BOGOMOLETS NATIONAL MEDICAL UNIVERSITY

Department of human anatomy

**GUIDELINES**

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| *Academic discipline* | HUMAN ANATOMY |
| Module № | 2 |
| Content module № | 5 |
| The theme of the lesson | Introduction to CNS.<br>Anatomy of spinal cord |
| Course | I |
| The number of hours | 3 |

2017

## 1.The relevance of the topic:

The spinal cord carries out the following major functions:
Electrical communication. Electrical signals are conducted up and down the cord, allowing communication between different sections of the body and with the brain, since the cord runs through different levels of the trunk section.
Walking (also known as locomotion). During walking, several muscle groups in the legs are coordinated to contract over and over again. Although the act of putting one foot in front of the other while walking may seem simple to us, it has to be carefully coordinated by several groups of neurons known as central pattern generators in the spinal cord! These neurons send signals to the muscles in the legs, causing to the extend or contract, producing the alternating movements that are involved in walking.
Reflexes. These are predictable involuntary responses to stimuli that involve the brain, spinal cord and nerves of the peripheral nervous system (PNS).Reflexes are further discussed later in this article.

## 2.Specific objectives:

- to determinate the main objective laws of structure and function of spinal cord;
- to determinate and demonstrate the fissure local inlet exit root, sensory ganglion of spinal nerves of spinal cord;
- to determinate the structure of segment of spinal cord and skeletopy of segment of different parts;
- to determinate the morphological basis of reflex arch, which isolates through spinal cord.

**3.Basic level** of student includes the knowledge of medical biology about the main objective laws of activity of nervous system. The student must know characteristics of structure of vertebra, bones of neurocranium.

## 4. Tasks for independent work 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.

| Defined notion | Definition |
|---|---|
| neuron | The neuron is the basic unit of the nervous system. |
| gray matter | The gray matter is consisting of neuronal cell bodies. |
| white matter | The white matter refers to areas of the central nervous system that are mainly made up of myelinated axons. |

## 4.2.Theoretical questions for the lesson:

1. Discuss brain phylogeny basing on CNS features in: fish, amphibians, reptiles, mammals.
2. Receptor: classification and functional meaning.
3. Gray matter of CNS: structure and function.
4. White matter of CNS: structure and function.
5. The structure and function of nerve fibers, fascicles, roots and nerves.
6. Classification, localization and function of nerve ganglion.
7. The structure of simple and complex refkex arch.
8. Spinal cord: location,upper limit, lower limit.
9. To characterize and demonstrate the external structure on the preparation of spinal cord.
10. Where is the puncture of spinal fluid done? Anatomical interpretation.
11. Segments of spinal cord: definition, limits.
12. Parts of spinal cord and them segments.
13. The structure of spinal cord on the vertical section.
14. Which intumescences are there in spinal cord? What is the reasone for their appearance?
15. Cauda equina: topography, appearance.
16. Spinal nerve: appearance and branches.
17. Discuss the posterior roots of spinal cord:origin,functional significance.
18. Discuss the anterior roots of spinal cord:origin,functional significance.

## 4.3. The list of standart practical skills:

cervical enlargement
lumbosacral enlargement
medullary cone

terminal filament
anteromedian groove
posterior median sulcus
anterolateral groove
posterolateral groove
funiculus of spinal cord:
ventral funiculus
dorsal funiculus
lateral funiculus
central canal
gray matter ( anterior horn, posterior horn)
white matter

**The content of the topic**:

The nervous system consists of the brain, spinal cord, sensory organs, and all of the nerves that connect these organs with the rest of the body. Together, these organs are responsible for the control of the body and communication among its parts. The brain and spinal cord form the control center known as the central nervous system (CNS), where information is evaluated and decisions made.

**Nervous Tissue**

The majority of the nervous system is tissue made up of two classes of cells: neurons and neuroglia.

**Neurons**. Neurons, also known as nerve cells, communicate within the body by transmitting electrochemical signals. Neurons look quite different from other cells in the body due to the many long cellular processes that extend from their central cell body. The cell body is the roughly round part of a neuron that contains the nucleus, mitochondria, and most of the cellular organelles. Small tree-like structures called dendrites extend from the cell body to pick up stimuli from the environment, other neurons, or sensory receptor cells. Long transmitting processes called axons extend from the cell body to send signals onward to other neurons or effector cells in the body.

There are 3 basic classes of neurons: afferent neurons, efferent neurons, and interneurons.

*Afferent neurons*. Also known as sensory neurons, afferent neurons transmit sensory signals to the central nervous system from receptors in the body.

*Efferent neurons*. Also known as motor neurons, efferent neurons transmit signals from the central nervous system to effectors in the body such as muscles and glands.

*Interneurons*. Interneurons form complex networks within the central nervous system to integrate the information received from afferent neurons and to direct the function of the body through efferent neurons.

Neuroglia. Neuroglia, also known as glial cells, act as the "helper" cells of the nervous system. Each neuron in the body is surrounded by anywhere from 6 to 60 neuroglia that protect, feed, and insulate the neuron. Because neurons are extremely specialized cells that are essential to body function and almost never reproduce, neuroglia are vital to maintaining a functional nervous system.

Nerves

Nerves are bundles of axons in the peripheral nervous system (PNS) that act as information highways to carry signals between the brain and spinal cord and the rest of the body. Each axon is wrapped in a connective tissue sheath called the endoneurium. Individual axons of the nerve are bundled into groups of axons called fascicles, wrapped in a sheath of connective tissue called the perineurium. Finally, many fascicles are wrapped together in another layer of

connective tissue called the epineurium to form a whole nerve. The wrapping of nerves with connective tissue helps to protect the axons and to increase the speed of their communication within the body.

*Afferent, Efferent, and Mixed Nerves*. Some of the nerves in the body are specialized for carrying information in only one direction, similar to a one-way street. Nerves that carry information from sensory receptors to the central nervous system only are called afferent nerves. Other neurons, known as efferent nerves, carry signals only from the central nervous system to effectors such as muscles and glands. Finally, some nerves are mixed nerves that contain both afferent and efferent axons. Mixed nerves function like 2-way streets where afferent axons act as lanes heading toward the central nervous system and efferent axons act as lanes heading away from the central nervous system.

The spinal cord is divided into four different regions: the cervical, thoracic, lumbar and sacral regions (Figure 3.1). The different cord regions can be visually distinguished from one another. Two enlargements of the spinal cord can be visualized: The cervical enlargement, which extends between C3 to T1; and the lumbar enlargements which extends between L1 to S2.

The cord is segmentally organized. There are 31 segments, defined by 31 pairs of nerves exiting the cord. These nerves are divided into 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal nerve. Dorsal and ventral roots enter and leave the vertebral column respectively through intervertebral foramen at the vertebral segments corresponding to the spinal segment. During the initial third month of embryonic development, the spinal cord extends the entire length of the vertebral canal and both grow at about the same rate. As development continues, the body and the vertebral column continue to grow at a much greater rate than the spinal cord proper. This results in displacement of the lower parts of the spinal cord with relation to the vertebrae column. The outcome of this uneven growth is that the adult spinal cord extends to the level of the first or second lumbar vertebrae, and the nerves grow to exit through the same intervertebral foramina as they did during embryonic development. This growth of the nerve roots occurring within the vertebral canal, results in the lumbar, sacral, and coccygeal roots extending to their appropriate vertebral levels.

A transverse section of the adult spinal cord shows white matter in the periphery, gray matter inside, and a tiny central canal filled with CSF at its center. Surrounding the canal is a single layer of cells, the ependymal layer. Surrounding the ependymal layer is the gray matter – a region containing cell bodies – shaped like the letter “H” or a “butterfly”. The two “wings” of the butterfly are connected across the midline by the dorsal gray commissure and below the white commissure. The shape and size of the gray matter varies according to spinal cord level. At the lower levels, the ratio between gray matter and white matter is greater than in higher levels, mainly because lower levels contain less ascending and descending nerve fibers.

**Introduction to CNS. Anatomy of spinal cord.**

**1**. It was necessary to get spinal fluid from 45-years old patient with suspision of inflommation of brain tunics. Exploratory puncture between arch of lumbar vertebra (L3-L4) was done. Which ligament should needle penetrate during the puncture?
**A.** iliolumbar ligament
**B.** ligamentum flavum
**C.** anterior longitudinal ligament
**D.** posterior longitudinal ligament
**E.** intertransverse ligament

**2.** Central part of efferent part of sympatic part of autonomic nervous system was interrupt as the result neoplastic process.Where is pathological process located?
**A.** peritoneum.
**B.** white pulp.
**C.** fibrous capsule.
**D.** red pulp.
**E.** smooth muscle.

**3.** A 54-years old patient has got trauma of nucleus proprius of posterior horns of spinal cord. What type of sensibility will not be noticed?
**A**. temperature and algesic
**B.** tactile
**C.** stereognosis
**D.** vibrotional
**E.** proprioceptive

**4.** A patient has got involuntary movement and disturbances of tonus of muscles of trunk. Which conduction tract was interrupt?
**A.** Tractus tectospinalis.
**B.** Tractus corticospinalis.
**C.** Tractus corticonuclearis.
**D.** Tractus spinothalamicus lateralis.
**E.** Tractus rubrospinalis

**5.** Differential diagnostics of spinal fluid is performed in order to to diagnose meningitis. Where is it safe to perform puncture?
**A.** Th XII — L I. **B.** L II — L III. **C.** L I — L II. **D.** L III — L IV. **E.** S II — S IV.

**6.** 34- years old man with spinal cord ingury was taken to the hospital. X-ray showed fracture of 11 thracic vertebra. What segment of spinal cord was injured?
**A.** 11 thoracic
**B.** 9 thoracic
**C.** 10 thoracic
**D.** 2-3 lumbar
**E.** 12 thoracic

**7.** A patient is unable to influencemuscle contraction after the injury of cervical part of column vertebra. What conduction trakt is responsible for innervation of skeletal muscle?
**A.** Tr. rubrospinalis.
**B.** Tr. corticospinalis anterior et lateralis.
**C.** Tr. olivospinalis.
**D.** Tr. bulbothalamicus.
**E.** Tr. reticulospinalis.

**8.**Gray matter was injured as a result of constriction with tumor . Which nucleus is in posterior horn of spinal cord?
**A.** Nucl. ambiguus.
**B.** Nucl. proprius.
**C.** Nucl. centralis.

**D.** Nucl. anterolateralis.
**E.** Nucl. spinalis
**9.** A patient lost ability to react to noxious thermal stimulus as a result of tumor growth in lateral funiculus of spinal cord. Which conduction trakt is responsible for conduction of noxious impulse?
**A.** Fasciculus gracilis.
**B.** Tr. spinothalamicus anterior.
**C.** Tr. spinothalamicus lateralis.
**D.** Tr. spinocerebellaris posterior.
**E.** Tr. tectospinalis**.**

**10.** A man got injured in a car accident which resulted in injure of posterior columns of gray matter of spinal cord. Which function interrupted?
**A.** noxious thermal stimulus
**B.** concious proprioceptive sensibility
**C.** subconcious proprioceptive sensibility
**D.** auditory sensitivity
**E.** visual sensitivity

## ANSWERS:

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