CENTRAL NERVOUS SYSTEM

ESSAY:

1. Describe the origin course termination and function of pyramidal tract:

origin:

The pyramidal tract arises from the pyramidal cells in the motor area (4), premotor area (6) and frontal eye field (8). It also gets fibers from the sensory areas (3,1,2)

course:

* From the cerebral cortex, the fibres desend as the corona radiata.
* The pyramidal tract pases through genu and anterior two-third of the posterior limb of the internal capsule (In this region, the fibres are closely packed and hence liable for extensive damage).
* Then the fibres pass through crus cerebri of the midbrain to enter pons. In pons, the fibers get scattered.

* After leaving the pons, the fibres again become compact in the medulla assuming a pyramidal shape.

* At the lower border of the medulla, the majority of fibres (about 80%) cross to the opposite side forming the crossed pyramidal tract or the lateral corticospinal tract.

* The remaining fibers form the uncrossed pyramidal tract, also termed the ventral corticospinal tract. These uncrossed fibres cross to the opposite side before they end on the anterior horn cell of spinal cord.

The tract is termed pyramidal tract because of the pyramidal shape assumed by it during its coarse through the medulla.

Termination :

The fibers of the pyramidal tract finally end on the anterior horn cell of the spinal cord.

* some fibres of the pyramidal tract while traveling from the cortex to the spinal cord give branches to the cranial nerve nucleus. These are called the corticonuclear fibres.

* As the corticospinal fibres descend through the brain from the cerebral cortex, they are accompained by the corticobulbar pathway.

* The corticobulbar pathway begins in the sensorimotor cortex and ends in brainstem. The corticobulbar fibres control the motor neurons, innervating the muscles of the eye, face, tongue and throat.

* They are the main source of voluntary control for the muscles of the head and neck.

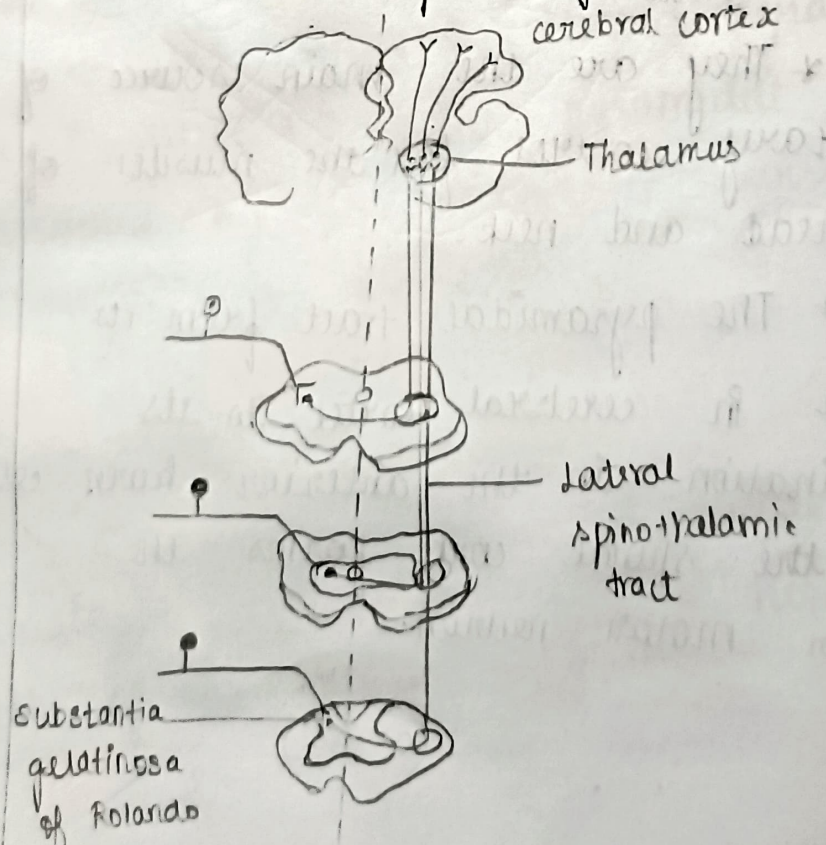
* The pyramidal tract from its origin in cerebral cortex to its termination in the anterior horn cell of the spinal cord forms the upper motor neuron.

The fibres from the anterior horn cell of the spinal cord to its termination on the muscle constituent the lower motor neuron.

Functions:

* The pyramidal tract carries impulses for voluntary movements from the brain to the spinal cord.
* It helps to maintain posture by regulating the action of the trunk muscles.
* It has an influence on the stretch reflex.

2. Describe the pathway for pain sensation



Pathway: (Spinothalamic Tract)

* The fibres arising from the receptors enter the spinal cord through the posterior or dorsal horn and end in the dorsal horn cells. This forms the first order neurons.

* The second order nucleus arise from the dorsal horn cells and cross to the opposite side in front of the central canal. They occupy the lateral or anterior part of the spinal cord.

* The axons of second order neurons from sacral and lumbar segments are pushed laterally after crossing the midline. In the spinal cord, cervical fibres are medial and sacral fibres are lateral.

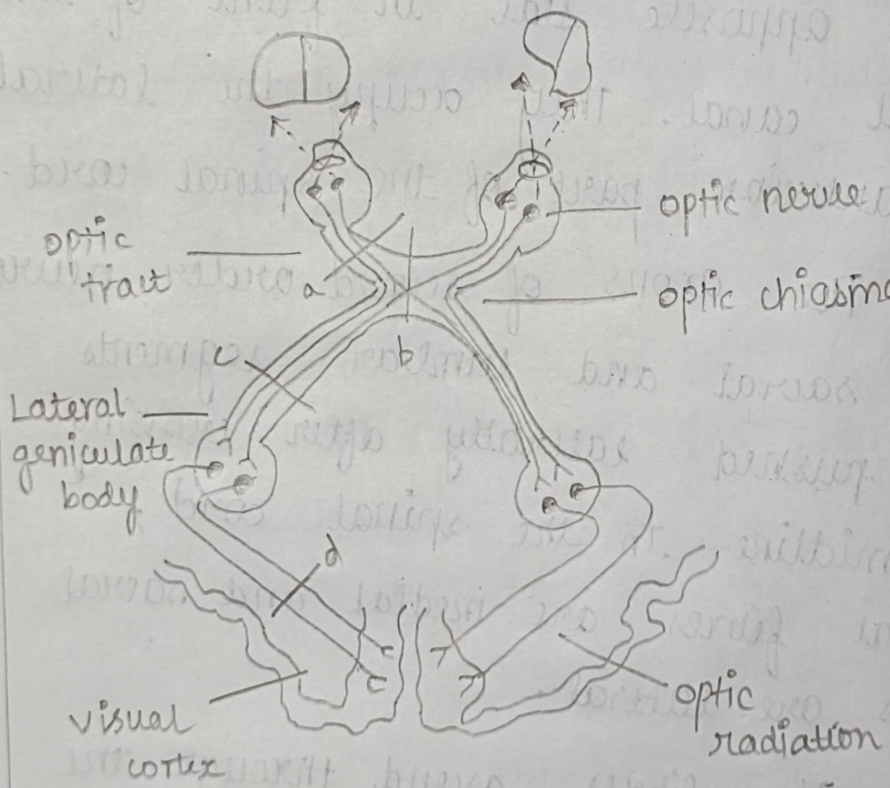
* The fibres ascend through the segments of the spinal cord, medulla, pons and midbrain to end in the ventral posterolateral nucleus of the thalamus

* As the tract ascends through the midbrain, it gives out branches to the reticular formation of brainstem.

Hence, the number of fibres is reduced.

* The third-order neurons from the thalamic nucleus reach the sensory cortex (areas 3, 1, 2).

3. Describe in detail about the visual pathway along with the neat labelled diagram.



* The visual pathway conveys the visual signal from the eye to the CNS

* The receptors for vision are the rods and cones. They synapse

with the ganglion cells. The axon of the ganglion cells form the optic nerve

* The fibres of each optic nerve decussate (crossover) partially at the optic chiasma. The fibres from the nasal half of each retina cross to the opposite side, but those from the temporal halves do not cross.

* After the decussation, an optic tract is formed. The fibres of the optic tract end in the lateral geniculate body. The optic tract contains temporal fibres of the same side and nasal fibres of the opposite side.

* From the lateral geniculate body, the neurons proceed as the optic radiation (geniculocalcarine tract) to terminate in the primary visual cortex (Brodmann's area 17).

* Visual fibers also end in other areas of the brain and are connected with specific function.

* Some of the axons of ganglion cells bypass the lateral geniculate body and reach the pretectal area.

* This pathway controls light reflex and movements of the eye. Frontal cortex and frontal eye fields are bilaterally concerned with eye movements and near response.

* The fibres emerging from the visual pathway perform other functions in addition to visual perception. The biological process exhibiting oscillation of about 24 hours (circadian rhythm) depends on input from the optic tract.

* circadian rhythm is controlled by the fibers of the optic tract reaching the hypothalamus.

* Rapid directional movements of both the eyes is controlled by fibres ending in superior colliculus

* Behavioral functions of the body are controlled by fibres ending in the ventral lateral geniculate body.

Short notes

1. Functions of ascending tracts:

* The ascending tracts are sensory tracts. They carry sensation from different receptors all over the body to the CNS.

* The major spinal tracts are multineuronal pathways connecting the brain and the peripheral parts of the body.

* They contain two or three neurons contributing successive tracts of the pathway.

* Tracts exhibit a precise spatial relationship representing orderly mapping of the body.

* In the uncrossed tracts, the sensory fibres carring information from the upper part of the body are located laterally and those carrying sensation from the lower parts are more medial.

* Ascending tracts relay sensory feedback to the cerebrum and cerebellum.

* Fine touch, vibration, pressure, proprioception, sensation of pain, crude touch, sensation of temperature are the feelings determined by ascending tracts.

2. Functions of descending tracts :

* Descending tracts carry motor information, like instructions to move the arm, from the brain down the spinal cord to the body.

* They carry motor information in efferent nerves from upper motor neurons of cordical structures like the cerebellum and cerebrum.

* The descending tracts transmit the information to lower motor neurons, allowing it to reach muscles.

(i). cortico-spinal tract
→ Influences voluntary movements

(ii) Reticulo spinal tract
→ Inhibits α and γ motor

(iii) Tecto-spinal tract
→ concerned with reflex actions

(iv) vestibulo-spinal tract
→ Acts on α and γ motor neuron

(v). Descending autonomic fibers
→ concerned with control of visceral activity

3. Functions of parietal lobe:

(a) Area 3, 1, 2 : The primary sensory cortex somatosensory area present in the postcentral gyrus.

* They receive information from receptors in the skin, joints and muscles.

* They are also connected with integration of sensory information.

* The map of the entire body is present in the somatosensory cortex. The area occupied by a particular part of the body depends on the number of receptors rather than on the size of the body part.

* Thus, the lips and the tip of a finger have larger representation than the trunk and thorax.

(b) Areas 5, 7:

* These are sensory association areas. They are concerned with the synthesis and interpretation of the information received by the somatosensory cortex.

* They store the memory of past experience, thus helping to compare the present situation with the past experience.

4. Functions of Temporal Lobe:

(a) Area 41, 42:

These are the primary auditory areas. They are responsible for the perceptions of auditory information.

(b) Area 22:

* This is Wernick's area.
* It is concerned with the interpretation of auditory information.
* It interprets the meaning of speech by recognizing spoken words.
* Damage to wernick's area results in fluent aphsia.
* The subject is able to speak but unable to arrange words in coherent fashion.

5. Functions of occipital lobe.

(a) Area 17:

* It is the primary visual area. It is concerned with processing visual information.

(b) Areas 18, 19:

* These are visual association areas. They are concerned with the interpretation of visual information received by the primary visual cortex.

* They are also responsible for the movemsnt of eyes.

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6. Functions of frontal lobe:

(a) Area 4:

* It is the primary motor area. This area helps to initiate voluntary movements.

* Stimulation of the lateral part causes movement of tongue. The arrangement of different parts of the body in motor cortex is termed motor homunculu

(b) Area 6:

* It is the premotor area. The fibers to to pyramidal tract also arise from this region.

* It is connected with skilled movement. It coordinates the actions initiated by area 4.

(c) Area 8:

* It is the frontal eye field area It helps in voluntary and conjugate movements of the eye.

* It also controls the movement of eyelids, size of pupils, and lacrimation.

(d) Area 44:

This is Broca's speech area. It helps in vocalization by controlling the movements of lips, tongue, larynx and respiratory muscles.

→ supplementary motor area:

* It lies in longitudinal fissure and extends to the superior frontal cortex. stimulation of this area produces contraction of muscle groups bilaterally.

(e) Pre-frontal cortex (9, 10, 11, 12, 13, 14, 29, 32).

It is connected with complex learning abilities, intelligence, personality, recall of information, reasoning, judgement, long term planning and conscience.

1. Functions of cerebellum:

(i) Vestibulocerebellum (Archicerebellum):

* concerned with the maintenance of balance and equilibrium ...
* Responsible for regulating the stability of head and body in space.
* Adjusts the tone of the trunk muscle and controls the ocular movements and postural reflexes.

(ii) Spinocerebellum (Paleocerebellum):

* Maintains the posture and helps in execution of gross movements.
* controls the interplay between the agonist and the antagonist group of muscles.
* Essential for the control of rapid muscular activities such as running and talking.

(iii) Cerebrocerebellum (Neocerebellum):

* controls fine, highly precise, and coordinated movements.
* Involved in programming of voluntary and skilled movements.

* Plays a major role in the timing of the motor activities and rapid progression from one movement to the next.

8. Functions of Basal ganglia:

* Responsible for planning and programming the voluntary motor activity. The thinking process starts in the brain from sensory inputs, stored memory and intended activity.

* Regulates stretch reflex throughout the body.

* controls the transfer of information from sensory and association areas to motor cortex.

* Essential for initiation, control and cessation of muscular activity

* Provides the necessary muscle tone for skilled movements

* coordinates the impulses for skilled motor activity.

* controls the normal automatic associated movements.

* Regulates the subconscious gross associated movements.

* Intact basal ganglia are necessary for a normal degree of tone and posture.

* controls the activity of muscle group of emotional expression.

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9. Functions of hypothalamus:

(i). control of food intake:

* The coordinated activity of these centers determines the feeding behaviour of the animal.

The mechanisms of control of food intake are as follows:

→ Glucostatic hypothesis
→ Lipostatic hypothesis
→ Gut peptide hypothesis
→ Thermostatic hypothesis

(ii). Regulation of water balance:

It controls water body by controlling water excretion from the body and fluid intake through the third mechanism.

(iii) control of anterior pituitary:

The hypothalamus produces releasing and inhibiting factors, which regulate the secretion from anterior pituitary.

(iv) control of posterior pituitary:

The hypothalamus regulates the formation and release of oxytocin and ADH.

(v) Regulation of body temperature:

It maintains the body temperature within a narrow range of fluctuation.

(vi) control of autonomic function:

The stimulation of hypothalamus produces vasoconstriction, decrease and increase in heart rate.

(vii) control of sleep and wakefulness

(viii) control of the circadian rhythm

(xi) control of behaviour.

10. Functions of Thalamus:

* A sensory relay station; relays general and special sensations except smell sensation.

* Functions as a subcortical center for perception of pain sensation.

* Helps in information storage and short-term memory.

* Forms a functional part of the reticular activating system responsible for consciousness, sleep and wakefulness.

* Forms a part of the neural circuit (papez) for emotional experience, personality and social behaviour.

* Regulates autonomic functions associated with emotions.

* Integrates cortical and subcortical areas for execution of speech.

* Plays an important role in the genesis and synchronization of waves of ECG.

* Forms a link between the cerebellum, basal ganglia and cerebral cortex.

11. Functions of middle ear:

* The ossicles of the middle ear conduct the sound from the external ear to the internal ear. They also amplify the sound.

* They provide impedance matching for the sound waves in air and movement of base of stapes in cochlear fluid.

* The small muscles, tensor tympani, and stapedius help in protecting the auditory receptors against loud sound (tympanic reflex or attenuation reflex).

* The Eustachian tube helps to equalize the pressure on either side of the tympanic membrane.

12. Trace the pathway for taste sensation.

* The nerve fibers from the anterior and posterior parts of the tongue end on the gustatory portion of the nucleus of tractus

solitarius (NTS) present in the medulla of brain.

* The second-order neurons arising from NTS end in the ventral posteromedial (VPM) nucleus of the thalamus.

* The third-order neurons arising from the thalamus end on the face area of the somatosensory cortex (lower lateral part of the postcentral gyrus deep in the lateral surface).

* Three nerves carry taste signals to the brain stem. They are

(i) The chorda tympani nerve (from the ~~to~~ front of the tongue)

(ii) The glossopharyngeal nerve (from the back of the tongue)

(iii) The vagus nerve (from the throat area and palate).

* Taste signals combine in the brain stem areas involved in arousal then with smell signals in the brain to produce the sensation of flavour.

13. Trace the pathway for olfaction:

* The axons of the olfactory cells pierce the cribiform plate of the ethmoid bone and end in the olfactory bulb.

* The short axons from the olfactory cells terminate in multiple globular structures within the olfactory bulb called glomeruli.

* Each glomerulus has dendrites from mitral cells and tufted cells.

* These cells in turn send axons through the olfactory tract to transmit olfactory sensations to CNS.

* The olfactory tract enters the brain at the anterior junction between the mesencephalon and the cerebrum.

* The tract divides into two pathways:

(i) Medial olfactory area

(ii) Lateral olfactory area.

Short notes:

1. Different Taste sensation:
   * sweet
   * salt
   * sour
   * Bitter
   * Umami.

2. Primary colours:
   Primary colours are basic colours that can be mixed together to produce other colours. They are
   * Red
   * green
   * Blue

3. Receptors for
   (i) vision – photoreceptors (rods and cones)
   (ii) Hearing – cochlea.

4. saltatory conduction:
   It describes the way an electrical impulse skips from node to node down the full length of an axon, speeding the arrival of impulse at nerve terminal.

5. Proprioreceptors:

These receptors provide information about the orientation of different parts of the body in space.

Eg: muscle spindle and Golgi Tendon organ

6. Blood brain barrier: (Functions)

* Maintains constancy of environment for the neurons in CNS.
* Protects brain from the effect of endogenous toxins.
* Prevents the escape of neurotransmitters from the CNS.

7. Impedance matching:

certain amplification is required to overcome the resistance offered by the fluid to the internal ear for the movement of the base of stapes. This is called impedance matching.

8. Two ascending Tracts:

* spinothalamic tract
* spinocerebellar tract

9. Two descending tracts:

* Cortico-spinal tract
* Reticulo-spinal tract.

10. synapse:

The synapse is a function between two neurons. The information from the nerve terminal of one neuron to other.

classification:

(a) anatomical types

* Axoaxonic
* Axodendritic
* Axosomatic
* Dendrodendritic

(b) Functional types

* Electrical
* Chimical
* confoint.

11. Receptors:

The receptors are modified nerve terminals capable of converting different forms of energy into electrical energy.

classification:

* Exteroreceptors
* Interoreceptors
* Telereceptors
* Proprioreceptors.