

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY

Department of human anatomy

**GUIDELINES**

<i>Academic discipline</i>	HUMAN ANATOMY
Module №	2
The theme of the lesson	Autonomic part of the peripheral nervous system
Course	I
Faculties	Medical 1,2,3,4, military, dental
The number of hours	3

### **1. Theme relevance:**

The autonomic nervous system regulates the functional activity of the body, thanks to her people learned to survive in stressful situations. Therefore, it is actual knowledge of anatomy of the autonomic nervous system for further study of physiology, neurology and other disciplines, as well as for physicians of all specialties.

### **2. Specific objectives:**

Giving definition: an autonomous part of the peripheral nervous system (autonomic nervous system), parts, features, objects innervation.

Treat morphological differences between the sympathetic and parasympathetic part of the autonomic nervous system.

Identify and demonstrate on the preparations of the brain central parasympathetic division of the ANS.

Demonstrate on the body and white sympathetic trunk connecting thread.

To determine the composition of the fibers of the cranial and spinal nerves

Draw a diagram of a simple reflex arc of the autonomic nervous system.

To interpret the differences between gray and white connecting branches.

### **3. Basic level of preparation, including a knowledge of medical biology**

classification of neurons in structure and function;

The student should know the anatomy of the course: the principles of the structure of the nervous system;

Name twelve pairs of cranial nerves and their functional significance; structure and function of formations of white and gray matter of the spinal cord and of the brain; Principles of formation of the spinal nerves, plexus formation.

### **4. Tasks for independent work during preparation for classes.**

4.1. The list of key terms, parameters, characteristics which the student is to assimilate while preparing for classes

Sympathetic part of the autonomic nervous system (PARS SYMPATHICA- is part of the sympathetic adaptation to changes in the environment and therefore - in enhancing trophic processes.

Parasympathetic part of ANS (PARS PARASYMPHATICA) -is security and aimed at maintaining a constant internal environment.

Autonomous units-contained units peripheral nerve centers. They occur cartoon pulses (one nodal fiber in contact with 50 or more host neurons) and their transformation from fast to slow.

Autonomic reflex-(impulse from receptor to perform organ function)- is a chain of nerve cells, providing of nerve impulses from sensory receptor neuron to effector endings in the working bodies.

### **4.2. Theoretical question for the class:**

1. Independent of the peripheral nervous system (autonomic nervous system), parts, features, objects innervation.

2. Differences between the somatic nervous system and autonomic nervous system.

3. Morphological differences autonomic reflex arch of the peripheral nervous

system (autonomic nervous system).

4. Morphological differences between the sympathetic and parasympathetic part of the autonomic peripheral nervous system (autonomic nervous system).

5. The central section of the SPA, its classification, formation.

6. The autonomic nervous system, peripheral department components.

7. Vegetative components: classification, structure, differences from sensitive sites.

8. A sympathetic trunk, branches, units and their connections.

9. Joining white branches: formation, topography.

10. Joining gray branches: formation, topography.

11. Items of parasympathetic innervation of the main center of the autonomic nervous system.

12. Items parasympathetic innervation of sacral center of the autonomic nervous system.

13. The cervical sympathetic trunk, upper cervical node, sources of preganglionic fibers, branches, areas of innervation .

14. Medium neck unit: sources of preganglionic fibers, branches, areas of innervation

15. Lower neck junction, sources of preganglionic fibers, branches, areas of innervation .

16. Thoracic sympathetic trunk: nodes, branches, areas of innervation.

17. Lumbar give sympathetic trunk: nodes, branches, areas of innervation.

18. Sacral give sympathetic trunk: nodes, key sources of fibers, branches, areas of innervation.

19. Which sympathetic fibers reach the sympathetic trunk?

20. How and where go sympathetic fibers?

21. Describe the progress nerve fibers that come from additional core oculomotor nerve.

21. Name course nerve fibers that go from the top core.

22. Name course nerve fibers that go from the bottom core.

23. Describe the progress nerve fibers that come from the dorsal nucleus of the vagus nerve.

24. What are the branches away from the vagus nerve to the internal organs, creating textures around them?

4.3. The list of standardized practical skills:

- Sympathetic trunk
- Units sympathetic trunk
- interstitial branches of the sympathetic trunk
- Large visceral nerve
- Small visceral nerve
- Abdominal textures and components

#### **4.4. The content of the topic**

For anatomical and functional principle nervous system is divided into two parts: the somatic nervous system and autonomic nervous system (ANS). Autonomous or vegetative nervous system division provides regulation of

physiological processes of the inner life of the body - circulation, respiration, digestion, excretion, metabolism and fulfills a trophic function. It has relative autonomy from the cerebral cortex and associated bodies operate spontaneously, automatically, independently of consciousness.

VNS for anatomical and functional principle is divided into two parts: the sympathetic and parasympathetic ANS part of the SPA. In recent years, within the VPS is isolated nervous system.

The sympathetic part of the ANS system is seen as stress mobilization system defenses and resources of the body when changing external factors or internal environment; performs adaptive-trophic effect, that ensures the adequacy of the level of metabolic functional activity of the body.

In VNS advisable to highlight the central section and the peripheral section.

Central Department VNS can be divided into three groups:

1) Centers regulation of sympathetic ANS - a lateral intermediate core, which is located in the lateral horns of the spinal cord at segments CVIII - LI-II of the spinal cord (nucl. intermediolateralis).

2) regulating centers of the parasympathetic ANS - by topography divided into:  
- cranial center located in the brain stem - a parasympathetic nucleus of cranial nerves: a) in the midbrain - additional oculomotor nucleus, nucl. osylomotorius accessorius (III pair);

b) bridge - nucl. salivatorius superior (VII para);

c) in the medulla oblongata

- sacral center - a lateral intermediate core, which is located in the lateral horns of the spinal cord at segments S2- S 4 spinal cord (nucl. parasympathici sacrales).

3) higher autonomic centers dominate the centers of the autonomic nervous system and regulate the functions of both parts of the autonomous nervous system and is therefore suprasegmental. They are located in different parts of the brain: the medulla oblongata; in the cerebellum (trophic skin, speed healing, reduce muscle lifting hair); 3) subthalamichnic area (reflex regulation of autonomic functions, centers metabolism, hunger, thirst, thermoregulation, sexual centers, the regulation of endocrine glands);

4) in the final of the brain

5) in the cerebral cortex (due to cortical-visceral connections bark can cause any changes in autonomic functions).

Peripheral autonomic department submitted nerves and plexuses autonomous nodes (ganglia).

Autonomical units. The nodes, which are located on the periphery, there is interruption efferent nerve fibers.

Classification nodes. Depending on the location distinguish the following groups of autonomous units:

- ganglia paravertebralia components lie on either side of the spine (the sympathetic trunk units);

- ganglia prevertebralia - located in front of the spine (units vegetative plexus and abdomen etc.). belonging to the sympathetic part of the autonomic nervous system;

- ganglia terminalia, end nodes located either near the body .

ANS reflex arc formed by the following parts:

- afferent part - formed VNS sensitive neurons contained in the nodes spinal or cranial nerve nodes (these nodes are common for somatic and autonomic nervous system), which are cells of the peripheral and central processes. Peripheral processes as part of autonomic nerves going to the internal organs, blood vessels The central processes through the posterior roots of the spinal nerves and cranial nerves traveling to the autonomic centers that lie in the spinal cord and brain stem.

- push part - formed plug neurons, located in the autonomic nuclei of the spinal cord and brain stem; axons of these cells have nuclei peredvuzlovymy afferent fibers that extend from the central nervous system in the front part of the roots and cranial nerves and sent to the stand-alone sites, where end.

- efferent part - formed neurons autonomous units; their axons are pislyavuzlovymy efferent fibers, which are composed of vegetative plexus reach working bodies.

Sympathetic part of ANS has two divisions - the central and peripheral. CUTE centers are nucl. intermediolateralis, which is located in the side pillars of gray matter of the spinal cord during VIII of the II cervical lumbar segments.

By sub department include: paravertebral sympathetic nodes that form the right and left sympathetic trunk; postganglionic sympathetic fibers, which depart from the nodes to the sympathetic innervation areas (gray binding and visceral branches, the sympathetic nerves);

Sympathetic trunk (truncus sympaticus) - fresh formations extending from the base of the skull to the tailbone, situated on either side of the spine; consisting of 20-25 nodes (ganglia trunci sympatici), which are interconnected interstitial branches, rami interganglionares.

As nodes are peripheral sympathetic trunk sympathetic efferent neurons of the nervous system. All of the thoracic and upper lumbar two units fit sympathetic trunk sympathetic fibers composed of white connective branches, rr. communicantes albi (covered by myelin sheath) that depart from the VIII cervical, thoracic and all two upper lumbar spinal nerves. By the cervical, lower lumbar, sacral and coccygeal nodes sympathetic trunk preganglionic fibers suitable for interstitial branches,

rr. interganglionares, without interruption to the respective nodes thoracic and lumbar sympathetic trunk.

From all nodes sympatic trunk branches away 2 types: - Connecting gray branches, rr. communicantes grisei, formed postganglionic fibers that are suitable to the nearby spinal nerve and disperse in all its branches and reach skeletal muscles; - visceral branches off from all nodes of the sympathetic trunk, are sent to the internal organs, creating a sympathetic nerves. Some of them consist of postganglionic fibers, and others in their composition and are fibers and fiber who were in transit through the sympathetic trunk units and sent to units autonomic plexus.

In the sympathetic trunk distinguished:

Cervical region has three sites - upper, middle and lower.

Upper cervical node, ganglion cervicale superius, most (2x6 mm) located in front of the transverse processes II-III cervical vertebrae; away from it:

- 1) gray thread connecting the four upper cervical spinal nerves;
- 2) visceral branches: n. caroticus internus, internal carotid nerve plexus forms around the internal carotid artery and its branches reaching glands and mucosa of the nose and palate, lacrimal gland covers the eyeball, nn. carotici externi, external carotid nerves form a plexus around the external carotid artery and its branches, providing a sympathetic innervation of blood vessels, glands and organs of the head; n. jugularis, jugular nerve goes through the wall of the internal jugular vein and the jugular hole section is divided into branches that apply to units IX and X pairs of cranial nerves and the hypoglossal nerve; nn. laryngopharyngei, laryngo-pharyngeal nerves going to the larynx and pharynx, forming a plexus around them; n. cardiacus cervicalis superior, superior cervical cardiac nerve extends down into the chest cavity, which is part of the cardiac plexus.

Average cervical node, ganglion cervicale medium, unstable, lies at VI transverse processes of the cervical vertebra; away from it 1) gray thread connecting the V and VI of the cervical spinal nerves; 2) visceral branches: n. cardiacus cervicalis medius, middle cervical cardiac nerve goes into the chest cavity to the cardiac plexus; n. thyroideus inferior, form a wreath at the inferior thyroid artery and its branches coming to thyroid and larynx; n. caroticus communis, forms a wreath at the common carotid artery.

Lower cervical node, ganglion cervicale inferius, 80% of it is connected to the node and chest, forming a cervical-thoracic junction, ganglion cervicothoracicum; Located at neck and rib behind the subclavian artery and well. vertebralis; away from it:

- 1) gray thread connecting the VII and VIII of the cervical spinal nerves;
- 2) visceral branches: subclavian branches, which form the subclavian plexus, plexus subclavius; the branches of the subclavian artery sympathetic fibers reach the thyroid and parathyroid glands, mediastinal organs and spread to the entire upper limb; n. vertebralis, n. cardiacus cervicalis inferior, lower cervical cardiac nerve descends into the chest cavity and forms the cardiac plexus with other cardiac nerves.

Pectoral consists of 10-12 nodes, ganglia thoracica, located under the parietal pleura on heads edges; depart from them:

- 1) gray thread connecting all the thoracic spinal nerves;
- 2) visceral branches of upper 5 on 6 units provide sympathetic innervation of the chest cavity:
  - nn. cardiaci thoracici, cardiac nerves away from the upper 5-6 nodes and chest with cervical cardiac nerves form the cardiac plexus;
  - nn. pulmonales, pulmonary nerves form the pulmonary plexus, plexus pulmonalis, together with the branches of the vagus nerve;
  - nn. oesophageales, esophageal nerves form a plexus oesophagealis with branches of the vagus nerve;
  - nn. aortici thoracici, thoracic aortic nerves form the thoracic aortic plexus, plexus aorticus thoracicus, distributed to all branches of the thoracic aorta

Visceral lower branches 6-7 thoracic sympathetic trunk units involved in the innervation of the abdominal cavity:

- n. splanchnicus major, large visceral nerve roots formed departing from V- IX thoracic nodes and contains postganglionic sympathetic fibers, but also sensitive, coming from the chest and abdominal cavities; on the lateral vertebrae of his spine are joined in one nerve, which runs between muscle bundles lumbar diaphragm into the abdominal cavity and ends in abdominal nodes (solar) plexus; at XII thoracic vertebra along this nerve found little thoracic visceral node, ganglion thoracicum splanchnicum;

- n. splanchnicus minor, small nutroschevy nerve starts from X-XI thoracic sympathetic trunk node;

- n. splanchnicus imus, lowest nutroschevy nerve unstable, starts from the XII thoracic junction and ends in the renal plexus.

Lumbar lumbar consists of 3-5 units, ganglia lumbalia, located on the surface of bodies perednobichniy lumbar vertebrae along the medial edge of a large lumbar muscle; depart from them:

- 1) gray thread connecting all approach to lumbar spinal nerves;

- 2) nn. splanchnici lumbales, lumbar visceral nerves that are composed of both preganglionic and postganglionic fibers that make up the abdominal aortic plexus, which applies to all branches of the abdominal aorta; nerve fibers of the switch to nodes vegetative plexus abdomen.

Lumbosacral has four sacral nodes, ganglia sacralia, which lie on the pelvic surface of sacrum medial to the pelvic sacral holes. At the bottom right and left sympathetic trunks converge and end in odd node, ganglion impar, which is located on the front surface and coccygeal vertebrae. From sacral nodes away:

- 1) rr. communicantes grisei, connecting the gray branches, suitable for all sacral spinal nerves;

- 2) nn. splanchnici sacrales, visceral sacral nerves that are composed

Autonomic plexus (plexus autonomici), located around blood vessels (periarterial plexus), internal organs and the wall of the internal organs (intramural); are present in sympathetic and parasympathetic fibers and sensory fibers of the vagus nerve and spinal nerves. In the wreath are self-contained units, ganglia plexus autonomica. The nodes plexus preganglionic autonomic fibers to postganglionic switch, and afferent fibers of the parasympathetic fibers pass through them in transit.

In the neck and chest cavity formed: carotid plexus, vertebral, subclavian, laryngeal, pharyngeal, esophageal, cardiac, breast aortic, pulmonary.

Major vegetative plexus located in the abdomen.

- Abdominal aortic plexus, plexus aorticus abdominalis, surrounds the abdominal aorta and extend to all its branches - the parietal and visceral.

- Abdominal plexus, plexus coeliacus ( «solar plexus"), given the large size it is called "abdominal brain"; located on the front surface of the abdominal aorta around the celiac trunk and superior mesenteric artery root.

The structure of the abdominal plexus consists of 5 major units:

- ganglia coeliaca, abdominal nodes venous forms, lie on either side of celiac trunk;

- ganglia aorticorenalia, renal-aortic nodes located near the place of discharge of new arteries from the aorta;
- ganglion mesentericum superius, superior mesenteric node contained at the root of the superior mesenteric artery. The structure consists of abdominal visceral plexus nerves, which depart from the thoracic sympathetic trunk and lumbar visceral nerves of the lumbar sympathetic trunk nodes. By abdominal plexus suitable fiber rear trunk of the vagus nerve (sensory and parasympathetic) and sensory fibers right phrenic nerve. Units away from the nerves, which include postganglionic sympathetic and parasympathetic preganglionic fibers traveling to the organs and organ forming periarterialni autonomic plexus.
  - superior mesenteric plexus, plexus mesentericus superior, accompanying all branches of the superior mesenteric artery. Its fibers are suitable to the small intestine, blind, ascending and transverse colon.
    - Lower mesenteric plexus, plexus mesentericus inferior, situated along the homonymous artery and its branches. It is part of the lower mesenteric node, ganglion mesentericum inferius; plexus nerves that reach the transverse, descending and sigmoid colon and upper part of the rectum.
      - Club plexus, plexus iliaci, right and left, continuing to split the wall of the aorta iliac arteries.
      - Plexus hypogastricus superior, below the aortic bifurcation between the common iliac artery and abdominal aortic branches established plexus nerves nutroshevymy from the lower lumbar and upper sacral sympathetic trunk nodes.
      - Plexus hypogastricus inferior, surrounded by branches of internal iliac arteries lie on the side of the bladder and rectum. They also form - be of nodes and branches connecting them.

#### Parasympatic part (PARS PARASYMPHATICA)

The central section is presented centers located in the brain stem, and fibers emerging from them and go to the part of the cranial nerves.

Skull: - Additional oculomotor nucleus, nucl. oculomotorius ascessorius gives rise fibers that are composed n.oculomotorius (III pair) go to the ciliary node (ganglion ciliare); pislyavuzlovi fibers composed of small ciliary nerves reach m. ciliaris and m. sphincter pupillae;

- Upper salivation core, nucl. salivatorius superior, gives rise to preganglionic fibers that come as a part of the facial nerve (VII pair). Some of these fibers separated in a claim. petrosus major, which passes through the canalis pterygoideus Postganglionic fibers composed of branches of the trigeminal nerve reach the lacrimal gland (through n. zygomaticus and n. lacrimalis), and nasal mucosa (through nn. nasales posteriores) and palate (via nn. palatini majora et minora). The second part of the parasympathetic fibers of the facial nerve is separated as part of chorda tympani, which is attached to language and reach nerve gangl. submandibulare, where interrupted. Postganglionic fibers go through rr. sublinguales to sublingual gland and a rr. glandulares.

- Lower salivation core pucl. salivatrius inferior, gives rise peredvuzlovym fibers

that come as a part of n. glossopharyngeus (IX pair), separated from it with n. tympanicus, then a part of n. petrosus minor fit to the ear node (ganglion oticum), where end

- Dorsal nucleus of the vagus nerve, nucl. dorsalis n. vagi, the largest parasympathetic nucleus contained in the medulla oblongata, designed to trigonum n. vagi rhomboid fossa. From the dorsal nucleus of cells begin prehanhliarni parasympathetic fibers of the vagus nerve (X pair) traveling to internal organs as part of its branches:

1) rr. pharyngei, pharyngeal branches are part of the plexus pharyngeus and terminate intramural nodes pharynx;

2) n. laryngeus superior, superior laryngeal nerve and n. laryngeus recurrens, turning laryngeal nerve, belonging to the laryngeal plexus terminate intramural nodes larynx and thyroid gland;

3) to heart - rr. cardiaci servicales superior et inferioris, rr. cardiaci thoracici, are part of the plexus cardiacus and terminate cardiac nodes, ganglia cardiaca;

4) to the lungs - rr. bronchiales, they are part plexus pulmonalis and terminate sites of textures;

5) into the stomach - rr. gastrici anteriores et posteriores, are included in the plexus gastrici intramural nodes and reach the stomach where interrupted;

6) to the liver - rr. hepatici, are part of the plexus hepaticus and terminate intramural plexus of nodes;

7) in the pancreas - rr. soeliasi that pass through the solar plexus and are part plexus pancreaticus;

8) to the kidneys - rr. renales, which terminate intramural nodes kidneys;

9) to the small intestine - rr. soeliasi which pass in transit through the celiac plexus and are part plexus mesentericus superior, reaching the intestinal wall, they terminate intramural nodes auerbahovoho (plexus myentericus) and meysnerovoho (plexus submucosus) plexus;

10) to the colon (except the sigmoid and rectal) - rr. soeliasi which pass in transit through the celiac plexus and are part plexus mesentericus superior et inferior, as part of the plexus fibers reach the bowel wall and terminate intramural nodes.

Lumbosacral: - nuclei parasympathici sacrales, located between the front and rear pillars gray matter of the spinal cord during II to IV sacral segments.

## **LITERATURE**

### **Base:**

1. Human anatomy: book in 3 volumes / A. S. Holovatsky, V.G.Cherkasov, N. G. Sapin [et al.] – Ed. 3-rd edition, modified – Vinnitsa: Nova knyga, 2015. – T. 3.
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### **Additional:**

1. Tests "KROK-1" - human anatomy: textbook / under the editorship of V. G. Cherkasova, I. V. Dzevulska, O.I. Kovalchuk. 5-th Edition, revised.
2. Human anatomy: in 3 volumes / ed. by V. G. Koveshnikov. – Lugansk: Virtual reality, 2008. – T. 3.

3. Netter F. Atlas of human anatomy / F. Netter; [transl. from eng. A. A. Tsegelsky]; ed. by U.B. Tchaikovsky. – Lviv: Nautilus, 2004.
4. International anatomical nomenclature. Ukrainian standard / edited by I. I. Bobryk, V. G. Kovesnikov. - Kiev: Health, 2001.

**Tests:**

1. The doctor of a man, 47 years old, found cyanosis of the extremities, increased sweating, sudden tides heat, and found violations of effector links sympathetic division of the autonomic nervous system due to sympathetic lesion sites. The nodes whose account is affected nodes?
  - A. Third.
  - B. Second.
  - C. First.
  - D. Fourth.
  - E. Fifth.
  
2. Physician woman, 45 years old, with many abnormal autonomic responses diagnosed violations center sympathetic division of the autonomic nervous system. Where is the center, broken by a woman?
  - A. In the spinal cord.
  - B. In the midbrain.
  - C. In the intermediate brain.
  - D. In the medulla oblongata.
  - E. In Bridge.
  
3. A doctor examines a woman, 40 years old, from malignant tumors of the uterus and violations of human sympathetic trunk sympathetic nodes receiving fiber through rami communicantes albi. What are sympathetic nodes affected by a woman?
  - A. Lower neck.
  - B. The top and middle neck.
  - C. The lower and upper lumbar sacral.
  - D. Sacrum
  - E. The lower thoracic and upper lumbar two.
  
4. The patient, 60 years old, process entailed a violation sympathetic nodes receiving fiber through the visceral nerves. What are the components affected?
  - A. December.
  - B. Units abdominal aortic plexus.
  - C. Lumbar.
  - D. Sacral
  - E. Neck.
  
5. The physician husband, 40, complained of constipation, disorders showed irritation osteophytes anterior branches of spinal nerves that have

parasympathetic fibers. Which spinal nerves with the parasympathetic fibers?

A. C4-C8. B. Th8-Th12. C. L1-L3. D. S2-S4. E. Th1-Th5.

6. The doctor of the patient, 60 years old, discovered a tumor that compresses the branches that make up the small visceral nerve. Which nodes sympathetic trunk away these branches, which compresses the swelling?

A. Th5-Th9. B. Th1-Th4. C. C1-NW. D. L1-L2. E. Th10-Th12.

7. Physician in Diabetes complaining of difficulties defecation, urination is found infringement visceral nerves that are parasympathetic fibers and end in plexus hypogastricus inferior. What nerves are affected?

A. Nn. splanchnici majores.

B. Nn. splanchnici minores.

C. Nn splanchnici sacrales.

D. Nn. splanchnici lumbales.

E. Nn. splanchnici pelvici.

8. A man, 60, after a trauma doctor found a violation of the sacral parasympathetic center from which the parasympathetic fibers obtained consisting anterior roots of spinal nerves. As part of the spinal nerves which pass these parasympathetic fibers?

A. TM2-L2. B. L3-L5. C. L4-S5 D. S2-S4. E. S3-S5

9. Examining the patient, thirty years, complaining of abdominal pain, the doctor found a lesion malignancy units abdominal aortic plexus. What units are not part of the abdominal aortic plexus?

A. Pelvic

B. Superior mesenteric.

C. The lower mesenteric.

D. Aortic-renal.

E. Lumbar

10. Physician woman, 60 years old, found a violation of one of the centers of the parasympathetic autonomic department the following symptoms: increased acidity of gastric juice, peristalsis strengthened the stomach and intestines, nausea. In the offices of CNS female doctor found broken center?

A. In a large brain.

B. In the cerebellum.

C. In the brainstem.

D. In the intermediate brain.

E. In the thoracic spinal cord.

**Answers:**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>C</b>	<b>A</b>	<b>E</b>	<b>B</b>	<b>D</b>	<b>E</b>	<b>E</b>	<b>D</b>	<b>E</b>	<b>C</b>

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