

The role of brain
in the regulation of
motor and autonomic functions of the
body

The neural organization of posterior brain

■ *Nuclei of cranial nerves:*

sensory : V, VII, VIII, IX, X,

vestibular nuclei: Shvalbe, Bechterew, Deyters,
descending nucleus

motor : V, VI, VII, IX, X, XI, XII

vegetative : VII, IX, X

■ *The nuclei of ascending somatosensory system :*

nuclei Gaulle and Burdach

■ *Reticular formation*

■ *Ways leading from the spinal cord to higher situated parts of the CNS*

Functions of posterior brain

- **Sensory**
- **Conduction**
- **Vegetative**
- **Reflex**

Sensory function of posterior brain

1 . Receptors of head:

- skin of face;
- nasal mucosa;
- oral mucosa;
- teeth;
- taste receptors;
- proprioceptors of the muscles (facial, masticatory, tongue, pharynx)
- auditory receptors;
- receptors of vestibular apparatus;

2 . Proprioceptors of neck, trunk, limbs

3 . Receptors of internal organs

Conduction functions of posterior brain

- Ascending pathways within :
 - lemnis system
 - extralemnis system
 - anterolateralis system
- Descending pathways to the spinal cord

Vegetative function of posterior brain

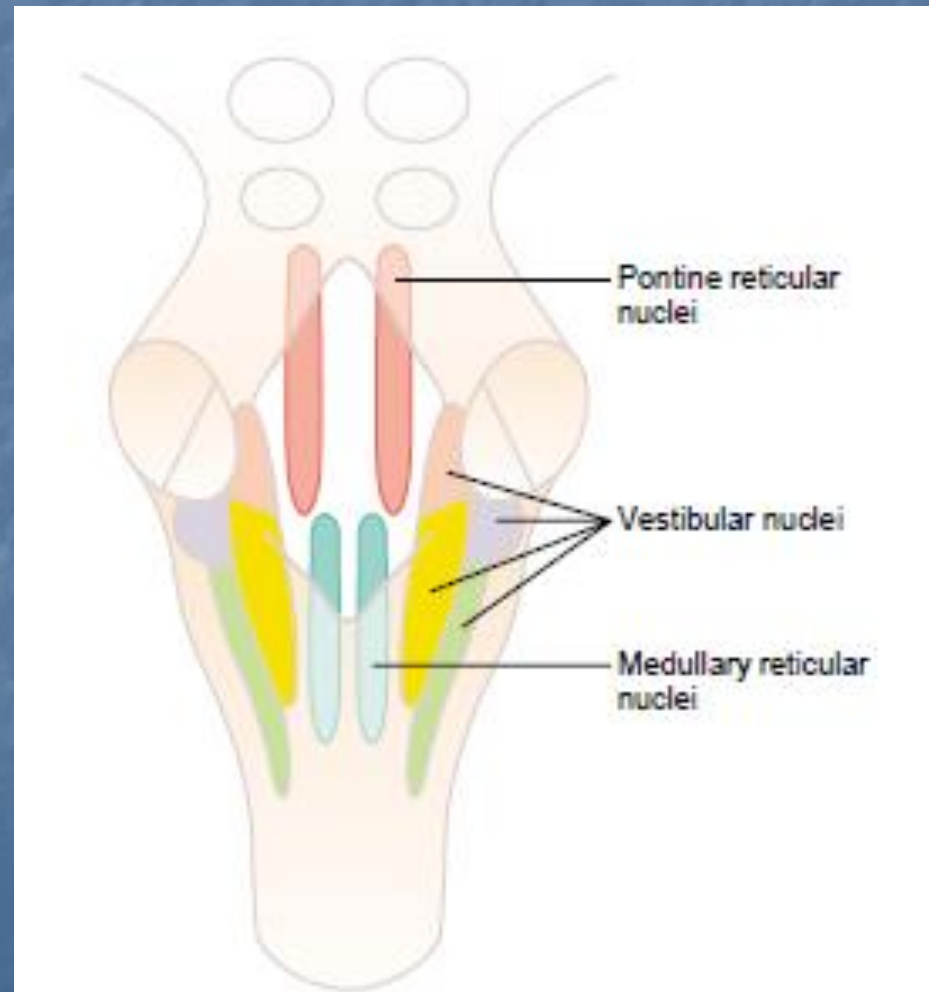
- **Participation in the provision of external respiration (the respiratory center)**
- **Participation in the regulation of the circulatory system (cardiovascular center)**
- **Participation in the regulation of digestion:**
 - chewing center
 - swallowing center
 - center of salivation
 - center of parasympathetic regulation of secretion and motility of stomach, pancreas, gall bladder, (food center)

Reflex functions of posterior brain

Maintaining a posture of antigravity

Centers that provide antigravity posture

- Vestibular nucleus
- reticular nuclei
- bridge formation
- Nuclei of reticular formation of the medulla oblongata



2. Redistribution of body muscle tone by changing head position

Reflexes to ensure redistribution of muscle tone
(tonic posture reflexes):

A) Vestibular static

B) Cervical tonic

Vestibular static reflexes

■ Reflex arc

Receptor : *Vestibular receptor (spherical and elliptical sacs)*

Center: *vestibular nucleus of medulla oblongata*

Efferent link : *vestibulospinal path fibers which ends on α -motoneurons of spinal cord*

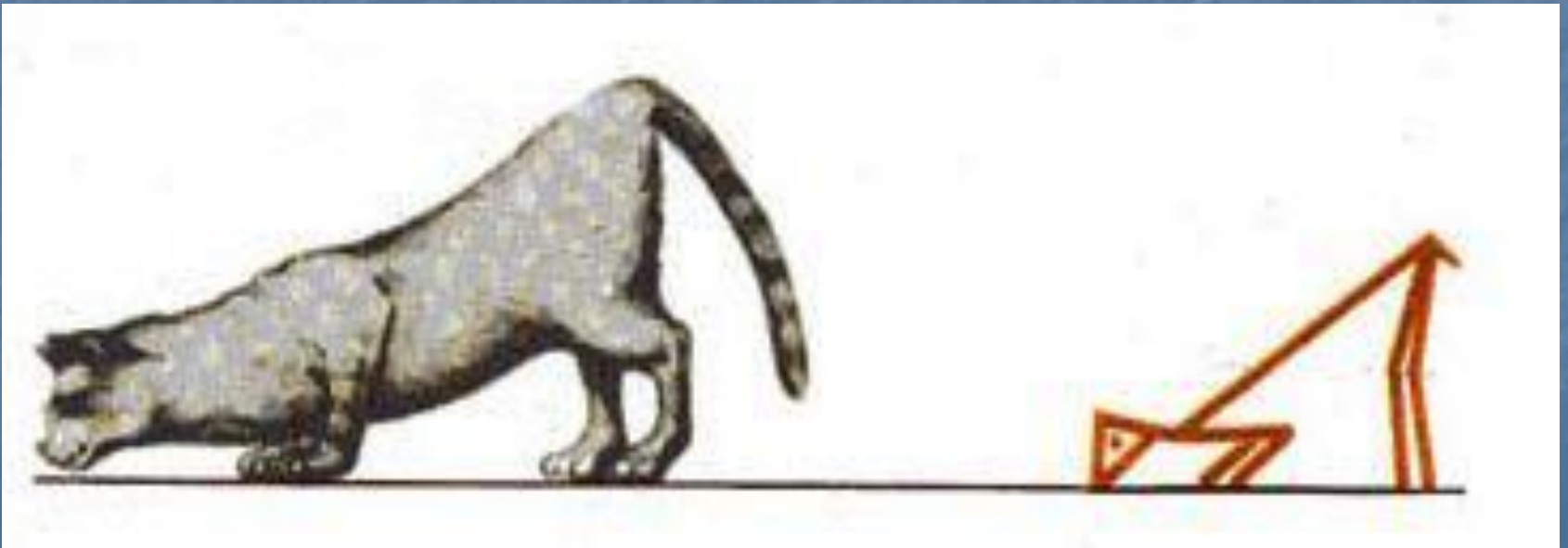
Effector: *extensor excited,
flexors inhibited*

Types of static vestibular reflexes

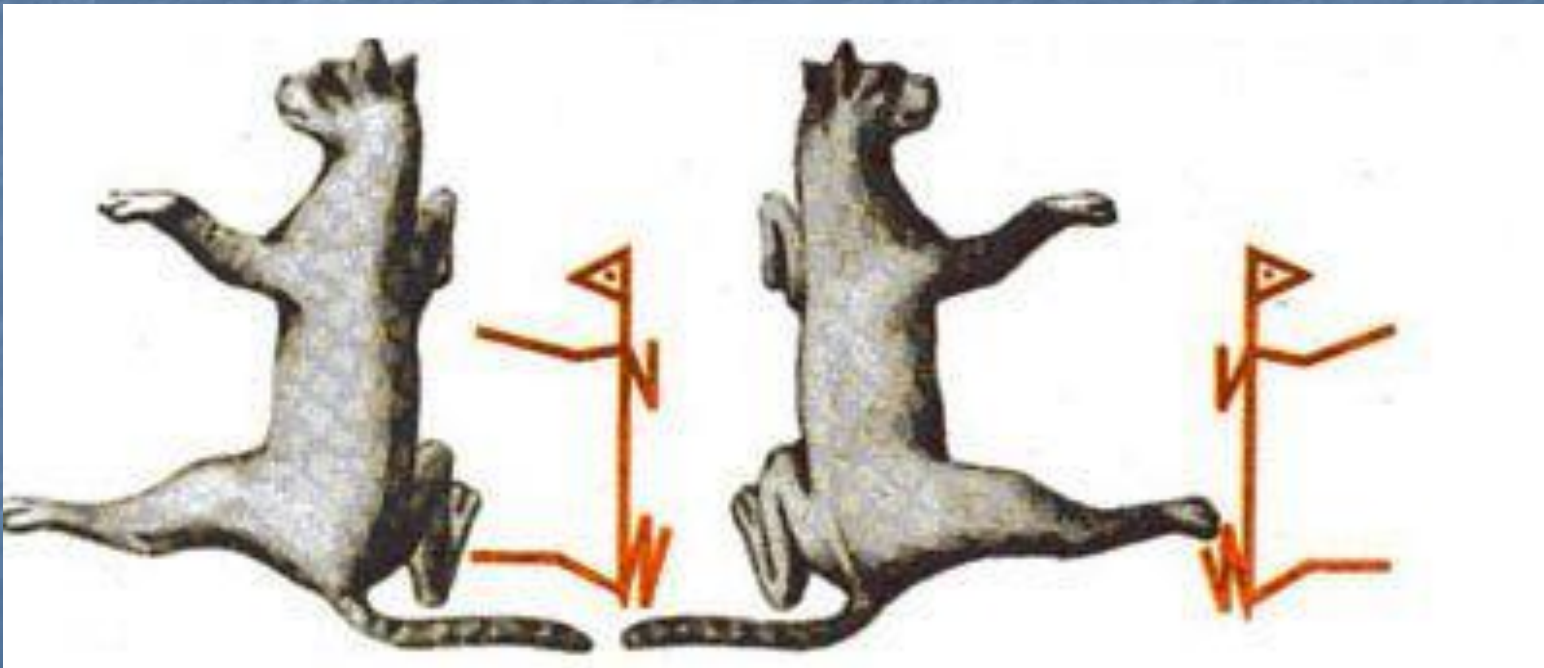
- When lifting the head increases extensor muscle tone of upper limbs and reduced muscle tone of extensor of hind limb



- When retracting the head increases extensor muscle tone of hind limbs and reduced muscle tone of extensor of upper limbs



- When tilt head sideways increases extensor muscle tone on the side where the head is tilted



Neck tonic reflexes

■ Reflex arc

Receptor : *proprioceptors of neck muscles*

Center : *motor nuclei of medulla oblongata*

Efferent link: - *vestibulospinal path fibers
which ends on α -motoneurons
of spinal cord;*
- *from the oculomotor nerve nuclei
(nuclei III, IV, VI of cranial nerves)
to the muscles of the eye*

Effector: - *Extensors excited,
flexors inhibited*
- *Movements of eyeballs*

The neural organization of the midbrain

- The red nucleus
- The black substance
- Midbrain reticular formation
- Nuclei of III, IV pairs of cranial nerves
- Corpora quadrigemina
- Descending and ascending pathways

Functions of midbrain

- **Sensory**
- **Conduction**
- **Vegetative**
- **Reflex**

Sensory functions of midbrain

- Anterior hillocks of corpora quadrigemina are primary visual centers
- Posterior hillocks of corpora quadrigemina are primary auditory centers

Vegetative functions of the midbrain

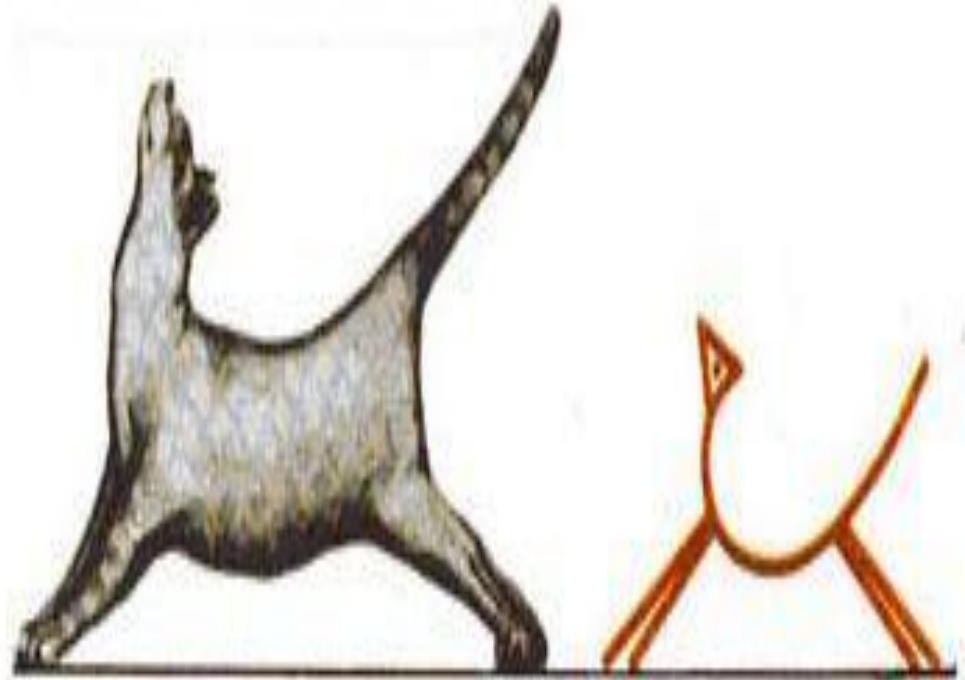
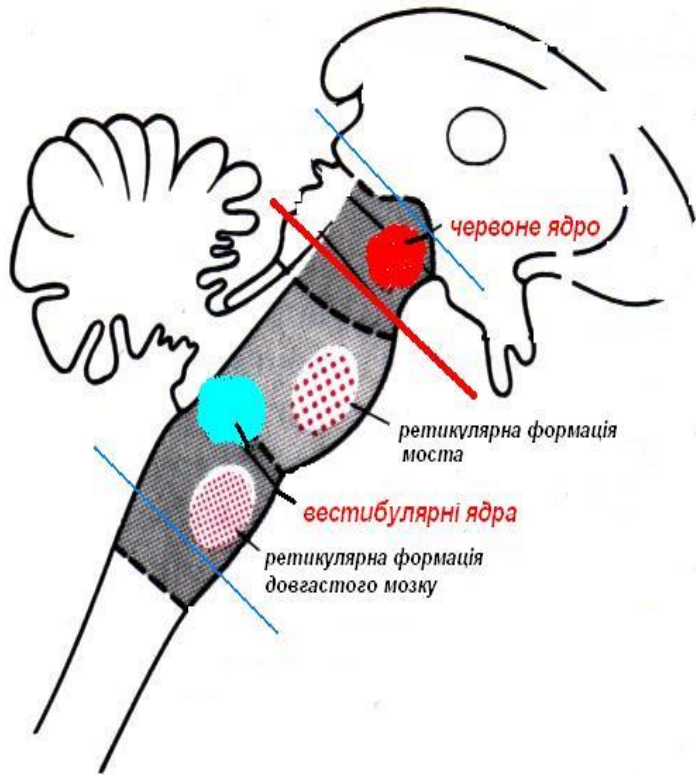
- Associated with the activity of parasympathetic nuclei (III pair)
- Fibres of these nerves innervate
 - ciliary muscle
 - sphincter pupil
- Through activation of these nerves is
 - accommodation eyes
 - adaptation of the eye

Reflex functions of midbrain

- Decerebrate stiffness
- Reflexes straightening
- Statokinetic reflexes
- Approximate reflexes

Decerebrate stiffness

Condition that occurs after crossing the midbrain and is characterized by a sharp increase in muscle tone - extensor



Reflexes straightening

Reflexes, aimed at protecting the natural posture animals crown top

Reflex arc

*receptors of the vestibular analyzer
(unnatural head position)*



turn the head upside crown



proprioceptors of neck muscles



*redistribution of muscle tone of trunk and
extremities*



animal becomes a natural position



Statokinetic reflex

Reflexes to preserve posture and maintain a balance in the event of acceleration (horizontal, vertical, angular)

Reflex arc

Angular acceleration

Excitation of hair cell of semicircular canals

Medulla oblongata (nucleus of VIII pair)

Vestibular nuclei

Motoneurons of neck muscles

*Midbrain
(n. oculomotor nerves)*

Turning a head

Turning eyes

Nistagm of head – head movements by the action of angular acceleration (first fast in the opposite direction of motion, then slowly in the direction of movement)

Nistagm of eyes – eye movements under the influence of angular acceleration (first fast in the opposite direction of motion, then slowly in the direction of movement)

The value of nystagm – preservation of normal visual orientation while driving

Functions of a red nucleus

- Provides malcontent movements
- Regulates muscle tone
 - increases muscle tone of flexors
 - reduces muscle tone of extensors

Functions of a black substance

- Provides a smooth motion
- Adjust the contraction of facial muscles-flexor
- Provides friendly gestures
- Correction of motor programs (due to connections with basal ganglia)
- Synthesis of the precursor of dopamine

Indicative reflexes

Patrol reflexes,
reflexes, "what?"

Reflexes that provide
fast turn the head, trunk,
eyes in the direction of
light or sound stimulus

1) Types:

Indicative visual reflex (front hillocks)

Auditory indicative reflex (rear hillocks)

2) Mean:

Orientation for new situations

Prepare to defend

Neuron organization of reticular formation

- About 40 nuclei that are part
 - medulla oblongata
 - bridge
 - midbrain
- It has direct links with
 - spinal cord
 - nonspecific thalamic nuclei
 - other departments of the central nervous system
- Neurons have a strong background impulse activity (5 - 10 Hz) due to
 - a large number of afferent signals
 - actions of humoral factors

Functions of reticular formation

■ Sensory

Receives afferent information from

- Extralemniscal somatosensory system
- visceral receptors
- proprioceptors
- receptors in the visual analyzer
- receptors in the auditory analyzer

■ Motor

Influences on the tone of skeletal muscles by spinal cord motoneurons

- Medial reticulospinal way (Varoli's bridge)
 - excitation of extensor motoneurons
 - inhibition of flexors motoneurons
- Lateral reticulospinal way (medulla oblongata)
 - excitation of flexors motoneurons
 - inhibition of extensor motoneurons

■ Integrative

Activates the neurons of the cerebral cortex

Adjust the cycle sleep-cheerfulness

Functions of the cerebellum

- Creation of motor programs
- Correction of motor programs
- Ensuring the initiation of movements
- Coordination of movements
- Equilibration
- Regulation of muscle tone
- Regulation of muscle strength
- Adaptive-trophic function

Symptoms that occur with lesions of the cerebellum

- Ataxia - a violation of motor coordination
- Asthenia – reducing of muscle strength
- Dystonia - a violation of muscle tone
- Dysmetria - violation of movement amplitude
- Astazia - not the ability to perform precise movements
- Disequilibrium – violation of balance
- Dysarthria - speech disorders
- Intentions tremor - shaking muscles when performing voluntary movements
- Eye nystagm, dizziness, vegetative disturbances

Functions of Thalamus

The Thalamus is an important relay center mainly for sensory fibers but also motor fibers from the basal ganglia and cerebellum on their way to the cerebral cortex. Crude appreciation of touch, pain and temperature may occur here.

It also relays part of the reticular activationg system which controls the level and state of consciousness.

Functional characteristic of thalamic nuclei

■ Specific core switch (relay)

Receives information from sensory systems (somatosensory, visual, auditory) and switch to the appropriate sensory cortex area

■ Nonspecific nuclei

Receive information from

- All senses
- Reticular formation of brainstem
- Hypothalamus

Turn information on sensory and motor cortex areas and limbic system

■ Associative nuclei

Receives information from specific and nonspecific thalamic nuclei

Turn information on associative cortex area

■ Relay nonsensory nuclei

Receives information from the cerebellum, basal nuclei

Turn information on motor cortex area

Functions of hypothalamus

- Contains higher centers of the sympathetic nervous system
- Center of thermoregulation
- Central regulation of water-salt metabolism
 - central osmoreceptors
 - thirst center
- Food center
 - the hunger center
 - the center of saturation
- Centers of sleep and wake
- Center of regulation of sexual behavior (pleasure center)
- Participation in the formation of motivations and emotions
- Neuroendocrine function (formation releasing factor, vasopressin, oxytocin)

Functions of basal nuclei

- Implementation of complex motor acts that require education and training
(Cycle of shell)
- The formation and preservation of the memory models of motor responses, which are elements of behavior in certain circumstances
(Caudate nuclei cycle)

Caudate nuclei cycle

