++ is excreted from the body about 3/4 through the digestive tract and 1/4 by the kidneys.
4. Regulation of erythropoiesis means the production of erythrocytes by the red bone marrow - is carried out by the nervous (hypothalamus) and humoral pathway (erythropoietin is produced in the YUGA of the kidneys and through cАМPh and cGMPh directs stem cells to divide along the red row), and also affect erythropoiesis hormones of general action: ACTH, TSH, glucocorticoids, sex hormones.

Task 7.

1. The norm of proteins in plasma is 65 - 83 g/l. The state of hypoproteinemia.

Functions of proteins: 1) regulate the pH of the blood; provide oncotic pressure; affect blood viscosity; provide humoral immunity; serve as important components of non-specific resistance; take part in blood clotting; contribute to the preservation of the liquid state of the blood; contribute to the dissolution of fibrin clots; serve as carriers of a number of hormones, lipids, minerals, etc .; provide the processes of repairing the growth and development of various cells of the body.

2. Insufficient intake of proteins; Violation of the secretory and absorption function in the gastrointestinal tract; insufficient intake with food; insufficient intake of fats, carbohydrates, trace elements, vitamins; decreased protein synthesis in the liver.

3. The volume of interstitial fluid increases by reducing the oncotic pressure of blood plasma and increases the output of water into the tissue (tissue edema).

4. Yes. The effective filtration pressure (EFP) is normally about 20 mm. Hg. The calculation of EFP = hydrostatic pressure of blood plasma - oncotic pressure of blood plasma - hydrostatic pressure of filtrate in the glomerulus. Therefore, EFP depends on the magnitude of hypoproteinemia.

5. Osmotic pressure, Erythrocyte sedimentation rate, viscosity number of shaped elements, hematocrit index, specific gravity.

Task 8.

1. Deposition of food, its mechanical, chemical and physico-chemical processing, portion evacuation of contents into the intestine. The fundal part and its body perform mainly depositing and hydrolytic functions. Anthropyloric - homogenizing, acid-lowering, evacuating and endocrine functions.

1. Homogenizing, acid-lowering, towing and endocrine. Compensation is possible, except for the production of gastromucoprotein - an internal factor of hematopoiesis.
2. No, because the main hydrolysis of nutrients is carried out in the intestine.
3. It is necessary to eat food in small portions after 2 hours, which will not lead to overflow of the stomach and stretching of its walls.
4. Yes. Gastromucoprotein - the intrinsic factor of hematopoiesis is synthesized mainly by the pyloric section of the stomach. This Castle-factor prevents the destruction of vit.B12 under the action of the HCl of the stomach, and this vitamin is absorbed into the blood, affecting the differentiation of stem cells along the red row. After resection of this department, B12 deficiency, i.e. hyperchromic anemia, develops.

Task 9

1. During intensive physical work, heat is generated, the volumetric velocity of blood flow increases, heat transfer increases by evaporating fluid from the surface of the body and respiratory tract. BCC compensation occurs due to interstitial fluid, increased absorption of fluid from the gastrointestinal tract and a decrease in fluid excretion through the urinary system.

2. Diencephalic, unconditional, vegetative, homeostatic.

3. Filtration will decrease and water reabsorption will increase, which leads to a change in the concentration of substances in the blood.

4. Glucose is a direct source of energy in the body. Glycogen of the liver and muscles is a reserve store of carbohydrates. With increased muscle load, glycogen is broken down by the enzyme phosphorylase. During intensive muscle work, the level of glucose in the blood is maintained within the normal range (4.4 - 6.7 mmol / l). Nervously - reflex - CNS and humoral - contrainsular hormones: glucagon, adrenaline, glucocorticoids, somatotropic hormone, thyroxine, triiodothyronine.

Task 10.

1. Tonic, voluntary and involuntary phases will disappear. The anterior roots of the spinal cord are efferent (motor). The impulses going along them to the muscles, ensure the muscle tone and all motor acts.
2. Muscle tone will disappear due to interruption of impulses from all parts of the central nervous system, paralysis occurs.
3. Pain and temperature sensitivity is preserved. Motor reflexes will disappear.
4. These are proprioceptors that respond to muscle contraction and provide myotonic reflexes.
5. γ-motor neurons through the intermediate neurons of the spinal cord, which are controlled through the reticular formation by the overlying parts of the central nervous system.
6. Yes, due to changes in blood circulation (stagnation) with non-working muscles.

Task 11.

1. A person will experience increased secretion of saliva - hypersalivation. Due to the stimulating irritation of mechano- and chemoreceptors, these processes are regulated in a complex-reflex way.

1. Refectory respiration arrest in the second phase of swallowing.
2. The first mental or cerebral phase of gastric secretion is conditionally and unconditionally reflexive.
3. In the gastric phase of secretion, the hormones gastrin, histamine, bombesin, motilin are involved. In this case, they are not formed, because there is no food, it is not swallowed.
4. Since gastric secretion increases and ulcers can form with the "empty stomach".
5. Yes, if a person once chewed gum - conditionally reflexively. If they have never chewed gum, than no.

Task 12.

1. This ability of the digestive glands is called adaptation to the food. The mechanism is reflexive. Dry and rejected foods excite the parasympathetic nervous system - there is a lot of saliva and it is liquid. Habitual food excites the sympathetic nervous system, saliva is lacking, but it is rich in enzymes and mucin.

2. Functions of saliva are: wetting food, dissolving nutrients and taste substances, licking chewed food, the possibility of hydrolysis of polysaccharides. Acid, rejected food, with irritation of chemoreceptors.

3. Stress. Protective, conditioned, defensive reflex is a characteristic of the reaction that occurs to a pear with acid, which is unpleasant for the animal.

4. Negative emotions are accompanied by excitation of the sympathetic department of the ANS. The release of adrenaline leads to an increase in heart rate (positive chronotropic effect), BD. In an animal, the appearance of a pear with acid causes negative emotions, the external manifestation of which manifests itself in the form of: avoidance, rage, anger.

Task 13.

1. Violation of sexual functions, vegetative-vascular dystonia. Vascular tone is normally regulated nervously - reflexively and humorally.

2. All parts of the central nervous system (from the spinal cord to the cerebral cortex) are involved in the coordination of movements. An important role belongs to the cerebellum. Toxic damage to neurons leads to a violation of the integrative and coordination activity of the central nervous system, disruption of connections.

3. Muscle tone is a state of some contraction, which has a reflex origin.

4. Muscle strength is the maximum weight that a muscle can lift per square centimeter of its cross-section. Muscle strength depends on the number of muscle fibers, the thicker the muscle, the stronger.

Task 14.

1. Interoreceptive from the stomach, small and large intestines with vascular reflexogenic zones. Diencephalic, unconditioned, vegetative.

2. From the chemoreceptors of the stomach, small and large intestines, blood vessels impulses along the afferent fibers to the medulla oblongata and from the nucleus of the vagus nerve to the pancreas. Vascular reflexogenic zones: sinocarotid and aortic. In this case, both the afferent and efferent link is disturbed.

3. The secretory reflex will be interrupted, but the secretion of pancreatic juice will be carried out due to humoral components.

4. Yes, it will be reduced, as the vagus nerve increases insulin secretion.

5. α cells produce glucagon, which carries out an enhanced breakdown of liver glycogen, stimulates glyconeogenesis, promotes the mobilization of fat from fat depots. β cells produce insulin, which affects all types of metabolism. Excess insulin causes hypoglycemia, the lack of it causes hyperglycemia. γ cells produce somatostatin, which inhibits the secretion of insulin and glucagon. σ cells produce gastrin. PP cells produce a small amount of pancreatic cells. a polypeptide that is an antagonist of cholicistokinin.

Task 15.

1. Vasomotor center at the bottom of the 4th ventricle of the medulla oblongata, in greater tone the pressor department. Tone is maintained by reflex and humoral factors.

1. Diencephalic, unconditional, vegetative.
2. Baroreceptors of large arteries → centers of the brain → effector nerves → resistive and capacitive vessels and the heart. The mediator of the SNS - norepinephrine when exposed to α-adrenergic receptors causes vasoconstriction, and on the β-adrenergic receptors - the expansion of the vessel.
3. After the operation, the tone of the vessels decreases, as the effect of the SNS on the vessels will cease. Only basal tone will remain.
4. Nicotine is a neurotropic poison that has a stimulating effect on the central nervous system, causing a rise in blood pressure, i.e. an increase in vascular tone. Elimination of efferentation with the central nervous system.
5. No.

Task16

1.Central paralysis. Spinal shock – is an immediate reduction of most types of motor reflex activity, arising from cutting (trauma) of the spinal cord. The downward is excluded,

activating the effect of the reticular formation.

2.All somatic reflexes (tendon, knee, etc.) will change. If there is a complete rupture, then the reflexes can be restored with favorable conditions, only after six months.

3. All autonomic reflexes change.

4. No. Regulation of movements is carried out by: extrapyramidal system,

anterior central gyrus of the cortex.

5. No. The arc of the autonomic reflex includes: receptor, spinal ganglion, lateral columns, anterior horns of spinal cord and efferent fibers go out.

6. All kinds of sensitivity below the rupture site will be violated: painful,

temperature, tactile, deep types of sensitivity.

Task 17

1. Two centers are excited, the center of hunger and pain. And in this case, the mechanism of irradiation of excitation from the pain center to the dominant center of hunger is triggered. These are the so-called allen rkflex, which are based on the irradiation of excitation and the principle of dominance.

2. Since the action of the current is weak, the impulses all on the principle of the dominant flock to the center of hunger and therefore hypersalivation is observed.

3. The principle of dominance is a temporarily dominant focus of excitation, formulated by N.E. Vvedensky.

4. Thirst inhibits the feeling of hunger.

5. Wetting food and forming a bolus (chyme).

Task 18.

1. The sight and smell of meat activates the hunger center, which is the part of the digestive center located in the hypothalamus. There is irritation of the posterior nuclei of the hypothalamus. For an animal, this is a state of stress. Stress hormones are released - adrenaline and norepinephrine, which leads to an increase in heart rate, to vasoconstriction and an increase in blood pressure.

2. Natural conditioned reflexes.

3.In the iris there are two types of muscle fibers surrounding the pupil. Some circular innervated by parasympathetic fibers of the oculomotor nerve; other radial - innervated by sympathetic fibers. With emotions accompanied by excitation of the sympathetic system, respectively, adrenaline causes pupil dilation.

4. The extrapyramidal system takes part in the regulation of movements.

5. Food center located in the hypothalamus. Properties of the dominant center.

Task 19.

1. Damage to the spinal cord at the level between the thoracic lumbar region.
2. Monosynaptic reflex arc, see the illustration
3. It will not change.
4. Spinal shock. Violation of voluntary movements of the lower extremities. On the side of the lesion disorders of muscle and pain sensitivity.
5. Yes. After 6 months or more.
6. Yes. Urination and defecation from involuntary will become voluntary.

Task 20.

1. The content of Ca is reduced, possibly due to a poorly balanced diet, because Ca enters the body with food. It can also be excessively excreted in the urine and feces due to a violation of the formation of thyroid hormone and a lack of vitamin D.
2. Parathyroid hormone with its deficiency, the content of Ca decreases, and with excess increases. Thyrocalcitonin reduces the content of Ca in the blood.
3. With food. The optimal ratio of Ca and phosphorus in milk. Cottage cheese, kefir, yogurt.

Task 21.

1. The mechanism of realization of the stress reaction is triggered in the hypothalamus under the influence of nerve impulses coming from the cerebral cortex, reticular formation, limbic system, the sympathetic nervous system is excited. The greatest participation in the implementation of stress is taken by corticoliberin, ACTH, corticosteroids, adrenaline. What stimulates changes in the thyroid gland - goiter, pancreas - diabetes mellitus.
2. Neuro-humoral.
3. Stress hormones act on the heart muscle, which leads to an increase in heart rate; the vessels narrow, therefore, blood pressure rises; narrow bronchi breathing becomes frequent and shallow.
4. Perhaps the motility of the intestine will be inhibited, because the sympathetic nervous system is excited, but violent peristalsis (nervous diarrhea) can also be observed.
5. Emotions are adaptive reactions of the body, the result of perceiving environmental influences.
6. In emotional states, the level of glucose in the blood rises, this stimulates adrenaline, but the glycogen store decreases.

Task 22.

1. Filtration, reabsorption, secretion.
2. With an excessive salt content in the blood plasma, osmoreceptors are excited, ADH secretion increases, water reabsorption increases, urination decreases and osmotically concentrated urine is released.
3. The osmotic pressure is quite constant, when salts are absorbed, it can increase, but there is a functional system for maintaining the constancy of osmotic pressure, which will work.
4. ADH. Increases permeability through the cycle. CORP.
5. In the sacral part of the spinal cord there is a reflex center of urination, it is under the control of the overlying departments. The cortex inhibits this act, making it arbitrary.

Task 23.

1. Polyuria. Norm 1-1,5 l
2. Eating sweet, salty and spicy foods.
3. Decreased production of ADH, diabetes insipidus, lack of insulin.
4. ADH enhances the reverse absorption of water by the walls of the collecting tubes of the kidneys, therefore, diuresis decreases, if the level of ADH decreases, then diuresis increases.
5. Filtration pressure increases.

Task 24.

1. Normally, under standard conditions in an adult, daily diuresis is 1.0-1.5 l.
2. Low salt intake; high ambient temperature, which can contribute to evaporation and reduce the excretion of water in the urine.
3. Massive bleeding, impaired renal function, hormonal disorders, stress.
4. Stress leads to the release of adrenaline, activation of the sympathetic department of the ANS, spasms occur in the glomeruli (vasoconstriction), and as a result, a decrease in filtration.
5. With massive blood loss, the volume of circulating blood (BCC) decreases. To preserve the minute volume of blood circulation in the body, water will be retained (vasopressin-antidiuretic hormone), i.e. the optimal level of BCC (with lower hematocrit) will be maintained. And as a result - a decrease in diuresis.
6. With a prolonged decrease in diuresis, the following will change: hematocrit, specific gravity, density, osmotic pressure, viscosity, plasma composition (electrolyte balance).

Task 25.

1. Daily diuresis is normally 1-1.5 liters, blood glucose is 3.3-6.6 mmol / l, there is normally no glucose in the urine, acetone in the urine is normally not contained.

The patient's condition according to the analysis: polyuria, glycosuria.

2. Glucose is a threshold substance. The excretion threshold for it is 10 mmol / L. Since its concentration exceeds the threshold, there is a lack of a hormone in the body that regulates the breakdown of glucose - insulin. The patient has diabetes mellitus.

3. Regulation of the level of insulin in the blood is carried out on the principle of feedback. The main regulator of insulin secretion is D-glucose of the inflowing blood.

4. Glucose has osmotic properties (5% solution is physiological), therefore, with an increase in the concentration of glucose in the urine, the proportion of water increases (the most important physiological constant - osmotic pressure is maintained), which leads to an increase in diuresis - polyuria.

5. Activating in beta cells a specific pool c AMP and through this intermediary leading to stimulation of insulin release from specific secretory granules

6. Glucose is not present in the urine of a healthy person, since the regulation of insulin levels is carried out depending on the concentration of glucose in the blood. It is completely broken down or goes to the depot in the form of glycogen.

In the urine of a patient with diabetes mellitus, glucose is present, because he has a lack of insulin production (or the target cells are not sensitive to it), the concentration of blood glucose is high, and part of it is excreted by the kidneys.

Task 26.

1. Increased peristalsis significantly increases the rate of passage of chyme through the parts of the small and large intestines, while reducing the processes of hydrolysis and absorption of all foods, especially fats, because in pancreatic juice the content of lipolytic enzymes for the synthesis of which a sufficient amount of Ca is reduced.

2. The main place of absorption of Ca is the gastrointestinal tract, with increased peristalsis, the amount of absorbed Ca decreases and its content in the blood serum decreases.

3. Extracellular Ca is necessary for normal bone mineralization, the process of blood coagulation, the functioning of cell membranes.

Intracellular Ca is necessary for the functioning of skeletal and cardiac muscle, the secretion of hormones, neurotransmitters, digestive enzymes, PD, the functioning of the retina, cell growth and division. With a lack of Ca in the blood, convulsions, osteomolation, weakening of the heart are possible.

4. Yes, because with increased peristalsis, the time of the chyme stay in the small intestine decreases and the effectiveness of parietal digestion worsens.

5. Blood pressure and BCC- will decrease, heart rate - willincrease.

Task No. 27.

1. Carbogen.

2. The specified irritant for the respiratory center is carbon dioxide.

3. This was demonstrated in Frederick's experiment with the cross-circulation of two dogs, one of which was pinching the trachea.

4. If there is no CO2 in the respiratory mixture, then breathing may become ineffective, while the NDD and the depth of inspiration may decrease. As a result, hypoxia will occur.

5. Use dissolved CO2 in perfused solutions.

Task 28.

In the given results of the examination of the heart rate is much higher than normal (70-75 v / min.), alkalosis is noted.

1. Pallor of the skin is caused by spasm of peripheral vessels due to the centralization of blood flow (redistributive process) due to a large loss of fluid during uncontrollable vomiting.

2. A decrease in BCC led to a decrease in blood pressure and the development of compensatory tachycardia to maintain the necessary IOC and blood pressure.

3. A decrease in BCC and blood pressure reduced the volume of filtration and enhanced the processes of water reabsorption with the release of an excessive amount of salts, which caused a change in pH. A decrease in blood pressure stimulates sympathetic nerves, renin angiotensin system, vasopressin secretion and aldosterone synthesis. Aldosterone reduces the excretion of N A and increases excretion, K without affecting renal hemodynamics. Reducing plasma K levels to 3.0 mEq/L reduces aldosterone secretion and plasma concentration.

4. Activation of the renin-angiotensin system, with a decrease in the level of systemic pressure in the vessels of the kidneys, caused an increase in the concentration of A-II in the blood and an increase in the tone of the resistive vessels.

5. Restoration of the disturbed water-salt balance is possible only with infusion (intravenous administration of blood-substituting solutions).

Task 29.

1. The patient has alkalosis (either respiratory or metabolic nature).

2. To maintain the pH of the blood in the body, there is a functional system, the actuators of which are: buffer systems, excretory organs (lungs, kidneys, liver, skin), as well as the circulatory system. Regulation is neuro-hemorrhage.

3. Organic (protein and hemoglobin) and inorganic (bicarbonate and phosphate).

4. The most significant of the organic is hemoglobin (70-75%), of the inorganic is bicarbonate.

Task 30.

1. Blood glucose - 4.4-6.6 mmol / L. There is normal gyukose in the urine. Probably there is a hyperglycemic coma caused by insufficient levels of insulin in the blood, due to the existing insulin-dependent diabetes mellitus **type I**, which usually occurs in childhood or adolescence. It develops as a result of autoimmune destruction of the B-cells of the islets, which normally produce insulin.

2. Normally, glucose is reabsorbed from filtrate by facilitated diffusion, and with normal plasma glucose content, all filtered glucose is reabsorbed. In diseases (for example, in diabetes mellitus), as soon as the level of glucose in the plasma is higher than normal, (more than 10 mole/l) and the cells of the body become unable to absorb an excessive amount of glucose, glucose appears in the urine (glucosuria), since the filtration rate exceeds the rate of reabsorption.

3. Diuresis increases significantly.

4. With a significant decrease in plasma volume, which is observed with dehydration of the body, the level of blood pressure also decreases significantly. Maintaining the normal value of blood pressure is provided by neuro-reflex and humoral mechanisms.

Task 31.

1. The cause of lower back pain is congestion in the right kidney due to a stone in the ureter and the resulting difficulty in the outflow of urine. Pain is always a signal of a violation of the function of the organ associated with the development of the pathological process.

2. The nociceptive system includes the following elements: 1.Nociceptors - free unmyelized nerve endings in various organs and tissues; 2.Afferent conductors of skin and visceral pain sensitivity are thin myelin (A-delta) and non-imielin (C) fibers. 3. The perceiving part of the afferent flow and its processing occurs in the reticular formation of the brain. 4. Thalamus. 5. Cerebral cortex.

3. With pain, the pulse rate, blood pressure increases, a spasm of peripheral vessels develops. The skin turns pale, and if the pain is short-lived, the vasospasm is replaced by their expansion, which is manifested by reddening of the skin.

4.Pain leads to tension of adaptive mechanisms, stress occurs and the mechanism of realization of the stress reaction is triggered. The hypothalamus-pituitary-adrenal cortex system is activated and the sympathetic nervous system is excited. The greatest participation in the implementation of stress is taken by corticoliberin, ACTH, GH, corticosteroids, adrenaline.

5. At the initial stage, due to the excitation of the sympathetic nervous system, thick saliva is first released, and then due to the activation of the parasympathetic department of the nervous system - liquid, and in general salivation increases. Subsequently, the secretion of saliva, gastric and pancreatic juice decreases, the motility of the stomach and intestines slows down, reflex oliguria and anuria are possible.

6. The intensity of urination processes in the right kidney will decrease, and in the left compensatory will increase.

Task 32.

1. Under the basic metabolism (BM) we understand the minimum level of energy consumption necessary to maintain the vital activity of the body in conditions of relative complete physical and emotional rest. Energy is spent on the implementation of the functions of the central nervous system, the constant synthesis of substances, the work of ion pumps, the maintenance of body temperature, the work of the respiratory muscles, the smooth muscles of the gastrointestinal tract, the work of the heart and kidneys.

2. A decrease in the level of basic metabolism is observed with hypothyroidism, i.e. insufficient level of thyroid hormone.

3. All indicators of CVS activity will be reduced, because with hypothyroidism there is a decrease in the activity of the central nervous system and the contractility of the myocardium.

4. Thermoregulation will be changed in the direction of reducing heat production, there is intolerance to cold, cool and dry skin.

5. There is a slowdown in reflex activity. On the part of the IRR, there is a delay in mental development.

Task 33

1. Under stress, which can be caused by severe fright, adaptive systems are turned on. The most important among them are: 1) the sympathetic-adrenal system, which pursues the goal of rapid "emergency" adaptation, mobilization of readiness due to intensive energy costs. In the blood, the content of adrenaline and norepinephrine increases, the sympathetic department of the autonomic nervous system is activated, the excitability of analyzers increases, etc.

In addition, under stress, other endocrine factors of adaptive orientation are mobilized - thyroid hormones, insular hormones, sex steroids, etc.

2. The mechanism of realization of the stress reaction is triggered in the hypothalamus under the influence of nerve impulses coming from the cerebral cortex, reticular formation, limbic system. The hypothalamus-pituitary-adrenal cortex system is activated and the sympathetic nervous system is excited, which leads to the activation of the heart and respiratory system.

3. Changes in motor skills can be of a twofold nature, both inhibition and activation.

4. Emotions are the external expression of sensations and motivations. This is a subjective attitude of a person to a particular situation. Emotions are a means of quickly assessing the factors damaging the body.

Task 34

1. At this level of traumatic rupture of the spinal cord, the phenomenon of spinal shock initially occurs, i.e. complete loss of brain functions, a drop in blood pressure and skeletal muscle tone. Breathing will be preserved only due to the diaphragm, the contraction of other respiratory muscles will be absent. The depth of breathing and GEL will decrease.

2. There will be a sharp decrease in functional indicators in the work of the CVS: a decrease in basal vascular tone and, as a consequence, a drop in blood pressure.

3. The loss of reflex influence on the internal organs of the higher parts of the central nervous system through the neurons of the spinal cord will lead to a violation of the secretory and motor function of the gastrointestinal tract.

4. The process of urination will occur quite well, but the emptying of the bladder will be carried out arbitrarily, i.e. according to the unconditional reflex principle as it is filled.

5. At this level of damage, all kinds of voluntary movements and spinal reflexes will be impossible.

Task 35

1. Orthostatic test consists in recording the functional indicators of the CCC when changing the position of the body from horizontal to vertical and then again to horizontal. Within 10 minutes, every minute, the patient's heart rate and blood pressure are determined. In healthy people in a standing position, there may be an increase in heart rate by 10-40 beats / min, systolic pressure does not change or decreases by 10-15 mm Hg. with subsequent alignment to normal, diastolic - does not change or slightly increases (by 5-10 mm Hg).

2. The condition of the CVS of the first patient is quite satisfactory, because it reacts in accordance with the norm. The second patient has significant deviations from the normal reaction both on the part of heart rate and blood pressure, which indicates decompensation on the part of the CCC.

3. Shortness of breath in the second patient is reflexive, since in this case there is a decrease in IOC and oxygen debt develops, i.e. circulatory hypoxia. The respiratory center is irritated by excessive CO2 of the blood and hyperventilation occurs.

4. When the position of the body changes in space from horizontal to vertical, the effect of orthostatic collapse occurs, i.e. stagnant phenomena in the venous system of the lower extremities and a decrease in the volume of blood flow to the heart. At the same time, blood pressure drops sharply and there is a deficit of blood supply to the brain, which is expressed in dizziness and manifests itself in such vegetative reactions as sweating.

5. The reflex arc of the system autoregulation of blood pressure includes: a) baro and chemoreceptors receptors of vascular reflexogenic zones. b) afferent pathways to the CDS of the medulla oblongata, and the center n.vagus. c) an efferent neuron through the descending pathways of the spinal cord to the muscular apparatus of the vascular wall or directly to the heart.

Task 36

1.

|  |  |  |
| --- | --- | --- |
| Normal quantity  | in men | in women |
| erythrocytes –  | 4-5·1012 | 4-4,5·1012 |
| hemoglobin –  | 130-160 g/liter | 120-150 g/liter |

2. Erythrocytosis is an increased number of red blood cells in the blood. In this case, erythrocytosis is a reaction of the red bone marrow to an excess of erythropoietin secreted by the kidneys, in response to prolonged exposure to a lack of oxygen in the inhaled air.

3. Oxygen is transported by 97% as oxyhemoglobin. CO2 is transported by 80% as bicarbonates and 17% as carbohemoglobin (HbCO 2)).

4. At an altitude of 3000m, breathing is frequent.

5. At an altitude of 3000 m, blood saturation O2 remains normal due to hyperventilation and increased heart rate, but since excessive amounts of CO 2 are excreted from the body, a shift **of** ph **to** the alkaline side (alkalosis) occurs.

6. Aortic and sinocarotid chemo receptors in response to a decrease in oxygen in arterial blood reflexively stimulate the work of the heart and respiration.

Task 37

1. Blood depot: liver, spleen, lungs, subcutaneous tissue.

2. Oxygen capacity of the blood is the maximum amount of oxygen contained in 100 ml of blood, depending on the amount of hemoglobin.

Calculation: CEK-[Hb] · 1.34 ml SCH2/gnb/100 ml blood

After training, the CEK increases. There is a thickening of the blood, as a result of increasing sweating and evaporation.

3. As a result of increased evaporation, sweating and thickening of the blood, its viscosity increases.

4. With thickening of the blood, the hematocrit increases.

5. During physical exertion, heat production increases sharply and at the same time heat transfer due to evaporation and sweating.

6. During physical exertion, the small vessels of the working muscles reflexively and humorally expand, the OPS decreases, and the heart rate and blood pressure increase. This is the result of a reflex increase in the tone of the sympathetic department of the central nervous system and the release of excess adrenergic substances into the blood.

Task 38

1. Blood loss reduces the BCC of blood and leads to a drop in blood pressure. Due to reduced blood pressure, irritation of the aortic and sinocarotid zones of the depressor nerves decreases, the tone of the vasomotor center decreases, the predominance of the tone of the vagus nerve center and reciprocal nerves disappears. The tone of the sympathetic department of the vasomotor center increases, which dictates an increase in the work of the heart.
2. Blood loss, a decrease in BCC, a drop in pressure lead to an insufficient supply of blood to tissues, where there is a lack of oxygen and an excess of CO2, which cause reflex shortness of breath.
3. On the part of the kidneys, we can expect the release of Renin that contributes to vasoconstriction, a decrease in the capacity of the vascular bed and an increase in blood pressure, as well as a decrease in the amount of urine excreted with an increase in its density.
4. With blood loss and a drop in blood pressure, reflexively and humorally, peripheral vessels narrow in the skin, so the skin is pale and cold.

Task No39

|  |  |  |
| --- | --- | --- |
| 1.        | MOD | ventilation |
| at rest –  | 7.700ml/min | 7,7-2,1 = 5,6l/min |
|  with load –  | 600 l/min | 60-4=54 l./min |

Ventilation increased by 9.8 times.

2. The functions of external respiration are normal.

3. During physical exertion, the accumulation of excess CO2 is excreted from the body and its partial pressure in the alveolar air tends to return to normal (40 mm Hg).

4. During physical work, the tone of the sympathetic department of the central nervous system increases conditionally and unconditionally reflexively. The adrenal medulla releases a large amount of adrenaline into the blood. As a result, systolic volume, heart rate and IOC increase in proportion to the load. Narrowing of the vessels mainly of the abdominal cavity and other areas not involved in the work leads to an increase in blood pressure.

Task 40

1. Liver, skin, spleen.
2. KEC is the amount of oxygen that blood can carry (either absolute - taking into account the IOC; or relative - only the grain of blood volume). KEK + 1,34\*Nv. THE CEC may increase due to the release of blood from the depot.
3. Blood viscosity may increase due to fluid loss by regurgism as a result of sweating.
4. The hematocrit index is the ratio of the volume of uniform elements to the volume of blood, therefore, with profuse sweating, the OCP decreases, therefore, the hematocrit may increase.
5. Sweating is an effective way to heat transfer. With physical exertion, it increases.
6. To provide tissues with oxygen with an increase in the need for it, the IOC increases, and therefore to varying degrees of heart rate and blood pressure. OpSS decreases, since it is inversely proportional to the value of blood pressure.

Task 41

1. Mobilization of blood from the depot and its inclusion in the general bloodstream; activation of hematopoietic organs; increased reabsorption of water from tissues into capillaries; reduction of diuresis; production of aldosterone and vasopressin (sodium retention and increased reabsorption of water).
2. Decrease in BCC, due to the inclusion of protective mechanisms, an increase in BCC.
3. Decrease in blood pressure and reflex vasoconstriction - decrease in renal blood flow - decrease in PD - decrease in urination.
4. yes - hypotension and tachycardia
5. KA, GCS, aldosterone, vasopressin.
6. An increase in PDD (tachypnea) and an increase in the depth of breathing, because CECs decrease, anemic hypoxia develops.

Task 42

1. Blood pressure is elevated (110-125/80 mm Hg); VD is elevated (2-5 mm Hg depends on the phase of inhalation and exhalation, on exhalation it becomes negative).
2. Volumetric velocity of blood flow – IOC; the value of the total peripheral resistance is OPSS (tension of the walls of the aorta and its large branches, creating elastic resistance; BCC; blood viscosity).
3. Increased blood pressure - mechanoreceptors of the aortic arch and bifurcation of the carotid artery - a decrease in the heart rate and a decrease in the strength of the heartbeat.
4. An increase in intracranial pressure (ICP) leads to venous hypertension, a violation of the outflow of lymph from tissues - increased filtration of water from blood vessels - stagnation of blood and in the liver - a decrease in the synthesis of albumins - a decrease in oncotic pressure - edema.
5. ICP (2-5 mm Hg. depends on the phase of inhalation and exhalation, on exhalation it becomes negative).

Task 43

1. This is the dissociation (or association) curve of hemoglobin.
2. R50= 27 mm Hg.
3. Most likely, HB A.
4. The process of oxygen binding occurs at pO215-60 mm Hg, and the recoil process at 40 – 20 mm Hg.
5. If the pO2 changes by 30 mm Hg in the lungs, then the oxygen saturation of the blood will decrease by no more than 10%. If the pO2 decreases in the tissues by the same amount, then the differences in hemoglobin oxygen saturation can be 30-40%.
6. The labile site of oxygen output to tissues is important for the body, because it responds to the needs of tissues in oxygen.

Task 44

1. The calculation of the minute volume of breathing (MVB) is carried out according to the formula: MVB = DO \* PD ; minute ventilation of the lungs MVL= (DO-AMP)\*PD

Day 1: MVB =250\*20=5 l/min, MVL= (250-60)\*20=3,8 l/min

Day 5: MVB =125\*40=5 l/min, MVL= (125-60)\*40=2,6 l/min

With the same INDICATORS of MOD in a patient on the 5th day, the degree of renewal of alveolar air significantly decreased.

1. An increase in pO2 (the Boron effect) and a decrease in pO2 contribute to the dissociation of HbO2 and a more efficient return of oxygen to the tissues.
2. Mechanisms of change in the nature of breathing: with an increase in pCO2 (hypercapnia) and a decrease in pO2 (hypoxia), central and peripheral chemoreceptors are excited, information from which enters the respiratory nerve center, which ultimately leads to a reflex deepening and increased respiration.
3. The respiratory center is a set of neutrons located at different levels of the central nervous system (spinal cord, medulla oblongata, hypothalamus, limbic system, cerebral cortex), providing regulation of breathing depending on environmental conditions and internal needs of the body.
4. The activity of the central nervous system will change due to increasing hypoxia and hypercapnia in the body.
5. The mechanism of increased heart rate is reflex and humoral (central and peripheral) in response to hypoxia and hypercapnia in the body.

CONCLUSION: the functional state of the external respiratory system deteriorated: the efficiency of breathing, the ventilation capacity of the lungs decreased, which led to a decrease in the oxygen tension in the arterial blood, and, consequently, the provision of O2 tissues and the development of hypoxia.

Task 45.

1. Reduced number of erythrocytes (erythropenia), platelets (thrombopenia), a decrease in the amount of Ca ++ (hypocalcemia), an increased amount of bilirubin (hyperbilirubinemia). Anticoagulant substances are used to preserve the blood. In this case, lemon-acid sodium is possible, which binds Ca++ ions, and as a result, hypocalcemia developed, which led to postoperative bleeding, and artificial circulation contributed to mechanical hemolysis, and as a result, erythropenia, thrombopenia and hyperbilirubinemia developed.

2. Hypotension and reflex increase in heart rate (tachycardia).

3. Lack of 4th plasma coagulation factor (Ca++) and thrombopenia - lack of cellular coagulation factors.

4. Parathyroid hormone, calcitonin, calcitriol and sex hormones androgens and estrogens.

5. When hemoglobin is destroyed, it is excreted in the form of stercobilin and urobilin.

