

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY
DEPARTMENT OF HUMAN ANATOMY

Guidelines

<i>Academic discipline</i>	HUMAN ANATOMY
<i>Module N^o</i>	3
<i>Content module N^o</i>	14
<i>Topic of the lesson</i>	X, XI, XII pairs of cranial nerves
<i>Course</i>	1
<i>The number of hours</i>	3

1. The relevance of the topic:

N. accessorius and n. hypoglossus are homologs of the anterior roots of spinal nerves. Knowledge of aspects of innervations of the oral cavity necessary for the production topical diagnosis in future clinical practice.

N. vagus is a derivative of the fourth and subsequent branchial arches, it innervates the neck, respiratory organs, most organs of the digestive system (up to sigmoid colon), and also gives branches to the heart, slowing the heart rate and giving the total parasympathetic effect on the organs and systems of the body.

This knowledge is necessary for further study of anatomy and teaching on other departments (theoretical and clinical).

2. Specific objectives:

1.1. Describe and demonstrate the localization of the branches of the vagus nerve, accessory and hypoglossal nerves and their relation to anatomical organs of the head and neck.

1.2. Determine the function of nuclei of the vagus nerve, accessory and hypoglossal nerves.

1.3. Be able to determine the fiber composition X, XI, XII pairs of cranial nerves.

1.5. Be able to explain the sensitive nodes of the vagus nerve.

1.6. Be able to demonstrate, where do the accessory and vagus nerves comes out from the cranium.

1.7. Be able to determine the participation of the vagus nerve in the formation of nerve plexus.

1.8. What areas are innervated by accessory nerve?

1.9. What areas are innervated by hypoglossal nerve?

3. Basic level of student's knowledge include knowledge from histology about development of the cranial nerves and features of innervation of these nerves to various parts of the body.

3.1. Demonstrate internal and external base of the cranium.

3.2. Describe and demonstrate the structure of the cervical part of the spinal cord.

3.3. Determine and demonstrate muscles of head and neck.

3.4. Describe and demonstrate the localization of the cranial nerve nuclei in the brain stem and their projection.

3.5. Explain the structure of the human brain stem.

3.6. Demonstrate the place of the passage IX, X, XI, XII pairs of cranial nerves and their branches.

The name of the nerve	Fiber composition	exit from the cranium
n.glossopharyngeus	Mixed	foramen jugulare
n.vagus	Mixed	foramen jugulare
n.accessorius	Motor	foramen jugulare
n.hypoglossus	Motor	canalis nervi hypoglossi

4. Task for independent during preparation to practical classes

4.1. Theoretical questions for the lesson

1. Name 12 pairs of cranial nerves.
2. Classification of cranial nerves according to fiber composition.
3. Classification of cranial nerves according to their origins.
4. Anatomical differences between cranial and spinal nerves.
5. General structural plan of motor cranial nerves.
6. General plan of the structure sensitive (real) cranial nerves.
7. General plan of the structure mixed cranial nerves.
8. Anatomical differences between structure of sensitive cranial nerves and real sensitive cranial nerves.

4.2. Questions for controlling final level of preparation

1. Name sensitive nodules of X pair of cranial nerves, determine their localization and functions.
2. Name motor nucleus n. vagus and branches of else cranial nerves with which they go to the internal organs.
3. Where are located vegetative nodules, which innervate n.dorsalis n. vagi?
4. Name cardiac branches of vagus nerve.
5. Determine the localization of the thoracic part of the vagus nerve.
6. Which organs are innervated by abdominal part of the vagus nerve.
7. Fiber of which nerves leaving the brain behind the olive?
8. Name peripheral processes of the top node of the vagus nerve.
9. How does the vagus nerve enters the abdominal cavity?
10. Which fibers forms vagus nerve in abdominal cavity.
11. Name nucleus of the accessory nerve and where its fibers comes out.
12. With which nerves and from where accessory nerve comes out from the cranium?
13. Which muscles are innervated by hypoglossal nerve?
14. Talk about branches of vagus nerve.
15. Demonstrate, where does the vagus nerve comes out from the brain and where it is located in cranial cavity.
16. Name sensitive nodules of vagus nerve and their localization.
17. Describe localization of the vagus nerve and name its parts.
18. Determine the fiber composition of the superior laryngeal nerve and the area of its innervation.
19. Determine the fiber composition of the pharyngeal branches of the vagus nerve and what they Innervate.
20. Name branches of the vagus nerve in the chest and determine the composition of its fibers.
21. Characterize the branches of the accessory and hypoglossal nerves.
22. Name nuclei hypoglossal nerve and their localization.

23. Demonstrate where the accessory and hypoglossal nerves come out from the cerebrum and their localization in cranial cavity.

4.3. The content of the topic:

The vagus nerve is the 10th cranial nerve (CN X). It is a functionally diverse nerve, offering many different modalities of innervation. Due to its widespread functions, pathology of the vagus nerve is implicated in a vast variety of clinical cases.

In this article we shall look at its anatomical course, motor, sensory and autonomic functions.

The vagus nerve is associated with the derivatives of the fourth pharyngeal arch.

Sensory: Innervates the skin of the external acoustic meatus and the internal surfaces of the laryngopharynx and larynx. Provides visceral sensation to the heart and abdominal viscera.

Special Sensory: Provides taste sensation to the epiglottis and root of the tongue.

Motor: Provides motor innervation to the majority of the muscles of the pharynx, soft palate and larynx.

Parasympathetic: Innervates the smooth muscle of the trachea, bronchi and gastro-intestinal tract and regulates heart rhythm.

The vagus nerve has the longest course of all the cranial nerves, extending from the head to the abdomen. Its name is derived from the Latin '*vagary*' – meaning wandering. It is sometimes referred to as the wandering nerve.

In the Head

The vagus nerve originates from the medulla of the brainstem. It exits the cranium via the **jugular foramen**, with the glossopharyngeal and accessory nerves (CN IX and XI respectively).

Within the cranium, the **auricular branch** arises. This supplies sensation to the posterior part of the external auditory and canal external ear.

In the Neck

In the neck, the vagus nerve passes into the carotid sheath, travelling inferiorly with the internal jugular vein and common carotid artery. At the base of the neck, the right and left nerves have differing pathways:

The **right vagus nerve** passes anterior to the subclavian artery and posterior to the sternoclavicular joint, entering the thorax.

The **left vagus nerve** passes inferiorly between the left common carotid and left subclavian arteries, posterior to the sternoclavicular joint, entering the thorax.

Several branches arise in the neck:

Pharyngeal branches – Provides motor innervation to the majority of the muscles of the pharynx and soft palate.

Superior laryngeal nerve – Splits into internal and external branches. The external laryngeal nerve innervates the cricothyroid muscle of the larynx. The internal laryngeal provides sensory innervation to the laryngopharynx and

superior part of the larynx.

Recurrent laryngeal nerve (right side only) – Hooks underneath the right subclavian artery, then ascends towards to the larynx. It innervates the majority of the intrinsic muscles of the larynx.

In the Thorax

In the thorax, the right vagus nerve forms the **posterior vagal trunk**, and the left forms the **anterior vagal trunk**. Branches from the vagal trunks contribute to the formation of the oesophageal plexus, which innervates the smooth muscle of the oesophagus.

Two other branches arise in the thorax:

- **Left recurrent laryngeal nerve** – it hooks under the arch of the aorta, ascending to innervate the majority of the intrinsic muscles of the larynx.
- **Cardiac branches** – these innervate regulate heart rate and provide visceral sensation to the organ.

The vagal trunks enter the abdomen via the oesophageal hiatus, an opening in the diaphragm.

In the Abdomen

In the abdomen, the vagal trunks terminate by dividing into branches that supply the oesophagus, stomach and the small and large bowel (up to the splenic flexure).

There are **somatic** and **visceral** components to the sensory function of the vagus nerve.

Somatic refers to sensation from the skin and muscles. This is provided by the auricular nerve, which innervates the skin of the posterior part of the external auditory canal and external ear.

Viscera sensation is that from the organs of the body. The vagus nerve innervates:

- **Laryngopharynx** – via the internal laryngeal nerve.
- Superior aspect of **larynx** (above vocal folds) – via the internal laryngeal nerve.
- **Heart** – via cardiac branches of the vagus nerve.
- **Gastro-intestinal tract** (up to the splenic flexure) – via the terminal branches of the vagus nerve.

The vagus nerve has a minor role in taste sensation. It carries afferent fibres from the **root of the tongue** and **epiglottis**.

(This is not to be confused with the special sensation of the glossopharyngeal nerve, which provides taste sensation for the posterior 1/3 of the tongue).

The vagus nerve innervates the majority of the muscles associated with the pharynx and larynx. These muscles are responsible for the initiation of swallowing and phonation.

Pharynx

Most of the muscles of the pharynx are innervated by the **pharyngeal branches** of the vagus nerve:

- Superior, middle and inferior pharyngeal constrictor muscles

- Palatopharyngeus
- Salpingopharyngeus

An additional muscle of the pharynx, the **stylopharyngeus**, is innervated by the glossopharyngeal nerve.

Larynx

Innervation to the intrinsic muscles of the larynx is achieved via the recurrent laryngeal nerve and external branch of the superior laryngeal nerve.

Recurrent laryngeal nerve:

- Thyro-arytenoid
- Posterior crico-arytenoid
- Lateral crico-arytenoid
- Transverse and oblique arytenoids
- Vocalis

External laryngeal nerve:

- Cricothyroid

Other Muscles

In addition to the pharynx and larynx, the vagus nerve also innervates the **palatoglossus** of the tongue, and the majority of the muscles of the **soft palate**.

Parasympathetic Functions

In the thorax and abdomen, the vagus nerve is the main parasympathetic outflow to the heart and gastro-intestinal organs.

The Heart

Cardiac branches arise in the thorax, conveying parasympathetic innervation to the sino-atrial and atrio-ventricular nodes of the heart (For more heart anatomy, see [here](#)).

These branches stimulate a reduction in the resting heart rate. They are constantly active, producing a rhythm of 60 – 80 beats per minute. If the vagus nerve was lesioned, the resting heart rate would be around 100 beats per minute.

Gastro-Intestinal System

The vagus nerve provides parasympathetic innervation to the majority of the abdominal organs. It sends branches to the oesophagus, stomach and most of the intestinal tract – up to the splenic flexure of the large colon.

The function of the vagus nerve is to stimulate smooth muscle contraction and glandular secretions in these organs. For example, in the stomach, the vagus nerve increases the rate of gastric emptying, and stimulates acid production.

Traditionally, the accessory nerve is divided into spinal and cranial parts.

Spinal Part

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The spinal portion arises from neurones of the upper spinal cord, specifically C1-C5/C6 spinal nerve roots. These fibres coalesce to form the spinal part of the accessory nerve, which then runs superiorly to enter the cranial cavity via the

foramen magnum.

The nerve traverses the posterior cranial fossa to reach the **jugular foramen**. It briefly meets the cranial portion of the accessory nerve, before exiting the skull (along with the glossopharyngeal and vagus nerves).

Outside the cranium, the spinal part descends along the **internal carotid artery** to reach the sternocleidomastoid muscle, which it innervates. It then moves across the posterior triangle of the neck to supply motor fibres to the trapezius.

Note: The extracranial course of the accessory nerve is relatively superficial (it runs between the investing and prevertebral layers of fascia), and thus leaves it vulnerable to damage.

Cranial Part

The cranial portion is much smaller, and arises from the lateral aspect of the **medulla oblongata**. It leaves the cranium via the **jugular foramen**, where it briefly contacts the spinal part of the accessory nerve.

Immediately after leaving the skull, cranial part combines with the **vagus nerve** (CN X) at the inferior ganglion of vagus nerve (a ganglion is a collection of nerve cell bodies). The fibres from the cranial part are then distributed through the **vagus nerve**. For this reason, the cranial part of the accessory nerve is considered as part of the vagus nerve.

The spinal accessory nerve innervates two muscles – the sternocleidomastoid and trapezius.

Sternocleidomastoid

Attachments – Runs from the mastoid process of the temporal bone to the manubrium (sternal head) and the medial third of the clavicle (clavicular head).

Actions – Lateral flexion and rotation of the neck when acting unilaterally, and extension of the neck at the atlanto-occipital joints when acting bilaterally.

Trapezius

Attachments – Runs from the base of the skull and the spinous processes of the C7-T12 vertebrae to lateral third of the clavicle and the acromion of the scapula.

Actions – It is made up of upper, middle and lower fibres. The upper fibres of the trapezius elevate the scapula and rotate it during abduction of the arm. The middle fibres retract the scapula and the lower fibres pull the scapula inferiorly.

The **hypoglossal nerve** arises from the **hypoglossal nucleus** in the **medulla oblongata** of the brain. It then passes laterally across the posterior cranial fossa, within the **subarachnoid space**. The nerve exits the cranium via the **hypoglossal canal**.

Now extracranial, the nerve receives a branch of the **cervical plexus** that conducts fibres from C1/C2 spinal nerve roots. These fibres do not combine with the hypoglossal nerve – they merely travel within its sheath.

It then passes inferiorly to the angle of the **mandible**, crossing the internal and external carotid arteries, and moving in an anterior direction to enter the tongue.

The hypoglossal nerve is responsible for motor innervation of the vast majority of

the muscles of the tongue (except for **palatoglossus**). These muscles can be subdivided into two groups:

i) **Extrinsic muscles**

- Genioglossus (makes up the bulk of the tongue)
- Hyoglossus
- Styloglossus
- Palatoglossus (innervated by vagus nerve)

ii) **Intrinsic muscles**

- Superior longitudinal
- Inferior longitudinal
- Transverse
- Vertical

Together, these muscles are responsible for all movements of the tongue.

Role of the C1/C2 Roots

The C1/C2 roots that travel with the hypoglossal nerve also have a motor function. They branch off to innervate the **geniohyoid** (elevates the hyoid bone) and **thyrohyoid** (depresses the hyoid bone) muscles.

Another branch containing C1/C2 fibres descends to supply the **ansa cervicalis** – a loop of nerves that is part of the cervical plexus. From the ansa cervicalis, nerves arise to innervate the omohyoid, sternohyoid and sternothyroid muscles. These muscles all act to depress the **hyoid bone**.

LITERATURE

Base:

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Tests

1. The clinic contacted the man, 45 years old, with complaints of loss of taste sensation in the posterior third of the tongue. A function of which pair of cranial nerves is broken?

- A.VIII
- B.XI
- C.IX
- D.V
- E.XII

2. Due to the growth of a malignant tumor in the brain stem, the patient revealed disturbances IX, X, XI pairs of cranial nerves. The study established that destroyed the core, which is located in retikuliarna formation of the medulla and is common for these nerves. What nucleus was damaged?

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

3. The man, 68 years old, the doctor found inflammation of the tympanic nerve. A branch of which cranial nerve affected?

- A. X
- B. XI
- C. XII
- D. IX
- E. VIII

4. The clinic contacted the man, 45 years old, with complaints of loss of sensitivity of mucous membrane of posterior third of tongue, which is associated with dysfunction of IX cranial nerve. Where the place of exit from the brain n. glossopharyngeus?

- A. sulcus medialis pedunculi cerebri
- B. sulcus anterolateralis
- C. sulcus posterolateralis
- D. sulcus bulbopontines
- E. angulus pontocerebellalis

5. In a patient with an aneurysm of the right subclavian artery - Siplast voice. Disturbed function of the nerve that is compressed by the aneurysm. What nerve is compressed by an aneurysm?

- A. n. laryngeus recurrens dexter.

- B. n. laryngeus inferior sinister.
- C. n. laryngeus recurrens sinister.
- D. n. laryngeus superior sinister.
- E. n. laryngeus superior dexter.

6. The patient, 40 years old, was admitted to the neurosurgical Department with intracranial tumor in the posterior cranial fossa. After further inspection it is established that the tumor compresses IX, X, XI cranial nerves near the opening of the skull through which these nerves leave the cranial cavity. Near a hole of the cranium damaged nerves?

- A. foramen lacerum
- B. foramen ovale
- C. foramen rotundum
- D. foramen jugulare
- E. foramen spinosum

7. The patient disturbed motor function of the tongue. With the pathology of a nerve it is connected?

- A. n. hypoglossus.
- B. n. facialis.
- C. n. glossopharyngeus.
- D. n. accessorius.
- E. n. vagus.

8. The patient has hiatus oesophagialis of the diaphragm. Which of the following structures may also be affected?

- A. Trunci nervi vagi
- B. Ductus thoracicus
- C. Truncus sympathicus dexter
- D. Vena azygos
- E. Vena hemiazygos

9. Damage to the ansa cervicalis resulted in disturbances of the function of any muscle is brought?

- A. m. longuscolli, m. longuscapitis.
- B. Musculus rectus capit.
- C. m. trapezius, m. sternocleidomastoideus.
- D. Musculus infrahyoglossus.
- E. Musculi scaleni.

10. What nucleus is affected at the damage of the vegetative nuclei of the medulla, leading to respiratory failure and cardiac activity?

- A. Nucleus dorsalis n. vagi.
- B. Nucleus salivatorius superior.
- C. Nucleus n. oculomotorii.
- D. Nucleus accessorius n. oculomotorii.
- E. Nucleus salivatorius inferior

Answers

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