The Structure of the Nervous System

Introduction

Neuroanatomy is challenging and we will:

- Focus on the general organization of the mammalian brain.
- Provide a canvas on which to paint the sensory and motor systems.

Gross Organization

In order to be a neurotransmitter, the molecule must:

- Be synthesized and stored in the presynaptic neuron.
- Be released by the presynaptic neuron upon stimulation.
- Produce a response in the postsynaptic cell when applied experimentally.

Anatomical References

- Anterior (rostral) – nose side
- Posterior (caudal) – tail side
- Dorsal – back side
- Ventral – belly side
- Medial – towards center
- Lateral – away from center
- Ipsilateral – same side
- Contralateral – opposite side
- Midsagittal – Splitting into equal left and right halves
- Sagittal – Sections parallel to midsagittal
- Coronal – perpendicular to ground and to sagittal plane
- Horizontal – parallel to ground
-

The Central Nervous System (CNS)

- Encased in bone
- Includes the brain and spinal cord

The Cerebrum

- The rostral and largest part of brain
- Split into cerebral hemispheres
- Separated by sagittal fissure (sulcus)
- In general the right cerebral hemisphere receives sensations from and controls movement of the left side of the body.
- In general the left cerebral hemisphere receives sensations from and controls movement of the right side of the body.
- Includes the frontal lobe, parietal lobe, occipital lobe, and the temporal lobe

The Cerebellum

- Behind the cerebrum.
- Primarily involved in movement
- In general the right side of the cerebellum is involved in control of movement of the right side of the body.
- In general the left side of the cerebellum is involved in control of movement of the left side of the body.

The Brain Stem

- Stalk of the brain
- Critical for vital functions such as breathing, consciousness, and control of body temperature
- Damage to the brain stem usually means rapid death
- Includes the hypothalamus, midbrain, pons and medulla oblongata

The Spinal Cord

- Attaches to the medulla oblongata of the brain stem.
- Communicates with body by way of spinal nerves.
- Each spinal nerve includes two branches, the dorsal root and the ventral root.

The Peripheral Nervous System (PNS)

- All parts of the nervous system outside of the brain and spinal cord.

The Somatic PNS

- All the spinal nerves that innervate the skin, the joints and the skeletal muscles.
- Somatic motor axons are derived from motor neurons in the ventral spinal cord and exit through the ventral roots.
    - The cell bodies of the motor neurons lie within the CNS.
- Somatic sensory axons enter the spinal cord via the dorsal roots.
    - The cell bodies of the sensory neurons lie within the dorsal root ganglia.

The Visceral PNS

- *Aka* the autonomic nervous system
- Consist of neurons that innervate the internal organs, blood vessels, and glands (innervate cardiac muscle, smooth muscle and glands).

The Cranial Nerves

- Twelve pairs of nerves that originate from the brain and brain stem and innervate the mainly the head.
- The cranial nerves include the:
    1. Olfactory nerve
    2. Optic nerve
    3. Oculomotor nerve
    4. Trochlear nerve

5. Trigeminal nerve
6. Abducens nerve
7. Facial nerve
8. Vestibulocochlear nerve
9. Glossopharyngeal nerve
10. Vagus nerve
11. Spinal accessory nerve
12. Hypoglossal nerve

The Meninges

- The brain and spinal cord are separated from bone by three membranes called the meninges.
- The outmost covering is the dura mater.
- Under the dura is the arachnoid membrane.
- Adhering to the brain is the pia mater.

The Ventricular System

- The brain is hollow at several locations.
- The cavities are called the ventricles.
- The cavities are filled with fluid called cerebral spinal fluid (CSF).
- The cavities include the:
    - Fourth ventricle
    - Midbrain aqueduct
    - Third ventricle
    - Interventricular Foramen
    - Right and left lateral ventricles