

"Clinical Notes"

» Relationship of Spinal Cord Segments to Vertebral Numbers

> Discrepancy: Spinal cord segments do not numerically match vertebrae levels due to the shorter length of the spinal cord compared to the vertebral column.

» Corresponding Nerves

- Cervical → Vertebrae: 7 + Nerves: 8
- Thoracic → Vertebrae: 12 + Nerves: 12
- Lumbar → Vertebrae: 5 + Nerves: 5
- Sacral → Vertebrae: 5 + Nerves: 5
- Coccygeal → Vertebrae: 4 + Nerves: 1

» Spinous Processes of Vertebral Bodies

Generally align with vertebral bodies, except in the lower thoracic region where they lie at the level of the vertebral body below.

» Spinal Cord and Brain Injuries

> Protection:

- Both the spinal cord and brain are suspended in cerebrospinal fluid (CSF) and surrounded by the bones of the vertebral column and skull.
- Despite protection, significant force can damage these structures, affecting underlying nervous tissue, cranial, spinal nerves, and blood vessels.

» Spinal Cord Injuries

> Anatomical Factors:

- Injury severity at different vertebral levels varies with anatomy.

1) Cervical Region:

- Common dislocation or fracture dislocation; large vertebral canal size usually prevents severe spinal cord injury

- Severe displacement can sever the cord, halting respiration if above C3-C5 (phrenic nerve origin), leading to diaphragm and intercostal muscle paralysis.

2) Thoracic Region:

- Small vertebral canal size results in severe injury with displacement.

3) Lumbar Region:

- Spinal cord terminates at the lower border of the 1st lumbar vertebra.
 - Large vertebral foramen allows ample room for cauda equina roots.
- Consequences: Injury may result in partial or complete loss of function at and below the lesion site, affecting afferent and efferent nerve tracts.

» Spinal Nerve Injuries

> Intervertebral Foramina:

- Transmit spinal nerves and segmental arteries/veins.
- Vulnerable to pressure or irritation from surrounding structures.

» Pathologies

- Herniated discs, vertebral fractures, osteoarthritis can cause pressure, stretching, or edema of spinal nerves, leading to dermatomal pain, muscle weakness, and altered reflexes.

» Herniated Intervertebral Discs

- > Common Locations: At junctions of mobile and immobile vertebral column parts (cervicothoracic and lumbosacral).
- > Mechanism: Posterior anulus fibrosus rupture -> nucleus pulposus herniation.

» Protrusion Types

- Central: Midline under posterior longitudinal ligament.
- Lateral: Near intervertebral foramen.

» Cervical disc herniations

- Less common than lumbar herniations.
- Susceptible discs: between C5-C6 and C6-C7.
- Lateral protrusions compress spinal nerves/roots, causing pain in corresponding nerve distribution.
- Central protrusions may press on the spinal cord and anterior spinal artery, affecting spinal tracts.

» Lumbar Disc Herniations

> Prevalence: More common than cervical disc herniations.

> Affected Discs: Typically between L4-L5 and L5-S1.

> Mechanism:

- Lateral herniation may press on one or two nerve roots, often involving the nerve root entering the intervertebral foramen just below.
- Direct backward herniation, if large, can compress the entire cauda equina, leading to paraplegia.

> Symptoms:

- Pain referred down the leg and foot in the affected nerve's distribution, known as sciatica.
- Paresthesia or sensory loss in severe cases.
- Muscle weakness due to pressure on anterior motor roots:
 - L5 motor root: Weakens ankle dorsiflexion.
 - S1 motor root: Weakens plantar flexion.
- Diminished or absent ankle jerk reflex.
- Large, central protrusion: Bilateral pain, muscle weakness in both legs, acute urine retention.

» Spinal Tap (Lumbar Puncture)

- > Purpose: Withdraw CSF for examination, inject drugs, induce anesthesia.

> Procedure:

- Patient position: Lying on the side or sitting upright with a flexed vertebral column.
- Landmark: Imaginary line joining iliac crests crosses L4 spine.
- Aseptic technique and local anesthesia are used.
- Needle passes through: Skin → Superficial fascia → Supraspinous ligament → Interspinous ligament → Ligamentum flavum → Areolar tissue with internal vertebral venous plexus → Dura mater → Arachnoid mater
- Depth: 1 inch (2.5 cm) in children, up to 4 inches (10 cm) in obese adults.

> Indications:

- Blood indicates needle is in a vein of the internal vertebral plexus.
- Patient may feel fleeting discomfort if nerve roots are touched.
- CSF pressure measurement: Normal range is 60-150 mm of water.
 - Queckenstedt sign: Used to detect subarachnoid space blockage by compressing internal jugular veins.

» Caudal Anesthesia

> Method: Injection into the sacral canal via the sacral hiatus.

> Distribution: Anesthetic solution bathes spinal nerves as they emerge from the dural sheath.

> Uses:

- Relieve labor pain (first and second stages) without affecting the infant.
- Operations in the sacral region, including anorectal surgery.

» Head Injuries

> Scalp Injury:

- Minor blows: Bruising.
- Severe blows: Tearing or splitting of the scalp.
 - Even with helmets, the brain can be severely damaged without scalp injury evidence.

> Adult Skull Fracture:

- Less resilient, resembling an eggshell.
- Severe blows cause localized indentations and bone splintering.
- Blows to the vault: Linear fractures radiate through thin bone areas.
- Petrous parts of temporal bones and occipital crests deflect linear fractures.

> Infant Skull Fracture:

- More resilient, separated by fibrous sutural ligaments.
- Localized blow causes depression without splintering ("pond" fracture).

» Brain Injuries

> Mechanism:

- Caused by displacement and distortion of neuronal tissues at impact.
- The brain floats in CSF, allowing limited anteroposterior and lateral movement.
- Anteroposterior movement is restricted by superior cerebral veins attached to the superior sagittal sinus.
- Lateral displacement is restricted by the falx cerebri; the tentorium cerebelli and falx cerebelli also limit brain movement.

> Impact Effects:

- Blows to the front or back of the head can cause severe cerebral damage, brainstem stretching, and tearing of brain commissures.
- Side impacts result in less cerebral displacement but can still cause damage due to the falx cerebri.
- Glancing blows can lead to brain rotation, shearing strains, and distortion, especially against bony prominences.
- Brain lacerations can occur when the brain is thrown against sharp bone edges inside the skull (e.g., lesser wings of the sphenoid).

> Pressure Effects:

- Sudden brain movement creates a suction effect, potentially rupturing surface blood vessels.
- Severe blows can cause damage at the impact point and the opposite brain pole (contrecoup injury).

> Vascular Effects:

- Brain movement may avulse cranial nerves and rupture tethering blood vessels.
- Large arteries at the brain's base are usually spared due to their strength and tortuosity.
- Thin-walled cortical veins are vulnerable, risking subdural or subarachnoid hemorrhage

» Traumatic Brain Injury Following an Explosion or Blast

• Types of Injuries:

- 1) Open Injuries: Visible injuries where shrapnel penetrates the brain.
- 2) Closed Injuries: Skull remains intact, but the brain may be damaged by blast-induced air pressure.

> Mechanism:

- Explosion's blast of air strikes the skull, causing brain movement against hard bony projections.

> Symptoms:

- Vary from mild to severe based on neurologic damage.
- Mild cases might be missed initially but can lead to headaches, nausea, mood changes, and memory loss later

> Diagnosis and Treatment:

- Early diagnosis is crucial for effective treatment of mild neurologic damage.
- Individuals exposed to explosions should undergo CT or MRI before resuming civilian life.

» Intracranial Hemorrhage

> General Concept:

- Brain cushioning by CSF within the subarachnoid space.
- Severe hemorrhages within the rigid skull increase intracranial pressure (ICP) and exert pressure on the brain.
- Four types of intracranial hemorrhage result from trauma or cerebral vascular lesions.

1) Epidural (Extradural) Hemorrhage:

- > Cause: Injuries to meningeal arteries or veins, commonly the anterior division of the middle meningeal artery.
- > Mechanism: Minor blow to the side of the head may sever the artery, leading to bleeding and stripping of the dura from the skull's internal surface.
- > Symptoms: Increased ICP, local pressure on the precentral gyrus, and possible soft swelling on the head's side.
- > Treatment: Ligation or plugging of the torn artery, and burr hole placement above the midpoint of the zygomatic arch.

2) Subdural Hemorrhage:

- > Cause: Tearing of superior cerebral veins entering the superior sagittal sinus, often due to anteroposterior brain displacement.
- > Mechanism: Minor blow causes low-pressure blood accumulation between the dura and arachnoid.

> Prevalence: More common than middle meningeal hemorrhage and rarely bilateral.

3) Subarachnoid Hemorrhage:

- > Cause: Nontraumatic leakage or rupture of a congenital aneurysm in the cerebral arterial circle or arteriovenous malformation.
- > Symptoms: Sudden severe headache, neck stiffness, and loss of consciousness.
- > Diagnosis: CT, MRI, or lumbar puncture revealing blood-stained CSF.

4) Cerebral Hemorrhage:

- > Cause: Spontaneous intracerebral hemorrhage, often due to hypertension and rupture of the lenticulostriate artery (a middle cerebral artery branch).
- > Symptoms: Hemiplegia on the contralateral side, immediate loss of consciousness, and evident paralysis upon regaining consciousness.
- > Diagnosis: Brain CT or MRI.

» Shaken Baby Syndrome

- > Cause: Sudden deceleration from shaking or head striking a hard surface.
- > Mechanism: Brain rotation causes diffuse injuries like axonal injury and subdural hematoma.
- > Age Group: Mostly in infants under 3 years, commonly during the first year of life.
- > Symptoms: Lethargy, irritability, seizures, altered muscle tone, raised ICP signs (impaired consciousness, vomiting, breathing abnormalities, apnea), bulging fontanelles, retinal hemorrhages.
- > Diagnosis: Blood in CSF from spinal tap, subdural or subarachnoid hemorrhages on CT or MRI.

» Space-Occupying Lesions Within the Skull

> Types: Tumor, hematoma, abscess.

> Mechanism:

- Skull's fixed volume leads to initial CSF expulsion.
- Vein compression, interference with blood and CSF circulation, increased ICP.
- Increased CSF production and diminished absorption create a vicious cycle.

> Symptoms: Severe headache (due to dura mater stretching), vomiting (due to brainstem pressure).

> Tumor Effects:

- Rapid ICP increase if obstructing CSF outflow or pressing on great veins.
- Symptoms depend on brain function interference and nervous tissue destruction.

> Precautions: Spinal tap contraindicated due to risk of brain displacement or herniation.

> Diagnosis: CT scans or MRIs.