

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

LEARNING OUTCOMES

- Identify prevalence, incidence, and risk factors responsible for disorders of cerebral blood flow and spinal cord structure and function.
- Explain the pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of clients with stroke, ruptured intracranial aneurysm, arteriovenous malformation, spinal cord injury, herniated intervertebral disk, and spinal cord tumor.
- Compare and contrast the acute treatment and care of the client with a stroke or ruptured intracranial aneurysm and a spinal cord injury.
- Discuss the pathophysiologic effects of injuries and tumors of the spinal cord by level of injury.
- Discuss the purposes, nursing implications, and health education of the client and family for medications used to treat stroke, ruptured intracranial aneurysm, and spinal cord injury.
- Describe the methods used to stabilize and immobilize spinal cord injuries.
- Describe the surgical procedures used to treat cerebrovascular and spinal cord disorders.

CLINICAL COMPETENCIES

- Assess functional status of clients with cerebrovascular and spinal cord disorders, and monitor, document, and report abnormal manifestations.
- Use evidence-based research to promote early recognition and treatment of the warning signs of a stroke.
- Determine priority nursing diagnoses, based on assessed data, to select and implement individualized nursing interventions for clients with cerebrovascular and spinal cord disorders.
- Administer oral and injectable medications used to treat cerebrovascular and spinal cord disorders knowledgeably and safely.
- Provide skilled care to clients having a carotid endarterectomy, halo fixation, and a posterior laminectomy.
- Integrate interdisciplinary care into care of clients with cerebrovascular and spinal cord disorders.
- Provide appropriate teaching to facilitate self-catheterization, self-care of a ruptured intervertebral disk, and community-based self-care of disabilities resulting from cerebrovascular and spinal cord disorders.
- Revise plan of care as needed to provide effective interventions to promote, maintain, or restore functional health status to clients with cerebrovascular and spinal cord disorders.

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>

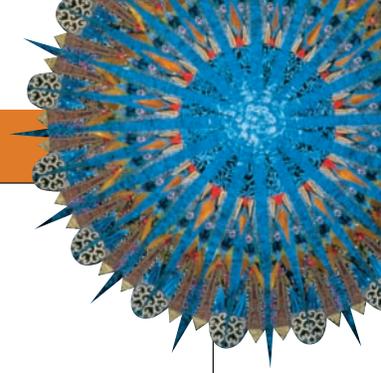


KEY TERMS

agnosia, 1582
aphasia, 1583
apraxia, 1582
autonomic dysreflexia, 1599
contralateral deficit, 1580
flaccidity, 1584
hemianopia, 1582

hemiparesis, 1584
hemiplegia, 1584
hydrocephalus, 1593
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spasticity, 1584
spinal cord injury (SCI), 1595
spinal shock, 1598
stroke, 1579
transient ischemic attack (TIA), 1581



The health problems discussed in this chapter result from alterations in cerebral blood flow and disorders of the spinal cord. Clients with disorders of cerebral blood flow and the spinal cord experience a wide variety of neurologic deficits that affect cognitive and perceptual functional health patterns. They also require treatment and care for both acute and long-term health problems.

Nursing care for clients with these disorders is tailored to meet the needs of the client and is individualized according to

the client's responses to alterations in intracranial and spinal cord structure and function. This chapter's discussion of nursing care includes consideration of both acute and long-term healthcare needs. The disabilities and long-term effects resulting from cerebrovascular disorders and spinal cord injuries almost always cause loss and grief, not only in the client but also in the family of the client. Chapter 5 ∞ provides information about client responses to loss and nursing interventions to help reduce grieving.

CEREBROVASCULAR DISORDERS

THE CLIENT WITH A STROKE

A **stroke** (*cerebral vascular accident [CVA]*, or *brain attack*), is a condition in which neurologic deficits result from a sudden decrease in blood flow to a localized area of the brain. Strokes may be *ischemic* (when blood supply to a part of the brain is suddenly interrupted by a thrombus [blood clot], embolus [foreign matter traveling through the circulation], or stenosis [narrowing]), or *hemorrhagic* (when a blood vessel breaks open, spilling blood into spaces surrounding neurons). The neurologic deficits caused by ischemia and the resultant necrosis of cells in the brain vary according to the area of the brain involved, the size of the affected area, and the length of time blood flow is decreased or stopped. A major loss of blood supply to the brain can cause severe disability or death. When the duration of decreased blood flow is short and the anatomic area involved is small, the person may not be aware that damage has been done.

Incidence and Prevalence

On average, someone in the United States has a stroke every 45 seconds and dies of a stroke every 3 minutes. Stroke is the third leading cause of death and disability in North America, where approximately 700,000 people suffer a stroke each year. Of those, 160,000 die, and many clients who survive are left with some type of functional impairment. Although strokes occur in every age group, the highest incidence occurs in people over 65 years of age; 28% of strokes occur in people under the age of 65. Strokes occur more frequently in men than women, although the risk of stroke may be greater in women during pregnancy and for the 6 weeks following birth (American Heart Association [AHA], 2005a).

FAST FACTS

Estimated Cost of Stroke in the United States

- Total costs: about \$57 billion/year.
- Direct costs for medical care and therapy: \$28 billion/year.
- Indirect costs from lost productivity and other factors: \$15 million/year.
- Costs within 30 days: depending on type, ranges from \$13,000 to \$20,000.

Source: AHA, 2005a.

Risk Factors

Certain diseases, lifestyle habits, and ethnic backgrounds increase the risk of a stroke (see the box on the next page), including the following (National Institute of Neurological Disorders and Stroke [NINDS], 2005d):

- **Hypertension.** Hypertension is the greatest risk factor for a stroke. Increased systolic and diastolic blood pressure is associated with damage to all blood vessels, including the cerebral vessels. People with hypertension have a four to six times greater risk for stroke than do those without hypertension. One-third of the adult American population has hypertension.
- **Heart disease.** Atrial fibrillation is the second greatest risk factor for stroke. Affecting as many as 2.2 million people, fibrillation increases the risk for stroke by 4% to 6% (AHA, 2005a). Other cardiovascular problems that increase the risk for a stroke are mitral valve stenosis, patent foramen ovale, and cardiac surgery.
- **Diabetes mellitus.** Diabetes leads to vascular changes in both the systemic and cerebral circulation and increases the risk of hypertension (the prevalence of hypertension is 40% higher in people with diabetes). People with diabetes

are three times more likely to have a stroke compared to those without diabetes.

- **Sleep apnea.** Considered a major risk for stroke, sleep apnea increases blood pressure and causes decreased oxygen and increased carbon dioxide in the blood.
- **Blood cholesterol levels.** Increased blood cholesterol levels contribute to the risk of atherosclerosis, including arteries in the cerebral circulation.
- **Smoking.** Cigarette smoking doubles a person's risk for ischemic stroke and increases the risk for cerebral hemorrhage by up to 3.5%. Smoking is directly responsible for more strokes in young adults.
- **Sickle cell disease.** Changes in the shape of the red blood cells (RBCs) increase blood viscosity and produce erythrocyte clumps that may occlude small cerebral vessels.
- **Substance abuse.** The injection of unpurified substances increases the risk for a stroke, and abuse of certain drugs can decrease cerebral blood flow and increase the risk for intracranial hemorrhage. Substances associated with strokes include marijuana, anabolic steroids, heroin, amphetamines, and cocaine.
- **Living in the stroke belt.** People living in the southeastern United States have the highest stroke mortality rate in the country. The cause has not been identified.

Other risk factors include a family history of stroke, obesity, a sedentary lifestyle, recent viral and bacterial infections, and previous transient ischemic attacks (TIAs). Risk factors specific to women are oral contraceptive use, pregnancy, childbirth, menopause, migraine headaches with aura, autoimmune disorders (such as diabetes and lupus), and clotting disorders.

In addition, having a stroke is a major risk factor for having another stroke (called recurrent stroke); about 5% to 14% of people who have a stroke and recover have another stroke within 1 year (AHA, 2005a). The risk is highest immediately after a stroke, then decreases with time. About 3% of clients with a stroke have another stroke within 30 days and one-third of recurrent strokes occur within 2 years of the first stroke (NINDS, 2005a).

Pathophysiology

The brain, which makes up only 2% of total body weight, receives approximately 20% of the cardiac output each minute (about 750 mL) and accounts for 20% of the body's oxygen consumption. Cerebral blood flow, especially in the deep cerebral vessels, is largely self-regulated by the brain to meet metabolic needs. This self-regulation (also called *autoregulation*) allows the brain to maintain a constant blood flow despite changes in systemic blood pressure. However, autoregulation is not effective when systemic blood pressure falls below 50 mmHg or rises above 160 mmHg. In the latter case, the increased systemic pressure (as in hypertension) causes an increase in cerebral blood flow with resultant overdistention of cerebral vessels. Cerebral blood flow also increases in response to increased carbon dioxide concentrations, increased hydrogen ion concentrations, and decreased oxygen concentrations.

When blood flow to and oxygenation of cerebral neurons are decreased or interrupted, pathophysiologic changes at the cellular level take place in 4 to 5 minutes. Cellular metabolism ceases as glucose, glycogen, and adenosine triphosphate (ATP) are depleted and the sodium-potassium pump fails. Cells swell as sodium draws water into the cell. Cerebral blood vessel walls also swell, further decreasing blood flow. Even if circulation is restored, vasospasm and increased blood viscosity can continue to impede blood flow. Severe or prolonged ischemia leads to cellular death. A central core of dead or dying cells is surrounded by a band of minimally perfused cells, called the *penumbra*. Although cells in the penumbra have impaired metabolic activities, their structural integrity is maintained. The survival of these cells depends on a timely return of adequate circulation, the volume of toxic products released by adjacent dying cells, the degree of cerebral edema, and alterations in local blood flow. The potential survival of cells in the penumbra has led to the use of fibrinolytic agents in the early treatment of ischemic stroke (Porth, 2005).

The neurologic deficits that occur as a result of a stroke can often be used to identify its location. Because the motor pathways cross at the junction of the medulla and spinal cord (decussation), strokes lead to loss or impairment of sensorimotor functions on the side of the body opposite the side of the brain that is damaged. This effect, known as a **contralateral deficit**, causes a stroke in the right hemisphere of the brain to be manifested by deficits in the left side of the body (and vice versa).

A stroke is characterized by a gradual or rapid onset of neurologic deficits due to compromised cerebral blood flow.



FOCUS ON DIVERSITY Risk Factors for Stroke

African Americans

- African Americans have almost twice the number of first-ever strokes compared to Caucasians.
- The prevalence of hypertension in African Americans is the highest in the world.
- Among African Americans age 20 and older, 62.9% of men and 77.2% of women are overweight or obese.

Hispanics

- Mexican Americans have an increased incidence of intracerebral hemorrhage, subarachnoid hemorrhage, ischemic stroke, transient ischemic attack and TIA at a younger age when compared to non-Hispanic whites.
- Diabetes is more common among Hispanics than Caucasians, with estimates that 30% or more of Hispanic adults have the disease.
- Hispanics have a greater proportion of hypertension than do Caucasians.
- Obesity is more prevalent among Hispanics than among non-Hispanic whites.
- As a result of language barriers and lack of transportation, Hispanics are more likely to delay or drop out of care.

(American Stroke Association, 2003).

Strokes may result from a variety of problems, including cerebral thrombosis, cerebral embolism, and cerebral hemorrhage.

Ischemic Stroke

Ischemic strokes result from blockage and/or stenosis of a cerebral artery, decreasing or stopping blood flow and ultimately causing a brain infarction. This type of stroke accounts for about 80% of all strokes (NINDS, 2005a). The blockage may result from a blood clot (either as a thrombus or an emboli), or from stenosis of a vessel resulting from a buildup of plaque. Plaque may cause stenosis in large blood vessels (called large vessel disease) or small blood vessels (called small vessel disease). Large vessel disease usually is the result of thrombi. Small vessel strokes, called lacunar infarcts, are small to very small infarcts in the deep, noncortical areas of the brain or the brainstem. Ischemic strokes are classified as transient, thrombotic, or embolic.

TRANSIENT ISCHEMIC ATTACK A **transient ischemic attack (TIA)**, sometimes called a mini-stroke, is a brief period of localized cerebral ischemia that causes neurologic deficits lasting for less than 24 hours (usually less than 1 to 2 hours) (Porth, 2005). The deficits may be present for only minutes or may last for hours. TIAs are often warning signals of an ischemic thrombotic stroke. One or many TIAs may precede a stroke, with the time between the TIA and a stroke ranging from hours to months. Of the 50,000 Americans who have a TIA each year, approximately one-third will have an acute stroke some time in the future (NINDS, 2005a). The etiology of TIA includes inflammatory artery disorders, sickle cell anemia, atherosclerotic changes in cerebral blood vessels, thrombosis, and emboli. Neurologic manifestations of a TIA vary according to the location and size of the cerebral vessel involved. Manifestations have a sudden onset and often disappear within minutes or hours. Commonly occurring deficits include contralateral numbness or weakness of the leg, hand, forearm, and corner of the mouth (due to middle cerebral artery involvement); aphasia (due to ischemia of the left hemisphere); and visual disturbances such as blurring (due to involvement of the posterior cerebral artery) (Porth, 2005). The client may also experience a visual disturbance called *amaurosis fugax* (a fleeting blindness of one eye, described as a shade coming down over vision with the affected eye).

THROMBOTIC STROKE A thrombotic stroke is caused by occlusion of a large cerebral vessel by a thrombus (blood clot). Thrombotic CVAs most often occur in older people who are resting or sleeping. The blood pressure is lower during sleep, so there is less pressure to push the blood through an already narrowed arterial lumen, and ischemia may result.

Thrombi tend to form in large arteries that bifurcate and have narrowed lumens as a result of deposits of atherosclerotic plaque. The plaque involves the intima of the arteries, causing the internal elastic lamina to become thin and frayed with exposure of underlying connective tissue. This structural change causes platelets to adhere to the rough surface and release the enzyme adenosine diphosphate. This enzyme initiates the clotting sequence, and the thrombus forms. A thrombus may remain in place and continue to enlarge, completely occluding

the lumen of the vessel, or a part of it may break off and become an embolus.

The most common locations of thrombi are the internal carotid artery, the vertebral arteries, and the junction of the vertebral and basilar arteries. Thrombotic strokes affecting the smaller cerebral vessels are called lacunar strokes, because the infarcted areas slough off, leaving a small cavity or “lake” in the brain tissue. A thrombotic stroke usually affects only one region of the brain that is supplied by a single cerebral artery.

A thrombotic stroke occurs rapidly but progresses slowly. It often begins with a TIA, and continues to worsen over 1 to 2 days; the condition is called a *stroke-in-evolution*. When maximum neurologic deficit has been reached, usually in 3 days, the condition is called a *completed stroke*. At that time, the damaged area of brain tissue is edematous and necrotic.

EMBOLIC STROKE An embolic stroke occurs when a blood clot or clump of matter traveling through the cerebral blood vessels becomes lodged in a vessel too narrow to permit further movement. The area of the brain supplied by the blocked vessel becomes ischemic. The most frequent sites of cerebral emboli are at bifurcations of vessels, particularly those of the carotid and middle cerebral arteries. This type of stroke is typically seen in clients who are younger than those experiencing thrombotic strokes and occurs when the client is awake and active.

Many embolic strokes originate from a thrombus in the left chambers of the heart, formed during atrial fibrillation. These are referred to as *cardiogenic embolic strokes*. Emboli result when parts of the thrombus break off and are carried through the arterial system to the brain. Cerebral emboli may also be due to carotid artery atherosclerotic plaque, bacterial endocarditis, recent myocardial infarction, rheumatic heart disease, and ventricular aneurysm.

An embolic stroke has a sudden onset and causes immediate deficits. If the embolus breaks up into smaller fragments and is absorbed by the body, manifestations will disappear in a few hours to a few days. If the embolus is not absorbed, manifestations will persist. Even if the embolus is absorbed, the vessel wall where the embolus lodges may be weakened, increasing the potential for cerebral hemorrhage.

Hemorrhagic Stroke

A hemorrhagic stroke, or intracranial hemorrhage, occurs when a cerebral blood vessel ruptures. It occurs most often in people with sustained increase in systolic-diastolic blood pressure. Intracranial hemorrhage usually occurs suddenly, often when the affected person is engaged in some activity. Although hypertension is the most common cause, a variety of factors may contribute to a hemorrhagic stroke, including rupture of a brittle plaque-encrusted artery wall, ruptured intracranial aneurysms, trauma, erosion of blood vessels by tumors, arteriovenous malformations, anticoagulant therapy, and blood disorders. Of all forms of stroke, this form is most often fatal and occurs in about 20% of all strokes (NINDS, 2005d). There are two types of hemorrhagic strokes: intracerebral hemorrhage and subarachnoid hemorrhage. Hemorrhagic strokes that result from ruptured cerebral aneurysm or an

arteriovenous malformation are discussed in the following sections of the chapter.

As a result of the blood vessel rupture, blood enters the brain tissue, the cerebral ventricles, or the subarachnoid space, compressing adjacent tissues and causing blood vessel spasm and cerebral edema. Blood in the ventricles or subarachnoid space irritates the meninges and brain tissue, causing an inflammatory reaction and impairing absorption and circulation of cerebrospinal fluid (CSF).

The onset of manifestations from a hemorrhagic stroke is rapid. Manifestations depend on the location of the hemorrhage, but may include vomiting, headache, seizures, hemiplegia, and loss of consciousness. Pressure on the brain tissue from increased intracranial pressure (discussed in Chapter 44 ∞) may cause coma and death.

Manifestations

Manifestations of a stroke vary according to the cerebral artery involved and the area of the brain affected. Manifestations are always sudden in onset, focal, and usually one sided. The most common manifestation is weakness involving the face and arm, and sometimes the leg. Other common manifestations are numbness on one side, loss of vision, speech difficulties, a sudden severe headache, and difficulties with balance. The various deficits associated with involvement of a specific cerebral artery are collectively referred to as stroke syndromes, although the deficits often overlap, as shown in the box below.

MANIFESTATIONS of a Stroke by Involved Cerebral Vessel

INTERNAL CAROTID ARTERY

- Contralateral paralysis of the arm, leg, and face
- Contralateral sensory deficits of the arm, leg, and face
- If the dominant hemisphere is involved: aphasia
- If the nondominant hemisphere is involved: apraxia, agnosia, unilateral neglect
- Homonymous hemianopia

MIDDLE CEREBRAL ARTERY

- Drowsiness, stupor, coma
- Contralateral hemiplegia of the arm and face
- Contralateral sensory deficits of the arm and face
- Global aphasia (if dominant hemisphere involved)
- Homonymous hemianopia

ANTERIOR CEREBRAL ARTERY

- Contralateral weakness or paralysis of the foot and leg
- Contralateral sensory loss of the toes, foot, and leg
- Loss of ability to make decisions or act voluntarily
- Urinary incontinence

VERTEBRAL ARTERY

- Pain in face, nose, or eye
- Numbness and weakness of the face on involved side
- Problems with gait
- Dysphagia

Complications

Typical complications include sensoriperceptual deficits, cognitive and behavioral changes, communication disorders, motor deficits, and elimination disorders. These may be transient or permanent, depending on the degree of ischemia and necrosis as well as time of treatment. As a result of the neurologic deficits, the client with a stroke has complications that involve many different body systems (see the box on the next page). The disabilities resulting from a stroke often cause serious alterations in functional health status.

Sensoriperceptual Deficits

A stroke may involve pathologic changes in neurologic pathways that alter the ability to integrate, interpret, and attend to sensory data. The client may experience deficits in vision, hearing, equilibrium, taste, and sense of smell. The ability to perceive vibration, pain, warmth, cold, and pressure may be impaired, as may proprioception (the body's sense of its position). The loss of these sensory abilities increases the risk for injury. Deficits may include:

- **Hemianopia:** the loss of half of the visual field of one or both eyes; when the same half is missing in each eye, the condition is called *homonymous hemianopia* (Figure 45–1 ■)
- **Agnosia:** the inability to recognize one or more subjects that were previously familiar; agnosia may be visual, tactile, or auditory
- **Apraxia:** the inability to carry out some motor pattern (e.g., drawing a figure, getting dressed) even when strength and coordination are adequate

Another form of sensory-perceptual deficit is the **neglect syndrome** (or *unilateral neglect*), in which the client has a disorder of attention. In this syndrome, the person cannot integrate and use perceptions from the affected side of the body or from the environment on the affected side, and ignores that part. In severe cases, the client may even deny the paralysis. This deficit is more common following a stroke of the right hemi-

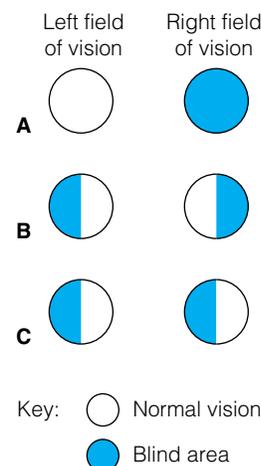


Figure 45–1 ■ Abnormal visual fields. A, Normal left field of vision with loss of vision in right field. B, Loss of vision in temporal half of both fields (bitemporal hemianopia). C, Loss of vision in nasal field of right eye and temporal field of left eye (homonymous hemianopia).


MANIFESTATIONS and Complications of Stroke by Body System
INTEGUMENT

- Decubitus (pressure) ulcers

NEUROLOGIC

- Hyperthermia
- Neglect syndrome
- Seizures
- Agnosias
- Communication deficits
 - a. Expressive aphasia
 - b. Receptive aphasia
 - c. Global aphasia
 - d. Agraphia
- Visual deficits
 - a. Homonymous hemianopia
 - b. Diplopia
 - c. Decreased acuity
- Cognitive changes
 - a. Memory loss
 - b. Short attention span
 - c. Distractibility
 - d. Poor judgment
 - e. Poor problem-solving ability
 - f. Disorientation
- Behavioral changes
 - a. Emotional lability
 - b. Loss of social inhibitions
 - c. Fear

- d. Hostility
- e. Anger
- f. Depression

- Increased intracranial pressure
- Alterations in consciousness
- Sensory loss (touch, pain, heat, cold, pressure)

RESPIRATORY

- Respiratory center damage
- Airway obstruction
- Decreased ability to cough

GASTROINTESTINAL

- Dysphagia
- Constipation
- Stool impaction

GENITOURINARY

- Incontinence
- Frequency
- Urgency
- Urinary retention
- Renal calculi

MUSCULOSKELETAL

- Hemiplegia
- Contractures
- Bony ankylosis
- Disuse atrophy
- Dysarthria

sphere where damage to the parietal lobe (a center for mediation of directed attention) results in perceptual deficits.

Pain and discomfort may accompany a stroke, with the client experiencing acute pain, numbness, or strange sensations. Although not common, damage to the thalamus may cause *central stroke pain* or *central pain syndrome (CPS)*. The pain in this syndrome includes hot and cold, burning, tingling, and sharp stabbing pain, most often in the extremities. It is worsened by movement and temperature changes. The painful sensations are not relieved by pain medications, nor are there any specific treatments.

Cognitive and Behavioral Changes

A change in consciousness, ranging from mild confusion to coma, is a common manifestation of a stroke. It may result from tissue damage following ischemia or hemorrhage involving either the carotid or vertebral arteries. Altered consciousness may also be the result of cerebral edema or increased intracranial pressure.

Behavioral changes include emotional lability (in which the client may laugh or cry inappropriately), loss of self-control (manifested by behavior such as swearing or refusing to wear clothing), and decreased tolerance for stress (resulting in anger or depression). Intellectual changes may include memory loss, decreased attention span, poor judgment, and an inability to think abstractly.

Communication Disorders

Communication is a complex process, involving motor functions, speech, language, memory, reasoning, and emotions. Communication disorders are usually the result of a stroke affecting the dominant hemisphere. The left hemisphere is dominant in about 95% of right-handed people and 70% of left-handed people (Porth, 2005).

Many different impairments may occur, and most are partial. Disorders of communication affect both speech (the mechanical act of articulating language through the spoken word) and language (the vocal or written formulation of ideas to communicate thoughts and feelings). Language involves oral and written expression and auditory and reading comprehension. Among these disorders are:

- **Aphasia:** the inability to use or understand language; aphasia may be expressive, receptive, or mixed (global).
- **Expressive aphasia:** a motor speech problem in which one can understand what is being said but can respond verbally only in short phrases; also called *Broca's aphasia*.
- **Receptive aphasia:** a sensory speech problem in which one cannot understand the spoken (and often written) word. Speech may be fluent but with inappropriate content; also called *Wernicke's aphasia*.
- **Mixed or global aphasia:** language dysfunction in both understanding and expression.
- **Dysarthria:** any disturbance in muscular control of speech.

Motor Deficits

Body movement results from a complex interaction between the brain, spinal cord, and peripheral nerves. The motor areas of the cerebral cortex, the basal ganglia, and the cerebellum initiate voluntary movement by sending messages to the spinal cord, which then transmits the messages to the peripheral nerves. A stroke may interrupt the central nervous system (CNS) component of this relay system and produce effects in the contralateral side ranging from mild weakness to severe limitation of any kind of movement.

Depending on the area of the brain involved, strokes may cause weakness, paralysis, and/or spasticity. The deficits include:

- **Hemiplegia:** paralysis of the left or right half of the body (Figure 45–2 ■).
- **Hemiparesis:** weakness of the left or right half of the body.
- **Flaccidity:** absence of muscle tone (hypotonia).
- **Spasticity:** increased muscle tone (hypertonia), usually with some degree of weakness. The flexor muscles are usually more strongly affected in the upper extremities, and the extensor muscles are more strongly affected in the lower extremities.

When the corticospinal tract is involved, the affected arm and leg almost always are initially flaccid and then become spastic within 6 to 8 weeks. Spasticity often causes characteristic body positioning: adduction of the shoulder, pronation of the forearm, flexion of the fingers, and extension of the hip and knee. There is often foot drop, outward rotation of the leg, and dependent edema in the involved extremities.

The motor deficits may result in altered mobility, further impairing body function. The complications of immobility involve multiple body systems and include orthostatic hypotension, increased thrombus formation, decreased cardiac output, impaired respiratory function, osteoporosis, formation of renal calculi, contractures, and decubitus ulcer formation.

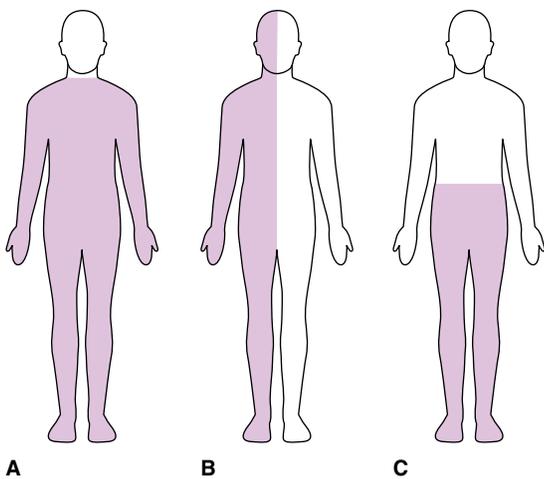


Figure 45–2 ■ Types of paralysis. *A*, Quadriplegia is complete or partial paralysis of the upper extremities and complete paralysis of the lower part of the body. *B*, Hemiplegia is paralysis of one-half of the body when it is divided along the median sagittal plane. *C*, Paraplegia is paralysis of the lower part of the body.

Elimination Disorders

Disorders of bladder and bowel elimination are common. A stroke may cause partial loss of the sensations that trigger bladder elimination, resulting in urinary frequency, urgency, or incontinence. Control of urination may be altered as a result of cognitive deficits. Changes in bowel elimination are common, resulting from changes in level of consciousness (LOC), immobility, and dehydration (Hickey, 2003).

INTERDISCIPLINARY CARE



The type of treatment a client with a stroke receives depends on the stage of the disease. In general there are three treatment stages: stroke prevention, acute care immediately after a stroke, and rehabilitation after a stroke. The client with an acute stroke may receive medical and/or surgical treatment. The focus in the acute care phase is on diagnosing the type and cause of the stroke, supporting cerebral circulation, and controlling or preventing further deficits. The goals of stroke care, defined by the American Heart Association (2005b), are to minimize brain injury and maximize client recovery by:

- Rapid recognition and reaction to stroke warning signs
- Rapid emergency medical services (EMS) dispatch
- Rapid EMS system transport and hospital prenotification
- Rapid diagnosis and treatment in the hospital.

Diagnosis

Diagnosis begins with a complete history and careful physical assessment, including a thorough neurologic examination. The time of the onset of stroke manifestations is a critical part of assessment. The National Institute of Health (NIH) Stroke Scale is a clinical evaluation tool widely used to assess neurologic outcome and degree of recovery. Part of the scale is illustrated in Table 45–1. The tool measures LOC, vision, facial paralysis, motor abilities, ataxia, sensation, language and attention.

Imaging tests are used to identify an increased risk for a stroke or to identify pathophysiologic changes after a stroke has occurred.

Computed tomography (CT) is the first imaging technique used to demonstrate the presence of hemorrhage, tumors, aneurysm, ischemia, edema, and tissue necrosis. A CT scan can also demonstrate a shift in intracranial contents and is useful in distinguishing the type of stroke (e.g., a hemorrhagic stroke results in an increase in density). Cerebral infarctions usually are visible with a CT scan 6 to 8 hours post-stroke; hemorrhage is visible immediately. Other imaging tests that may be used for diagnosis include a cerebral arteriogram, a transcranial ultrasound Doppler, an MRI, an MRA, a PET, and a SPECT (see the Diagnostic Tests box in Chapter 43 ∞).

A lumbar puncture may be performed to obtain CSF for examination if there is no danger of increased intracranial pressure (IICP). (Removal of CSF when intracranial pressure is increased can result in herniation of the brainstem.) A thrombotic stroke may elevate CSF pressure; after a hemorrhagic stroke frank blood may be seen in the CSF.

TABLE 45–1 NIH Stroke Scale: Assessment of Level of Consciousness

INSTRUCTIONS	SCALE DEFINITION	SCORE
<p>1a. Level of Consciousness: The investigator must choose a response, even if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.</p>	<p>0 = Alert, keenly responsive. 1 = Not alert, but arousable by minor stimulation to obey, answer, or respond. 2 = Not alert, requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements (not stereotyped). 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, are flexic.</p>	_____
<p>1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct. There is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier, or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not “help” the patient with verbal or nonverbal cues.</p>	<p>0 = Answers both questions correctly. 1 = Answers one question correctly. 2 = Answers neither question correctly.</p>	_____
<p>1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the nonparetic hand. Substitute another one-step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command the task should be demonstrated to them (pantomime) and score the results (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.</p>	<p>0 = Performs both tasks correctly. 1 = Performs one task correctly. 2 = Performs neither task correctly.</p>	_____

Note: This is a sample of only one part of the NIH Stroke Scale. The entire scale may be viewed as a PDF file at <http://www.strokecenter.org/trials/scales/nihss.pdf#search=niH%20Stroke%20scale>.

In addition to imaging tests, a blood test has recently been approved to screen for recurrent stroke risk. The PLAC test scans the blood for high levels of lipoprotein-associated phospholipase A2 (Lp-PlA2), found to be more common in people who have had strokes.

Medications

Medications are administered to prevent a stroke in clients with TIAs or a previous stroke, and to treat the client during the acute phase of a stroke.

PREVENTION Antiplatelet agents are often used to treat clients with TIAs or who have had a previous stroke. Platelets are concentrated in high blood flow arteries, where they adhere to endothelial tissue damaged by atherosclerosis and occlude the vessel. The drugs used to prevent clot formation and blood vessel occlusion include aspirin, clopidogrel (Plavix), dipyridamole (Persantine), and ticlopidine (Ticlid).

Daily low-dose aspirin reduces TIA occurrence and stroke risk by interfering with platelet aggregation. Ticlopidine (Ticlid) is a platelet-aggregation inhibitor that has shown reduction in thrombotic stroke risk.

ACUTE STROKE Medications are used to treat the client during the acute phase of an ischemic stroke to prevent further thrombosis formation, increase cerebral blood flow, and protect cerebral

neurons. The type of medication used varies according to the type of stroke.

Anticoagulant drug therapy (discussed in Chapter 34 ∞) is often ordered for an ischemic stroke. The most commonly used anticoagulants are warfarin (Coumadin), heparin, and enoxaparin (Lovenox). Anticoagulants are never administered to a client with a hemorrhagic stroke. Anticoagulants do not dissolve an existing clot but prevent further extension of the clot and formation of new clots. Sodium heparin may be given subcutaneously or by continuous IV drip, or warfarin sodium (Coumadin) may be given orally.

Fibrinolytic therapy, using a tissue plasminogen activator such as recombinant tissue plasminogen activator alteplase (rt-PA, tPA), sometimes given concurrently with an anticoagulant, is used to treat thrombotic stroke. The drug converts plasminogen to plasmin, resulting in fibrinolysis of the clot. To be effective, it must be given intravenously within 3 hours of the onset of manifestations, after confirming (with a CT scan) that the client has had an ischemic stroke (Tierney et al., 2005). Antithrombotic drugs, which inhibit the platelet phase of clot formation, have been used as a preventive measure for clients at risk for embolic and thrombotic CVA. Both aspirin and dipyridamole have been used for this purpose. These drugs are sometimes also used in combination with other drugs during acute treatment. Antiplatelet agents are contraindicated in clients with a hemorrhagic stroke.

Management of hypertension is controversial but if the client is eligible for fibrinolytic therapy, blood pressure control is essential to decrease the risk of bleeding. If the blood pressure is sustained at levels >185 mmHg systolic or >110 diastolic, the client cannot be treated with IV tPA (American Heart Association, 2005b).

Corticosteroids, such as prednisone or dexamethasone, have been used to treat cerebral edema, but the results are not always positive. If the client has IICP, hyperosmolar solutions (such as mannitol) or diuretics (such as furosemide) may be administered. Anticonvulsants, such as phenytoin (Dilantin), and barbiturates may be prescribed if IICP causes seizures. Increased intracranial pressure is discussed in Chapter 44 .

Treatments

The treatments used in the management of a stroke include surgery and rehabilitation.

SURGERY Surgery may be performed to prevent the occurrence of a stroke, to restore blood flow when a stroke has already occurred, or to repair vascular damage or malformations. In people who have had TIAs or are in danger of having another stroke, a carotid endarterectomy at the carotid artery bifurcation may be performed to remove atherosclerotic plaque (Figure 45–3 ). Nursing care for the client in the initial postoperative period following a carotid endarterectomy is described in the following box.

When an occluded or stenotic vessel is not directly accessible, an extracranial-intracranial bypass may be performed. Bypass of the internal carotid, middle cerebral, or vertebral arteries may be required. The indications for the bypass are manifestations of ischemia caused by TIAs or a mild completed stroke. The procedure reestablishes blood flow to the affected area of the brain.

A carotid angioplasty with stenting is a newer option for treating cerebral stenosis. During the procedure an angioplasty balloon catheter is inserted through an artery in the client's arm or leg. Under fluoroscopy, the catheter is advanced to the area of carotid artery stenosis and a small filter is inserted to catch any clots or pieces of debris that might break loose. The balloon is then inflated to widen the artery, followed by insertion of a permanent stent in the area of the angioplasty (Palmieri, 2006).

REHABILITATION Various types of therapy are necessary for post-stroke rehabilitation. Listed below are the types and goals of therapies used:

- Physical therapy may help prevent contractures and improve muscle strength and coordination. Physical therapists teach exercises to enable the client to relearn how to walk, sit, lie down, and change from one type of movement to another.
- Occupational therapy provides assistive devices and a plan for regaining lost motor skills that greatly improve quality of life after a stroke. These skills include eating, drinking, bathing, cooking, reading, writing, and toileting.
- Speech therapy is provided to help the client relearn language and communication skills, as well as improve swallowing.



NURSING CARE OF THE CLIENT HAVING A Carotid Endarterectomy

POSTOPERATIVE CARE

- Position on the unoperated side and either maintain a flat position or elevate the head of the bed 30 degrees as prescribed. Maintain head and neck alignment and avoid rotating, flexing, or hyperextending head. *Pressure on the wound is undesirable. Elevating the head decreases edema in the operative site. Maintaining head and neck alignment prevents additional tension or pressure on the operative side.*
- Support the head when changing position. Teach to support the head with the hands when able to move about. *Supporting the head helps prevent stress on the operative site (which may cause bleeding and hematoma formation); it also helps reduce stress on the suture line.*
- Perform focused assessments to monitor for complications:
 - a. *Hemorrhage.* Assess the dressing and the area under the neck and shoulders for drainage. Assess for increased pulse and decreased blood pressure. *The most common cause of respiratory problems is pressure on the trachea from a hematoma formation.*
 - b. *Respiratory distress.* Assess respiratory rate, rhythm, depth, and effort. Observe for restlessness. Keep a tracheostomy tray at the bedside. *Respiratory distress, may result from edema and hematoma formation, which may compress the trachea.*
 - c. *Cranial nerve impairment.* Observe and record any facial drooping, tongue deviation, hoarseness, dysphagia, or loss of facial sensation. *Cranial nerves may be stretched during surgery, leading to temporary deficits in cranial nerve function.*
 - d. *Hypertension or hypotension.* Take and record blood pressure at least hourly. Report any changes immediately and implement orders for medications to treat hypertension or hypotension. *About one-half of all clients having a carotid endarterectomy develop unstable blood pressure related to surgical denervation of the carotid sinus. Uncontrolled hypertension may precipitate a CVA. The most common problem is hypotension, possibly related to stimulation of the carotid body baroreceptors, which are exposed during surgery. Hypotension may result in myocardial ischemia.*

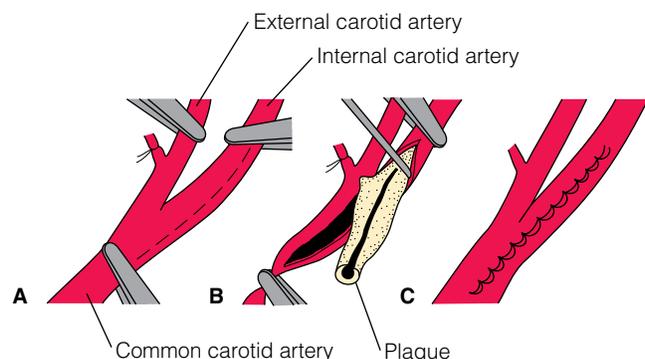


Figure 45–3 ■ Carotid endarterectomy. *A*, The occluded area is clamped off and an incision is made in the artery. *B*, Plaque is removed from the inner layer of the artery. *C*, To restore blood flow through the artery, the artery is sutured, or a graft is completed.



NURSING CARE

Even though many people who have a stroke have full recovery, a substantial number are left with disabilities that affect their physical, emotional, interpersonal, and family status.

The required nursing care is often complex and multidimensional, requiring consideration of continuity of care for clients in acute care settings, long-term care settings, rehabilitation centers, and the home.

Nurses caring for clients who have had a stroke require knowledge and skill to meet client needs during both the acute and the rehabilitative phases of care. The client may have multiple losses: loss of mobility, ability to provide self-care, communications, concept of self, and interpersonal or intimate relationships with others. Holistic, individualized nursing care is essential in all settings and focuses on promoting the achievement of maximum potential and quality of life.

The client's family is often faced with many changes. The young to middle-aged adult with a family member who has had a stroke may be faced with economic difficulties and social isolation. The middle-aged adult family member may become the caretaker for an older parent, in essence switching roles with the parent. An older adult may not be able to care for a spouse and may have to accept nursing home placement. In addition, the older adult who has no family may have to struggle alone to regain the ability to function independently. Although not all of these problems are amenable to nursing solutions, the nurse is most often the healthcare provider who assesses and identifies the needs of each individual and provides information and referrals to clients and families to help meet those needs.

Because a stroke has the potential to cause many different health problems, a wide variety of nursing diagnoses may be appropriate. It is important to remember that each person will be affected differently, depending on the degree of ischemia and the area of the brain involved. Nursing diagnoses discussed in this section focus on problems with cerebral tissue perfusion (specific to nursing care during the acute phase), physical mobility, self-care, communication, sensory-perceptual deficits, bowel and urine elimination, and swallowing (specific to prevention of complications and rehabilitation). A Nursing Care Plan for a client with a stroke is found on the next page.

Health Promotion

Health promotion activities focus on stroke prevention, especially for those people with known risk factors. It is important to discuss, as appropriate, the importance of stopping smoking and drug use with clients of all ages. Maintaining a normal weight through diet and exercise can help reduce obesity, which increases the risk of hypertension and type 2 diabetes mellitus (both in turn increase the risk of a stroke). Cholesterol levels should be screened regularly to monitor for hyperlipidemia. Regular health care to monitor for and treat cardiovascular disorders and to detect and treat infections such as infective endocarditis is important. It is also important to increase public awareness of the signs of a TIA or stroke and of the need to call 911 or to seek care immediately if the following warning signs or symptoms occur:

- Sudden weakness or numbness of the face, arm, or leg, especially on one side of the body
- Sudden confusion, difficulty speaking, or difficulty understanding speech
- Sudden trouble walking, dizziness, loss of coordination

- Sudden difficulty with vision in one or both eyes
- Sudden severe headache without a cause.

Information about public awareness of stroke manifestations and the need for immediate treatment is discussed in the Nursing Research box on page 1589.

Assessment

The following data are collected through the health history and physical examination (see Chapter 43 ∞). Further focused assessments are described with nursing interventions. If the client is a woman, she has risks for stroke different than from a man and should be asked questions specific to her gender (see the box on page 1589).

- *Health history:* Risk factors, previous stroke, drug use (prescribed, over-the-counter, street drugs), smoking history, when manifestations began, severity of manifestations, presence of incontinence, level of consciousness, family support system.
- *Physical assessment:* Level of consciousness, motor strength, coordination, communication, cranial nerves, sensory function.

Nursing Diagnoses and Interventions

The acute phase of a stroke is most often the time from admission to the hospital until the client is stabilized, usually 24 to 72 hours after admission (Hickey, 2003). Depending on the severity of the stroke, the client may be admitted to the intensive care unit. Regardless of the hospital setting, the nurse provides interventions to maintain body functions and prevent complications.

Ineffective Tissue Perfusion: Cerebral

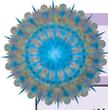
The initial assessment and care of the client admitted for intensive care focuses on identifying changes that may indicate altered cerebral perfusion. The client's airway, breathing, circulation, and neurologic status are monitored and interventions are provided to maintain cerebral perfusion.

- Monitor respiratory status and airway patency. Auscultate pulmonary sounds and monitor respiratory rate and results of studies of arterial blood gases.
- Suction as necessary, using care to suction no longer than 10 seconds at any one time, and using sterile technique.
- Place in a side-lying position.
- Administer oxygen as prescribed.

The client is often unconscious and breathing may be impaired. Suctioning removes secretions that not only obstruct airflow but also poses the risk for aspiration and pneumonia. Suctioning for longer than 10 seconds at a time may increase intracranial pressure (Hickey, 2003). Respiratory complications develop rapidly, as manifested by crackles and wheezes, rapid respirations, and respiratory acidosis. The administration of oxygen decreases the risk for hypoxia and hypercapnia, which can increase cerebral ischemia and intracranial pressure.

PRACTICE ALERT

Positioning the client on the side allows secretions to drain out of the mouth, helping to prevent aspiration.



NURSING CARE PLAN A Client with a Stroke

Orville Boren is a 63-year-old African American who had a stroke due to right cerebral thrombosis 1 week ago. He is a history instructor at the local community college. His hobbies are wood carving and gardening. Mr. Boren is also an active member of his church. For the past 2 years, Mr. Boren has been taking medication for hypertension, but his wife Emily reports that he often forgets to take it and that his blood pressure was high at his last physical examination. Mrs. Boren tells the staff that she has never had to worry about her husband's health before and that she wants to learn everything she can to care for him at home. However, she says that her husband was always the one to make the decisions and pay the bills. Mrs. Boren adds that all the children, grandchildren, neighbors, and family pastor want to see Mr. Boren back at home as soon as possible.

ASSESSMENT

Carol Merck, RN, the nurse assigned to Mr. Boren, completes a health history and physical assessment, with Mrs. Boren providing information for the history. Mrs. Boren reports that her husband did have several spells of dizziness and blurred vision the week before his stroke, but they lasted only a few minutes and he believed them to be due to "old age and working out in the sun." On the morning of admission, Mr. Boren woke up and could not move his left arm or leg; he also could not speak sensibly. Mrs. Boren called 911, and an ambulance took her husband to the hospital.

Physical assessment findings include the following: Mr. Boren is drowsy but responds to verbal stimuli. Although he does not respond verbally, he can nod his head to indicate "yes" when asked questions. Flaccid paralysis is present in his left arm and left leg, with no response noted to touch in those extremities (he is left handed). Visual fields are decreased in a pattern consistent with homonymous hemianopia. A CT scan, negative on admission; is repeated on the day after admission and confirms the medical diagnosis of a right-brain stroke due to a thrombus of the middle cerebral artery.

Mr. Boren's medical treatment includes heparin sodium administered by continuous intravenous drip, with clotting studies to be performed every 4 hours and the dose adjusted accordingly.

DIAGNOSES

- *Feeding Self-Care Deficit* related to loss of the ability to use the left hand and arm
- *Impaired Physical Mobility* related to neurologic deficits causing left hemiplegia
- *Risk for Impaired Skin Integrity* related to inability to change position
- *Sensory Perception Disturbed: Visual* related to changes in visual fields
- *Impaired Verbal Communication* related to cerebral injury

EXPECTED OUTCOMES

- Learn to use his right hand to feed himself.
- Participate in exercises necessary to maintain muscle strength and tone.
- Maintain skin integrity.
- Indicate understanding that visual fields may improve in a few weeks.
- Practice and implement speech therapy activities while at the same time using alternative methods of communication.

PLANNING AND IMPLEMENTATION

- Arrange mealtimes so that he is sitting up by the window in a clean and private environment.
- Provide adaptive devices (silverware with thick handles and nonslip plates).
- Encourage Mrs. Boren to visit at mealtimes, to assist with meals, and periodically to bring a favorite food from home.
- Provide passive ROM exercises for his left arm and leg; schedule active ROM exercises for his right extremities as well as quadriceps and gluteal sets every 4 hours during waking hours.
- Keep his skin clean and dry at all times.
- Establish and maintain a regular schedule for turning when he is in bed.
- Place objects (e.g., call bell, tissues) on unaffected side and approach him from that side.
- Support attempts to communicate verbally; when he is not understood, he prefers to use a large marker and tablet.

EVALUATION

Mr. Boren is discharged to his home after being in the hospital for 10 days. During the first 2 months after discharge, Martha Grimes, RN, the home health nurse, visits Mr. and Mrs. Boren at home. At the end of 2 months, Mr. Boren is using his right hand to feed himself. He has regained partial use of his left arm and leg and is using a walker to move around the house and yard; he is even able to work in his flower garden. His skin has remained intact, and his vision is back to normal. He is slowly relearning speech; this has been the most difficult change for him to accept. Once he writes on his tablet, "I think God has forgotten me."

CRITICAL THINKING IN THE NURSING PROCESS

1. Hypertension is sometimes referred to as "the silent killer." Provide justifications for this statement.
2. The functional changes Mr. Boren has experienced may make a return to teaching difficult. What other uses of his knowledge and abilities might you suggest?
3. What would be your reply if, after you had completed passive ROM on Mr. Boren's left arm, he wrote: "I just ignore that part of my body—it doesn't work anyway"?

See Evaluating Your Response in Appendix C.

- Monitor mental status and LOC: restlessness, drowsiness, lethargy, inability to follow commands, unresponsiveness.
- Monitor strength and reflexes, and assess for pain, headache, decreased muscle strength, sluggish pupillary reflexes, absent gag or swallowing reflexes, hemiplegia, Babinski's sign, and decerebrate or decorticate posturing.

Frequent monitoring of neurologic status is necessary to detect changes. Alterations in mental status, LOC, movement, strength, and reflexes indicate increased intracranial pressure, the major cause of death in the acute phase of a stroke.

- Continuously monitor cardiac status, observing for dysrhythmias. A stroke may cause cardiac dysrhythmias, in-



NURSING RESEARCH Evidence-Based Practice: Improve Rapid Treatment of a Stroke

Stroke is the third leading cause of death in the United States and is also a leading cause of severe, long-term disability. The risk of disability and death can be reduced in people who experience a sudden ischemic stroke by the administration of tissue plasminogen activator (tPA). To be effective, tPA must be administered within 3 hours of the warning signs of a stroke, but the public's awareness of stroke manifestations and the need for immediate treatment remain poor. This is especially true for those most at risk: people older than 75 years of age, African Americans, and men. Maze and Bakas (2004) conducted a study to determine (1) the most common manifestations leading to the decision to seek medical care, (2) who makes the decision, (3) the most common mode of transportation, (4) hospital arrival time in relation to onset of warning signs, and (5) factors most associated with hospital arrival time. They found that the most common warning sign leading people to come to the hospital was sudden confusion or trouble speaking or understanding speech, followed by sudden numbness or weakness in one part of the body. In the majority of cases, it was the person having the stroke that decided to come to the hospital, and the most common mode of transportation was by ambulance via the emergency medical system (EMS). The mean arrival time at the hospital after the onset of manifestations was more than 5 hours; only about 29% of those having a stroke arrived within 3 hours. Those that arrived by EMS and reported their incomes as adequate had the shortest arrival times.

IMPLICATIONS FOR NURSING

Nurses provide information to the public in a wide variety of health promotion activities, including stroke awareness and the need for immediate treatment to ensure the best outcomes of care. It is important that the programs be geared toward the specific population most at risk, and targeting people from all socioeconomic and cultural backgrounds. Although not measured in this study, factors that affect behavior, such as perceived risk, benefits and barriers of care, readiness to change, and self-efficacy, are areas that may be effective in designing educational programs to increase stroke awareness.

CRITICAL THINKING IN CLIENT CARE

1. If you were planning a stroke awareness educational program, where would you have it in order to reach the largest number of the population? How would you advertise stroke warning manifestations to reach the most people?
2. How would you change the design of your program for the following groups?
 - a. Long-term care or assisted living residents
 - b. A men's study group in an African American church
 - c. A group of Mexican American women.
3. Think of a slogan for the public that increases awareness of the 3-hour time limit for treatment with tPA.

cluding bradycardia, PVCs, tachycardia, and AV block. Characteristic ECG changes include a shortened PR interval, peaked T waves, and a depressed ST segment.

- Monitor body temperature. Hyperthermia may develop if the hypothalamus is affected.

MEETING INDIVIDUALIZED NEEDS

Risk Factors for Stroke in Women

Some risk factors for stroke apply only to women, most specifically pregnancy, childbirth, and menopause. These risks are the result of fluctuations in hormones that occur at different stages of life. However, other risks are also more common for women, and information should be collected during a health history. For accurate assessment, ask the following questions, depending on the woman's age:

- How many pregnancies have you had?
- Have you had a miscarriage? If so, how many?
- How many births have you had? When was your last delivery?
- When was your last menstrual cycle?
- Do you take any type of hormone replacement therapy?
- Do you take birth control pills?
- Do you have migraine headaches? If so, do you have an aura?
- Have you ever been diagnosed with diabetes or lupus?
- Have you ever been diagnosed with a clotting disorder? Have you ever had a clot in your leg?

- Maintain accurate intake and output records; measure urinary output via a Foley catheter. A stroke may damage the pituitary gland, resulting in diabetes insipidus and the possibility of dehydration from greatly increased urinary output.

PRACTICE ALERT

Diabetes insipidus is indicated by a large output of dilute urine; dehydration is indicated by scanty amounts of dark, concentrated urine.

- Monitor for seizures. Pad the side rails, and administer prescribed anticonvulsants. Seizures may be the result of cerebral tissue damage or increased intracranial pressure. Padded side rails prevent injury if a seizure occurs. Anticonvulsants prevent or treat seizures.

Impaired Physical Mobility

The goals of care for clients with impaired mobility are to maintain and improve functional abilities (by maintaining normal function and alignment, preventing edema of extremities, and reducing spasticity) and to prevent complications.

- Encourage active range-of-motion (ROM) exercises for unaffected extremities and perform passive ROM exercises for affected extremities every 4 hours during day and evening shifts and once during the night shift. Support the joint during passive ROM exercises. Active ROM exercises maintain or improve muscle strength and

endurance, and help to maintain cardiopulmonary function. Passive ROM exercises do not strengthen muscles but do help maintain joint flexibility.

PRACTICE ALERT

Both active and passive exercises increase venous return, decreasing the risk of thrombophlebitis.

- Turn every 2 hours around the clock, following a posted schedule for side-to-side and supine-to-prone position changes (verify prone positioning with the physician). Maintain body alignment and support extremities in proper position with pillows. *Turning on a regular basis, accompanied by proper positioning, maintains joint function, alleviates pressure on bony prominences that can lead to skin breakdown, decreases dependent edema in hands and feet, and lessens the risk of complications resulting from immobility (Figure 45–4 ■).*



A



B



C

Figure 45–4 ■ Positioning the client with hemiplegia is important in preventing deformity of the affected extremities. *A*, With the client in a supine position, place a pillow in the axilla (to prevent adduction) and under the hand and arm, with the hand higher than the elbow (to prevent flexion and edema). *B*, When the client is lying supine, use a pillow from the iliac crest to the middle of the thigh to prevent external rotation of the hip. *C*, When the client is in the prone position, place a pillow under the pelvis to promote hip hyperextension.

PRACTICE ALERT

When lying on the affected side, clients may be restless because they do not have normal sensation and feel as if they may fall.

- Monitor the lower extremities each shift for symptoms of thrombophlebitis. Assess for increased warmth and redness in calves; measure the circumference of the calves and thighs. *Clients on bed rest (especially those with loss of muscle strength and tone) are particularly prone to the development of deep venous thrombosis. Promptly report manifestations of thrombophlebitis.*
- Collaborate with the physical therapist as the client gains mobility, using consistent techniques to move the client from the bed to the wheelchair and to help the client ambulate. *The use of consistent techniques facilitates rehabilitation.*

Self-Care Deficit

The client who has had a stroke may have a self-care deficit as a result of impaired mobility or mental confusion. It is important for clients to perform as much of their own physical care and grooming as possible to promote functional ability, increase independence, decrease feelings of powerlessness, and improve self-esteem.

Before establishing a plan to increase self-care, determine which hand was dominant before the stroke. If the client's dominant side is affected, self-care will be more difficult.

- Encourage use of the unaffected arm to bathe, brush teeth, comb hair, dress, and eat. *Use of the unaffected arm promotes functional ability and independence.*
- Teach the client to put on clothing by first dressing the affected extremities and then dressing the unaffected extremities. *This technique facilitates self-dressing with minimal assistance.*
- Collaborate with the occupational therapist in scheduling times for training for upper extremity functioning necessary for activities of daily living (ADLs). Encourage the use of assistive devices (if required) for eating, physical hygiene, and dressing. *Following a regular schedule in daily routines promotes learning. The use of assistive devices promotes independence and decreases feelings of powerlessness. Optimal grooming facilitates positive self-concept.*

Impaired Verbal Communication

The client who loses communication abilities requires intensive speech therapy and emotional support. It is important to determine the specific nature of the impairment when planning interventions and helping family members understand specific problems. Although the speech therapist is usually most involved with speech rehabilitation, nurses must plan interventions to meet communication needs during all phases of care.

Use the following guidelines:

- Approach and treat the client as an adult.
- Do not assume that the client who does not respond verbally cannot hear. Do not use a raised voice when addressing the client.
- Allow adequate time for the client to respond.
- Face the client and speak slowly.

- When you do not understand the client's speech, be honest and say so.
- Use short, simple statements and questions.
Accepting the client and providing dignity and respect enhances the nurse–client relationship. Allowing adequate response time and using short verbal statements or questions while facing the client motivates the client to communicate and decreases frustration.
- Accept frustration and anger as a normal reaction to the loss of function. *Anger represents the client's frustration at the inability to control the loss of function.*
- Try alternate methods of communication, including writing tablets, flash cards, and computerized talking boards. *Clients unable to communicate verbally may use other methods effectively.*

Impaired Urinary Elimination and Risk for Constipation

Both urinary and bowel elimination may be altered because of neurologic deficits, impaired mobility, cognitive impairment, communication deficits, or preexisting problems (especially if the client is an older adult). Other causes include changes in food and fluid intake and side effects of medications. Urinary incontinence or retention and constipation and fecal impaction are the usual manifestations.

- Assess for urinary frequency, urgency, incontinence, nocturia, and voiding in small amounts. In addition, assess the client's ability to respond to the need to void, the ability to use the call light, and the ability to use toiletting equipment.

PRACTICE ALERT

Voiding small amounts of urine frequently may be a manifestation of a bladder dysfunction. Assess for a distended bladder.

- Encourage bladder training by having client void on schedule, such as every 2 hours, rather than in response to the urge to void.
- Teach Kegel exercises. To perform Kegel exercises, the client contracts the perineal muscles as though stopping urination, holds the contraction for 5 seconds, and then releases.
- Use positive reinforcement (verbal praise) for successful management of urinary elimination.
Voiding every 2 hours or on schedule promotes bladder tone and urine storage. Kegel exercises increase pubococcygeal muscle tone and bladder control, decreasing incontinence. Positive reinforcement can be a useful part of the teaching program.
- Discuss prestroke bowel habits, as well as the pattern of bowel elimination since the stroke.
- If the client is able to swallow without difficulty, encourage fluids (up to 2000 mL per day) and a high-fiber diet.
- Increase physical activity as tolerated.
- Assist in using the toilet facilities at the same time each day (based on usual patterns of bowel elimination), ensuring privacy and having client sit in upright position if at all possible.

- Administer prescribed stool softeners if the client is following a bowel elimination routine or is not drinking sufficient fluids.

Increased fluids, fiber, and activity stimulate intestinal motility. Establishing a regular daily time for bowel movements in the upright position and in privacy promotes normal bowel elimination. Stool softeners help prevent the formation of hard stool that is more difficult to expel.

Impaired Swallowing

A stroke may impair the ability to swallow. Weakness or lack of coordination of the tongue, attention deficits, and deficits involving the swallowing reflex all play a role. Dysphagia (difficulty swallowing) may result in choking, drooling, aspiration, or regurgitation. Nursing care focuses on maintaining safety by preventing aspiration and on ensuring adequate nutrition.

- Monitor results of swallowing studies prior to providing oral food and fluids.
- Ensure safety when eating.
 - Position in upright sitting position with neck slightly flexed.
 - Order puréed or soft food. Liquids should be of the same consistency as honey.
 - Feed or teach client to eat by putting food behind the front teeth on the unaffected side of mouth and tilting the head slightly backward. Teach to swallow one bite at a time.
 - Assess for coughing with eating or drinking. *Coughing may be indicative of dysphagia.*

PRACTICE ALERT

After eating, check the mouth for "pocketing" of food, especially in the affected cheek.

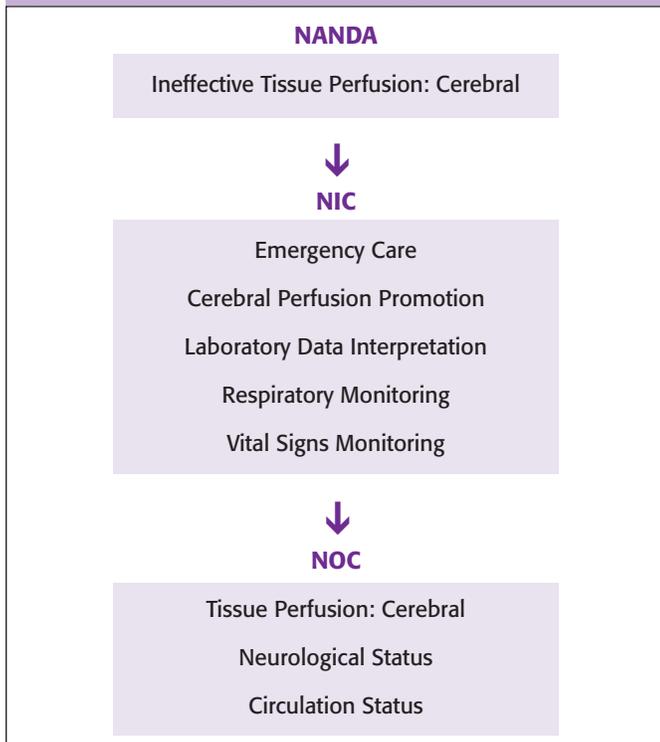
- Have suction equipment available at the bedside in case of choking or aspiration.
Sitting upright with the head and neck first slightly flexed and then tilted back helps the client swallow. The client can usually swallow puréed or soft foods more easily than liquid or solid foods. Using the unaffected side of the mouth helps prevent food from collecting in the mouth and makes swallowing safer; in addition, food is less likely to fall out of the mouth.
- Monitor lung sounds. *Coarse lung sounds heard in the right upper and/or lower lobes may indicate aspiration as the right bronchus is the first division of the bronchi and where the majority of aspirations occur.*
- Minimize distractions and, if necessary, give step-by-step instructions for eating. *Distractions increase the risk of aspiration. Complex activities are easier to perform when broken down into small steps.*

Using NANDA, NIC, AND NOC

Chart 45–1 shows links between NANDA nursing diagnoses, NIC, and NOC when caring for the client with a stroke.

Community-Based Care

Throughout the rehabilitation process, it is important to encourage self-care as much as possible but also to involve family members in the plan of care. Stress that ADLs may take twice as long as they did before the stroke. Emphasize that physical function may continue to improve for up to 3 months,

NANDA, NIC, AND NOC LINKAGES
CHART 45–1 The Client with a Stroke


Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bluechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

and speech may continue to improve for even longer. Address the following topics in preparing the client and family for community-based care.

- Physical care, medications, physical therapy, occupational therapy, speech therapy
- Realistic expectations
- Time off for the caregiver, respite care services
- Distributors for equipment and supplies
- Home environment conducive to using equipment (e.g., a wheelchair or walker)
- Home and equipment modifications (e.g., a raised toilet seat, grab bars in the bathroom, a bath chair, a vise lid opener, a long-handled shoehorn)
- Home health services
- Community resources, such as Meals-on-Wheels, senior centers, eldercare, large-print telephone dials, stroke clubs, Life-line (emergency alerting systems through a local hospital or agency). Financial assistance may be available within the community for housekeeping and personal care assistance.
- Helpful organizational resources:
 - American Heart Association
 - National Stroke Association
 - Stroke Clubs International
 - The National Institute of Neurological Disorders and Stroke.

THE CLIENT WITH AN INTRACRANIAL ANEURYSM

An *intracranial aneurysm* is a saccular outpouching of a cerebral artery that occurs at the site of a weakness in the vessel wall. The weakness may be the result of atherosclerosis, a congenital defect, trauma to the head, aging, or hypertension. A ruptured cerebral aneurysm is the most common cause of a hemorrhagic stroke.

Incidence and Prevalence

Approximately 5 million North Americans have intracranial aneurysms; most go through life without any manifestations of bleeding. However, it is estimated that 30,000 people will have a rupture of an intracranial aneurysm each year, and two-thirds of the survivors will have serious disabilities. Intracranial aneurysms are most common in adults ages 30 to 60 (Hickey, 2003).

The exact etiology is unknown, but theories of cause include (1) a developmental defect in the vessel wall and (2) degeneration or fragility of the vessel wall due to conditions such as hypertension, atherosclerosis, connective tissue disease, or abnormal blood flow. Hypertension and cigarette smoking may be contributing factors.

Pathophysiology

Intracranial aneurysms tend to occur at the bifurcations and branches of the carotid arteries and the vertebrobasilar arteries at the circle of Willis, with most aneurysms (85%) located anteriorly. They range in size from smaller than 15 mm to larger than 50 mm. Intracranial aneurysms tend to enlarge with time, making the vessel wall thin and increasing the probability of rupture.

There are several different types of intracranial aneurysms: A *berry aneurysm* is probably the result of a congenital abnormality of the tunica media of the artery. The aneurysm usually ruptures without warning. A *saccular aneurysm* is any aneurysm with a saccular outpouching, which distends only a small portion of the vessel wall. This type of aneurysm is often caused by trauma. In a *fusiform aneurysm*, the entire circumference of a blood vessel swells to form an elongated tube. Most aneurysms of this type occur as a result of the changes of arteriosclerosis. Fusiform aneurysms act as space-occupying lesions. In a *dissecting aneurysm*, the tunica intima pulls away from the tunica media of the artery, and blood is forced between the two layers. It may result from atherosclerosis, inflammation, or trauma. *Mycotic aneurysms* are caused by emboli from infections such as bacterial endocarditis.

Intracranial aneurysms typically rupture from the dome rather than the base, forcing blood into the subarachnoid space at the base of the brain. The aneurysm may also rupture and force blood into brain tissue, the ventricles, or the subdural space. This discussion focuses on intracranial hemorrhages due to rupture of a cerebral aneurysm. See Chapter 44 ∞ for further discussion of types of intracranial bleeding and hematomas.

Manifestations

An intracranial aneurysm is usually asymptomatic until it ruptures, although very large aneurysms may cause headache

and/or neurologic deficits due to pressure on adjacent intracranial structures. Small leakages of blood may occur periodically, causing headache, nausea, vomiting, and pain in the neck and back. The client may also have prodromal manifestations before the rupture occurs, such as headache, eye pain, visual deficits, and a dilated pupil.

The manifestations of a ruptured intracranial aneurysm (and subsequent subarachnoid hemorrhage) include a sudden, explosive headache; loss of consciousness; nausea and vomiting; a stiff neck and photophobia (due to meningeal irritation); cranial nerve deficits; stroke syndrome manifestations; and pituitary malfunctions (that result primarily from changes in ADH secretion).

The severity of the rupture is often inferred from the manifestations of the subarachnoid hemorrhage. The Hunt-Hess classification of subarachnoid manifestations is frequently used to classify nontraumatic subarachnoid hemorrhages. The grades of severity are:

- Grade 1: Asymptomatic, or minimal headache and slight neck rigidity
- Grade 2: Moderate to severe headache, neck rigidity, cranial nerve deficits
- Grade 3: Drowsy, lethargic, mild neurologic deficits
- Grade 4: Stuporous, moderate to severe hemiparesis, early decerebrate rigidity
- Grade 5: Deep coma, decerebrate rigidity, moribund appearance.

Fibrin and platelets seal off the bleeding point, but the escaped blood forms a clot that irritates the brain tissue. The resulting inflammatory response causes cerebral edema, and both the edema and the hemorrhage increase intracranial pressure (Hickey, 2003). Bleeding into the subarachnoid space causes meningeal irritation. Hypothalamic dysfunction and seizures are also potential complications.

Complications

The major complications of a ruptured intracranial aneurysm are rebleeding, vasospasm, and hydrocephalus.

Rebleeding

The greatest risk for rebleeding is within the first day after the initial rupture, and again in 7 to 10 days (when the initial clot breaks down). Rebleeding is manifested by a sudden severe headache, nausea and vomiting, decreasing levels of consciousness, and new neurologic deficits (Hickey, 2003). The mortality from rebleeding is as high as from the initial rupture.

Vasospasm

Cerebral vasospasm is a common but dangerous complication that occurs between 3 and 10 days after a subarachnoid hemorrhage. It is associated with a large number of deaths and disability. A cerebral vasospasm narrows the lumen of one or more cerebral vessels, causing ischemia and infarction of tissue supplied by the affected vessels. The actual cause is unknown, but it occurs in blood vessels surrounded by thick blood clots, suggesting that some substance in the clot initiates the spasm. The manifestations vary according to the degree of spasm and the area of brain affected. Regional alterations may cause focal

deficits (such as hemiplegia), whereas global alterations cause loss of consciousness.

Hydrocephalus

Hydrocephalus, an abnormal accumulation of CSF within the cranial vault and dilation of the ventricles, is a potential complication of a ruptured intracranial aneurysm. Hydrocephalus is thought to be the result of obstruction of reabsorption of CSF through the arachnoid villi. The obstruction is caused by an increased protein content of the CSF because of lysis of blood in the subarachnoid space (Porth, 2005). The accumulation of cerebrospinal fluid increases intracranial pressure. Initial manifestations of hydrocephalus are typically nonspecific but commonly include decreasing levels of consciousness.

INTERDISCIPLINARY CARE



The care of the client with a ruptured intracranial aneurysm includes determining the location of the aneurysm, treating the manifestations of the hemorrhage, and preventing rebleeding and vasospasm. Interventions using radiology, angiography and a variety of procedures may be used to prevent aneurysm rupture or to stop the bleeding. Surgery is usually the treatment of choice to repair the bleeding artery.

Diagnosis

The diagnostic tests conducted to identify the site and extent of a ruptured intracranial aneurysm, as well as rebleeding, are a CT scan and bilateral carotid and vertebral cerebral angiograms. A cerebral angiogram is the gold standard for evaluating cerebral aneurysm; it can demonstrate the source of the aneurysm in about 80% to 85% of the time (Hickey, 2003). A lumbar puncture will reveal blood-tinged spinal fluid. These tests are described in Chapter 43 ∞.

Medications

Calcium channel blockers, such as nimodipine (Nimotop), are used to improve neurologic deficits due to vasospasm following subarachnoid hemorrhage from ruptured intracranial aneurysms. Administered for 21 consecutive days, it has been found to enhance collateral blood flow and reduce the incidence of ischemic deficits from arterial spasm without side effects (Hickey, 2003; Tierney et al., 2005).

Other medications that may be prescribed include anticonvulsants, such as phenytoin (Dilantin), to prevent seizures if the client has increased intracranial pressure; analgesics for headache; and stool softeners, such as docusate, to prevent constipation and straining with a bowel movement (which increases intracranial pressure and blood pressure and may cause rebleeding).

Procedures Used to Treat Aneurysm

Treatments for an intracranial aneurysm are performed either to prevent rupture or to isolate the vessel to prevent further bleeding. Clients with good neurologic status may have surgery soon after the rupture. In clients with significant neurologic deficits, surgery may be delayed until they are more stable and less at risk for vasospasm; however, the trend is toward surgery as soon as possible.

Several different types of procedures are used to repair a ruptured intracranial aneurysm or to prevent the rupture of an existing large aneurysm. These include:

- The skull is opened (craniotomy), and the aneurysm is located. The neck of the aneurysm may be clipped with a metal clip (preventing the entry of blood into the aneurysm), or the involved artery may be clipped both proximally and distally to the aneurysm to isolate the affected area.
- Endovascular Guglielmi detachable coils (GDCs) are a method used to treat nonruptured aneurysms. One or more small platinum coils are inserted through a microcatheter and threaded through the carotid or femoral artery to the site of the aneurysm, where they are released and fill the body of the aneurysm. The coils initiate the immune response, and the body produces a blood clot inside the aneurysm, strengthening the artery walls and reducing the risk of rupture. After the aneurysm is stabilized, it can be clipped with less risk of hemorrhage and death (NINDS, 2005a). However, endovascular coil procedures are also effective without surgery, especially for smaller aneurysms.
- Stents, which are coil or mesh tubes introduced into the body through a catheter, are used to cover the neck of an aneurysm while coils are deposited within the body of the aneurysm.
- Balloon remodeling is used for large, multiple, or surgically inaccessible aneurysms. A balloon is placed across the neck of the aneurysm and coils are inserted into the body of the aneurysm. The balloon prevents the coils from moving out to the aneurysm.
- Parent vessel occlusion is performed to occlude the parent vessel that supplies blood to the aneurysm. Prior to permanent occlusion, the risk of neurologic impairment is assessed by monitoring motor, sensory, and cognitive functions in an awake client while temporary occlusion is conducted.



NURSING CARE

Nursing care is planned and implemented for the client with a ruptured intracranial aneurysm to prevent rebleeding as well as to meet needs resulting from neurologic deficits.

Nursing Diagnoses and Interventions

Appropriate nursing diagnoses and interventions are described earlier in the chapter in the discussion of nursing care for the client with a stroke. The priority interventions in the acute care stage of a ruptured intracranial aneurysm focus on ineffective cerebral tissue perfusion.

Ineffective Tissue Perfusion: Cerebral

These interventions are for the care of the client immediately after the intracranial aneurysm ruptures. The expected outcome of care is preventing rebleeding and improving cerebral tissue perfusion.

- Institute aneurysm precautions to prevent rebleeding, as follows:
 - Keep the client in a private, quiet, darkened room. Disconnect or remove the telephone. Avoid using bright overhead lights. *A quiet environment helps prevent an increase in blood pressure, which could precipitate rebleeding. The client may experience photophobia (abnormal sensitivity to light) if hemorrhage has damaged the oculomotor nerve.*

- Elevate the head of the bed 30 to 45 degrees; follow prescribed activity orders (usually complete bed rest, but in some cases bathroom privileges may be approved). *Elevating the head of the bed promotes venous return from the brain and thus decreases intracranial pressure. Decreasing activity reduces the likelihood of increases in blood pressure.*
- Limit visitors to two family members at any one time, and limit the duration of visits. Monitor client response to visitors and decrease interactions if the client becomes agitated or upset. *Psychologic stress may increase blood pressure and the risk of rebleeding; however, social isolation may increase anxiety and stress. Each client (and family) must be individually evaluated.*
- Allow reading, watching television, or listening to the radio to promote relaxation. *Although these passive activities were previously contraindicated for the client on aneurysm precautions, current therapy is based on the belief that these activities promote relaxation and help control blood pressure.*
- Prevent constipation and straining to have a bowel movement. Administer stool softeners as prescribed. Collaborate with the client and physician about use of a bedside commode or the bathroom. Do not administer enemas. *The client is at risk for constipation as a result of decreased mobility and the administration of narcotics (such as codeine) for headache. When straining to have a bowel movement, the client uses the Valsalva maneuver, which increases intracranial pressure and may precipitate rebleeding.*

PRACTICE ALERT

Maintaining a daily stool chart is an important assessment in preventing constipation.

- If the client is alert (and depending on physician preferences), allow to feed self and provide own personal care. *In many instances, self-care causes less anxiety and stress than care provided by the nurse. The extent of care provided varies according to client condition and physician preferences.*
- Monitor vital signs and neurologic status as indicated by client condition (frequency of assessments may range from every 15 minutes to every 4 hours). *Vital signs and neurologic assessments provide ongoing data for evaluation of changes indicative of increasing intracranial pressure and decreasing neurologic function. Report any change immediately to the physician.*

PRACTICE ALERT

Restlessness and changes in respirations are often early manifestations of increased intracranial pressure.

- Maintain seizure precautions: Have suction equipment and an oropharyngeal tube at the bedside, maintain the bed in the low position, and keep the side rails padded and raised. *Applying suction and inserting an oropharyngeal airway may be necessary to maintain an open airway in case of seizure. A lowered bed and padded, raised side rails prevent injury if a seizure occurs.*

- Avoid positioning and activities that increase intracranial pressure such as coughing, sneezing, vomiting, sharply flexing the neck, blowing the nose, enemas, or moving self up in bed. *These measures help to prevent increasing intracranial pressure and rebleeding.*

THE CLIENT WITH AN ARTERIOVENOUS MALFORMATION

An arteriovenous (AV) malformation is a congenital intracranial lesion, formed by a tangled collection of dilated arteries and veins that allows blood to flow directly from the arterial into the venous system, bypassing the normal capillary network. Most AV malformations (90%) are located in the cerebral hemispheres; the remainder are found in the cerebellum and brainstem.

Rupture of vessels in the malformations account for 2% of all strokes. Clients with this condition develop manifestations before 40 years of age; it affects men and women equally (Porth, 2005). The manifestations are the result of spontaneous bleeding from the lesion into the subarachnoid space or brain tissue.

Pathophysiology

AV malformations displace rather than encompass normal brain tissue (Hickey, 2003). The pathophysiologic effects of an AV malformation are the result of the shunting of blood from the arterial to the venous system and of altered perfusion of cerebral tissue near the malformation. The shunting of arterial blood directly into the venous system within the malformation transfers the higher arterial pressure directly into the lower pressure venous system. This increased pressure is likely to cause spontaneous bleeding or progressive expansion and rupture of a blood vessel.

Altered cerebral perfusion results when blood flow through a large, high-flow malformation is diverted from the normal cerebral circulation, causing tissue ischemia of the area sur-

rounding the malformation. This is sometimes called a vascular “steal” phenomenon.

AV malformations range in size from very small to very large. Large malformations are usually initially manifested by seizure activity. In contrast, the manifestations of a small malformation are more often due to a hemorrhage that causes neurologic deficits. In both instances, the client may have recurrent headaches that do not respond to treatment.

INTERDISCIPLINARY CARE

AV malformations are diagnosed with the same diagnostic tests used to diagnose an intracranial aneurysm.

If the malformation is accessible, the ideal treatment is excision of the malformation and removal of any hematoma. Large malformations may be treated by embolization. In this procedure, substances such as Gelfoam or metallic pellets are introduced into the involved area of the cerebral circulation, where they form emboli and gradually obstruct blood flow in the malformation. Inaccessible malformations are also treated with radiation therapy or laser therapy, to coagulate blood in the malformation and thicken its vascular elements, eventually obstructing it. When the malformation is excised or obstructed, blood flow is no longer shunted, and cerebral perfusion improves.



NURSING CARE

Nursing care depends on the condition of the malformation. If hemorrhage has not occurred, teach the client to avoid activities that raise blood pressure or could cause injury. The client is usually given medications to control blood pressure and prevent seizures.

If the malformation ruptures and causes an intracranial hemorrhage, nursing care is the same as for any client who has had a hemorrhagic stroke (discussed earlier in this chapter).

SPINAL CORD DISORDERS

THE CLIENT WITH A SPINAL CORD INJURY

Nursing care of clients with a spinal cord injury takes place from the acute management phase through ongoing rehabilitation in a variety of settings. Although priorities of care may change depending on the client and setting, care focuses on maximizing functional health status to preserve quality of life. The nurse provides care and also collaborates with other healthcare professionals in meeting this goal.

Incidence and Prevalence

A **spinal cord injury (SCI)** is usually due to trauma. The major causes of SCI are contusion, laceration, transection, hemorrhage, and damage to blood vessels that supply the spinal cord. If vertebrae are fractured and ligaments are torn, bony fragments can damage the cord and make the spinal column unstable. Injury to blood vessels supplying the cord can cause permanent damage. The injury is identified by vertebral level. For example, a C6 spinal cord injury is at the sixth cervical vertebra.

FAST FACTS

SCI

- Approximately 11,000 people have a SCI each year.
- An estimated 25,000 to 96,000 people are living with SCIs in the United States.
- Although SCIs occur in people of all ages, they are most often seen in young adults ages 16 to 30.
- The majority of the injuries are due to motor vehicle crashes; other causes include acts of violence, falls and sports injuries.

Source: National Spinal Cord Injury Association [NSCIA], 2006.

Risk Factors

The three major risk factors for SCIs are age, gender, and alcohol or drug abuse. Young men are more prone to risk-taking behaviors than are women. Older adults are more likely to have a cord injury from even minor trauma as a result of age-related vertebral degeneration. Motor vehicle crashes while under the influence of alcohol or drugs are a major source of trauma to people of all ages.



Pathophysiology

The spinal cord provides a two-way pathway for the conduction of impulses and information to and from the brain and the body, serves as a major reflex center, and (through its attached spinal nerves) is involved in the sensory and motor innervation of the entire body below the head. It consists of an outer region of white matter and an inner region of gray matter. The gray matter comprises the central canal of the cord, the posterior horns, the anterior horns, and the lateral horns. It is divided into a sensory half (dorsally) and a motor half (ventrally) and innervates somatic and visceral regions of the body. The white matter consists of tracts or pathways that convey information. The ascending (sensory) pathways carry information about proprioception, fine touch, discrimination, pain, temperature, deep pressure, and touch. The descending (motor) pathways carry information about movement. The pyramidal tracts control skilled voluntary movements (such as writing). The extrapyramidal tracts (all tracts other than the pyramidal tracts) bring about all other body movements. See Chapter 43 ∞ for further information.

When the spinal cord is injured, the primary injury causes microscopic hemorrhages in the gray matter of the cord and edema of the white matter of the cord. These initial pathologic changes are followed by the secondary injury, with mechanisms that increase the area of injury. The hemorrhages extend, eventually involving the entire gray matter. Microcirculation to the cord is impaired by edema and hemorrhage. The injured tissue releases norepinephrine, serotonin, dopamine, and histamine; these vasoactive substances cause vasospasm and further decrease microcirculation. As a result, vascular perfusion and oxygen tension of the affected area are decreased, which leads to ischemia.

When ischemia is prolonged, necrosis of both gray and white matter begins within a few hours, and within 24 hours the function of nerves passing through the injured area is lost. Although circulation returns to the white matter of the cord in about 24 hours, decreased circulation in the gray matter continues. Because edema extends the level of injury for two cord segments above and below the affected level, the extent of injury cannot be determined for up to 1 week.

Tissue repair occurs over a period of 3 to 4 weeks. Phagocytes enter the area in 36 to 48 hours after the initial injury. Neurons degenerate and are removed by microphages in the first 10 days after the injury. RBC disintegrate, and the hemorrhages are reabsorbed. Eventually the area of injury is replaced by acellular collagenous tissue, and the meninges thicken.

Forces Resulting in SCI

SCIs are the result of the application of excessive force to the spinal column. The most common cause of abnormal spinal column movements are acceleration and deceleration (forces that are applied to the body, for example, in automobile crashes and falls). *Acceleration* occurs when external force is applied in a rear-end collision; the upper torso and head are forced backward and then forward. *Deceleration* occurs in a head-on collision; the external force is applied from the front. The head and body move forward until they meet a stationary object and then are forced backward. The following forces and movements (Figure 45-5 ■) may cause a variety of spinal cord in-

juries, with the extent of injury depending on the amount and direction of motion, and the rate of application of force:

- **Hyperflexion**, or forcible forward bending, may compress vertebral bodies and disrupt ligaments and intervertebral disks.

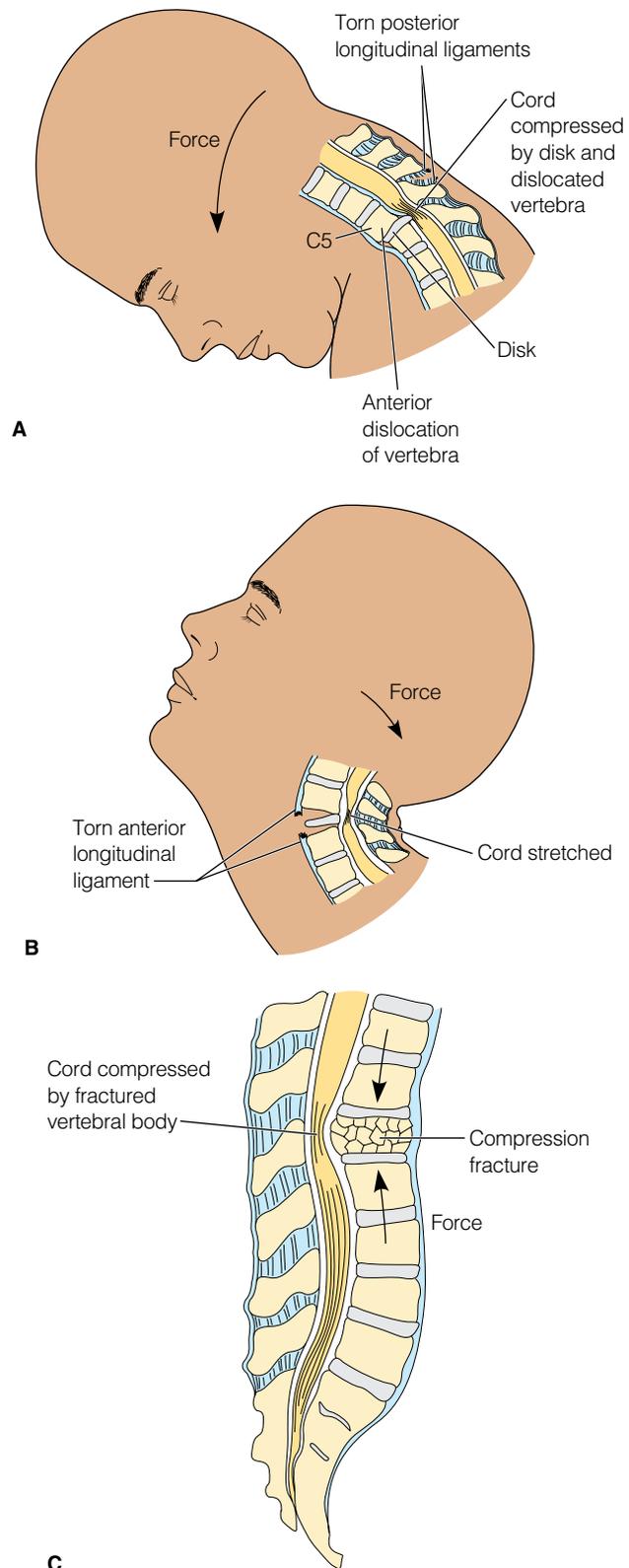


Figure 45-5 ■ Spinal cord injury mechanisms. A, Hyperflexion. B, Hyperextension. C, Axial loading, a form of compression.

- *Hyperextension*, or forcible backward bending, often disrupts ligaments and causes vertebral fractures. A whiplash injury is a less severe form of hyperextension, with injury to soft tissues but no vertebral or spinal cord damage.
- *Axial loading*, a form of compression, is the application of vertical force to the spinal column (for instance, by falling and landing on the feet or buttocks or by diving into shallow water).
- *Excessive rotation*, in which the head is excessively turned, may tear ligaments, fracture articular surfaces, and cause compression fractures.

The alteration of the spinal cord and soft tissues caused by these abnormal movements is called **deformation**. The spinal cord may be penetrated by bullets and other foreign objects (e.g., sharp objects used as weapons, shrapnel from explosions). Penetrating injuries may cause vertebral fractures, tear ligaments and muscles, or cut through a part or all of the spinal cord. Complete severing of the cord is rare.

Sites of Pathology

Injuries occur most often in the lumbar and cervical regions. The most frequent sites of injury of the cord are at the first, second, and fourth to sixth cervical vertebrae (C1, C2, C4 to C6); and the eleventh thoracic to second lumbar vertebrae (T11 to L2). Because the cervical spine has a wider range of movement than the rest of the spine, the cervical portion is more likely to be affected by externally applied forces. In addition, the cord fills most of the vertebral canal in the cervical and lumbar regions and thus is more easily injured. Damage to the vertebrae and ligaments causes the spinal column to become unstable, increasing the possibility of compression or stretching of the spinal cord with any further movement.

Classification of SCI

SCIs are classified according to systems, for instance (1) as complete or incomplete cord injury, (2) by cause of injury, and (3) by level of injury. In clinical practice, these classifications often overlap. In a *complete SCI* (about 45% of all injuries), the motor and sensory neural pathways are completely interrupted (transected), resulting in total loss of motor and sensory function below the level of the injury. However, “complete” does not necessarily mean the spinal cord has been severed. In an *incomplete SCI* (about 55% of all injuries), the motor and sensory pathways are only partially interrupted, with variable loss of function below the level of injury. Incomplete spinal cord injuries are further classified into syndromes as outlined in Table 45–2. Both complete and incomplete injuries can occur in paraplegia and quadriplegia (NSCIA, 2006). The alterations in function that occur as the result of a spinal cord injury vary greatly depending on the amount of tissue damage and the level of injury.

Manifestations

The spinal cord, the vertebrae, the intervertebral disks, the spinal nerves, the ligaments, and the surrounding soft tissue structures are in such close anatomic proximity that any condition or injury affecting one structure may well affect any one or all of the other structures. The conditions with the most critical effects are disorders affecting the spinal cord. Disorders and injuries of the spinal cord have the potential to affect movement, perception, sensation, sexual function, and elimination. Manifestations and complications of SCI by body system are listed in the box on the next page.

TABLE 45–2 Incomplete Spinal Cord Injury Syndromes

TYPE	CAUSE	LOCATION	DEFICITS
Central syndrome	Cord transection Hyperextension	Cervical	Spastic paralysis of the upper extremities Variable paralysis of the lower extremities Variable effects on the bowel, the bladder, and sexual function
Anterior syndrome	Damage to the anterior spinal artery Infarction of the anterior spinal artery Hyperflexion	Anterior two-thirds of the cord	Paralysis below the level of injury Loss of temperature and pain sensation below the level of injury
Posterior syndrome	Vertebral dislocation Herniated disk Compression	Nerve roots	Weakness in isolated muscle groups Tingling, pain Decreased or absent reflexes in the involved area Bowel or bladder dysfunction
Brown-Séquard syndrome	Penetrating trauma	Hemisection of the anterior and posterior cord	Paralysis below the level of injury on the ipsilateral (same) side of the body Contralateral loss of temperature and pain sensation below the level of injury Ipsilateral loss of proprioception below the level of injury
Homer’s syndrome	Incomplete cord transection	Cervical sympathetic nerves	Ipsilateral ptosis of the eyelid, constricted pupil, and facial anhidrosis (inability to perspire)



MANIFESTATIONS and Complications of Spinal Cord Injury by Body System

INTEGUMENT

- Decubitus (pressure) ulcers

NEUROLOGIC

- Pain
- Areflexia
- Hypotonia
- Autonomic dysreflexia

CARDIOVASCULAR

- Spinal shock
- Paroxysmal hypertension
- Orthostatic hypotension
- Cardiac dysrhythmias
- Decreased venous return
- Hypercalcemia

RESPIRATORY

- Limited chest expansion
- Decreased cough reflex
- Decreased vital capacity

GASTROINTESTINAL

- Stress ulcers
- Paralytic ileus
- Stool impaction
- Stool incontinence

GENITOURINARY

- Urinary retention
- Urinary incontinence
- Neurogenic bladder
- Impotence
- Testicular atrophy
- Inability to ejaculate
- Decreased vaginal lubrication

MUSCULOSKELETAL

- Joint contractures
- Bone demineralization
- Osteoporosis
- Muscle spasms
- Muscle atrophy
- Pathologic fractures
- Paraplegia
- Quadriplegia

Spinal shock is the temporary loss of reflex function (called *areflexia*) below the level of injury. This response begins immediately after complete transection of the spinal cord, when connections between the brain and the spinal cord are interrupted and the cord does not function at all. The response also occurs (although in varying degrees) after partial transection as well as after spinal cord contusions, compression, and ischemia.

Normal activity of the spinal cord is dependent on constant impulses from the higher centers of the brain. When damage from an injury stops these impulses, spinal shock follows. There is loss of motor function, tendon reflexes, and autonomic function. Spinal shock may begin within 1 hour of the injury. The condition may last from a few minutes to several months (although it usually lasts from 1 to 6 weeks), and then reflex activity returns. Spinal shock ends slowly, with the gradual reappearance of reflexes, hyperreflexia (increased reflex responses), muscle spasticity, and reflex bladder emptying.

The manifestations of acute spinal shock (which vary in degree) include the following:

- Flaccid paralysis of skeletal muscles below the level of injury
- Loss of all spinal reflexes below the level of injury
- Loss of sensations of pain, touch, temperature, and pressure below the level of injury
- Absence of visceral and somatic sensations below the level of injury
- Bowel and bladder dysfunction
- Loss of the ability to perspire below the level of injury.

A person with a cervical or upper thoracic SCI may also have neurogenic shock, resulting in cardiovascular changes. These

changes are due to the inability of higher centers in the brainstem to modulate reflexes. As a result, vascular beds below the level of injury dilate, and the cardiac accelerator reflex is suppressed. The client experiences hypotension and bradycardia. Other manifestations may include respiratory insufficiency due to loss of innervation of the diaphragm in C1 to C4 injuries, hypothermia, paralytic ileus, urinary retention, and oliguria.

Both bradycardia and hypotension may persist even after the spinal shock resolves. In addition to losing sympathetic control of the heart rate, the client with a high-level SCI experiences decreased peripheral resistance and loss of muscle activity. These changes result in sluggish blood flow and decreased venous return, increasing the risk for thrombophlebitis.

Complications

The complications of an SCI involve many different body systems and result often in permanent disability and loss of functional health status. The complications include but are not limited to upper and lower motor neuron deficits, paraplegia and quadriplegia, and autonomic dysreflexia. Other complications, depending on the level and severity of the injury, are ineffective respirations; altered skin integrity; increased risk of thrombosis; and alterations in bowel elimination, urinary elimination, and sexual pattern.

Upper and Lower Motor Neuron Deficits

Injuries to the spinal cord are often classified as either *upper motor neuron lesions* or *lower motor neuron lesions*. Motor neurons are functional units that carry motor impulses. The upper motor neurons (located in the cerebral cortex, thalamus, brainstem, and

corticospinal and corticobulbar tracts) are responsible for voluntary movement. When these motor pathways are interrupted, the client experiences spastic paralysis and hyperreflexia and may be unable to carry out skilled movement.

Lower motor neurons (located in the anterior horn of the spinal cord, the motor nuclei of the brainstem, and the axons that reach the motor end plate of skeletal muscles) are responsible for innervation and contraction of skeletal muscles. Interruption of lower motor neurons results in muscle flaccidity and extensive muscle atrophy, with loss of both voluntary and involuntary movement. If only some of the motor neurons supplying a muscle are affected, the client experiences partial paralysis (paresis); if all motor neurons to a muscle are affected, the client experiences complete paralysis. Hyporeflexia is also present.

Paraplegia and Quadriplegia

Two common neurologic deficits resulting from an SCI are paraplegia and quadriplegia (see Figure 45–2). **Paraplegia** is paralysis of the lower portion of the body, sometimes involving the lower trunk. Paraplegia occurs when the thoracic, lumbar, and sacral portions of the spinal cord are injured, causing loss or impairment of sensory and/or motor function. **Quadriplegia**, also called *tetraplegia*, occurs when cervical segments of the cord are injured, impairing function of the arms, trunk, legs, and pelvic organs.

Autonomic Dysreflexia

Autonomic dysreflexia (also called *autonomic hyperreflexia*) is an exaggerated sympathetic response that occurs in clients with SCIs at or above the T6 level. This response, which is seen only after recovery from spinal shock, occurs as a result of a lack of control of the autonomic nervous system by higher centers. When stimuli are unable to ascend the cord, mass reflex stimulation of the sympathetic nerves below the level of the injured cord area occurs, triggering massive vasoconstriction. In response, the vagus nerve causes bradycardia and vasodilation above the level of injury. If untreated, autonomic dysreflexia can cause seizures, a stroke, or a myocardial infarction and is potentially fatal (Hickey, 2003).

Autonomic dysreflexia is triggered by stimuli that would normally cause abdominal discomfort (a full bladder is the most common cause), by stimulation of pain receptors, and by visceral contractions (Porth, 2005). Causes include fecal impaction, bladder infections or stones, intrauterine contractions, ejaculation, peritonitis, and stimulation from pressure ulcers or ingrown toenails. The most common precipitating event is a blocked urinary catheter.

The manifestations of this condition include pounding headache; bradycardia; hypertension (with readings as high as 300/160); flushed, warm skin with profuse sweating above the lesion and pale, cold, and dry skin below it; and anxiety (Porth, 2005). Dysreflexia is a neurologic emergency and requires immediate treatment.

INTERDISCIPLINARY CARE



The client with an acute SCI requires emergency assessment and care and medications; sometimes the client also requires immo-

bilization and surgery. The client is first assessed and stabilized at the scene of the accident, initially treated in the emergency room, and then admitted to the hospital intensive care unit.

Emergency Care

The danger of death from SCI is greatest when there is damage to or transection of the upper cervical region. When the injury is at the C1 to C4 level, respiratory paralysis is common, and the client who survives requires ventilator assistance to breathe. Injuries below C4 may increase the risk of respiratory failure if edema ascends the cord. It is of critical importance not to complicate the initial injury by allowing the fractured vertebrae to damage the cord further during transport to the hospital. Although at one time injuries to the high cervical cord were almost always fatal, advances in trauma care have greatly improved the survival rate.

All people who have sustained trauma to the head or spine, or who are unconscious, should be treated as though they have a spinal cord injury. Prehospital management includes rapid assessment of the ABCs (airway, breathing, circulation), immobilizing and stabilizing the head and neck, removing the person from the site of injury, stabilizing other life-threatening injuries, and rapidly transporting the person to the appropriate facility. Guidelines for emergency care are as follows:

- Avoid flexing, extending, or rotating the neck.
- Immobilize the neck, using rolled towels or blankets, or apply a cervical collar before moving the client onto a backboard.
- Secure the head by placing a belt or tape across the forehead and securing it to the stretcher.
- Maintain the client in the supine position.
- Transfer directly from the stretcher with backboard still in place to the type of bed that will be used in the hospital.

Assessment findings at the scene of the accident or in the emergency room vary according to the level of injury. The assessment findings common to the level of injury and spinal shock are outlined in Box 45–1.

The client in the emergency department with a suspected or identified SCI is also treated for respiratory problems, paralytic ileus, atonic bladder, and cardiovascular alterations. Respiratory distress in the client with a cervical-level injury is treated by placing the client on a ventilator. Oxygen is administered to the client with a thoracic-level injury. Paralytic ileus (obstruction of the intestines due to lack of peristalsis) is common in clients with a spinal cord injury and is treated by the insertion of a nasogastric tube with connection to suction. To prevent overdistention of an atonic bladder, an indwelling catheter is inserted and connected to dependent drainage. Cardiovascular status is assessed on a continuous basis by inserting invasive monitoring devices, such as a Swan-Ganz catheter, and attaching the client to a cardiac monitor; or by arterial monitoring to identify hypotension and to draw arterial blood gases (ABGs).

High-dose steroid protocol using methylprednisolone (Medrol) must be implemented within 8 hours of the injury to improve neurologic recovery. Clinical research indicates that the use of this adrenocorticosteroid is effective in preventing secondary spinal cord damage from edema and ischemia. Treatment with G_{M1} ganglioside for 3 to 4 weeks is an experimental approach that has been effective for some clients (Tierney et al., 2005).

BOX 45–1 Assessment Findings in Acute SCI**Cervical Injury**

- Paralysis or weakness of extremities
- Respiratory distress manifested by changes in ABG studies, cyanosis, flaring of the nostrils, use of accessory muscles of respiration, and restlessness
- Pulse rate below 60 and systolic BP below 80
- Decreased peristalsis

Thoracic and Lumbar Injury

- Paralysis or weakness of extremities

Spinal Shock

- Loss of skin sensation
- Flaccid paralysis, areflexia
- Absent bowel sounds
- Bladder distention
- Decreasing blood pressure
- Absence of the cremasteric reflex in males (retraction of the left or right testicle in response to stimulation of the skin of, respectively, the inner left or right thigh)

Diagnosis

Diagnostic tests are ordered to identify the level and extent of injury, and to detect any complications. The tests include x-ray of the spine, CT or MRI of the spine, and somatosensory evoked potential studies to locate the level of spinal cord injury by stimulating peripheral nerves and measuring response times. ABG are measured to establish a baseline or to identify problems due to respiratory insufficiency.

Medications

The pharmacologic treatment of the client with SCI is symptomatic. It is directed primarily toward decreasing edema from the injury, treating hypotension and bradycardia, and treating spasticity.

- Corticosteroids, discussed earlier in this section, may be used to decrease or control edema of the cord.

- Vasopressors are used in the immediate acute care phase to treat bradycardia or hypotension due to spinal and neurogenic shock. Examples of drugs are dopamine (Intropin) to treat hypotension in neurogenic shock and dobutamine (Dobutrex) to support cardiac function. Atropine should be available at the bedside to treat bradycardia.
- Antispasmodics are used to treat spasticity in clients with spinal cord injury. Both baclofen (Lioresal) and diazepam (Valium) may be used. A discussion of nursing implications of treatment with antispasmodics is found in the Medication Administration box below.
- Analgesics such as nonsteroidal anti-inflammatory drugs (NSAIDs) and narcotics are administered to reduce pain.
- Proton pump inhibitors, such as omeprazole (Prilosec), rabeprazole (Aciphex), or pantoprazole (Protonix), are often administered to prevent stress-related gastric ulcers, a common complication in SCI.
- Unless contraindicated, anticoagulants (heparin or warfarin) may be given to prevent thrombophlebitis.
- Stool softeners may be administered as part of a bowel training program.

Treatments

The treatments used in the management of an SCI include surgery, stabilization, and immobilization.

SURGERY Early surgical treatment may be necessary if there is evidence of compression of the spinal cord by bone fragments or a hematoma. Surgery may also be done to stabilize and support the spine. However, many clients are treated with stabilization devices and do not require surgery. Surgeries that may be performed include a decompression laminectomy, a spinal fusion, and insertion of metal rods. Surgeries of the spine are discussed later in the chapter.

STABILIZATION AND IMMOBILIZATION As a result of one or more dislocations or fractures of the cervical vertebrae, the client with an SCI may be immobilized in some type of traction or external fixation device to stabilize the vertebral column and

MEDICATION ADMINISTRATION**Antispasmodics in Spinal Cord Injury****Baclofen (Lioresal)****Chlorzoxazone (Paraflex)****Cyclobenzaprine hydrochloride (Flexeril)****Diazepam (Valium)****Orphenadrine citrate (Norflex)**

These drugs depress the central nervous system and inhibit the transmission of impulses from the spinal cord to skeletal muscle. They are used to control muscle spasm and pain associated with acute or chronic musculoskeletal conditions. They are not always effective in controlling spasticity resulting from cerebral or spinal cord conditions.

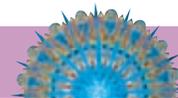
NURSING RESPONSIBILITIES

- Assess the client's spasticity and involuntary movements to obtain baseline data for comparison of results of therapy.

- Do not expect therapy to have effects for 1 week.
- Administer oral medications with food to decrease gastrointestinal symptoms.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- These drugs may cause drowsiness, diplopia, and impotence.
- Take your medications with meals to decrease gastric irritation.
- Physical improvement may take several weeks.
- Report slurred speech, drooling, or inability to carry out usual functions to the physician.
- Do not stop taking the medication without consulting your healthcare provider.



prevent any further damage (Figure 45-6 ■). Traction may also be used to stabilize the spinal column for clients who are not yet in a condition to have surgery or who have severe bleeding and edema of the injured cord. The physician applies the traction or fixation device; the nurse is responsible for assessments and interventions following the application.

Although used less frequently today, various devices provide cervical traction. For example, Gardner-Wells tongs may be used (Figure 45-7 ■). In this type of traction, the physician applies pins to the skull, approximately 1 cm above each ear, and weights are attached to the device.

The halo external fixation device is often used to provide stabilization if there is no significant involvement of the ligaments (Figure 45-8 ■). It is most often used to provide stability for fractures of the cervical and high thoracic vertebrae without cord damage. This device allows greater mobility, self-care, and participation in rehabilitation programs. The device is



Figure 45-6 ■ Examples of traction or external fixation devices.

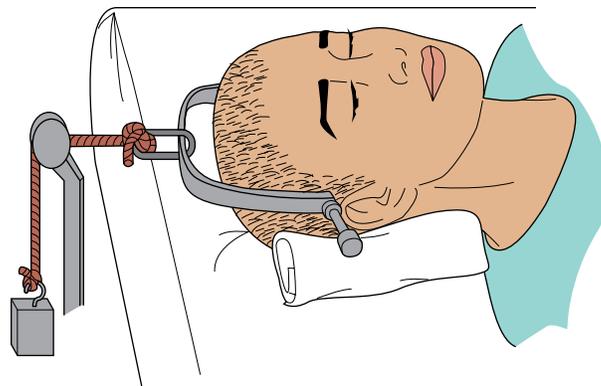


Figure 45-7 ■ Cervical traction may be applied by several methods, including Gardner-Wells tongs.

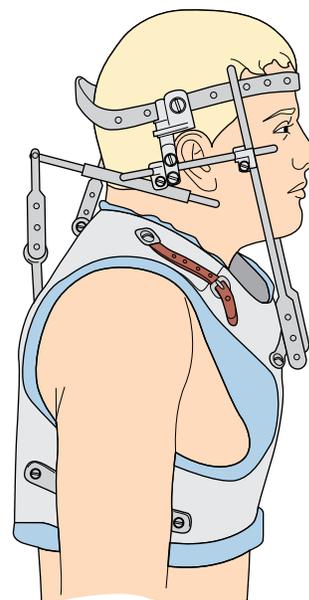


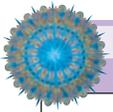
Figure 45-8 ■ The halo external fixation device.

secured with four pins inserted into the skull, two in the frontal bone and two in the occipital bone. The halo ring is then attached to a rigid plastic vest lined with sheepskin. Nursing interventions for the client using a halo fixation device are described in the box on the next page.



NURSING CARE

Both during the acute phase and the rehabilitative phase, the client with a SCI has complex needs that involve all members of the healthcare team. Because these injuries are more common in younger clients, consideration of lifelong effects on both the client and the family is essential. The nurse coordinates client care and develops and implements a care plan that is individualized to each client and family. The focus of the plan is to prevent the secondary complications of immobility and altered body functions, to promote self-care, and to educate the client and family. A Nursing Care Plan for a client with a SCI is found on page 1603.



NURSING CARE OF THE CLIENT IN Halo Fixation

- Maintain integrity of the halo external fixation device.
 - a. Inspect pins and traction bars for tightness; report loosened pins to physician.
 - b. Tape the appropriate wrench to the head of the bed for emergency intervention.
 - c. Never use the halo ring to lift or reposition the client. *Loosening of the apparatus poses the risk of further damage to the cord. It is the responsibility of the nurse to maintain the integrity of the apparatus and the safety of the client.*

- Assess muscle function and skin sensation every 2 hours in the acute phase and every 4 hours thereafter.
 - a. Assess motor function on a scale of 0 to 5, with 0 being no evidence of muscle contraction and 5 being normal muscle strength with full range of motion.
 - b. Assess sensation by comparing touch and pain, moving from impaired to normal areas, and testing both the right and left sides of the body.

Monitoring muscle function and skin sensation allows early identification of potential neurologic deficits.

- Monitor pin sites each shift and follow hospital policy for pin care. Here are some general guidelines.
 - a. Assess pin sites for redness, edema, and drainage.
 - b. Depending on policy, clean each pin site with a sterile applicator dipped in hydrogen peroxide, apply a topical antibiotic and cover with sterile 2-inch split gauze squares. *Organisms can enter the body through the pin-insertion site; assessments and care are provided to detect signs of and prevent infection.*

- Maintain skin integrity.
 - a. Turn the immobile client every 2 hours.
 - b. Inspect the skin around edges of the vest every 4 hours.
 - c. Change the sheepskin liner when it is soiled and at least once each week.

These interventions prevent skin injury and irritation.

Health Promotion

Health promotion for SCI primarily involves preventing injuries. Nurses can provide valuable information in the community and in the workplace to prevent SCI. Programs that focus on wearing seat belts and using approved infant seats and child booster chairs in automobiles can do much to help decrease the number of SCIs each year. Educational programs that promote workplace safety and farm safety should include information to prevent falls and how to use heavy equipment safely.

Assessment

The following data are collected through the health history and physical examination (see Chapter 43 ∞). Further focused assessments are described with nursing interventions in the next section.

- *Health history:* Time, location, and type of event-causing injury; location, duration, quality, and intensity of pain; dyspnea; sensation; paresthesia.
- *Physical examination:* Vital signs, motor strength, movement, spinal reflexes, bowel sounds, bladder distention.

Nursing Diagnoses and Interventions

Because an SCI has many possible effects, many nursing diagnoses may be appropriate. Nursing diagnoses discussed in this section focus on problems with physical mobility, respirations, dysreflexia, bowel and bladder elimination, sexual dysfunction, and self-esteem.

Impaired Physical Mobility

After the initial period of spinal shock and areflexia, the client regains spinal reflex activity and muscle tone that is not under the control of higher centers. Clients with injuries above the level of T12 experience involuntary spastic movements of skeletal muscles. These movements reach a peak about 2 years after the injury and then gradually subside (Porth, 2005). Spasms impair the ability to carry out the activities of daily life and work. In addition, the paraplegia or quadriplegia increases the potential for impaired skin integrity, thrombophlebitis, and contractures.

The goals of care for clients with impaired mobility related to a spinal cord injury are to reduce the effects of spasticity and to prevent complications involving the skin, the cardiovascular system, and joint function.

- Perform passive ROM exercises for all extremities at least twice a day. Identify stimuli that cause spastic movements and either avoid the stimuli (such as certain exercises) or teach the client to expect the movements. *ROM exercises help prevent contractures and stretch spastic muscles, promoting rehabilitation.*
- Maintain skin integrity by turning every 2 hours, assessing pressure points at least once each shift, and using a special bed if necessary. The client may be placed on a regular or special bed, such as a kinetic bed. *Immobility compresses soft tissues and promotes the development of decubitus ulcers. The lack of sensory warning mechanisms and of voluntary motor control of skin dermatomes further increases the risk for altered skin integrity. Special beds allow movement or turning while keeping the spinal column in alignment.*
- Assess the lower extremities each shift for manifestations of thrombophlebitis. Observe for redness and for increased heat every shift; measure thigh and calf circumference daily. If antiembolic stockings (TEDs) are ordered, remove for 30 to 60 minutes each shift. Assess for skin impairment and provide skin care while TEDs are removed. *Clients with neurologic deficits are at high risk for deep venous thrombosis as a result of immobility, vasomotor dysfunction, and decreased venous return with venous stasis. Antiembolic stockings help to prevent the pooling of blood in the lower extremities and increase venous return, lessening the risk for venous stasis and thrombus formation.*



NURSING CARE PLAN A Client with an SCI

Jim Valdez, a 19-year-old college sophomore, is admitted to the hospital by ambulance following an automobile crash. His family (father, mother, and sister) live 100 miles away and cannot visit often, although they are very concerned. On admission to the hospital, a CT scan of the spine shows a fracture and partial laceration of the cord at the C7 level. Mr. Valdez is in halo traction. One night, he tells the nurse, "I wish I had just died when I got hurt. I don't think I can stand to live like this."

ASSESSMENT

When Mr. Valdez is admitted to the intensive care unit, he has flaccid paralysis involving all extremities. He has no sensation below the clavicle or in portions of his arms and legs. His bladder is distended and bowel sounds are absent. Other assessment findings include BP 90/56, P 50, T 97°F (36.1°C), arterial blood gases pH 7.4, PaO₂ 96, PaCO₂ 37, SaO₂ 96%. Oxygen per nasal cannula is given at 2 L/min, and halo traction is applied. A Foley catheter is inserted into his bladder, and a nasogastric tube is inserted and attached to low-pressure continuous suction.

After 7 days, Mr. Valdez is moved from the intensive care unit to the neurosurgical unit for continuing care and planning for transfer to a rehabilitation hospital in his home town. His vital signs have stabilized and are normal for his age; respirations and oxygenation are normal. Other neurologic assessments remain the same.

DIAGNOSES

- *Impaired Physical Mobility* related to paralysis of lower and upper extremities
- *Bowel Incontinence* related to lack of voluntary sphincter control
- *Dysfunctional Grieving* related to denial of loss.

EXPECTED OUTCOMES

- Be actively involved in exercise programs.
- Have a soft, formed stool every second or third day.
- Verbally express his grief to parents and staff.

PLANNING AND IMPLEMENTATION

- Conduct passive exercises on all extremities four times a day.
- Provide progressive mobilization by initially raising the head of the bed 90 degrees (repeat two to three times during the first

day of movement); if blood pressure remains normal, dangle for 5 minutes before transferring him to a chair.

- His usual time for a bowel movement is after breakfast; schedule retraining program for that time.
- Encourage a diet high in fiber and fluids. Likes whole-wheat bread, orange juice, and cola; does not like water.
- Promote grief work by providing time to express feelings. Explain to the family that his denial and anger are part of the grieving process.
- Determine food likes and dislikes and order preferred foods from the menu. Encourage his friends to bring in his favorite foods periodically.
- Take and record weight every third day, using the bed scales.

EVALUATION

By the time Mr. Valdez is transferred to the rehabilitation hospital he is looking forward to learning how to use special equipment and getting his own motorized wheelchair. He is able to sit up in a chair without dizziness or hypotension. The use of ordered stool softeners combined with a high-fiber diet and fluid intake of 2000 to 3000 mL per day has maintained bowel elimination. Mr. Valdez and his parents have spent 3 hours talking about their feelings related to the accident and the future. Although the discussion is emotionally difficult, all three say they now feel much better. Mr. Valdez still has episodes of angry outbursts and tears, but he is more optimistic about what can be done and believes he can finish college. He selects foods from the menu each day and eats most of his meals, but he especially enjoys the times his friends bring in pizza or hamburgers.

CRITICAL THINKING IN THE NURSING PROCESS

1. Considering Mr. Valdez's age and developmental level, do you think his emotional responses to his injury were appropriate?
2. Issues of sexuality are obviously important for the client with a spinal cord injury. How would you approach Mr. Valdez about this topic?
3. What would be your response as a male or female nurse if Mr. Valdez would allow only male nurses to provide care?
4. Outline a teaching program to help Mr. Valdez meet long-term urinary elimination needs.

See Evaluating Your Response in Appendix C.

PRACTICE ALERT

Removing TED stockings each shift not only promotes healthy skin but also lets the nurse assess skin integrity.

Impaired Gas Exchange

Injuries at the level of T1 to T7 leave the phrenic nerve intact, but the innervation of intercostal muscles is affected, compromising respiratory function. In addition, because the abdominal muscles are paralyzed, the client cannot expel secretions by coughing. Clients with cord injuries at C3 or above have paralysis of the respiratory muscles and cannot breathe without a ventilator.

- Monitor vital capacity and respiratory effectiveness, assessing for tachycardia, restlessness, PaO₂ less than 60 mmHg, PaCO₂ greater than 50 mmHg, and vital capacity less than 1 L. *Clients with cervical cord injuries frequently require ventilatory support because of reduced vital capacity and inability to expel secretions by coughing.*

PRACTICE ALERT

Changes in ABGs and vital capacity signal respiratory insufficiency.

- Monitor for signs of ascending edema of the spinal cord, including difficulty in swallowing or coughing, respiratory

stridor, use of accessory muscles of respiration, bradycardia, and increased motor and sensory loss. *Hemorrhage and edema can further impair respiratory function.*

- Help the client to cough, as follows: Place the hand between the umbilicus and xiphoid process and push in and up as the client exhales and coughs. *The client who is unable to cough effectively and has decreased ventilatory capacity may develop atelectasis, pneumonia, and respiratory failure.*

Ineffective Breathing Patterns

Respiratory function is impaired in the client with SCI in the cervical and thoracic levels if the diaphragm (innervated at C3 to C5), the intercostal muscles (innervated at T1 to T7), and the abdominal muscles are affected. In clients with injury at higher levels, assisted ventilation and a tracheostomy are necessary; when the injury is at lower levels, the client's ability to take a deep breath and cough is diminished. The goal of nursing interventions is to maintain normal respiratory rate (12 to 20 breaths per minute) and to prevent pulmonary complications such as atelectasis and pneumonia.

- Assess respiratory rate, rhythm, and depth every 4 hours (or more frequently if needed). Auscultate breath sounds as a part of respiratory assessment. *Injury to the cord in the cervical or thoracic regions can decrease respiratory function and increase the risk for respiratory problems.*

PRACTICE ALERT

Auscultate the lungs for crackles and wheezes.

- Monitor results of oxygen saturation with pulse oximetry and ABG studies. *ABG studies provide information about gas exchange; decreasing pH, oxygen, and oxygen saturation levels, and increasing carbon dioxide levels signal respiratory acidosis.*
- Administer supplemental oxygen as prescribed. *Oxygen saturation must be maintained at 100% with supplemental oxygen to prevent hypoxemia and secondary SCI in all acute SCI clients.*
- Help the client turn, cough, and deep breathe at least every 2 hours. Use assisted coughing as necessary. *Paralysis of intercostal or abdominal muscles decreases the ability to expel secretions by coughing; retained secretions increase the risk for pneumonia. The inability to breathe deeply may result in atelectasis.*
- Increase fluids given by mouth to 3000 mL per day (if oral intake is approved), according to client preference for type of liquids and predicated on the client's ability to swallow. *Increased fluid intake thins secretions, which can more easily be expelled and expectorated.*

Dysreflexia

Autonomic dysreflexia is an emergency that requires immediate assessment and intervention to prevent complications of extremely high blood pressure (loss of consciousness, seizure, and even death).

- Elevate the head of the client's bed and remove TEDs or sequential compression boots. *These measures increase pool-*

ing of blood in the lower extremities and decrease venous return, thus decreasing blood pressure.

- Assess blood pressure every 2 to 3 minutes while at the same time assessing for stimuli that initiated the response (such as a full bladder, impacted stool, or skin pressure). *The most serious danger in dysreflexia is elevated blood pressure, which could precipitate a stroke, myocardial infarction, dysrhythmias, or seizures. If the client has a Foley catheter, ensure that there are no kinks in the tubing. If the client does not have a Foley catheter, drain the bladder with a straight catheter. If manifestations persist, assess for a fecal impaction. If an impaction is present, insert Nupercaine cream into the anus, wait 10 minutes, and manually remove the impaction.*

PRACTICE ALERT

Blood pressure readings may be as high as 300/160.

- If blood pressure remains dangerously elevated, the physician may prescribe intravenous administration of diazoxide (Hyperstat). Other medications that may be used include nifedipine (Procardia) and hydralazine (Apresoline). *Diazoxide is an antihypertensive drug used in emergency situations to lower blood pressure in adults with dangerously high readings. Nifedipine and hydralazine are peripheral vasodilators that are administered to decrease the elevated blood pressure.*

PRACTICE ALERT

It is important to closely monitor for hypotension following administration of these medications, especially if the stimulus for the dysreflexia has been removed.

Impaired Urinary Elimination and Constipation

Depending on the level of the injury, the client with a SCI may have alterations in bowel and bladder function. Clients with injuries to the cord at or above the S2 to S4 levels will have a neurogenic bladder, with deficits in control of micturition. Voluntary and involuntary bowel control is affected in the client with a lower motor neuron injury. Both bowel and bladder retraining are possible; if not, some form of assisted elimination is necessary. Although an indwelling catheter may be used in the acute phase of care, the goal is to reestablish a catheter-free state.

- Monitor for manifestations of a full bladder. *Overdistention stretches the bladder and can lead to backflow of urine into the ureters and kidney; stasis of urine in an incompletely emptied bladder increases the risk for infection.*

PRACTICE ALERT

A distended bladder can be palpated over the lower abdomen above the symphysis pubis.

- Teach client to use trigger voiding techniques prior to straight catheterization. These techniques include stroking the inner thigh, pulling the pubic hair, tapping on the abdomen over the bladder, and (in females) pouring warm water over the vulva. *These trigger voiding techniques stimulate*

parasympathetic nerve fibers to cause reflex activity and may facilitate voiding.

- Teach self-catheterization to clients who will be able to carry out the procedure alone or with minimal assistance (Procedure 45–1). *Straight catheterization at regular intervals is part of bladder training because periodic distention and relaxation of the muscles of the bladder promote reflex bladder activity. In addition, self-care fosters independence.*
- Monitor residual urine throughout the bladder retraining program. *A residual urine amount of less than 80 mL after a triggered voiding is considered satisfactory.*
- Institute a bowel retraining program as follows:
 - Assess usual patterns of bowel elimination to establish best times for individualized program.
 - Maintain a high-fluid, high-fiber diet.
 - Use stool softeners as prescribed; rectal suppositories and enemas may be used 30 minutes after meals to stimulate stronger peristalsis and facilitate evacuation.
 - Maintain upright position if at all possible and ensure privacy.
 - If client is unable to evacuate, digital stimulation or manual removal on a regular basis may be the most effective long-term management.

A bowel retraining program to regulate the bowel through reflex activity may be instituted in clients with upper motor

neuron injuries. The client with a lower motor neuron injury loses the defecation reflex, and bowel retraining is more difficult (if not impossible).

Sexual Dysfunction

Sexual intercourse is often still possible for the client with an SCI. In men, the general rule is that the higher the level of injury the greater the potential to have reflexogenic erections, although ejaculation or orgasm may not occur, and fertility is usually lower as a result of a lack of temperature control of the testes. However, ejaculation may be stimulated and the sperm used to inseminate the client's partner, so that fatherhood is a possibility. Men who have sacral-level injuries do not have reflexogenic erections but may have psychogenic erections. They are also more likely to remain fertile.

Women with SCI generally do not have sensation during sexual intercourse, but pregnancy is possible. However, pregnant women with an SCI are at increased risk for autonomic dysreflexia during labor and delivery. Birth control options should be discussed prior to discharge from the acute care setting.

A client with an SCI may be deeply concerned about alterations in sexual function. These concerns may lead to lowered self-esteem, altered self-image, or changes in feelings about being an attractive and desirable person. Assess concerns and provide a

PROCEDURE 45–1 CLIENT SELF-CATHETERIZATION



Self-catheterization on an intermittent basis (usually a part of self-care at home) is a clean rather than a sterile procedure. The hands should

be washed before and after the procedure, and the urinary meatus should be cleaned by washing with soap and water.

FEMALE SELF-CATHETERIZATION

- Attempt to void. If urine is not of sufficient quantity (at least 100 mL) or if you cannot void at all, do self-catheterization. *A large amount of residual urine means that more frequent catheterizations (every 4 to 6 hours) are necessary.*
- While sitting on the wheelchair or the commode, locate the urethra. Visualize the urethra by looking in a mirror, or palpate the urethra with a fingertip. *Visualization or palpation of the meatus is necessary for proper catheter insertion.*
- Lubricate the meatus with a water-soluble lubricant. *Lubrication facilitates the insertion of the catheter and reduces trauma to tissues.*

- Take a deep breath and insert the catheter tip 2 to 3 inches or until urine flows. *The catheter enters the bladder more easily when the sphincter is relaxed. The deep breath relaxes the sphincter. The female urethra is 1½ to 2½ inches long.*
- Hold the catheter securely and allow urine to drain until the flow stops. *Withdrawing and reinserting the catheter increase the risk of infection.*
- Withdraw the catheter and wash it with soap and water. Store the catheter in a clean container. *The catheter can be reused until it is too soft or too hard to be directed into and through the urinary meatus. Clean rather than sterile technique is usually used for self-catheterization at home.*

MALE SELF-CATHETERIZATION

- Attempt to void. If urine is not of sufficient quantity (e.g., less than 100 mL) or if you cannot void at all, do self-catheterization. *A large amount of residual urine means that more frequent catheterizations (every 4 to 6 hours) are necessary.*
- Sit either on the commode or in the wheelchair. Hold the penis with slight upward tension and extend it to its full length. *Extending the penis straightens the urethra.*
- Lubricate the catheter from the tip to about 6 inches downward. *Lubrication is especially important for male catheterization because of the length of the urethra.*
- Take a deep breath and insert the catheter 6 to 7 inches or until urine flows. *The catheter enters the bladder more easily when the*

- sphincter is relaxed. The deep breath relaxes the sphincter. The male urethra is about 6 inches long.*
- Hold the catheter securely and allow urine to drain until flow has stopped. *Withdrawing and reinserting the catheter increase the risk of infection.*
- Withdraw the catheter and wash it with soap and water. Store the catheter in a clean container. *The catheter can be reused until it is too soft or too hard to be directed into and through the urethra. Clean rather than sterile technique is usually used for self-catheterization at home.*

climate that is receptive to discussion about sexuality. Examples of objectives for sexual counseling for the client with an SCI are that the client will understand how the injury has altered sexual functioning, be aware of alternative ways of achieving sexual pleasure, and have a positive self-concept and body image.

- Include data about sexuality when obtaining the nursing history and database. *Sexuality is a private matter for most people, and the client may not discuss it unless the nurse introduces the topic.*
- Provide accurate information about the effect of the SCI on sexual function. *Accurate information gives the client a realistic picture of how the injury will affect sexuality.*
- Initiate a discussion with the client and partner of alternative means of gaining sexual satisfaction; these include the use of vibrators, and oral–genital and manual stimulation. *Alternatives to intercourse can meet sexual needs and help maintain the relationship with a significant other.*
- Refer for sexual counseling, if appropriate, or to local support groups where questions can be answered by others with similar experiences. *Knowing that others have had similar experiences can decrease social isolation and provide a means of learning alternative methods of sexual functioning.*

Low Self-Esteem

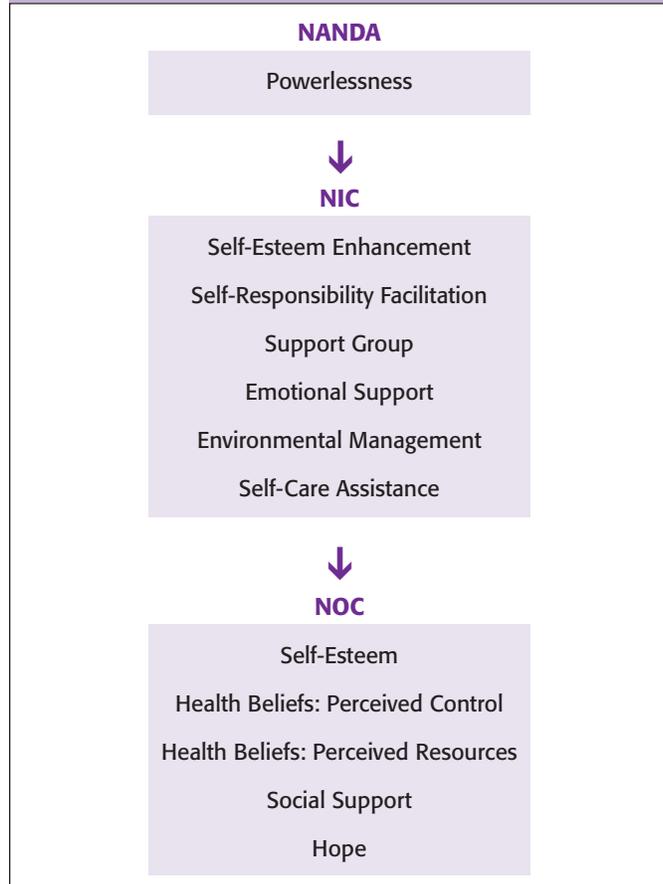
An SCI is often the result of sudden trauma. Within moments, a formerly independent, fully functioning individual is suddenly unable to move and faces enormous adjustments in social, economic, and personal roles and relationships. Body image, self-esteem, and role performance are all affected by the damage. As a result, the client often demonstrates behaviors that may be difficult for the nurse to handle: depression, denial, and anger are seen in the period immediately after the injury. In addition to these responses, the young adult client may act out by making sexually overt statements.

- Encourage talking about all aspects of physical function and care. *Talking provides a safe outlet for fears and frustrations and also increases self-awareness. Acceptance of self facilitates rehabilitation.*
- Encourage self-care and independent decision making. *Participating in self-care can promote positive coping; making decisions decreases feelings of powerlessness.*
- Help identify strategies to increase independence in desired roles; include both short- and long-term goals. Discuss assistive devices (such as hand-operated automobiles). *Identifying strategies to increase independence in the future fosters a positive self-concept and motivates the client to achieve rehabilitation goals.*
- Include family members and important others in discussions. *The realization that others do care and will continue to provide support is important in fostering positive self-regard.*
- Refer the client and family to support groups or for psychological counseling. *Adjustment to change is more likely when the client and family seek peer and professional assistance.*

Using NANDA, NIC, and NOC

Chart 45–2 shows links between NANDA nursing diagnoses, NIC, and NOC when caring for the client with an SCI.

NANDA, NIC, AND NOC LINKAGES
CHART 45–2 The Client with an SCI



Data from NANDA's *Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bluechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

Community-Based Care

Rehabilitation of the client with an SCI is an ongoing process that moves from intensive care through intermediate care to rehabilitation and then community-based and home care. Nursing interventions are necessary at all points in the process to prevent the complications of altered physical mobility and body functions, and to teach the client and family measures that promote independence in self-care.

Discharge planning should be addressed even in the initial plan of care while the client is in the critical care setting. Advance planning ensures continuity of care when the client leaves the hospital setting.

The following should be included in teaching the client and family about care at home.

- Self-care activities (ADLs, exercises, bowel and bladder programs, skin care)
- Mobility (use of assistive devices: wheelchair, crutches, special automobiles)
- Preparation of the home environment
 - If the client is in a wheelchair, will steps, stairs, doors, or carpeted floors present physical barriers?

- If a special bed is necessary, have arrangements been made, and is it in the home?
- Psychologic support
- Independent activities
- Community resources, such as Life-line (emergency alerting systems through a local hospital or agency), support groups, career centers for job retraining, counseling
- Coping skills for client and caregiver
- Referral to a home health agency and physical therapist for the client who is returning home
- Helpful resources:
 - The National Spinal Cord Injury Association
 - American Paralysis Association
 - Christopher Reeve Paralysis Foundation
 - Paralyzed Veterans of America
 - Canadian Paraplegic Association
 - Australian Quadriplegic Association.

THE CLIENT WITH A HERNIATED INTERVERTEBRAL DISK

A herniated intervertebral disk, also called a ruptured disk, herniated nucleus pulposus, or a slipped disk, is a rupture of the cartilage surrounding the intervertebral disk with protrusion of the nucleus pulposus (Figure 45-9 ■). Perhaps few neuro-orthopedic disorders are as challenging as those involving the intervertebral disks. Clients with herniation (rupture) of a disk have not only excruciating pain but also limited mobility. These problems may in turn cause alterations in role function, coping, and the ability to perform activities of daily living.

Incidence and Prevalence

A herniated intervertebral disk may occur at any adult age. However, it is more common as people enter middle age and age-related changes occur. The nucleus pulposus loses fluid content, and the disks are less able to absorb shocks. The disks become smaller and slip out of place more easily. Aging causes degeneration in the annulus fibrosus and the posterior longitudinal ligaments, and the vertebrae and disks are less able to respond to movement and are more easily injured.

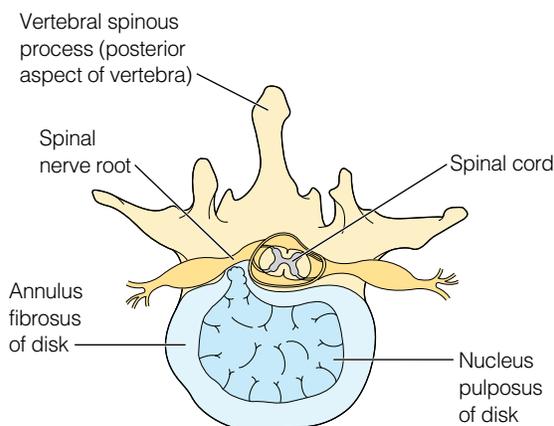


Figure 45-9 ■ A herniated intervertebral disk. The herniated nucleus pulposus is applying pressure against the nerve root.

FAST FACTS

Herniated Intervertebral Disks

- Herniated intervertebral disks are more common in men than women.
- Most clients are between the ages of 30 and 50.
- The majority of herniated disks occur in the lumbar region (L4 or L5 to S1); when disks herniate in the cervical region, they most commonly do so at C6 to C7.
- Multiple herniations are not common, occurring in only about 10% of all clients (Hickey, 2003).

Pathophysiology

The intervertebral disks, located between the vertebral bodies, are made of an inner nucleus pulposus and an outer collar (the annulus fibrosus). The disks allow the spine to absorb compression by acting as shock absorbers. A herniated intervertebral disk occurs when the nucleus pulposus protrudes through a weakened or torn annulus fibrosus of an intervertebral disk (see Figure 45-9). This protrusion may occur anywhere along the vertebral column, but herniation of thoracic disks is uncommon. The protrusion may occur spontaneously or as a result of trauma, with trauma (such as lifting heavy objects or falling) causing about half of all cases. Rupture of the disk allows herniation of the nucleus pulposus in a posterolateral direction, with compression of the associated nerve root. The resulting pressure on adjacent spinal nerves causes characteristic manifestations, which vary with the location and the amount of protruding disk material (see the box below). Occasionally the herniation is central rather than posterolateral, with pressure on the spinal cord.



MANIFESTATIONS of a Ruptured Intervertebral Disk

L4 TO L5 LEVEL (AFFECTS FIFTH LUMBAR NERVE ROOT)

- Pain in hip, lower back, posterolateral thigh, anterior leg, dorsal surface of foot, great toe
- Muscle spasms in affected areas
- Paresthesia over lateral leg and web of great toe
- Foot drop (rare)
- Decreased or absent ankle reflex
- Cauda equina syndrome (with complete nerve root compression): bowel and bladder incontinence, paralysis of lower extremities

L5 TO S1 LEVEL (AFFECTS FIRST SACRAL NERVE ROOT)

- Pain in midgluteal region, posterior thigh, calf to heel, plantar surface of the foot to the fourth and fifth toes
- Paresthesias in posterior calf and lateral heel, foot, and toes
- Difficulty walking on toes

C5 TO C6 LEVEL (AFFECTS SIXTH CERVICAL NERVE ROOT)

- Pain in neck, shoulder, anterior upper arm, radial area of forearm, thumb
- Paresthesia of forearm, thumb, forefinger, and lateral arm
- Decreased biceps and supinator reflex
- Triceps reflex normal to hyperactive

The herniation may be abrupt or gradual. Lifting incorrectly or suddenly twisting the spine can cause rupture with immediate intense pain and muscle spasms. Gradual herniation is the result of degenerative changes, osteoarthritis, or ankylosis spondylitis. Clients with a gradual herniation have a slow onset of pain and neurologic deficits.

Lumbar Disk Manifestations

The classic manifestation of a ruptured lumbar disk is recurrent episodes of pain in the lower back. The pain typically radiates across the buttock and down the posterior leg, although it may be experienced only in the leg. **Sciatica** is a term used to describe lumbar back pain that radiates down the posterior leg to the ankle and is increased by sneezing or coughing (the result of pressure on nerve roots L4, L5, S1, S2, or S3, which give rise to the sciatic nerve). Sciatica may be elicited by straight-leg raising: The client feels pain when lifting one leg while dorsiflexing the foot of that leg. Sciatica pain varies in intensity, ranging from mildly uncomfortable to excruciating. It is aggravated by a variety of positions and activities, including sitting, straining, coughing, sneezing, climbing stairs, walking, and riding in a car.

Other manifestations include postural deformity, motor deficits, sensory deficits, and changes in reflexes. In about 60% of clients with ruptured lumbar disks, the normal lumbar lordosis is absent. When standing, the client typically has a slight forward tilt to the trunk, scoliosis of the lumbar spine, slight flexion of the hip and knee on the affected side, and paravertebral muscle spasms (Hickey, 2003). Motor deficits include weakness and in some clients problems with sexual function and urinary elimination. Sensory deficits include paresthesias and numbness. Knee and ankle reflexes are decreased or absent.

Cervical Disk Manifestations

Cervical disks that herniate laterally cause pain in the shoulder, neck, and arm. Other manifestations of lateral cervical herniation include paresthesias, muscle spasms and stiff neck, and decreased or absent arm reflexes. Central cervical herniations result in mild, intermittent pain; however, the client may also experience lower extremity weakness, unsteady gait, muscle spasms, urinary elimination problems, altered sexual function, and hyperactive lower extremity reflexes.

INTERDISCIPLINARY CARE



Considerations for the client with a ruptured intervertebral disk include identifying the location of herniation and determining whether conservative treatment or surgery is indicated. Nursing care is directed toward preparing clients for diagnostic tests and providing teaching and care for the client who has either medical or surgical interventions.

Diagnosis

Diagnostic tests are ordered to differentiate the cause of back pain; for example, back and leg pain is also caused by spinal tumors, degenerative processes, or abdominal diseases. Assessing pain is an important part of diagnosis. The tests in-

clude x-rays and CT scans of the lumbosacral or cervical area to identify skeletal deformities and narrowing of the disk spaces (see Chapter 43 ∞). Electromyography (EMG), which measures electrical activity of skeletal muscles at rest and during voluntary contraction, may be conducted to identify specific muscles affected by the pressure of the herniation on the nerve roots.

A myelogram with contrast medium is done to illustrate areas of herniation, although it does not provide the detail found with CT or MRI. However, myelography is diagnostic in 80% to 90% of all cases and is used both to rule out tumors and locate the herniation. Nursing implications for the care of a client having a myelogram are described in Chapter 43 ∞.

Medications

The client with a ruptured intervertebral disk is treated with medications to relieve pain and reduce swelling and muscle spasms. Pain is usually managed with NSAIDs (see Chapter 9 ∞). Muscle spasms are treated with muscle relaxants.

Treatments

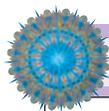
A ruptured intervertebral disk may be treated conservatively or with surgery.

CONSERVATIVE TREATMENT A ruptured intervertebral disk is usually managed conservatively unless the client is experiencing severe neurologic deficits. The goals of treatment are pain relief and healing of the involved disk by fibrosis. Conservative treatment is usually prescribed for 2 to 6 weeks. If the client continues to have pain after that time, surgery may be considered. The treatment regimen depends on the severity of the manifestations. Decreasing activity level with bed rest is no longer recommended; and in many cases, the client is advised to continue with normal activities while taking prescribed medications for pain, inflammation, and muscle spasms.

Medications used to treat back pain include nonnarcotic analgesics, anti-inflammatory drugs such as the NSAIDs, muscle relaxants, and sedative-tranquilizers.

SURGERY Surgery is indicated for clients who do not respond to conservative management or have serious neurologic deficits. Several surgical interventions are used to treat a ruptured intervertebral disk. The type of surgery chosen depends on the location of the disk and the stability of the spinal column.

- A *laminectomy*, the type of surgery most often performed, is the removal of a part of the vertebral lamina. The surgery is done to relieve pressure on the nerves. It is often combined with removal of the protruding nucleus pulposus (*nuclectomy*). Nursing care for the client having a laminectomy is discussed in the box on the next page. A *discectomy* is the removal of the nucleus pulposus of an intervertebral disk. Discectomy may be performed alone or along with a laminectomy.
- Spinal fusion is the insertion of a wedge-shaped piece of bone or bone chips between the vertebrae to stabilize them. The bone is usually taken from a client donor site, such as the iliac crest. A spinal fusion may also be performed through a spinal implant with a device called a BAK (a hollow titanium cylinder with holes), which is packed with grafted bone from a donor site and placed in the space where a disk is removed. Although not



NURSING CARE OF THE CLIENT HAVING A Posterior Laminectomy

PREOPERATIVE TEACHING

- Demonstrate and ask the client to practice logrolling; explain that it will be done by the nurses for the first day or two, and then the client can do it alone. *To ensure healing, the spinal column must remain in alignment when turning and moving.*
- Explain the importance of taking pain medications regularly and of asking for them before the pain is severe. Include information about the possibility of the pain being much the same after surgery. *Pain is easier to control if medications are taken before the pain is severe. Pain may be the same following surgery for a herniated intervertebral disk because edema due to surgery irritates and compresses the nerve roots.*
- Demonstrate the use of a fracture bedpan and ask the client to practice its use. *The client usually must remain flat in bed for a period of time following surgery. A fracture bedpan is more comfortable for clients who must lie flat.*
- Explain that the client may need to eat while lying flat. *This position prevents flexion of the spine.*
- Demonstrate and ask the client to demonstrate deep breathing, the use of the incentive spirometer, and leg exercises. *These measures prevent respiratory and circulatory complications.*

POSTOPERATIVE CARE

- Maintain the client in a position that minimizes stress on the surgical wound. For clients with cervical laminectomy:
 - a. Elevate the head of the bed slightly.
 - b. Position a small pillow under the neck.
 - c. Maintain the position of the cervical collar.
 For clients with lumbar laminectomy:
 - a. Keep the bed flat or elevate the head of the bed slightly.
 - b. Place a small pillow under the head.
 - c. Place a small pillow under the knees, or use a pillow to support the upper leg when the client lies on one side.*These positions minimize stress on the surgical wound and suture line. A cervical collar provides stability and prevents flexing or twisting the neck.*
- Turn the client every 2 hours, using the logrolling technique. Teach the client **not** to use the side rails to change position. Maintain proper body alignment in all positions. *The client's body is turned as a single unit (usually with a turning sheet) to avoid movement of the operative area. Pulling on the side rails puts stress on the operative area and may also cause misalignment of the vertebral column.*
- Monitor the client for signs of nerve root compression.
 - a. Cervical laminectomy: Assess hand grips and arm strength, ability to move the fingers, and ability to detect touch.
 - b. Lumbar laminectomy: Assess leg strength, ability to wiggle the toes, and ability to detect touch.
 Compare bilateral findings. Report muscle weakness or sensory impairment to the physician immediately. *Loss of motor and sensory function may indicate nerve root compression.*
- Assess for hematoma formation as manifested by severe incisional pain that is not relieved by analgesics and decreased motor function. Report these findings immediately. *A hematoma may form at the surgical site. If untreated, it may cause irre-*

versible neurologic deficits including paraplegia and bowel/bladder dysfunctions (Hickey, 2003).

- Assess for leakage of cerebrospinal fluid. Assess the dressing for increased moisture. Check the sheets for wetness when the client is lying supine; check for clear liquid running down the back when the client is sitting or standing. Gently palpate the sides of the wound to detect a bulge. Use a Dextrostix strip to assess any leakage for the presence of glucose, a positive indicator of cerebrospinal fluid. *Although uncommon, leakage of cerebrospinal fluid greatly increases the risk for infection of the wound and of the meninges.*
- Assess for nerve root injury. Assess the client's ability to dorsiflex the foot (lumbar laminectomy) and the client's grip strength (cervical laminectomy). Assess the client who has had a cervical laminectomy for hoarseness. Report hoarseness and further assess the client's ability to swallow. *Nerve root compression may cause permanent damage, resulting in footdrop (in lumbar laminectomy clients) and hand weakness (in cervical laminectomy clients). Damage to the laryngeal nerve may cause permanent hoarseness. Impaired ability to swallow puts the client at risk for aspiration.*
- Assess for urinary retention. The client should void within 8 hours after surgery. If the physician allows, let males stand to void. Compare intake and output for each 8-hour period. *All clients who have received a general anesthetic are at risk for urinary retention. The client who has had a lumbar laminectomy may have even more difficulty voiding as a result of stimulation of sympathetic nerves during surgery.*
- Assess for pain using a scale from 0 (no pain) to 10 (severe pain). Administer prescribed analgesics on a regular basis, or teach the client to use patient-controlled analgesia (PCA), if prescribed. Discuss client concerns about pain that is unrelieved by surgery. *Compression of the nerve root over time results in edema and inflammation. Because of surgery-induced edema, the client is likely to experience either the same pain or perhaps more severe pain in the period immediately after surgery. This pain usually persists for several weeks after surgery. In addition, many clients who have had a lumbar laminectomy have muscle spasms in the lower back, abdomen, and thighs for the first few days after surgery.*
- Assess for infection by taking and recording vital signs at least every 4 hours; report increased body temperature. Assess the wound and dressing for signs of infection: increased redness, drainage, pain, and pus. Use sterile technique to change dressings. *The surgical client is always at risk for infection; the client with a laminectomy is also at risk for arachnoiditis. This inflammation of the arachnoid layer of the spinal meninges results from wound infection or contamination during surgery and may cause the formation of painful adhesions.*
- Encourage deep breathing and the use of the incentive spirometer every 2 hours; coughing may be discouraged. *Anesthesia and immobility depress respiratory function. Coughing may be discouraged because it can disrupt healing tissues, especially in clients having a cervical laminectomy.*
- Increase mobility as prescribed. (The time frame for ambulation is prescribed by the physician; the routine here is

(continued)



NURSING CARE OF THE CLIENT HAVING A Posterior Laminectomy (continued)

representative.) Clients often sit on the side of the bed and dangle their legs the evening after surgery or the first day thereafter. Many clients ambulate the first or second postoperative day. To help the client out of bed, first elevate the head of the bed. Then bring the client's legs over the side of the bed at the same time that the upper body moves into the upright

position. Clients should not ambulate without assistance until they are no longer dizzy or weak. *Early ambulation increases respiratory and circulatory function and decreases the risk of thrombophlebitis of the lower extremities. The vertebral column should remain in alignment while the client sits and stands. Safety must be considered throughout care.*

appropriate for all clients requiring a spinal fusion, this does facilitate a short hospital stay and convalescence.

- Foraminotomy is an enlargement of the opening between the disk and the facet joint to remove bony overgrowth compressing the nerve. The location and size of the incision vary according to the surgeon's preference and the location and size of the ruptured disk. The posterior approach is taken for lumbar surgery. Either the posterior or the anterior approach may be taken for cervical disks.
- Intradiscal electrothermal therapy (IDET) uses thermal energy to treat pain from a bulging spinal disk. A special needle is inserted into the disk and heated to a high temperature. The heat thickens and seals the disk wall and decreases bulging of the disk.
- A microdiscectomy, in which microsurgical techniques are used, is performed through a very small incision. This type of surgery decreases the possibility of trauma to surrounding structures during surgery and allows early postoperative mobility and a short hospital stay.



NURSING CARE

Nursing care for the client with a ruptured intervertebral disk may be provided through information in community and work settings, during conservative treatment, and during pre- and postoperative treatment. The pain of the ruptured disk is often discouraging and debilitating, and may well affect the client's ability to work.

Health Promotion

Proper body mechanics may help prevent the occurrence of a ruptured intervertebral disk. Teaching the proper method of lifting and moving heavy objects should begin when children enter school. This information should also be given to all workers (including nurses) who have lifting as part of their responsibilities. The guidelines for proper body mechanics are as follows:

- Begin activities by spreading the feet apart to broaden the base of support.
- Use large muscles of the arms to lift and the legs to push when lifting.
- Work as closely as possible to the object that is to be lifted or moved.
- Slide, roll, push, or pull an object rather than lift it.
- When lifting, bend the knees and lift up over your center of gravity.
- When lifting, use a back support belt.

Assessment

The following data are collected through the health history and physical examination (see Chapter 43 ∞).

- *Health history:* Type of employment, risk factors, pain (location, duration, intensity).
- *Physical assessment:* Muscle strength and coordination, sensation, reflexes.

Nursing Diagnosis and Interventions

Nursing care for clients with a herniated intervertebral disk focuses largely on pain management, both during conservative management and after surgery.

Acute Pain

Clients with a ruptured intervertebral disk experience acute back and leg pain. Acute pain may be related to preoperative muscle spasms or nerve root compression. After surgery, the client may have pain at the site of the incision and in the surgical area.

- Assess the degree of pain on a 0 to 10 scale (10 being greatest pain) and identify contributing and relieving factors. *Pain is a subjective experience. The nurse needs to assess it thoroughly before initiating interventions.*
- Use a firm mattress or place a board under the mattress. *A firm bed supports the spinal column and muscles.*
- Teach the client to avoid turning or twisting the spinal column and to assume positions that decrease stress on the vertebral column (e.g., when in the supine position, flex the hips slightly). A small pillow may be placed under the knees (for clients with a herniated lumbar disk) or under the neck (for clients with a herniated cervical disk). *Correct body positions can decrease intradisk pressure.*
- Provide analgesic medications around the clock. *Intense pain can increase muscle spasms; maintaining serum levels of analgesics often prevents severe pain.*

PRACTICE ALERT

It is important to maintain a constant level of pain relief. Healthcare providers have the responsibility of relieving pain with adequate medications.

Chronic Pain

The client with a ruptured intervertebral disk often has pain for an extended period of time. Despite conservative treatment or previous surgery, pain may be ongoing or intermittent. If previous surgery has not relieved the pain, the client may be de-

pressed or angry. Caring for a client with chronic pain is frustrating, and the client is often regarded as difficult.

- Treat the client's reports of pain with respect. *The client is the person experiencing the pain and is thus the expert about it.*
- Do not refer to the client as being addicted to pain medication. *All types of pain medications may be used legitimately to manage pain.*

PRACTICE ALERT

Although the client may develop tolerance to a narcotic analgesic, tolerance does not imply addiction.

- Monitor the client carefully for any changes in condition. *Significant changes in the client's condition may go unrecognized when pain is present for a prolonged period of time.*
- Maintain written plans of care for pain management that are individualized and ensure continuity of care. *When the client makes several visits (for instance, to an emergency department or a pain clinic), written records help caregivers determine what is effective in managing pain and what is not.*
- Teach the client alternative methods of pain management. *Consider the client's coping style when recommending methods. Clients who have a passive coping style are often better able to manage pain by depending on others, taking medications, and resting. Clients with an active coping style are probably better able to manage pain by learning self-management methods, taking part in activities, and staying busy.*
- Develop effective methods of improving rest and sleep. Problems with rest and sleep make pain management more difficult. *Sleeping poorly at night contributes to decreased motivation, confused thinking, depression, and muscle aches.*
- Refer the client to a physical therapist for an exercise program, if appropriate. *The client needs to know exactly what exercises to do, how many repetitions are recommended, for how long, and how often. The client should not exercise to the point of causing increased pain.*
- Assess the need for referrals (and make them if necessary) for the client who is depressed or anxious. *Anxiety and de-*

pression often are a part of long-term chronic pain, making pain management more difficult. Suggest that referrals for help with the frustration (rather than "depression") may make a significant difference in the client's ability to manage pain.

Constipation

The client with a ruptured intervertebral disk often has problems with constipation because of reduced mobility. Nursing interventions to alleviate and prevent constipation are important because straining to have a bowel movement can increase intradisk pressure, thus increasing pain.

- Assess the client's usual bowel routine, including diet, fluid intake, and the use of laxatives or enemas. *Effective interventions are based on individualized needs.*

PRACTICE ALERT

People who use laxatives or enemas for long periods of time may be dependent on those methods of having a bowel movement.

- Encourage a fluid intake of 2500 to 3000 mL per day unless contraindicated by the presence of renal or cardiac disease. *Adequate fluid intake facilitates the passage of feces.*
- Increase fiber and bulk in the diet. If the client is unable to tolerate increased fiber, consult with the physician about the use of stool softeners or bulk-forming agents. *Bulk and fiber promote regularity by retaining water in the large intestine.*

Community-Based Care

It is the nurse's responsibility to teach the client and family about chronic pain control, including specific interventions to alleviate pain. The nurse's role may be that of advocate and creative problem solver (see the Meeting Individualized Needs box below). The following topics should be addressed:

- Often the goal is to control pain so that the client can perform normal ADLs, rather than to reach a pain-free state.

MEETING INDIVIDUALIZED NEEDS Teaching the Client with a Ruptured Intervertebral Disk

- Sleep on a firm mattress; use a bedboard if necessary.
- When lying in the supine position, flex the knees to approximately a 45-degree angle with a small pillow and use a small pillow under the head.
- Avoid any activities that flex the spine, such as bending or lifting, and do not twist the back.
- Follow your diet to maintain body weight or to lose weight if needed.
- Follow the prescribed exercise program, for example:
 - a. Lie flat on your back on the floor. Tighten your abdominal and buttock muscles and tilt your pelvis forward so that your lower back is flat on the floor (this is called a *pelvic tilt*). Hold the position for 3 seconds and repeat for the prescribed number of times.
 - b. Lying on the back on a firm surface, press the feet to the floor, tighten the abdominal muscles, and lift the upper half of the body off the floor. Hold the position for 3 seconds, and repeat as prescribed.
 - c. Lying on your back on a firm surface, bring your knees up to the chest. Put your hands around your knees and raise the buttocks off the floor. Repeat as prescribed.
 - d. Sit upright on the floor or a firm surface. Keep one leg straight and bend the other knee. Reach for the toes of the straightened leg. Switch legs. Repeat as prescribed.
 - e. Stand upright. Squat down, flexing the hips and knees. Straighten your back. Stand upright by straightening the knees. Repeat as prescribed.
- Wear flat-heeled shoes that provide good support.
- Use proper lifting techniques. For instance, squat and use your thigh muscles to lift an object from the floor, and spread your feet to get a wide base of support when you lift while you are standing.

- Nonpharmacologic methods of pain management include relaxation techniques, guided imagery, distraction, hypnosis, and music. Joining a support group may be an effective intervention in coping with and managing pain.
- Clients may be referred to a physical therapist for education about body mechanics and back-strengthening exercises. Nurses should have the client demonstrate the exercises to reinforce teaching.

THE CLIENT WITH A SPINAL CORD TUMOR

Spinal cord tumors may be benign or malignant, primary or metastatic. They may arise at any level of the spinal column. Of all spinal cord tumors, 50% are thoracic, 30% are cervical, and 20% are lumbosacral. They constitute about 0.5% to 1% of all tumors (Hickey, 2003). Tumors of the spinal cord are seen equally in men and in women, and they most often occur between the ages of 20 and 60. They are rarely seen in the older adult.

Classification

Spinal cord tumors are classified by anatomic location as either intramedullary or extramedullary tumors. Intramedullary tumors, which make up about 10% of spinal tumors, arise from within the neural tissues of the spinal cord; those that occur include astrocytomas, ependymomas, glioblastomas, and medulloblastomas (Tierney et al., 2005). Extramedullary tumors arise from tissues outside the spinal cord, with commonly occurring tumors including neurofibromas, meningiomas, sarcomas, chordomas, and vascular tumors.

Extramedullary tumors are further categorized as intradural (arising from the nerve roots or meninges within the subarachnoid space) or extradural (arising from epidural tissue or the vertebrae outside the dura).

Tumors of the spinal cord are also classified as either primary or secondary (metastatic). Primary tumors, arising from the epidural vessels, spinal meninges, or glial cells, have an unknown cause. Secondary tumors are metastatic in origin, most commonly the result of malignancies of the lung, breast, prostate, gastrointestinal tract, or uterus.

Pathophysiology

Depending on their anatomic location, spinal cord tumors result in pathologic changes as a result of compression, invasion, or ischemia secondary to arterial or venous obstruction. Extramedullary tumors (whether benign or malignant) alter normal function through compression of the spinal cord, with destruction of white matter and eventual filling of the space around the spinal cord. Cord compression interferes with normal blood flow and membrane potentials, altering afferent and efferent motor, sensory, and reflex impulses. Compression of the spinal cord also causes edema, which can ascend the cord and cause further neurologic deficits. Intramedullary tumors both compress and invade. As the tumor grows within the cord, the cord also enlarges and distorts the white matter.

Manifestations

The manifestations of a spinal cord tumor depend on the anatomic location, level of occurrence, type of tumor, and spinal nerves involved. General manifestations of a spinal cord tumor include pain, motor and sensory deficits, changes in bowel and/or bladder elimination, and changes in sexual function. Specific manifestations by anatomic level are outlined in the box below.

Pain is often the first manifestation of a spinal cord tumor. It is caused by compression of the spinal cord, tension on the spinal nerves, or tumor attachment to the proximal dura (the covering of the spinal cord). The pain may be either localized or radicular. Localized pain is felt when pressure is applied over the spinous process of the involved area; this type of pain often accompanies metastatic tumors involving the vertebrae. Radicular pain is felt along the course of a nerve as a result of compression, irritation, or tension of a nerve root. The pain is often made worse by any activity that causes intraspinal pressure, such as sneezing or coughing.

Motor manifestations resulting from a spinal cord tumor include paresis and paralysis below the level of the tumor, spasticity, and hyperactive reflexes. The Babinski reflex may be positive. These deficits are the result of involvement of the corticospinal tracts.

Many different sensory manifestations may occur, depending on the location and level of the tumor. Lateral tumor growth and compression affect the lateral spinothalamic tracts, causing pain, numbness, tingling, and coldness. If the tumor involves



MANIFESTATIONS of Spinal Cord Tumors

CERVICAL CORD TUMORS

- Ipsilateral arm motor involvement, followed by ipsilateral and contralateral leg involvement, followed by contralateral arm involvement
- Paresis of the arms and legs
- Stiffness of the neck
- Paraplegia
- Pain in the shoulders and arms
- Hyperactive reflexes

THORACIC CORD TUMORS

- Paresis and spasticity of one leg, followed by paresis and spasticity of the other leg
- Pain in the back and chest
- Positive Babinski reflex
- Bowel and bladder dysfunction
- Sexual dysfunction

LUMBOSACRAL CORD TUMORS

- Paresis and spasticity of one leg, followed by paresis and spasticity of the other leg
- Pain in the lower back, radiating to the legs and perineal area
- Loss of sensation in the legs
- Bowel and bladder dysfunction
- Sexual dysfunction
- Decreased or absent ankle and knee reflexes

the posterior columns, the senses of vibration and proprioception of body parts are affected.

Bladder and bowel elimination and sexual function are often affected. Bowel elimination deficits include constipation that may progress to paralytic ileus. Initial bladder elimination deficits include frequency, urgency, and difficulty voiding. The deficits may progress to urinary retention and a neurogenic bladder. In addition, the male client may be impotent.

Syringomyelia is a complication of some spinal cord tumors. In this condition, a fluid-filled cystic cavity forms in the central intramedullary gray matter. This syndrome causes pain, motor weakness, and spasticity.

INTERDISCIPLINARY CARE



The medical management of the client with a spinal cord tumor focuses first on diagnosis. Treatment depends on the type of tumor, its location, and the client's condition.

Diagnosis

The client with a spinal cord tumor undergoes many of the same diagnostic tests as does the client with a ruptured intervertebral disk. The tests used to identify the tumor include x-rays, CT scans, MRI, and myelogram (see Chapter 43 ∞). A lumbar puncture of the client with a spinal cord tumor will demonstrate CSF that is commonly xanthochromic (having a yellow color), has increased protein, has few to no cells, and clots immediately (this cluster of findings is called Froin's syndrome).

Medications

The client with a spinal cord tumor is given medications to relieve pain and control edema. If the pain is severe and the result of a metastatic tumor, an epidural catheter may be inserted for narcotic analgesic administration. Pain management for clients with a spinal cord tumor is provided by narcotic analgesics (see Chapter 9 ∞). Steroids, such as dexamethasone (Decadron), are administered to control edema of the cord.

Surgery

Intramedullary and intradural tumors are surgically excised when possible. Advances in microsurgical techniques and laser surgery have increased the possibility of tumor excision. Metastatic tumors may be partially excised to reduce cord compression; rapidly growing metastatic lesions may require

surgical decompression to preserve motor, bowel, or bladder function.

The surgical excision is made through a laminectomy. The client with a tumor involving more than two vertebrae often has a spinal fusion and may also have rods inserted to stabilize the spinal column.

Radiation Therapy

Radiation therapy is used to treat metastatic spinal cord tumors for several different reasons. It may be used on an emergency basis to treat the client with rapidly progressing neurologic deficits. It may be used to reduce pain. Radiation may also be used following surgical excision of as much tumor mass as possible.

Radiation of the spinal cord may cause the development of radiation-induced myelopathy. This complication of radiation exposure occurs over time, with manifestations of a *Brown-Séquard syndrome* (weakness or paralysis on one side of the body and loss of sensation on the opposite side) developing 12 to 15 months after therapy. The manifestations may progress to paraplegia, sensory loss, and loss of bowel and bladder control (Hickey, 2003).



NURSING CARE

Nursing care for the client with a spinal cord tumor is individualized in accordance with the type of tumor and the type of treatment. The client with a benign tumor that is removed by surgery has different healthcare needs than the client with a metastatic tumor, even though they may have similar neurologic deficits. The client with a spinal cord tumor (regardless of type) requires nursing care to monitor for neurologic changes, to provide pain management, and to manage motor and sensory deficits in order to preserve quality of life.

The assessments and nursing interventions for the client with a spinal cord tumor are similar to those described for the client with SCI or who is undergoing surgery for a ruptured intervertebral disk. Following surgical treatment, the client may be transferred to a rehabilitation center or may go home for the recovery period. Referrals for home care, occupational therapy, and physical therapy often help the client regain functional abilities. Teach family members how to move the client in the bed and from the bed to a chair. Also teach them how to provide physical care, care for any appliances (such as an indwelling catheter), and prevent or treat constipation.

EXPLORE MEDIA LINK

Prentice Hall Nursing MediaLink DVD-ROM



Audio Glossary
NCLEX-RN® Review

COMPANION WEBSITE www.prenhall.com/lemone



Audio Glossary
NCLEX-RN® Review
Care Plan Activity: Hemorrhagic Stroke
Case Study: Spinal Cord Injury
MediaLink Applications
Intracranial Pressure
Spinal Cord Injury
Stroke
Stroke Lifestyle Changes
Links to Resources



CHAPTER HIGHLIGHTS

- A stroke is a condition in which neurologic deficits result from a sudden decrease in blood flow to a localized area of the brain. Strokes may be ischemic or hemorrhagic. Ischemic strokes result from a blockage of a cerebral artery by formation of a blood clot or by a clot or foreign substance (such as fat or bacteria) lodging in a blood vessel; they include transient ischemic attacks, thrombotic strokes, or embolic strokes. Hemorrhagic strokes occur when a cerebral blood vessel ruptures.
- Depending on the size and location of cerebral tissue damage, strokes may cause cognitive and behavior changes, sensory-perceptual deficits, language disorders, and motor deficits. Treatment of an ischemic stroke with fibrinolytic therapy within 3 hours of the onset of manifestations may reverse damage to cerebral neurons.
- Nursing care is directed toward both prevention of a stroke through community-based educational programs and interventions to promote recovery and decrease complications.
- Intracerebral hemorrhage may follow rupture of an intracranial aneurysm or arteriovenous malformation. Intracranial aneurysms occur at the site of a weakness in a cerebral blood vessel, while AV malformations are a tangled collection of dilated arteries and veins.
- Spinal cord injuries are almost always the result of trauma, with the major risk factors being age (young adults), gender (male), and alcohol or drug abuse. The causes of injury to the spinal cord include contusion, laceration, transection, hemorrhage, and damage to spinal cord blood vessels.
- In a complete SCI, the motor and sensory pathways in the spinal cord are completely interrupted (*transected*), resulting in total loss of motor and sensory function below the level of the injury. In an incomplete SCI, the motor and sensory pathways are only partially interrupted, resulting in variable loss of function below the level of injury. Injuries of the spinal cord have the potential to affect movement, perception, sensation, sexual function, and elimination.
- Spinal shock is the temporary loss of all reflexes (areflexia) below the level of injury. Manifestations of spinal shock include bradycardia, hypotension, and flaccid paralysis.
- Autonomic dysreflexia is an exaggerated sympathetic response in clients with an SCI at or above the T6 level. Triggered by noxious stimuli (such as a blocked urinary catheter or a fecal impaction), this condition results in extreme hypertension and, if untreated, may cause seizures, stroke, or a myocardial infarction.
- Rehabilitation of the client with an SCI is an ongoing process from intensive care to home care. Nursing interventions are necessary in all settings to promote independence in self-care.
- A herniated intervertebral disk is a rupture of the cartilage surrounding the intervertebral disk with protrusion of the nucleus pulposus. The major manifestation of lumbar disks is lower back and sciatic pain on the affected side. Cervical disks cause pain in the shoulder, neck, and arm. A variety of medications, treatments, and surgical procedures are available for the client.
- Spinal cord tumors may be benign or malignant, primary or metastatic. Depending on their size and location, they cause pathologic changes in spinal cord function through compression, invasion, or ischemia.

TEST YOURSELF NCLEX-RN® REVIEW

- 1 Which of the following manifestations would alert you to the possibility that your client has had a TIA?
 1. sudden severe pain over the left eye
 2. numbness and tingling in the corner of the mouth
 3. complete paralysis of the right arm and leg
 4. loss of sensation and reflexes in both legs
- 2 Although all of the following are risk factors for a stroke, which one is the greatest risk?
 1. hypertension
 2. heart disease
 3. diabetes
 4. high cholesterol levels

- 3** You have been assigned to care for a client who has had an acute ischemic stroke of a left cerebral vessel. You read the chart and realize the client has contralateral deficits. What does this mean?
- Both sides of the body are involved.
 - The client will have neurologic deficits on the left side of the body.
 - The client will have neurologic deficits on the right side of the body.
 - Deficits will be present below the level of the stroke.
- 4** What is the rationale for administration of a tissue plasminogen activator within the first 3 hours of a thrombotic stroke?
- to reduce the risk of vasospasm
 - to decrease the risk of infection
 - to increase platelet aggregation
 - to cause fibrinolysis of the clot
- 5** Oxygen is often administered to the client who has had a stroke. Preventing hypoxia and hypercapnia through this treatment will lessen the risk of which complication?
- fluid accumulation in the lungs
 - pulmonary emboli
 - increased intracranial pressure
 - rebleeding
- 6** What is the primary pathophysiologic process of spinal shock?
- temporary loss of reflex function below the level of injury
 - loss of control of cardiovascular mechanisms
 - exaggerated sympathetic response
 - damage to the lower motor neurons
- 7** Your client has manifestations of autonomic dysreflexia. Which of these assessments would indicate a possible cause for this condition?
- extreme hypertension
 - kinked catheter tubing
 - respiratory wheezes and stridor
 - skin breakdown over the coccyx
- 8** A client is admitted to the emergency department following an automobile crash. An SCI at the cervical level is identified. What will be done to facilitate respirations?
- No treatments are necessary.
 - Oxygen per nasal cannula will be administered.
 - The client will be placed on a ventilator.
 - The head of the bed will be elevated.
- 9** Many different medications may be given to the client with an acute SCI. Which of the following will possibly be administered? (Select all that apply.)
- corticosteroids
 - vasopressors
 - antibiotics
 - analgesics
 - antihistamines
- 10** You are conducting a class at a factory to teach methods to prevent a ruptured intervertebral disk. What should be included? (Choose all that apply.)
- Spread the feet apart to broaden the base of support.
 - Bend from the waist to lift articles from the floor.
 - Use large leg muscles to push when lifting.
 - Always lift articles rather than rolling or pushing them.
 - Work as closely as possible to the object to be moved.

See *Test Yourself answers in Appendix C.*

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