Corticospinal (pyramidal) and corticonuclear tract

Contains Info about: Corticospinal (pyramidal) and Corticonuclear tract

Descending tracts serve as the conduits through which motor signals travel from the brain to lower motor neurons, which then directly innervate muscles to initiate movement. These tracts can be broadly categorized into two groups based on their origin and function:

1. Cortical Origin (Pyramidal Tracts): These tracts originate in the cerebral cortex and are responsible for voluntary control of body and facial musculature.
    - Corticospinal Tract: Majority of fibers cross at the medullary pyramids to form the lateral corticospinal tract, while a portion remains uncrossed, forming the anterior corticospinal tract.
    - Cortico-Nuclei Tracts: These include cortico-pontine, cortico-mesencephalic, and cortico-medullary (cortico-bulbar) tracts.
2. Subcortical Origin (Extrapyramidal Tracts): Originating in the brainstem, these tracts control involuntary and automatic musculature functions such as muscle tone, balance, posture, and locomotion.
    - Rubro-Spinal, Vestibulo-Spinal, Reticulo-Spinal, Tecto-Spinal, and Olivo-Spinal Tracts.

In the descending pathways, there are no synapses; the neurons synapse directly with lower motor neurons. Thus, all neurons within the descending motor system are categorized as upper motor neurons. Their cell bodies are located in the cerebral cortex or brainstem, with their axons remaining in the central nervous system (CNS) until synapsing with lower motor neurons that extend to the peripheral nervous system (PNS).

- Corticospinal Tracts: Supply musculature of the body.
- Corticobulbar Tracts: Supply musculature of the head and neck.

Corticospinal tracts

The corticospinal tracts, originating in the cerebral cortex, receive inputs from key areas like the primary motor cortex, premotor cortex, and supplementary motor area. After this origin, these neural pathways converge and make their way through a vital white matter pathway called the internal capsule. It's worth noting that this pathway is quite susceptible to compression from hemorrhagic bleeds, known as capsular stroke, which can affect the descending tracts.

Continuing their journey, these neural pathways travel through the midbrain's crus cerebri, the pons, and eventually reach the medulla. At the lower part of the medulla, the corticospinal tract splits into two distinct branches:

1. Lateral Corticospinal Tract: This tract carries about 90% of the fibers. These fibers cross over (decussate) at a point called the pyramids in the medulla and then descend into the spinal cord through the lateral columns. Here, they connect with lower motor neurons in the ventral horn, responsible for controlling muscles in the limbs.
2. Anterior Corticospinal Tract: The remaining fibers that don't cross over at the pyramids continue their descent on the same side (ipsilaterally). They form the anterior corticospinal tract within the spinal cord's anterior columns. These fibers eventually cross over at a lower level and innervate muscles associated with trunk and abdominal movements. They terminate in the ventral horn of specific spinal cord segments.

Understanding these pathways sheds light on how the brain communicates with lower motor neurons to control voluntary movements throughout the body.

Corticobulbar Tracts (also known as Corticonuclear tracts)

The corticobulbar tracts emerge from the lateral aspect of the primary motor cortex, receiving similar inputs as the corticospinal tract. These neural pathways converge and traverse through the internal capsule, making their way to the brainstem.

Once in the brainstem, the neurons of the corticobulbar tracts terminate on the motor nuclei of the cranial nerves. Here, they synapse with lower motor neurons, which then carry the motor signals to the muscles of the face and neck.

It's clinically significant to understand how the corticobulbar (or corticonuclear) fibers are organized. Many of these fibers innervate the motor neurons bilaterally. For instance, fibers originating from the left primary motor cortex act as upper motor neurons for both the right and left trochlear nuclei.

However, there are a few exceptions to this bilateral innervation pattern:

- Upper motor neurons for the facial nerve exhibit contralateral innervation, affecting only the muscles below the eyes.
- Upper motor neurons for the hypoglossal nerve provide solely contralateral innervation.

This organization sheds light on the complex neural pathways involved in controlling facial and neck muscles, underscoring the importance of understanding these patterns in clinical settings.

Clinical

1. Injury above decussation of pyramid - Damage to contralateral side of motor control
2. injury below decussation of pyramid - Damage to ipsilateral side of motor control
3. Corticonuclear Damage - Results in damage to motor activity of cranial nerves (Exception : oculomotor CN II, which connected via interneurons and receive information also from other structures.)