Federal State Budgetary Educational Institution of Higher Education

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Ministry of Health of the Russian Federation

Department of physiology named after professor A.T.Pshonik

**GUIDELINES FOR STUDENTS**

**for individual study**

**in**

**Normal Physiology.**

**Specialty 31.05.01 – General medicine**

**TO THE PRACTICAL LESSON**

**From 13.04.2022 to 19.04.2022**

**TOPIC:**

**OLFACTORY, GUSTATORY AND SOMATOSENSORY SYSTEMS.**

**(in an interactive format –**

**individual preparation of presentations**

**according to the following questions).**

*Questions for presentations:*

1. Olfactory analyzer, its structure and functions, research methods.

2. Taste analyzer, its structure and functions, research methods.

3. Physiology of tactile and temperature analyzers. Ways of conducting somatosensory sensitivity.

4. Physiology of motor and interoreceptive analyzers.

5. Physiology of the vestibular analyzer.

6. Nociceptive and antinociceptive sensory systems.

7. Structural and functional characteristics of the vestibular analyzer in ontogenesis.

8. Formation of various types of sensitivity of the skin analyzer in ontogenesis.

9. Structural and functional features of the gustatory and olfactory analyzers in ontogeny

10. Features of olfactory, gustatory and tactile sensitivity in children.

11. The use of various olfactory substances in medical practice.

12. Classification of olfactory (olfactory) substances, the theory of smell.

13. Methods for studying the olfactory function. Occurring anomalies of smell, causes and consequences, methods of correction.

14. Physiology of pain and anesthesia

15. Interaction of olfactory and gustatory analyzers.

Olfactory analyzer. The receptor section of the olfactory analyzer is located in the region of the upper nasal passages and is represented by olfactory receptor cells. The total number of olfactory receptors in humans is about 10 million.

Olfactory receptor cells are spindle-shaped. The peripheral process of these cells ends with a thickening - an olfactory club, from which several (6-12) finest hairs protrude. They are immersed in a liquid medium produced by Bowman's glands. It is believed that the presence of hairs several times (tens of times) increases the area of ​​contact of receptors with molecules of odorous substances. It is possible that the hairs, performing a motor function, increase the reliability of capturing odorous substance molecules and contact with them. It is believed that the receptor potential is generated in the mace.

Molecules of an odorous substance come into contact with the mucous membrane of the nasal passages, interacting with specialized proteins built into the receptor membrane. As a result of this interaction, a receptor potential is generated in the receptor, and then an impulse activity is generated. Excitation transmitted through the fiber of the olfactory nerve enters the olfactory bulb - the primary nerve center of the olfactory analyzer.

The olfactory tract leaving the olfactory bulb consists of several bundles that are sent to different parts of the forebrain: the anterior olfactory nucleus, olfactory tubercle, preperiform cortex, and part of the nuclei of the amygdala complex. It is believed that most areas of the projection of the olfactory tract can be considered as association areas that provide a link between the olfactory analyzer and other sensory systems.

Each olfactory receptor responds to many odorous substances, however, “giving preference” to some of them. Perhaps these properties of olfactory receptors, which differ in their tuning to different groups of substances, underlie the coding of stimuli (odors) and their identification in the centers of the olfactory analyzer.

The sensitivity of the olfactory analyzer is evaluated by the threshold of smell. The threshold of olfactory sensitivity is the smallest amount of vapors of an odorous substance that, when exposed to receptors, can cause an olfactory sensation. The determination of the thresholds of olfactory sensitivity is carried out using olfactometry.

The sensitivity of the human olfactory analyzer is very high: one olfactory receptor can be excited by one molecule of an odorous substance.

Taste analyzer. The peripheral part of the taste analyzer - taste buds located in the epithelium of the tongue and, to a lesser extent, the mucous membrane of the oral cavity and pharynx. Taste buds react only to substances dissolved in water, and insoluble substances have no taste.

From the receptors, information about taste stimuli through the fibers of the glossopharyngeal and partially facial and vagus nerves enters the midbrain, the nuclei of the thalamus and, finally, to the inner surface of the temporal lobes of the cerebral cortex, where the higher centers of the taste analyzer are located.

”The set of devices of the oral part of the body that carry out contact analysis of environmental objects, including tactile temperature and chemical devices of the nasolabial triangle and oral cavity organs, was called by I.P. Pavlov an “oral analyzer”. In the works of I.P. Pavlov, the term “oral analyzer” was used in a narrow sense as an oral analyzer, that is, denoting the function of the sensory systems of the oral cavity. A feature of the sensory function of the oral mucosa is its taste sensitivity.

It is difficult to determine the role and significance of the taste analyzer in isolation, since an adequate stimulus - food entering the oral cavity simultaneously excites the receptors of other analyzers.

Therefore, taste sensations are a complex sum of excitations going to the cortex from taste, olfactory, tactile, temperature and pain receptors. Tactile receptors are excited first of all in the oral mucosa, then temperature receptors, and later than all receptors that react to the chemical composition of food - chemoreceptors. Impulses from these receptors enter the CNS through different nerve fibers at different speeds, and this leads to dispersion in the time of excitation coverage of the nerve centers. Various shades of taste sensations depend on the complex of arising excitations.

Taste receptor cells are part of specialized chemoreceptor structures - taste buds. Humans have over 10,000 taste buds. They are located mainly on the taste buds, which are divided into three types: mushroom-shaped, trough-shaped and leaf-shaped. The nerve endings that form synaptic contacts with the receptor cells of the taste buds are peripheral processes of afferent neurons that are part of the cranial nerves (facial, trigeminal, glossopharyngeal). The central processes of taste afferent fibers end in the nucleus of a single bundle of the medulla oblongata. From this nucleus, the axons of the second neurons go as part of the medial loop to the arcuate nucleus of the thalamus, where the third neurons are located, the axons of which go to the cortical centers of the taste analyzer. The primary zone of the taste analyzer is located in the orbital zone of the cortex, and the secondary zone is located in the somatosensory.

When studying the perception of various chemicals with the help of psychophysiological methods, a person identified the presence of four main sensations (modalities): sweet, bitter, sour and salty. Different areas of the tongue have different sensitivity to basic taste modalities. The receptors most sensitive to sweet are located mainly on the tip of the tongue, to bitter - at the root of the tongue, to sour and salty on the lateral surfaces of the tongue.

The study of the sensitivity of the taste analyzer is carried out by the method of determining the thresholds of taste sensitivity and the method of functional mobility. The threshold of taste sensitivity is the lowest concentration of a solution of a flavoring substance that, when applied to the tongue, causes a corresponding taste sensation. Different taste modalities have different sensitivity thresholds.

Using the method of functional mobility, it has been established that the number of active taste buds of the tongue is constantly changing depending on the functional state of the body and, above all, on the state of the digestive system. The highest level of mobilization of taste buds is observed on an empty stomach, and after eating it decreases. This reaction of taste buds is the result of reflex influences from the stomach, which is irritated by food. This phenomenon is called the gastrolingual reflex. In this reflex, taste buds act as effectors.

Somatosensory analyzer. In humans, there are three types of skin sensitivity: 1) tactile, combining the feeling of touch and pressure, 2) temperature and 3) pain. According to the place of occurrence of sensations, sensitivity is classified as exteroceptive (sensations arising from the surface of the body), visceral (sensations arising in the internal organs) and deep (sensations come from deep-lying tissues - fascia, muscles, bones).

Somatic sensory signals are transmitted at high speed, with high accuracy of localization and determination of the minimum intensity gradations or changes in the strength of the sensory signal. Visceral signals are characterized by a lower conduction velocity, a less developed system of spatial localization of signal perception, a less developed system of stimulation strength gradation, and a lower ability to transmit rapid signal changes.

Tactile sensations are perceived by tactile bodies (Meissner bodies) and lamellar bodies (Vater-Pacini bodies), tactile menisci or Merkel cells, and nerve plexuses around hair follicles.

To temperature influences, in addition to special receptor formations (Croise flasks for cold and Ruffini bodies for heat), free nerve endings are also sensitive. Cold receptors are located more superficially (0.17 mm) than thermal receptors (0.3 mm). There are approximately 10 times fewer thermal points than cold ones. Under certain conditions, cold receptors can also be excited by heat. This explains the acute sensation of cold when quickly immersed in a hot bath (temperature above 45°C).

Almost all sensory information from the segments of the body enters the spinal cord through the central processes of the sensory neurons of the spinal nodes passing through the posterior roots. Having entered the spinal cord, the central processes of sensory neurons either go directly to the medulla oblongata (lemniscal system: thin or delicate Gaulle's bundle and Burdach's sphenoid bundle), or end on intercalary neurons, the axons of which go to the thalamus as part of the ventral, or anterior and lateral , or lateral spinothalamic ascending tract.

The thin and wedge-shaped bundles are pathways for proprioceptive and tactile sensitivity; the ventral spinothalamic pathway conducts tactile and pressor sensations from skin mechanoreceptors. The lateral spinothalamic pathway is the main pathway for pain and temperature sensitivity.

The vestibular (pre-door) apparatus, or the organ of balance, is located in the petrous part of the temporal bone and consists of the bony and membranous labyrinths. The bony labyrinth is a system of semicircular ducts (canales semicirculares) and a cavity communicating with them - the vestibule (vestibulum). The membranous labyrinth is a system of thin-walled tubes and sacs located inside the bony labyrinth. In the bone ampullae, the membranous canals expand. In each ampullar extension of the semicircular canal are scallops (crista ampullaris). On the eve of the membranous labyrinth, two interconnected cavities are formed: the uterus, into which the membranous semicircular canals open, and the sac. The sensitive areas of these cavities are spots. The membranous semicircular canals, the uterus and the sac are filled with endolymph and communicate with the cochlea, as well as with the endolymphatic sac located in the cranial cavity. The scallops and spots, the receptive regions of the vestibular organ, contain receptor hair cells. In the semicircular canals, rotational movements are registered (angular acceleration), in the uterus and sac - linear acceleration.

Sensitive spots and scallops. In the epithelium of spots and scallops there are sensitive hair and supporting cells. The epithelium of the spots is covered with a gelatinous otolithic membrane containing otoliths - calcium carbonate crystals. The epithelium of the scallops is surrounded by a jelly-like transparent dome, which is easily displaced by the movements of the endolymph.

Hair cells are found in the scallops of each ampulla of the semicircular canals and in the spots of the sacs of the vestibule. Hair receptor cells in the apical part contain 40–110 immobile hairs (stereocilia) and one mobile cilium (kinocilium) located on the periphery of the bundle of stereocilia. The longest stereocilia are located near the kinocilium, while the length of the rest decreases with distance from the kinocilium. Hair cells are sensitive to the direction of the stimulus (direction sensitivity). When the stimulus is directed from the stereocilia to the kinocilium, the hair cell is excited (depolarization occurs). With the opposite direction of the stimulus, the response is suppressed (hyperpolarization).

There are two types of hair cells. Type I cells are usually located in the center of the scallops, while type II cells are located along their periphery.

Type I cells are amphora-shaped with a rounded bottom and housed in the goblet cavity of the afferent nerve ending. Efferent fibers form synaptic endings on afferent fibers associated with type I cells.

Type II cells have the form of cylinders with a rounded base. A characteristic feature of these cells is their innervation: the nerve endings here can be both afferent (most) and efferent.

In the epithelium of the spots, the kinocilia are distributed in a special way. Here the hair cells form groups of several hundred units. Within each group, the kinocilia are oriented in the same way, but the orientation of the kinocilia is different between different groups.

Stimulation of the semicircular canals. The receptors of the semicircular canals perceive the acceleration of rotation, i.e. angular acceleration. At rest, there is a balance in the frequency of nerve impulses from the ampullae of both sides of the head. An angular acceleration on the order of 0.5° per second is sufficient to displace the dome and bend the cilia. Angular acceleration is recorded due to the inertia of the endolymph. When the head is turned, the endolymph remains in the same position, and the free end of the dome deviates in the direction opposite to the turn. Movement of the dome bends the kinocilium and sterocilia embedded in the jelly-like structure of the dome. The inclination of the stereocilia towards the kinocilium causes depolarization and excitation; the opposite direction of tilt results in hyperpolarization and inhibition. When excited, a receptor potential is generated in the hair cells and acetylcholine is released, which activates the afferent endings of the vestibular nerve.

The semicircular canals detect turning or rotation of the head. When the head suddenly begins to turn in any direction (this is called angular acceleration), then the endolymph in the semicircular canals, due to its large inertia, remains for some time in a stationary state. The semicircular canals at this time continue to move, which causes the endolymph flow in the opposite direction to the rotation of the head. This leads to the activation of the vestibular nerve endings, and the frequency of nerve impulses exceeds the frequency of spontaneous impulses at rest. If the rotation continues, the pulse frequency gradually decreases and returns to its original level within a few seconds.

Body reactions caused by stimulation of the semicircular canals. Stimulation of the semicircular canals causes subjective sensations in the form of dizziness, nausea and other reactions associated with the excitation of the autonomic nervous system. To this are added objective manifestations in the form of a change in the tone of the eye muscles (nystagmus) and the tone of anti-gravity muscles (fall reaction).

Dizziness is a sensation of rotation and can cause imbalance and a fall. The direction of sensation of rotation depends on which semicircular canal was stimulated. In each case, the vertigo is oriented in the opposite direction to the displacement of the endolymph. During rotation, the feeling of dizziness is directed towards the direction of rotation. The sensation experienced after the rotation stops is directed in the opposite direction from the actual rotation. As a result of dizziness, vegetative reactions occur - nausea, vomiting, pallor, sweating, and with intense stimulation of the semicircular canals, a sharp drop in blood pressure (collapse) is possible.

Nystagmus and muscle tone disorders. Stimulation of the semicircular canals causes changes in muscle tone, manifested in nystagmus, impaired coordination tests and a fall reaction. Nystagmus - rhythmic twitching of the eye, consisting of slow and fast movements. Slow movements are always directed towards the movement of the endolymph and are a reflex reaction. The reflex occurs in the crests of the semicircular canals, the impulses arrive at the vestibular nuclei of the brainstem and from there switch to the muscles of the eye. Rapid movements are determined by the direction of the nystagmus; they result from CNS activity (as part of the vestibular reflex from the reticular formation to the brainstem). Rotation in the horizontal plane causes horizontal nystagmus, rotation in the sagittal plane causes vertical nystagmus, and rotation in the frontal plane causes rotational nystagmus.

rectifying reflex. Violation of the pointing test and the fall reaction are the result of changes in the tone of the antigravity muscles. The tone of the extensor muscles increases on the side of the body where the displacement of the endolymph is directed, and decreases on the opposite side. So, if the forces of gravity are directed to the right foot, then the head and body of a person deviate to the right, shifting the endolymph to the left. The resulting reflex will immediately cause extension of the right leg and arm and flexion of the left arm and leg, accompanied by a deviation of the eyes to the left. These movements are a protective rectifying reflex.

Projection pathways of the vestibular apparatus. The vestibular branch of the VIII cranial nerve is formed by the processes of approximately 19,000 bipolar neurons that form a sensory ganglion. The peripheral processes of these neurons approach the hair cells of each semicircular canal, uterus and sac, and the central processes go to the vestibular nuclei of the medulla oblongata. The axons of nerve cells of the second order are connected with the spinal cord (pre-door-spinal tract, olivo-spinal tract) and rise as part of the medial longitudinal bundles to the motor nuclei of the cranial nerves that control eye movements. There is also a pathway that conducts impulses from the vestibular receptors through the thalamus to the cerebral cortex.

Predverno-spinal path (tractus vestibulospinalis). The lateral pre-door-spinal tract starts from the lateral vestibular nucleus (Deiters), passes in the anterior cord and reaches the a- and g motor neurons in the anterior horns. The axons of the neurons of the medial vestibular nucleus (Schwalbe) join the medial longitudinal bundle (fasciculus longitudinalis medialis) and go down in the form of a medial vestibular tract to the thoracic spinal cord.

Olivo-spinal path (tractus olivospinalis). The nerve fibers of the bundle start from the olive nucleus, pass in the anterior funiculus of the cervical spinal cord and end in the anterior horns.

The vestibular apparatus is part of a multimodal system that includes visual and somatic receptors that send signals to the vestibular nuclei either directly or through the vestibular nuclei of the cerebellum or the reticular formation. Input signals are integrated in the vestibular nuclei, and output commands act on the oculomotor and spinal motor control systems.

**Practical work №1. Threshold determination of gustation (gustometry).**

**Objective of the work:** to determine the thresholds of taste sensitivity for sweet, salty, sour and bitter. Analyze the results obtained.

By the threshold of gustation we mean the minimal concentration of the substance solution which, when applied to the tongue, causes a corresponding gustatory sensation.

To master the method of determining the thresholds of gustation by the method of drip irritations.

**Work progress.** The research is conducted on a person. According to the topography of the taste fields (sweet substance - on the tip, salty and sour - on the lateral surfaces, bitter - on the root of the tongue), a drop of solution is applied on the tongue with a dropper, starting with the minimum concentration and increasing it until the taste of the substance will not be precisely defined. Each test lasts 10-12 seconds, after which the mouth is rinsed with water. The interval between samples is not less than 1-2 minutes.

**Research protocol:**

Patient’s data:

Full name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Age \_\_\_\_\_\_ Gender: Male / Female

1. Fill the result in the table below by putting «**+**» under the needed concentration- the threshold gustatory sensitivity.

|  |  |
| --- | --- |
| **Stimulating solutions** | **Concentration, %** |
|  | **0,001** | **0,01** | **0,1** | **1** |
| **Sweet**  |  |  |  |  |
| **Sour** |  |  |  |  |
| **Salty** |  |  |  |  |
| **Bitter** |  |  |  |  |

1. Make a conclusion by comparing the results. Note the concentration of which substance is the minimal threshold. Indicate what the gustatory sensitivity depends on and what the individual differences in the thresholds of gustatory perception may be related to.

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**Practical work №2. Study of the vestibular analyzer using functional tests.**

The functional state of the vestibular apparatus is assessed using functional tests.

**Sample 1. Nystagmus of the head and eyes while rotating**

**Work progress:** the subject makes rotational movements until he feels discomfort, light dizziness. Pay close attention to the position of the head, torso, and eyes immediately after stopping. In the normal functional state of the labyrinths, nystagmus of the head and eyes is observed. The time of nystagmus is recorded, considering, that its average duration is 20-30 s. The experiment is repeated, asking the subject to close his eyes during rotation.

**Research protocol:**

Patient’s data:

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Age\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Gender\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time of nystagmus after the rotation with open eyes\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time of nystagmus after the rotation with closed eyes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Interpretation of results.** Normally post-rotational nystagmus after 10 rotations for 20 sec lasts from 30 till 45 sec

Conclusion\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Sample 2. Rotative probe of Yarotsky**

**Objective of the work:** Assessmentof the duration of maintaining body balance during head rotation.

**Work progress:** Performing rotational movements of the head in one direction at a speed of 2 times in 1 s and determining the time during which the subject is able to maintain body balance.

**Research protocol:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| № | Name  | Age | Gender | Time of keeping the balance of the body during head rotation |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

**Interpretation of results:** Non-trained people keep balance in average for 28-30 sec while trained sportsmen- for 90 and more.

The conclusion about the functional state of the vestibular analyzer is based on the analysis of the performed samples, as satisfactory, good, unsatisfactory.

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Questions:

1. Write down the basal parts of the vestibular analyzer\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What are vestibulo-motor reflexes? Write down the examples

3. What are the vestibulo-sensor reflexes?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What is nystagmus?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. What are vestibulo-vegetative reflexes?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Practical work №3. Research of tactile sensitivity.**

**Objective of the work:** To find and determine the number of the so-called tactile points in a selected area of the skin, make conclusions about the state of tactile sensitivity as a result of the current study.

**Work progress:** With the help of Frey's hair, it is necessary to find and determine the number of so-called tactile points in the selected area of ​​the skin. To do this, an area of ​​1 cm2 is drawn on the palm of the hand with a chemical pencil, inside which the hair is applied to all points of the surface. Each point of irritation is marked with a colored pen. The points found are called touch and pressure points. Tactile sensitivity is considered normal if the subject perceives 50-60 points / cm2. Make a conclusion about the state of tactile sensitivity as a result of the current study.

**Research protocol:**

**Number of tactile points:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Interpretation of results:** Tactile sensitivity is normal if the subject feels from 50-60 dots/ sm2

**Conclusion:\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**1. Tactical sensitivity of the gingival papillae of the alveolar arch decreases**

from the center in the distal direction \*

from the periphery to the center
from right to left

from left to right

from bottom to top

**2. Of all groups of teeth, … havethe lowest threshold of thermal sensitivity**

Incisors \*

canines

premolars

molars

wisdom teeth

**3. A part of the basal cells in the taste bud perform the** **function of the**

mechanoreceptors \*

taste receptors

proprioceptors

nociceptors

visceroceptors

**4. With prolonged exposure to the taste stimulus of the tongue receptors… occurs**

Adaptation \*

decompensation

sensibilization

compensation

reverb

**5. In the mucosa of the oral cavity, reception of the tactilic irritants is carried out by**

Meissner's bodies \*

Merkel discs

Pacini's corpuscles

taste buds

free nerve endings

**6. Threshold gistometry method allows to determine the threshold of**

taste sensation of various substances \*

sensations of the substance cold properties

spaces at the tip of the tongue

touch sensations

perception of the substance thermal properties

**7. With age dentin sensitivity**

decreases \*

does not change

alternately changes

increases

increases dramatically

**8. Taste buds that perceive sweetness are**

on the tip of the tongue \*

at the root of the tongue

under the tongue

at the lateral surfaces of the tongue

**9. A burning taste arises on irritation of the**

pain receptors of the tongue \*

tactile receptors

chemoreceptors

thermoreceptors

**10. Bitter food causes changes**

reduce blood flow to the extremities, increase blood flow to the brain, reduce skin\* temperature, increase heart rate and increase blood pressure

increased blood flow to the extremities, decreased blood flow to the brain and increased skin temperature

dilation of brain and peripheral vessels

increase blood flow to the brain, increase skin temperature

**11. Sweet substances, when acting on the taste buds, have the following effects**

vascular spasm \*

vasoconstrictive effect

vasodilating effect

no effect

**12. The method of studying the threshold of taste sensitivity is called**

Gustometry\*

electroodontometry

functional mobility

thermovisiography

algesimetry

**13. … do not belong to the taste buds of the tongue**

Tongue filiform papillae\*

Foliate papillae

Circumvallate papillae

Clavate papillae

Circumvallate papillae

**14. Pulsed current of various frequencies used for electroanalgesia, limiting the ascending nociceptive flow, causes**

inhibition of nociceptive neurons of the trigeminal complex of nuclei\*

hyperpolarization of A-delta fibers

depolarization of A-delta fibers

inhibition of the nuclei of the reticular formation

inhibition of cortical neurons

**15. During electroanalgesis in nervous fibers under the influence of dc… occurs**

long-term polarization\*

reflex inhibition

excitatory postsynaptic potential

hyperpolarization

impulse activity

**16. When food enters the oral cavity, the mucosal receptors are excited in the following sequence**

tactile, temperature, taste\*

temperature, tactile, taste

temperature, taste, tactile

taste, tactile, temperature

**17. In the direction from the anterior to posterior parts of the oral cavity cold sensitivity**

Decreases\*

increases

does not change

first increases, then decreases

changes in waves

**18. In the intercellular relations of taste buds are essential processes of the... associated with the flow of fluids, ions, metabolites through intercellular spaces**

Ultracirculations\*

microcirculation

hemodynamics

excitations ion exchange

**19. When acting on the taste buds, acidic substances cause**

vasoconstrictive effect\*

do not affect the tone of blood vessels

dilatation effect

 **vasodilating effect**

**20. Cold thermoreceptors predominate on**

the vestibular surface of the gums\*

the root of the tongue

the palatine arches

the soft palate

the hard palate

**21. Pain receptors have properties**

high threshold of excitation\*

the low excitation threshold

rapid adaptation to the current stimulus

lack of excitation threshold

lack of specificity

**22. Nociceptors are receptors**

perceiving pain\*

preventing the development of pain

 perceiving sprains localized in ligaments and muscles

**23. The oral receptors which are not classified as somatosensory ones**

Gustatory\*

temperature

pain

tactile

proprioceptive

**24. In case of thermal irritation, the depulped tooth responds with the appearance of a feeling**

does not react\*

of pain

of heat

of cold

of touch

**25. Out of all groups of teeth, the highest threshold of thermal sensitivity has**

Incisors\*

canines

molars

premolars

wisdom teeth

**26. Phase tactile receptors of the oral mucosa have the following properties**

high sensitivity and rapid adaptation high sensitivity and slow adaptation\*

low sensitivity and slow adaptation

low sensitivity and rapid adaptation

low adaptation

**27. … sensitivity increases in the direction from the proximal to distal parts of the oral cavity**

Thermal\*

Cold

Proprioceptive

Tactile

Taste

**28. The reaction of taste buds to food intake is carried out by the mechanism of ... reflex**

sensori-sensory\*

sensorimotor

conditional

unconditional

motor

**29. During the first feeding of a newborn, the main function of regulating the act of eating is carried out by information from the… receptors**

taste buds.\*

tactile

pain

temperature

visual

**30. Papillae covered with keratinizing epithelium include**

Filamentous\*

foliate

clavate

circumvallate

gingival

**31. Salty substances when acting on the taste buds cause**

short-term narrowing and persistent vasodilation\*

only narrowing of blood vessels

only vasodilatation

do not have an impact

**32. How many taste buds does an adult have**

9-10 thousand\*

2-5 thousand

20-30 thousand

more than 30 thousand

**33. Taste buds in the oral cavity can be located**

on the papillae of the tongue\*

on the mucous membrane of the palate, pharynx, larynx

in the mucosa of the tonsils and Palatine curtain

in all the listed formations

**34. Irritation of which receptors forms an astringent taste**

tactile receptors\*

chemoreceptors

taste bulbs of sweet and bitter at the same time

pain receptors

**35. Afferentation from oral cavity receptors is of leading importance in the development of …saturation**

Sensory\*

metabolic

true

conditioned reflex

**36. Taste buds are located**

in the papillae of the tongue\*

on the lips and tongue

on the hard and soft palate

around the salivary gland ducts

**37. Cold thermoreceptors of the oral cavity prevail on the**

vestibular surface of the gums\*

soft palate

root of the tongue

 side surfaces of the tongue

**38. In the intercellular relations of taste buds are essential processes of the... associated with the flow of fluids, ions, metabolites through intercellular spaces**

Ultracirculations\*

microcirculation

hemodynamics

excitations ion exchange

**39. When acting on the taste buds, acidic substances cause**

vasoconstrictive effect\*

do not affect the tone of blood vessels

dilatation effect

vasodilating effect

**40. Cold thermoreceptors predominate on**

the vestibular surface of the gums\*

the palatine arches

the root of the tongue

the soft palate

the hard palate

41. THE CORTICAL REPRESENTATION OF THE TACTILE ANALYZER IS IN:

1) occipital region of the cerebral cortex;

2) the parietal region of the cerebral cortex;

3) frontal lobes;

4) somatosensory zones\*

42. SENSITIVITY OF TASTE RECEPTORS TO SALT IN ALL PEOPLE:

1) initially the same for everyone;

2) individual and the same throughout life;

3) different initially and the same until the end of life;

4) individual and may vary depending on the state of the organism\*

43. ODOR ASSESSMENT IS PERFORMED IN:

1) olfactory bulb;

2) olfactory tract;

3) thalamus;

4) hypothalamus;

5) cerebral cortex\*

44. TOUCH IS:

1) a set of sensations arising from irritation of the receptors of the musculoskeletal system;

2) a set of sensations arising from irritation of mucosal receptors (touch, pressure, vibration, tickling, temperature);

3) a set of sensations arising from irritation of the receptors of the skin of the fingers when touching an object or surface;

4) a set of sensations arising from irritation of the receptors of the skin and mucous membranes (touch, pressure, vibration, tickling, temperature, pain) and receptors of the musculoskeletal system\*

45. SECONDARY SENSING RECEPTORS ARE:

1) olfactory;

2) tactile;

3) muscle spindles;

4) rods and cones\*

**Course textbooks and manuals**

1. Dunn, R. B. USMLE Step 1. Lecture Notes. Physiology / R. B. Dunn ; ed. D. E. Fitzovich. - [S. l.] : Kaplan, 2006. - 576 p.

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3. Sherwood, L. Fundamentals of Human Physiology / L. Sherwood. – 4th ed. – Belmont, CA, USA: Brooks/Cole, 2012. – 764 p.

4. Silbernagl, S. Color Atlas of Phisiology / S. Silbernagl, A. Despopoulos. - 7th ed. - Stuttgart : Thieme, 2015. - 458 p.

5. Wilson, L.B. USMLE Step 1. Lecture Notes. Physiology / L.B. Wilson. - Kaplan, 2013. - 423 p.