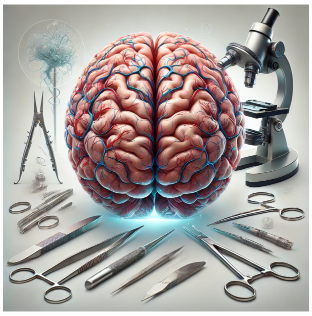


CNS—Anatomy~6
Written by: Dr.Ali Abujammil

Arterial Blood Supply to the Brain

The brain receives its blood supply from two main paired arteries: Internal Carotid Arteries and Vertebral Arteries.

Location and Pathway: These four arteries travel through the subarachnoid space, a fluid-filled space between the pia mater and arachnoid mater, which surrounds the brain with cerebrospinal fluid (CSF) for protection and nourishment; Upon reaching the base of the brain, they give off several branches to supply different brain regions.

Formation of the Circle of Willis: The terminal branches of these arteries connect on the inferior surface of the brain, forming an arterial ring known as the Circle of Willis serves as an essential collateral circulation system that ensures continuous blood supply to the brain, even if one artery is blocked.

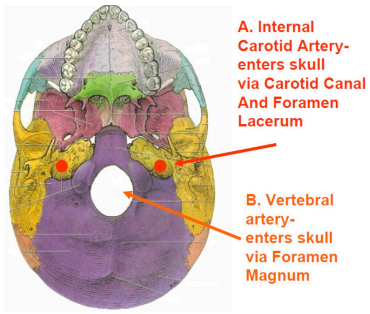
Importance of the Circle of Willis:

1. Blood Flow Compensation: If one artery is blocked, the Circle of Willis allows blood to flow through alternate pathways, maintaining adequate cerebral perfusion.

2. Stroke Prevention: It helps reduce the risk of ischemic strokes by providing an alternative route for blood circulation.

3. Maintains Cerebral Blood Flow even in cases of vascular obstructions.

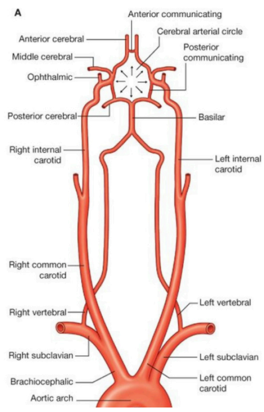
Internal Carotid Artery: Arises from the Common Carotid Artery and enters the skull via the Carotid Canal, supplying the anterior brain regions.



Vertebral Artery: Originates from the Subclavian Artery, ascends through the transverse foramina of the cervical vertebrae, and merges with its counterpart to form the Basilar Artery, which supplies the brainstem and cerebellum.

The Circle of Willis consists of: Anterior Cerebral Arteries, Posterior Cerebral Arteries and Communicating Arteries (Anterior & Posterior).

This image illustrates the arterial blood supply to the brain, highlighting the Circle of Willis, a crucial arterial network at the base of the brain that helps regulate and maintain cerebral blood flow, even in cases of arterial blockage, Major Arteries Supplying the Brain:



A. Carotid Arteries: Right & Left Common Carotid Arteries; each common

carotid artery bifurcates into: Internal Carotid Artery (supplies the brain) and External Carotid Artery (supplies the face and neck; not shown in the image), Only the internal carotid artery is visible in the image as it is responsible for cerebral circulation.

B. Vertebral Arteries: Right & Left Vertebral Arteries; these arise from the subclavian arteries and travel through the cervical vertebrae before entering the skull, where they merge to form the Basilar Artery.

Circle of Willis Formation: is a crucial anastomotic system composed of interconnected arteries, ensuring balanced blood distribution to the brain.

Anterior Arteries

1. Anterior Cerebral Artery: Supplies the frontal lobes and medial cerebral hemispheres.

2. Anterior Communicating Artery: Connects the right and left anterior cerebral arteries, allowing blood exchange between them.

Middle Arteries

3. Middle Cerebral Artery: Supplies most of the lateral cerebral cortex, including motor and sensory areas for the upper limbs and face.

4. Ophthalmic Artery: Branches from the internal carotid artery and supplies the eyes and surrounding structures.

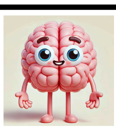
Posterior Arteries

5. Posterior Cerebral Artery: Supplies the occipital lobe (vision processing) and parts of the temporal lobe and cerebellum.

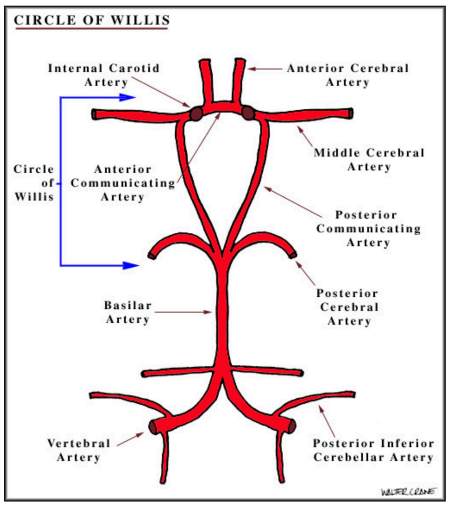
6. Posterior Communicating Artery: Connects the internal carotid artery with the posterior cerebral artery, ensuring collateral circulation between anterior and posterior regions.

 # Basilar Artery: Formed by the merging of the vertebral arteries, it supplies the brainstem, cerebellum, and occipital lobes.

Importance of the Circle of Willis: Acts as a safety mechanism against arterial blockages by providing alternative routes for blood flow and Ensures continuous blood supply to the brain, even in cases of vascular disease also Protects against ischemic strokes by compensating for reduced blood flow in obstructed arteries.



Let's explain again, repetition makes us remember.



This image illustrates the Circle of Willis, a crucial arterial network located at the base of the brain. It plays a vital role in distributing blood to the brain and provides a collateral circulation pathway in case of arterial blockage, Major Arteries in the Circle of Willis:

Internal Carotid Artery:Supplies blood to the anterior parts of the brain.

Anterior Cerebral Artery: Feeds the medial and anterior portions of the brain, particularly the frontal lobe.

Anterior Communicating Artery: Connects the two anterior cerebral arteries, helping balance blood flow between hemispheres.

Middle Cerebral Artery: Supplies most of the lateral cortical surface, including motor, sensory, and language areas.

Posterior Cerebral Artery: Provides blood to the occipital lobe and the lower parts of the temporal lobe, responsible for vision.

Posterior Communicating Artery: Links the internal carotid artery to the posterior cerebral artery, allowing blood redistribution.

Basilar Artery: Formed by the merging of the vertebral arteries; it supplies the brainstem and cerebellum.

Vertebral Artery: Contributes to posterior circulation by joining to form the basilar artery.

Posterior Inferior Cerebellar Artery (PICA): Provides blood to the cerebellum and part of the brainstem.

Importance of the Circle of Willis: Ensures continuous blood supply to the brain, even if one major artery is blocked; Acts as a protective mechanism against strokes by providing alternative blood pathways; Regulates blood pressure within the brain to maintain balanced circulation.

The blood supply to the spinal cord is vital for maintaining its function, ensuring oxygen and nutrients reach all its regions. This supply is accomplished through a series of main arteries and their branches that cover the entire spinal cord.

1. Longitudinal Arteries:

Anterior Spinal Artery: This major artery arises from the vertebral arteries, which stem from the subclavian arteries. It runs in the anterior median fissure of the spinal cord and supplies blood to the anterior part of the spinal cord and is crucial for providing blood to the regions responsible for motor functions and sensory processing, including the corticospinal tract.

Posterior Spinal Arteries: These two arteries arise from the posterior inferior cerebellar artery and run in the posterolateral sulcus of the spinal cord, They supply the posterior aspect of the spinal cord, which is important for sensory functions, especially related to proprioception and fine touch.

2. Segmental Spinal Arteries; supply specific parts of the spinal cord through various origins:

Vertebral Arteries: These arteries, originating from the subclavian arteries, supply the upper spinal cord, particularly the cervical region.

Deep Cervical Arteries: These arteries supply blood to the cervical spinal cord, supporting neural tissues in the neck region.

Posterior Intercostal Arteries: These arteries supply the thoracic region of the spinal cord, feeding blood to the intercostal muscles and the associated neural structures.

Lumbar Arteries:The lumbar arteries provide blood to the lumbar region of the spinal cord, serving the lower back and abdominal regions.

Main Branches of Segmental Spinal Arteries:

Anterior Radicular Arteries: These arteries supply the anterior roots of the spinal nerves, which are involved in motor function. They provide oxygenated blood to the nerve roots that innervate muscles.

Posterior Radicular Arteries: These arteries supply the posterior roots, which are involved in sensory processing. They feed the nerve roots that transmit sensory signals from the body to the spinal cord.

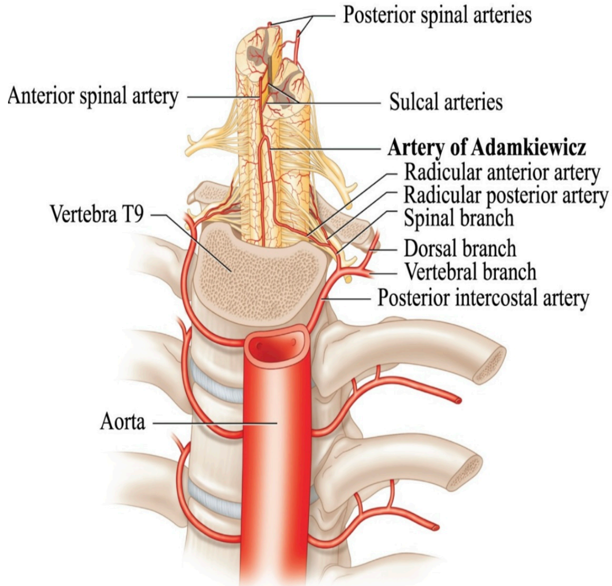
Segmental Medullary Arteries: These arteries branch from the segmental arteries and provide blood to the spinal cord at specific segments. They act as a support system to ensure continuous blood flow along the spinal cord.

3. Artery of Adamkiewicz:

Function and Location: is one of the most important arteries in the blood supply to the spinal cord, especially for the lower parts. It ensures that the lower two-thirds of the spinal cord receive adequate blood flow; It typically arises on the left side, from the left posterior intercostal artery, usually between the 9th and 12th intercostal arteries.

Anastomosis and Branching: anastomoses with the anterior spinal artery, reinforcing blood supply to the lower spinal cord. This artery is essential for the motor and sensory functions of the lower limbs.

I hope you don't get tired of returning. Because it's very useful.



The image depicts the vascular supply of the spinal cord. The illustration shows the major arteries that supply blood to the spinal cord. Let's discuss them in detail, Major Arteries:

Anterior Spinal Artery: This is the main artery supplying the anterior aspect of the spinal cord. It arises from the vertebral arteries and runs the length of the spinal cord.

Posterior Spinal Arteries: These two arteries (one on each side) supply the posterior aspect of the

spinal cord. They also arise from the vertebral arteries.

Artery of Adamkiewicz: Also known as the great anterior radicular artery, this is a large, single artery that supplies the lower portion of the spinal cord. It's crucial because it provides the majority of blood flow to the lower half of the spinal cord. Its location is variable, but it's typically found on the left side between the eighth and tenth thoracic vertebrae (T8-T10).

Radicular Anterior and Posterior Arteries: These smaller arteries supply the spinal cord with blood via the anterior and posterior radicular branches of the nerve roots.

Spinal, Dorsal, and Vertebral Branches: These branches arise from the major arteries and distribute blood to different parts of the spinal cord.

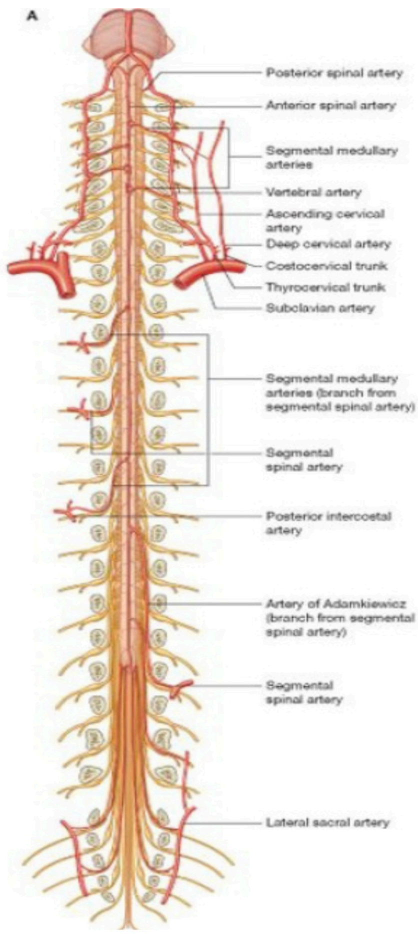
Posterior Intercostal Artery: This artery contributes to the blood supply of the spinal cord, particularly in the thoracic region.

Venous Drainage: Blood is drained from the spinal cord via a network of anterior and posterior spinal veins, which ultimately converge into larger veins.

Clinical Significance: Injury to any of these arteries, particularly the artery of Adamkiewicz, is serious and can lead to spinal cord ischemia and permanent neurological damage.

Let's do this again and again and again …..... Until we become dominant.

The image shows a diagram of the arterial supply of the spinal cord. The illustration depicts the major arteries supplying blood to the spinal cord, starting from the head region down to the sacrum. Let's discuss them in detail;
Major Arteries:



Anterior Spinal Artery: This major artery runs along the anterior surface of the spinal cord. It arises from the vertebral arteries at the base of the skull.

Posterior Spinal Arteries: These two arteries (one on each side) supply the posterior surface of the spinal cord. They also arise from the vertebral arteries.

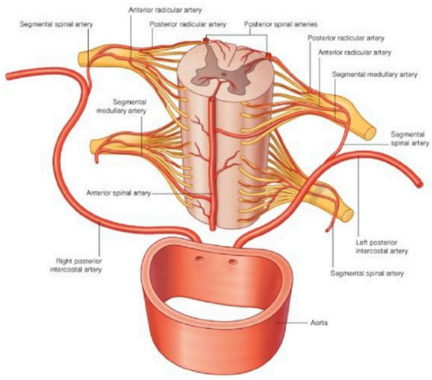
Radicular Arteries: These arteries branch from the vertebral arteries, and lower arteries such as the intercostal arteries, lumbar arteries, and sacral arteries. They are important because they reinforce the blood flow to the anterior and posterior spinal arteries. The most important of these is the artery of Adamkiewicz.

Artery of Adamkiewicz: This is a large, single artery, usually on the left side, supplying the lower part of the spinal cord. It's crucial because it provides the majority of blood flow to the lower half of the spinal cord. Its location is variable, but it's typically found between the eighth and tenth thoracic vertebrae (T8-T10).

Segmental Spinal Arteries: These arteries branch from the radicular arteries and supply specific segments of the spinal cord.

Other Arteries: The diagram also shows other arteries that contribute to the supply of the major spinal arteries, such as the ascending cervical arteries, deep cervical arteries, costocervical trunk, thyrocervical trunk, subclavian artery, posterior intercostal artery, and lateral sacral artery.

The image shows the arterial supply of the spinal cord. The illustration depicts the major and minor arteries that supply blood to the spinal cord.



Anterior Spinal Artery: This major artery runs along the anterior surface of the spinal cord. It supplies the anterior portion of the gray and white matter. It arises from the vertebral arteries at the base of the skull. This artery is relatively small and relies on radicular arteries for supplemental blood supply.

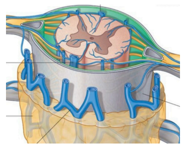
Posterior Spinal Arteries: These two arteries (one on each side) run along the posterior surface of the spinal cord. Each supplies the posterior portion of the white matter. They also arise from the vertebral arteries. Similar to the anterior spinal artery, they rely on radicular arteries for supplemental blood supply.

Radicular Arteries: These arteries are the main source of blood for both the anterior and posterior spinal arteries. They branch from larger arteries adjacent to the spinal cord, such as the intercostal arteries, lumbar arteries, and sacral arteries. These arteries reinforce blood flow to the major spinal arteries. The most important of these is the artery of Adamkiewicz.

Artery of Adamkiewicz: This is a large, single artery, usually on the left side, supplying the lower part of the spinal cord. It's crucial because it provides the majority of blood flow to the lower half of the spinal cord. Its location is variable, but it's typically found between the eighth and tenth thoracic vertebrae (T8-T10). Occlusion of this artery can lead to serious spinal cord ischemia.

Segmental Spinal Arteries: These arteries branch from the radicular arteries and supply specific segments of the spinal cord.

Venous drainage of the spinal cord is essential for returning deoxygenated blood and waste products from the spinal cord to the systemic circulation. The venous drainage system consists of several channels and veins that work together to efficiently drain the blood from the spinal cord.



1. Vein Pairs: There are two pairs of veins on each side of the spinal cord. These veins collect venous blood from different regions of the spinal cord.

2. Median Channels: Anterior Median Fissure Channel runs along the anterior median fissure of the spinal cord. This channel collects venous blood from the anterior part of the spinal cord and directs it into the venous drainage system and Posterior Median Sulcus Channel another median channel runs along the posterior median sulcus of the spinal cord, collecting venous blood from the posterior part of the spinal cord.

3. Drainage into the Internal Vertebral Plexus: The collected venous blood from the various spinal regions drains into the internal vertebral plexus, which is located in the extradural (epidural) space surrounding the spinal cord; The internal vertebral plexus acts as a network to gather blood from the spinal cord and prepare it for further drainage.

4. Connection to Major Systemic Veins: From the internal vertebral plexus, blood drains into segmentally arranged vessels that connect with major systemic veins, facilitating the return of deoxygenated blood to the body circulation like Azygos System in the Thorax; In the thoracic region, the internal vertebral plexus connects to the azygos system, a network of veins that helps drain blood from the thoracic wall and other parts of the body and Intracranial Veins; Eventually, the internal vertebral plexus connects to intracranial veins, which return the venous blood to the cranial circulation before it is pumped back to the heart, This venous drainage system ensures the proper removal of waste products from the spinal cord, maintaining a healthy and functional spinal cord.

The blood supply to the spinal cord involves various arteries and their branches, which collaborate to ensure adequate blood flow to all regions of the spinal cord. This process forms an intricate network of vessels that ensures proper distribution of blood to the tissues within the spinal cord.

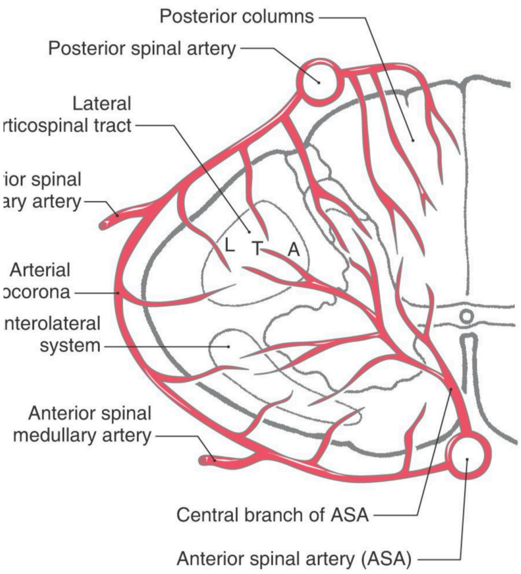
1. Terminal Branches of Spinal Medullary Arteries: join together to form the arterial vasocorona, a circular arterial network that surrounds the spinal cord. This vascular network helps ensure that blood is distributed evenly to various parts of the spinal cord.

2. Posterior Spinal Arteries and Arterial Vasocorona: The posterior spinal arteries supply blood to the posterior columns and peripheral parts of the lateral and anterior funiculi of the spinal cord; They provide blood to the areas responsible for sensation and sensory functions, as well as some other regions of the spinal cord while Arterial Vasocorona further supports the posterior and peripheral areas of the spinal cord, enhancing blood supply to the posterior columns and the peripheral parts of the lateral and anterior funiculi.

3. Anterior Spinal Artery:provides blood to most of the gray matter of the spinal cord and the adjacent parts of the white matter, This region includes areas responsible for motor functions

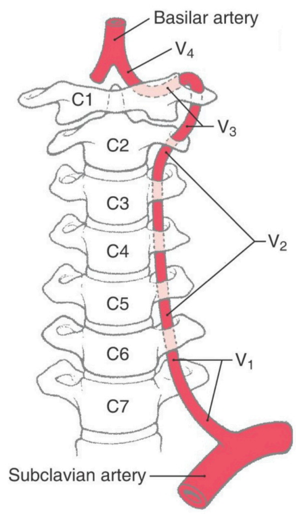
and other related activities, making the anterior spinal artery crucial for the functioning of these parts.

The diagram shows in more detail how the major arteries branch to supply each part of the spinal cord with blood. The anterior spinal artery (ASA), for example, runs along the anterior surface of the spinal cord and sends small branches that nourish both the gray and white matter. The posterior spinal arteries are smaller and run along the posterior surface of the spinal cord, supplying the posterior parts with blood. The diagram also shows the anastomoses between these arteries, where they connect to each other via collateral branches, ensuring a continuous blood flow even if one artery is blocked. This interconnectedness is crucial for maintaining the integrity of spinal cord function. The diagram may also show the radicular arteries, which are small arteries arising from the vertebral arteries and supplying the spinal cord through the nerve roots. Finally, the diagram might highlight areas that are more vulnerable to reduced blood supply, which can lead to serious neurological damage.

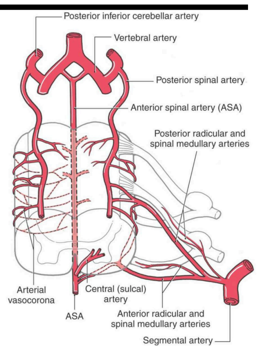


The image depicts the vertebral arteries and their blood supply to the upper cervical spinal cord. Let's explain it in detail:

The vertebral arteries originate from the subclavian arteries and ascend through the transverse foramina of the cervical vertebrae. In the image, we see the subclavian artery at the bottom, then the vertebral arteries (V1, V2, V3, V4) ascend to finally unite to form the basilar artery in the brainstem region. The vertebral arteries send small branches that supply the cervical spinal cord (C1-C7). These branches contribute to the formation of a network of small arteries that supply the spinal cord with the blood necessary for its functions. The area shaded in light pink indicates the anastomoses between the vertebral arteries, which ensure the continuity of blood flow even if one artery is blocked. This interconnectedness is very important to avoid ischemia in the spinal cord. Note that the labeling V1, V2, V3, V4 refers to different parts of the vertebral artery as it ascends through the cervical vertebrae.



The diagram illustrates the complex network of arteries supplying the spinal cord. The main blood supply originates from the vertebral arteries, which unite to form the basilar artery in the brainstem region. From the basilar artery, the anterior spinal artery (ASA) arises, which is



the major artery running along the anterior surface of the spinal cord, supplying the largest portion of it. The posterior spinal arteries are also shown; these are smaller and run along the posterior surface of the spinal cord. In addition, the diagram shows the radicular arteries and spinal medullary arteries, which are smaller arteries supplying specific parts of the spinal cord. Anastomoses between these arteries are evident, ensuring continuous blood flow even if one artery is blocked. The anterior spinal artery (ASA) is particularly vulnerable to occlusion, as any blockage can lead to serious spinal cord ischemia. The diagram also shows the central (or sulcal) artery supplying the central portion of the spinal cord.

Central Cord Syndrome (CCS) is a neurological condition caused by injury or damage to the spinal cord due to disruptions in blood flow to the central regions of the spinal cord. This syndrome is most commonly seen following trauma, particularly hyperextension injuries of the neck. It frequently affects older adults who may already have pre-existing spinal conditions, such as cervical spondylosis.

1. Causes and Mechanism:

Hyperextension of the Neck: This condition often results from trauma, such as accidents, falls, or sports injuries, where the neck is forced into an extended position; The hyperextension causes compression of the blood vessels supplying the spinal cord, particularly the anterior spinal artery, which leads to reduced blood flow to the central region of the spinal cord.

Occlusion of the Anterior Spinal Artery: The anterior spinal artery supplies blood to the gray matter of the spinal cord. When this artery becomes occluded, it leads to ischemia in the central spinal cord, causing motor deficits, The loss of blood flow to the central areas of the spinal cord disrupts motor control, especially affecting voluntary movements.

2. Symptoms and Clinical Signs:

Bilateral Weakness of the Extremities: Patients typically experience symmetrical weakness in both the upper and lower extremities, with greater weakness in the upper limbs (arms) than in the lower limbs (legs), This weakness occurs due to the involvement of motor pathways in the spinal cord, which control voluntary muscle movements.

Loss of Pain and Thermal Sensation: There is often a loss of the ability to sense pain and temperature, as the sensory pathways running through the spinal cord are affected; This sensory deficit is usually more pronounced in the upper limbs.

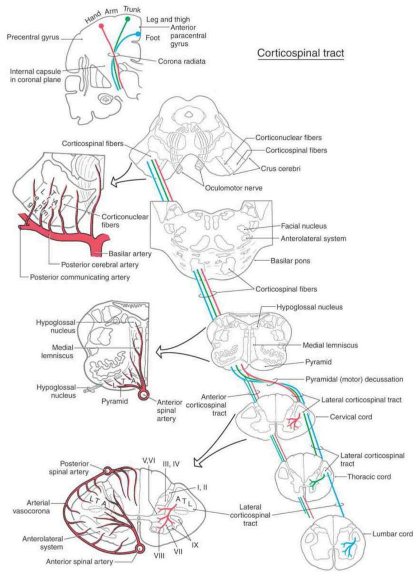
Bladder Dysfunction: Patients may have difficulty controlling bladder function, leading to issues such as urinary incontinence or urinary retention; This dysfunction results from the disruption of neural pathways that control the bladder and its muscles.

Additional Effects: Patients may also experience sensory disturbances in the lower extremities, along with impaired coordination, making it difficult to walk or perform daily activities.

3. Effect of Posterior Spinal Artery Occlusion: If the posterior spinal artery is affected, there is a loss or reduction in discriminative touch, which is the ability to distinguish different types of touch (e.g., soft vs. firm); Additionally, loss of proprioception (awareness of body position) and vibratory sensation (ability to sense vibrations) may occur on the side of the body affected by the injury; These effects primarily involve the lateral and posterior aspects of the spinal cord.

4. Diagnosis and Treatment: Diagnosis of Central Cord Syndrome relies on clinical presentation and imaging studies such as MRI to assess spinal cord damage and identify affected regions, Treatment typically includes physical therapy to strengthen muscles and restore sensation; In some cases, surgical intervention may be necessary to relieve pressure on the spinal cord and improve blood flow.

Central Cord Syndrome involves both motor and sensory deficits, significantly affecting a patient quality of life. Prompt diagnosis and management are essential to optimize recovery and prevent permanent disability.



The image is a diagram illustrating the corticospinal tracts in the brain, brainstem, and spinal cord. It shows the motor pathways that carry signals from the cerebral cortex to the muscles. It also depicts the major blood vessels supplying these areas.

Central cord syndrome is a medical condition resulting from injury to the central part of the spinal cord, usually in the cervical (neck) region. This injury primarily affects the sensory and motor pathways that run through the center of the spinal cord. Because of the location of the injury in the center of the spinal cord, the symptoms differ from those seen in other spinal cord injuries; Symptoms:

Weakness or paralysis in the upper extremities (arms and hands): These symptoms are more pronounced than weakness in the lower extremities (legs and feet). This is because the nerve fibers controlling upper extremity functions are located in the central part of the spinal cord, and are most affected in this syndrome.

Partial weakness or paralysis in the lower extremities: Weakness in the lower extremities is less severe than weakness in the upper extremities.

Sensory disturbances: The patient may experience loss of sensation of touch, temperature, pain, and pressure in the upper and lower extremities, but loss of sensation is usually more pronounced in the upper extremities.

Bowel and bladder dysfunction: The patient may experience difficulty controlling bowel and bladder functions.

The most common cause of central cord syndrome is cervical spine injury, such as: Cervical injuries resulting from car accidents, falls, sports, violence, Spinal cord inflammation, Spinal cord ischemia (reduced blood flow).

Treatment for central cord syndrome depends on the severity of the injury, may include: Physical therapy help restore movement and function; Occupational therapy help cope with daily life, Medications control pain and swelling and Surgery In some cases, surgery may be necessary to relieve pressure on the spinal cord.

Repetition is one of the most powerful tools for success in our field. In neurosurgery, every procedure, no matter how complex, is built on the experience gained through continuous repetition. Don't hesitate to consistently practice surgical techniques, analyze past cases, and review the latest research in the field. Through ongoing repetition, your skills evolve, and each challenge becomes an opportunity to enhance your knowledge and confidence. Repetition not only improves performance but also enables you to excel in handling complex cases and ensuring the best care for your patients. Every step you repeat brings you closer to achieving complete success and distinction in your field.