

# McCance: Pathophysiology, 6th Edition

## Chapter 14: Structure and Function of the Neurologic System

### Key Points – Print

#### SUMMARY REVIEW

##### Overview and Organization of the Nervous System

1. The divisions of the nervous system have been categorized as either structural (CNS and PNS) or functional (somatic nervous system and ANS).
2. The CNS is contained within the brain and spinal cord.
3. The PNS is composed of cranial and spinal nerves that carry impulses toward the CNS (afferent) and away from the CNS (efferent) to target organs or skeletal muscle.

##### Cells of the Nervous System

1. The neuron and neuroglial cells make up nervous tissue. The neuron is specialized to transmit and receive electrical and chemical impulses, and the neuroglial cell provides supportive functions. The neuron is further divided into unipolar, pseudounipolar, bipolar, and multipolar categories, according to structure and particular mechanics of impulse transmission.
2. The neuron is composed of a cell body, one or more dendrites, and an axon. A myelin sheath around selected axons forms an insulation that allows quicker nerve impulse conduction, referred to as *saltatory conduction*.
3. Neurons have four basic types of cell configuration: (1) unipolar, (2) pseudounipolar, (3) bipolar, and (4) multipolar. The three function types of neurons are sensory, associational, and motor.
4. Neuroglial cells (“nerve glue”) support the CNS and make up approximately half of the total brain and spinal cord volume.
5. Nerve injury triggers a sequence of events known as *wallerian degeneration*. The degree of nerve regeneration that occurs depends on many factors.

##### Nerve Impulse

1. The region between adjacent neurons is the synapse, and the region between the neuron and muscle is the myoneural junction.
2. Neurotransmitters are responsible for chemical conduction across the synapse and myoneural junction. Nerve impulse is predominantly regulated by a balance of IPSPs and EPSPs, temporal and spatial summation, and convergence and divergence.

### Central Nervous System

1. The brain is contained within the cranial vault and is divided into three distinct regions: (a) forebrain, (b) midbrain, and (c) hindbrain.
2. The forebrain comprises the two cerebral hemispheres and allows conscious perception of internal and external stimuli, thought and memory processes, and voluntary control of skeletal muscles. The deep portion of the forebrain is termed the *diencephalon* and processes incoming sensory data. The center for voluntary control of skeletal muscle movements is located along the precentral gyrus in the frontal lobe, whereas the center for perception is along the postcentral gyrus in the parietal lobe. The Broca area (rostral to the postcentral gyrus) and the Wernicke area (superoposterior temporal lobe) are major speech centers.
3. The midbrain is primarily a relay center for motor and sensory tracts, as well as a center for auditory and visual reflexes.
4. The hindbrain allows sampling and comparison of sensory data from the periphery and motor impulses from the cerebral hemispheres for the purpose of coordination and refinement of skeletal muscle movement.
5. The spinal cord contains the majority of nerve fibers connecting the brain with the periphery. Reflex arcs are completed in the spinal cord and influenced by the higher centers in the brain.
6. The four clinically relevant motor pathways are the lateral corticospinal, corticobulbar, basal ganglia, and vestibulospinal.
7. The three clinically important afferent pathways are the posterior column, anterior spinothalamic, and lateral spinothalamic.
8. The CNS is protected by the scalp, bony cranium, meninges, vertebral column, and CSF. The CSF is formed from blood components in the choroid plexuses of the ventricles and is reabsorbed in the arachnoid villi (located in the dural venous sinuses) after circulating through the brain and spinal cord.
9. The paired carotid and vertebral arteries supply blood to the brain and connect to form the circle of Willis. The major branches projecting from the circle of Willis are the anterior, middle, and posterior cerebral arteries. Drainage of blood from the brain is accomplished through the venous sinuses and jugular veins.
10. Blood supply to the spinal cord originates from the vertebral arteries and branches arising from the aorta.

### Peripheral Nervous System

1. The PNS functions to relay information from the CNS to muscle and effector organs through cranial and spinal nerve tracts arranged in fascicles (multiple fascicles bound together form the peripheral nerve).
2. The 31 pairs of spinal nerves contain sensory and motor neurons.

### Autonomic Nervous System

1. The ANS is responsible for the maintenance of a steady-state in the internal environment. Two opposing systems make up the ANS: (1) the sympathetic nervous system responds to stress by mobilizing energy stores and prepares the body to defend itself, and (2) the parasympathetic nervous system conserves energy and the body's resources.

### Aging and the Nervous System

1. Major structural changes with aging include a decrease in number of neurons and a decrease in brain weight and size.
2. Deposition of lipofuscin and the presence of senile plaques, multiple neurofibrillary tangles, and Lewy bodies are common cellular changes with aging.
3. A progressive slowing of neurologic function occurs with advancing age.

### Tests of Nervous System Function

1. Tests of nervous system function include x-ray films, CT, MRI and MRA, PET, brain scan, cerebral angiography, myelography, echoencephalography, electroencephalography, EPs potentials, and analysis of the CSF.