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DISCUSS THE SOMATOSENSORY PATHWAYS.

The somatosensory system is composed of the neurons that make sensing touch, temperature, and position in space possibwe. It is distributed throughout all major parts of our body. It is also responsible for sensing touch, temperature, posture, limb position, and more. It includes both sensory receptor neurons in the periphery (eg., skin, muscle, and organs) and deeper neurons within the central nervous system.

The 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.

There are numerous pathways which allow different types of information to be passed to the brain. Types of general somatic sensation include pain, touch, temperature and kinaesthesia (conscious proprioception). This sensory information is sent to one of two destinations; the cerebral cortex or the cerebellum.

When sensory information is relayed to the cerebral cortex, information first passes via the thalamus. The signal may be relayed one or more times by the thalamus en route to the cortex. This sensory information reaches higher levels within the brain and therefore consciousness. The cerebellum is involved in co-ordination and this sensory information does not reach consciousness.

The primary somatosensory area of the human cortex is located in the postcentral gyrus of the parietal lobe. The postcentral gyrus is the location of the primary somatosensory area, the area of the cortex dedicated to the processing of touch information. At this location there is a map of sensory space referred to as a sensory homunculus. A cortical homunculus is the brain's physical representation of the human body; it is a neurological map of the anatomical divisions of the body. The surface area of cortex dedicated to a body part correlates with the amount of somatosensory input from that area. For example, there is a large area of cortex devoted to sensation in the hands, while the back requires a much smaller area. Somatosensory information involved with proprioception and posture is processed in the cerebellum.

FUNCTIONS.

The somatosensory system functions in the body's periphery, spinal cord, and the brain.

Periphery: Sensory receptors (i.e., thermoreceptors, mechanoreceptors, etc.) detect the various stimuli.

Spinal cord: Afferent pathways in the spinal cord serve to pass information from the periphery and the rest of the body to the brain.

Brain: The postcentral gyrus contains Brodmann areas (BA) 3a, 3b, 1, and 2 that make up the somatosensory cortex. BA3a is involved with the sense of relative position of neighboring body parts and the amount of effort being used during movement. BA3b is responsible for distributing somatosensory information to BA1 and shape and size information to BA2.

THE SOMATOSENSORY PATHWAY.

Sensations from the skin, muscles, and internal organs of the body are transmitted to the central nervous system via axons that enter via spinal nerves. Somatosensory information from the head and face is carried to the brain primarily via cranial nerve V, the trigeminal nerve. The cell bodies of these somatosensory receptors are located in clusters called dorsal root ganglia and cranial nerve ganglia. Two separate somatosensory pathways transmit information about sensations that are tightly localized (fine touch of the exteroceptive system & kinesthesia of the proprioceptive system) and poorly localized (temperature and pain of the exteroceptive system). Fine touch ascends via the segment of spinal cord white matter called the dorsal columns (the dorsal-column medial-lemniscal system), whereas diffuse somatosensory information ascends via the spinothalamic tract of the spinal cord (the anterolateral system). Each pathway projects to distinct areas of the thalamus and somatosensory cortex located in parietal lobe.

The dorsal-column medial-lemniscal system begins with somatosensory axons entering the spinal cord via the dorsal root and ascending in the dorsal columns ipsilaterally. The first synapse point for this pathway is in the dorsal column nuclei located in the medulla. The axons of neurons originating in the dorsal column nuclei decussate (cross over), ascending via the medial lemniscus to the contralateral ventral posterior thalamic nucleus (VPN). Somatosensory

fibers of the trigeminal nerve (CN V), carrying information from the contralateral side of the face and head, also synapse in the VPN. The majority of VPN neurons project to the primary somatosensory cortex (SI), the remaining project to the secondary somatosensory cortex (SII) of the posterior parietal lobe.

The anterolateral system begins with somatosensory axons entering the spinal cord via the dorsal root and synapsing upon entry. The majority of these second-order axons decussate, and ascend to the brain via the anterolateral portion of the spinal cord white matter. This ascending system is composed of three separate tracts, the spinothalamic tract, the spinoreticular tract, and the spinotectal tract. The spinothalamic tract projects to the ventral posterior nucleus of the thalamus. This tract is involved in the perception of touch, temperature, and sharp pain. The spinoreticular tract projects to the brain stem reticular formation on its way to the parafasicular nucleus and intralaminar nucleus of the thalamus. This pathway seems to be selectively involved in the perception of deep, chronic pain. The spinotectal tract projects to the tectum of midbrain. This tract is likely involved in some aspect of pain perception. The tracts of the anterolateral system project to both the primary and secondary somatosensory cortex, and to more posterior locations within the parietal lobe.

The selective area of skin innervated by the left and right dorsal roots of a particular spinal nerve is called a dermatome. The surface of the body has been mapped according to these dermatomes. It is important to note, however, that in reality the boundaries of these somatosensory regions overlap each other by approximately half of their width. Damage to a single dorsal root, therefore, produces slight loss of sensation. Both the sensation type and region of body represented are kept somewhat separate along all levels of the somatosensory pathway.

The Basic parts In Somatosensory pathways are:

1) The inputs from the body and head that form the medial and trigeminal lemnisci coalesce in the thalamus to form a single body map, which projects to the somatosensory cortex to form the humunculus.

2) Both pathways are crossed (although they cross at different anatomical levels) - this means that somatosensory stimuli from one side are perceived in the contralateral cortex.

3) The spinothalamic tract projects to more diffuse areas of cortex, directly activating non-sensory regions.