# The Spinal Cord

The spinal cord is part of the central nervous system. It is a continuation of the medulla and passes out of the cranial vault through the foramen magnum and continues to run caudally in the vertebral canal, formed from the adjacent vertebral foramina.

Realize that the spinal cord does not extend the entire length of the vertebral column in the adult. In the developing embryo the spinal cord extends all the way down to the sacral region, however, during growth and development the vertebral column grows faster than the spinal cord, thus spinal levels and vertebral levels do not coincide.

1) realize that the spinal cord ends at approximately the L3 vertebral level in infants, and approximately the L1-L2 vertebral level in adults.
2) this mean that the spinal cord segments do not correspond to the vertebral levels.

Notice that the spinal cord has two areas of enlargement.

1) Cervical enlargement.
2) Lumbosacral enlargement.

These enlargements are caused by the corresponding nerves making up the brachial plexus and the lumbar and sacral plexi.

## Spinal Nerves

There are 31 pair of spinal nerves.

8 cervical.
12 thoracic.
5 lumbar.
5 sacral.
1 coccygeal.

Note that there are only 7 cervical vertebrae, thus one pair of cervical spinal nerves exits the spinal cord above C1.

Spinal nerves are made of dorsal and ventral roots.

Ventral roots leave the anterior (ventral) horn of the spinal cord and carry motor (efferent) fibers.
Dorsal roots enter the posterior (dorsal) horn of the spinal cord and carry sensory (afferent) fibers.

This means that the cell bodies whose axons make up the ventral root are found in the ventral horn of the spinal cord. Note that these are unipolar neurons.

The dorsal root, however, is comprised of axons from pseudounipolar neurons whose cell bodies are located in the dorsal root ganglion (spinal ganglion). The spinal ganglion is found in the intervertebral foramen, here it can lay on the pedicle of the lower vertebra.

Distal to the spinal ganglion, and immediately outside the vertebral foramen, the dorsal and ventral roots join to form a spinal nerve. This spinal nerve subsequently divides into a dorsal and ventral rami.

DO NOT confuse dorsal and ventral rami with dorsal and ventral roots.

Notice the spinal cord ending at approximately the L1-L2 vertebral level, yet the dorsal and ventral roots continue down the vertebral canal to exit at their appropriate vertebral levels. This collection of dorsal and ventral roots is termed the cauda equina which literally means the horses tail.

The tip (caudal end) of the spinal cord is cone shaped and is termed the conus medullaris.

Extending from the tip of the conus medullaris is a delicate filament which helps anchor the spinal cord, the filum terminale. It ends at the S2 vertebral level where it attaches to the inferior portion of the dural sac. The filum terminale has no functional significance.

## The Meninges

The meninges are thin tissue layers which surround and support the spinal cord.

There are three layers of meninges:
1) dura mater.
2) arachnoid mater.
3) pia mater.
the arachnoid and pia mater together are termed the leptomeninges.

### Dura Mater (tough mother)

is the outermost layer of the meninges and is composed of fibrous and elastic tissue. It surrounds the brain and the spinal cord. The spinal portion is a long tube which hangs from the foramen magnum and is usually anchored at the inferior border of S2 in adults

### Arachnoid Mater (weblike)

is the middle layer of the meninges. It very closely follows the dura mater but is not adhered to it. The dura and arachnoid are separated by a potential space termed the subdural space. Note that the arachnoid also surrounds the cauda equina.

### Pia Mater (tender mother)

is the deepest layer of the meninges. it is separated from the arachnoid by an actual space, the subarachnoid space. These two layers are connected by delicate strands of connective tissue called arachnoid trabeculae. The subarachnoid space is filled with CSF (cerebrospinal fluid) which bathes the brain and spinal cord with shock absorbing fluid.

The pia mater is made up of two fused layers of loose connective tissue. These enclose a fine meshwork of blood vessels and adhere very closely to the spinal cord.

The pia mater forms the denticulate ligaments. These are ligaments (21 of them) which anchor the spinal cord to the dura mater.

## Blood supply of the spinal cord

The spinal cord receives its blood supply principally from 3 longitudinal vessels.
1 anterior spinal artery and 2 posterior spinal arteries

### Anterior Spinal Artery

runs down the entire length of the spinal cord in the ventral median fissure

supplies the anterior 2/3 of the spinal cord

Notice that it begins to taper until it is resupplied by a major radicular artery. Thus it is smallest in the area of vertebral levels T4 to T8.

### Posterior Spinal Artery

arises off of either the vertebral arteries or the posterior inferior cerebellar arteries and passes down the posterior aspect of the spinal cord.

These arteries have extensive anastomoses between themselves and the anterior spinal artery.

In general, the posterior spinal arteries supply the posterior 1/3 of the spinal cord.

Notice that these vessels also taper until resupplied by radicular arteries.

The anterior and posterior arteries alone can only supply enough blood to maintain the upper cervical segments of the spinal cord, hence they must be supplied with blood at increasingly lower levels. This is accomplished via radicular arteries.

Anterior radicular arteries supply the anterior spinal artery.

Posterior radicular arteries supply the posterior spinal arteries.

The radicular arterial supply arises from spinal branches of the following arteries:
1) vertebral.
2) ascending cervical.
3) posterior intercostal.
4) lumbar.
5) lateral sacral.

The radicular arteries also supply the vertebra and the meninges.

These arteries enter through the intervertebral foramen and pass along the anterior and posterior (ventral and dorsal) roots of the spinal nerves to reach the cord.

The Great Radicular Artery (artery of Adamkiewicz)
is a large artery, usually one of the anterior radiculars, which supplies the lumbosacral enlargement of the cord.

is also known as the arteria radicularis magnus. It is important because it is the major blood supply to the inferior 2/3 of the spinal cord.

Notice the watershed area of the spinal cord in the midthoracic region.

Venous Drainage of the Spinal Cord.

The veins of the spinal cord are distributed similar to the arteries. There are usually 3 anterior veins and 3 posterior veins. These veins communicate extensively with each other and are drained via radicular veins which lead to intervertebral veins and then to vertebral veins, ascending lumbar veins, and to the azygous system.