IMMANUEL KANT BALTIC FEDERAL UNIVERSITY
DEPARTMENT OF FUNDAMENTAL MEDICINE

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# ANATOMY: CENTRAL NERVOUS SYSTEM

Methodological recommendations
for students of medicine

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The manual is prepared according to requirements of the working program of the discipline “Anatomy” and contains methodical indications for the section Central nervous system according to the existing curriculum. The manual is intended for the English-speaking students of medical faculty studying on specialties 31.05.01 “General medicine”.

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# Topic 1

## STRUCTURE OF THE SPINAL CORD AND ITS MENINGES

### INTRODUCTION TO THE TOPIC

The diseases of the spinal cord are often observed; they are associated with motor, sensitive and secretory disorders. To diagnose correctly, to locate a pathological process and to choose the correct tactics of treatment, it is necessary to know the anatomy and topography of the spinal cord and spinal nerves. Understanding of this topic will ease the study of the brain structure and to understand the development of the nervous system.

**Before the study of the topic you should know:**

1. The structure of vertebral column.
2. Functional and morphological classification of the nervous system.
3. The structure of neurons, types of neurons.
4. The structure of nerve fibers, types of nerve fibers.
5. Classification and structure of the reflex arches.

### SELF-STUDY GOALS

After independently studying this topic, the student should know the following:

- the spinal cord: its segments, roots and nerves in English and Latin;
- internal and external structure of the spinal cord; meninges and intermeningeal spaces of the spinal cord;
- be able to draw the reflex arch; to show the indicated structures on a demonstration preparation.

### TOPIC CONTENT

- Development of the spinal cord.
- Spinal cord anatomy:

— external structure (thickenings, grooves, roots, ganglion);

— internal structure (gray matter — nuclei, central canal, columns, horns; white matter — short and long fascicles).

- Segment of the spinal cord.
- Apparatus of two-way connections with the brain.
- Anatomy of the spinal cord meninges:

— dura mater;
— arachnoid;
— pia mater;
— intermeningeal spaces and their contents.

- Diagram of the reflex arch.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |
| Draw a diagram of the spinal cord internal structure in your notebook | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |
| Draw a diagram of the reflex arch | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. What parts of the nervous system are distinguished?
2. Describe the parts of a neuron.
3. Classify the neurons according to the number of processes and according to the function.
4. Describe the spinal cord beginning, end, enlargements. At the level of which vertebrae does it end?
5. What is the cauda equina?
6. Describe the external relief of the spinal cord: its grooves, funiculi.
7. Describe the white and gray matter of the spinal cord.
8. Give the definition of the spinal cord segment. How many segments do you know?
9. Explain the formation of the spinal nerves: the roots, the trunks, main branches (their composition) of the spinal nerves.
10. Through which spinal cord grooves do the spinal nerve radices pass?
11. How do the spinal nerves leave the vertebral canal (name the openings)?
12. What nuclei are located in the anterior, posterior and lateral horn (give a functional description of the nuclei)?
13. What is the spinal ganglion? Where is it located? What type of neurons are there?
14. What types of the conduction tracts are in the funiculus anterior, funiculus lateralis, funiculus posterior?
15. Explain the structure of a simple reflex arch. Describe the differences between the simple and complex reflex arches.
16. Enumerate the spinal cord meninges and intermeningeal spaces.
17. What is located in the epidural, subdural and subarachnoid spaces?
18. Which segments of the spinal cord contain the lateral horns?
19. What is the main function of the segmental apparatus of the spinal cord?

**Written task:**

1. Draw the meninges of the spinal cord and intermeningeal spaces in a notebook and label them.
2. Draw a cross-sectional diagram of the spinal cord in your notebook.

## PRACTICAL SKILLS

1. Spinal cord, *medulla spinalis*; спинной мозг.
2. Anterior median fissure, *fissura mediana anterior*; передняя серединная щель.
3. Posterior median sulcus, *sulcus medianus posterior*; задняя серединная борозда.

4. Anterolateral sulcus, *sulcus anterolateralis;* переднебоковая борозда.

5. Posterolateral sulcus, *sulcus posterolateralis*; заднебоковая борозда.

6. Spinal ganglion, *ganlion spinale*; спинномозговой узел.

7. Anterior root of the spinal nerve, *radix anterior nervi spinalis*; передний корешок спинномозгового нерва.

8. Posterior root of the spinal nerve, *radix posterior nervi spinalis*; задний корешок спинномозгового нерва.

9. Trunk of the spinal nerve, *truncus nervi spinalis*; ствол спинномозгового нерва.

10. Segment of the spinal cord, *segmentum medullae spinalis*; сегмент спинного мозга.

11. Cervical enlargement, *intumescentia cervicalis*; шейное утолщение.

12. Lumbosacral enlargement, *intumescentia lumbosacralis*; пояснично-крестцовое утолщение.

13. Central canal, *canalis centralis*; центральный канал.

14. Grey matter of the spinal cord, *substantia grisea*; серое вещество.

15. White matter of the spinal cord, *substantia alba*; белое вещество.

16. Anterior horn, *cornu anterius*; передний рог.

17. Posterior horn, *cornu posterius*; задний рог.

18. Lateral horn, *cornu laterale*; боковой рог.

19. Anterior white commissure, *comissura alba anterior*; передняя белая спайка.

20. Anterior funiculus, *funiculus anterior*; передний канатик.

21. Lateral funiculus, *funiculus lateralis*; боковой канатик.

22. Posterior funiculus, *funiculus posterior*; задний канатик.

23. Cauda equina, *cauda equina*; конский хвост.

24. Medullary cone*, conus medullaris*; мозговой конус.

25. Filum terminale, *filum terminale*; концевая нить.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

3. *Sapin, M. R.* Textbook of human anatomy for medical students. Vol. 2 / L. L. Kolesnikov, D. B. Nikitjuk, M. R. Sapin. — 2nd ed. — Moscow : New Wave Publishing Agency, 2019. — 480 p.

4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 2

## THE GENERAL ORGANIZATION OF THE BRAIN: BASE, SAGITTAL SECTION, TOPOGRAPHY OF THE CRANIAL NERVE ROOTS ON THE CEREBRAL BASE

### INTRODUCTION TO THE TOPIC

There are some important cerebral formations on the base of the brain, like one of the endocrine glands, the hypophysis. Its hormones are involved in the regulation of body growth, vascular tone, regulation of the activity of other endocrine glands and internal body functions.

At the cerebral base is the medulla oblongata which contains the vital centers of respiration and cardiac activity. Here are the roots of the 12 cranial nerves; the damage to them cause the disorder of the sensory organs (olfactory, visual, auditory), and sensory and motor innervation of the head. To know the general brain organization is important for the study of the brain parts.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the Latin and English names and position of the brain formations on its inferior surface (basis) and on the sagittal section;
- the stages of the brain development;
- must be able to name and show the cranial nerves roots localization at the base of the brain.

### TOPIC CONTENT

- Formation of initially three brain vesicles: forebrain (prosencephalon), midbrain (mesencephalon), and hindbrain (rhombencephalon).
- Differentiation of the 3 primary cerebral vesicles into 5 secondary vesicles: the prosencephalon is subdivided into the telencephalon and diencephalon, the rhombencephalon differentiates into the metencephalon and myelencephalon. The mesencephalon remains as the mesencephalon.

• The telecephalon will become the cerebrum. The diencephalon gives rise to the thalamus and the hypothalamus. The mesencephalon does not differentiate into any finer divisions. The metencephalon gives rise to the pons and cerebellum. The myelencephalon develops into the medulla oblongata.

• General overview of the brain base.

◦ When studying the formations of the base of the brain, one should not only remember their names and relative positions, but also relate them to certain derivatives of the brain vesicles and to the corresponding parts of the brain.

◦ Formations of the telencephalon: olfactory bulb, tract, triangle, anterior perforated substance; formations of the diencephalon: optic chiasm, tract, gray tubercle, infundibulum, pituitary gland, mammillary bodies; midbrain: cerebral peduncles; hindbrain: pons and cerebellum; rhombencephalon: medulla oblongata.

• Sagittal section of the brain.

• All formations encountered must be assigned according to their genetic basis to the appropriate section:

— formations of the telencephalon: cortex, corpus callosum, fornix;

— formations of the diencephalon: thalamus, hypothalamus, epithalamus;

— formations of the mesencephalon: pedunculus cerebri, lamina tecti;

— formations of the metencephalon; pons, cerebellum;

— formations of the myelencephalon; medulla oblongata;

— pay attention to the fact that each part of the brain has its own cavity — respectively, the lateral ventricles, the third ventricle, the Sylvian aqueduct and the fourth ventricle.

• Study the name of the cranial nerves (from I to XII pairs) and positions of their roots on the brain base.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details on a table, diagram and natural preparations |
| Revise the openings, channels, grooves on the skull associated with the study of a given cranial nerve root | Studying the topic is accompanied by a demonstration of structural details on the skull |

*The end of Table*

| Activity | Step Description |
|---|---|
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, nerves etc.;<br>4) internal structure — cavities |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. Classify the brain divisions according to the development.
2. What structures are located at the basis cerebri? Name and show them.
3. What formations belong to the telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon?
4. Enumerate all the cranial nerves names.
5. Describe the cranial nerves roots position on the basis cerebri.
6. Show all the cranial nerves roots on the basis cerebri.
7. Show and name the formations of the telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon on the brain sagittal section.
8. Name the cavities of the brain which are seen on its sagittal section.

## PRACTICAL SKILLS

1. Olfactory bulb, *bulbus olfactorius*; обонятельная луковица.
2. Olfactory tract, *tractus olfactorius*; обонятельный тракт.
3. Olfactory trigone, *trigonum olfactorium*; обонятельный треугольник.
4. Optic chiasm, *chiasma opticum*; зрительный перекрест.
5. Tuber cinereum, *tuber cinereum*; серый бугор.
6. Infundibulum, *infundibulum*; воронка.

7. Hypophysis, *hypophysis*; гипофиз.

8. Mamillary bodies, *corpora mamillaria*; сосцевидные тела.

9. Anterior perforated substance, *substantia perforata anterior*; переднее продырявленное вещество.

10. Cerebral peduncles, *pedunculi crebri*; ножки мозга.

11. Interpeduncular fossa, *fossa interpduncularis*; межножковая ямка.

12. Posterior perforated substance, *substantia perforata posterior*; заднее продырявленное вещество.

13. Pons, *pons*; мост.

14. Cerebellum, *cerebellum*; мозжечок.

15. Brain stem, *truncus cerebri*; ствол мозга.

16. Cerebral hemisphere, *hemispheria cerebri*; полушария большого мозга.

17. Longitudinal cerebral fissure, *fissura longitudinalis cerebri*; продольная щель мозга.

18. Transverse cerebral fissure, *fissura transversa cerebri*; поперечная щель мозга.

19. Corpus callosum, *corpus callosum*; мозолистое тело.

20. Rhombencephalon, *rhombencephalon*; ромбовидный мозг.

21. Medulla oblongata, *medulla oblongata*; продолговатый мозг.

22. Metencephalon, *metencephalon*; задний мозг.

23. Mesencephalon, *mesencephalon*; средний мозг.

24. Diencephalon, *diencephalon*; промежуточный мозг.

25. Telencephalon, *telencephalon*; конечный мозг.

26. The roots of the I cranial nerve, *nervus olfactorius*; обонятельный нерв.

27. The roots of the II cranial nerve, *nervus opticus*; зрительный нерв.

28. The roots of the III cranial nerve, *nervus oculomotorius*; глазодвигательный нерв.

29. The roots of the IV cranial nerve, *nervus trochlearis*; блоковый нерв.

30. The roots of the V cranial nerve, *nervus trigeminus*; тройничный нерв.

31. The roots of the VI cranial nerve, *nervus abducens*; отводящий нерв.

32. The roots of the VII cranial nerve, *nervus facialis*; лицевой нерв.

33. The roots of the VIII cranial nerve, *nervus vestibulocochlearis*; преддверно-улитковый нерв.

34. The roots of the IX cranial nerve, *nervus glossopharyngeus*; языкоглоточный нерв.

35. The roots of the X cranial nerve, *nervus vagus*; блуждающий нерв.

36. The roots of the XI cranial nerve, *nervus accessorius*; добавочный нерв.

37. The roots of the XII cranial nerve, *nervus hypoglossus*; подъязычный нерв.

## Literature

1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

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4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 3

## RHOMBENCEPHALON: MEDULLA OBLONGATA, PONS, CEREBELLUM. ISTHMUS RHOMBENCEPHALI

### INTRODUCTION TO THE TOPIC

Knowledge of the anatomy of the medulla oblongata is necessary for studying subsequent topics of brain morphology, pathways, anatomy of cranial nerves, and cerebrospinal fluid outflow tracts. The presence of vital centers (respiratory and cardiovascular) in the medulla oblongata determines its enormous importance in ensuring the normal functioning of the body as a whole. The medulla oblongata contains all the pathways connecting the periphery with the brain. The nuclei of the IX-XII pairs of cranial nerves are located in the medulla oblongata, nuclei of the V-VIII cranial nerves are in the pons. The human cerebellum performs three main functions: regulation and maintenance of muscle tone, maintaining balance, and sensorimotor coordination. Knowledge of the anatomy of this parts of the brain is necessary to understand the complex functions of the brain, as well as for the correct topical diagnosis for neurosurgeons and neuropathologists.

**Before the studying the topic you need to know:**

1. The general structure of the white and grey matter of CNS.
2. The structure of skull.
3. Names and roots of the cranial nerves.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the English and Latin terminology on this topic;
- the internal, external structure, functions of the medulla oblongata, pons, cerebellum, isthmus rhombencephali;
- V—XII cranial nerves roots (places of their exit at the cerebral base; the nuclei of these nerves and their locations;
- should be able to demonstrate the corresponding external brain structures on the models and natural preparations.

## TOPIC CONTENT

• External relief of the medulla oblongata: fussura, grooves, pyramids, olives, fascicles.

• Internal structure of the medulla oblongata:

◦ gray matter: nuclei of cranial nerves IX-XII, olive nucleus, nucleus gracilis and cuneatus;

◦ reticular formation;

◦ respiratory and circulatory centers;

◦ white matter of the medulla oblongata — bulbo-thalamic tract, olivo-cerebellar tract, pyramidal tract; decussations.

• Pons: trigeminofacial line, basilar groove.

◦ internal structure of the pons:

— ventral and dorsal parts (the border between them is the trapezoid body);

— dorsal nucleus of the trapezius body;

— reticular formation;

— nuclei of cranial nerves V—VIII.

• The cerebellar hemispheres (gyri, sulci, superior and inferior surfaces, lobules), vermis, flocculus and its legs, nodulus (part of the vermis).

• Internal structure of the cerebellum:

◦ nucleus fastigeus, nucleus globosus, nucleus emboliformis, nucleus dentatus. Phylogenetic connections of the nuclei with different cerebellar parts (fastigeal nucleus with flocculus, globose and emboliform nuclei with vermis, dentate nucleus with cerebellar hemispheres);

◦ tree of life (arbor vitae cerebelli-ernlike pattern of white and gray matter in a cross-section).

• Inferior, middle and superior cerebellar peduncles.

• Isthmus rhombencephali:

◦ pedunculus cerebellaris superior;

◦ vellum medullaris superior;

◦ trigonum lemnisci (bounded anteriorly by the brachium inferior of the lamina tecti, posteriorly by the pedunculus cerebellaris superior, laterally by the pedunculus cerebri.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |

*The end of Table*

| Activity | Step Description |
|---|---|
| Draw a diagram of the corresponding brain part in your notebook | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. Describe the parts of the brain (rhombencephalon, mesencephalon, diencephalon, telencephalon).
2. At which level does the spinal cord continue with the medulla oblongata?
3. What are the functions of the medulla oblongata?
4. From which cerebral vesicle does the medulla oblongata develop?
5. Which cranial nerves emerge from the medulla oblongata?
6. Describe the medulla oblongata external relief: fissure, sulci, funiculi, olives, fascicles, pyramids, decussatio pyramidalis.
7. Describe the internal structure of the medulla oblongata (reticular formation, gray and white matter elements).
8. Describe the functional characteristic of the medulla oblongata nuclei.
9. Which decussations of the medulla oblongata do you know?
10. Where is the pons located?
11. From which cerebral vesicle does the pons develop?
12. Describe the external relief of the pons.

13. Name the nuclei of the cranial nerves emerging from the pons. Which of them are sensory, motor, parasympathetic?

14. Describe white matter of the pons.

15. The nuclei of which pairs of cranial nerves lie in the pons?

16. Describe the relief of the cerebellum.

17. What formation is the ancient part of the cerebellum? The old part? New part?

18. What nuclei does the cerebellum have?

19. What peduncles does the cerebellum have? What do they connect?

20. What structures make up the isthmus of the rhombencephalon?

**Written task:**

Draw a diagram of the internal structure of the medulla oblongata and the pons.

## PRACTICAL SKILLS

1. Brain stem, *truncus cerebri*; ствол головного мозга.

2. Medulla oblongata, *medulla oblongata*; продолговатый мозг.

3. Anterior median fissure, *fissura mediana anterior*; передняя серединная щель.

4. Posterior median sulcus, *sulcus medianus posterior*; задняя серединная борозда.

5. Pyramid, *pyramis medullae oblongatae*; пирамида.

6. Pyramidal decussation, *decussatio pyramidum*; перекрест пирамид.

7. Gracile fasciculus, *fasciculus gracilis*; тонкий пучок.

8. Cuneate fasciculus, *fasciculus cuneatus*; клиновидный пучок.

9. Olive, *oliva*; олива.

10. Anterolateral sulcus, *sulcus anterolateralis*; переднелатеральная борозда.

11. Posterolateral sulcus, *sulcus posterolateralis*; заднелатеральная борозда.

12. Gracile tubercle, *tuberculum gracile*; тонкий бугорок.

13. Cuneate tubercles, *tuberculum cuneatum*; клиновидный бугорок.

14. Pons, *pons*; мост.

15. Basilar sulcus, *sulcus basilaris*; базилярная борозда.

16. Cerebellum, *cerebellum*; мозжечок.

17. Superior cerebellar peduncles, *pedunculi cerebellares supriores*; верхние ножки мозжечка.

18. Middle cerebellar peduncles, *pedunculi cerebellares medii*; средние ножки мозжечка.

19. Inferior cerebellar peduncles, *pedunculi cerebellares inferiores*; нижние ножки мозжечка.

20. Cerbellar hemisphere, *hemispheria cerebelli*; полушария мозжечка.

21. Superior surface, *facies superior cerebelli*; верхняя поверхность мозжечка.

22. Inferior surface, *facies inferior cerebelli*; нижняя поверхность мозжечка.

23. Vermis, *vermis cerebelli*; червь мозжечка.

24. Folia of cerebellum, *folia cerebelli*; листки мозжечка.

25. Horizontal fissure, *fissura horizontalis*; горизонтальная щель.

26. Flocculus, *flocculus*; клочок.

27. Nodulus, *nodulus*; узелок.

28. Superior medullary velum, *velum medullare superius*; верхний мозговой парус.

29. Isthmus of rhombencephalon, *isthmus rhombencephali*; перешеек ромбовидного мозга.

30. Trigone of lemniscus, *trigonum lemnisci*; треугольник петли.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

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4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 4

## THE FOURTH VENTRICLE, RHOMBOID FOSSA, PROJECTION OF THE CRANIAL NERVES NUCLEI ONTO THE RHOMBOID FOSSA. MIDBRAIN

### INTRODUCTION TO THE TOPIC

The educational material of this topic is necessary when studying subsequent topics in the anatomy of the central and peripheral nervous system (topography of the nuclei of the cranial nerves, cerebrospinal fluid and its outflow pathways, nerve pathways, III—VIII pairs of cranial nerves. Understanding the anatomy of this division of the brain is necessary for understanding the complex functions of the brain, as well as for the correct formulation of a topical diagnosis by neurosurgeons and neuropathologists.

**Before the study of the topic you should know:**

1. The general structure of the grey and white matter of CNS.
2. The structure of skull.
3. Names and roots of the cranial nerves.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the names in English and Latin of all formations of the midbrain;
- the structure of the fossa rhomboidea, its topography and projection of the cranial nerve nuclei;
- the structure of the IV ventricle and its communications with other cerebral cavities;
- the functional significance of the rhombencephalon and mesencephalon;
- must be able to show anatomical formations on a preparation.

### TOPIC CONTENT

- Relief of the fossa rhomboidea:

◦ borderlines, grooves, stria, elevations, vestibular area, triangles;

◦ projection of the cranial nerves nuclei: trigeminal; abducens; facial; intermediate; vestibulocochlear (vestibular+cochlear); glossopharyngeal; vagus; accessory; hypoglossal nerves.

- The structure of the IV ventricle: floor, roof, apertures, communications of the ventricle with other ventricles and the spatium subarachnoidale of the brain.
- Roof of the midbrain (lamina tecti):
  - colliculus superior;
  - colliculus inferior;
- Pedunculus cerebri (base, tegmentum).
- Aqueductus cerebri.
- Mesencephalon.
- Internal structures of the midbrain:
  - tectum (its nuclei);
  - tegmentum and basis of the pedunculus cerebri (borderlines, white and gray matter);
  - paired nucleus motorius of the nervus oculomotorius (III) (level of the colliculus superior);
  - paired vegetative parasympathetic nuclei: nucleus accessorius (Yakubovich's) and unpaired nucleus medianus (Perlya's);
  - paired nucleus motorius of the nervus trochlearis (IV) (level of the colliculus inferior);
  - substantia nigra (it divides the pedunculus cerebri into the tegmentum (dorsally) and basis (ventrally);
  - nucleus ruber;
  - formatio reticularis;
  - fasciculus longitudinalis medialis.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying of the topic is accompanied by a demonstration of structural details in a table and a diagram |
| Draw a diagram of the projection of cranial nerves nuclei onto the rhomboid fossa in your notebook | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |
| Draw a diagram of midbrain Internal structures | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |

*The end of Table*

| Activity | Step Description |
|---|---|
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. Where is the IV ventricle located?
2. What structures belong to the midbrain?
3. What is the cavity of the midbrain?
4. Describe the communications of the cerebral aqueduct.
5. Where do the nuclei of the III pair of cranial nerves, IV pairs lie?
6. Describe the arrangement of grey matter relatively to white matter in the midbrain.
7. What nuclei of the midbrain do you know?
8. What is the function of the nucleus ruber?
9. What is the function of the substantia nigra?
10. What structures form the roof of the IV ventricle.
11. Describe the floor of the IV ventricle.
12. Describe the communications of the fourth ventricle with another ventricles and intermeningeal spaces.
13. Describe the position and functions of the choroid plexus.
14. What do the lateral (Luschka`s foramen) and median (Magendie`s foramen) apertures communicate the fourth ventricle with? Describe the location of the foramina.
15. Describe the borderlines of the rhomboid fossa.

16. Describe the relief of the rhomboid fossa.
17. The nuclei of which cranial nerves project below the stria medullaris?
18. The nuclei of which cranial nerves project above the stria medullaris?
19. The nuclei of which cranial nerves occupy the trigonum nervi hypoglossi? Is it motor, vegetative or sensory?
20. The nuclei of which cranial nerves occupy the trigones of vagus nerve? Name this nucleus.
21. The nuclei of which cranial nerves occupy the vestibular areas? What types do they belong to?
22. How is the facial colliculus formed?

**Written task:**
1. Draw a diagram of the projection of the cranial nerve nuclei onto the rhomboid fossa.
2. Draw a diagram of the midbrain internal structures.

## PRACTICAL SKILLS

1. Rhomboid fossa, *fossa rhomboidea*; ромбовидная ямка.
2. Median sulcus, *sulcus medianus*; срединная борозда.
3. Medial eminence, *eminentia medialis*; срединное возвышение.
4. Trigone of hypoglossal nerve, *trigonum nervi hypolossi*; треугольник подъязычного нерва.
5. Trigone of vagus nerve, *trigonum nervi vagi*; треугольник блуждающего нерва.
6. Facial colliculus, *colliculus facialis*; лицевой бугорок.
7. Medullary striae, *striae medullares*; мозговые полоски.
8. Superior medullary velum, *velum medullare superius*; верхний мозговой парус.
9. Inferior medullary velum, *velum medullare inferius*; нижний мозговой парус.
10. Fourth ventricle, *ventriculus quartus*; четвёртый желудочек.
11. Choroid tela, *tela choroidea*; сосудистая основа.
12. Cerebral peduncles, *pedunculi cerebri*; ножки мозга.
13. Tectum of mesencephalon, *tectum mesencephali*; крыша среднего мозга.
14. Substantia nigra, *substantia nigra*; черное вещество.
15. Tegmentum of midbrain, *tegmentum mesencephali*; покрышка среднего мозга.
16. Base of mesencephalon, *basis mesencephali*; основание среднего мозга.
17. Interpeduncular fossa, *fossa interpenduncularis*; межножковая ямка.
18. Posterior perforated substance, *substantia perforata posterior*; заднее продырявленное вещество.

19. Superior colliculi, *colliculi superiors*; верхние холмики.

20. Inferior colliculi, *colliculi inferiors*; нижние холмики.

21. Brachia of superior and inferior colliculi, *brachia colliculi superioris et inferioris*; ручки верхних и нижних бугорков.

22. Trigone of lemnisci, *trigonum lemnisci*; треугольник петли.

23. Cerebral aqueduct, *aqueductus cerebri*; водопровод мозга.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

3. *Sapin, M. R.* Textbook of human anatomy for medical students. Vol. 2 / L. L. Kolesnikov, D. B. Nikitjuk, M. R. Sapin. — 2nd ed. — Moscow : New Wave Publishing Agency, 2019. — 480 p.

4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 5

## DIENCEPHALON, III VENTRICLE

### INTRODUCTION TO THE TOPIC

The knowledge of this topic is essential for the subsequent anatomy topics about the central and peripheral nervous systems: subcortical vegetative centers, ascending conduction tracts, endocrine system structures, subcortical visual and olfactory centers, circulation of the cerebrospinal fluid.

The diencephalon contains vitally important centers (different subcortical sensory centers, center of water and salt metabolism, center controlling the endocrine gland functioning, limbic and extrapyramidal system centers, etc.), endocrine glands (epiphysis, hypophysis, structures of olfactory, auditory and visual analyzers, important sensory conduction tracts; good knowledge of this material is vital for the diagnostics of brain pathology.

**Before the study of the topic you should know:**

1. Names and roots of the cranial nerves.
2. The structure and communications of the forth ventricle.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the names in English and Latin of all formations of the diencephalon;
- the structure of the III ventricle, its connections with other cavities;
- the functional significance of the diencephalon;
- must be able to show anatomical formations on a preparation.

### TOPIC CONTENT

- Thalamencephalon, its parts:

◦ thalamus (sulcus terminalis, groups of the thalamic nuclei, tuberculum anterior, pulvinar, adhesio interthalamica, stria medullaris thalami);

◦ epithalamus (corpus pineale (epiphysis), habenula, trigonum habenulae, commissura habenularum, commissura cerebri posterior);

◦ metathalamus (corpus geniculatum mediale-subcortical auditory center, corpus geniculatum laterale-subcortical visual center).

- Hypothalamus:
◦ hypophysis, tuber cinereum, infundibulum;
◦ chiasma opticum, tractus opticus;
◦ corpus mammillaris;
◦ regio hypothalamica posterior (Lewis body).
- Ventriculus tertius (III ventricle):
◦ superior wall (roof): plexus choroideus;
◦ inferior wall (floor): sulcus hypothalamicus, chiasma opticum, tuber cinereum, corpus mammillaris, substantia perforata posterior;
◦ lateral walls: medial surfaces of the thalamus;
◦ anterior wall: lamina terminalis, columna fornicis, commissura cerebri anterior;
◦ posterior wall: commissura habenularum, epiphysis, comissura cerebri posterior;
◦ recessuses of the III ventricle: recessus opticus, recessus pinealis, recessus infundibula;
◦ communications of the III ventricle: paired foramen interventriculare (lead into the lateral ventricle), opening of the aqueduct (leads into the IV ventricle).

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |
| Draw a diagram of diencephalon Internal structures | Use a red color pencil for drawing the motor structures, blue one — for the sensory and green one — for the vegetative structures |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |

*The end of Table*

| Activity | Step Description |
|---|---|
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. What structures belong to the thalamus?
2. Describe the nuclei of the thalamus, their functions.
3. What parts does the epithalamus consist of? Describe the function of each part.
4. What parts does the metathalamus include?
5. Describe the function of the nuclei in the medial and lateral geniculate bodies.
6. What structures belong to the hypothalamus?
7. What is the function of the hypothalamic structures?
8. Describe the nuclei of the hypothalamus, their functions and their effect on the hypophysis.
9. Describe the function of the hypophysis.
10. What is the cavity of the diencephalon?
11. What structures make up the walls of the third ventricle?
12. What pouches does the third ventricle have?
13. How and with what does the third ventricle communicate?
14. Fill in the table:

| Walls of the third ventricle | Upper | Lower | Front | Back | Lateral |
|---|---|---|---|---|---|
| Anatomical structures that form them | | | | | |

## PRACTICAL SKILLS

1. Thalamus, *thalamus*; таламус.
2. Interthalamic adhesion, *adhesio interthalamica*; межталамическое сращение.
3. Anterior tubercle, *tuberculum anterius thalami*; передний бугорок таламуса.
4. Pulvinar, *pulvinar thalami*; подушка таламуса.
5. Stria medullaris, *stria medullaris thalami*; мозговые полоски таламуса.

6. Epithalamus, *epithalamus*; эпиталамус.

7. Habenular trigone, *trigonum habenulae*; треугольник поводка.

8. Habenulae, *habenulae*; поводок.

9. Habenular comissure, *comissura habenularum*; спайка поводков.

10. Epiphysis, *glandula pinealis*; шишковидное тело (эпифиз).

11. Metathalamus, *metathalamus*; мететаламус.

12. Medial geniculate body, *corpus geniculatum mediale*; медиальное коленчатое тело.

13. Lateral geniculate body, *corpus geniculatum laterale*; латеральное коленчатое тело.

14. Hypothalamus, *hypothalamus*; гипоталамус.

15. Mamillary bodies, *corpora mamillaria*; сосцевидные тела.

16. Tuber cinereum, *tuber cinereum*; серый бугор.

17. Infundibulum, *infundibulum*; воронка.

18. Hypophisis, *hypophisis*; гипофиз.

19. Optic chiasma, *chiasma opticus*; зрительный перекрест.

20. Optic tract, *tractus opticus*; зрительный тракт.

21. Lamina terminalis, *lamina terminalis*; пограничная пластинка.

22. III ventricle, *ventriculus tertius*; третий желудочек.

23. Fornix, *fornix*; свод.

24. Column of fornix, *columnae fornicis*; столбы свода.

25. Anterior cerebral comissure, *comissura cerebri anterior*; передняя спайка мозга.

26. Posterior cerebral comissure, *comissura cerebri posterior*; задняя спайка мозга.

27. Choroid plexus, *plexus choroideus*; сосудистое сплетение.

28. Intervenricular opening, *foramen interventriculare*; межжелудочковое отверстие.

29. Choroid tela, *tela choroidea*; сосудистая основа.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

3. *Sapin, M. R.* Textbook of human anatomy for medical students. Vol. 2 / L. L. Kolesnikov, D. B. Nikitjuk, M. R. Sapin. — 2nd ed. — Moscow : New Wave Publishing Agency, 2019. — 480 p.

4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 6

## CEREBRUM: CORTEX RELIEF (SULCI, GYRI). MORPHOLOGICAL BASES OF THE DYNAMIC LOCALIZATION OF THE FUNCTIONS IN THE CEREBRAL CORTEX. THE RHINENCEPHALON

### INTRODUCTION TO THE TOPIC

In case of the diseases of the central nervous system or the brain trauma, a doctor locates the affected area of the cerebral cortex, choosing the place of surgical intervention.

To make a correct diagnosis and to choose a correct surgical and conservative treatment a doctor should know the anatomy of the cerebral hemispheres: sulci, gyri and localization of functions.

**Before the study of the topic you should know:**

The general structure of the white and grey matter of CNS.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the names in English and Latin of all formations of the cerebral cortex: fissure, grooves, lobes, gyri, olfactory brain structures, cortical centers;
- the functional significance of the cortical centers;
- be able to show anatomical formations on a preparation.

### TOPIC CONTENT

<u>The structure of the cerebral cortex.</u>

- The division of the brain hemispheres by grooves (sulcus lateralis, centralis, occipitoparietalis) into lobes (lobus frontalis, occipitalis, temporalis, parietalis, insula).
- Grooves of the brain lobes:

◦ lobus frontalis (sulcus precentralis, olfactorius, frontalis superior, frontalis inferior);

◦ lobus temporalis (sulcus temporalis superior, temporalis inferior, hippocampalis, occipitoparietalis, collateralis);

◦ lobus occipitalis (sulcus calcarinus, occipitalis transversus);

◦ lobus parietalis (sulcus postcentralis, intraparietalis).

- Gyri of the brain lobes:

◦ lobus frontalis (gyrus precentral, frontalis superior, frontalis mediud, frontalis inferior);

◦ lobus occipitalis (cuneus);

◦ lobus parietalis (gyrus postcentralis, lobules parietalis superior, lobules parietalis inferior (gyrus supramarginalis, gyrus angularis));

◦ lobus temporalis (gyrus temporalis superior, temporalis medius, temporalis inferior, gyrus occipitotemporalis medialis and lateralis on the lower surface);

◦ facies medialis of the brain cortex (lobules paracentralis, precuneus, gyrus fornicates (includes gyrus cinguli, isthmus, gyrus parahippocampalis, uncus).

- The concept of the cortical end of the analyzer.
- The concept of the primary zone of the cerebral cortex, the nucleus of the analyzer.
- The concept of the secondary and tertiary zones of the cerebral cortex,
- Localization of the lobus frontalis cortical centers (motor analyzer nucleus, analyzers of impulses coming from internal organs, center of singing, analyzers of combined rotation of the head and eyes in the direction opposite to the source of excitation in the cortex, motor analyzer of written speech (center of writing), analyzers of social behavior, motor analyzer of speech articulation (Broca's area)).
- Localization of analyzer nuclei in the parietal lobe (nucleus of the of general sensitivity analyzer, analyzer of impulses coming from internal organs, analyzer of stereognosis — cutaneous spatial sensitivity, visual analyzer of written speech (center of reading), center of praxis).
- Localization of the lobus temporalis cortical centers (nuclei of the auditory analyzer, analyzer of impulses coming from the statokinetic apparatus, sensory analyzer of oral speech (Wernicke's area)).
- Localization of the analyzer nuclei in the occipital lobe (nuclei of the visual analyzer, visual memory analyzer).
- Localization of the olfactory analyzer centers.
- Development of the olfactory brain:

◦ peripheral part of the human olfactory brain (olfactory bulb, tract and triangle, anterior perforated substance);

◦ the central part of the human olfactory brain (parahippocampal gyrus, dentate gyrus, fornicate gyrus with uncus).

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. What lobes are located in the cerebral hemispheres?
2. What grooves separate the lobes of the brain from each other?
3. Name the grooves in the frontal lobe.
4. Name the grooves in the parietal lobe.
5. Name the grooves in the temporal lobe.
6. Name the grooves in the occipital lobe.
7. Name the gyri of the frontal lobe.
8. Name the gyri of the parietal lobe.
9. Name the gyri of the temporal lobe.
10. Name the gyri of the occipital lobe.
11. Describe the relief of the medial surface of the hemisphere.
12. Describe the relief of the inferior surface of the hemisphere.
13. Name the components of the fornicate gyrus. What is its function?

14. What is the analyzer nucleus?
15. What are the primary, secondary, tertiary zones in the cerebral cortex, and what function do they perform?
16. The nuclei of which analyzers are localized in the frontal lobe?
17. The nuclei of which analyzers are localized in the parietal lobe?
18. The nuclei of which analyzers are localized in the temporal lobe?
19. The nuclei of which analyzers are localized in the occipital lobe?
20. Describe the symptoms in damage to the cortical areas.
21. What structures belong to the rhinencephalon?
22. What formations does the peripheral part of the olfactory brain include?
23. What formations does the olfactory brain include?

**Written task:**

Draw the diagram of the brain hemispheria and indicate the localization of functions in the cortex.

## PRACTICAL SKILLS

1. Superolateral surface of cerebral hemisphere, *facies superolateralis hemispherii cerebri*; верхнелатеральная поверхность полушарий головного мозга.
2. Medial surface of cerebral hemisphere, *facies medialis hemispherii cerebri*; медиальная поверхность полушарий головного мозга.
3. Inferior surface of cerebral hemisphere, *facies inferior hemispherii cerebri*; нижняя поверхность полушарий головного мозга.
4. Lateral sulcus, *sulcus lateralis*; латеральная борозда.
5. Central sulcus, *sulcus centralis*; центральная борозда.
6. Frontal lobe, *lobus frontalis*; лобная доля.
7. Parietal lobe, *lobus parietalis*; теменная доля.
8. Occipital lobe, *lobus occipitalis*; затылочная доля.
9. Temporal lobe, *lobus temporalis*; височная доля.
10. Insula, *insula*; островок.
11. Precentral sulcus, *sulcus precentralis*; предцентральная борозда.
12. Superior frontal sulcus, *sulcus frontalis superior*; верхняя лобная борозда.
13. Inferior frontal sulcus, *sulcus frontalis inferior*; нижняя лобная борозда.
14. Precentral gyrus, *gyrus precentralis*; предцентральная извилина.
15. Superior frontal gyrus, *gyrus frontalis superior*; верхняя лобная извилина.
16. Middle frontal gyrus, *gyrus frontalis medius*; средняя лобная извилина.

17. Inferior frontal gyrus, *gyrus frontalis inferior*; нижняя лобная извилина.

18. Postcentral sulcus, *sulcus postcentralis*; постцентральная борозда.

19. Intraparietal sulcus, *sulcus intraparietalis*; внутритеменная борозда.

20. Postcentral gyrus, *gyrus postcentralis*; постцентральная извилина.

21. Superior parietal lobule, *lobulus parietalis superior*; верхняя теменная долька.

22. Inferior parietal lobule, *lobulus parietalis inferior*; нижняя теменная долька.

23. Supramarginal gyrus, *gyrus supramarginalis*; надкраевая извилина.

24. Angular gyrus, *gyrus angularis*; угловая извилина.

25. Superior temporal sulcus, *sulcus temporalis superior*; верхняя виочная борозда.

26. Inferior temporal sulcus, *sulcus temporalis inferior*; нижняя височная борозда

27. Superior temporal gyrus, *gyrus temporalis superior*; верхняя височная извилина.

28. Middle temporal gyrus, *gyrus temporalis medius*; средняя височная извилина.

29. Inferior temporal gyrus, *gyrus temporalis inferior*; нижняя височная извилина.

30. Sulcus of corpus callosum, *sulcus corporis callosi*; борозда мозолистого тела.

31. Hippocampal sulcus, *sulcus hippocampi*; гиппокампальная борозда.

32. Cingulate sulcus, *sulcus cinguli*; поясная борозда.

33. Parietoocipital sulcus, *sulcus parietooccipitalis*; теменно-затылочная борозда.

34. Calcarine sulcus, *sulcus calcarinus*; шпорная борозда.

35. Paracentral lobule, *lobulus paracentralis*; парацентральная долька.

36. Precuneus, *precuneus*; предклинье.

37. Cuneus, *cuneus*; клин.

38. Cingulate gyrus, *gyrus cinguli*; поясная извилина.

39. Isthmus of cingulate gyrus, *isthmus gyri cinguli*; перешеек поясной извилины.

40. Parahippocampal gyrus, *gyrus parahippocampalis*; парагиппокампальная извилина.

41. Fornicate gyrus, *gyrus fornicatus*; сводчатая извилина.

42. Olfactory sulcus, *sulcus olfactorius*; обонятельная борода.

43. Straight gyrus, *gyrus rectus*; прямая извилина.

44. Orbital sulci, *sulci orbitales*; глазничные борозды.

45. Orbital gyri, *gyri orbitales*; глазничные извилины.

46. Occipitotemporal sulcus, *sulcus occipitotemporalis*; затылочно-височная борозда.

47. Collateral sulcus, *sulcus collateralis*; коллатеральная борозда.

48. Rhinal sulcus, *sulcus rhinalis*; носовая борозда.

49. Lateral occipitotemporal gyrus, *gyrus occipitotemporalis lateralis*; латеральная затылочно-височная борозда.

50. Medial occipitotemporal gyrus, *gyrus occipitotemporalis medialis*; медиальная затылочно-височная борозда.

51. Lingual gyrus, *gyrus lingualis*; язычная извилина.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

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4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 7

## CEREBRUM: WHITE MATTER, LATERAL VENTRICLES, BASAL NUCLEI, INTERNAL CAPSULE. MENINGES OF THE BRAIN. CIRCULATION OF THE CEREBROSPINAL FLUID

### INTRODUCTION TO THE TOPIC

The active development of neurophysiology, neurosurgery, histology and the advances in the study of the brain ultrastructure allow doctors to diagnose and treat both morphological and functional changes in central nervous system (brain tumors, psychoses, cortical strokes, etc.). All this requires a good knowledge of the telencephalon anatomy.

The cerebral meninges contribute to the normal functioning of the brain. They create a mechanical barrier for the brain and perform a trophic function, providing the constancy of the brain`s internal environment. The circulation of blood and cerebrospinal fluid depends on the state of the cerebral meninges.

The meninges are often involved in cerebral pathological processes. So to understand pathogenesis of cerebral diseases, to make correct diagnosis and to choose proper treatment it is important to know the structure of the cerebral meninges and circulation of the cerebrospinal fluid.

**Before the study of the topic you should know:**

1. The cerebral lobes, gyri and grooves.
2. Location and communication of the cerebral ventricles.
3. Names and location of the grooves for the sinuses on the skull bones.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- the names in English and Latin of all formations of the cerebral hemispheria: lateral ventricles, basal ganglia, white matter;

• know the anatomy of the cerebral meninges and intemeningeal spaces, venous sinuses, cisterns, subarachnoid space; formation and outflow pathways of cerebrospinal fluid;

• must be able to show anatomical formations on a preparation.

## TOPIC CONTENT

• Formation of the walls of the lateral ventricles:

◦ anterior horn: septum pellucidum, head of the caudate nucleus, cover of the corpus callosum;

◦ central part: corpus callosum, body of the caudate nucleus and part of the superior surface of the thalamus;

◦ inferior horn: hippocampus, hippocampal fimbria, collateral eminence, tapetum, tail of the caudate nucleus;

◦ posterior horn: tapetum, calcar avis.

• Location of the caudate nucleus, lentiform nucleus, amygdaloid nucleus, claustrum.

• Formation of internal, external, extreme capsules.

• The white matter of the cerebral hemispheres: associative, commissural and projection fibers. Associative fibers connect neighboring gyri and lobes of the same hemisphere, commissural fibers connect symmetrical parts of both hemispheres, and projection fibers connect the underlying structural formations of the central nervous system.

• Anatomy of the limbic system and its function.

• Anatomy of the brain meninges:

◦ dura mater, arachnoid, pia mater;

◦ processes of dura mater: falx cerebri, tentorium cerebelli, diaphragma sellae, falx cerebelli;

◦ dural venous sinuses: sinus sagittalis superior, sinus sagittal inferior, sinus rectus, confluens sinuum, sinus transversus, sinus occipitalis, sunus cavernosus dexter et sinister, sinus intercavernous anterior et posterior, sinus sigmoidus, sinus petrosus superior et inferior, sinus sphenoparietalis;

◦ spatuim subdurale;

◦ spatium subarachnoidale (cisterna cerebellomedullaris, cisterna interpeduncularis, cisterna chiasmatis, cisterna fossae lateralis).

• Circulation of the cerebrospinal fluid (CSF): CSF is produced by the choroid plexuses of the cerebral ventricles → lateral ventricles → interventricular foramina → third ventricle → cerebral aqueduct → fourth ventricle → median and lateral apertures → fourth ventricle → subarachnoid space → Pachionian granulations → dural venous sinuses.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. What cavity is in the telencephalon?
2. Describe the lateral ventricles parts and their localization.
3. Describe the borderlines of the cornu anterius ventriculi laterais.
4. Describe the borderlines of the cornu inferius ventriculi laterais.
5. Describe the borderlines of the cornu posterius ventriculi laterais.
6. Describe the borderlines of the pars centralis ventriculi laterais.
7. What communications of the lateral ventricles do you know?
8. List the types of the hemispheria white matter fibers.
9. Enumerate the subcortical basal nuclei.
10. What parts does the corpus striatum consist of?
11. What basal ganglia is the internal capsule bounded by?
12. What do we call the striopallidar system?
13. Describe the structure of the caudate nucleus.
14. Name the components of the lentiform nucleus.

15. Enumerate the limbic system structures and describe their function.

16. Give the definition of the association fibers of the hemispheria.

17. Give the definition of the commissural nerve fibers of the hemispheria.

18. Describe the fascicles of the association and commissural fibers, their direction and function.

19. Describe the fornix: position, parts, functions.

20. Give the definition of the projection fibers of the hemispheria.

21. Describe the location and borderlines of the internal, external and extreme capsules.

22. Explain the significance of the capsula interna. What segments do you know?

23. What meninges of the brain do you know?

24. What sinuses of the dura mater of the brain do you know?

25. Describe how venous blood passes through the sinuses (the direction of the blood flow and connections between sinuses).

26. Where does the venous blood of sinuses flow out?

27. What processes of the dura mater do you know?

28. What is the role and significance of the venous sinuses of the dura mater?

29. Describe the arachnoid granulations function.

30. Show and name the cisterns of the subarachnoid space.

31. What intemeningeal spaces do you know?

32. Explain the pathways of cerebral fluid outflow.

33. What is the function of the cerebrospinal fluid?

34. Where is the cerebrospinal fluid produced?

35. What are the differences between the meninges of the spinal cord and brain?

## PRACTICAL SKILLS

1. Caudate nucleus, *nucleus caudatus*; хвостатое ядро.

2. Lentiform nucleus, *nucleus lentiformis*; чечевицеобразное ядро.

3. Putamen, *putamen*; скорлупа.

4. Globus pallidus, *globus pallidus*; бледный шар.

5. Claustrum, *claustrum*; ограда.

6. Corpus amigdaloideum, *corpus amigdaloideum*; миндалевидное ядро.

7. Internal capsule, *capsula interna*; внутренняя капсула.

8. Genu of internal capsule, *genu capsulae internae*; колено внутренней капсулы.

9. Anterior limb of internal capsule, *crus anterius*; передняя ножка.

10. Posterior limb of internal capsule, *crus posterius*; задняя ножка.

11. External capsule, *capsula externa*; наружная капсула.

12. Extreme capsule, *capsula extrema*; самая наружная капсула.

13. Anterior cerebral commissure, *commissura cerebri anterior*; передняя мозговая спайка.

14. Posterior cerebral commissure, *commissura cerebri posterior*; задняя мозговая спайка.

15. Habenular commissure, *commissura habenularum*; спайка поводков.

16. Interthalamic adhesion, *adhesion interthalamica*; межталамическое сращение.

17. Lateral ventricles, *ventriculi laterales*; боковые желудочки.

18. Central part, *pars centralis*; центральная часть.

19. Anterior horns, *cornua anteriores*; передние рога.

20. Posterior horns, *cornua posteriores*; задние рога.

21. Inferior horns, *cornua inferiores*; нижние рога.

22. Choroid plexus, *plexus choroideus*; сосудистое сплетение.

23. Septum pellucudum, *septum pellucudum*; прозрачная перегородка.

24. Collateral eminence, *eminentia collateralis*; коллатеральное возвышение.

25. Calcarine spur, *calcar avis*; птичья шпора.

26. Hippocampus, *hippocampus*; гиппокамп.

27. Corpus callosum, *corpus callosum*; мозолистое тело.

28. Rostrum, *rostrum corporis callosi*; клюв мозолистого тела.

29. Genu, *genu corporis callosi*; колено мозолистого тела.

30. Trunk, *truncus corporis callosi*; ствол мозолистого тела.

31. Splenium, *splenium corporis callosi*; валик мозолистого тела.

32. Fornix, *fornix*; свод.

33. Columns, *columnae fornicis*; столбы свода.

34. Body, *corpus fornicis*; тело свода.

35. Crura, *crura fornicis*; ножки свода.

36. Comissure, *comissura fornicis*; спайка свода.

37. Dura mater, *dura mater encephali*; твёрдая оболочка головного мозга.

38. Pia mater, *pia mater encephali*; мягкая оболочка головного мозга.

39. Falx cerebri, *falx cerebri*; серп мозга.

40. Tentorium cerebelli, *tentorium cerebelli*; намёт можечка.

41. Falx cerebelli, *falx cerebelli*; серп мозжечка.

42. Sellar diaphragm, *diaphragma sellae*; диафрагма седла.

43. Transverse sinus, *sinus transversus*; поперечный синус.

44. Superior sagittal sinus, *sinus sagittalis superior*; верхний сагиттальный синус.

45. Occipital sinus, *sinus occipitalis*; зытылочный синус.

46. Straight sinus, *sinus rectus*; прямой синус.

47. Confluence of sinuses, *confluens sinuum*; сток синусов.

48. Cavernous sinus, *sinus cavernosus*; пещеристый синус.

49. Intercavernous sinus, *sinus intercavernosus*; межпещеристый синус.

50. Superior petrosal sinus, *sinus petrosus superior*; верхний каменистый синус.

51. Inferior petrosal sinus, *sinus petrosus inferior*; нижний каменистый синус.

52. Basilar plexus, *plexus basilaris*; базилярное сплетение.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

3. *Sapin, M. R.* Textbook of human anatomy for medical students. Vol. 2 / L. L. Kolesnikov, D. B. Nikitjuk, M. R. Sapin. — 2nd ed. — Moscow : New Wave Publishing Agency, 2019. — 480 p.

4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 8

## OVERVIEW OF THE CONDUCTING TRACTS OF THE BRAIN AND SPINAL CORD (ASCENDING AND DESCENDING TRACTS)

### INTRODUCTION TO THE TOPIC

One of the severe complications of the central nervous system injuries is the discoordination of both motor and sensory body functions. To know the anatomy of conduction tracts is necessary for the diagnostics and proper treatment.

In clinical practice the diseases and injuries of the brain and spinal cord are often observed; they may be accompanied by paresis and paralysis of skeletal muscles of the trunk and head, by disorders of the balance and coordination of movements. To diagnose correctly, to understand the pathophysiological mechanisms and to treat properly, a doctor needs to know the anatomy of the descending conduction tracts arising from the cerebral cortex and from the parts of the extrapyramidal system.

**Before the study of the topic you should know:**

1. Three — member somatic reflex arch.
2. The grey and white matter organization of the CNS (spinal cord, brainstem, cerebellum, large hemispheres).
3. The cortical centers.

### SELF-STUDY GOALS

After independently studying the topic, the student should know the following:

- afferent pathways of exteroceptive (tactile, temperature, pain, skin spatial) and proprioceptive sensitivity;
- the location of neurons in the pyramidal tract;
- motor nuclei of the cranial nerves, their locations in the brainstem, the course of fibres of the lateral and anterior pyramidal tracts, elements of the extrapyramidal system, the course of the extrapyramidal tracts;
- must be able to show on brain preparations, tables the course of the ascending and descending pathways, the location of the neurons of these tracts.

## TOPIC CONTENT

• Topographo-anatomical location of the afferent pathways neurons bodies; terminology according to the textbook and demonstration preparations: 1) spinal ganglion; 2) location of the cornu posterius nuclei of the spinal cord; 3) the lateral and posterior funiculus of the spinal cord, the place of passage of the axons of the 1st and 2nd neurons of the afferent pathways; 4) medulla oblongata: fasciculus gracilis, fasciculus cuneatus, their nuclei; the formation of the lemniscus medialis; 5) medulla oblongata: position of the cranial nerve nuclei; 6) pedunculus cerebellaris superior, pedunculus cerebellaris inferior, their formation; 7) nuclei of the cerebellum; 8) velum medullare superior, velum medullare interior; 9) thalamus: groups of nuclei; 10) internal capsule: segments; 11) cortex cerebri: location of cortical centers.

• Tractus corticospinalis lateralis, tractus corticospinalis anterior (lateral and anterior pyramidal tracts). The 1st neuron is in the frontal lobe ($5^{th}$ layer of the precentral gyrus cortex). The course of the fibers of this path through the internal capsule, cerebral peduncles, pons, medulla oblongata. Place of desussation: border of the medulla oblongata and spinal cord). $2^{nd}$ neurons are in the anterior horns of the spinal cord. Effector — muscle. Function of the pyramidal tract.

• Tractus corticonuclearis. The 1st neuron is in the frontal lobe (5th layer of the lower third of the precentral gyrus). The course of the fibers of this path through the internal capsule, cerebral peduncles, pons, medulla oblongata. 2nd neurons are in the motor nuclei of the cranial nerves. Effector — muscle.

• Subcortical nuclei forming the extrapyramidal system, their locations in the brain.

• The course of fibers and the function of extrapyramidal tracts (rubrospinal, tectospinal, vestibulospinal, olivospinal, reticulospinal tract).

• Locations of neuron cell bodies of the cerebellorubrospinal tract. The points of decussation of this tracts. The function of this tract.

• Locations of neuron bodies of the corticopontocerebellar tract. The points of decussation of this tracts. The function of this tract.

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details in a table and a diagram |

*The end of Table*

| Activity | Step Description |
|---|---|
| Describe the material you have studied, showing anatomical details on a specimen | I. While describing the ascending tract, use the following plan:<br>1) English and Latin names of the name of the tract;<br>2) the function of the tract;<br>3) the beginning of tract;<br>4) the number and location of neurons;<br>5) the level of the decussation of tract fibers (if the tract has a decussation);<br>6) position of tract fibers in the spinal cord;<br>7) position of tract fibers in the medulla oblongata, pons, midbrain and other parts of the brain;<br>8) the end of tract.<br><br>II. While describing the descending tract, use the following plan:<br>1) English and Latin names of the name of the tract;<br>2) the function of the tract;<br>3) the beginning of tract;<br>4) the number and location of neurons;<br>5) the level of the decussation of tract fibers;<br>6) position of tract fibers in the midbrain, pons, medulla oblongata;<br>7) position of tract fibers in the spinal cord;<br>8) the end of tract |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR SELF-CONTROL

1. Where are the bodies of the first neurons located in all ascending tracts?
2. Where are the second neurons of the ascending tracts located?
3. Where are the third neurons of the ascending conduction tracts located?

4. Where is the beginning of the ascending conduction tracts?
5. What main groups the afferent tracts do you know?
6. What is the topography of the exteroceptive sensory tracts?
7. What is the topography of the cortical proprioceptive sensory tracts?
8. Where does the cortical end of the tactile sensitivity pathway lie?
9. Where does the cortical end of spatial general sensitivity lie?
10. Where is the cortical end of temperature and pain sensitivity located?
11. Where is the cortical end of proprioceptive sensitivity located?
12. Describe the spinocerebellar tracts.
13. Give the definition of the efferent conduction tracts.
14. What is the function of the efferent conduction tracts?
15. What types of efferent tracts, according to the function, do you know?
16. Where are the cell bodies of pyramidal tract neurons located?
17. What are the signs of damage to the pyramidal tract above its decussation?
18. What are the signs of damage to the pyramidal tract below its decussation?
19. What structures does the extrapyramidal system consist of?
20. How do the pathways of the extrapyramidal system differ from the pathways of the pyramidal system?
21. List and characterize all the extrapyramidal tracts.
22. Describe the cerebellorubrospinal tract.
23. Describe the corticopontocerebellar tract.
24. Where is the end of the descending conduction tracts?

## PRACTICAL SKILLS

1. Gangliospinothalamocortical tract, *tractus gangliospinothalamocorticalis*; ганглио-спинно-таламо-корковый путь.
2. Ganglionucleothalamocortical tract, *tractus ganglionucleothalamocorticalis*; ганглио-ядерно-таламо-корковый путь.
3. Gangliobulbothalamocortical tract, *tractus gangliobulbothalamocorticalis*; ганглио-бульбарно-таламо-корковый путь.
4. Anterior spinocerebral tract, *tractus spinocerebellaris anterior*; передний спинно-мозжечковый путь.
5. Posterior spinocerebral tract, *tractus spinocerebellaris posterior*; задний спинно-мозжечковый путь.
6. Corticospinal tract, *tractus corticospinalis*; кортикоспинальный путь.
7. Corticonuclear tract, *tractus corticinuclearis*; кортиконуклеарный путь.
8. Tectospinal tract, *tractus tectospinalis*; тектоспинальный путь.

9. Cerebellorubrospinal tract, *tractus cerebellorubrospinalis*; мозжечково-красноядерно-спинномозговой путь.

10. Vestibulospinal tract, *tractus vestibulospinalis*; вестибулоспинальный путь.

11. Olivospinal tract, *tractus olivospinalis*; оливоспинальный путь.

12. Reticulospinal tract, *tractus reticulospinalis*; ретикулоспинальный путь.

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

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4. *Atlas* of Human Anatomy / Frank H. Netter. — 6th ed. — Philadelphia : Elsevier, 2014. — 531 p., ill.

5. *Lecture* material.

# Topic 9

## MAJOR CONTROL: CENTRAL NERVOUS SYSTEM

### INTRODUCTION TO THE TOPIC

This lesson provides a summary and review of the studied material in central nervous system, helping students to reinforce their understanding of key concepts.

### SELF-STUDY GOALS

After revising the topic material, the student:

- should be able to complete a major computer test on LMS;
- know the functions, external and internal structure, topography, of the spinal cord and brain;
- should be able to demonstrate all the studies CNS formations on the natural preparations, models, tables;
- should know the theoretical aspects of central nervous system development, variants and anomalies of development, etc.

### TOPIC CONTENT

*REVISE:*

- Peculiarities of the outer and inner structure of the spinal cord.
- Peculiarities of the outer and inner structure of the brainstem parts and the large hemispheria.
- Peculiarities of the brain ventricles, meninges and intermeningeal spaces, ways of outflow of cerebrospinal fluid.
- Ascending and descending tracts.
- Classification of neurons, nervous system (lecture material).
- Embryogenesis of the central nervous system.
- Developmental anomalies (lecture material).
- Latin terms (see the list of practical skills: Topic 1—8).

## METHODOLOGICAL RECOMMENDATIONS FOR STUDYING THE MATERIAL

| Activity | Step Description |
|---|---|
| Read the introduction to the topic | — |
| Study the corresponding section in literature sources | Studying the topic is accompanied by a demonstration of structural details on a table and diagram |
| Describe the material you have studied, showing anatomical details on a specimen | While describing the topic material, check the following:<br>1) English and Latin names of the of the central nervous system department;<br>2) source of development;<br>3) external structure — main components; characteristics of surfaces, grooves, convolutions, etc.;<br>4) internal structure — localization of nuclei, pathways, cavities;<br>5) functional characteristics of formations (sensory, motor, vegetative, mixed) |
| Revise the conduction system of the CNS | While describing ascending and descending tracts, use the plan of the tracts description:<br>1) latin name of the tract;<br>2) significance of the tract;<br>3) origination of the tract;<br>4) position and number of neurons;<br>5) place of the decussation;<br>6) position of tract fibers in the midbrain, pons, medulla oblongata;<br>7) position of tract fibers in the spinal cord;<br>8) the end of tract |
| Write down new Latin terms | Put down new Latin terms in your notebook (see the list of Practical skills) |
| Check your knowledge with self-control questions | Answer the questions given in the assignment |

## QUESTIONS FOR MAJOR PERIPHERAL NERVOUS SYSTEM

1. Describe the spinal cord beginning, end, location, segments, sulci, funiculi.
2. Describe the location and significance of the grey matter nuclei of the spinal cord.

3. Describe the elements of the spinal cord white matter.

4. Describe the 3-member simple reflex arch.

5. Give the classification of the brain parts. What cavities does each of the brain parts contain?

6. Describe the functions, external, internal structure of the medulla oblongata.

7. The pons: give the information about its functions, external, internal structure.

8. Cerebellum: give the information about its functions, external, internal structure.

9. The forth ventricle: superior, inferior walls, choroid plexus, communications.

10. Describe the rhomboid fossa relief, projection of cranial nerves nuclei onto the rhomboid fossa.

11. Describe the external, internal structure and functions of the mesencephalon.

12. Thalamus: give the information about its localization, functions, external, internal structure, nuclei.

13. Metathalamus: give the information about its localization, functions, external, internal structure.

14. Epithalamus: give the information about its localization, functions, external, internal structure.

15. Hypothalamus: give the information about its localization, functions, external, internal structure.

16. The third ventricle: describe its walls, communications.

17. Describe the sulci and gyri of the superolateral cortical surface.

18. Describe the sulci and gyri of the medial cortical surface.

19. Describe the sulci and gyri of the inferior cortical surface.

20. Describe the cortical areas (location and function).

21. Describe the basal nuclei of the telencephalon: names, location, function.

22. Describe the association white matter fasciculi of the telencephalon.

23. Describe the commissural white matter fibers of the telencephalon. Name the parts of the corpus callosum.

24. Describe the white matter capsules (internal, external, extreme).

25. Describe the lateral ventricles: their parts, location, walls, communication.

26. Describe the parts and significance of the olfactory brain (rhinencephalon).

27. Limbic system: give the information about its components, functions.

28. Extrapyramidal system: give the information about its components, functions.

29. Explain the special features of the spinal cord and brain meninges and intermeningeal spaces.

30. Enumerate the distinctions in between the brain and spinal cord meninges. Describe the location of sinuses and dura mater processes.

31. Give the information about process of the cerebrospinal fluid circulation (significance, volume, production, pathway, absorption,).

32. Give the full information about ascending tract of the exteroceptive sensation (Latin name of the tract; significance, origination, position and number of neurons, place of the decussation, position of tract fibers in the midbrain, pons, medulla oblongata, spinal cord, the end of tract).

33. Give the full information about ascending tract of the proprioceptive sensation (to the cerebellum and to the cerebral cortex) (Latin name of the tract; significance, origination, position and number of neurons, place of the decussation, position of tract fibers in the midbrain, pons, medulla oblongata, spinal cord, the end of tract).

34. Describe the pyramidal tracts (Latin name of the tract; significance, origination, position and number of neurons, place of the decussation, position of tract fibers in the midbrain, pons, medulla oblongata, spinal cord, the end of tract).

35. Describe the extrapyramidal tracts (Latin name of the tract; significance, origination, position and number of neurons, place of the decussation, position of tract fibers in the midbrain, pons, medulla oblongata, spinal cord, the end of tract).

## Literature


1. *Human* anatomy : 2 vol. / M. Prives, N. Lysenkov, V. Bushkovich. — Moscow : Mir Publishers, 1985. — Vol. 2. — 439 p., ill.

2. *Textbook* of Human Anatomy. In 3 vol. Vol. 3: Nervous system. Esthesiology / L. L. Kolesnikov, D. B. Nikitiuk, S. V. Klochkova, I. G. Stelnikova. — Moscow : GEOTAR-Media, 2018. — 216 p.

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5. *Lecture* material.

6. *List* of practical skills. Topic 1—8.

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Methodological recommendations for students of medicine

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