Brown-Séquard Syndrome and Tabes Dorsalis — Anatomy and Lesions of the Spinal Cord

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The spinal cord is the continuation of the brain stem medulla below the foramen magnum. This article discusses Brown-Séquard syndrome and tabes dorsalis, which are lesions and diseases of the spinal cord.

Anatomy of the Spinal Cord

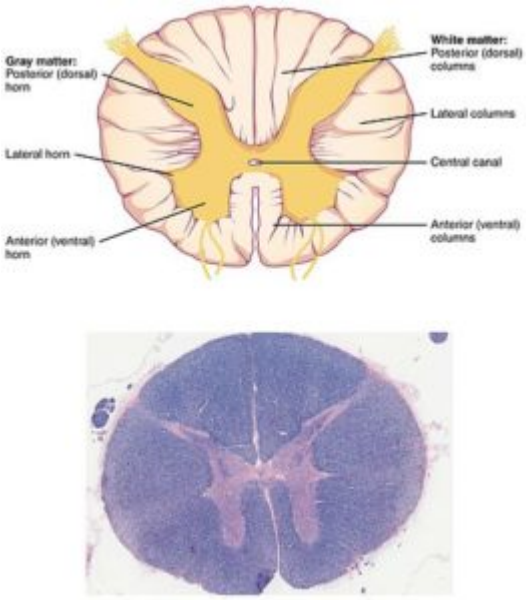

Image: "Cross section of the spinal cord" by OpenStax – https://cnx.org/contents/FPtK1zmh@8.25:fEI3C8Ot@10/Preface. License: CC BY 4.0

The spinal cord consists of H-shaped gray matter surrounded by white matter. The central canal contains cerebrospinal fluid, which runs in the center of the H.

The H is organized into the anterior horn, which subserves motor function, and the thinner posterior horn, which subserves sensory function. The white matter tracts are organized as shown in the diagram. The lateral corticospinal tract, spinothalamic tract, and dorsal tracts are the most important parts of the spinal cord. The functions of the various tracts are summarized below.

Tract	Description
Dorsal column: Gracilis (medial) and cuneatus (lateral) The organization from medial to lateral is sacral to cervical fibers.	Ascending tract: Position sense, vibration sense, and fine touch from ipsilateral side to the gracilis and cuneate nucleus in the medulla. They cross in the medulla as internal arcuate fibers and proceed to the contralateral somatosensory cortex via the thalamus.
Pyramidal tract: The organization from medial to lateral is cervical to sacral fibers.	Descending tract: Lateral corticospinal tract: crosses in the pyramid in the medulla Anterior corticospinal tract: crosses in the spinal cord Provides supraspinal contralateral inhibitory control on the anterior horn cells modulating fine motor activity.
Spinothalamic tract: The organization from medial to lateral is cervical to sacral fibers.	Ascending tract: Anterior spinothalamic axons cross in the anterior white commissure to form the contralateral lateral spinothalamic tract after ascending ipsilaterally for about 2 levels. They carry pain and temperature sensations.
Dorsal and ventral spinocerebellar tracts	Ascending tracts: Provide unconscious proprioception information to the cerebellum
Vestibulospinal, rubrospinal and tectospinal tracts	These form the extrapyramidal system, mainly for control of antigravity muscles.

Blood supply

The spinal cord is supplied in a segmented fashion. The major blood supply is from 1 anterior spinal artery (ASA) and 2 posterior spinal arteries (PSAs) from the extradural part of the vertebral artery.

The branches of the same anastomose extensively form the vasa corona. This is reinforced by medullary branches of the lateral branch of intercostal arteries at the corresponding levels.

The largest medullary branch is the artery of Adamkiewicz. Also known as arteria radicularis magna, it typically arises from a left posterior intercostal artery at the level of the 9th–12th intercostal artery, which branches out from the aorta. It supplies the lower two-thirds of the spinal cord via the anterior spinal artery.

The ASA supplies the anterior two-thirds of the spinal cord. Traumatic injury, occlusive thrombosis of the ASA secondary to infection, or embolus lead to anterior cord syndrome. This mainly involves the corticospinal tracts and the spinothalamic tracts bilaterally.

Occlusion of the PSA leads to posterior cord syndrome. The dorsal column is predominantly involved.

Injury to the artery of Adamkiewicz, especially during surgical procedures such as abdominal aortic aneurysm repair and neurosurgery, can lead to postoperative paralysis and neurological deficits.

Brown-Séquard Syndrome

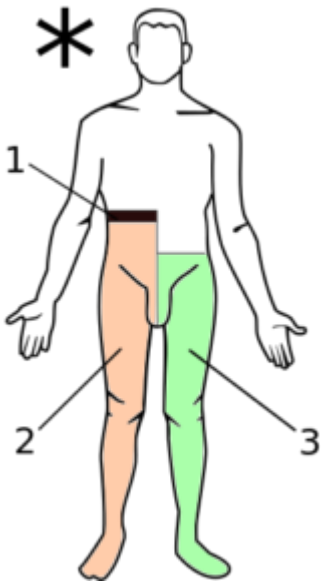

Image: “Brown-Séquard syndrome symptoms. * = side of lesion; 1 = hypotonic paresis 2 = ipsilateral symptoms; 3 = contralateral symptoms” by Rhcastilhos – Own work. License: CC BY-SA 3.0

The physiologist Charles-Édouard Brown-Séquard first described this condition in 1850. It involves damage to 1 side of the spinal cord, resulting in ipsilateral loss of motor function and posterior column sensations and contralateral spinothalamic involvement 1 to 2

levels below the level of cord damage.

Cord involvement can be summarized as follows:

- The corticospinal lesion produces ipsilateral spastic paralysis below the level of the lesion (due to loss of moderation by the upper motor neuron). At the level of the lesion, there is flaccid paralysis of the muscles supplied by the nerve of that level (since lower motor neurons are affected at the level of the lesion).
- The lesion to the posterior column tracts, fasciculus gracilis, or fasciculus cuneatus results in ipsilateral loss of vibration and proprioception (position sense) as well as the loss of all sensation of fine touch.
- The damage to the spinothalamic tract leads to the loss of contralateral pain and temperature sensation, beginning 1 or 2 segments below the lesion due to Lissauer's tract.
- Involvement of descending sympathetic fibers in lesions above T1 can lead to ipsilateral Horner's syndrome.

Brown-Séquard syndrome is classically seen in cases of traumatic spinal cord injury and in intradural extramedullary tumors such as neurofibromas and schwannomas, which cause cord compression from one side. Less frequent causes include infections such as tuberculosis and ischemic occlusive diseases of the spinal cord.

Any presentation of spinal injury that is an incomplete lesion (hemisection) is called a partial Brown-Séquard or incomplete Brown-Séquard syndrome. Brown-Séquard-plus syndrome is Brown-Séquard syndrome with bladder involvement.

Magnetic resonance imaging is the imaging of choice in spinal cord lesions.

Treatment depends on the inciting factor. The use of steroids to decrease cord edema and inflammation is controversial in spinal cord injury.

Tabes Dorsalis

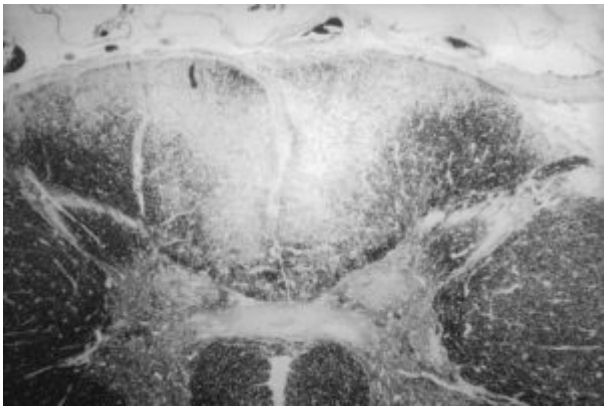

Image: "Demyelinization of the posterior columns of the spinal cord known as tabes dorsalis, or tabetic neurosyphilis. This image shows severe demyelinisation of the posterior columns of the spinal cord due to long-standing syphilis disease. This can result in a staggering, wide-based gait, postural instability, pain, and paresthesias; Myelin stain; magnification 450X" by Photo Credit: Content Providers: CDC/Susan Lindsley. License: Public Domain

Also known as syphilitic myelopathy, tabes dorsalis is a culmination of slow degeneration and demyelination of dorsal column nerves. The disease is rarely seen today, although it was quite prevalent when neurosyphilis was commonly left untreated for a long time. It

was seen in men more than women, typically in mid-life.

Coinfection with HIV can potentially lead to a resurgence of this condition. A sexually transmitted disease in nature, it is caused by the spirochete bacterium *Treponema pallidum.*

Spinal cord involvement can be summarized as follows:

- Involvement of the dorsal column white matter tracts leads to loss of position sense, vibration sense, and discriminative anaesthesia, with preservation of pain and temperature sense. Loss of proprioception leads to positive Romberg's sign. Severe ataxia is also present.
- Involvement of large-diameter dorsal nerve root fibers leads to intense pain, paraesthesias, and weakness
- Involvement of dorsal root ganglion cells leads to diminished reflexes.

The disease is classically associated with Argyll-Robertson pupils. This condition is seen in young women and features accommodation reflex, absent light reflex, and absent bilateral deep tendon reflexes.

Some of the other classically described but now rare related conditions include:

- Tabes dorsalgia: related back pain
- Tabetic gait: high-stepping gait due to loss of proprioception
- Tabetic ocular crisis: also known as Pel's crisis, it consists of sudden intense eye pain, tearing of the eyes, and sensitivity to light

T. palladium is very sensitive to penicillins. However, the neurological deficit, once set in, is rarely completely reversible. Physiotherapy for paralysis and pain management with the help of opiates are important treatment adjuncts.

Prophylactic treatment for those who come inadvertently into sexual contact with syphilitic patients is indicated.

Tabes dorsalis can progress to blindness, paralysis, and dementia if not appropriately controlled.

Summary

- Brown-Séquard syndrome involves hemisection of the spinal cord with ipsilateral motor and posterior column function involvement and contralateral spinothalamic functions, as well as pain and temperature involvement.
- Tabes dorsalis mainly involves the posterior column, sensory fibers, and dorsal root ganglion cells. There is pain, paraesthesias, weakness, ataxia, and loss of reflexes.

References

DeJong's Textbook of Neurology

Notes