Chapter 16: Spinal Cord and Spinal Nerves

1. Introduction

- The **spinal cord** is a crucial link between the brain and the rest of the body.
- **Spinal nerves** serve two main functions:
    - **Pathway for sensory and motor impulses**
    - **Facilitating reflexes** – the body's fastest responses to stimuli.

2. Gross Anatomy of the Spinal Cord

Basic Features

- **Dimensions**: About ¾ inch in diameter and 16-18 inches long.
- **Extent**: From the **foramen magnum** to the **L1 vertebra**.

Regions of the Spinal Cord

1. **Cervical Part**: Superior region; associated with **cervical nerves**.
2. **Thoracic Part**: Below cervical; associated with **thoracic nerves**.
3. **Lumbar Part**: Below thoracic; associated with **lumbar nerves**.
4. **Sacral Part**: Below lumbar; associated with **sacral nerves**.
5. **Coccygeal Part**: Inferior tip; associated with **coccygeal nerve**.

Key Structures

- **Conus Medullaris**: Tapered end of the spinal cord.
- **Cauda Equina**: Bundle of nerves extending from the conus medullaris (“horse's tail”).
- **Filum Terminale**: Thin strand of **pia mater** that anchors the conus medullaris to the coccyx.

Enlargements

- **Cervical Enlargement**: Supplies nerves to the **upper limbs**.
- **Lumbosacral Enlargement**: Supplies nerves to the **lower limbs**.

External Depressions

- **Posterior Median Sulcus**: Shallow groove on the back.
- **Anterior Median Fissure**: Deep groove on the front.

Spinal Nerves

- **31 Pairs of Spinal Nerves**:
    - **8 Cervical (C1–C8)**
    - **12 Thoracic (T1–T12)**
    - **5 Lumbar (L1–L5)**
    - **5 Sacral (S1–S5)**
    - **1 Coccygeal (Co1)**

3. Spinal Cord Meninges

Layers of Meninges

1. **Dura Mater**: Tough outer layer.
    a. Contains **epidural space** (site for epidural anesthesia).
2. **Arachnoid Mater**: Web-like middle layer.
    a. Contains **subarachnoid space** filled with **CSF**.
3. **Pia Mater**: Delicate inner layer adhering to the spinal cord.
    a. Forms **denticulate ligaments** that anchor the spinal cord laterally.

4. Sectional Anatomy of the Spinal Cord

Gray Matter

- **Composition**: Neuron cell bodies, dendrites, and unmyelinated axons.
- **Subdivisions**:

    - **Anterior Horns**: Somatic motor neurons.
    - **Lateral Horns**: Autonomic motor neurons (only in T1–L2).
    - **Posterior Horns**: Sensory neurons and interneurons.
    - **Gray Commissure**: Connects left and right sides; surrounds the **central canal**.

White Matter

- **Composition**: Myelinated axons.
- **Subdivisions** (Funiculi):
    - **Posterior Funiculus**
    - **Lateral Funiculus**
    - **Anterior Funiculus** (connected by the **white commissure**).
- Organized into **tracts** that carry sensory and motor signals.

5. Spinal Nerves

Structure of Spinal Nerves

- **Anterior Root**: Motor axons (from anterior and lateral horns).
- **Posterior Root**: Sensory axons (with **posterior root ganglion**).
- **Spinal Nerve**: Fusion of anterior and posterior roots; mixed (sensory and motor) function.

Nerve Branches (Rami)

- **Posterior Ramus**: Innervates deep back muscles and skin.
- **Anterior Ramus**: Innervates the trunk and limbs.
- **Rami Communicantes**: Connect spinal nerves to the sympathetic trunk.

Dermatomes

- **Dermatome**: Area of skin supplied by a single spinal nerve.
- Useful for diagnosing nerve damage.

6. Nerve Plexuses

Major Plexuses

1. **Cervical Plexus (C1–C4)**:
    a. **Phrenic Nerve**: Innervates the diaphragm.
2. **Brachial Plexus (C5–T1)**:
    a. Supplies the **upper limbs**.
    b. Major Branches: Axillary, Musculocutaneous, Median, Radial, and Ulnar nerves.
3. **Lumbar Plexus (L1–L4)**:
    a. Supplies the **lower limbs**.
    b. Major Nerves: Femoral and Obturator nerves.
4. **Sacral Plexus (L4–S4)**:
    a. Supplies the **lower limbs**.
    b. Major Nerve: **Sciatic Nerve** (largest in the body).

7. Reflexes

Properties of Reflexes

1. **Stimulus** required to initiate a response.
2. **Rapid Response** with minimal synaptic delay.
3. **Preprogrammed Response** that occurs the same way each time.
4. **Involuntary Response** without conscious intent.

Reflex Arc Components

1. **Receptor**: Detects stimulus.
2. **Sensory Neuron**: Carries impulse to the CNS.
3. **Interneurons**: Process information (in polysynaptic reflexes).
4. **Motor Neuron**: Carries response signal to the effector.
5. **Effector**: Muscle or gland that responds.

Types of Reflexes

- **Monosynaptic Reflex**: Direct connection between sensory and motor neurons (e.g., knee-jerk reflex).
- **Polysynaptic Reflex**: Involves interneurons (e.g., withdrawal reflex).

Quick Study

Spinal Nerve Distribution

Region	Nerve Count	Range
Cervical	8	C1–C8
Thoracic	12	T1–T12
Lumbar	5	L1–L5
Sacral	5	S1–S5
Coccygeal	1	Co1

Mnemonic:

“Breakfast at 8, Lunch at 12, Dinner at 5, Supper at 5, and a Snack at 1.”

Spinal Meninges Mnemonic

Mnemonic:

“DAP” (from outer to inner):

- **D**ura Mater
- **A**rachnoid Mater
- **P**ia Mater

Nerve Plexuses

Plexus	Nerve Range	Major Nerves
Cervical	C1–C4	Phrenic Nerve

Brachial	C5–T1	Axillary, Median, Ulnar, Radial
Lumbar	L1–L4	Femoral, Obturator
Sacral	L4–S4	Sciatic

Mnemonic:

“Clever Bunnies Love Snacks”

- **C**: Cervical
- **B**: Brachial
- **L**: Lumbar
- **S**: Sacral