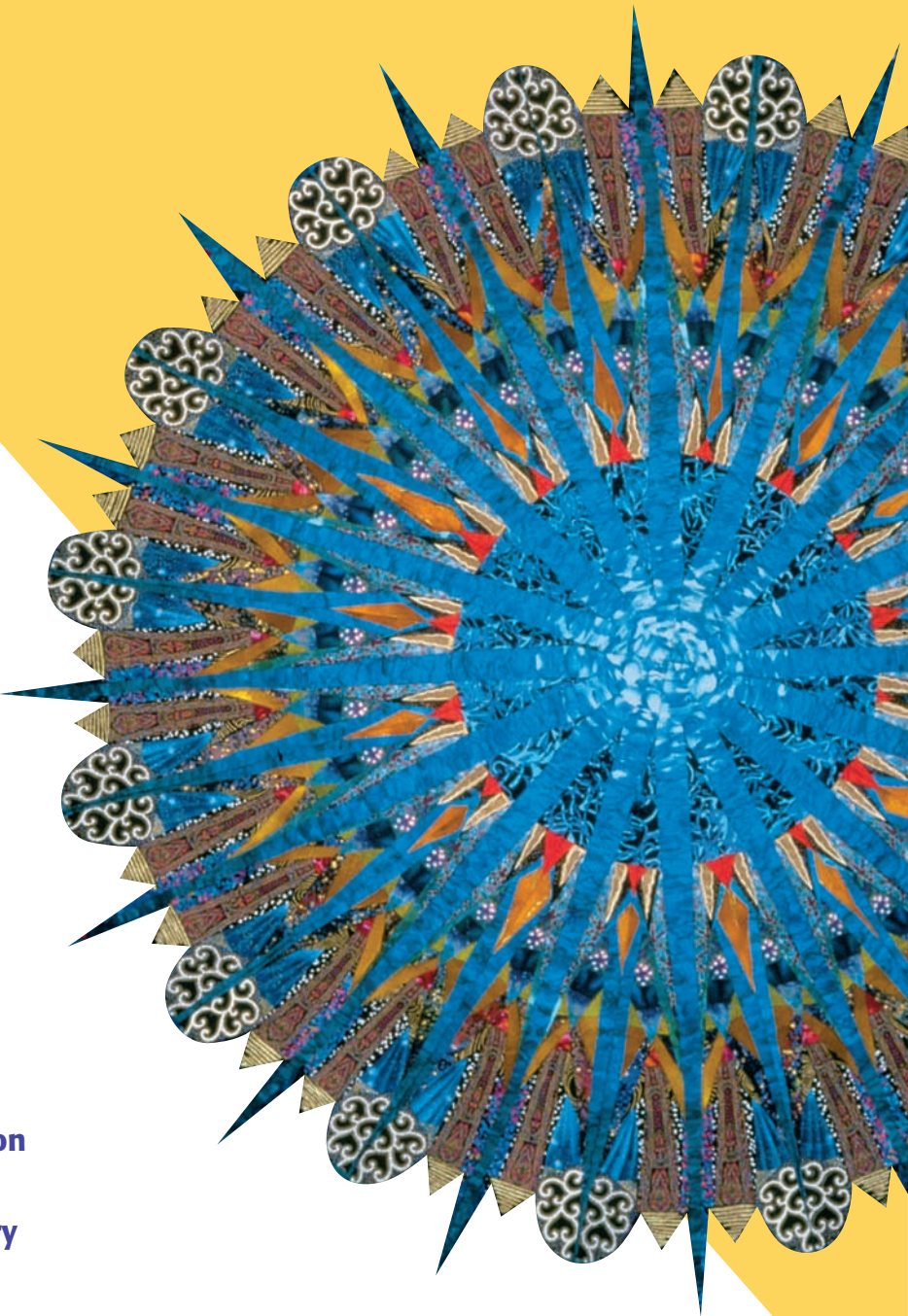


PART V

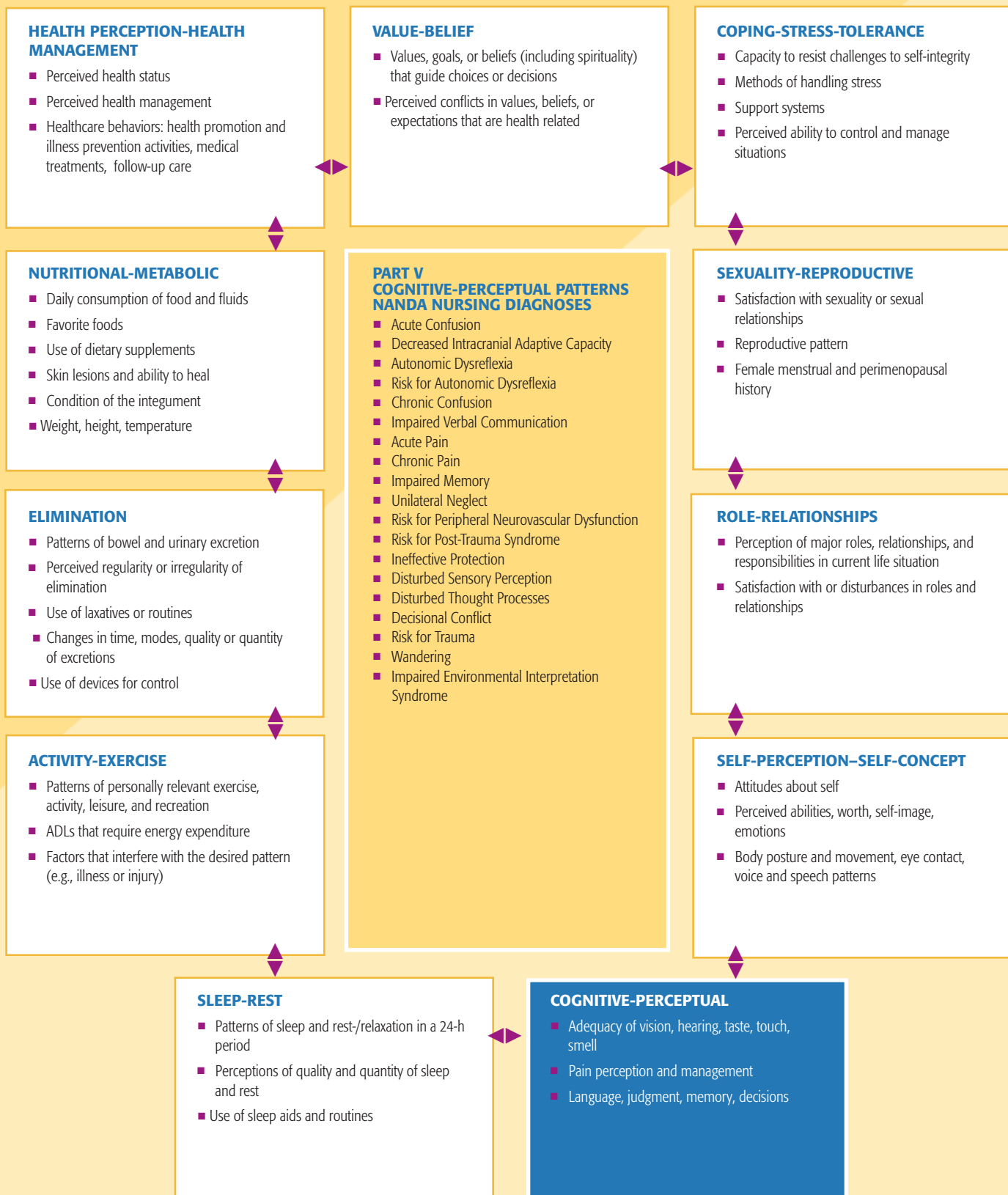
Cognitive and Perceptual Patterns

UNIT 13
Responses to Altered Neurologic Function

UNIT 14
**Responses to Altered Visual and Auditory
Function**



Functional Health Patterns with Related Nursing Diagnoses



UNIT 13

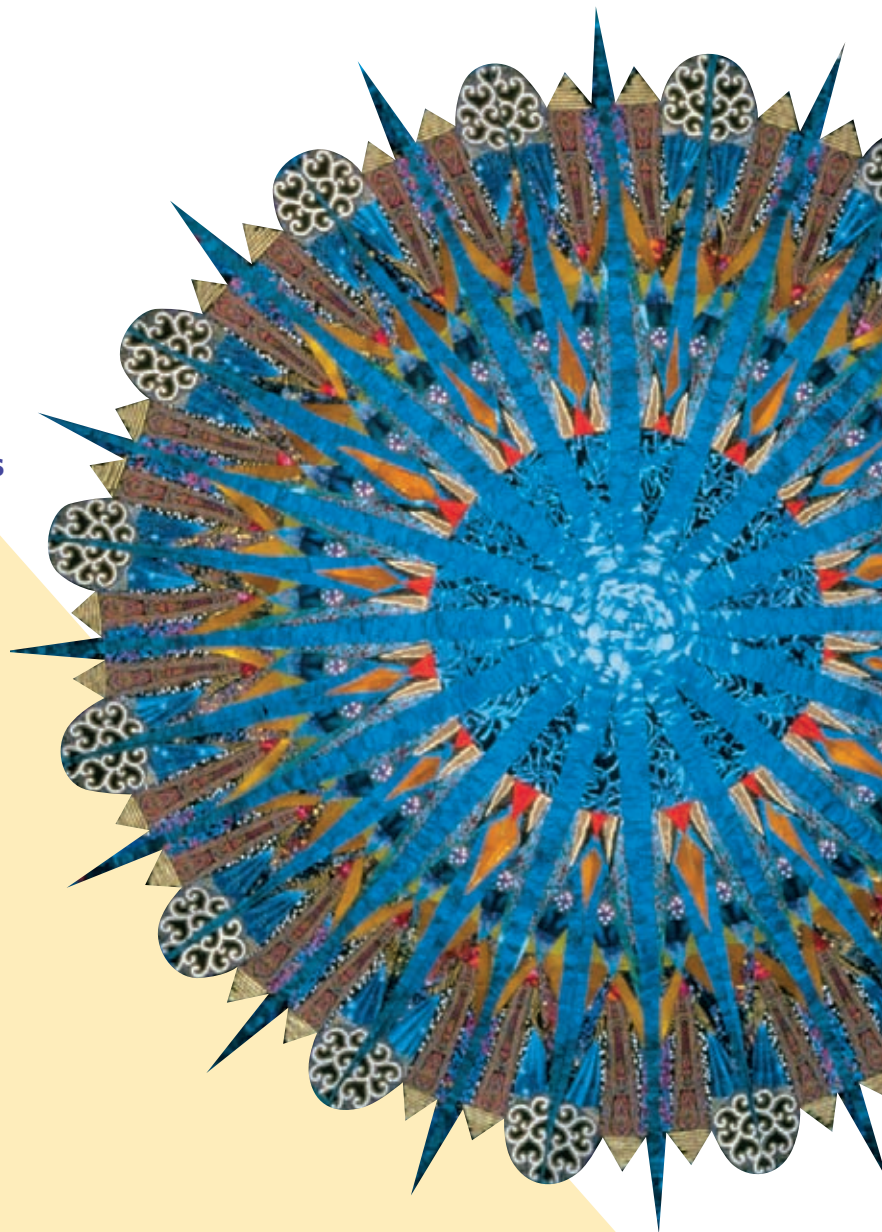
Responses to Altered Neurologic Function

CHAPTER 43
Assessing Clients with Neurologic Disorders

CHAPTER 44
Nursing Care of Clients with Intracranial Disorders

CHAPTER 45
Nursing Care of Clients with Cerebrovascular and Spinal Cord Disorders

CHAPTER 46
Nursing Care of Clients with Neurologic Disorders



CHAPTER Assessing Clients 43 with Neurologic Disorders

LEARNING OUTCOMES

- Describe the anatomy, physiology, and functions of the nervous system.
- Identify specific topics for consideration during a health history assessment interview of the client with neurologic disorders.
- Explain techniques for assessment of neurologic function, including examinations of mental status, cranial nerves, sensory nerves, motor nerves, cerebellar function, and reflexes.
- Identify manifestations of impairment of neurologic function.
- Describe normal variations in assessment findings for the older adult.

CLINICAL COMPETENCIES

- Conduct and document a health history for clients having or at risk for alterations in the neurologic system.
- Conduct and document a physical assessment of neurologic structures and functions.
- Perform specific neurologic assessments for clients with suspected meningeal irritation and for disoriented or comatose clients.
- Monitor the results of diagnostic tests and report abnormal findings.

EQUIPMENT NEEDED

- Cotton balls
- Safety pin
- Tongue depressor
- Tuning fork
- Reflex hammer
- Pencil and paper
- Penlight
- Printed materials
- Substances to test the senses of smell and taste

MEDIA LINK



Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at <http://www.prenhall.com/lemone>

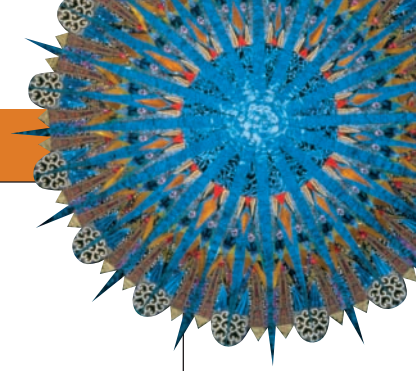


KEY TERMS

anosmia, 1519
aphasia, 1518
ataxia, 1522
decerebrate posturing, 1525
decorticate posturing, 1525
diaphoresis, 1512

dysarthria, 1518
dysphagia, 1520
dysphonia, 1518
fasciculations, 1521
flaccidity, 1522
kinesthesia, 1521

nystagmus, 1519
ptosis, 1520
spasticity, 1522
tremors, 1522



The nervous system regulates and integrates all body functions, muscle movements, senses, mental abilities, and emotions. It collects information from the internal and external environ-

ments as sensory input, processes and interprets the input, and causes responses that are manifested as motor or sensory output.

ANATOMY, PHYSIOLOGY, AND FUNCTIONS OF THE NERVOUS SYSTEM

The nervous system is divided into two regions: the central nervous system (CNS), which consists of the brain and spinal cord, and the peripheral nervous system (PNS), which consists of the cranial nerves, the spinal nerves, and the autonomic nervous system.

Nerve Cells, Action Potentials, and Neurotransmitters

The highly integrated CNS and PNS consist of just two types of cells: neurons, which receive impulses and send them on to other cells, and neuroglia, which protect and nourish the neurons.

Neurons

Each neuron consists of a dendrite, a cell body, and an axon (Figure 43-1 ■). The dendrite is a short process (projection) from the cell body that conducts impulses toward (afferent) the cell body. Cell bodies, most of which are located within the CNS, are clustered in ganglia or nuclei. The cell bodies and dendrites comprise what is often called the gray matter of the CNS. The axon, a long process, conducts impulses away (efferent) from the cell body. Many axons are covered with a myelin sheath, a white lipid substance. It is interrupted at intervals in unmyelinated areas called nodes of Ranvier, which allow movement of ions between the axon and the extracellular fluid. The myelin sheath serves to increase the speed of nerve impulse conduction in axons and is essential for the survival of larger nerve processes. Myelinated nerve fibers comprise the white matter of the brain and spinal cord.

Action Potentials

Action potentials are impulses (movements of electrical charge along an axon membrane) that allow neurons to communicate with other neurons and body cells. They are initiated by stimuli and propagated by the rapid movement of charged ions through the cell membrane. When a neuron reaches a certain level of stimulation, an electrical impulse is generated and conducted along the length of its axon. The movement of impulses to and from the CNS is made possible by afferent and efferent neurons. Afferent, or sensory, neurons have receptors in skin, muscles, and other organs and relay impulses to the CNS. Ef-

ferent, or motor, neurons transmit impulses from the CNS to cause some type of action.

Nerve impulses occur when a stimulus reaches a point great enough to generate a change in electrical charge across the cell membrane of a neuron. A neuron that is not involved in impulse conduction is in a resting, or polarized, state, in which the number of positive ions in the fluid outside of the cell membrane is greater than in the fluid within the cell. The chief regulators of membrane potential are sodium and potassium: Sodium is the major positive ion in the extracellular fluid, and potassium is the major positive ion in the intracellular fluid. In response to an electrical stimulus, the cell membrane becomes permeable to sodium, which moves into

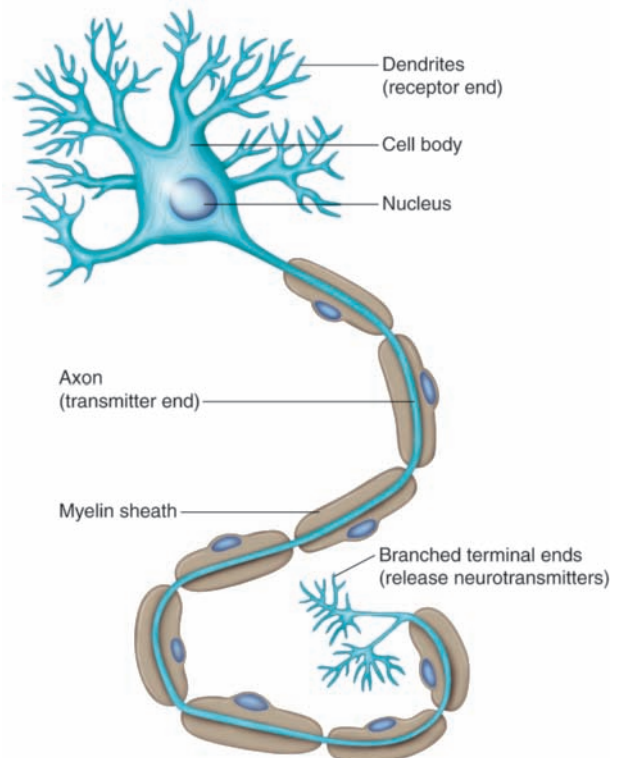


Figure 43-1 ■ A typical neuron.

the cell. This changes the polarity of the cell membrane, and the neuron is said to depolarize. This event stimulates an action potential, or a nerve impulse, to travel down the axon. When the charges and ions return to their original resting state, the neuron is repolarized. The events in an action potential are as follows:

1. Initially, sodium permeability increases. As the membrane is depolarized, sodium channels open and sodium rushes into the cell to a point of depolarization (the inside of the cell becomes less negative in comparison to the outside of the cell).
2. This is followed by a decrease in sodium permeability, lasting only about 1 millisecond. The sodium gates close and the sodium influx stops.
3. The final event is an increase in potassium permeability. The potassium gates open, potassium rushes out of the cell, and the cell interior becomes progressively less positive. The membrane potential moves back to its resting state and is repolarized.

The action potential is generated only at the point of the stimulus; but once generated, it is propagated along the entire length of the axon regardless of whether the stimulus continues. Conduction of the impulse is rapid in myelinated fibers, with the action potential “jumping” from one node of Ranvier to the next. The conduction of the impulse is slower in unmyelinated fibers.

Neurotransmitters

Neurotransmitters are the chemical messengers of the nervous system. When the action potential reaches the end of the axon at the presynaptic terminal, a neurotransmitter is released and travels across the synaptic cleft to bind with receptors in the postsynaptic neuron dendrite or cell body. The neurotransmitter may either be inhibitory or excitatory. The excitatory neurotransmitter is almost always acetylcholine (ACh), which is rapidly degraded by the enzyme acetylcholinesterase. Norepinephrine (NE), which may be either excitatory or inhibitory, is another major neurotransmitter.

Nerves that transmit impulses through the release of ACh are called *cholinergic*. Receptors that bind ACh are found in the viscera, skeletal muscle cells, and the adrenal medulla (where they stimulate the release of epinephrine). The effect of ACh binding may be either to stimulate or to inhibit a response.

Nerves that transmit impulses through the release of NE are called *adrenergic*. Receptors that bind NE are found in the heart, lungs, kidneys, blood vessels, and all target organs stimulated by the sympathetic division except the heart. Adrenergic receptors are further divided into alpha and beta types. Alpha-adrenergic receptors help control such varied functions as arterial vasoconstriction and pupil dilation. Beta-adrenergic fibers may be either beta₁- or beta₂-receptors. Beta₁-receptors are found in the heart, where they regulate the rate and force of contraction. Beta₂-receptors are found in receptor cells of the lungs, arteries, liver, and uterus; they help regulate bronchial diameter, arterial diameter, and glycogenesis. Generally, binding of NE to alpha-receptors stimulates a response, whereas binding to beta-receptors inhibits a response.

Other neurotransmitters include gamma aminobutyric acid (GABA), which inhibits CNS function; dopamine, which may

be inhibitory or excitatory and helps control fine movement and emotions; and serotonin, which is usually inhibitory and controls sleep, hunger, and behavior and also affects consciousness.

The Central Nervous System

The central nervous system (CNS) consists of the brain and spinal cord, highly evolved clusters of neurons that act to accept, interconnect, interpret, and generate a response to nerve impulses originating throughout the body.

The Brain

The brain is the control center of the nervous system and also generates thoughts, emotions, and speech. Averaging 3 to 4 lb in weight, the brain is surrounded by the skull, a bony structure that provides support and protection. The brain has four major regions: the cerebrum, the diencephalon, the brainstem, and the cerebellum (Figure 43–2 ■). The general functions of these regions are summarized in Table 43–1.

The two hemispheres of the cerebrum account for almost 60% of brain weight. The surface of the cerebrum is folded into elevated ridges of tissue called gyri, which are separated by shallow grooves called sulci. Deep grooves called fissures further divide the surface of the cerebrum. The longitudinal fissure separates the hemispheres, and the transverse fissure separates the cerebrum from the cerebellum. In addition, each cerebral hemisphere is divided into frontal, parietal, temporal, and occipital lobes (Figure 43–3 ■).

The cerebral hemispheres are connected by a thick band of nerve fibers called the corpus callosum, which allows communication between the two hemispheres. Each hemisphere receives sensory and motor impulses from the opposite side of the body. One of the cerebral hemispheres tends to develop more than the other. Most people have a more highly developed left hemisphere, which is responsible for the control of language. The right hemisphere has greater control over nonverbal perceptual functions.

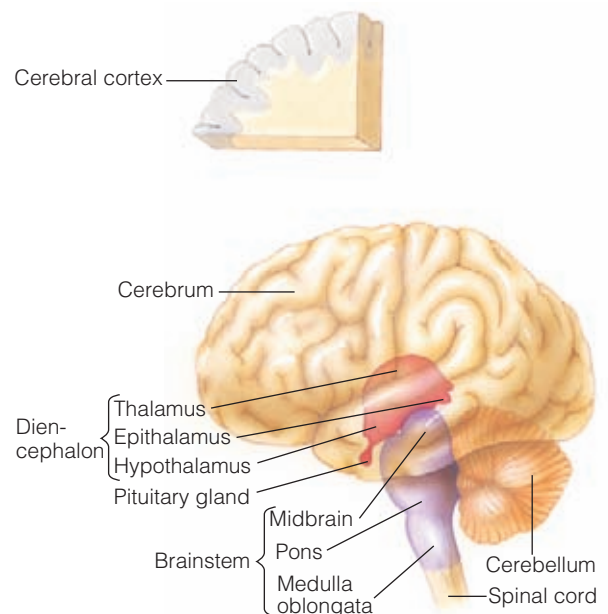


Figure 43–2 ■ The four major regions of the brain.

TABLE 43–1 General Functions of the Four Regions of the Brain

REGION	FUNCTIONS
Cerebrum	Interprets sensory input. Controls skeletal muscle activity. Processes intellect and emotions. Contains skills memory.
Diencephalon	Conducts sensory and motor impulses. Regulates autonomic nervous system. Regulates and produces hormones. Mediates emotional responses.
Brainstem	Serves as conduction pathway. Serves as site of decussation of tracts. Contains respiratory nuclei. Helps regulate skeletal muscles.
Cerebellum	Processes information. Provides information necessary for balance, posture, and coordinated muscle movement.

The cerebral cortex is the outer surface of the cerebrum. It consists of neuron cell bodies, unmyelinated fibers, neuroglia, and blood vessels. The functions of the different lobes of the cerebrum and the specific areas of the cerebral cortex are shown in Figure 43–3 and listed in Table 43–2.

The diencephalon is embedded in the cerebrum superior to the brainstem. It consists of the thalamus, hypothalamus, and epithalamus (see Figure 43–2). The thalamus begins to process sensory impulses before they ascend to the cerebral cortex. It serves as a sorting, processing, and relay station for input into the cortical region. The hypothalamus, located inferior to the thalamus, regulates temperature, water metabolism, appetite, emotional expressions, part of the sleep–wake cycle, and thirst. The epithalamus forms the dorsal part of the diencephalon and includes the pineal body, which is part of the endocrine system that affects growth and development.

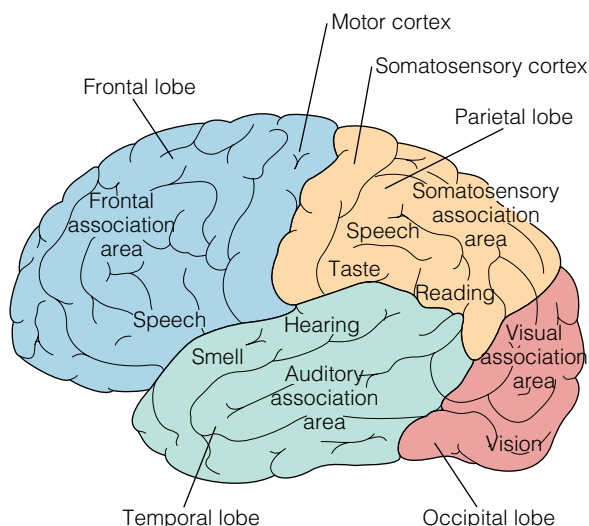


Figure 43–3 ■ Lobes of the cerebrum and functional areas of the cerebral cortex.

TABLE 43–2 Functions of Lobes of the Cerebrum and Areas of the Cerebral Cortex

AREA	FUNCTIONS
Parietal lobe (somatic sensory area of cerebral cortex)	Promotes recognition of pain, coldness, and light touch. The left side receives input from the right side of the body, and vice versa.
Occipital lobe	Receives and interprets visual stimuli.
Temporal lobe	Receives and interprets olfactory and auditory stimuli.
Frontal lobe	Controls movements of voluntary muscles.
Primary motor area	Facilitates voluntary movement of skeletal muscles.
Speech area	Promotes understanding of spoken and written words.
Motor speech area (Broca's area)	Promotes vocalization of words.

BRAINSTEM The brainstem consists of the midbrain, pons, and medulla oblongata (see Figure 43–2). The midbrain is a center for auditory and visual reflexes. In addition, it functions as a nerve pathway between the cerebral hemispheres and lower brain. The pons is located just below the midbrain. It consists mostly of fiber tracts, but it also contains nuclei that control respiration. The medulla oblongata, located at the base of the brainstem, is continuous with the superior portion of the spinal cord. Nuclei of the medulla oblongata play an important role in controlling cardiac rate, blood pressure, respiration, and swallowing.

The cerebellum is connected to the midbrain, pons, and medulla. Its functions include coordinating skeletal muscle activity, maintaining balance, and controlling fine movements.

VENTRICLES The brain contains four ventricles, which are chambers filled with cerebrospinal fluid (CSF). They are linked by ducts that allow the CSF to circulate. One lateral ventricle is located within each hemisphere. These communicate with the third ventricle through the foramen of Monro. The third ventricle communicates with the fourth ventricle through the cerebral aqueduct that runs through the midbrain. The cerebral aqueduct is continuous with the central canal of the spinal cord.

CEREBROSPINAL FLUID Cerebrospinal fluid, a clear and colorless liquid, is formed by the choroid plexus, which are groups of specialized capillaries located in the brain ventricles. Derived from blood plasma, CSF consists of 99% water and contains protein, sodium, chloride, potassium, bicarbonate, and glucose (see Table 43–3 for normal laboratory values for CSF). The usual amount of CSF ranges from 80 to 200 mL, averaging about 150 mL, and is replaced several times each day. It is absorbed by arachnoid villi. CSF is normally produced and absorbed in equal amounts. CSF circulates from the lateral ventricles of the cerebral hemispheres into the third ventricle, through the midbrain, and into the fourth ventricle. Some CSF flows down the center of the spinal cord as the rest of it circulates into the subarachnoid space and returns to the

TABLE 43–3 Normal Laboratory Values for Cerebrospinal Fluid

COMPONENT	NORMAL VALUE
Appearance	Clear and colorless
pH	7.35
Specific gravity	1.007
WBCs	0–8 mm ³
Protein	15–45 mg/dL
Glucose	40–80 mg/dL
Chloride	118–132 mEq/L
Pressure	<200 mmH ₂ O

blood through the arachnoid villi. CSF forms a cushion for the brain tissue, protects the brain and spinal cord from trauma, helps provide nourishment for the brain, and removes waste products of cerebrospinal cellular metabolism.

Meninges The brain and spinal cord are covered and protected by three connective tissue membranes called meninges. The meninges form divisions within the skull, enclose venous sinuses, and contain CSF. The meninges have three layers (Figure 43–4 ■). The outermost double layer, the dura mater, is attached to the inner surface of the skull. The middle layer is the arachnoid mater, which encloses the entire CNS. It forms the subarachnoid space that contains CSF. The innermost layer, the pia mater, clings to the brain, spinal cord, and segmental nerves and is filled with small blood vessels.

CEREBRAL CIRCULATION AND THE BLOOD–BRAIN BARRIER

The brain receives about 750 mL of blood each minute and uses 20% of the body's total oxygen uptake. The large amount of oxygen is necessary for metabolism of glucose, which is the brain's sole source of energy. Blood flow to the brain is mostly controlled by autoregulatory or local mechanisms that respond

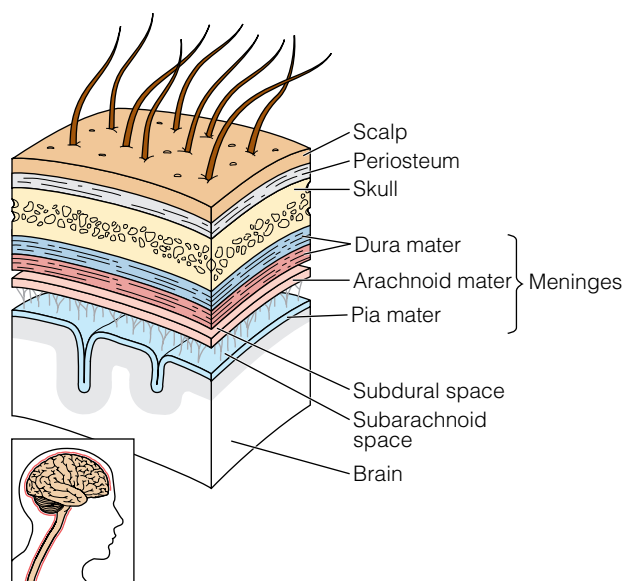


Figure 43–4 ■ Anatomy of the meninges.

to the brain's metabolic needs. Autoregulation is defined as the ability of the brain to maintain constant cerebral blood flow despite changes in systemic blood pressure. At least three metabolic factors affect cerebral blood flow: carbon dioxide, hydrogen ion, and oxygen concentrations. Of these, increased carbon dioxide is the major stimulus for vasodilatation with resultant increased cerebral blood flow.

The anterior part of the brain is supplied with blood by the two internal carotid arteries, and the posterior part of the brain is supplied with blood by the vertebral arteries. The internal carotid artery branches into further arteries: the ophthalmic, posterior communicating, anterior choroidal, anterior cerebral, and middle cerebral. The brainstem and cerebellum receive their blood supply from the basilar artery. These major arteries are connected by small anterior and posterior communicating arteries, which form a circle of connected blood vessels called the circle of Willis (Figure 43–5 ■). This circle serves as a protective device, providing alternative routes for brain tissues to receive their blood supply.

The capillaries in the brain have low permeability because the cells that compose their walls join at very tight junctions and are surrounded by a basement membrane and by the processes of supporting cells in the brain (called astrocytes). As a result, the brain is protected from many harmful substances in the blood. This blood–brain barrier allows lipids, glucose, some amino acids, water, carbon dioxide, and oxygen to pass through it, thus maintaining a controlled environment. Substances such as urea, creatinine, proteins, some toxins, and most antibiotics cannot pass this barrier and enter brain tissue. However, injury to or infection of the brain may cause increased permeability of the blood–brain barrier, altering concentrations of proteins, water, and electrolytes.

THE LIMBIC SYSTEM AND THE RETICULAR FORMATION The limbic system and the reticular formation are functional brain systems. These systems, made of networks of neurons, communicate across areas of the brain.

The limbic system consists of structures that form a ring of tissue in the medial side of each hemisphere, surrounding the upper portion of the brainstem and corpus callosum. The limbic system integrates and modulates input to make up the affective part of the brain, providing emotional and behavioral responses to environmental stimuli.

The reticular formation is located through the central core of the medulla oblongata, pons, and midbrain. This system has widespread connections throughout the brain and relays sensory input from all body systems to all levels of the brain. The reticular formation includes the reticular activating system (RAS). The RAS is a stimulating system for the cerebral cortex, keeping it alert and responsive to incoming sensory stimuli while filtering out repetitive or unwanted stimuli. The sleep center inhibits activity of the RAS, and drugs and alcohol may depress it. Other parts of the reticular formation include motor nuclei that help maintain muscle tone and coordinated movements through interconnections with spinal nerves, and the vasomotor and cardiovascular regulatory centers, which are part of autonomic regulation of the cardiovascular system.

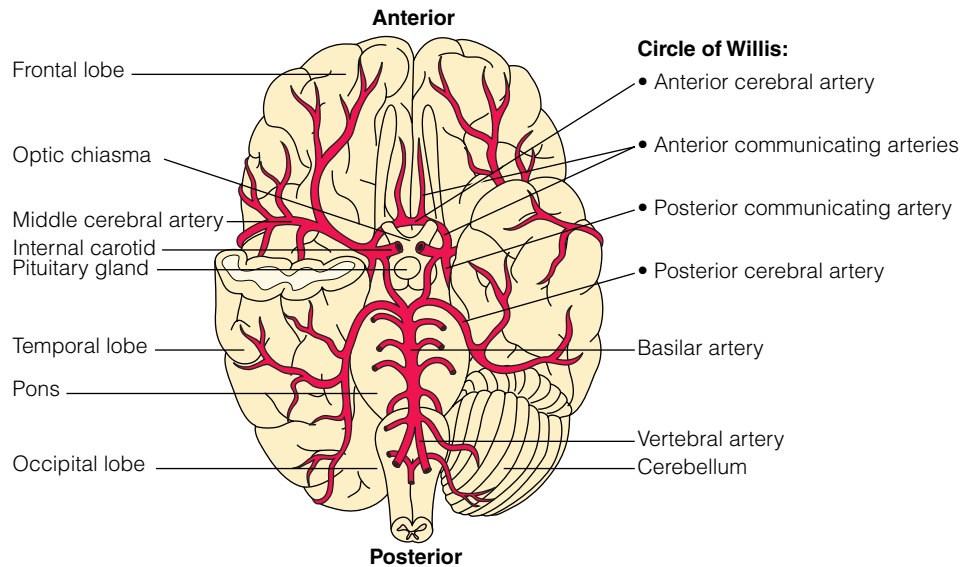


Figure 43–5 ■ Major arteries serving the brain and the circle of Willis.

The Spinal Cord

The spinal cord extends from the medulla to the level of the first lumbar vertebra (Figure 43–6 ■). It serves as a center for conducting messages to and from the brain and as a reflex center. The spinal cord is about 17 inches (42 cm) long and 0.75 inch (1.8 cm) thick. The cord is protected by the vertebrae, the meninges, and CSF. The gray matter of the cord is on the inside, and the white matter is on the outside (the reverse of the arrangement in the brain).

The spinal cord is surrounded and protected by 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 fused vertebrae, which form the coccyx. Each vertebra consists of a body and a vertebral arch formed by projections from the body. This arch encloses a space called the vertebral foramen. The vertebral foramina of all the vertebrae form the vertebral canal through which the spinal cord passes. Intervertebral foramina are spaces between the vertebrae through which spinal nerve roots pass as they exit the vertebral column.

Intervertebral disks are located between each of the movable vertebrae. Each disk is made of a thick capsule surrounding a gelatinous core called the nucleus pulposus. Ligaments that provide mobility and protection surround the vertebral column, discussed in greater detail in Chapter 45 ∞.

The roots of 31 pairs of spinal nerves, divided into the cervical, thoracic, lumbar, sacral, and coccygeal nerves, arise from the cord (see Figure 43–6). Each separates into posterior (sensory) and anterior (motor) roots. Damage to the posterior roots results in loss of sensation, whereas damage to the anterior root results in flaccid paralysis.

FUNCTIONS OF THE SPINAL CORD AND SPINAL ROOTS

Messages to and from the brain are conducted via ascending (sensory) pathways and descending (motor) pathways (Figure 43–7 ■). The major ascending tracts are the lateral and anterior spinothalamic tracts, which carry sensations for pain, temperature, and crude touch; and the posterior tracts, which carry sensations for fine touch, position, and vibra-

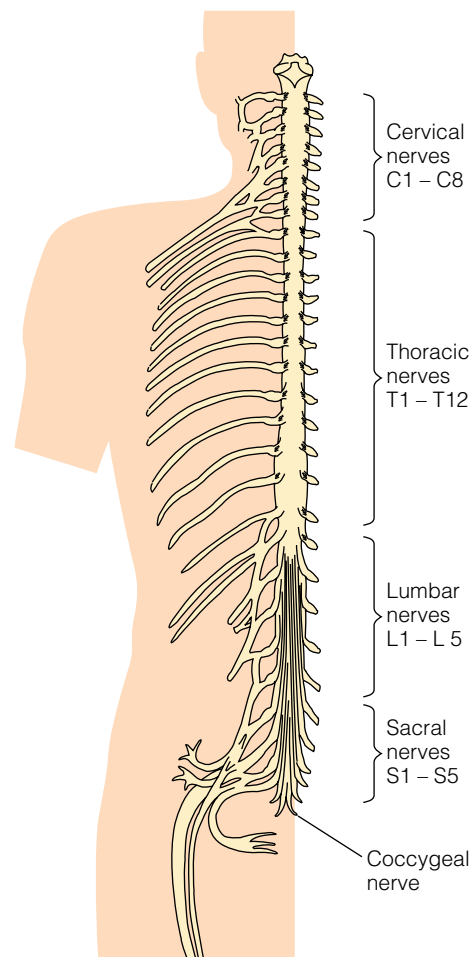


Figure 43–6 ■ Distribution of spinal nerves.

tion. The lateral and anterior corticospinal (pyramidal) tracts are descending tracts consisting of fibers that originate in the motor cortex of the brain and travel to the brainstem and then down the spinal cord. They mediate voluntary purposeful

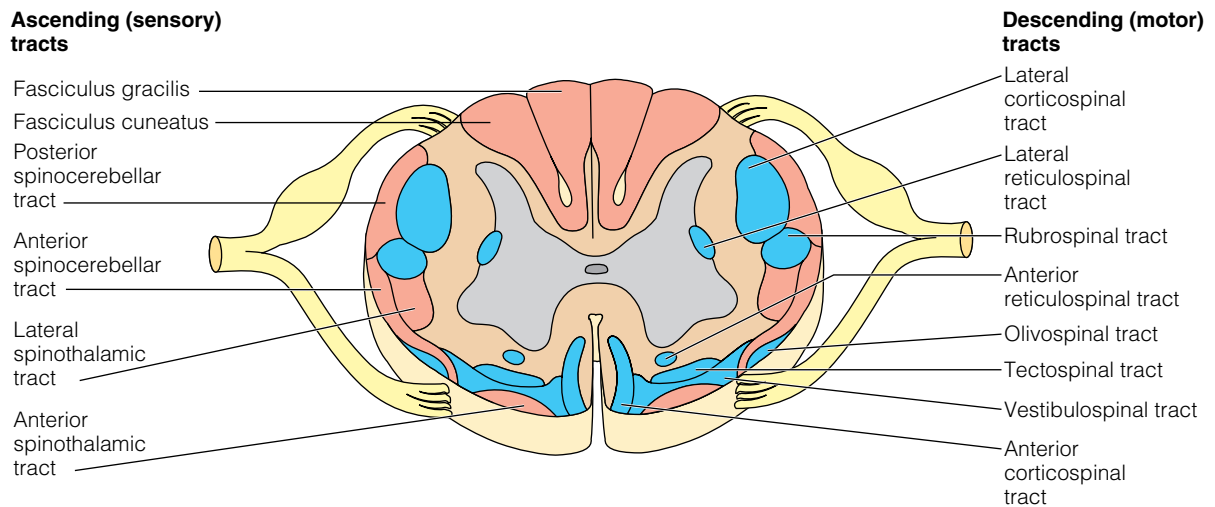


Figure 43-7 ■ Ascending and descending tracts of the spinal cord.

movements and stimulate certain muscular actions while inhibiting others. They also carry fibers that inhibit muscle tone. The rubrospinal, anterior and lateral reticulospinal, and tectospinal (extrapyramidal) tracts include the pathways between the cerebral cortex, basal ganglia, brainstem, and spinal cord outside the pyramidal tract. They maintain muscle tone and gross body movements.

UPPER AND LOWER MOTOR NEURONS Upper motor neurons, such as those of the corticospinal and extrapyramidal tract, carry impulses from the cerebral cortex to the anterior gray column of the spinal cord. Damage to upper motor neurons results in increased muscle tone, decreased muscle strength, decreased coordination, and hyperactive reflexes. Lower motor neurons begin in the anterior gray column of the spinal cord and end in the muscle. Damage to lower motor neurons results in decreased muscle tone, muscle atrophy, fasciculations, and loss of reflexes.

The Peripheral Nervous System

The peripheral nervous system links the CNS with the rest of the body. It is responsible for receiving and transmitting information from and about the external environment. The PNS consists of nerves, ganglia (groups of nerve cells), and sensory receptors located outside—or peripheral to—the brain and spinal cord. The PNS is divided into a sensory (afferent) division and a motor (efferent) division. Most nerves of the PNS contain fibers for both divisions and all are classified regionally as either spinal nerves or cranial nerves.

Spinal Nerves

The 31 pairs of spinal nerves (see Figure 43-6) are named by their location:

- Cervical nerves: 8 pairs
- Thoracic nerves: 12 pairs
- Lumbar nerves: 5 pairs
- Sacral nerves: 5 pairs
- Coccygeal nerves: 1 pair

Spinal nerves exit the vertebral column through intervertebral foramina to travel to the body regions they serve. The spinal cord does not reach the end of the vertebral column; as a result, the lumbar and sacral nerve roots travel inferiorly through the vertebral canal for some distance before exiting the vertebral column through their associated intervertebral foramina. This collection of descending nerve roots is called the cauda equina.

Each spinal nerve contains both sensory and motor fibers. The sensory fibers are located in the dorsal root, and their cell bodies are located within the dorsal root ganglion. The motor fibers are located in the ventral root, and their cell bodies are located within the spinal cord. The dorsal and ventral roots merge outside the vertebral canal just past the dorsal root ganglion, forming a spinal nerve. Each spinal nerve further divides into branches called rami.

The ventral rami of the cervical, brachial, lumbar, and sacral regions form complex clusters of nerves called plexuses. The main spinal nerve plexuses innervate the skin and the underlying muscles of the arms and legs. For example, the cervical plexus innervates the diaphragm through the phrenic nerve; the brachial plexus innervates the upper extremities through the median, ulnar, and radial nerves; and the lumbar plexus innervates the anterior thigh through the femoral nerve.

An area of skin innervated by cutaneous branches of a single spinal nerve is called a dermatome. The dorsal roots of the spinal nerves carry sensations from these specific dermatomes. Dermatomes provide anatomic landmarks that are useful for locating neurologic lesions (Figure 43-8 ■).

Cranial Nerves

Twelve pairs of cranial nerves originate in the forebrain and brainstem (Figure 43-9 ■). The vagus nerve extends into the ventral body cavity, but the 11 other pairs innervate only head and neck regions. Although most are mixed nerves, three pairs (olfactory, optic, and acoustic) are solely sensory. The cranial nerves and their related functions are listed in Table 43-4.

Reflexes

A reflex is a rapid, involuntary, predictable motor response to a stimulus. Reflexes are categorized as either somatic or autonomic.

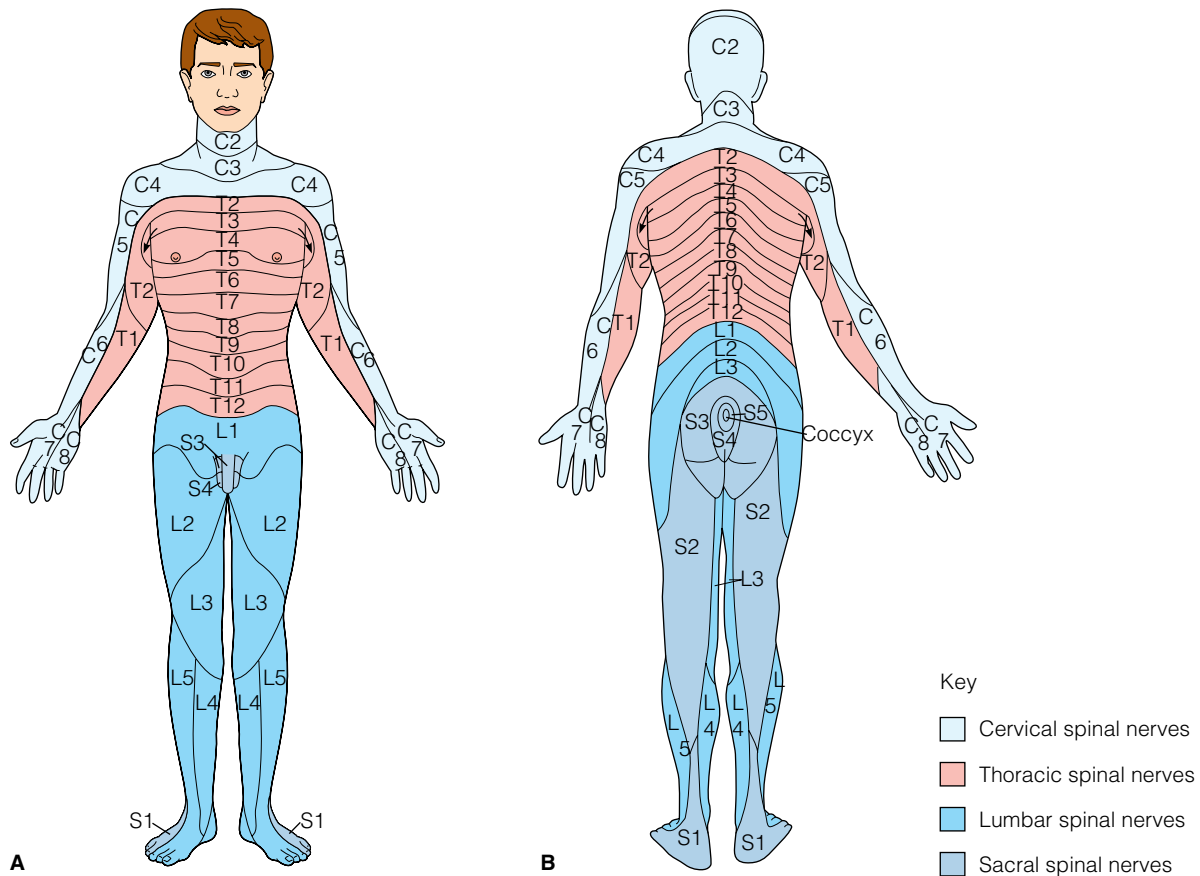


Figure 43-8 ■ A, Anterior, and B, posterior dermatomes of the body.

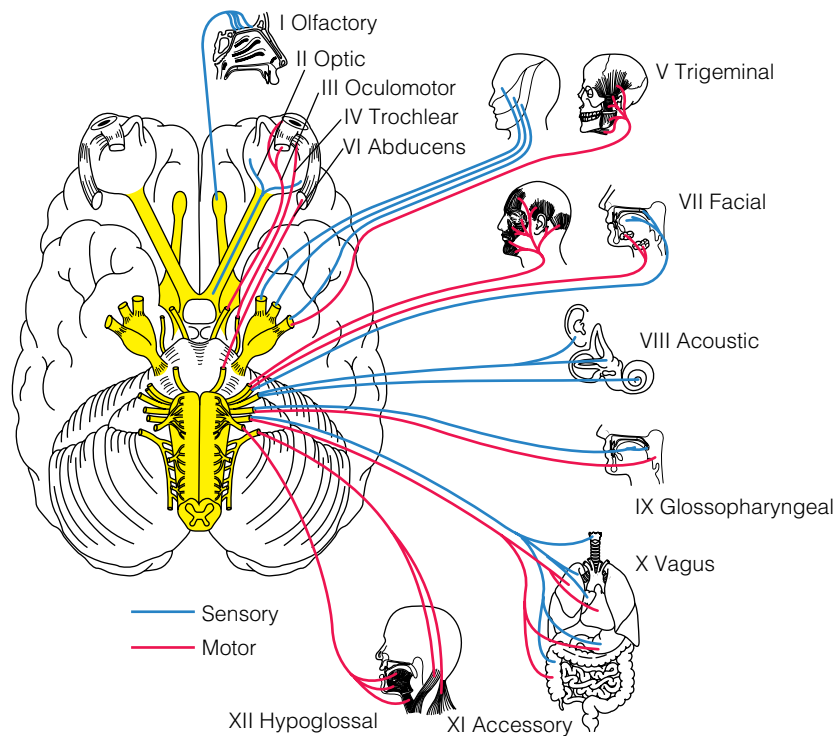


Figure 43-9 ■ Cranial nerves.

TABLE 43–4 Cranial Nerves

NAME	FUNCTION
I Olfactory	Sense of smell
II Optic	Vision
III Oculomotor	Eyeball movement Raising of upper eyelid Constriction of pupil Proprioception
IV Trochlear	Eyeball movement
V Trigeminal	Sensation of the upper scalp, upper eyelid, nose, nasal cavity, cornea, and lacrimal gland Sensation of the palate, upper teeth, cheek, top lip, lower eyelid, and scalp Sensation of the tongue, lower teeth, chin, and temporal scalp Chewing
VI Abducens	Lateral movement of the eyeball
VII Facial	Movement of facial muscles Secretions of lacrimal, nasal, submandibular, and sublingual glands Sensation of taste
VIII Acoustic	Sense of equilibrium Sense of hearing
IX Glossopharyngeal	Swallowing Gag reflex Secretions of parotid salivary gland Sense of taste Touch, pressure, and pain from pharynx and posterior tongue Pressure from carotid arteries Receptors to regulate blood pressure
X Vagus	Swallowing Regulation of cardiac rate Regulation of respirations Digestion Sensation from thoracic and abdominal organs Proprioception Sense of taste
XI Accessory	Movement of head and neck Proprioception
XII Hypoglossal	Movement of tongue for speech and swallowing

Somatic reflexes result in skeletal muscle contraction. Autonomic reflexes activate cardiac muscle, smooth muscle, and glands. A reflex occurs over a pathway called a reflex arc.

The essential components of a reflex arc are a receptor, a sensory neuron to carry afferent impulses to the CNS, an integration center in the spinal cord or brain, a motor neuron to carry efferent impulses, and an effector (the tissue that responds by contracting or secreting) (Figure 43–10 ■).

Somatic reflexes mediated by the spinal cord are called *spinal reflexes*. Many spinal reflexes occur without impulses traveling to and from the brain, with the cord serving as the integration center, whereas others require brain activity and modulation.

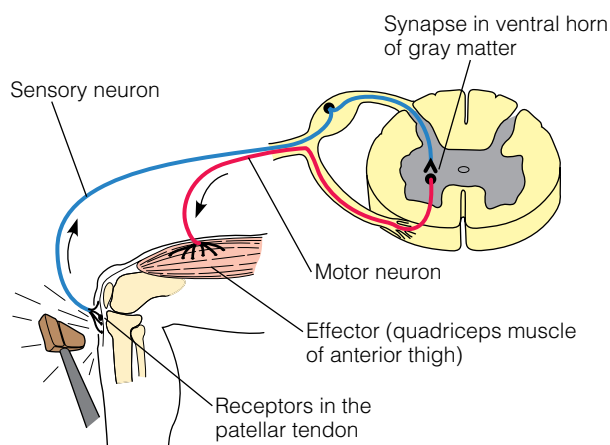


Figure 43–10 ■ A typical reflex arc of a spinal nerve. In the two-neuron reflex arc, the stimulus is transferred from the sensory neuron directly to the motor neuron at the point of synapse in the spinal cord.

Deep tendon reflexes (DTRs) occur in response to muscle contraction and cause muscle relaxation and lengthening. DTRs depend on intact sensory and motor nerve roots, functional synapses in the spinal cord, a functional neuromuscular junction, and a competent muscle. Thus, an abnormal DTR could indicate a variety of health problems, including a lesion of a spinal nerve. Flexor, or withdrawal, reflexes are caused by actual or perceived painful stimuli and result in withdrawal of the part of the body that is threatened. Superficial responses result from gentle cutaneous stimulation. These responses depend on functional upper motor pathways and on an intact reflex arc.

The Autonomic Nervous System

The autonomic nervous system (ANS) is a division of the PNS that regulates the internal environment of the body. It is also called the general visceral motor system, because it consists of motor neurons that innervate the body's viscera. Whereas skeletal muscle activity and reflexes are regulated by a division of the PNS called the somatic nervous system, the ANS regulates the activity of cardiac muscle, smooth muscle, and glands.

The ANS is primarily controlled by the reticular formation in the brainstem. Stimulation of centers in the medulla initiates reflexes that regulate cardiac rate, blood vessel diameter, and gastrointestinal function.

The ANS has sympathetic and parasympathetic divisions. Although fibers from both divisions affect the same structures, the actions of the two divisions are opposite in effect, and they serve to counterbalance each other. The major neurotransmitters for impulse transmission in the ANS are acetylcholine and norepinephrine. Acetylcholine is the primary neurotransmitter of the parasympathetic division. Norepinephrine is the primary neurotransmitter of the sympathetic division.

Sympathetic Division

The sympathetic division of the ANS prepares the body to handle situations that are perceived as harmful or stressful and to participate in strenuous activity. Cell bodies for this division arise in the lateral horns of the spinal cord in the area from

T1 through L2. The fibers separate after leaving the cord and form a chain of ganglia that extends from the neck to the pelvis. Long fibers then extend to the organs that are supplied by the sympathetic division. Stimulation of the sympathetic division can exert the following effects on target organs or tissues:

- Dilated pupils
- Inhibited secretions
- Copious production of sweat (**diaphoresis**)
- Increased rate and force of heartbeat
- Vasodilation of the coronary arteries
- Dilation of the bronchioles
- Decreased digestion
- Increased release of glucose by the liver
- Decreased urine output
- Vasoconstriction of arteries
- Vasoconstriction of abdominal and skin blood vessels
- Increased blood clotting
- Increased metabolic rate
- Increased mental alertness.

Parasympathetic Division

The parasympathetic division of the ANS operates during non-stressful situations. Cell bodies for this division are located in the brainstem (for the cranial nerves) and in the lateral gray matter of S2 through S4. Other than the fibers supplying the cranial nerves III, VII, IX, and X, the fibers are carried by the vagus nerve to body tissues, thoracic organs, and visceral organs. Stimulation of the parasympathetic division of the ANS produces the following effects:

- Constriction of pupils
- Stimulation of glandular secretions
- Decreased heart rate
- Vasoconstriction of coronary arteries
- Constriction of the bronchioles
- Increased peristalsis and secretion of gastrointestinal fluid.

ASSESSING NEUROLOGIC FUNCTION

Structures and functions of the neurologic system are assessed by findings from diagnostic tests, a health assessment interview to collect subjective data, and a physical assessment to collect objective data. Sample documentation of an assessment of the neurologic system is included in the box on this page.

Diagnostic Tests

The results of diagnostic tests of neurologic structure and function are used to support the diagnosis of a specific injury or disease, to provide information to identify or modify the appropriate medications or therapy used to treat the disease, and to help nurses monitor the client's responses to treatment and nursing care interventions. Diagnostic tests to assess the structures and functions of the neurologic system are described in table beginning on page 1514 and summarized in the following bulleted list. More information is included in the discussion of specific injuries or diseases in Chapters 44, 45, and 46 ∞.

- Radiologic examinations of the skull and spine include standard x-rays, computed tomography (CT) scans, magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), and

SAMPLE DOCUMENTATION

Assessment of the Neurologic System

45-year-old male having annual physical examination. No history of injury or infection involving the head or spine. No history of seizures, dizziness, headaches, memory loss, or problems with speaking, or swallowing. Alert, oriented to person, place, and time. Able to follow directions, explain simple proverbs, and compare unlike objects. Cranial nerve testing results:

I = Identifies scents correctly.

II = Vision 40/20 in both eyes. Has full visual fields bilaterally.

III, IV, VI = Bilateral full extraocular movements, pupils are equally round, react to light and accommodation. No ptosis present in either eye.

V = Able to identify sharp, dull, and light touch to forehead, cheek, and chin. Corneal reflex present bilaterally, but decreased (wears contact lenses).

VII = Able to smile, frown, wrinkle forehead, show teeth, puff out cheek, purse lips, raise eyebrows, and close eyes against resistance.

VIII = Heard whispered words with both ears.

IX, X = Gag reflex present. Swallows without difficulty.

XI = Equal strength when shrugging both shoulders.

XII = Able to protrude tongue midline without tremors.

All extremities have full range of motion without tremors, tics, or weakness. No atrophy of muscles noted. Can perform repetitive alternating movements without difficulty. Gait is steady. Negative Romberg test. All reflexes are 2+ bilaterally. Abdominal reflex present. No Babinski's present.

magnetic resonance spectroscopy (MRS). Findings from these examinations are used to diagnose and evaluate fractures, vertebral displacements, tumors, hemorrhage, aneurysms, cysts, edema, ischemia, atrophy, necrosis, seizures, multiple sclerosis, Alzheimer's disease, coma, and vascular lesions.

- Both positron emission tomography (PET) and single-photon emission computed tomography (SPECT) are used to assess brain function and blood flow, to differentiate types of dementia, to evaluate the stage of a brain tumor, and to identify brain tumors, strokes, and seizure disorders.
- Occlusion of the carotid arteries is evaluated by measuring velocity of blood flow with a carotid duplex study; and extracranial blood vessels are evaluated with a transcranial Doppler study.
- Electrical activity of the brain is measured with an electroencephalogram (EEG) to diagnose brain disease and brain death. A magnetoencephalogram (MEG) measures electrical activity of neurons to pinpoint the area of the brain affected by a stroke, brain trauma, brain disorders, or seizures.
- Cerebrospinal fluid, removed through a lumbar puncture (LP), is examined in the laboratory to diagnose a variety of brain diseases and infections.
- A myelogram is used to identify lesions of the spinal cord, such as tumors or herniated intervertebral disks.

Regardless of the type of diagnostic test, the nurse is responsible for explaining the procedure and any special prepa-

ration needed, assessing for medication use that may affect the outcome of the tests, supporting the client during the examination as necessary, documenting the procedures as appropriate, and monitoring the results of the tests.

Genetic Considerations

When conducting a health assessment interview and a physical assessment, it is important for the nurse to consider genetic influences on the health of the adult. Several neurologic diseases that directly affect the nervous system have a genetic component; some are due to mutation of a single gene while others have a more complex method of inheritance (National Institutes of Health, 2003). During the health assessment interview,

GENETIC CONSIDERATIONS Neurologic Disorders

- In all types of spinocerebellar ataxia, there is degeneration of the spinal cord and cerebellum, resulting in loss of muscular coordination and spasticity.
- One recently confirmed risk factor for Parkinson's disease is a positive family history of the disease. This neurodegenerative disease affects more than half a million people, manifested by tremor, muscular stiffness, and difficulty with balance and walking.
- Although multiple sclerosis (MS) is not directly inherited, genetic factors may influence a predisposition to MS within families as well as the severity and course of the disease.
- Narcolepsy, a sleep disorder, does have a familial connection.
- Huntington's disease is an inherited degenerative disorder that leads to dementia. It currently affects approximately 30,000 Americans, with an additional 150,000 at risk for inheriting the disease from their parents.
- Friedreich's ataxia is a rare inherited disease that causes a progressive loss of voluntary muscle coordination and enlargement of the heart.
- Essential tremor, as a primary disorder, affects as many as 3 to 4 million people. In more than half of cases, essential tremor is inherited as an autosomal dominant trait, meaning that children of an individual with the disease have a 50% chance of also developing the disorder.
- Epilepsy is one of the most common neurologic diseases, characterized by abnormal cell firing in the brain that causes recurring seizures. Recent evidence suggests that there may be a genetic predisposition in up to 70% of cases.
- Charcot-Marie-Tooth syndrome is the most common inherited peripheral neuropathy in the world, characterized by a slowly progressive degeneration of the muscles of the foot, lower leg, hand, and forearm.
- Alzheimer's disease (AD) is a leading cause of death in adults, increasing in incidence with age and more common in women. AD tends to run in families, with mutations in 4 genes believed to be responsible for the disease.
- Amyotrophic lateral sclerosis (ALS) is a neurologic disease that causes progressive degeneration of motor neurons in the brain and spinal cord, resulting in paralysis and death. Chromosome abnormalities have been linked to familial ALS.
- Although Tay-Sachs disease is most often considered a disease of children, there is a chronic adult form that causes neuron dysfunction and psychosis.

ask about family members with health problems affecting neurologic structure or function. In addition, ask about a family history of problems with muscular coordination, Parkinson's disease, narcolepsy, tremor, seizures, Alzheimer's disease, or amyotrophic lateral sclerosis (ALS). During the physical assessment, assess for any manifestations that might indicate a genetic disorder (see the box on this page). If data is found to indicate genetic risk factors or alterations, ask about genetic testing and refer for appropriate genetic counseling and evaluation. Chapter 8 ∞ provides further information about genetics in medical-surgical nursing.

Health Assessment Interview

A health assessment to determine problems with neurologic structure and/or function may be conducted during a health screening, may focus on a chief complaint (such as headaches), or may be part of a total health assessment. Health problems affecting the neurologic system may manifest as problems with musculoskeletal function and an assessment of both systems may be necessary. If the client's level of consciousness is altered, the nurse may need to rely on family members for information. The client's level of consciousness may be assessed by using the Glasgow Coma Scale (Table 43–5).

If the client has problems with neurologic structure or function, analyze its onset, characteristics, course, severity, precipitating and relieving factors, and any associated symptoms, noting the time and circumstances. For example, ask the client the following:

- Describe the location and intensity of the pain you have experienced in your left leg. Is it made worse by coughing, sneezing, or walking?
- When did you first notice that you were having numbness in your fingers?
- Describe the difficulty you have when you try to walk.

Questions about present health status include information about numbness, tingling sensations, tremors, problems with

TABLE 43–5 Glasgow Coma Scale

ASSESSMENT	RESPONSE	SCORE*
Eyes open (Record C if eyes are closed by swelling.)	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best motor response (Record best upper arm response.)	Obeys commands	6
	Localizes pain	5
	Flexion-withdrawal	4
	Abnormal flexion	3
	Abnormal extension	2
Best verbal response (Record T if an endotracheal or tracheostomy tube is in place.)	No response	1
	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Total Score:		_____

*A higher score indicates a higher level of functioning.


DIAGNOSTIC TESTS of the Neurologic System
NAME OF TEST X-rays of skull and spine

PURPOSE AND DESCRIPTION Standard x-rays of the skull and spine are done to identify fractures, displacement of

vertebrae, spinal curves, and tissue displacement (as by tumors).

RELATED NURSING CARE No special preparation is needed.

NAME OF TEST Computed tomography (CT) scan

PURPOSE AND DESCRIPTION Used to identify intracerebral hemorrhage, tumors, cysts, aneurysms, edema, ischemia, atrophy, and tissue necrosis. May also be used to evaluate a shift in intracranial contents and differentiate type of stroke. Involves computer assisted x-rays of several levels of cross sections of the body part being examined; may be done with or without contrast.

CLIENT PREPARATION

- Ensure a signed consent form.
- Check hospital policy on withholding food and fluids. Clients are usually on NPO status (except for the medications ordered as part of the test) for 8 hours before the test if it is done in the morning. If the test is done in the afternoon, the client may have a liquid breakfast.
- Give medications up to 2 hours before test.
- Assess for possible reaction to iodine dye (by asking about allergy to seafood). Document any allergy and inform the physician and radiology department.
- Remove metal hairpins, clips, and earrings.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- *(If applicable)* Do not drink or eat anything before the test except for the ordered medications.
- You may be given an intravenous infusion. When the contrast dye is injected, you may feel warm and have a metallic taste in the mouth.
- The exam lasts from 30 to 90 minutes.
- Your head will be positioned in a cradle, and a wide rubber strap will be applied snugly across the forehead during the test (to keep your head immobilized).
- The CT scanner is circular with a round opening. You are strapped to a special table, and the scanner revolves around the body part to be examined. The scanner makes a clicking noise.
- The test is painless.
- Someone is always immediately available during the test.

NAME OF TEST Magnetic Resonance Imaging (MRI)
Functional MRI

PURPOSE AND DESCRIPTION An *MRI* is done to identify and monitor conditions of the brain and spinal cord, including stroke, tumors, trauma, seizures, and multiple sclerosis. Uses magnetic energy to provide images. Gadolinium contrast media may be

used to enhance visualization. A *functional MRI* is done to evaluate metabolic or blood flow responses of the brain to specific tasks, such as activity and rest.

RELATED NURSING CARE Assess for metal implants (such as a pacemaker or defibrillator), body piercings, and shrapnel, which would contraindicate tests.

NAME OF TEST Magnetic Resonance Angiography (MRA)

PURPOSE AND DESCRIPTION Can provide information about the blood vessels of the brain and identify vascular lesions. Uses the signals from blood vessels to reconstruct

only those vessels with blood flow. Can also be done using contrast media.

RELATED NURSING CARE Assess for metal implants (such as a pacemaker) and shrapnel, which would contraindicate tests.

NAME OF TEST Magnetic Resonance Spectroscopy (MRS)

PURPOSE AND DESCRIPTION Uses a scanner to confirm the presence of Alzheimer's disease, determine the extent of head injury from trauma or stroke, and identify the causes of coma.

RELATED NURSING CARE Assess for metal implants, as for an MRI, which would contraindicate tests.

NAME OF TEST Positron Emission Tomography (PET)
Single-Photon Emission Computed Tomography (SPECT)

PURPOSE AND DESCRIPTION When used to study the brain, a *PET* can assess normal brain function and cerebral blood flow and volume; can differentiate different types of dementia; and can identify stages of brain tumors. A substance containing a radionuclide is given by gas or by injection and cross sections of

tissue are detected and displayed by computer. A *SPECT* is similar to a PET, but uses different substances. It can be used to diagnose strokes, brain tumors, and seizure disorders.

RELATED NURSING CARE Tell the client not to drink coffee or alcohol or to smoke for 24 hours before the test. Assess glucose levels pretest. Post-test, encourage oral fluids to facilitate excretion of the radioactive substance.

NAME OF TEST Cerebral Angiogram

PURPOSE AND DESCRIPTION The definitive diagnostic procedure for aneurysms, arteriovenous malformations, blood vessel patency and stenosis, thrombosis, vasospasm, aneurysm, and space-occupying lesions (such as tumors or hematomas). May be performed either as part of a surgical procedure or with local anesthesia. In radiology, a contrast medium is injected and films are taken at various time intervals.

RELATED NURSING CARE Obtain informed consent, inform about need to remain NPO for 8 hours prior to the procedure, explain that a burning sensation may be felt for a few (4 to 6) seconds behind the eyes or in the jaw, teeth, tongue, or lips. Bed rest is maintained for 8 hours after the procedure, vital signs are monitored, and fluids are forced to clear the contrast medium.


DIAGNOSTIC TESTS of the Neurologic System (continued)
NAME OF TEST Carotid Duplex Study
Transcranial Doppler Study

PURPOSE AND DESCRIPTION A *carotid duplex study* evaluates the velocity of blood flow through the carotid arteries and identifies occlusive disease. Uses sound waves produced by the

blood flow to produce an image. A *transcranial Doppler study* follows the same procedure, but is used to evaluate intracranial blood vessels.

RELATED NURSING CARE No special preparation is needed.

NAME OF TEST Electroencephalogram (EEG)
Magnetoencephalogram (MEG)

PURPOSE AND DESCRIPTION An *EEG* is used to measure the electrical activity of the brain to diagnose brain disease and brain death. Electrodes are applied to the scalp with skin clips and a graphic picture is obtained (similar to an ECG of the heart). A *MEG* can identify the area of the brain affected by a stroke, brain disorders or trauma, or seizures. MEG detects magnetic fields generated by activity of neurons.

vulsants, tranquilizers, depressants, and caffeine-containing foods (e.g., coffee, tea, colas, and chocolate). Medications are usually withheld for 24 to 48 hours before the test.

■ Help the client wash the hair before the test.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- The test takes about 1 hour.
- The test is painless and will be performed while sitting in a comfortable chair or lying on a stretcher.
- The electrodes are applied to the scalp with a thick paste.
- During the test, you will first be asked to breathe in and out deeply for a few minutes. Then, you will close your eyes while a light is flashed on them and, finally, you will lie quietly with your eyes closed.
- After the test, the nurse will help you wash the paste out of your hair.

CLIENT PREPARATION

- Explain the procedure, emphasizing the importance of cooperation.
- Withhold fluids, foods, and medications (as prescribed) that may stimulate or depress brain waves. These include anticon-

NAME OF TEST Evoked Potentials

PURPOSE AND DESCRIPTION Measures nerve conduction along pathways to evaluate evoked potential of muscle contractions. Used to diagnose and evaluate neuromuscular

diseases and identify nerve damage. Transcutaneous or percutaneous electrodes are applied to the skin and provide recordings.

RELATED NURSING CARE No special preparation is needed.

NAME OF TEST Electromyogram (EMG)

PURPOSE AND DESCRIPTION Measures the electrical activity of skeletal muscles at rest and during contraction; useful in diagnosing neuromuscular diseases. Needle electrodes are inserted into skeletal muscle (as on the legs) and electrical activity can be heard, viewed on an oscilloscope, and recorded on graph paper. Normally, there is no electrical activity at rest.

RELATED NURSING CARE Tell client not to drink fluids containing caffeine or to smoke for 3 hours before the test, and not to take medications such as muscle relaxants, anticholinergics, and cholinergics.

NAME OF TEST Lumbar Puncture (LP)

PURPOSE AND DESCRIPTION Used to measure CSF pressure and to obtain a sample of CSF to use in diagnosis of multiple sclerosis, or increased intracranial pressure from meningitis, subarachnoid hemorrhage, brain tumor, brain abscess, encephalitis and viral infections. A needle is inserted in L3–L4 or L4–L5 and fluid is aspirated.

RELATED NURSING CARE Related nursing care for the client having a lumbar puncture is described below.

CLIENT PREPARATION

- Ensure a signed consent form (this consent may be obtained as part of the general consent given on admission to the hospital or agency).
- Ask the client to empty the bladder before the procedure begins.
- Help the client to assume a lateral recumbent position near the side of the bed. The client should assume the fetal position (knees flexed toward the head, head bent toward the chest), with the hands clasped around the knees.

CLIENT AND FAMILY TEACHING

- A local anesthetic is injected into the skin over the area of the needle insertion. This medication may cause a burning sensation.
- A long, thin needle is inserted into the lower back below the level of the spinal cord. Cerebrospinal fluid is withdrawn.
- The cerebrospinal fluid pressure is measured with a calibrated tube called a manometer.
- There may be slight pain down one leg during the procedure.
- It is important to remain still during the procedure.
- A small dressing is used to cover the place where the needle was inserted.
- After the procedure, remain flat in bed for the number of hours prescribed by the physician (this ranges from 4 to 24 hours). The nurses will take your vital signs and look under the small dressing at regular intervals.
- Drink fluids so that your body can replace the fluid that was withdrawn.
- If you have a headache or backache, take medications for pain.
- Notify your healthcare provider if you notice increased pain or drainage from the area where the procedure was done.

(continued)

DIAGNOSTIC TESTS of the Neurologic System (continued)

POSTPROCEDURE NURSING CARE (LP)

- Take and record vital signs as indicated by agency standards.
- Monitor neurologic status at least every 4 hours for 24 hours.
- Monitor the puncture site for leakage of cerebrospinal fluid or hematoma formation.

- Ensure that the client voids within 8 hours of the procedure.
- Encourage increased intake of fluids (up to 3000 mL in 24 hours).
- Administer analgesics as prescribed for pain.

NAME OF TEST Myelogram

PURPOSE AND DESCRIPTION Used to identify lesions of the spinal cord, such as tumors or herniated intervertebral disk. A lumbar puncture is done, a contrast medium is injected into the subarachnoid space, and x-rays are taken.

CLIENT PREPARATION

- Ensure a signed informed consent.
- The meal prior to the procedure is usually omitted.
- The client should be well hydrated.
- Administer enemas or laxatives as ordered to ensure visualization of lumbar spine.
- Administer prescribed pretest medications, such as a sedative or diazepam (Valium).

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- Remain NPO several hours before the test.
- The examination lasts about 1 hour.
- The position used to perform the examination will depend on the physician. You may have to lie on your stomach, sit and lean forward, or sit with the knees to the chest.
- A strap may be used to prevent falls, and the table will be tilted during the examination.
- A lumbar puncture ("spinal tap") is performed to inject the dye. A local anesthetic is used where the needle will be inserted. There may be a feeling of pressure during needle insertion. The needle is inserted below the level of the spinal cord.
- Tell the physician if you experience pain.
- Stay in bed with the head of the bed elevated for at least 6 to 12 hours (the length of time will depend on physician preference and hospital policy).

- The nurse will check your blood pressure, pulse, and respirations. The nurse will also check your ability to feel and move at least every 4 hours (or more often) after the examination.

POSTPROCEDURE NURSING CARE

- Take and record vital signs and assess neurologic status as prescribed (and at least every 4 hours) for 24 hours postexamination. Record and report any changes.
- Assess the site of the lumbar puncture for leakage of cerebrospinal fluid or bleeding every 4 hours. Notify the physician of leakage or bleeding.
- Encourage increased intake of oral fluids to replace that withdrawn during the examination. (This may also help decrease a postmyelogram headache.)
- Make sure that the client voids within 8 hours after the examination. If policy permits, allow male clients to stand at the bedside, or clients of either gender to use the bathroom. Notify the physician if the client has not voided within 8 hours.
- Administer analgesics as prescribed for postexamination pain, headache, or muscle spasms.
- Keep the client's head elevated at least 30 degrees (in bed or in a chair) for 12 hours, or as ordered.
- Resume diet if there is no nausea or vomiting.
- Force oral fluids to 2400 to 3000 mL in 24 hours, beginning immediately after the procedure.
- Administer prescribed medications for nausea.
- Do not give any phenothiazine derivatives for 48 hours (to reduce the possibility of seizures).

coordination or balance, or loss of movement in any part of the body. Ask the client about difficulty with speaking, seeing, hearing, tasting, or detecting odors. In addition, elicit information about memory, feeling state (such as anxiety or depression), recent changes in sleep patterns, ability to perform self-care and activities of daily living, sexual activity, and weight. If the client is taking prescribed medications, over-the-counter medications, or herbal supplements, ask about the type and purpose, as well as the frequency and duration of use.

Ask about any past history of seizures, fainting, dizziness, headaches, and any trauma, tumors, or surgery of the brain, spinal cord, or nerves. Discuss illnesses that may cause neurologic manifestations, including cardiac disease, strokes, pernicious anemia, sinus infections, liver disease, and/or renal failure. Also ask the client about family history of neurologic health problems, diabetes mellitus, hypertension, seizures, or mental health problems.

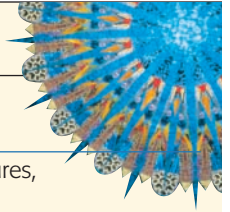
Question the client about occupational hazards, such as exposure to toxic chemicals or materials, use of protective head-

gear, and the amount of time spent performing repetitive motions (e.g., data entry and assembly). Ask questions about self-care to assess the client's diet and use of tobacco, drugs, or alcohol, and ask whether the client wears a helmet when riding a bike or motorcycle or participating in contact sports or uses seat belts when driving a vehicle.

Interview questions categorized by functional health patterns are listed in the Functional Health Pattern Interview table on the following page.

Physical Assessment

Physical assessment of the client begins when the nurse first meets the client and makes an overall evaluation of the client's mental and physical status. The mental status examination is conducted with both the nurse and the client seated. The rest of the neurologic examination may be performed with the client either sitting or standing. A thorough neurologic examination is discussed here, but in most instances,

FUNCTIONAL HEALTH PATTERN INTERVIEW **Neurologic System**

Functional Health Pattern
Interview Questions and Leading Statements
Health Perception-Health Management

- Have you ever had a surgery, injury, or illness of the neurologic system, such as seizures, stroke, tumor, meningitis? If so, describe the problem and how it was treated.
- Do you have high blood pressure? If so, how is it treated?
- Have you ever had problems with the ability to move body parts? Describe.
- Would you say you think clearly? If not, how and when did the change occur?
- Are you having any problems with the ability to see, hear, taste, or smell? Explain.
- Have you ever had any diagnostic tests for a neurologic problem, such as an MRI or spinal tap? If so, what were the results?
- Do you take medications for seizures, headaches, or other neurologic problems? If so, what are they and how often do you take them?
- Do you now or have you ever smoked, used street drugs, or drank alcohol? If so, what type, how much, and for how long?
- Where were you born and raised as a child?

Nutritional-Metabolic

- Describe your usual food and fluid intake for a 24-hour period.
- Have you noticed any problems with chewing or swallowing your food?
- Do you have trouble with coughing when you eat or drink?

Elimination

- Has there been any change in your urinary or bowel elimination? If so, describe the change.
- Do you use laxatives, suppositories, or enemas to assist with bowel elimination? If so, what type and how often?
- Are you able to go to the bathroom without assistance? If not, describe your usual routine.

Activity-Exercise

- Describe your usual activities in a 24-hour period.
- Do you have any problems with balance, coordination, or walking? Do you use any assistive device when you walk, such as a cane or walker?
- Have you noticed any weakness in your arms or legs? If so, describe.
- Are you able to move all of your body parts? If not, explain.
- Do you trip or fall easily?
- Have you experienced any shakiness or tremors? Where?
- If you have seizures, what type do you have? Can you tell when they are going to happen? Does anything specific make you have a seizure? How do you feel after the seizure is over?

Sleep-Rest

- Does this health problem interfere with your ability to sleep and rest? If so, how?
- Do you take any medication to help you sleep? If so, what?
- Describe your energy level. Do rest and sleep restore your energy?

Cognitive-Perceptual

- Describe any headaches you experience, including frequency, type, location, and precipitating/relieving factors.
- Do you ever feel dizzy or have you fainted? Do you ever feel the room is spinning? Explain.
- Do you ever experience any numbness, burning, or tingling sensations? If so, where and when?
- Do you have any visual problems, such as double vision, blurring, or blind spots?
- Do you have any problems with hearing? Explain.
- Has there been any change in your ability to taste or smell? If so, explain.
- Do you have any difficulty remembering things? If so, describe what you do.

Self-Perception-Self-Concept

- How does having this condition make you feel about yourself?

Role-Relationships

- How has having this condition affected your relationships with others?
- Has having this condition interfered with your ability to work? Explain.
- Has anyone in your family had problems with neurologic disease? Explain.

Sexuality-Reproductive

- Has this condition interfered with your usual sexual activity?

Coping-Stress-Tolerance

- Has having this condition created stress for you? If so, does your health problem seem to be more difficult when you are stressed?
- Have you experienced any kind of stress that makes the condition worse? Explain.
- Describe what you do when you feel stressed.

Value-Belief

- Describe how specific relationships or activities help you cope with this problem.
- Describe specific cultural beliefs or practices that affect how you care for and feel about this problem.
- Are there any specific treatments that you would not use to treat this problem?

the nurse will conduct a focused assessment specific to the client's health status.

The neurologic system is assessed through inspection, palpation, and percussion (with a reflex hammer). When conducting the mental status and cognitive portions of the examination, be aware that fatigue or illness may alter findings. Provide rest periods for the client as needed. When interpreting findings, consider the client's age, educational background, and cultural orientation. Normal age-related findings for the older adult are summarized in Table 43–6.

The assessment should take place in a private, comfortable setting. Ask the client to remove outer clothing, shoes, and stockings. Provide a gown for the client to wear. It is important to explain that the neurologic examination is lengthy and may consist of questions and requests that seem strange to the client. Explain the rationale for each part of the examination.

A brief version of this physical assessment, often referred to as a *neuro check*, may be performed in a shorter time period when a client requires frequent ongoing assessments of neurologic status (Box 43–1).

BOX 43–1 Abbreviated Neurologic Assessment (Neuro Check)

1. Assess level of consciousness (response to auditory and/or tactile stimulus).
2. Obtain vital signs (BP, P, R).
3. Check pupillary response to light.
4. Assess strength of hand grip and movement of extremities bilaterally.
5. Determine ability to sense touch/pain in extremities.

TABLE 43–6 Age-Related Changes in the Neurologic System

AGE-RELATED CHANGE	SIGNIFICANCE
<ul style="list-style-type: none"> ■ ↓ number of brain cells, cerebral blood flow, and metabolism. ■ Slower nerve conduction velocity. ■ Slower retrieval of information from long-term memory. 	<p>Delayed response to multiple stimuli and slower reflexes; may need additional time to process and respond to verbal stimuli. There is some age-related forgetfulness, which can be improved by using memory aids such as making lists. May contribute to increased risk for falls.</p>
<ul style="list-style-type: none"> ■ Slower response to changes in balance. ■ May exhibit less readiness to learn and depend on prior experiences to solve problems. ■ Is more easily distracted and has a decrease in the ability to maintain attention. 	
	<p>Learning new skills or knowledge is improved when they are related to previously learned information and when limits are set on times for learning (for example, no more than 30 minutes at one time).</p>

NEUROLOGIC ASSESSMENTS

Technique/Normal Findings

Abnormal Findings

Mental Status Assessment

Assess appearance, including dress, hygiene, grooming, gait, and posture. *The client should be appropriately dressed and clean, with normal gait and posture.*

Assess behavior, including actions and affect, content and quality of speech, and level of consciousness (LOC). Use the Glasgow Coma Scale (see Table 43–5) to document findings. *A score of 15 on the Glasgow Coma Scale indicates the client is alert and oriented.*

- Unilateral neglect (inattention to one side of body) may occur with some strokes. Poor hygiene and grooming may be seen in clients with dementing disorders.
- Abnormal gait and posture may be seen in transient ischemic attacks (TIAs), strokes, and Parkinson's disease.
- Emotional swings or changes in personality may be observed in clients who have had a stroke.
- The face appears masklike (very little expressive movement of facial muscles) in clients with Parkinson's disease.
- Apathy is seen in dementing disorders.
- **Aphasia** (defective or absent language function) may occur in TIAs and strokes. Aphasias are seen with damage to the left cerebral cortex. Aphasias are more often seen with strokes of the left hemisphere than the right hemisphere.
- **Dysphonia** (change in the tone of the voice) is common in strokes. Dysphonia is seen with paralysis of the vocal cords (cranial nerve X).
- **Dysarthria** (difficulty speaking) is seen with lesions of upper and lower motor neurons, the cerebellum, and the extrapyramidal tract.
- Damage to the brainstem and/or cerebral cortex may alter LOC.
- Drowsiness and decreased LOC may be associated with brain trauma, infections, TIAs, stroke, and brain tumors.
- Level of consciousness, ranging from confusion to coma, is usually altered with a stroke.

Technique/Normal Findings

Assess cognitive function.
Note orientation to time, place, and person.

Note attention span and recent and remote memory.

Ask the client to:

1. Repeat five to seven numbers.
2. Recall three items after 5 minutes.
3. Recall his or her address, breakfast, or birthday.

Assess thought processes (both content and perceptions) by noting responses to questions.

Note ability to understand what is said and to express thoughts.


Note ability to make logical and safe judgments. *The client should be oriented to time, place, and person; demonstrate attention and ability to remember recent and past events; respond appropriately to questions; and be able to make judgments.*

Cranial Nerve Assessments



Test CN I (olfactory).

Note client's ability to smell scents (e.g., soap, coffee) with each nostril. This test is usually done only if a problem with the ability to smell is reported. *Sense of smell should be equal in both nostrils.*

Test CN II (optic).

Assess vision in each eye with Snellen chart (see Chapter 47  for guidelines). *Based on previous ability to see and use of visual aids, client should be able to see with both eyes.*

Test CN III, IV, and VI (oculomotor, trochlear, and abducens).

Assess extraocular movements by asking the client to follow your finger as you write an *H* in the air (see Chapter 47 ). Assess PERRL ("pupils equally round and reactive to light") by covering one eye at a time and shining a bright light directly into the uncovered eye (use a penlight or the ophthalmoscope). See Chapter 47  for more detailed assessment guidelines. *Extraocular movements should be present bilaterally, and pupils should be equally round and reactive to light.*

Abnormal Findings

- Disorientation to time and place may occur in clients with stroke of the right cerebral hemisphere.
- Memory deficits are often seen in clients with a stroke.
- Perceptual deficits may be seen in strokes. These same deficits may occur following brain trauma and in dementing disorders.
- Impaired cognition is often noted with strokes, cerebral trauma, and brain tumors.

- **Anosmia** (an inability to smell) may be seen with lesions of the frontal lobe and may also occur with impaired blood flow to the middle cerebral artery.

- Blindness in one eye may be seen with strokes or with TIAs. Impaired vision or blindness in one side of both eyes (homonymous hemianopia) is associated with stroke.
- Impaired vision may be seen with strokes and brain tumors.
- Blindness or double vision may be noted with stroke and TIAs.

- **Nystagmus** (involuntary eye movement) may be seen with strokes.
- Constricted pupils are associated with impaired blood flow from a stroke.


Technique/Normal Findings

Assess for **ptosis** (drooping eyelids). *Eyelids should not droop.*

Test CN V (trigeminal). Assess ability to feel light, dull, and sharp sensations on the face. With the client's eyes closed, check whether sensation is the same on both sides of the face. Stroke the cheek with a wisp of cotton for light touch, with a closed safety pin for dull touch, and with a tongue depressor for sharp touch. If the sharp point of a safety pin is used to assess sharp touch, be sure to avoid scratching the surface of the skin, and discard the pin after it is used.

Assess the corneal reflex by touching the corneal surface with a wisp of cotton. The reflex may be absent or decreased in clients who wear contact lenses. *Ability to feel light, dull, and sharp sensations should be intact. Normally the client blinks.*

Test CN VII (facial). Assess ability to taste sweet, sour, and salt on the anterior two-thirds of the tongue by asking the client to stick out the tongue and applying a salty, sweet, or sour substance. Assess ability to frown, show teeth, blow out cheeks, raise eyebrows, smile, and close eyes **tightly**. *Ability to taste sweet, sour, and salt is intact. Should be able to frown, show teeth, blow out cheeks, raise eyebrows, smile, and close eyes tightly. Muscle movement should be equal bilaterally.*

Test CN VIII (acoustic). Assess ability to hear the ticking of a watch and whispered and spoken words (see Chapter 47 ). *Client should be able to hear with both ears.*

Test CN IX and X (glossopharyngeal and vagus). If gag reflex is intact, observe client swallowing a small drink of water. Observe for a symmetrical rise of the soft palate and uvula as the client says "ah."

Abnormal Findings

- Ptosis (also called Horner syndrome) occurs with strokes, myasthenia gravis, and palsy of CN III.
- Changes in facial sensations are noted with impaired blood flow to the carotid artery.
- Decreased sensations to the face and cornea on the same side of the body, as well as numbness of the lip and mouth, occur with strokes.
- Loss of facial sensation or contraction of the masseter and temporal muscles is seen with lesions of CN V.
- Severe facial pain is seen with trigeminal neuralgia (tic douloureux).
- The corneal reflex may be impaired with lesions of CN V or VII.
- Loss of ability to taste may occur with brain tumors or with nerve impairment.
- Asymmetry or decreased movement of facial muscles is noted with lesions of the upper and lower motor neurons.
- Paralysis of the lower motor neurons from injury to CN VII results in the inability to close eyes, a flat nasolabial fold, paralysis of lower face, and inability to wrinkle forehead.
- Paralysis of the upper motor neurons from a stroke results in weakness of eyelids and paralysis of lower face.
- Pain, paralysis, and sagging of facial muscles is seen on the affected side in Bell's palsy.
- Decreased hearing or deafness may occur with strokes and/or tumors of CN VIII.
- **Dysphagia** (difficulty swallowing) is common with impaired blood flow to the brain.
- Unilateral loss of the gag reflex occurs with lesions of CN IX and X.

Technique/Normal Findings

Assess gag reflex by touching back of client's throat with tongue depressor.

Assess ability to taste salty, sweet, and sour substances on the posterior third of the tongue (see previous description). *Client should be able to swallow without difficulty, have symmetrical rise of the soft palate, have intact gag reflex, and taste appropriately.*

Test CN XI (spinal accessory). Assess the client's ability to shrug the shoulders and turn head against resistance: Ask the client to turn the head to one side against the resistance of your hand; ask the client to shrug the shoulders while you exert downward pressure. Observe symmetry, strength, and size of muscles. *Client should be able to shrug shoulders and turn head against resistance.*

Test CN XII (hypoglossal). Assess the client's ability to stick out the tongue and move the tongue from side to side against resistance of a tongue depressor. *Client should be able to stick out tongue, and move it from side to side against resistance.*

Sensory Function Assessments Findings

Assess ability to perceive various sensations. Touch both sides of various parts of the body (the chest, abdomen, arms, and legs) with one or more of the following:

- Cotton wisp
- Sharp object
- Dull object
- Vibrating tuning fork placed on bony prominences. *Client can differentiate between soft and sharp, and can feel vibrations appropriately.*

Assess sense of position (**kines-thesia**). Move the client's finger or big toe up or down. Ask the client to describe the movement. *Client can accurately describe position of finger or toe when moved up or down.*

Abnormal Findings

- Muscle weakness is noted with lower motor neuron disease. Contralateral hemiparesis is seen with strokes.
- Atrophy and **fasciculations** (twitches) of the tongue are seen in lower motor neuron disease. The tongue may deviate toward involved side of the body.

- Decreased sensation of pain occurs with injury to the spinothalamic tract.
- Decreased vibratory sensations are seen with injuries to the posterior column tract.
- Transient numbness of face, arm, or hand is seen with TIAs.
- Sensory loss on one side of the body is seen with lesions of higher pathways to the spinal cord.
- Bilateral sensory loss is seen in polyneuropathy (a disease in which multiple peripheral nerves are affected, such as Guillain-Barré syndrome or diabetes mellitus). Sensations are impaired with strokes, brain tumors, and spinal cord trauma or compression.
- Lesions of the posterior column of the spinal cord may affect sense of position.

Technique/Normal Findings

Assess ability to discriminate fine touch.

Ask the client to identify:

1. Object in hand, such as a coin or key (tests stereognosis).
2. Number written on hand (tests graphesthesia) (Figure 43–11 ■).
3. Two points of simultaneous pinpricks on the hand (tests two-point discrimination) (Figure 43–12 ■).
4. Where he or she is being touched (tests localization).
5. How many sensations are felt when touched simultaneously on both sides of the body (tests extinction). *Client can identify and discriminate fine touch.*

Abnormal Findings

- Inability to discriminate fine touch (stereognosis, graphesthesia, two points, point localization, and extinction) may occur with injury to the posterior columns or sensory cortex.

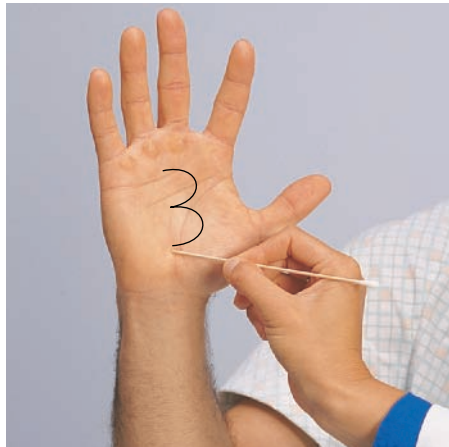


Figure 43–11 ■ Testing graphesthesia.



Figure 43–12 ■ Testing two-point discrimination.

Motor Function Assessments


Assess bilateral symmetry and size of muscles.

Assess for **tremors** (rhythmic movements) and fasciculations (irregular movements). Observe movements as client is at rest (not making a purposeful movement) and with activity (making a purposeful movement, such as reaching for a glass of water). *Muscles are bilaterally symmetrical and of equal size. Tremors or fasciculations are not present.*

Assess muscle tone. *Muscle tone is appropriate.*

Assess bilateral muscle strength and movement.

Ask the client to:

1. Squeeze your hands.
 2. Push feet against the resistance of your hands.
 3. Raise both legs off the bed.
- See Chapter 40  for a scale to grade muscle strength. *Muscle strength and movement are bilaterally equal and strong.*

- Atrophy of muscles is seen with disease of the lower motor neurons.
- Tremors that occur with activity are seen in multiple sclerosis and diseases of the cerebellar system.
- Tremors that occur at rest and disappear with movement are common in Parkinson's disease.
- Fasciculations occur in disease or trauma to the lower motor neurons, as a side effect of medications, in fever, in sodium deficiency, and in uremia.

- Muscle tone is decreased (**flaccidity**) in disease or trauma of the lower motor neurons and early stroke.
- Muscle tone is increased (**spasticity**) in disease of the corticospinal motor tract.
- Muscles are rigid in disease of the extrapyramidal motor tract.
- Muscles move in small, regular jerky movements (cogwheel rigidity) in Parkinson's disease.
- Weakness of the arms, legs, or hands is often seen with TIAs.
- Hemiplegia (paralysis of one-half of the body vertically) is noted with strokes.
- Flaccid paralysis is noted with strokes.
- Paralysis or decreased movement is seen in multiple sclerosis and myasthenia gravis.
- There is total loss of motor function below the level of injury in complete spinal cord transection and in injuries to the anterior portion of the spinal cord.
- Spasticity of muscles may occur as a result of incomplete spinal cord injuries.

Cerebellar Function Assessments

Assess the gait. Ask the client to walk normally, then in a heel-to-toe fashion, then on toes, and finally on heels.

- **Ataxia** is a lack of coordination and a clumsiness of movements, with staggering, wide-based, and unbalanced gait. Ataxia is often seen with strokes and cerebellar tumors. Swaying and falling are seen in cerebellar ataxia. Inability to walk on toes, then heels, may indicate disease of the upper motor neurons.

Technique/Normal Findings

Client has appropriate gait, and can walk heel-to-toe, on toes, and on heels.

Perform Romberg's test: Ask the client to stand with the feet together and eyes closed. (Stand close to client to prevent falling). There should be minimal swaying for up to 20 seconds.

Assess coordination.

Observe ability to pat knees, alternating front and back of hands and increasing speed. Observe ability to touch each finger of one hand to the thumb. Observe ability to touch the nose, then one of your fingers, then the nose again. Observe ability to run each heel down each shin, while in a supine position (Figure 43–13 ■). Client demonstrates coordinated movements.

Abnormal Findings

- Spastic hemiparesis is often associated with strokes or upper motor neuron disease. The client walks with one leg stiffly dragging while the other leg circles out and forward. One arm is held flexed and close to the side.
- Steppage gait is noted with disease of the lower motor neurons. The client drags or lifts the foot high, then slaps the foot onto the floor. The client cannot walk on the heels.
- Sensory ataxia may be associated with polyneuropathy or damage to the posterior columns. The client walks on the heels before bringing down the toes and the feet are held wide apart. Gait worsens with the eyes closed.
- Parkinsonian gait is often seen in Parkinson's disease. The client stoops over while walking and shuffles the feet. The arms are held close to the side.
- A positive Romberg's test may be seen in cerebellar ataxia.
- Ataxic movements are apparent in cerebellar disease.



Figure 43–13 ■ Heel-to-shin test.

REFLEX ASSESSMENTS

A reflex hammer is used to strike the tendon of various reflex sites. To test deep tendon reflexes, ask the client to lock the fingers of both hands together and then pull; this encourages relaxation and promotes reflexes of lower extremities. Superficial reflexes are assessed by lightly stroking the area with the end of a tongue depressor. The following criteria for recording reflexes are often used:

- 0 = absent or no response
 - 1 = hypoactive; weaker than normal (+)
 - 2 = normal (++)
 - 3 = stronger than normal (+++)
 - 4 = hyperactive, sustained clonus (++++)
- A score of 2 is considered normal.

Technique/Normal Findings

Assess the patellar, biceps, brachioradialis, triceps, and Achilles deep tendon reflexes (Figure 43–14 ■).

Assess for clonus by dorsiflexing the client's foot.

Abnormal Findings

- Hyperactive reflexes are present with lesions of upper motor neurons.
- Decreased reflexes are present with lower motor neuron involvement.
- Clonus, a hyperactive, rhythmic dorsiflexion and plantar flexion, is noted with upper motor neuron disease.



A



B



C



D



E

Figure 43–14 ■ Deep tendon reflexes. A, Using reinforcement technique to test the patellar reflex. B, Biceps reflex. C, Brachioradialis reflex. D, Triceps reflex. E, Achilles reflex.



Technique/Normal Findings

Assess the superficial abdominal and cremasteric reflexes.

Abdominal reflex: Lightly stroke the abdomen with a tongue depressor from the side to the midline. Normally the side of the abdomen being stroked will contract toward the umbilicus (Figure 43–15 ■).

Cremasteric reflex: Lightly stroke the inner thigh of the male client with a tongue depressor. Normally, the testicle on the side being stroked will rise.

Assess the Babinski reflex (Figure 43–16 ■).

Abnormal Findings

- Superficial reflexes may be absent with disease of the lower and upper motor neurons.

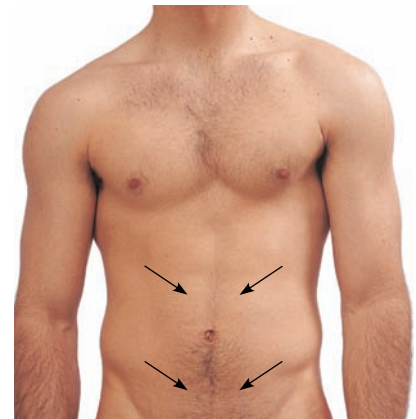


Figure 43–15 ■ Location of superficial abdominal reflexes.

- Dorsiflexion of the big toe and fanning of the other toes is seen with upper motor neuron disease of the pyramidal tract.



Figure 43–16 ■ Assessing the Babinski reflex.

Special Neurologic Assessments

Assess for Brudzinski's sign. With the client supine, flex the head to the chest (Figure 43–17 ■). *There should be no pain, resistance, or flexion of the hips or knees.*

Assess for Kernig's sign. With the client supine, flex the knees and hips, then straighten the knee (Figure 43–18 ■). *There should be no pain or resistance.*

- Pain, resistance, and flexion of hips and knees occur with meningeal irritation.
- Excessive pain and/or resistance occurs with meningeal irritation.

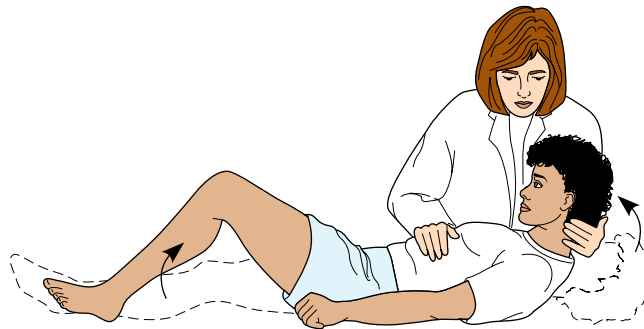


Figure 43–17 ■ Assessing Brudzinski's sign.

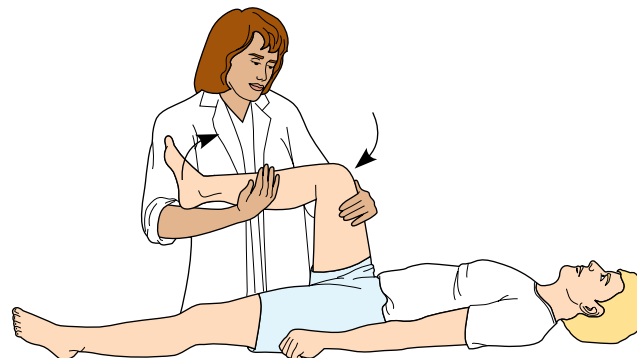


Figure 43–18 ■ Assessing Kernig's sign.

Technique/Normal Findings

Assess for abnormal postures in clients who are unconscious. There should be no abnormal posturing.

Abnormal Findings

Observe for **decorticate posturing**, in which the upper arms are close to the sides; the elbows, wrists, and fingers are flexed; the legs are extended with internal rotation; and the feet are plantar flexed (Figure 43–19 ■).

Observe for **decerebrate posturing**, in which the neck is extended, with the jaw clenched; the arms are pronated, extended, and close to the sides; the legs are extended straight out; and the feet are plantar flexed (Figure 43–20 ■).

- Decorticate posturing occurs with lesions of the corticospinal tracts.
- Decerebrate posturing occurs with lesions of the midbrain, pons, or diencephalon.

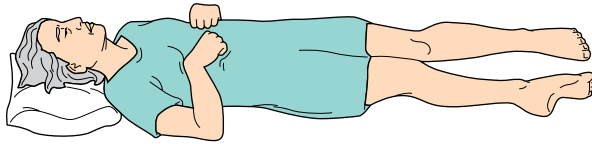


Figure 43–19 ■ Decorticate posturing.

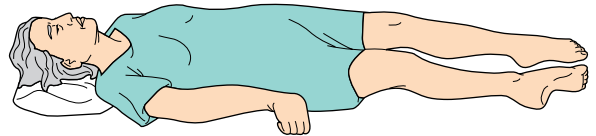


Figure 43–20 ■ Decerebrate posturing.

EXPLORE MEDIA LINK

Prentice Hall Nursing MediaLink DVD-ROM



Audio Glossary
NCLEX-RN® Review

Animation/Video

Testing Reflexes

COMPANION WEBSITE www.prenhall.com/lemone



Audio Glossary
NCLEX-RN® Review

Care Plan Activity: Neurologic Disorders
Case Study: Assessing an Unconscious Client
MediaLink Application: NIH Stroke Scale
Links to Resources



TEST YOURSELF NCLEX-RN® REVIEW

- 1 What component of the brain protects it from harmful substances?
 1. the circulation of cerebrospinal fluid
 2. the large oxygen demand
 3. the structure of neurons
 4. the blood-brain barrier
- 2 What pathophysiology results from damage to the lower motor neurons?
 1. loss of cognitive ability
 2. inability to communicate verbally
 3. loss of reflexes
 4. decreasing levels of consciousness
- 3 Which of the following statements about cerebrospinal fluid (CSF) is true?
 1. If CSF contains glucose, the person has a metabolic disorder.
 2. CSF circulates through the brain via the meninges.
 3. CSF protects the brain and spinal cord from trauma.
 4. A lumbar puncture is done to withdraw CSF from the brain.
- 4 Following a motorcycle crash, a client has damage to the posterior spinal roots. What assessment would you expect to find?
 1. loss of sensation to dull and sharp
 2. flaccid paralysis of the legs
 3. changes in peripheral vision in both eyes
 4. decreased sense of smell and taste
- 5 You narrowly miss having an automobile crash while merging onto the freeway. Your body responses to this stress are caused by which division of the autonomic nervous system?
 1. sympathetic
 2. parasympathetic
 3. cholinergic
 4. adrenergic
- 6 Which of the physical assessment techniques is **not** used in the neurologic examination?
 1. inspection
 2. auscultation
 3. percussion
 4. palpation

- 7** What would you need to assess function of cranial nerve V (trigeminal)?
1. cotton ball and safety pin
 2. stethoscope with bell and diaphragm
 3. measuring tape and pencil
 4. various scents, such as coffee and vanilla
- 8** In which of the following clients would assessing the corneal reflex be appropriate?
1. anyone over the age of 50
 2. people who wear contact lenses
 3. a client with spinal cord trauma
 4. an unconscious client

- 9** You have been asked to assess a client's gag reflex. What equipment would you need to do this?
1. safety pin
 2. cotton ball
 3. tongue depressor
 4. stethoscope
- 10** Which position best describes decorticate posturing?
1. neck extended, arms extended and pronated, feet plantar flexed
 2. arms close to sides, elbows and wrists flexed, legs extended
 3. in prone position with arms and knees sharply flexed
 4. in supine position, spine extended, legs extended

See *Test Yourself answers in Appendix C.*

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