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Assignment: Discuss the somatosensory pathways

Nervous pathways of sensations are called the sensory pathways. These pathways carry the impulses from receptors in different parts of the body to centers in brain.

Sensory pathways are of two types :

1. Pathways of somatosensory system
2. Pathways of viscerosensory system.

Pathways of somatosensory system convey the information from sensory receptors in skin, skeletal muscles and joints. Pathways of this system are constituted by somatic nerve fibers called somatic afferents.

Pathways of viscerosensory system convey the information from receptors of the viscera. Pathways of this system. Are constituted by visceral or autonomic fibers.

A somatosensory pathway will typically consist of three neurons: primary, secondary, and tertiary.

In the periphery, the primary neuron is the sensory receptor that detects sensory stimuli like touch or temperature. The cell body of the primary neuron is housed in the dorsal root ganglion of a spinal nerve or, if sensation is in the head or neck, the ganglia of the trigeminal or cranial nerves.

The secondary neuron acts as a relay and is located in either the spinal cord or the brainstem. This neuron's ascending axons will cross, or decussate, to the opposite side of the spinal cord or brainstem and travel up the spinal cord to the brain, where most will terminate in either the thalamus or the cerebellum.

Tertiary neurons have cell bodies in the thalamus and project to the postcentral gyrus of the parietal lobe, forming a sensory homunculus in the case of touch. Regarding posture, the tertiary neuron is located in the cerebellum.

## TRACTS IN THE SPINAL CORD

Groups of nerve fibres passing through spinal cord are known as tracts of the spinal cord. The spinal tracts are divided into two main groups.

- Short Tracts

Fibres of the short tracts connect different parts of spinal cord itself. Short tracts are of two types:

- I. Association or intrinsic tracts: which connect adjacent segments of spinal cord on the same side
- II. Commissural tracts, which connect opposite halves of same segment of spinal cord.

- Long Tracts

Long tracts of spinal cord, which are also called projection tracts, connect the spinal cord with other parts of central nervous system.

Long tracts are of two types:

- I. Ascending tracts, which carry sensory impulses from the spinal cord to brain
- II. Descending tracts, which carry motor impulses from brain to the spinal cord.

## ASCENDING TRACTS OF SPINAL CORD

Ascending tracts of spinal cord carry the impulses of various sensations to the brain. Pathway for each sensation is formed by two or three groups of neurons, which are:

- First order neurons
- Second order neurons
- Third order neurons.

### First Order Neurons

First order neurons receive sensory impulses from the receptors and send them to sensory neurons present in the posterior gray horn of

spinal cord through their fibres. Nerve cell bodies of these neurons are located in the posterior nerve root ganglion.

### Second Order Neurons

Second order neurons are the sensory neurons present in the posterior gray horn. Fibres from these neurons form the ascending tracts of spinal cord. These fibres carry sensory impulses from spinal cord to different brain areas below cerebral cortex (subcortical areas) such as thalamus. All the ascending tracts are formed by fibres of second order neurons of the sensory pathways except the ascending tracts in the posterior white funiculus, which are formed by the fibres of first order neurons.

### Third Order Neurons

Third order neurons are in the subcortical areas. Fibres of these neurons carry the sensory impulses from subcortical areas to cerebral cortex.

- **ANTERIOR SPINOTHALAMIC TRACT**

Anterior spinothalamic tract is formed by the fibres of second order neurons of the pathway for crude touch sensation.

#### Effect of lesion

Bilateral lesion of this tract leads to loss of crude touch sensation and loss of sensation like itching and tickling. Unilateral lesion of this tract causes loss of crude touch sensation in opposite side below the level of lesion (because fibres of this tract cross to the opposite side in spinal cord).

- **LATERAL SPINOTHALAMIC TRACT**

Lateral spinothalamic tract is formed by the fibres from second order neurons of the pathway for the sensations of pain and temperature.

#### Effect of lesion

Bilateral lesion of this tract leads to total loss of pain and temperature sensations on both sides below the level of lesion. Unilateral lesion or sectioning of the lateral spinothalamic tract causes loss of pain (analgesia) and temperature (thermoanaesthesia) below the level of lesion in the opposite side.

- **VENTRAL SPINOCEREBELLAR TRACT**

Ventral spinocerebellar tract is also known as Gower tract, indirect spinocerebellar tract or anterior spinocerebellar tract. It is constituted by the fibres of second order neurons of the pathway for subconscious kinesthetics sensation.

Effect of Lesion

Lesion of this tract leads to loss of subconscious kinesthetics sensation in the opposite side.

- **DORSAL SPINOCEREBELLAR TRACT**

Dorsal spinocerebellar tract is otherwise called Flechsig tract, direct spinocerebellar tract or posterior spinocerebellar tract. Like the ventral spinocerebellar tract, this tract is also constituted by the second order neuron fibres of the pathway for subconscious kinesthetics sensation. The first order neurons are in the posterior nerve root ganglia. But, the fibres of this tract are uncrossed.

Effect of lesion

Unilateral loss of the subconscious kinesthetics sensation occurs in lesion of this tract on the same side, as this tract has uncrossed fibres.

- **SPINOTECTAL TRACT**

Spinotectal tract is considered as a component of anterior spinothalamic tract. It is constituted by the fibres of second order neurons.

- **FASCICULUS DORSOLATERALIS**

Fasciculus dorsolateralis is otherwise called tract of Lissauer. It is considered as a component of lateral spinothalamic tract. And, it is constituted by the fibres of first order neurons.

- **SPINORETICULAR TRACT**

Spin reticular tract is formed by the fibres of second order neurons.

- **SPINOOLIVARY TRACT**

Spino-olivary tract is situated in anterolateral part of white column. Origin of the fibres of this tract is not specific. However, the fibres terminate in olivary nucleus of medulla oblongata. From here, the neurons project into cerebellum. This tract is concerned with proprioception.

- **SPINOVESTIBULAR TRACT**

Spinovestibular tract is situated in the lateral white column of the spinal cord. Fibres of this tract arise from all the segments of spinal

cord and terminate on the lateral vestibular nucleus. This tract is also concerned with proprioception.

- FASCICULUS GRACILIS (TRACT OF GOLL) AND

- FASCICULUS CUNEATUS (TRACT OF BURDACH)

Fasciculus gracilis and fasciculus cuneatus are together called ascending posterior column tracts. These tracts are formed by the fibres from posterior root ganglia. Thus, both the tracts are constituted by the fibres of first order neurons of sensory pathway.

#### Effect of Lesion

Lesion of nerve fibres in tracts of Goll and Burdach or lesion in the posterior white column leads to the following symptoms on the same side below the lesion:

I. Loss of fine tactile sensation; however, crude touch sensation is normal

II. Loss of tactile localization

III. Loss of two-point discrimination

IV. Loss of sensation of vibration

V. Astereognosis (inability to recognize known objects by touch while closing the eyes)

VI. Lack of ability to differentiate the weight of different objects

VII. Loss of proprioception (inability to appreciate the position and movement of different parts of the body)

VIII. Sensory ataxia or posterior column ataxia (condition characterized by uncoordinated, slow and clumsy voluntary movements because of the loss of proprioception).

- COMMA TRACT OF SCHULTZE

Comma tract of schultze is also called fasciculus interfascicularis. It is situated in between tracts of Goll and Burdach. This tract is formed by the short descending fibres, arising from the medial division of posterior nerve root. These fibres are also considered as the descending branches of the tracts of Goll and Burdach. Function of this tract is to establish intersegmental communications and to form short reflex arc.