Management of Patients With Neurologic Trauma

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Differentiate among patients with head injuries according to mechanism of injury, clinical signs and symptoms, diagnostic testing, and treatment options.
2. Describe the nursing management of head-injured patients.
3. Use the nursing process as a framework for care of patients with brain injury.
4. Identify the population at risk for spinal cord injury.
5. Describe three clinical features of the patient with neurogenic shock.
6. Discuss the pathophysiology of autonomic dysreflexia and describe the appropriate nursing interventions.
7. Use the nursing process as a framework for care of patients with spinal cord injury.
Trauma involving the central nervous system can be life-threatening. Even if not life-threatening, brain and spinal cord injury may result in major physical and psychological dysfunction and can alter the patient’s life completely. Neurologic trauma affects the patient, the family, the health care system, and society as a whole because of its major sequelae and the costs of acute and long-term care of patients with trauma to the brain and spinal cord.

Head Injuries

Head injury is a broad classification that includes injury to the scalp, skull, or brain. It is the most common cause of death from trauma in the United States. Approximately 1 million people receive treatment for head injuries every year. Of these, 230,000 are hospitalized, 80,000 have permanent disabilities, and 50,000 people die (Centers for Disease Control and Prevention [CDC], 2001). Traumatic brain injury is the most serious form of head injury. The most common causes of traumatic brain injury are motor vehicle crashes, violence, and falls. Groups at highest risk for traumatic brain injury are persons age 15 to 24 years and males, who suffer traumatic brain injury at a rate almost twice that of females. The very young (under 5) and the very old (over 75) are also at increased risk. It is estimated that 5.3 million Americans today are living with a disability as a result of a traumatic brain injury (CDC, 2001). The best approach to head injury is prevention (Chart 63-1).

Pathophysiology

Research suggests that not all brain damage occurs at the moment of impact. Damage to the brain from traumatic injury takes two forms: primary injury and secondary injury. Primary injury is the initial damage to the brain that results from the traumatic event. This may include contusions, lacerations, and torn blood vessels from impact, acceleration/deceleration, or foreign object penetration (Blank-Reid & Reid, 2000; Porth, 2002). Secondary injury evolves over the ensuing hours and days after the initial injury and is due primarily to brain swelling or ongoing bleeding.

An injured brain is different from other injured body areas due to its unique characteristics. It resides within the skull, which is a rigid closed compartment (Bader & Palmer, 2000). Unlike an injured ankle, in which the covering skin expands with swelling, the confines of the skull do not allow for the expansion of cranial contents. Thus, any bleeding or swelling within the skull increases the volume of contents within a container of fixed size and so can cause increased intracranial pressure (ICP) (see Chap. 61). If the increased pressure is high enough, it can cause a downward or lateral displacement of the brain through or against the rigid structures of the skull. This causes restriction of blood flow to the brain, decreasing oxygen delivery and waste removal. Cells within the brain become anoxic and cannot metabolize properly, producing ischemia, infarction, irreversible brain damage, and eventually brain death (Fig. 63-1).

SCALP INJURY

Isolated scalp trauma is generally classified as a minor head injury. Because its many blood vessels constrict poorly, the scalp bleeds to its unique characteristics. It resides within the skull, which is a

Glossary

- autonomic dysreflexia: a life-threatening emergency in spinal cord injury patients that causes a hypertensive emergency; also called autonomic hyperreflexia
- brain injury: an injury to the skull or brain that is severe enough to interfere with normal functioning
- brain injury, closed (blunt): occurs when the head accelerates and then rapidly decelerates or collides with another object and brain tissue is damaged, but there is no opening through the skull and dura
- brain injury, open: occurs when an object penetrates the skull, enters the brain, and damages the soft brain tissue in its path (penetrating injury), or when blunt trauma to the head is so severe that it opens the scalp, skull, and dura to expose the brain
- concussion: a temporary loss of neurologic function with no apparent structural damage to the brain
- contusion: bruising of the brain surface
- complete spinal cord lesion: a condition that involves total loss of sensation and voluntary muscle control below the lesion
- halo vest: a lightweight vest with an attached halo that stabilizes the cervical spine
- incomplete spinal cord lesion: a condition where there is preservation of the sensory or motor fibers, or both, below the lesion
- neurogenic bladder: bladder dysfunction that results from a disorder or dysfunction of the nervous system; may result in either urinary retention or bladder overactivity
- paraplegia: paralysis of the lower extremities with dysfunction of the bowel and bladder from a lesion in the thoracic, lumbar, or sacral regions of the spinal cord
- quadriplegia (tetraplegia): paralysis of both arms and legs, with dysfunction of bowel and bladder from a lesion of the cervical segments of the spinal cord
- secondary injury: an insult to the brain subsequent to the original traumatic event
- spinal cord injury (SCI): an injury to the spinal cord, vertebral column, supporting soft tissue, or intervertebral disks caused by trauma
- transection: severing of the spinal cord itself; transection can be complete (all the way through the cord) or incomplete (partially through)
profusely when injured. Trauma may result in an abrasion (brush wound), contusion, laceration, or hematoma beneath the layers of tissue of the scalp (subgaleal hematoma). Large avulsions of the scalp may be potentially life-threatening and are true emergencies. Diagnosis of any scalp injury is based on physical examination, inspection, and palpation. Scalp wounds are potential portals of entry of organisms that cause intracranial infections. Therefore, the area is irrigated before the laceration is sutured to remove foreign material and to reduce the risk for infection. Subgaleal hematomas (hematomas below the outer covering of the skull) usually absorb on their own and do not require any specific treatment.

**SKULL FRACTURES**

A skull fracture is a break in the continuity of the skull caused by forceful trauma. It may occur with or without damage to the brain. Skull fractures are classified as linear, comminuted, depressed, or basilar. A fracture may be open, indicating a scalp laceration or tear in the dura (e.g., from a bullet or an ice pick), or closed, in which the dura is intact (Fig. 63-2).

**Clinical Manifestations**

The symptoms, apart from those of the local injury, depend on the severity and the distribution of brain injury. Persistent, localized pain usually suggests that a fracture is present. Fractures of the cranial vault may or may not produce swelling in the region of the fracture; therefore, an x-ray is needed for diagnosis.

Fractures of the base of the skull tend to traverse the paranasal sinus of the frontal bone or the middle ear located in the temporal bone (see Fig. 63-2). Thus, they frequently produce hemorrhage from the nose, pharynx, or ears, and blood may appear under the conjunctiva. An area of ecchymosis (bruising) may be seen over the mastoid (Battle’s sign). Basal skull fractures are suspected when cerebrospinal fluid escapes from the ears (CSF otorrhea) and the nose (CSF rhinorrhea). A halo sign (a blood stain surrounded by a yellowish stain) may be seen on bed linens or the head dressing and is highly suggestive of a CSF leak. Drainage of CSF is a serious problem because meningeal infection can occur if organisms gain access to the cranial contents through the nose, ear, or sinus through a tear in the dura. Bloody CSF suggests a brain laceration or contusion.

**Assessment and Diagnostic Findings**

Although a rapid physical examination and evaluation of neurologic status detect the more obvious brain injuries, a computed tomography (CT) scan can detect less apparent abnormalities by the degree to which the soft tissue absorbs the x-rays. It is a fast, accurate, and safe diagnostic study that shows the presence, nature, location, and extent of acute lesions. It is also helpful in the ongoing management of patients with head injury as it can disclose cerebral edema, contusion, intracerebral or extracerebral hematoma, subarachnoid and intraventricular hemorrhage, and late changes (infarction, hydrocephalus). Magnetic resonance imaging (MRI) is used to evaluate patients with head injury when a more accurate picture of the anatomic nature of the injury is warranted and when the patient is stable enough to undergo this longer diagnostic study.
Cerebral angiography may also be used; it identifies supratentorial, extracerebral, and intracerebral hematomas and cerebral contusions. Lateral and anteroposterior views of the skull are obtained.

**Medical Management**

Nondepressed skull fractures generally do not require surgical treatment; however, close observation of the patient is essential. Nursing personnel may observe the patient in the hospital, but if no underlying brain injury is present, the patient may be allowed to return home. If the patient is discharged home, specific instructions (see the section on concussions below) must be given to the family. Many depressed skull fractures are managed conservatively; only contaminated or deforming fractures require surgery.

If surgery is necessary, the scalp is shaved and cleansed with copious amounts of saline to remove debris. The fracture is then exposed. After the skull fragments are elevated, the area is debrided. Large defects can be repaired immediately with bone or artificial grafts; if significant cerebral edema is present, repair of the defect can be delayed for 3 to 6 months. Penetrating wounds require surgical débridement to remove foreign bodies and devitalized brain tissue and to control hemorrhage (Blank-Reid & Reid, 2000). Antibiotic treatment is instituted immediately, and blood component therapy is administered if indicated.

As stated previously, fractures of the base of the skull are serious because they are usually open (involving the paranasal sinuses or middle or external ear) and result in CSF leakage. The nasopharynx and the external ear should be kept clean. Usually a piece of sterile cotton is placed loosely in the ear, or a sterile cotton pad may be taped loosely under the nose or against the ear to collect the draining fluid. The patient who is conscious is cautioned against sneezing or blowing the nose. The head is elevated 30 degrees to reduce ICP and promote spontaneous closure of the leak (Sullivan, 2000), although some neurosurgeons prefer that the bed be kept flat. Persistent CSF rhinorrhea or otorrhea usually requires surgical intervention.

**Brain Injury**

The most important consideration in any head injury is whether or not the brain is injured. Even seemingly minor injury can cause significant brain damage secondary to obstructed blood flow and decreased tissue perfusion. The brain cannot store oxygen and glucose to any significant degree. Because the cerebral cells need an uninterrupted blood supply to obtain these nutrients, irreversible brain damage and cell death occur when the blood supply is interrupted for even a few minutes. Clinical manifestations of brain injury are listed in Chart 63-2. Closed (blunt) brain injury occurs when the head accelerates and then rapidly decelerates or collides with another object (eg, a wall or dashboard of a car) and brain tissue is damaged, but there is no opening through the skull and dura. Open brain injury occurs when an object penetrates the skull, enters the brain, and damages the soft brain tissue in its path (penetrating injury), or when blunt trauma to the head is so severe that it opens the scalp, skull, and dura to expose the brain.

**Concussion**

A cerebral concussion after head injury is a temporary loss of neurologic function with no apparent structural damage. A concussion generally involves a period of unconsciousness lasting from a few seconds to a few minutes. The jarring of the brain may be so slight as to cause only dizziness and spots before the eyes (“seeing stars”), or it may be severe enough to cause complete loss of consciousness for a time. If the brain tissue in the frontal lobe is affected, the patient may exhibit bizarre irrational behavior, whereas involvement of the temporal lobe can produce temporary amnesia or disorientation.

The patient may be hospitalized overnight for observation or discharged from the hospital in a relatively short time after a concussion. Treatment involves observing the patient for headache, dizziness, lethargy, irritability, and anxiety. The occurrence of these symptoms after injury is referred to as postconcussion syndrome. Giving the patient information, explanations, and encouragement may reduce some of the problems of postconcussion syndrome. The patient is advised to resume normal activities slowly, and the family is instructed to observe for the following signs and symptoms and to notify the physician or clinic (or bring the patient to the emergency department) if they occur:

- Difficulty in awakening
- Difficulty in speaking
- Confusion
- Severe headache
- Vomiting
- Weakness of one side of the body

A concussion was once thought of as a minor head injury without significant sequelae. However, studies have demonstrated that there are often disturbing and sometimes residual effects, including headache, lethargy, personality and behavior changes, attention deficits, difficulty with memory, and disruption in work habits (Ponsford et al., 1999).

**Gerontologic Considerations**

Elderly patients must be assessed very carefully. Even given similar mechanisms of injury, an elderly person will often suffer more severe injury than a young person and will often recover more slowly and with more complications (Perdue et al., 1998). The elderly patient with confusion or behavioral disturbances should be assessed for head injury, because unrecognized “minor” head trauma may account for behavioral and confusional episodes in some elderly people (Walshaw, 2000). A misdiagnosed or untreated episode of confusion in an elderly patient may result in

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**Chart 63-2 Clinical Manifestations of Brain Injury**

- Altered level of consciousness
- Confusion
- Pupillary abnormalities (changes in shape, size, and response to light)
- Altered or absent gag reflex
- Absent corneal reflex
- Sudden onset of neurologic deficits
- Changes in vital signs (altered respiratory pattern, hypertension, bradycardia, tachycardia, hypothermia or hyperthermia)
- Vision and hearing impairment
- Sensory dysfunction
- Spasticity
- Headache
- Vertigo
- Movement disorders
- Seizures
long-term disability that might have been avoided if the injury had been detected and treated promptly.

**Contusion**

Cerebral contusion is a more severe injury in which the brain is bruised, with possible surface hemorrhage. The patient is unconscious for more than a few seconds or minutes. Clinical signs and symptoms depend on the size of the contusion and the amount of associated cerebral edema. The patient may lie motionless, with a faint pulse, shallow respirations, and cool, pale skin. Often there is involuntary evacuation of the bowels and the bladder. The patient may be aroused with effort but soon slips back into unconsciousness. The blood pressure and the temperature are subnormal, and the picture is somewhat similar to that of shock.

In general, patients with severe brain injury who have abnormal motor function, abnormal eye movements, and elevated ICP have poor outcomes—that is, brain damage, disability, or death. Conversely, the patient may recover consciousness but pass into a stage of cerebral irritability. In this stage, the patient is conscious and easily disturbed by any form of stimulation such as noises, light, and voices; he or she may become hyperactive at times. Gradually, the pulse, respirations, temperature, and other body functions return to normal, but full recovery can be delayed for months. Residual headache and vertigo are common, and impaired mental function or seizures may occur as a result of irreparable cerebral damage.

**Diffuse Axonal Injury**

Diffuse axonal injury involves widespread damage to axons in the cerebral hemispheres, corpus callosum, and brain stem. It can be seen in mild, moderate, or severe head trauma and results in axonal swelling and disconnection (Porth, 2002). Clinically, with severe injury, the patient has no lucid intervals and experiences immediate coma, decorticate and decerebrate posturing (see Fig. 61-1 in Chap. 61 and discussion in Chap. 60), and global cerebral edema. Diagnosis is made by clinical signs in conjunction with a CT scan or MRI. Recovery depends on the severity of the axonal injury.

**Intracranial Hemorrhage**

Hematomas (collections of blood) that develop within the cranial vault are the most serious brain injuries (Porth, 2002). A hematoma may be epidural (above the dura), subdural (below the dura), or intracerebral (within the brain) (Fig. 63-3). Major symptoms are frequently delayed until the hematoma is large enough to cause distortion of the brain and increased ICP. The signs and symptoms of cerebral ischemia resulting from the compression by a hematoma are variable and depend on the speed with which vital areas are affected and the area that is injured. In general, a rapidly developing hematoma, even if small, may be fatal, whereas a larger but slowly developing collection of blood may allow compensation for increases in ICP.

**Epidural Hematoma (Extradural Hematoma or Hemorrhage)**

After a head injury, blood may collect in the epidural (extradural) space between the skull and the dura. This can result from a skull fracture that causes a rupture or laceration of the middle meningeal artery, the artery that runs between the dura and the skull inferior to a thin portion of temporal bone. Hemorrhage from this artery causes rapid pressure on the brain.

Symptoms are caused by the expanding hematoma. Usually, there is a momentary loss of consciousness at the time of injury, followed by an interval of apparent recovery (lucid interval). Although the lucid interval is considered a classic characteristic of an epidural hematoma, no lucid interval has been reported in many patients with this lesion (Servadei, 1997), and thus it should not be considered a critical defining criterion. During the lucid interval, compensation for the expanding hematoma takes place by rapid absorption of CSF and decreased intravascular volume, both of which help maintain a normal ICP. When these mechanisms can no longer compensate, even a small increase in the volume of the blood clot produces a marked elevation in ICP. Then, often suddenly, signs of compression appear (usually deterioration of consciousness and signs of focal neurologic deficits such as dilation and fixation of a pupil or paralysis of an extremity), and the patient deteriorates rapidly.

An epidural hematoma is considered an extreme emergency; marked neurologic deficit or even respiratory arrest can occur within minutes. Treatment consists of making openings through the skull (burr holes) to decrease ICP emergently, remove the clot, and control the bleeding. A craniotomy may be required to remove the clot and control the bleeding. A drain is usually inserted after creation of burr holes or a craniotomy to prevent reaccumulation of blood.

**Subdural Hematoma**

A subdural hematoma is a collection of blood between the dura and the brain, a space normally occupied by a thin cushion of fluid. The most common cause of subdural hematoma is trauma, but it may also occur from coagulopathies or rupture of an aneurysm. A subdural hemorrhage is more frequently venous in origin and is due to the rupture of small vessels that bridge the subdural space. A subdural hematoma may be acute, subacute, or chronic, depending on the size of the involved vessel and the amount of bleeding present.
Acute and Subacute Subdural Hematoma. Acute subdural hematomas are associated with major head injury involving contusion or laceration. Clinical symptoms develop over 24 to 48 hours. Signs and symptoms include changes in the level of consciousness (LOC), pupillary signs, and hemiparesis. There may be minor or even no symptoms with small collections of blood. Coma, increasing blood pressure, decreasing heart rate, and slowing respiratory rate are all signs of a rapidly expanding mass requiring immediate intervention.

Subacute subdural hematomas are the result of less severe contusions and head trauma. Clinical manifestations usually appear between 48 hours and 2 weeks after the injury. Signs and symptoms are similar to those of an acute subdural hematoma.

If the patient can be transported rapidly to the hospital, an immediate craniotomy is performed to open the dura, allowing the subdural clot to be evacuated. Successful outcome also depends on the control of ICP and careful monitoring of respiratory function (see “The Patient Undergoing Intracranial Surgery” in Chap. 61). The mortality rate for patients with acute and subacute subdural hematomas is high because of associated brain damage.

Chronic Subdural Hematoma. Chronic subdural hematomas can develop from seemingly minor head injuries and are seen most frequently in the elderly. The elderly are prone to this type of head injury secondary to brain atrophy, which is an expected consequence of the aging process. Seemingly minor head trauma may produce enough impact to shift the brain contents abnormally. The time between injury and onset of symptoms may be lengthy (eg, 3 weeks to months), so the actual insult may be forgotten.

A chronic subdural hematoma resembles other conditions and may be mistaken for a stroke. The bleeding is less profuse and there is compression of the intracranial contents. The blood within the brain changes in character in 2 to 4 days, becoming thicker and darker. In a few weeks, the clot breaks down and has the color and consistency of motor oil. Eventually, calcification or ossification of the clot takes place. The brain adapts to this foreign body invasion, and the clinical signs and symptoms fluctuate. There may be severe headache, which tends to come and go; alternating focal neurologic signs; personality changes; mental deterioration; and focal seizures. Unfortunately, the patient may be labeled neurotic or psychotic if the cause of the symptoms is overlooked.

The treatment of a chronic subdural hematoma consists of surgical evacuation of the clot. The procedure may be carried out through multiple burr holes, or a craniotomy may be performed for a sizable subdural mass that cannot be suctioned or drained through burr holes.

INTRACEREBRAL HEMORRHAGE AND HEMATOMA
Intracerebral hemorrhage is bleeding into the substance of the brain. It is commonly seen in head injuries when force is exerted to the head over a small area (missile injuries or bullet wounds; stab injury). These hemorrhages within the brain may also result from systemic hypertension, which causes degeneration and rupture of a vessel; rupture of a saccular aneurysm; vascular anomalies; intracranial tumors; systemic causes, including bleeding disorders such as leukemia, hemophilia, aplastic anemia, and thrombocytopenia; and complications of anticoagulant therapy. Nontraumatic causes of intracerebral hemorrhage are discussed in Chapter 62.

The onset may be insidious, beginning with the development of neurologic deficits followed by headache. Management includes supportive care, control of ICP, and careful administration of fluids, electrolytes, and antihypertensive medications. Surgical intervention by craniotomy or craniectomy permits removal of the blood clot and control of hemorrhage but may not be possible because of the inaccessible location of the bleeding or the lack of a clearly circumscribed area of blood that can be removed.

Management of Brain Injuries
Assessment and diagnosis of the extent of injury are accomplished by the initial physical and neurologic examinations. CT and MRI are the primary neuroimaging diagnostic tools and are useful in evaluating soft tissue injuries. Positron emission tomography (PET scan) is available in some trauma centers; this method of scanning examines brain function rather than structure. A flowchart developed by the Brain Trauma Foundation for the initial management of brain-injured patients is presented in Figure 63-4 (Brain Trauma Foundation, 2000).

Any individual with a head injury is presumed to have a cerebral spine injury until proven otherwise. From the scene of the injury, the patient is transported on a board with the head and neck maintained in alignment with the axis of the body. A cervical collar should be applied and maintained until cervical spine x-rays have been obtained and the absence of cervical spinal cord injury documented.

All therapy is directed toward preserving brain homeostasis and preventing secondary brain injury. “Secondary injury” is a term used to describe injury to the brain subsequent to the original traumatic event (Bader & Palmer, 2000). Common causes of secondary injury are cerebral edema, hypotension, and respiratory depression that may lead to hypoxemia and electrolyte imbalance. Treatments to prevent this include stabilization of cardiovascular and respiratory function to maintain adequate cerebral perfusion, control of hemorrhage and hypovolemia, and maintenance of optimal blood gas values (Wong, 2000).

TREATMENT OF INCREASED INTRACRANIAL PRESSURE
As the damaged brain swells with edema or as blood collects within the brain, a rise in ICP occurs; this requires aggressive treatment. See Chapter 61 for a discussion of the relationship of ICP to cerebral perfusion pressure (CPP). If the ICP remains elevated, it can decrease the CPP. Initial management is based on the principle of preventing secondary injury and maintaining adequate cerebral oxygenation (see Fig. 63-4).

Surgery is required for evacuation of blood clots, debridement and elevation of depressed fractures of the skull, and suture of severe scalp lacerations. ICP is monitored closely; if increased, it is managed by maintaining adequate oxygenation, elevating the head of the bed, and maintaining normal blood volume. Devices to monitor ICP or drain CSF can be inserted during surgery or at the bedside using aseptic technique. The patient is cared for in the intensive care unit, where expert nursing care and medical treatment are readily available.

SUPPORTIVE MEASURES
Treatment also includes ventilatory support, seizure prevention, fluid and electrolyte maintenance, nutritional support, and pain and anxiety management. Comatose patients are intubated and mechanically ventilated to ensure adequate oxygenation and protect the airway.

Because seizures are common after head injury and can cause secondary brain damage from hypoxia, antiseizure agents may be administered. If the patient is very agitated, benzodiazepines may
be prescribed to calm him or her without decreasing LOC. These medications do not affect ICP or CPP, making them good choices for the head-injured patient.

A nasogastric tube may be inserted because reduced gastric motility and reverse peristalsis are associated with head injury, making regurgitation and aspiration common in the first few hours.

BRAIN DEATH
When a patient has sustained a severe head injury incompatible with life, the nurse may assist in the clinical examination for determination of brain death and in the process of organ procurement. Since 1981, all 50 states have recognized the Uniform Determination of Brain Death Act (Lovasik, 2000). This act states that death will be determined with accepted medical standards and that death will indicate irreversible loss of all brain function. The patient has no neurologic activity upon clinical examination; adjunctive tests such as EEG and cerebral blood flow (CBF) studies are often used to confirm brain death (Lovasik, 2000). Many of these patients are potential organ donors, and the nurse may provide information to the family.
and assist them with this decision-making process about organ donation.

**NURSING PROCESS: THE PATIENT WITH A BRAIN INJURY**

**Assessment**

Depending on the patient's neurologic status, the nurse may elicit information from the patient, family, or witnesses or from emergency rescue personnel (Munro, 2000). Although it may not be possible to obtain all usual baseline data initially, the immediate health history should include the following questions:

- When did the injury occur?
- What caused the injury? A high-velocity missile? An object striking the head? A fall?
- What was the direction and force of the blow?

Since a history of unconsciousness or amnesia after a head injury indicates a significant degree of brain damage, and since changes that occur minutes to hours after the initial injury can reflect recovery or indicate the development of secondary brain damage, the nurse should try to determine if there was a loss of consciousness, what the duration of the unconscious period was, and if the patient could be aroused.

In addition to questions that establish the nature of the injury and the patient's condition immediately after the injury, the nurse should examine the patient thoroughly. This assessment should include determining the patient's LOC, ability to respond to verbal commands (if conscious), response to tactile stimuli (if unconscious), pupillary response to light, status of corneal and gag reflexes, motor function, and Glasgow Coma Scale score (Chart 63-4).

Additional detailed neurologic and systems assessments are made initially and at frequent intervals throughout the acute phase of care (Dibsie, 1998). The baseline and ongoing assessments are critical nursing interventions for the brain-injured patient, whose condition can worsen dramatically and irrevocably if subtle signs are overlooked. More information on assessment is provided below and in Figure 63-5 and Table 63-1.

**Diagnosis**

**NURSING DIAGNOSES**

Based on the assessment data, the patient's major nursing diagnoses may include the following:

- Ineffective airway clearance and impaired gas exchange related to brain injury
- Ineffective cerebral tissue perfusion related to increased ICP and decreased CPP
- Deficient fluid volume related to decreased LOC and hormonal dysfunction
- Imbalanced nutrition, less than body requirements, related to metabolic changes, fluid restriction, and inadequate intake
- Risk for injury (self-directed and directed at others) related to seizures, disorientation, restlessness, or brain damage
- Risk for imbalanced (increased) body temperature related to damaged temperature-regulating mechanism
- Potential for impaired skin integrity related to bed rest, hemiparesis, hemiplegia, and immobility
- Disturbed thought processes (deficits in intellectual function, communication, memory, information processing) related to brain injury
- Potential for disturbed sleep pattern related to brain injury and frequent neurologic checks
- Potential for compromised family coping related to unresponsiveness of patient, unpredictability of outcome, prolonged recovery period, and the patient's residual physical and emotional deficit
- Deficient knowledge about recovery and the rehabilitation process

The nursing diagnoses for the unconscious patient and the patient with increased ICP also apply (see Chap. 61).
COLLABORATIVE PROBLEMS/ POTENTIAL COMPLICATIONS
Based on all the assessment data, the major complications include the following:

- Decreased cerebral perfusion
- Cerebral edema and herniation
- Impaired oxygenation and ventilation
- Impaired fluid, electrolyte, and nutritional balance
- Risk of post-traumatic seizures

Planning and Goals
The goals for the patient may include maintenance of a patent airway, adequate CPP, fluid and electrolyte balance, adequate nutritional status, prevention of secondary injury, maintenance of normal body temperature, maintenance of skin integrity, improvement of cognitive function, prevention of sleep deprivation, effective family coping, increased knowledge about the rehabilitation process, and absence of complications.

Nursing Interventions
The nursing interventions for the patient with a head injury are extensive and diverse; they include making nursing assessments, setting priorities for nursing interventions, anticipating needs and complications, and initiating rehabilitation.

MONITORING FOR DECLINING NEUROLOGIC FUNCTION
The importance of ongoing assessment and monitoring of the brain-injured patient cannot be overstated. The following parameters are assessed initially and as frequently as the patient’s condition requires. As soon as the initial assessment is made, the use of a neurologic flow chart is started and maintained.

Level of Consciousness
The LOC is regularly assessed because changes in it precede all other changes in vital and neurologic signs. The Glasgow Coma Scale, which is used to assess LOC, is based on the three criteria of eye opening, verbal responses, and motor responses to verbal commands or painful stimuli. It is particularly useful for monitoring changes during the acute phase, the first few days after a head injury. It does not take the place of an in-depth neurologic assessment; rather, it is used to monitor the patient’s motor, verbal, and eye-opening responses. The patient’s best responses to predetermined stimuli are recorded (see Chart 63-4). Each response is scored (the greater the number the better the functioning), and the sum of these scores gives an indication of the severity of coma and a prediction of possible outcome. The lowest score is 3 (least responsive); the highest is 15 (most responsive). A score of 8 or less is generally accepted as indicating a severe head injury (Teasdale & Jennett, 1974).
### Summary of Multisystem Assessment Measures for the Brain-Injured Patient

**Neurologic System**
- Severe head injury will result in unconsciousness and will alter many neurologic functions.
- All body functions must be supported.
- Increased ICP and herniation syndromes are life-threatening.
- Measures are instituted to control elevated ICP.

**Integumentary System (Skin and Mucous Membranes)**
- Immobility secondary to injury and unconsciousness contributes to the development of pressure areas and skin breakdown.
- Intubation causes irritation of the mucous membrane.

**Musculoskeletal System**
- Immobility contributes to musculoskeletal changes.
- Decerebrate or decorticate posturing makes proper positioning difficult.

**Gastrointestinal System**
- Administration of corticosteroids places the patient at high risk for GI hemorrhage.
- Injury to the GI tract can result in paralytic ileus.
- Constipation can result from bed rest, NPO status, fluid restriction, and opioids given for pain control.
- Bowel incontinence is related to the patient’s unconscious state or altered mental state.

**Genitourinary System**
- Fluid restriction or use of diuretics can alter the amount of urinary output.
- Urinary incontinence is related to the patient’s unconscious state.

**Metabolic (Nutritional) System**
- The patient receives all fluids intravenously for the first few days until the GI tract is functioning.
- A nutritional consultation is initiated within the first 24–48 h; parenteral nutrition may be started.

**Respiratory System**
- Complete or partial airway obstruction will compromise the oxygen supply to the brain.
- An altered respiratory pattern can result in cerebral hypoxia.
- A short period of apnea at the moment of impact can result in spotty atelectasis.
- Systemic disturbances from head injury can cause hypoxemia.
- Brain injury can alter brain stem respiratory function.
- Shunting of blood to the lungs as a result of a sympathetic discharge at the time of injury can cause neurogenic pulmonary edema.

**Cardiovascular System**
- The patient may develop cardiac dysrhythmias, tachycardia, or bradycardia.
- The patient may develop hypotension or hypertension.
- Because of immobility and unconsciousness, the patient is at high risk for deep vein thromboses and pulmonary emboli.
- Fluid and electrolyte imbalance can be related to several problems, including alterations in antidiuretic hormone (ADH) secretion, the stress response, or fluid restriction.
- Specific conditions may occur:
  — Diabetes insipidus (DI)
  — Syndrome of inappropriate secretion of ADH (SIADH)
  — Fluid and electrolyte imbalance
  — Hyperosmolar nonketotic hyperglycemia

**Psychological/Emotional Response**
- The severely head-injured patient is unconscious.
- The family needs emotional support to deal with the crisis.

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**Table 63-1**

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<th>SYSTEM-SPECIFIC CONSIDERATIONS</th>
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<td>• Calculation of cerebral perfusion pressure if ICP monitor is in place</td>
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<tr>
<td><strong>Musculoskeletal System</strong></td>
<td>• Assessment of range of motion of joints and development of deformities or spasticity</td>
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<tr>
<td><strong>Gastrointestinal System</strong></td>
<td>• Assessment of abdomen for bowel sounds and distention</td>
</tr>
<tr>
<td></td>
<td>• Monitoring for decreased hemoglobin</td>
</tr>
<tr>
<td><strong>Genitourinary System</strong></td>
<td>• Intake and output record</td>
</tr>
<tr>
<td><strong>Metabolic (Nutritional) System</strong></td>
<td>• Assessment of fluid and electrolyte balance</td>
</tr>
<tr>
<td></td>
<td>• Recording of weight, if possible</td>
</tr>
<tr>
<td></td>
<td>• Hematocrit</td>
</tr>
<tr>
<td></td>
<td>• Electrolyte studies</td>
</tr>
<tr>
<td><strong>Respiratory System</strong></td>
<td>• Assessment of respiratory function</td>
</tr>
<tr>
<td></td>
<td>— Auscultate chest for breath sounds</td>
</tr>
<tr>
<td></td>
<td>— Note the respiratory pattern if possible (not possible if a ventilator is being used)</td>
</tr>
<tr>
<td></td>
<td>— Note the respiratory rate</td>
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<tr>
<td></td>
<td>— Note whether the cough reflex is intact</td>
</tr>
<tr>
<td></td>
<td>• Arterial blood gas levels</td>
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<td></td>
<td>• Complete blood count</td>
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<td></td>
<td>• Chest x-ray studies</td>
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<td>• Sputum cultures</td>
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<td></td>
<td>• O₂ saturation using pulse oximetry</td>
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<tr>
<td><strong>Cardiovascular System</strong></td>
<td>• Assessment of vital signs</td>
</tr>
<tr>
<td></td>
<td>• Monitoring for cardiac dysrhythmias</td>
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<tr>
<td></td>
<td>• Assessment for deep vein thromboses of legs</td>
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<td></td>
<td>• Electrocardiogram</td>
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<tr>
<td></td>
<td>• Electrolyte studies</td>
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<td></td>
<td>• Blood coagulation studies</td>
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<td>• I125 fibrinogen scan of legs</td>
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<td>• Blood glucose level</td>
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<td></td>
<td>• Blood acetone level</td>
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<tr>
<td></td>
<td>• Blood osmolality</td>
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<tr>
<td></td>
<td>• Urine specific gravity</td>
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<tr>
<td><strong>Psychological/Emotional Response</strong></td>
<td>• Collection of information about the family and the role of the head-injured person within the family</td>
</tr>
<tr>
<td></td>
<td>• Assessment of the family to determine how functional it was before the injury occurred</td>
</tr>
</tbody>
</table>
Vital Signs
Although a change in LOC is the most sensitive neurologic indication of deterioration of the patient’s condition, vital signs are monitored at frequent intervals also to assess the intracranial status. Table 63-1 depicts the general assessment parameters for the patient with a head injury.

Signs of increasing ICP include slowing of the heart rate (bradycardia), increasing systolic blood pressure, and widening pulse pressure. As brain compression increases, respirations become rapid, the blood pressure may decrease, and the pulse slows further. This is an ominous development, as is a rapid fluctuation of vital signs (March, 2000). A rapid rise in body temperature is regarded as unfavorable because hyperthermia increases the metabolic demands of the brain and may indicate brain stem damage, a poor prognostic sign. The temperature is maintained at less than 38°C (100.4°F). Tachycardia and arterial hypotension may indicate that bleeding is occurring elsewhere in the body.

Motor Function
Motor function is assessed frequently by observing spontaneous movements, asking the patient to raise and lower the extremities, and comparing the strength and equality of the hand grasp and pedal push at periodic intervals. To assess the hand grasp, the nurse instructs the patient to squeeze the examiner’s fingers tightly. The nurse assesses lower extremity motor strength (pedal push) by placing the hands on the soles of the patient’s feet and asking the patient to push down against the examiner’s hands. Motor assessment is discussed in Chapter 60 in more detail. The presence or absence of spontaneous movement of each extremity is also noted, and speech and eye signs are assessed.

If the patient does not demonstrate spontaneous movement, responses to painful stimuli are assessed. Motor response to pain is assessed by applying a central stimulus, such as pinching the pectoralis major muscle, to determine the patient’s best response. Peripheral stimulation may provide inaccurate assessment data because it may result in a reflex movement rather than a voluntary motor response. Abnormal responses (lack of motor response; extension responses) are associated with a poorer prognosis.

Other Neurologic Signs
In addition to the patient’s spontaneous eye opening evaluated with the Glasgow Coma Scale, the size and equality of the pupils and their reaction to light are assessed. A unilaterally dilated and poorly responding pupil may indicate a developing hematoma, with subsequent pressure on the third cranial nerve due to shifting of the brain. If both pupils become fixed and dilated, this indicates overwhelming injury and intrinsic damage to the upper brain stem and is a poor prognostic sign.

The patient with a head injury may develop focal nerve palsies such as anosmia (lack of sense of smell) or eye movement abnormalities and focal neurologic deficits such as aphasia, memory deficits, and post-traumatic seizures or epilepsy. Patients may be left with residual organic psychological deficits (impulsiveness, emotional lability, or uninhibited, aggressive behaviors) and, as a consequence of the impairment, lack insight into their emotional responses (Davis, 2000).

MAINTAINING THE AIRWAY
One of the most important nursing goals in the management of the patient with a head injury is to establish and maintain an adequate airway. The brain is extremely sensitive to hypoxia, and a neurologic deficit can worsen if the patient is hypoxic. Therapy is directed toward maintaining optimal oxygenation to preserve cerebral function. An obstructed airway causes CO₂ retention and hypoventilation, which can produce cerebral vessel dilation and increased ICP.

Interventions to ensure an adequate exchange of air are discussed in Chapter 61 and include the following:

- Keep the unconscious patient in a position that facilitates drainage of oral secretions, with the head of the bed elevated about 30 degrees to decrease intracranial venous pressure (Bader & Palmer, 2000).
- Establish effective suctioning procedures (pulmonary secretions produce coughing and straining, which increase ICP).
- Guard against aspiration and respiratory insufficiency.
- Closely monitor arterial blood gas values to assess the adequacy of ventilation. The goal is to keep blood gas values within the normal range to ensure adequate cerebral blood flow.
- Monitor the patient who is receiving mechanical ventilation.
- Monitor for pulmonary complications such as acute respiratory distress syndrome (ARDS) and pneumonia (Munro, 2000).

MONITORING FLUID AND ELECTROLYTE BALANCE
Brain damage can produce metabolic and hormonal dysfunctions. The monitoring of serum electrolyte levels is important, especially in patients receiving osmotic diuretics, those with inappropriate antidiuretic hormone secretion, and those with post-traumatic diabetes insipidus.

Serial studies of blood and urine electrolytes and osmolality are carried out because head injuries may be accompanied by disorders of sodium regulation. Hyponatremia is common following head injury due to shifts in extracellular fluid, electrolytes, and volume. Hyperglycemia, for example, may cause an increase in extracellular fluid that lowers sodium (Hickey, 2003). Hypernatremia may also occur due to sodium retention that may last several days, followed by sodium diuresis. Increasing lethargy, confusion, and seizures may be due to electrolyte imbalance.

Endocrine function is evaluated by monitoring serum electrolytes, blood glucose values, and intake and output. Urine is tested regularly for acetone. A record of daily weights is maintained, especially if the patient has hypothalamic involvement and is at risk for the development of diabetes insipidus.

PROMOTING ADEQUATE NUTRITION
Head injury results in metabolic changes that increase calorie consumption and nitrogen excretion (Donaldson et al., 2000). There is an increased demand for protein. As soon as possible, nutrition should be provided. Early initiation of nutritional therapy has been shown to improve outcomes in head-injured patients (Bader & Palmer, 2000). Parenteral nutrition via a central line or enteral feedings administered via a nasogastric or nasojugal feeding tube may be used. If there is discharge of CSF from the nose (CSF rhinorrhea), an oral feeding tube should be inserted in place of a nasal tube.

Laboratory values should be monitored closely in patients receiving parenteral nutrition. Elevating the head of the bed and aspirating the enteral tube for evidence of residual feeding before administrating additional feedings can help prevent distention, regurgitation, and aspiration. A continuous-drip infusion or pump...
may be used to regulate the feeding. The principles and technique of enteral feedings are discussed in Chapter 36. Enteral or parenteral feedings are usually continued until the swallowing reflex returns and the patient can meet caloric requirements orally.

PREVENTING INJURY

As the patient emerges from coma, there is often a period of lethargy and stupor followed by a period of agitation. Each phase is variable and depends on the individual, the location of the injury, the depth and duration of coma, and the patient’s age. The patient emerging from a coma may become increasingly agitated toward the end of the day. Restlessness may be due to hypoxia, fever, pain, or a full bladder. It may indicate injury to the brain but may also be a sign that the patient is regaining consciousness. (Some restlessness may be beneficial because the lungs and extremities are exercised.) Agitation may also be due to discomfort from catheters, intravenous lines, restraints, and repeated neurologic checks. Alternatives to restraints must be used whenever possible.

Strategies to prevent injury include the following:

- Assess the patient to ensure that oxygenation is adequate and the bladder is not distended. Check dressings and casts for constriction.
- To protect the patient from self-injury and dislodging of tubes, use padded side rails or wrap the patient’s hands in mitts (Fig. 63-6). Restraints are avoided because straining against them can increase ICP or cause other injury. Enclosed or floor-level specialty beds may be indicated.
- Avoid using opioids as a means of controlling restlessness because these medications depress respiration, constrict the pupils, and alter responsiveness.
- Minimize environmental stimuli by keeping the room quiet, limiting visitors, speaking calmly, and providing frequent orientation information (eg, explaining where the patient is and what is being done).
- Provide adequate lighting to prevent visual hallucinations.
- Minimize disruption of the patient’s sleep/wake cycles.
- Lubricate the skin with oil or emollient lotion to prevent irritation due to rubbing against the sheet.

- If incontinence occurs, consider use of an external sheath catheter on a male patient. Because prolonged use of an indwelling catheter inevitably produces infection, the patient may be placed on an intermittent catheterization schedule.

MAINTAINING BODY TEMPERATURE

An increase in body temperature in the head-injured patient can be the result of damage to the hypothalamus, cerebral irritation from hemorrhage, or infection. The nurse monitors the patient’s temperature every 4 hours. If the temperature rises, efforts are undertaken to identify the cause and to control it using acetaminophen and cooling blankets as prescribed (Bader & Palmer, 2000). Cooling blankets should be used with caution so as not to induce shivering, which increases ICP. If infection is suspected, potential sites of infection are cultured and antibiotics are prescribed and administered.

MAINTAINING SKIN INTEGRITY

Patients with traumatic head injury often require assistance in turning and positioning because of immobility or unconsciousness. Prolonged pressure on the tissues will decrease circulation and lead to tissue necrosis. Potential areas of breakdown need to be identified early to avoid the development of pressure ulcers. Specific nursing measures include the following:

- Assess all body surfaces and document skin integrity at least every 8 hours.
- Turn and reposition the patient every 2 hours.
- Provide skin care every 4 hours.
- Assist patient to get out of bed to a chair three times a day if physically able.

IMPROVING COGNITIVE FUNCTIONING

Although many patients with head injury survive because of resuscitative and supportive technology, they frequently have significant cognitive sequelae that may not be detected during the acute phase of injury. Cognitive impairment includes memory deficits, decreased ability to focus and sustain attention to a task (distractibility), reduced ability to process information, and slowness in thinking, perceiving, communicating, reading, and writing. Psychiatric or emotional problems develop in as many as 44% of patients with head injury (van Reekum et al., 2000). Resulting psychosocial, behavioral, emotional, and cognitive impairments are devastating to the family as well as to the patient (Davis, 2000; Perlesz, Kinsella, & Crowe, 1999).

These problems require collaboration among many disciplines (Bader & Palmer, 2000). A neuropsychologist (specialist in evaluating and treating cognitive problems) plans a program and initiates therapy or counseling to help the patient reach maximal potential. Cognitive rehabilitation activities help the patient to devise new problem-solving strategies. The retraining is carried out over an extended period and may include the use of sensory stimulation and reinforcement, behavior modification, reality orientation, computer-training programs, and video games. Assistance from many disciplines is necessary during this phase of recovery. Even if intellectual ability does not improve, social and behavioral abilities may.

The patient recovering from a brain injury may experience fluctuations in the level of cognitive function, with orientation, attention, and memory frequently affected. When pushed to a level greater than the impaired cortical functioning allows, the patient

**FIGURE 63-6** Hands of the patient with a head injury may be placed in a Posey mitt to prevent self-injury. This mitt has finger holes so that circulation can be assessed without removing the mitt. Photo courtesy of Sarah Trainer, RN, Roxborough Memorial Hospital, Philadelphia.
may show symptoms of fatigue, anger, and stress (headache, dizziness). The Rancho Los Amigos Level of Cognitive Function is a scale frequently used to assess cognitive function and evaluate ongoing recovery from head injury. Nursing management and a description of each level are included in Table 63-2.

PREVENTING SLEEP PATTERN DISTURBANCE

Patients who require frequent monitoring of neurologic status may experience sleep deprivation. They are awakened hourly to assess LOC and as a result are deprived of long periods of sleep and rest. In an effort to allow the patient longer times of uninterrupted sleep and rest, the nurse can group nursing care activities so that the patient is disturbed less frequently. Environmental noise is decreased and the room lights are dimmed. Back rubs and other activities to increase comfort can assist in promoting sleep and rest.

SUPPORTING FAMILY COPING

Having a loved one sustain a serious head injury can produce a great deal of prolonged stress in the family. This stress can result from the patient’s physical and emotional deficits, the unpredictable outcome, and altered family relationships. Families report difficulties in coping with changes in the patient’s temperament, behavior, and personality. Such changes are associated with disruption in family cohesion, loss of leisure pursuits, and loss of work capacity, as well as social isolation of the caretaker. The family may experience anger, grief, guilt, and denial in recurring cycles (Perlesz et al., 1999).

To promote effective coping, the nurse can ask the family how the patient is different at this time: What has been lost? What is most difficult about coping with this situation? Helpful interventions include providing family members with accurate and honest information and encouraging them to continue to set well-defined, mutual, short-term goals. Family counseling helps address the family members’ overwhelming feelings of loss and helplessness and gives them guidance for the management of inappropriate behaviors. Support groups help the family members share problems, develop insight, gain information, network, and gain assistance in maintaining realistic expectations and hope.

The National Head Injury Foundation serves as a clearinghouse for information and resources for patients with head injuries and their families, including specific information on coma, rehabilitation, behavioral consequences of head injury, and family issues. This organization can provide names of facilities and professionals who work with patients with head injuries and can assist families in organizing local support groups. See the end of this chapter for more information on resources.

Many patients with severe head injury die of their injuries, and many of those who survive experience long-term problems that prevent them from resuming their previous roles and functions. During the most acute phase of injury, family members need support and facts from the health care team.

Many individuals with severe head injuries that result in brain death are young and otherwise healthy and are therefore considered for organ donation. Family members of patients with such injuries need support during this extremely stressful time and assistance in making decisions to end life support and permit donation of organs. They need to know that the brain-dead patient whose respiratory and cardiovascular systems are maintained through life support is not going to survive and that the severe head injury, not the removal of the patient’s organs or the removal of life support, is the cause of patient’s death. Bereavement counselors and members of the organ procurement team are often very helpful to family members in making decisions about organ donation and in helping them cope with stress.

MONITORING AND MANAGING POTENTIAL COMPLICATIONS

Decreased Cerebral Perfusion

Maintenance of adequate CPP is important to prevent serious complications of head injury due to decreased cerebral perfusion (Bader & Palmer, 2000; March, 2000). Adequate CPP is greater than 70 mm Hg. Any decrease in this pressure can impair cerebral perfusion and cause brain hypoxia and ischemia, leading to permanent damage. Therapy (eg, elevation of the head of the bed and increased intravenous fluids) is directed toward decreasing cerebral edema and increasing venous outflow from the brain. Systemic hypotension, which causes vasoconstriction and a significant decrease in CPP, is treated with increased intravenous fluids.

Cerebral Edema and Herniation

The patient with a head injury is at risk for additional complications such as increased ICP and brain stem herniation. Cerebral edema is the most common cause of increased ICP in the patient with a head injury, with the swelling peaking approximately 48 to 72 hours after injury. Bleeding also may increase the volume of contents within the rigid closed compartment of the skull, causing increased ICP and herniation of the brain stem and resulting in irreversible brain anoxia and brain death. Measures to control ICP are listed in Chart 63-5 (Zafonte et al., 1999) and discussed in Chapter 61.

Impaired Oxygenation and Ventilation

Impaired oxygen and ventilation may necessitate mechanical ventilatory support. The patient must be monitored for a patent airway, altered breathing patterns, and hypoxemia and pneumonia. Interventions may include endotracheal intubation, mechanical ventilation, and positive end-expiratory pressure. These topics are discussed in further detail in Chapters 25 and 61.

Impaired Fluid, Electrolyte, and Nutritional Balance

Fluid, electrolyte, and nutritional imbalances are common in the patient with a head injury. Common imbalances may include hyponatremia, which is often associated with the syndrome of inappropriate secretion of antidiuretic hormone (see Chaps. 14 and 42), hypokalemia, and hyperglycemia (Hickey, 2003). Modifications in fluid intake with tube feedings or intravenous fluids may be necessary to treat these imbalances. Insulin administration may be prescribed to treat hyperglycemia.

Undernutrition is also a common problem in response to the increased metabolic needs associated with severe head injury. If the patient cannot eat, enteral feedings or parenteral nutrition may be initiated within 24 hours of injury to provide adequate calories and nutrients.

Post-traumatic Seizures

Patients with head injury are at an increased risk for post-traumatic seizures. Post-traumatic seizures are classified as immediate (within 24 hours of injury), early (within 1 to 7 days of injury), or late (more than 7 days following injury) (Kado & Patel, 1999). Seizure prophylaxis refers to the practice of administering antiseizure medications to patients following head injury to prevent seizures. It is important to prevent post-traumatic seizures,
### Table 63-2 • Rancho Los Amigos Scale: Levels of Cognitive Function

<table>
<thead>
<tr>
<th>COGNITIVE LEVEL</th>
<th>DESCRIPTION</th>
<th>NURSING MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: No response</td>
<td>Completely unresponsive to all stimuli, including painful stimuli</td>
<td>For levels I–III, the key approach is to provide stimulation. Multiple modalities of sensory input should be used. Examples are listed below, but should be individualized and expanded based on available materials and patient preferences (determined by obtaining information from the family).</td>
</tr>
<tr>
<td>II: Generalized response</td>
<td>Nonpurposeful response; responds to pain, but in a nonpurposeful manner</td>
<td>Olfactory: perfumes, flowers, shaving lotion Visual: family pictures, card, personal items</td>
</tr>
<tr>
<td>III: Localized response</td>
<td>Responses more focused: withholds to pain; turns toward sound; follows moving objects that pass within visual field; pulls on sources of discomfort (eg, tubes, restraints); may follow simple commands but inconsistently and in a delayed manner</td>
<td>Auditory: radio, television, tapes of family voices or favorite recordings, talking to patient (nurse, family members). The nurse should tell patient what is going to be done, discuss the environment, provide encouragement. Tactile: touching of skin, rubbing various textures on skin Movement: range of motion exercises, turning, repositioning, use of water mattress</td>
</tr>
<tr>
<td>IV: Confused, agitated response</td>
<td>Alert, hyperactive state in which patient responds to internal confusion/agitation; behavior nonpurposeful in relation to the environment; aggressive, bizarre behavior common</td>
<td>For level IV, which lasts 2–4 weeks, interventions are directed at decreasing agitation, increasing environmental awareness, and promoting safety. Approach patient in a calm manner, and use a soft voice. Screen patient from environmental stimuli (eg, sounds, sights); provide a quiet, controlled environment. Remove devices that contribute to agitation (eg, tubes), if possible. Functional goals cannot be set, because the patient is unable to cooperate.</td>
</tr>
<tr>
<td>V: Confused, inappropriate response</td>
<td>When agitation occurs, it is the result of external rather than internal stimuli; focused attention is difficult; memory is severely impaired; responses are fragmented and inappropriate to the situation; there is no carryover of learning from one situation to the other.</td>
<td>For levels V and VI, interventions are directed at decreasing confusion, improving cognitive function, and improving independence in performing ADLs. Provide supervision. Use repetition and cues to teach ADLs. Focus the patient’s attention and help to increase his or her concentration.</td>
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<tr>
<td>VI: Confused, appropriate response</td>
<td>Follows simple directions consistently but is inconsistently oriented to time and place; short-term memory worse than long-term memory; can perform some ADLs</td>
<td>Help the patient organize activity. Clarify misinformation and reorient when confused. Provide a consistent, predictable schedule (eg, post daily schedule on large poster board).</td>
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<tr>
<td>VII: Automatic, appropriate response</td>
<td>Appropriately responsive and oriented within the hospital setting; needs little supervision in ADLs; some carryover of learning; patient has superficial insight into disabilities; has decreased judgment and problem-solving abilities; lacks realistic planning for future</td>
<td>For levels VII–X, interventions are directed at increasing the patient’s ability to function with minimal or no supervision in the community. Reduce environmental structure. Help the patient plan for adapting ADLs for self into the home environment. Discuss and adapt home living skills (eg, cleaning, cooking) to patient’s ability. Provide stand-by assistance as needed for ADLs and home living skills.</td>
</tr>
<tr>
<td>VIII: Purposeful, appropriate</td>
<td>Alert, oriented, intact memory; has realistic goals for the future. Able to complete familiar tasks for 1 hour in a distracting environment; overestimates or underestimates abilities, argumentative, easily frustrated, self-centered. Uncharacteristically dependent/independent.</td>
<td>(continued)</td>
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</table>
Currently, there is no conclusive evidence that long-term anti-seizure prophylaxis improves outcomes in patients with head injury. Research evidence supports the use of prophylactic antiseizure agents to prevent immediate and early seizure after head injury, but not for prevention of late seizures (Brain Trauma Foundation, American Association of Neurological Surgeons, Joint Section on Neurotrauma and Critical Care, 2000).

especially in the immediate and early phase of recovery, as seizures may increase ICP and decrease oxygenation. Many antiseizure medications impair cognitive performance, prolonging the duration of rehabilitation. Therefore, it is important to weigh the overall benefit of these medications against their side effects. Currently, there is no conclusive evidence that long-term anti-seizure prophylaxis improves outcomes in patients with head injury. Research evidence supports the use of prophylactic antiseizure agents to prevent immediate and early seizure after head injury, but not for prevention of late seizures (Brain Trauma Foundation, American Association of Neurological Surgeons, Joint Section on Neurotrauma and Critical Care, 2000).

Nursing Implications
Meeting the needs of families is a key part of nursing care of the patients in a neuroscience unit and furthermore an important component of a holistic nursing approach. Nurses need to be acutely aware of the pivotal role they play in helping the family members to cope and maintain hope in a difficult situation. Nurses should encourage supportive relationships with the families, and maintain an open and honest dialogue. Families need accurate, current information on a level they can understand and assimilate. Nurses need to be cognizant that their care is crucial not just for the patient, but for the entire family.

Table 63-2 • Rancho Los Amigos Scale: Levels of Cognitive Function (Continued)

<table>
<thead>
<tr>
<th>COGNITIVE LEVEL</th>
<th>DESCRIPTION</th>
<th>NURSING MANAGEMENT</th>
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<tbody>
<tr>
<td>IX: Purposeful, appropriate</td>
<td>Independently shifts back and forth between tasks and completes them accurately for at least two consecutive hours. Uses assistive memory devices to recall schedule and activities. Aware of and acknowledges impairments and disabilities when they interfere with task completion. Depression may continue. May be easily irritable and have a low frustration tolerance.</td>
<td>• Provide assistance on request for adapting ADLs and home living skills,</td>
</tr>
<tr>
<td>X: Purposeful, appropriate</td>
<td>Able to handle multiple tasks simultaneously in all environments but may require periodic breaks. Independently initiates and carries out familiar and unfamiliar tasks but may require more than usual amount of time and/or compensatory strategies to complete them. Accurately estimates abilities and independently adjusts to task demands. Periodic periods of depression may occur. Irritability and low frustration tolerance when sick, fatigued and/or under stress.</td>
<td>• Monitor for signs and symptoms of depression. • Help the patient plan, anticipate concerns, and solve problems.</td>
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</table>

Used with permission from Los Amigos Research and Education Institute, Inc., Downey, CA, 2002.
Nurses must assess patients carefully for the development of post-traumatic seizures. Risk factors that increase the likelihood of seizures are brain contusion with subdural hematoma, skull fracture, loss of consciousness or amnesia of 1 day or more, and age over 65 years (Annegers & Coan, 2000). The nursing management of seizures is addressed in Chapter 61.

Other complications after traumatic head injury include systemic infections (pneumonia, urinary tract infection [UTI], sepsisemia), neurosurgical infections (wound infection, osteomyelitis, meningitis, ventriculitis, brain abscess), and heterotrophic ossification (painful bone overgrowth in weight-bearing joints).

**PROMOTING HOME AND COMMUNITY-BASED CARE**

**Teaching Patients Self-Care**

Teaching early in the course of head injury often focuses on reinforcing information given to the family about the patient’s condition and prognosis. As the patient’s status and expected outcome change over time, family teaching may focus on interpretation and explanation of changes in the patient’s physical and psychological responses.

If the patient’s physical status allows him or her to be discharged home, the patient and family are instructed about limitations that can be expected and complications that may occur. Monitoring for complications that merit contacting the neurosurgeon is explained to the patient and family verbally and in writing. Depending on the patient’s prognosis and physical and cognitive status, the patient may be included in teaching about self-care management strategies.

Because of the risk for post-traumatic seizures, antiseizure medications may be prescribed for 1 to 2 years after injury. The patient and family require instruction about the side effects of these medications and about the importance of continuing to take them as prescribed.

**Continuing Care**

Rehabilitation of the patient with a head injury begins at the time of injury and extends into the home and community. Depending on the degree of brain damage, the patient may be referred to a rehabilitation setting that specializes in cognitive restructuring of the brain-injured patient. The patient is encouraged to continue the rehabilitation program after discharge because improvement in status may continue 3 or more years after injury. Changes in the head-injured patient and the effects of long-term rehabilitation on the family and their coping abilities need frequent assessment. Teaching and continued support of the patient and family are essential as their needs and the patient’s status change.

Teaching points to address with the family of the head-injured patient who is about to return home are described in Chart 63-6.

Depending on his or her status, the patient is encouraged to return to normal activities gradually. Referral to support groups and the National Head Injury Foundation may be warranted.

During the acute and rehabilitation phase of care, the focus of teaching is on obvious needs, issues, and deficits. The nurse needs to remind patients and family members of the need for continuing health promotion and screening practices following these initial phases. Patients who have not been involved in these practices in the past are educated about their importance and are referred to appropriate health care providers.

**Evaluation**

**EXPECTED PATIENT OUTCOMES**

Expected patient outcomes may include:

1. Attains or maintains effective airway clearance, ventilation, and brain oxygenation
   a. Achieves normal blood gas values and has normal breath sounds on auscultation
   b. Mobilizes and clears secretions

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**Chart 63-5**

**Controlling ICP in Severely Brain-Injured Patients**

- Elevate the head of bed 30 degrees.
- Maintain the patient’s head and neck in neutral alignment (no twisting).
- Initiate measures to prevent the Valsalva maneuver (eg, stool softeners).
- Maintain normal body temperature.
- Administer O₂ to maintain PaO₂ > 90 mm Hg.
- Maintain fluid balance with normal saline solution.
- Avoid noxious stimuli (eg, excessive suctioning, painful procedures).
- Administer sedation to reduce agitation.
- Maintain cerebral perfusion pressure > 70 mm Hg.

**Chart 63-6**

**Home Care Checklist • The Patient With a Head Injury**

At the completion of the home care instruction, the patient or caregiver will be able to:

<table>
<thead>
<tr>
<th>Patient</th>
<th>Caregiver</th>
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- Explain the need for monitoring for changes in neurologic status and for complications
- Identify changes in neurologic status and signs and symptoms of complications that should be reported to the neurosurgeon or nurse
- Demonstrate safe techniques to assist patient with self-care, hygiene, and ambulation
- Demonstrate safe technique for eating, feeding patient, or assisting patient with eating
- Explain rationale for taking medications as prescribed
- Identify need for close monitoring of behavior due to changes in cognitive functioning
- Describe household modifications needed to ensure safe environment for the patient
- Describe strategies for reinforcing positive behaviors
- State importance of continuing follow-up by health care team
2. Achieves satisfactory fluid and electrolyte balance
   a. Demonstrates serum electrolytes within normal range
   b. Has no clinical signs of dehydration or overhydration
3. Attains adequate nutritional status
   a. Has less than 50 mL of aspirate in stomach before each tube feeding
   b. Is free of gastric distention and vomiting
   c. Shows minimal weight loss
4. Avoids injury
   a. Shows lessening agitation and restlessness
   b. Is oriented to time, place, and person
5. Does not have a fever
6. Demonstrates intact skin integrity
   a. Exhibits no redness or breaks in skin integrity
   b. Exhibits no pressure ulcers
7. Shows improvement in cognitive function and improved memory
8. Demonstrates normal sleep/wake cycle
9. Demonstrates absence of complications
   a. Exhibits normal ICP, normal vital signs and body temperature, and increasing orientation to time, place, and person
   b. Demonstrates reduced ICP
10. Patient experiences no post-traumatic seizures
    a. Takes antiseizure medications as prescribed
    b. Identifies side effects/adverse effects of antiseizure medications
11. Demonstrate adaptive coping mechanisms for family members
    a. Join support group
    b. Share feelings with appropriate health care personnel
    c. Make end-of-life decisions, if needed
12. Participate in rehabilitation process as indicated for patient and family members
    a. Take active role in identifying rehabilitation goals and participating in recommended patient care activities
    b. Prepare for discharge of patient

Spinal Cord Injury

Spinal cord injury (SCI) is a major health problem. Nearly 200,000 people in the United States live each day with a disability from SCI, with an estimated 11,000 new injuries occurring each year. SCI occurs almost four times more often in males than females. Young people aged 16 to 30 suffer more than half of the new SCIs each year. African Americans are at a higher risk than Caucasians, with the incidence rising in recent years. The most common cause of SCI is motor vehicle crashes, which account for 35% of the injuries. Violence-related injuries account for nearly as many SCIs (30%), with falls causing 19% and sports-related injuries causing 8% (CDC, 2001). There is a high frequency of associated injuries and medical complications.

The predominant risk factors for SCI include age, gender, and alcohol and drug use. The frequency with which these risk factors are associated with SCI serves to emphasize the importance of primary prevention. The same interventions suggested earlier in this chapter for head injury prevention will serve to decrease the incidence of SCI as well (see Chart 63-1) (CDC, 2001; Elovic & Kirschblum, 1999).

The vertebrae most frequently involved in SCI are the 5th, 6th, and 7th cervical (neck), the 12th thoracic, and the 1st lumbar vertebrae. These vertebrae are the most susceptible because there is a greater range of mobility in the vertebral column in these areas (Dlbsie, 1998).

Pathophysiology

Damage to the spinal cord ranges from transient concussion (from which the patient fully recovers) to contusion, laceration, and compression of the cord substance (either alone or in combination), to complete transection of the cord (which renders the patient paralyzed below the level of the injury).

SCIs can be separated into two categories: primary injuries and secondary injuries (Porth, 2002). Primary injuries are the result of the initial insult or trauma and are usually permanent. Secondary injuries are usually the result of a contusion or tear injury, in which the nerve fibers begin to swell and disintegrate. A secondary chain of events produces ischemia, hypoxia, edema, and hemorrhagic lesions, which in turn result in destruction of myelin and axons (Hickey, 2003). These secondary reactions, believed to be the principal causes of spinal cord degeneration at the level of injury, are now thought to be reversible 4 to 6 hours after injury. Therefore, if the cord has not suffered irreparable damage, some method of early treatment is needed to prevent partial damage from developing into total and permanent damage (see the section on management) (Zafonte et al., 1999).

Clinical Manifestations

Manifestations depend on the type and level of injury (Chart 63-7). The type of injury refers to the extent of injury to the spinal cord itself. Incomplete spinal cord lesions are classified according to the area of spinal cord damage: central, lateral, anterior, or peripheral. The American Spinal Injury Association (ASIA) provides another standard classification of SCI according to the degree of sensory and motor function present after injury (Chart 63-8). “Neurologic level” refers to the lowest level at which sensory and motor functions are normal. Below the neurologic level, there is total sensory and motor paralysis, loss of bladder and bowel control (usually with urinary retention and bladder distention), loss of sweating and vasomotor tone, and marked reduction of blood pressure from loss of peripheral vascular resistance. A complete spinal cord lesion can result in paraplegia (paralysis of the lower body) or quadriplegia (paralysis of all four extremities).

If conscious, the patient usually complains of acute pain in the back or neck, which may radiate along the involved nerve. Absence of pain, however, does not rule out spinal injury, and a careful assessment of the spine should be done in the face of any significant mechanism of injury. Often the patient speaks of fear that the neck or back is broken.

Respiratory dysfunction is related to the level of injury. The muscles contributing to respiration are the abdominals and intercostals (T1 to T11) and the diaphragm. In high cervical cord injury, acute respiratory failure is the leading cause of death.

Assessment and Diagnostic Findings

A detailed neurologic examination is performed. Diagnostic x-rays (lateral cervical spine x-rays) and CT scanning are usually performed initially. An MRI scan may be ordered as a further work-up if a ligamentous injury is suspected, since significant spinal cord damage may exist even in the absence of bony injury. A search is made for other injuries, because spinal trauma often is accompanied by concomitant injuries, commonly to the head.
**Central Cord Syndrome**
- Characteristics: Motor deficits (in the upper extremities compared to the lower extremities; sensory loss varies but is more pronounced in the upper extremities); bowel/bladder dysfunction is variable, or function may be completely preserved.
- Cause: Injury or edema of the central cord, usually of the cervical area.

**Anterior Cord Syndrome**
- Characteristics: Loss of pain, temperature, and motor function is noted below the level of the lesion; light touch, position, and vibration sensation remain intact.
- Cause: The syndrome may be caused by acute disk herniation or hyperflexion injuries associated with fracture-dislocation of vertebra. It also may occur as a result of injury to the anterior spinal artery, which supplies the anterior two thirds of the spinal cord.

**Brown-Sequard Syndrome (Lateral Cord Syndrome)**
- Characteristics: Ipsilateral paralysis or paresis is noted, together with ipsilateral loss of touch, pressure, and vibration and contralateral loss of pain and temperature.
- Cause: The lesion is caused by a transverse hemisection of the cord (half of the cord is transected from north to south), usually as a result of a knife or missile injury, fracture-dislocation of a unilateral articular process, or possibly an acute ruptured disk.

and chest. Continuous electrocardiographic monitoring may be indicated if a cord injury is suspected since bradycardia (slow heart rate) and asystole (cardiac standstill) are common in acute spinal injuries.

**Emergency Management**

The immediate management of the patient at the scene of the injury is critical, because improper handling can cause further damage and loss of neurologic function. Any patient involved in a motor vehicle or diving injury, a contact sports injury, a fall, or any direct trauma to the head and neck must be considered to have SCI until such an injury is ruled out. Initial care must include a rapid assessment, immobilization, extrication, stabilization or control of life-threatening injuries, and transportation to the most appropriate medical facility.

At the scene of the injury, the patient must be immobilized on a spinal (back) board, with head and neck in a neutral position, to prevent an incomplete injury from becoming complete. One member of the team must assume control of the patient’s head to prevent flexion, rotation, or extension; this is done by placing the hands on both sides of the patient’s head at about the ear to limit movement and maintain alignment while a spinal board or cervical immobilizing device is applied. If possible, at least four people should slide the victim carefully onto a board for transfer to the hospital. Any twisting movement may irreversibly damage the spinal cord by causing a bony fragment of the vertebra to cut into, crush, or sever the cord completely.

The patient must be referred to a regional spinal injury or trauma center because of the multidisciplinary personnel and support services required to counteract the destructive changes that occur in the first few hours after injury. During treatment in the emergency and x-ray departments, the patient is kept on the transfer board. The patient must always be maintained in an extended position. No part of the body should be twisted or turned, nor should the patient be allowed to sit up. Once the extent of the injury has been determined, the patient may be placed on a rotating bed (Fig. 63-7) or in a cervical collar (Fig. 63-8). Later, if SCI and bone instability have been ruled out, the patient can be moved to a conventional bed or the collar removed without harm. If a rotating bed is needed but not available, the patient should be placed in a cervical collar and on a firm mattress with a bedboard under it.

**Management of Spinal Cord Injuries (Acute Phase)**

The goals of management are to prevent further SCI and to observe for symptoms of progressive neurologic deficits. The patient is resuscitated as necessary, and oxygenation and cardiovascular stability are maintained. Many changes in the treatment of SCI have occurred during the past 20 years. Treatments such as hypothermia, corticosteroids, and naloxone were investigated and used during the 1980s; of these, high-dose corticosteroids have shown the most promise, but their use remains controversial (Short et al., 2000). Currently, regeneration therapy is being investigated; this involves transplanting fetal tissue into the injured spinal cord in hopes of regenerating the damaged tissue (Vacanti et al., 2001). SCI continues to be a devastating event, and new treatment methods are continually being investigated.

**PHARMACOLOGIC THERAPY**

In some studies, the administration of high-dose corticosteroids, specifically methylprednisolone, has been found to improve motor and sensory outcomes at 6 weeks, 6 months, and 1 year if given within 8 hours of injury (Hickey, 2003). In other studies, little improvement was found (Short et al., 2000). Use of high-dose methylprednisolone, a corticosteroid, is accepted as standard therapy in many countries and remains an established clinical practice in most institutions in the United States (Bracken, 2000; Hickey, 2003).

**RESPIRATORY THERAPY**

Oxygen is administered to maintain a high arterial PO$_2$ because hypoxemia can create or worsen a neurologic deficit of the spinal cord. If endotracheal intubation is necessary, extreme care is taken to avoid flexing or extending the patient’s neck, which can result in an extension of a cervical injury.

In high cervical spine injuries, spinal cord innervation to the phrenic nerve, which stimulates the diaphragm, is lost. Di-
The traction force is exerted along the longitudinal axis of the vertebral bodies, with the patient’s neck in a neutral position. The traction is then gradually increased by adding more weights. As the amount of traction is increased, the spaces between the intervertebral disks widen and the vertebrae may slip back into position. Reduction usually takes place after correct alignment has been restored. Once reduction is achieved, as verified by cervical spine x-rays and neurologic examination, the weights are gradually removed until the amount of weight needed to maintain the alignment is identified. The weights should hang freely so as not to interfere with the traction. Traction is sometimes supplemented with manual manipulation of the neck by a surgeon to help achieve realignment of the vertebral bodies.

A halo device may be used initially with traction or may be applied after removal of the tongs. It consists of a stainless-steel halo ring that is fixed to the skull by four pins. The ring is attached to a removable halo vest, which suspends the weight of the unit circumferentially around the chest. A metal frame connects the ring to the chest. Halo devices provide immobilization of the cervical spine while allowing early ambulation (Fig. 63-10).

Thoracic and lumbar injuries are usually treated with surgical intervention followed by immobilization with a fitted brace. Traction is not indicated either before or after surgery.

Surgical Management

Surgery is indicated in any of the following instances:

- Compression of the cord is evident.
- The injury results in a fragmented or unstable vertebral body.
- The injury involves a wound that penetrates the cord.
- There are bony fragments in the spinal canal.
- The patient’s neurologic status is deteriorating.

Surgery is performed to reduce the spinal fracture or dislocation or to decompress the cord. A laminectomy (excision of the posterior arches and spinous processes of a vertebra) may be indicated in the presence of progressive neurologic deficit, suspected epidural hematoma, bony fragments, or penetrating injuries that require surgical débridement, or to permit direct visualization and exploration of the cord. Vertebral bodies may also be surgically fused to create a stable spinal column.

Management of Complications of Spinal Cord Injury

SPINAL AND NEUROGENIC SHOCK

The spinal shock associated with SCI represents a sudden depression of reflex activity in the spinal cord (areflexia) below the level of injury. The muscles innervated by the part of the spinal cord segment below the level of the lesion are without sensation, paralyzed, and flaccid, and the reflexes are absent. In particular, the reflexes that initiate bladder and bowel function are affected. Bowel distention and paralytic ileus can be caused by depression of the reflexes and are treated with intestinal decompression by insertion of a nasogastric tube (Hickey, 2003).

Neurogenic shock develops due to the loss of autonomic nervous system function below the level of the lesion (Hickey, 2003). The vital organs are affected, causing the blood pressure and heart rate to fall. This loss of sympathetic innervation causes a variety
of other clinical manifestations, including a decrease in cardiac output, venous pooling in the extremities, and peripheral vasodilation. In addition, the patient does not perspire on the paralyzed portions of the body because sympathetic activity is blocked; therefore, close observation is required for early detection of an abrupt onset of fever. (A discussion of neurogenic shock can be found in Chap. 15.)

With injuries to the cervical and upper thoracic spinal cord, innervation to the major accessory muscles of respiration is lost and respiratory problems develop. These include decreased vital capacity, retention of secretions, increased PaCO₂ levels and decreased oxygen levels, respiratory failure, and pulmonary edema.

**DEEP VEIN THROMBOSIS**

Deep vein thrombosis (DVT) is a potential complication of immobility and is common in patients with SCI. Patients who develop DVT are at risk for pulmonary embolism (PE), a life-threatening complication. One estimate from a meta-analysis of recent studies of the incidence of DVT and PE in SCI patients put the rate at 6.3% for PE and 17.4% for DVT (Velmahos et al., 2000). Manifestations of PE include pleuritic chest pain, anxiety, shortness of breath, and abnormal blood gas values (increased PaCO₂ and decreased PaO₂). Thigh and calf measurements are made daily. The patient is evaluated for the presence of DVT if there is a significant increase in the circumference of one extremity. Low-dose anticoagulation therapy usually is initiated to prevent DVT and PE, along with thigh-high elastic compression stockings or pneumatic compression devices. In some cases, permanent indwelling filters (see Chap. 31) may be placed in the vena cava to prevent dislodged clots (emboli) from migrating to the lungs and causing pulmonary emboli (Velmahos et al., 2000).

**OTHER COMPLICATIONS**

In addition to respiratory complications (respiratory failure, pneumonia) and autonomic dysreflexia (characterized by pounding headache, profuse sweating, nasal congestion, piloerection [“goose bumps”], bradycardia, and hypertension), other complications that may occur include pressure ulcers and infection (urinary, respiratory, and local infection at the skeletal traction pin sites) (Sullivan, 1999).
NURSING PROCESS:
THE PATIENT WITH ACUTE SPINAL CORD INJURY

Assessment

The breathing pattern is observed, the strength of the cough is assessed, and the lungs are auscultated, because paralysis of abdominal and respiratory muscles diminishes coughing and makes it difficult to clear bronchial and pharyngeal secretions. Reduced excursion of the chest also results.

The patient is monitored closely for any changes in motor or sensory function and for symptoms of progressive neurologic damage. It may be impossible in the early stages of SCI to determine whether the cord has been severed, because signs and symptoms of cord edema are indistinguishable from those of cord transection. Edema of the spinal cord may occur with any severe cord injury and may further compromise spinal cord function.

Motor and sensory functions are assessed through careful neurologic examination. These findings are recorded most often on a flow sheet so that changes in the baseline neurologic status can be closely monitored accurately. The American Spinal Injury Association (ASIA) classification is commonly used to describe level of function for SCI patients. Chart 63-7 also gives an example of nursing assessment of spinal cord function.

- Motor ability is tested by asking the patient to spread the fingers, squeeze the examiner’s hand, and move the toes or turn the feet.
- Sensation is evaluated by gently pinching the skin or touching it lightly with a small object such as a tongue blade, starting at shoulder level and working down both sides of the extremities. The patient should have both eyes closed so that the examination reveals true findings, not what the patient hopes to feel. The patient is asked where the sensation is felt.
- Any decrease in neurologic function is reported immediately.

The patient is also assessed for spinal shock, a complete loss of autonomic function. The lower abdomen is palpated for signs of urinary retention and overdistention of the bladder. Further assessment is made for signs and symptoms of the examination reveals true findings, not what the patient hopes to feel. The patient is asked where the sensation is felt.

Temperature is monitored because the patient may have periods of hyperthermia as a result of alteration in temperature control due to autonomic disruption.

Diagnosis

NURSING DIAGNOSES

Based on the assessment data, the patient’s major nursing diagnoses may include the following:

- Ineffective breathing patterns related to weakness or paralysis of abdominal and intercostal muscles and inability to clear secretions
- Ineffective airway clearance related to weakness of intercostal muscles
- Impaired physical mobility related to motor and sensory impairment
- Disturbed sensory perception related to motor and sensory impairment
- Risk for impaired skin integrity related to immobility and sensory loss
- Urinary retention related to inability to void spontaneously
- Constipation related to presence of atonic bowel as a result of autonomic disruption
- Acute pain and discomfort related to treatment and prolonged immobility

COLLABORATIVE PROBLEMS/
POTENTIAL COMPLICATIONS

Based on the assessment data, potential complications that may develop include:

- DVT
- Orthostatic hypotension
- Autonomic dysreflexia

Planning and Goals

The goals for the patient may include improved breathing pattern and airway clearance, improved mobility, improved sensory and perceptual awareness, maintenance of skin integrity, relief of urinary retention, improved bowel function, promotion of comfort, and absence of complications.

Nursing Interventions

PROMOTING ADEQUATE BREATHING
AND AIRWAY CLEARANCE

Possible impending respiratory failure is detected by observing the patient, measuring vital capacity, monitoring oxygen saturation through pulse oximetry, and monitoring arterial blood gas values. Early and vigorous attention to clearing bronchial and pharyngeal secretions can prevent retention of secretions and atelectasis. Suctioning may be indicated, but caution must be used during suctioning because this procedure can stimulate the vagus nerve, producing bradycardia, which can result in cardiac arrest.

If the patient cannot cough effectively because of decreased inspiratory volume and inability to generate sufficient expiratory pressure, chest physical therapy and assisted coughing may be indicated. Specific breathing exercises are supervised by the nurse to increase the strength and endurance of the inspiratory muscles, particularly the diaphragm. Assisted coughing promotes clearing of secretions from the upper respiratory tract and is similar to using abdominal thrusts to clear an airway (see Chap. 25). It is important to ensure proper humidification and hydration to prevent secretions from becoming thick and difficult to remove even with coughing. The patient is assessed for signs of respiratory infection (cough, fever, dyspnea). Smoking is discouraged because it increases bronchial and pulmonary secretions and impairs ciliary action.

Ascending edema of the spinal cord in the acute phase may cause respiratory difficulty that requires immediate intervention. Therefore, the patient’s respiratory status must be monitored frequently.

IMPROVING MOBILITY

Proper body alignment is maintained at all times. The patient is repositioned frequently and is assisted out of bed as soon as the spinal column is stabilized. The feet are prone to footdrop; therefore, various types of splints are used to prevent footdrop. When used, the splints are removed and reapplied every 2 hours. Trochanter rolls, applied from the crest of the ilium to the midthigh of both legs, help prevent external rotation of the hip joints.
Patients with lesions above the midthoracic level have loss of sympathetic control of peripheral vasoconstrictor activity, leading to hypotension. These patients may tolerate changes in position poorly and require monitoring of blood pressure when positions are changed. Usually the patient is turned every 2 hours. If not on a rotating bed, the patient should not be turned unless the spine is stable and the physician has indicated that it is safe to do so.

Contractures develop rapidly with immobility and muscle paralysis. A joint that is immobilized too long becomes fixed as a result of contractures of the tendon and joint capsule. Atrophy of the extremities results from disuse. Contractures and other complications may be prevented by range-of-motion exercises that help preserve joint motion and stimulate circulation. Passive range-of-motion exercises should be implemented as soon as possible after injury. Toes, metatarsals, ankles, knees, and hips should be put through a full range of motion at least four, and ideally five, times daily.

For most patients with a cervical fracture without neurologic deficit, reduction in traction followed by rigid immobilization for about 6 to 8 weeks restores skeletal integrity. These patients are allowed to move gradually to an erect position. A four-poster neck brace or molded collar is applied when the patient is mobilized after traction is removed (see Fig. 63-8).

**PROMOTING ADAPTATION TO SENSORY AND PERCEPTUAL ALTERATIONS**

The nurse assists the patient to compensate for sensory and perceptual alterations that occur with SCI. The intact senses above the level of the injury are stimulated through touch, aromas, flavorful food and beverages, conversation, and music. Additional strategies include the following:

- Providing prism glasses to enable the patient to see from the supine position
- Encouraging use of hearing aids, if indicated, to enable the patient to hear conversations and environmental sounds
- Providing emotional support to the patient
- Teaching the patient strategies to compensate for or cope with these deficits

**MAINTAINING SKIN INTEGRITY**

Because the patient with SCI is immobilized and has loss of sensation below the level of the lesion, there is an ever-present, life-threatening risk of pressure ulcers. In areas of local tissue ischemia, where there is continuous pressure and where the peripheral circulation is inadequate as a result of the spinal shock and recumbent position, pressure ulcers have developed within 6 hours. Prolonged immobilization of the patient on a transfer board increases the risk of pressure ulcers. The most common sites are over the ischial tuberosity, the greater trochanter, and the sacrum. In addition, patients who wear cervical collars for prolonged periods may develop breakdown from the pressure of the collar under the chin, on the shoulders, and at the occiput.

The patient’s position is changed at least every 2 hours. Turning not only assists in the prevention of pressure ulcers but also prevents the pooling of blood and tissue fluid in the dependent areas. Careful inspection of the skin is made each time the patient comes detached, the head is stabilized in a neutral position by one

The patient’s skin should be kept clean by washing with a mild soap, rinsed well, and blotted dry. Pressure-sensitive areas should be kept well lubricated and soft with bland cream or lotion. The patient is informed about the danger of pressure ulcers to encourage understanding of the reason for preventive measures. See Chapter 11 for other aspects of the prevention of pressure ulcers.

**NURSING ALERT** Never massage the calves or thighs due to the danger of dislodging an undetected DVT.

**MAINTAINING URINARY ELIMINATION**

Immediately after SCI, the urinary bladder becomes atonic and cannot contract by reflex activity. Urinary retention is the immediate result. Because the patient has no sensation of bladder distention, overstrecthing of the bladder and detrusor muscle may occur, delaying the return of bladder function.

Intermittent catheterization is carried out to avoid overdistention of the bladder and UTI. If this is not feasible, an indwelling catheter is inserted temporarily. At an early stage, family members are shown how to carry out intermittent catheterization and are encouraged to participate in this facet of care, because they will be involved in long-term follow-up and must be able to recognize complications so that treatment can be instituted.

The patient is taught to record fluid intake, voiding pattern, amounts of residual urine after catheterization, characteristics of urine, and any unusual sensations that may occur. The management of a neurogenic bladder is discussed in detail in Chapter 11.

**IMPROVING BOWEL FUNCTION**

Immediately after SCI, a paralytic ileus usually develops due to neurogenic paralysis of the bowel; therefore, a nasogastric tube is often required to relieve distention and prevent aspiration.

Bowel activity usually returns within the first week. As soon as bowel sounds are heard on auscultation, the patient is given a high-calorie, high-protein, high-fiber diet, with the amount of food gradually increased. The nurse administers prescribed stool softeners to counteract the effects of immobility and pain medications. A bowel program is instituted as early as possible.

**PROVIDING COMFORT MEASURES**

After cervical injury, if pins, tongs, or calipers are in place, the skull is assessed for signs of infection, including drainage. The back of the head is checked periodically for signs of pressure, with care taken not to move the neck. The hair around the tongs usually is shaved to facilitate inspection. Probing under encrusted areas is avoided.

The Patient in Halo Traction

Patients who have been placed in a halo device after cervical stabilization may have a slight headache or discomfort around the skull pins for several days after the pins are inserted. The patient initially may be bothered by the rather startling appearance of this apparatus but usually readily adapts to it because the device provides comfort for the unstable neck. The patient may complain of being caged in and of noise created by any object coming in contact with the steel frame, but he or she can be reassured that adaptation to such annoyances will occur.

The areas around the pin sites are cleansed daily and observed for redness, drainage, and pain. The pins are observed for loosening, which may contribute to infection. If one of the pins becomes detached, the head is stabilized in a neutral position by one
The skin under the halo vest is inspected for excessive perspiration, redness, and skin blistering, especially on the bony prominences. The vest is opened at the sides to allow the torso to be washed. The liner of the vest should not become wet, because dampness causes skin excoriation. Powder is not used inside the vest, because it may contribute to the development of pressure ulcers. The liner should be changed periodically to promote hygiene and good skin care. If the patient is to be discharged with the vest, detailed instructions must be given to the family and time allowed for them to return demonstrate the necessary skills (Chart 63-9).

**MONITORING AND MANAGING POTENTIAL COMPLICATIONS**

**Thrombophlebitis**

Thrombophlebitis is a relatively common complication in patients after SCI. DVT occurs in a high percentage of SCI patients; thus, they are at risk for PE. The patient must be assessed for symptoms of thrombophlebitis and PE: chest pain, shortness of breath, and changes in arterial blood gas values must be reported promptly to the physician. The circumstances of the thighs and calves are measured and recorded daily; further diagnostic studies will be performed if a significant increase is noted. Patients remain at high risk for thrombophlebitis for several months after the initial injury. Patients with paraplegia or quadriplegia are at increased risk for the rest of their lives. Immobilization and the associated venous stasis, as well as varying degrees of autonomic disruption, contribute to the high risk and susceptibility for DVT (Zafonte et al., 1999).

Anticoagulation is initiated once head and other systemic injuries have been ruled out. Low-dose fractionated or unfractionated heparin may be followed by long-term oral anticoagulation (ie, warfarin) or subcutaneous fractionated heparin injections. Additional measures such as range-of-motion exercises, thigh-high elastic compression stockings, and adequate hydration are important preventive measures. Pneumatic compression devices may also be used to reduce venous pooling and promote venous return. It is also important to avoid external pressure on the lower extremities that may result from flexion of the knees while the patient is in bed.

**Orthostatic Hypotension**

For the first 2 weeks after SCI, the blood pressure tends to be unstable and quite low. There is a gradual return to preinjury levels, but periodic episodes of severe orthostatic hypotension frequently interfere with efforts to mobilize the patient. Interruption in the reflex arcs that normally produce vasoconstriction in the upright position, coupled with vasodilation and pooling in abdominal and lower extremity vessels, can result in blood pressure readings of 40 mm Hg systolic and 0 mm Hg diastolic. Orthostatic hypotension is a particularly common problem for patients with lesions above T7. In some quadriplegic patients, even slight elevations of the head can result in dramatic changes in blood pressure.

A number of techniques can be used to reduce the frequency of hypotensive episodes. Close monitoring of vital signs before and during position changes is essential. Vasopressor medication can be used to treat the profound vasodilation. Thigh-high elastic compression stockings should be applied to improve venous return from the lower extremities. Abdominal binders may also be used to encourage venous return and provide diaphragmatic support when upright. Activity should be planned in advance and adequate time given for a slow progression of position changes from recumbent to sitting and upright. Tilt tables frequently are helpful in assisting patients to make this transition.

**Autonomic Dysreflexia**

**Autonomic dysreflexia** (autonomic hyperreflexia) is an acute emergency that occurs as a result of exaggerated autonomic responses to stimuli that are harmless in normal people. It occurs only after spinal shock has resolved. This syndrome is characterized by a severe, pounding headache with paroxysmal hypertension, profuse diaphoresis (most often of the forehead), nausea, nasal congestion, and bradycardia. It occurs among patients with cord lesions above T6 (the sympathetic visceral outflow level) after spinal shock has subsided. The sudden rise in blood pressure may cause a rupture of one or more cerebral blood vessels or lead to increased ICP. A number of stimuli may trigger this reflex: distended bladder (the most common cause); distention or contraction of the visceral organs, especially the bowel (from constipation, impaction); or stimulation of the skin (tactile, pain, thermal stimuli, pressure ulcer). Because this is an emergency situation, the objective is to remove the triggering stimulus and to avoid the possibly serious complications.

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**Chart 63-9**

**Home Care Checklist • The Patient With a Halo Vest**

At the completion of the home care instruction, the patient or caregiver will be able to:

- Describe the rationale for use of the halo vest
- Demonstrate assessment of frame, traction, tongs, and pins
- Describe emergency measures if respiratory or other complications develop while patient is in halo vest or if frame becomes dislodged
- Demonstrate pin care using correct technique
- Identify signs and symptoms of infection
- Assess the skin for reddened or irritated areas and breakdown
- Demonstrate care of skin
- Explain the reasons for and the method for changing the vest liner
- Demonstrate safe techniques to assist patient with self-care, hygiene, and ambulation
- Identify signs and symptoms of complications (deep venous thrombosis, respiratory impairment, urinary tract infection)

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The nurse becomes a support to both the patient and the family, assisting them to assume responsibility for increasing aspects of patient care and management. Care for the SCI patient involves members of all the health care disciplines; these may include nursing, medicine, rehabilitation, respiratory therapy, physical and occupational therapy, case management, social services, and so forth. The nurse often serves as coordinator of the management team and as a liaison with rehabilitation centers and home care agencies. The patient and family often require assistance in dealing with the psychological impact of the injury and its consequences; referral to a psychiatric clinical nurse specialist or other mental health care professional often is helpful.

The nurse should reassure female SCI patients that pregnancy is not contraindicated, but pregnant women with acute or chronic SCI pose unique management challenges. The normal physiologic changes of pregnancy may predispose women with SCI to many potentially life-threatening complications, including autonomic dysreflexia, pyelonephritis, respiratory insufficiency, thrombophlebitis, PE, and unattended delivery (Atterbury & Groome, 1998).

As more patients survive acute SCI, they will face the changes associated with aging with a disability. Thus, teaching in the home and community focuses on health promotion and addresses the need to minimize risk factors (eg, smoking, alcohol and drug abuse, obesity). Home care nurses and others who have contact with patients with SCI are in a position to teach patients about healthy lifestyles, remind them of the need for health screenings, and make referrals as appropriate. Assisting patients to identify accessible health care providers and imaging centers may increase the likelihood that they will participate in health screening (eg, gynecologic examinations, mammograms, etc.).

### Evaluation

#### EXPECTED PATIENT OUTCOMES

Expected patient outcomes may include:

1. Demonstrates improvement in gas exchange and clearance of secretions, as evidenced by normal breath sounds on auscultation
   a. Breaths easily without shortness of breath
   b. Performs hourly deep-breathing exercises, coughs effectively, and clears pulmonary secretions
   c. Is free of respiratory infection (ie, has normal temperature, respiratory rate, and pulse, normal breath sounds, absence of purulent sputum)
2. Moves within limits of the dysfunction and demonstrates completion of exercises within functional limitations
3. Demonstrates adaptation to sensory and perceptual alterations
   a. Uses assistive devices (eg, prism glasses, hearing aids, computers) as indicated
   b. Describes sensory and perceptual alterations as a consequence of injury
4. Demonstrates optimal skin integrity
   a. Exhibits normal skin turgor; skin is free of reddened areas or breaks
   b. Participates in skin care and monitoring procedures within functional limitations
5. Regains urinary bladder function
   a. Exhibits no signs of UTI (ie, has normal temperature; voids clear, dilute urine)
   b. Has adequate fluid intake

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**PROMOTING HOME AND COMMUNITY-BASED CARE**

**Teaching Patients Self-Care**

In most cases, SCI patients need long-term rehabilitation. The process begins during hospitalization as acute symptoms begin to subside or come under better control and the overall deficits and long-term effects of the injury become clear. The goals begin to shift from merely surviving the injury to learning strategies necessary to cope with the alterations that injury imposes on activities of daily living. The emphasis shifts from ensuring that the patient is stable and free of complications to specific assessment and planning designed to meet the patient’s rehabilitation needs. Patient teaching may initially focus on the injury and its effects on mobility, dressing, and bowel, bladder, and sexual function. As the patient and family acknowledge the consequences of the injury, the focus of teaching may broaden to address issues necessary to carry out the tasks of daily living. Teaching begins in the acute phase and continues throughout rehabilitation and throughout the patient’s life as changes occur, the patient ages, and problems arise.

Caring for the SCI patient at home may at first seem a daunting task to the family. They will require dedicated nursing support to gradually assume full care of the patient (Craig et al., 1999).

Although maintaining function and preventing complications will remain important, goals regarding self-care and preparation for discharge will assist in a smooth transition to rehabilitation and eventually to the community.

**Continuing Care**

The ultimate goal of the rehabilitation process is independence. The nurse becomes a support to both the patient and the family, assisting in a smooth transition to rehabilitation and eventually to the community.

The rehabilitation of the patient with a SCI (ie, the quadriplegic or paraplegic patient) is discussed below.
c. Participates in bladder training program within functional limitations
6. Regains bowel function
   a. Reports regular pattern of bowel movement
   b. Consumes adequate dietary fiber and oral fluids
   c. Participates in bowel training program within functional limitations
7. Reports absence of pain and discomfort
8. Is free of complications
   a. Demonstrates no signs of thrombophlebitis, DVT, or PE
   b. Exhibits no manifestations of pulmonary embolism (eg, no chest pain or shortness of breath; arterial blood gas values are normal)
   c. Maintains blood pressure within normal limits
   d. Has no lightheadedness with position changes
   e. Exhibits no manifestations of autonomic dysreflexia (ie, no headache, diaphoresis, nasal congestion, bradycardia, or diaphoresis)

Management of the Quadriplegic or Paraplegic Patient

Quadriplegia refers to the loss of movement and sensation in all four extremities and the trunk, associated with injury to the cervical spinal cord. Paraplegia refers to loss of motion and sensation in the lower extremities and all or part of the trunk as a result of damage to the thoracic or lumbar spinal cord or to the sacral root. Both conditions most frequently follow trauma such as falls, injuries, and gunshot wounds, but they may also be the result of spinal cord lesions (intervertebral disk, tumor, vascular lesions), multiple sclerosis, infections and abscesses of the spinal cord, and congenital disorders.

The patient faces a lifetime of great disability, requiring ongoing follow-up and care and the expertise of a number of health professionals, including physicians (specifically a physiatrist), rehabilitation nurses, occupational therapist, physical therapist, psychologist, social worker, rehabilitation engineer, and vocational counselor at different times as the need arises.

As the years go by, these patients also have the same medical problems as others in the aging population. In addition, they face the threat of complications associated with their disability. Usually the patient is encouraged to attend a spinal clinic when complications and other issues arise. Lifetime care includes assessment of the urinary tract at prescribed intervals, because there is the likelihood of continuing alteration in detrusor and sphincter function and the patient is prone to UTI.

Long-term problems and complications of SCI include disuse syndrome, autonomic dysreflexia (discussed earlier), bladder and kidney infections, spasticity, and depression. Pressure ulcers with potential complications of sepsis, osteomyelitis, and fistulas occur in about 10% of patients. Flexor muscle spasms may be particularly disabling and occur in up to 25% of patients (Sullivan, 1999). Heterotopic ossification (overgrowth of bone) in the hips, knees, shoulders, and elbows occurs in up to 30% of SCI patients. This complication is painful and can produce a loss of range of motion (Mitcho & Yanko, 1999; Subbarao & Garrison, 1999). Management includes observing for and addressing any alteration in physiologic status and psychological outlook, and the prevention and treatment of long-term complications. The nursing role involves emphasizing the need for vigilance in self-assessment and care.

NURSING PROCESS: THE PATIENT WITH QUADRIPLEGIA OR PARAPLEGIA

Assessment

Assessment focuses on the patient’s general condition, complications, and how the patient is managing at that particular point in time. A head-to-toe assessment and review of systems should be part of the database, with emphasis on the areas prone to problems in this population. A thorough inspection of all areas of the skin for redness or breakdown is critical. It is also important to review with the patient the established bowel and bladder program, because the program must continue uninterrupted. Patients with quadriplegia or paraplegia have varying degrees of loss of motor power, deep and superficial sensation, vasomotor control, bladder and bowel control, and sexual function. They are faced with potential complications related to immobility, skin breakdown and pressure ulcers, recurring UTI, contractures, and psychosocial disruptions. Knowledge about these particular issues can further guide the assessment in any setting. Nurses in all settings, including home care, must be aware of these potential complications in the lifetime management of these patients.

An understanding of the emotional and psychological responses to quadriplegia or paraplegia is achieved by observing the responses and behaviors of the patient and family and by listening to their concerns (see Chart 63-10 for a discussion of ethical issues). Documenting these assessments and reviewing the plan with the entire team on a regular basis provide insight into how both the patient and the family are coping with the changes in lifestyle and body functioning. Additional information frequently can be gathered from the social worker or psychiatric/mental health worker.

When the Patient Wants to Die . . .

Situation
A 70-year-old man has been in neurologic intensive care since he suffered a complete C1-C2 cervical fracture 2 weeks ago, which left him quadriplegic and ventilator-dependent. Since his admission, he has asked to be allowed to die. He has a living will and his wife is his designated durable power of attorney for health care. Before his injury, his health was exceptional. He played golf daily and was very active. He is awake, alert, and oriented and can communicate by letter board. He states that he does not want to spend his life unable to do the things he enjoys. He continues to request extubation so that he can die. His family and friends are with him, and he has asked his attorneys to tend to his affairs. With the loving support of his family, the decision to remove the ventilator has been made. Sedatives will be administered to help him deal with hypoxia and anoxia.

Dilemma
What is the nurse’s role in caring for this patient at this time?

Discussion
Is the removal of the ventilator an act of assisted suicide? Is it active or passive euthanasia? What is the nurse’s role in caring for the patient if this action conflicts with his/her personal beliefs? If no other nurse is available to provide care? If the physician writes the order for the nurse to remove the ventilator?
It takes time for the patient and family to comprehend the magnitude of the disability. They may go through stages of grief, including shock, disbelief, denial, anger, depression, and acceptance. During the acute phase of the injury, denial can be a protective mechanism to shield patients from the overwhelming reality of what has happened. As they realize the permanent nature of paraplegia or quadriplegia, the grieving process may be prolonged and all-encompassing because of the recognition that long-held plans and expectations may be interrupted or permanently altered. A period of depression often follows as the patient experiences a loss of self-esteem in areas of self-identity, sexual functioning, and social and emotional roles. Exploration and assessment of these issues can assist in developing a meaningful plan of care.

Diagnosis

NURSING DIAGNOSES
Based on the assessment data, the major nursing diagnoses of the patient with quadriplegia or paraplegia may include the following:

- Impaired physical mobility related to loss of motor function
- Risk for disuse syndrome
- Risk for impaired skin integrity related to permanent sensory loss and immobility
- Urinary retention related to level of injury
- Constipation related to effects of spinal cord disruption
- Sexual dysfunction related to neurologic dysfunction
- Ineffective coping related to impact of dysfunction on daily living
- Deficient knowledge about requirements for long-term management

COLLABORATIVE PROBLEMS/POTENTIAL COMPLICATIONS
Based on all the assessment data, potential complications of quadriplegia or paraplegia that may develop include:

- Spasticity
- Infection and sepsis

Planning and Goals

The goals for the patient may include attainment of some form of mobility, maintenance of healthy, intact skin, achievement of bladder management without infection, achievement of bowel control, achievement of sexual expression, strengthening of coping mechanisms, and absence of complications.

Nursing Interventions

The patient requires extensive rehabilitation, which is less difficult if appropriate nursing management has been carried out during the acute phase of the injury or illness. Nursing care is one of the key factors determining the success of the rehabilitation program. The main objective is for the patient to live as independently as possible in the home and community.

INCREASING MOBILITY

Exercise Programs
The unaffected parts of the body are built up to optimal strength to promote maximal self-care. The muscles of the hands, arms, shoulders, chest, spine, abdomen, and neck must be strengthened in the paraplegic patient because he or she must bear full weight on these muscles to ambulate. The triceps and the latissimus dorsi are important muscles used in crutch walking. The muscles of the abdomen and the back also are necessary for balance and for maintaining the upright position.

To strengthen these muscles, the patient can do push-ups when in a prone position and sit-ups when in a sitting position. Extending the arms while holding weights (traction weights can be used) also develops muscle strength. Squeezing rubber balls or crumbling newspaper promotes hand strength.

With encouragement from all members of the rehabilitation team, the paraplegic patient can develop the increased exercise tolerance needed for gait training and ambulation activities. The importance of maintaining cardiovascular fitness is stressed to the patient. Alternative exercises to increase the heart rate to target levels must be designed within the patient’s abilities.

Mobilization

When the spine is stable enough to allow the patient to assume an upright posture, mobilization activities are initiated. A brace or vest may be used, depending on the level of the lesion. A patient whose paralysis is due to complete transection of the cord can begin weight-bearing early because no further damage can be incurred. The sooner muscles are used, the less chance there is of disuse atrophy. The earlier the patient is brought to a standing position, the less opportunity for osteoporotic changes to take place in the long bones. Weight-bearing also reduces the possibility of renal calculi and enhances many other metabolic processes.

Braces and crutches enable some paraplegic patients to ambulate for short distances. Ambulation using crutches requires a high expenditure of energy. Motorized wheelchairs and specially equipped vans can provide greater independence and mobility for patients with high-level SCI or other lesions. Every effort should be made to encourage the patient to be as mobile and active as possible.

PREVENTING DISUSE SYNDROME

Patients are at high risk for developing contractures as a result of disuse syndrome due to the musculoskeletal system changes (atrophy) brought about by the loss of motor and sensory functions below the level of injury. Range-of-motion exercises must be provided at least four times a day, and care is taken to stretch the Achilles tendon with exercises (Hickey, 2003). The patient is repositioned frequently and maintained in proper body alignment whether in bed or in a wheelchair (Hickey, 2003).

PROMOTING SKIN INTEGRITY

Because these patients spend a great portion of their lives in wheelchairs, pressure ulcers are an ever-present threat. Contributing factors are permanent sensory loss over pressure areas; immobility, which makes relief of pressure difficult; trauma from bumps (against the wheelchair, toilet, furniture, and so forth) that cause unperceived abrasions and wounds; loss of protective function of the skin from excoriation and maceration due to excessive perspiration and possible urinary and fecal incontinence; and poor general health (anemia, edema, malnutrition), leading to poor tissue perfusion. The prevention and management of pressure ulcers are discussed in detail in Chapter 11.

The person with quadriplegia or paraplegia must take responsibility for monitoring (or directing) his or her skin status. This
involves relieving pressure and not remaining in any position for longer than 2 hours, in addition to ensuring that the skin receives meticulous attention and cleansing. The patient is taught that ulcers develop over bony prominences exposed to unrelieved pressure in the lying and sitting positions. The most vulnerable areas are identified. The paraplegic patient is instructed to use mirrors, if possible, to inspect these areas morning and night, observing for redness, slight edema, or any abrasions. While in bed, the patient should turn at 2-hour intervals and then inspect the skin again for redness that does not fade on pressure. The bottom sheet should be checked for wetness and for creases. The quadriplegic or paraplegic patient who cannot perform these activities is encouraged to direct others to check these areas and prevent ulcers from developing.

The patient is taught to relieve pressure while in the wheelchair by doing push-ups, leaning from side to side to relieve ischial pressure, and tilting forward while leaning on a table. The caregiver for the quadriplegic patient will need to perform these activities if the patient cannot do so independently. A wheelchair cushion is prescribed to meet individual needs, which may change in time with changes in posture, weight, and skin tolerance. A referral can be made to a rehabilitation engineer, who can measure pressure levels while the patient is sitting and then tailor the cushion and other necessary aids and assistive devices to the patient’s needs.

The diet for the patient with quadriplegia or paraplegia should be high in protein, vitamins, and calories to ensure minimal wasting of muscle and the maintenance of healthy skin, and high in fluids to maintain well-functioning kidneys. Excessive weight gain and obesity should be avoided because they limit mobility.

**IMPROVING BLADDER MANAGEMENT**

The effect of the spinal cord lesion on the bladder depends on the level of injury, the degree of cord damage, and the length of time after injury. A patient with quadriplegia or paraplegia usually has either a reflex or a nonreflex bladder (see Chaps. 11 and 44). Both bladder types increase the risk of UTI.

The nurse emphasizes the importance of maintaining an adequate flow of urine by encouraging a fluid intake of about 2.5 L daily. The patient should empty the bladder frequently so there is minimal residual urine and should pay attention to personal hygiene, because infection of the bladder and kidneys almost always occurs by the ascending route. The perineum must be kept clean and dry and attention given to the perianal skin after defecation. Underwear should be cotton (more absorbent) and changed at least once a day.

If an external catheter (condom catheter) is used, the sheath is removed nightly; the penis is cleansed to remove urine and is dried carefully, because warm urine on the periurethral skin promotes the growth of bacteria. Attention also is given to the collection bag. The nurse emphasizes the importance of monitoring for indications of UTI: cloudy, foul-smelling urine or hematuria (blood in the urine), fever, or chills.

The female patient who cannot achieve reflex bladder control or self-catheterization may need to wear pads or waterproof undergarments. Surgical intervention may be indicated in some patients to create a urinary diversion.

**COUNSELING ON SEXUAL EXPRESSION**

Many paraplegic and quadriplegic patients can have some form of meaningful sexual relationship, although some modifications will be necessary. The patient and partner benefit from counseling about the range of sexual expression possible, special techniques and positions, exploration of body sensations offering sensual feelings, and urinary and bowel hygiene as related to sexual activity. For men with erectile failure, penile prostheses enable them to have and sustain an erection. Sildenafil (Viagra) is an oral smooth muscle relaxant that causes blood to flow into the penis, resulting in an erection (see Chap. 49).

Sexual education and counseling services are included in the rehabilitation services at spinal centers. Small-group meetings in which the patients can share their feelings, receive information, and discuss sexual concerns and practical aspects are helpful in producing effective attitudes and adjustments (Sipski & Alexander, 1997).

**ENHANCING COPING MECHANISMS**

The impact of the disability and loss becomes marked when patients return home. Each time something new enters their lives (eg, a new relationship, going to work), they are reminded anew of their limitations. Grief reactions and depression are common.

To work through this depression, patients must have some hope for relief in the future. Thus, the nurse can encourage them to feel confident in their ability to achieve self-care and relative independence. The role of the nurse ranges from caretaker during the acute phase to teacher, counselor, and facilitator as patients gain mobility and independence.

The patient’s disability affects not only the patient, but also the entire family. In many cases, family therapy is helpful to help work through issues as they arise.

Adjustment to the disability leads to the development of realistic goals for the future, making the best of the abilities that are left intact and reinvesting in other activities and relationships. Rejection of the disability causes self-destructive neglect and noncompliance with the therapeutic program, which leads to more frustration and depression. Crises for which interventions may be sought include social, psychological, marital, sexual, and psychiatric problems. The family usually requires counseling, social services, and other support systems to help them cope with the changes in their lifestyle and socioeconomic status.

A major goal of nursing management is to help patients overcome their sense of futility and to encourage them in the emotional adjustment that must be made before they are willing to venture into the outside world. However, an excessively sympathetic attitude on the part of the nurse may cause patients to
develop an overdependence that defeats the purpose of the entire rehabilitation program. Patients are taught and assisted when necessary, but the nurse should avoid performing activities that patients can do for themselves with a little effort. This approach to care more than repays itself in the satisfaction of seeing a completely demoralized and helpless patient become independent and find meaning in a newly emerging lifestyle.

**MONITORING AND MANAGING POTENTIAL COMPLICATIONS**

**Spasticity**

Muscle spasticity is one of the most problematic complications of quadriplegia and paraplegia. These incapacitating flexor or extensor spasms, which occur below the level of the spinal cord lesion, interfere with both the rehabilitation process and activities of daily living. Spasticity results from an imbalance between the facilitatory and inhibitory effects on neurons that exist normally. The area of the cord distal to the site of injury or lesion becomes disconnected from the higher inhibitory centers located in the brain. Facilitatory impulses, which originate from muscles, skin, and ligaments, thus predominate.

Spasticity is defined as a condition of increased muscle tone in a muscle that is weak. Initial resistance to stretching is quickly followed by sudden relaxation. The stimulus that precipitates spasm can be either obvious, such as movement or a position change, or subtle, such as a slight jarring of the wheelchair. Most patients with quadriplegia or paraplegia have some degree of spasticity. With SCI, the onset of spasticity usually occurs from a few weeks to 6 months after the injury. The same muscles that are flaccid during the period of spinal shock will develop spasticity during recovery. The intensity of spasticity tends to peak around 2 years after the injury, after which the spasms tend to regress.

Management of spasticity is based on the severity of symptoms and the degree of incapacitation. Antispasmodic medications such as diazepam (Valium), baclofen (Librasol), and dantrolene (Dantrium) are frequently effective in controlling spasm but cause drowsiness, weakness, and vertigo in some patients. Passive range-of-motion exercises and frequent turning and repositioning are helpful because stiffness tends to increase spasticity. These activities also are essential in the prevention of contractures, pressure ulcers, and bowel and bladder dysfunction.

Contractures can complicate day-to-day care, increasing the difficulty with positioning and decreasing mobility. A number of surgical procedures have been tried with varying degrees of success. These techniques are used if more conservative approaches fail. The best treatment is prevention.

**Infection and Sepsis**

Patients with quadriplegia and paraplegia are at increased risk for infection and sepsis from a variety of sources: urinary tract, respiratory tract, and pressure ulcers. Sepsis remains a major cause of death and complications in these patients. Prevention of infection and sepsis is essential through maintenance of skin integrity, complete emptying of the bladder at regular intervals, and prevention of urinary and fecal incontinence. The risk of respiratory infection can be decreased by avoiding contact with people with symptoms of respiratory infection, performing coughing and deep-breathing exercises to prevent pooling of respiratory secretions, receiving yearly influenza vaccines, and giving up smoking. A high-protein diet is important in maintaining an adequate immune system, as is avoiding factors that may reduce immune system function (eg, excessive stress, drug abuse, excessive alcohol intake).

If infection occurs, the patient requires thorough assessment and prompt treatment. Antibiotic therapy and adequate hydration, in addition to local measures (depending on the site of infection), are initiated immediately. UTIs are minimized or prevented by:

- Aseptic technique in catheter management
- Adequate hydration
- Bladder training program
- Prevention of overdistention of the bladder and stasis

Skin breakdown and infection are prevented by:

- Maintenance of a turning schedule
- Frequent back care
- Regular assessment of all skin areas
- Regular cleansing and lubrication of the skin
- Passive range-of-motion exercise to prevent contractures
- Pressure relief, particularly over broken skin areas, bony prominences, and heels
- Wrinkle-free bed linen

Pulmonary infections are managed and prevented by:

- Frequent coughing, turning, and deep-breathing exercises and chest physiotherapy
- Aggressive respiratory care and suctioning of the airway if a tracheostomy is present
- Assisted coughing
- Adequate hydration

Infections of any kind can be life-threatening. Therefore, aggressive nursing interventions are key to their prevention and management.

**PROMOTING HOME AND COMMUNITY-BASED CARE**

**Teaching Patients Self-Care**

Patients with quadriplegia or paraplegia are at risk for complications for the rest of their lives. Thus, a major aspect of nursing care is teaching patients and their families about these complications and about strategies to minimize this risk. UTIs, contractures, infected pressure ulcers, and sepsis may necessitate hospitalization. Other late complications that may occur include lower extremity edema, joint contractures, respiratory dysfunction, and pain. To avoid these and other complications, the patient and a family member are taught skin care, catheter care, range-of-motion exercises, breathing exercises, and other care techniques. Teaching is initiated as soon as possible and extends into the rehabilitation or long-term care facility and home.

**Continuing Care**

Referral for home care is often appropriate for assessment of the home setting, patient teaching, and evaluation of the patient’s physical and emotional status. During visits by the home care nurse, teaching about strategies to prevent or minimize potential complications is reinforced. The home environment is assessed for adequacy for care and for safety. Environmental modifications are made and specialized equipment is obtained, ideally before the patient goes home.

The home care nurse also assesses the patient’s and the family’s adherence to recommendations and their use of coping strategies. The use of inappropriate coping strategies such as drug and alcohol use is assessed and referrals to counseling are made for the
patient and family. Appropriate and effective coping strategies are reinforced. The nurse reviews previous teaching and determines the need for further physical or psychological assistance. The patient’s self-esteem and body image may be very poor at this time. Because people with high levels of social support often report feelings of well-being despite major physical disability, it is beneficial for the nurse to assess and promote further development of the support system and effective coping strategies of each patient.

The patient requires continuing, life-long follow-up by the physician, physical therapist, and other rehabilitation team members because the neurologic deficit is usually permanent and new deficits and complications can develop. These require prompt attention before they take their toll in additional physical impairment, time, morale, and financial costs. The local counselor for the Office of Vocational Rehabilitation works with the patient with respect to job placement or additional educational or vocational training.

The nurse is in a good position to remind patients and family members of the need for continuing health promotion and screening practices. Referral to accessible health care providers and imaging centers is important in health promotion.

**Evaluation**

**EXPECTED PATIENT OUTCOMES**

Expected patient outcomes may include:

1. Attains some form of mobility
2. Contractures do not develop
3. Maintains healthy, intact skin
4. Achieves bladder control, absence of UTI
5. Achieves bowel control
6. Reports sexual satisfaction
7. Shows improved adaptation to environment and others
8. Exhibits reduction in spasticity
   a. Reports understanding of the precipitating factors
   b. Reports understanding of measures to reduce spasticity
9. Describes long-term management required
10. Exhibits absence of complications

**Critical Thinking Exercises**

1. A patient has been brought to the emergency department after he was hit in the head with a bat during a company baseball game. His coworkers report that he was unconscious for about 3 minutes. He now seems alert and oriented. What type of injury has he most likely sustained? What discharge instructions are warranted for this patient’s family? How would you modify your discharge instructions if the patient lives alone?

2. A 25-year-old man with paraplegia secondary to SCI is scheduled to return home after an 8-month stay in a rehabilitation facility. What health promotion strategies are relevant to teach the patient prior to discharge? What modifications in patient teaching would be indicated if the patient were a 50-year-old woman?

3. A patient with a T4 SCI has just returned to the nursing unit from physical therapy. He reports a severe, pounding headache and nausea. His blood pressure is very elevated and his pulse is slow. What are the possible causes of these signs and symptoms? What immediate actions should you take? What treatments can you anticipate? What teaching is warranted, and why?

**REFERENCES AND SELECTED READINGS**

**Books**


**Journals**

* Asterisks indicate nursing research articles.

**Head Injury**


**Neurotrauma**


**Spinal Cord Injury**


**Resources and Websites**

American Association of Neuroscience Nurses (AANN), 4700 W. Lake Ave, Chicago, IL 60025-1485; (847) 375-4733; (888)-557-2266; [http://www.aann.org](http://www.aann.org).