"Central and Peripheral Nervous Systems"

》 Overview

- Nervous system divided into:

1) Central nervous system (CNS)

2) Peripheral nervous system (PNS)

》 Central Nervous System (CNS)

> Components:

- Brain
- Spinal cord

> Function:

- Main centers for correlation and integration of nervous information

> Protection:

i) Covered with meninges

ii) Suspended in cerebrospinal fluid (CSF)

iii) Bones of the skull

iv) Vertebral column

> Composition:

- Neurons: excitable nerve cells and their processes (axons or nerve fibers)
- Supported by neuroglia

> Interior organization:

- Gray matter: nerve cells embedded in neuroglia
- White matter: nerve fibers embedded in neuroglia; white color due to lipid material in myelin sheaths

» Peripheral Nervous System (PNS)

> Components:

- Cranial nerves
- Spinal nerves
- Associated ganglia

> Function:

- Conduct information to and from the CNS

> Structure:

- Bundles of nerve fibers (axons)
- Surrounded by fibrous sheaths
- Vulnerable to damage by trauma

》 Autonomic Nervous System

- Part of the nervous system that innervates involuntary structures (heart, smooth muscle, glands)
- Distributed throughout CNS and PNS
- Divided into two parts:

i) Sympathetic: Prepares the body for an emergency

ii) Parasympathetic: Conserves and restores energy

- Both parts contain afferent and efferent nerve fibers

"Major Divisions of the Central Nervous System"

》 Spinal Cord

> Location and Protection

- Situated within the vertebral canal of the vertebral column
- Surrounded by three meninges:
i) Dura mater
ii) Arachnoid mater
ii) Pia mater
- Further protected by cerebrospinal fluid (CSF) in the subarachnoid space

> Structure

- Roughly cylindrical
- Begins at the foramen magnum, continuous with the medulla oblongata
- Terminates in the lumbar region, tapering into the conus medullaris
- Filum terminale descends from the conus medullaris to attach to the coccyx -> is a prolongation of pia mater

》 Nerve Attachments

- 31 pairs of spinal nerves attached by anterior (motor) and posterior (sensory) roots
- Each root attached by a series of rootlets along the corresponding segment
- Posterior nerve root has a posterior root ganglion with peripheral and central nerve fibers

》 Internal Composition

- Inner core of gray matter surrounded by white matter
- Gray matter: H-shaped with anterior and posterior gray columns, connected by a gray commissure with a central canal
- White matter: Divided into anterior, lateral, and posterior white columns

》 Brain

> Location and Protection

- Lies in the cranial cavity
- Continuous with the spinal cord through the foramen magnum
- Surrounded by dura mater, arachnoid mater, and pia mater, continuous with spinal cord meninges
- CSF surrounds the brain in the subarachnoid space

> Major Divisions

- Three major divisions:

i) Hindbrain
ii) Midbrain
iii) Forebrain

- Brainstem includes:

i) Medulla oblongata
ii) Pons
iii) Midbrain

» Hindbrain Components:

i) Medulla oblongata
ii) Pons
iii) Cerebellum

» Medulla Oblongata

- Conical shape
- Connects pons to spinal cord
- Contains nuclei and serves as a conduit for nerve fibers

» Pons

> Location:

- Situated on the anterior surface of the cerebellum
- Inferior to the midbrain
- Superior to the medulla oblongata

> Structure:

- Named "bridge" for the large number of transverse fibers connecting the two cerebellar hemispheres
- Contains many nuclei and ascending and descending nerve fibers

》 Cerebellum

> Location:

- Lies within the posterior cranial fossa of the skull
- Posterior to the pons and the medulla oblongata

> Structure:

- Consists of two hemispheres connected by the vermis

> Connected to:

- Midbrain by superior cerebellar peduncles
- Pons by middle cerebellar peduncles
- Medulla by inferior cerebellar peduncles

(Peduncles composed of large bundles of nerve fibers)

》 Structure

- Cortex: Surface layer of gray matter, folded into folia separated by transverse fissures
- Interior gray matter masses, with the largest being the dentate nucleus

> Surrounding Structures:

- Surrounds the fourth ventricle, filled with CSF
- Fourth ventricle connected to the third ventricle by the cerebral aqueduct
- Continuous with the central canal of the spinal cord
- Communicates with the subarachnoid space through three openings in the inferior part of the roof

》 Midbrain

> Location:

- Narrow part connecting the forebrain to the hindbrain

> Structure:

- Contains the cerebral aqueduct, connecting the third and fourth ventricles
- Contains many nuclei and bundles of ascending and descending nerve fibers

》 Forebrain

> Components:

i) Diencephalon (central part of the forebrain)

ii) Cerebrum

》 Diencephalon

> Location:

- Almost completely hidden from the brain's surface

> Structure:

- Consists of:
i) Dorsal thalamus
ii) Ventral hypothalamus

》 Thalamus:

- Large, egg-shaped mass of gray matter
- Lies on either side of the third ventricle
- Anterior end forms the posterior boundary of the interventricular foramen (between the third and lateral ventricles)

》 Hypothalamus:

- Forms the lower part of the lateral wall and floor of the third ventricle

》 Cerebrum

> Overview
- Largest part of the brain

> Components:
- Two cerebral hemispheres
- Connected by the corpus callosum (mass of white matter)

> Location

- Extends from frontal to occipital bones
- Superior to the anterior and middle cranial fossae
- Posteriorly lies above the tentorium cerebelli
- Hemispheres separated by the longitudinal fissure with the falx cerebri projecting into it

> Surface Structure

• Cortex:

- Composed of gray matter
- Surface thrown into folds (gyri) separated by fissures (sulci)
- Arrangement increases surface area
- Large sulci subdivide each hemisphere into lobes named after the cranial bones they lie under

> Internal Composition

• White Matter:
- Central core within each hemisphere
- Contains several large masses of gray matter (basal nuclei or ganglia)

• Corona Radiata:

- Fan-shaped collection of nerve fibers
- Passes in white matter to and from cerebral cortex to brainstem
- Converges on basal nuclei, passing between them as the internal capsule

• Nuclei:

- Medial to internal capsule: caudate nucleus
- Lateral to internal capsule: lentiform nucleus

> Ventricles

• Lateral Ventricles:

- Located within each cerebral hemisphere
- Communicate with the third ventricle through the interventricular foramina

> Development

- Cerebrum becomes enlarged and overhangs the diencephalon, midbrain, and hindbrain during development

》 Brain Structure

> Composition:

- Inner core of white matter
- Outer covering of gray matter

> Deep Gray Matter:

- Gray cerebellar nuclei in the cerebellum
- Gray thalamic, caudate, and lentiform nuclei in the cerebrum

"Major Divisions of the Peripheral Nervous System"

》 Components:

- Cranial nerves
- Spinal nerves
- Associated ganglia

》 Cranial and Spinal Nerves

> Cranial Nerves

• Quantity: 12 pairs

• Pathway:

- Leave the brain

- Pass through foramina in the skull

> Spinal Nerves

• Quantity: 31 pairs

• Pathway:

- Leave the spinal cord

- Pass through intervertebral foramina in the vertebral column

》 Regions:

- 8 cervical nerves (7 cervical vertebrae)
- 12 thoracic nerves
- 5 lumbar nerves
- 5 sacral nerves
- 1 coccygeal nerve (4 coccygeal vertebrae)

» Roots

> Anterior Root:

- Consists of efferent fibers
- Carries nerve impulses away from the CNS
- Motor fibers to skeletal muscles (originate in anterior gray horn of the spinal cord)

> Posterior Root:

- Consists of afferent fibers
- Carries nerve impulses to the CNS
- Sensory fibers for touch, pain, temperature, vibration (cell bodies in posterior root ganglion)

» Spinal Nerve Structure

> Formation:

- Anterior and posterior roots unite to form a spinal nerve
- Mixed fibers (motor and sensory)

> Disproportionate Growth:

- Spinal nerve roots' length increases progressively from top to bottom
- Upper cervical region: short, horizontal roots
- Lumbar and sacral nerves: form cauda equina around filum terminale

》 Division Post-Emergence

> Rami:

- Spinal nerve divides into:

i) Large anterior ramus

ii) Smaller posterior ramus

i) Posterior Ramus:

- Supplies muscles and skin of the back

ii) Anterior Ramus:

- Supplies muscles and skin over the anterolateral body wall and limbs

> Nerve Plexuses:

- Formed by anterior ramus
- Cervical and brachial plexuses (upper limbs)
- Lumbar and sacral plexuses (lower limbs)

» Ganglia

i) Sensory Ganglia

> Location:

- Fusiform swellings on the posterior root of each spinal nerve
- Proximal to junction with corresponding anterior root

> Example:

- Sensory ganglia found along cranial nerves V, VII, VIII, IX, X

ii) Autonomic Ganglia

> Shape:

- Often irregular

> Location:

- Along efferent nerve fibers of the ANS
- Paravertebral sympathetic chains
- Around roots of great visceral arteries in the abdomen
- Close to or within the walls of various viscera