

Unit 4 Lecture 11

The Spinal Cord and Spinal Nerves

THE MENINGES

The meninges are three coverings that run continuously around the spinal cord and brain. The outermost layer is the dura mater, the middle layer is the arachnoid, and the innermost layer is the pia mater which contains many blood vessels. Between the vertebral wall and dura mater is the epidural space which is lined with fat, blood vessels, and connective tissue (protective layer). Between the dura mater and the arachnoid is the subdural space which contains interstitial fluid. Between the arachnoid and pia mater is the subarachnoid space which contains cerebral spinal fluid. Inflammation of the meninges is called meningitis and requires immediate clinical intervention.

SPINAL CORD ANATOMY

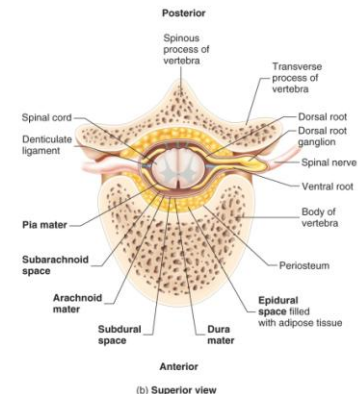
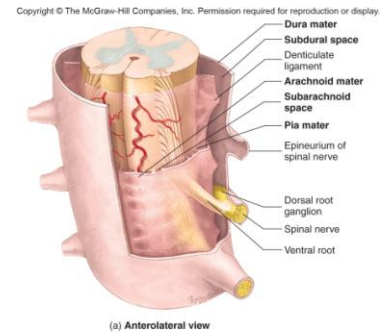
The spinal cord is protected by the vertebral column. The meninges, cerebral spinal fluid, vertebral ligaments, and denticulate ligaments protect the spinal cord against shock and displacement.

External Anatomy of the Spinal Cord

The spinal cord begins as a continuation of the medulla oblongata and terminates at about the second sacral vertebra in an adult. It is composed of thirty-one segments, each giving rise to a pair of spinal nerves. It contains the cervical and lumbar enlargements that serve as points of origin for nerves to the extremities. The tapered end of the spinal cord is the conus medullaris, from which arise the filum terminale and cauda equina. The spinal cord is divided into left and right sides by the anterior median fissure and posterior median sulcus. A spinal tap removes CSF to diagnose pathologies and to administer drugs.

Internal Anatomy of the Spinal Cord

The gray matter is shaped like the letter H and is surrounded by white matter; gray matter is divided into horns and white matter into columns. White matter is composed of bundles of myelinated nerve fibers. In the center of the spinal cord is the central canal, which runs the length of the spinal cord and contains CSF. Parts of the spinal fluid observed in cross section are the gray commissure, central canal, anterior, posterior, and lateral gray horns, anterior, posterior and lateral white columns, and ascending and descending tracts. The spinal cord conveys sensory and motor information by way of the ascending and descending tracts, respectively.



Peripheral Nervous System (PNS)

The peripheral nervous system consists of cranial and spinal nerves that branch out from the brain and spinal cord to all body parts. It is divided into the Somatic and the Autonomic Nervous Systems.

Spinal Nerves

Thirty-one pairs originate in the spinal cord and provide a two-way communication system between the spinal cord and the arms, legs, neck and trunk. They are grouped according to the vertebral levels from which they arise and are numbered sequentially. They have dorsal and ventral roots. Dorsal roots contain sensory fibers and have a dorsal root ganglion. Ventral roots contain motor fibers. Just beyond its foramen, each spinal nerve divides into several branches known as rami. Most spinal nerves form plexuses that direct nerve fibers to a particular body area. The main plexuses are the cervical plexus, brachial plexus, lumbar plexus, and sacral plexus. Refer to your text to reference which locations in the body are served by each plexus. The skin over the entire body surface is supplied by somatic neurons. A **dermatome** is the spinal nerve that provides the sensory input to the CNS.

SPINAL CORD PHYSIOLOGY

Sensory and Motor Tracts

A major function of the spinal cord is to convey nerve impulses from the periphery to the brain (via sensory tracts) and to conduct motor impulses from the brain to the periphery (via motor tracts). Sensory information travels up the spinal cord to the brain along three main routes on each side of the cord: the spinothalamic tracts and the posterior column tracts (fasciculus gracilis and fasciculus cuneatus). The spinothalamic tracts conduct impulses related to pain, temperature, touch and deep pressure. Proprioception is awareness of movements of muscles, tendons, and joints. Discriminative touch is the ability to feel exactly what part of the body is touched. Two-point discrimination is the ability to feel when two points are touched even if they are close together.

The descending tracts are corticospinal, reticulospinal, and rubrospinal tracts found in the lateral portions of the spinal cord. Motor information travels from the brain down the spinal cord to the muscles and glands along two main descending tracts, the pyramidal tracts (corticospinal tracts) and the extrapyramidal tracts (reticulospinal and rubrospinal tracts). The direct (pyramidal) tracts carry impulses for voluntary movements. The indirect (extrapyramidal) tracts carry impulses for automatic movements of voluntary muscles. Many of the fibers in the ascending and descending tracts cross over in the spinal cord or brain.

Reflexes

A second function of the spinal cord is to be an integrating center for spinal reflexes. This is performed in the gray matter. A reflex is a fast, predictable, automatic response to changes in the environment that helps to maintain homeostasis. In addition to the spinal reflex, reflexes may also be cranial (if it involves the brain as the integration center), somatic, or autonomic (involves visceral reflexes).

There are five types of reflexes: the [reflex arc](#), the stretch reflex, the tendon reflex, the withdrawal reflex, and the crossed extensor reflex. A reflex arc is the simplest type of pathway; pathways are specific neuronal circuits and include at least one synapse. The components of the reflex arc are the receptor, sensory neuron, integrating center, motor neuron, and effector. In Reflex Behavior, the reflexes are automatic, unconscious responses to changes. The stretch reflex causes contraction of a muscle that has already been stretched. The tendon reflex causes relaxation of the muscle attached to the stimulated tendon. The withdrawal reflexes are protective actions. Finally, a crossed extensor reflex causes contraction of muscles that extend joints in the limb opposite a painful stimulus.

Why is this chapter important?

The chapter covers the spinal cord and nerves and how they contribute to homeostasis by providing quick, reflexive responses to many stimuli. You should know the layers of the spinal cord as well as the columns and tracts found within the cord and their function. Also covered are the major plexuses and the reflexes.