

Bogomolets National Medical University

Department of human anatomy

Metodical Recommendations

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| Academic Subject Matter | HUMAN ANATOMY |
| Module № | 2 |
| Content module № | 11 |
| The theme of the lesson | Origin of the brain. Rhombencephalon. |
| Course | I |
| Faculty | Medical1,2,3,4, military |
| Amount of hours | 3 |

2017

1. Relevance of the topic:

The **medulla oblongata**, located at the base of the brain, contains important vital centers which regulate internal activity of the body. These are:

1. Respiratory center which controls muscles of respiration in response to chemical or other stimuli;
2. Cardiac center which tends to slow heart rate so it will not beat too rapidly to be effective; and
3. Vasomotor center which affects (constricts or dilates) the muscles in the blood vessel walls thus influencing blood pressure.

Through the white matter of the medulla implement two-way communication of the spinal cord with the parts of the cerebrum and cerebellum located above. Knowledge of this section of the anatomy is essential for students of all specialities for further studies and understanding of the body activities.

2. Specific objectives:

1. To determine the basic stages of phylo - and ontogenesis of cerebrum as an integral part of the nervous system, to know the age peculiarities of the cerebrum structure.
2. To determine and demonstrate on sagittal preparation the derivatives of posterior cerebral bladder (the medulla oblongata, pons, the cerebellum), the middle cerebral bladder (mesencephalon), anterior cerebral bladder (intermediate and eventual brain).
3. To demonstrate on total preparation and on the sagittal cut of the brain components of the brain stem, cerebellum and cortex.
4. To demonstrate the position of the parts of the brain in the cranial cavity.
5. To describe the external structure of the medulla oblongata and the pons and demonstrate on the preparation of the brain stem the boundaries and topography of the medulla oblongata and the pons.
6. To know the internal structure of the medulla oblongata and the pons (to draw diagrams).
7. To show on cross-sections of the brain stem the distribution of the fibers of white matter and nuclei of gray matter in different parts of the medulla oblongata and the pons in accordance with their functional characteristics.

3. Basic training level

From the course of biology – phylogenesis and common structure of the nervous system;

From the course of human anatomy: osteology - the bones of the skull and their compounds. Be able to describe the structural features of the internal base of the skull, to classify the nervous system from the point of view of structure and functions, to know the development of the nervous system. Schematically draw the structure of a reflex arc.

4. Tasks for self-control during preparation to practical classes.

4.1. A list of the main terms, parameters, characteristics that need to learn by the student during the preparation for the lesson.

| Term | Definition |
|--|---|
| THE MEDULLA OBLONGATA | Continuation of the spinal cord in the brain stem is also a part of the rhombencephalon; combines the features of the structure of dorsal and initial department of the cerebrum. |
| THIN AND WEDGE-SHAPED NUCLEI (NUCL. GRACILIS ET CUNEATUS) | Neurocyte of these nuclei are bodies of other neurones of the proprioceptive path cortical areas (Gaulle and Burdakh's ways), partially tactile sensitivity and a stereognosis |
| THE PYRAMIDS | The fibers of cortico-spinal (pyramidal) pathways |
| THE INTERSECTION OF THE PYRAMIDS | Cortico-spinal (pyramidal) path, which forms on border with the spinal cord an incomplete decussation of pyramids (about 90% of fibers). |
| OLIVE NUCLEUS (NUCLEUS OLIVARIS) | Regulates the balance of the body through connections with the cerebellum (tractus olivocerebellaris) and spinal cord (tractus olivospinalis). |
| PONS NUCLEI (NUCL. PONTIS) | Bodies of 2 neurones, in which cortical-pons fibers are switch. |

4.2. Theoretical questions to the lesson:

1. What departments of the cerebrum are determined by a structure and development?
2. What structures comprise the brain stem?
3. On what formations of an internal basis of the skull there is a brain stem?
4. What are the main stages of phylogenesis of the brain as an integral part of the nervous system?
5. Brain development in human embryogenesis: stage of three cerebral vesicles.
6. Brain development in human embryogenesis: stage of five cerebral vesicles.
7. Where is the boundary between the medulla oblongata and spinal cord?
8. What surfaces are distinguished in the medulla oblongata?
9. Where is the upper border of the medulla oblongata on the dorsal surface of the brain stem?

10. Where is the upper border of the medulla oblongata on the ventral surface of the brain stem?
11. Show the pyramids of the medulla oblongata, what fibers pass in them?
12. Roots of which pairs of cranial nerves emerge from the anteriolateral sulcus?
13. Roots of which pairs of cranial nerves emerge from the posterolateral sulcus?
14. The structure of white matter of the medulla oblongata, what carrying-out ways pass there.
15. Lemniscus medialis: formation, composition, functional value.
16. What path starts from the bottom of the olive complex?
17. What is formed by the posterior longitudinal bundle, its function?
18. What is formed by the media longitudinal bundle, its value?
19. What is formed by the inferior cerebellar peduncles of cerebellum?
20. The reticular formation, its structure and significance.
21. What are the parts of metencephalon?
22. What parts and surfaces has the pons, its limits?
23. What is the boundary between the parts of the pons in frontal section?
24. What does the trapezoid body of the pons form?
25. What are the nuclei of gray matter has the pons: structure, functional value.
26. The structure of the white matter of the pons, what carrying-out ways pass there.
27. What does the spinal lemniscus consist of?
28. What does the trigeminal lemniscus consist of?
29. What are the nuclei of the extrapyramidal system located in the medulla oblongata and the pons?

4.3. The list of standardized practical skills:

The medulla oblongata:

- Fissura mediana anterior
- Pyramides medullae oblongatae
- Decussatio pyramidum
- Sulcus anterolateralis
- Olivae
- Sulcus posterolateralis
- Fasciculus cuneatus
- Tuberculum cuneatum
- Fasciculus gracilis
- Tuberculum gracile
- Sulcus medianus posterior
- Pedunculus cerebellaris inferior

The pons: - Sulcus basilaris

- Pedunculus cerebellaris medius
- Pedunculus cerebellaris superior
- Velum medullare superius
- Tectum cerebelli (in cross section)
- Pars basilaris pontis

Relevance of the topic:

The brain development: on the fourth week (3,5-4 weeks) of an embryonal development the cranial extremity of a nervous tube owing to difficult transformations forms three primary cerebral bubbles:

the diamond-shaped brain (*rhombencephalon*).

the midbrain (*mesencephalon*).

the forebrain (*prosencephalon*).

These brain vesicles demarcated by a constriction of the neural tube. In five weeks by dividing a diamond-shaped and front bubbles which formed five secondary brain vesicles.

A *diamond-shaped brain* is divided into two secondary brain vesicles: the medulla oblongata (*myelencephalon*). hindbrain (*metencephalon*).

The *forebrain* is divided into: diencephalon (*diencephalon*), telencephalon (*telencephalon*).

Definitively divisions of the brain and its cavities are: the medulla oblongata, the pons;

IV-th ventricle, cerebral aqueduct, third ventricle; the lateral (I and II) ventricles.

THE BRAIN (*encephalon*)

On preparation of the brain noticeable three greater parts:

The brain stem (*truncus encephali*), cerebellum (*cerebellum*) — the small brain; the large brain (*cerebrum*).

The brain stem includes:

- the medulla oblongata (*medulla oblongata*);
- the pons (*pons*),
- the average brain (*mesencephalon*).

The medulla oblongata (*medulla oblongata*), bulb of the brain (*bulbus cerebri*) (*gr.myelencephalon*)

The external structure

The medulla unites lines of a structure of the spinal cord and brain stem and has the anatomic educations characteristic of these departments of a CNS on the surface. The medulla has on its surface: the anterior median fissure; 2 pairs (anteriolateral and posteriolateral) sulcus; the posterior median sulcus; posterior intermediate sulcus.

From sides from the anterior median fissure there are pyramids, and the lateral from them— an olive. Behind the olive (posterolateral sulcus) are the roots of the vagus group of nerves (IX, X, XI), and in front of the olive the roots of the hypoglossal nerve (XII pair).

The posterior median sulcus separates the thin fascicles, from the side of which are wedge-shaped bundles.

These bundles over the same tubercles. The remainder of the posterior surface of the medulla belongs to the lower 1/2 of the surface of the rhomboid fossa, which is bounded from below by the inferior cerebellar

peduncles.

Internal structure.

The gray matter of the medulla oblongata located in its column:

1. Thin and wedge-shaped nuclei are in the same tubercles. Neurocyte of these nuclei are bodies of other neurones of the proprioceptive path cortical areas (Gaulle and Burdakh's ways), partially tactile sensitivity and a stereognosis. The axons of these neurons form the internal arcuate fibers that are routed on the opposite side, forming dorsal intersection of lemniscus medialis. These fibers are part of lemniscus medialis; the external arcuate fibers, which are divided into: the posterior, heading to the inferior cerebellar peduncles its side and anterior, which make the intersection and part of the inferior cerebellar peduncles of the opposite side.

2. Olive nucleus contained in olive and regulates the balance of the body through connections with the cerebellum (tractus olivocerebellaris) and spinal cord (tractus olivospinalis).

3. The nuclei of IX, X, XI, XII pairs of the cranial nerves.

4. The reticular substance (formation) is concentrated in dorsal departments of the medulla oblongata and it is a continuation of the reticulated substance of the spinal cord. It permeates the entire brain stem, reaching the intermediate brain and, by individual reports, the telencephalon.

5. Vital centers of respiration and circulation associated with the nuclei of the vagus nerve (damage the centers caused by a condition of clinical death). The white substance of the medulla oblongata, the bundles of nerve fibers can be systematized:

1. Transit mutual pathways (ascending and descending) connections - the spinal cord-the brain.

2. Pathways that are switched on nuclei of the medulla oblongata.

3. Pathways, started in the medulla.

Important conduction tract of the first group is cortico-spinal (pyramidal) path, which forms on border with the spinal cord an incomplete decussation of pyramids (about 90% of fibers). This ventral motor decussation of the medulla in contrast to the dorsal sensitive decussation above — lemniscus medialis.

(More precisely, the intersection of the internal arcuate fibers. The media lemniscus is a broader concept and is composed of: internal arcuate fibers (proprioception, stereognosis), spinal lemniscus (all exteroceptive and interoceptive way of a trunk, extremities, neck), trigeminal lemniscus. This is a classic “lemniscus way”.)

THE HINDBRAIN (metencephalon).

The pons (pons Varolii). *The external structure.* The pons is located above the medulla oblongata (sulcus bulbopontinus) in the form of a transverse roller, which borders the cranial midbrain on both sides — with the media cerebellar peduncles for conditional trigeminal facial line (drawn through the roots of the V and VII pairs of cranial nerves). In sulcus bulbopontinus are roots VI, VII pairs of cranial nerves, and on the ends of the sulcus — VIII pair of cranial nerves. In the middle of the front surface of the pons is the main sulcus (sulcus basilaris).

The posterior surface of the pons is the upper 1/2 of the surface of the rhomboid fossa.

Internal structure. Transverse fibers of the pons (the trapezoid body, auditory paths) share the pons on the front and back.

The gray matter of the front part:

- Nuclei of the pons. In them, as bodies of 2 neurons, switch cortico-pontis fibers.

The gray matter of the back part:

- the nucleus V, VI, VII, VIII pairs of cranial nerves;
- the reticular substance (formation) with nucleus;
- the nucleus of the trapezoid body.

In the bulk a bridge is the explorer vehicle of cerebrum.

The white matter in the front part:

- Tractus corticonuclearis (fibers) (fibrae corticonucleares pontis);
- Tractus corticospinalis (fibrae corticospinales),
- Fibrae corticopontinus (fibrae corticopontinae),
- Fibrae pontocerebellares (fibrae pontocerebellaris).

The white substance at the back part (tegmentum pontis):

- Lateral lemniscus (lemniscus lateralis),
- Media lemniscus (lemniscus medialis);
- Tractus spinotectalis (tractus spinotectalis),
- Tractus spinocerebellaris anterior (tractus spinocerebellaris anterior),
- Tractus tectospinalis (tractus tectospinalis);
- Tractus rubrospinalis (tractus rubrospinalis);
- Tractus thalamospinalis (tractus thalamospinalis);
- Tractus reticulospinalis (tractus reticulospinalis),
- The medial longitudinal bundle (fasciculus longitudinalis medialis),
- The posterior longitudinal bundle (fasciculus longitudinalis posterior).

Tractus thalamospinalis is extrapyramidal and provides the tone and contraction of a particular muscle group, resulting in a forced position of the body in various diseases. An offshoot of this pathway on somatic-motor nucleus of the cranial nerves, particularly V, VII pairs of the cranial nerves provides emotional (playback) various stimuli.

Fasciculus longitudinalis posterior (Schutz) — referent vegetative path: the cortex - midbrain — nuclei of vegetative lesions (foci) of the brain stem and

spinal cord, autonomic ganglia — the working body (muscle, gland).

Materials for self-control:

1. The patient after suffering arachnoiditis increased pressure of the cerebrospinal fluid in the fourth ventricle of the brain. What can obstruct the outflow of cerebrospinal fluid from the ventricle into the subarachnoid space?
 - A. Imperforate foramen interventriculare on the right.
 - B. Imperforate foramen interventriculare on the left.
 - C. Imperforate aqueduct of the mesencephalon.
 - D. Imperforate median and lateral apertures of the IV ventricle.
 - E. Imperforate central canal of the spinal cord.

2. In the neurosurgical department received a patient with concussion of a brain of 2-3 degrees. The patient's condition is satisfactory. On the radiograph of a skull fracture have not been identified. But after a few hours the patient's condition deteriorated: he lost consciousness, showed signs of disorder of cardiovascular system and respiratory disorders. In which of the brain is the cardiovascular and respiratory centers?
 - A. In the pons.
 - B. In the intermediate brain.
 - C. In the medulla oblongata.
 - D. In the cerebellum.
 - E. In the midbrain.

3. The patient's tumor process is corrupted vegetative (parasympathic) - IX cranial nerve, which is located in the formation reticularis of the medulla oblongata between the n.ambiguus and olive nucleus. What the nucleus is?
 - A. Nucl.salivatorius inferior.
 - B. Nucl.salivatorius superior.
 - C. Nucl.thoracicus.
 - D. Nucl.tractus solitarii.
 - E. Nucl.anterolateralis.

4. The patient's tumor process located on the ventral surface of the bridge, closer to linea trigeminofacialis. What structure in the brain located lateral from it?
 - A. Pedunculus cerebellaris superior.
 - B. Pedunculus cerebellaris inferior.
 - C. Pedunculus cerebri.
 - D. Pedunculus cerebellaris media.
 - E. Velum medullare superius.

5. Due to the growth of a malignant tumor in the brain stem, the patient revealed functional disorders of the IX, X and XI pairs of cranial nerves, which evolved from the Gill arches. The medical research established that destroyed nucleus, which is located in reticular formation of the medulla and is common for these nerves. What nucleus of the cranial nerve was damaged?

- A. Nucl.accessorius.
- B. Nucl.motorius n.trigemini.
- C. Nucl.tractus solitarii.
- D. Nucl.ambiguus.
- E. Nucl.salivatorius inferior.

6. The patient using x-ray method of research revealed the tumor, which is located in the tegmentum pontis. What nuclei of pairs of the cranial nerves can be damaged?

- A.V- VIII. B. IX -XII. C.III -IV.D. V-XII. E. III -VIII.

7. Patient T., 73 years old, hospitalized to neurology unit of the hospital with a diagnosis of hemorrhage in the brain stem. It's established that the hematoma tends to increase. Which of the following nuclei lie in the dorsal part of the medulla oblongata and may suffer damage?

- A. Nucl.salivatorius superior.
- B. Nucl.gracilis.
- C. Nucl.impar.
- D. Nucl. n.abducentis.
- E. Nucl. n.facialis.

8. After conducting tomographic imaging of the brain, the patient discovered tuberculoma at the level of colliculus facialis of a rhomboid fossa. The nucleus of which pair of the cranial nerves is projected onto the colliculus facialis?

- A. Nucl.vestibularis medialis.
- B. Nucl.accessorius.
- C. Nucl.vestibularis superior.
- D. Nucl.cochlearis ventralis.
- E. Nucl.abducentis.

9. The patient revealed local damage of pars basilaris pontis with dysfunction of longitudinal and transverse fibers. What fibers form the fibrae transversae pars basalis pontis?

- A. Fibrae corticospinales.
- B. Fibrae corticonucleares.
- C. Fibrae pontocerebellares.

- D. Fibrae corticoreticulares.
- E. Fibrae corticopontinae.

10. As a result of histological examination of the cerebellum substance was established the tumor damage of the dentate nucleus. What, behind a phylogenetic sign, the department of a cerebellum suffered?

- A. Archicerebellum.
- B. Paleocerebellum.
- C. Vestibulocerebellum.
- D. Pontocerebellum.
- E. Spinocerebellum.

Keys to the tests:

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| D | C | A | D | D | A | E | C | E | D |

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