CHAPTER 22

Care of Patients With Head and Spinal Cord Injuries

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Objectives

Upon completion of this chapter you should be able to:

Theory

1. Describe the types of injuries that result from head trauma.
2. Compare and contrast the signs and symptoms of subdural hematoma and epidural hematoma.
3. Explain why an epidural hematoma causes an emergency situation.
4. Discuss the type of procedure performed to relieve a subdural hematoma.
5. Illustrate the pathophysiology of increasing intracranial pressure in a patient who has experienced a severe head injury.
6. Identify the reasons why an elderly person is more at risk for an intracranial bleed from a head injury.
7. Explain the possible ramifications of spinal cord injury.
8. List appropriate nursing interventions necessary to provide comprehensive care for a patient who has suffered a C5 spinal cord injury.
9. Analyze the symptoms of low back pain and correlate them with their cause.

Clinical Practice

1. Teach a family member how to properly assess and care for a patient who has suffered a concussion.
2. Perform a neurologic check on a patient who has suffered head trauma.
3. Participate in a collaborative care planning conference for a patient who has sustained a spinal cord injury.
4. Prepare a teaching plan for a patient who suffers from low back pain self-care measures.

Key Terms

Be sure to check out the bonus material on the Companion CD-ROM, including selected audio pronunciations.

concussion (cŏn-KŬ-shŭn, p. XX)
contralateral (kŏn-tră-LĂT-ĕr-ăl, p. XX)
contusion (kŏn-TŪ-zhŭn, p. XX)
coup-contrecoup injury (koo kôtre-koo, p. XX)
epidural hematoma (Ĕ-pĭ-DŪ-rŭl hē-mă-TŌ-mă, p. XX)
hydrocephalus (hī-drō-SĔF-ă-lăs, p. XX)
intracerebral hematoma (ĭn-trăh-sĕ-RĒ-brăl, p. XX)
ipsilateral (ĭp-sĭ-LĂT-ĕr-ăl, p. XX)
paraplegia (păr-ă-PLĒ-jă, p. XX)
polydipsia (pŏl-ē-DĬP-sē-ă, p. XX)
paraplegia (p. XX)
polydipsia (p. XX)
quadriplegia (kwŏd-rĭ-PLĒ-jă, p. XX)
subdural hematoma (sŭb- DŪ-rŭl, p. XX)
subluxation (sŭb-lŭk-SĀ-shŭn, p. XX)

HEAD INJURIES

Head injuries are a frequent cause of death. About 1.5 million people sustain head and brain injury in the United States each year. Approximately 50,000 die and 1.1 million are treated for traumatic brain injury and released. Those who survive initial head injury require meticulous observation and care so that damage to the brain cells can be kept at a minimum and death averted. There are about 5.3 million people in the United States who have need of lifelong help with activities of daily living due to residual disabilities from brain injury (Brain Injury Association of America, 2007.)

Etiology

A blow to the head may cause a laceration of the skin or scalp and fracture of the skull, or may only cause a minor contusion. The injury may cause movement of the brain within the skull, tearing blood vessels. Accidents are the most common cause of head injury, with motor vehicle accidents being the leading cause.

Pathophysiology

When a depressed skull fracture occurs, there is bruising, contusion, or laceration of the underlying brain tissue with the inflammatory changes that occur with any wound. A minor head injury may cause concussion. Concussion is the term used to describe a closed head injury in which there is a brief disruption in level of consciousness (LOC), amnesia regarding the occurrence, and headache. Skull fractures are described as:

- Linear or depressed
- Simple, comminuted, or compound
- Closed or open

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A *closed* injury is one in which the scalp and skull remain intact, but the underlying brain tissue is damaged. There may be contused areas or hematoma. In an *open* injury there is laceration of the scalp and fracture of the skull with damage to brain tissue.

Elder Care Points

The brain atrophies with age and does not take up as much space in the cranial vault. This allows for more movement and more potential for torn vessels and contusions on the brain when an accident occurs that involves a head injury.

In a **contusion,** the brain tissue is bruised, blood from broken vessels accumulates, and edema develops causing increased intracranial pressure (ICP).

A **coup-contrecoup injury,** or an *acceleration-deceleration injury,* occurs when the head is moving rapidly and hits a stationary object, such as a windshield. The contents within the cranium hit the inside of the skull (coup) and then bounce back and hit the bony area opposite the site of impact, causing a second injury (contrecoup) (Figure 22–1).

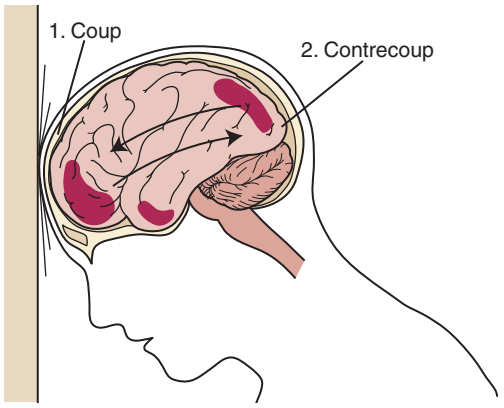


FIGURE **22–1** Coup-contrecoup (acceleration-deceleration) injury.

Subdural hematoma is a common result of head injury. It often happens in the elderly as a result of a fall. Anticoagulant therapy puts a patient at greater risk for a subdural hematoma after even a minor blow to the head. A hematoma is a blood-filled swelling. When a blow is delivered to the head, it may rupture the blood vessels that lie between the delicate arachnoid membrane covering the brain and the tough, fibrous dura mater. As the blood leaks under the dura mater (subdural), the hematoma grows in size, pressing against the softer arachnoid and the brain tissue it is covering (Figure 22–2).

Elder Care Points

Because the brain of the older person tends to move more in the cranial vault when head trauma occurs, small vessels may be torn and the patient is more at risk for a slow developing subdural hematoma. The person should be watched for several months for signs of personality change, decreasing LOC, increased irritability, and other signs of increased ICP.

An **epidural hematoma** occurs more rarely, but when it does, it is caused by rapid leakage of blood from the middle meningeal artery, which quickly elevates ICP (see Figure 22–2). This constitutes a medical emergency. A craniotomy is needed to repair the damaged vessel and relieve the rapidly rising pressure before death occurs from the increased ICP (see Chapter 23 for a discussion of the craniotomy procedure). An **intracerebral hematoma** may occur within the brain.

Signs and Symptoms

The severity of brain damage from a head injury is best judged by the symptoms presented by the patient, a neurologic assessment, the history of the type of blow received, and whether the victim lost consciousness and for how long. The outward symptoms of head injury are fairly obvious; these include bruising,

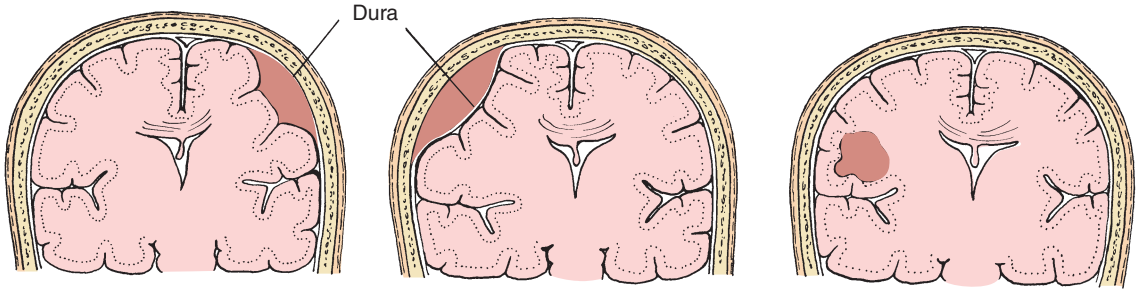


FIGURE **22–2** **A,** Subdural hematoma. As a result of trauma to the head, small ruptured blood vessels leak blood into the space under the dura mater (slower than an epidural bleed). **B,** Epidural hematoma, the result of a head injury that tears a large meningeal artery, causing a rapid bleed with a large amount of blood above the dura mater. If not relieved, subdural and epidural hematomas can be fatal. **C,** Intracerebral hematoma. Small vessels within the brain have torn and bled.

FIGURE 22–3 Battle's sign.

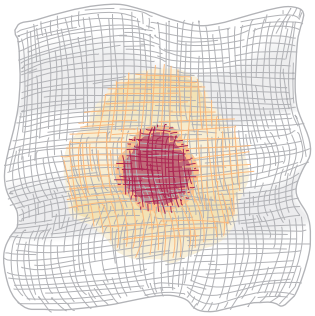


FIGURE 22–4 Assessing for the halo sign on fluid from the nose or ear after a head injury. The blood will draw together in the middle of the gauze pad, leaving a yellow ring (halo) around the blood, indicating the presence of cerebrospinal fluid.

swelling, lacerations, and bleeding. There may be periorbital fractures with *ecchymoses* (raccoon eyes), or ecchymoses behind the ear (Battle's sign) (Figure 22–3). *Otorhea* (fluid from the ear), *rhinorrhea* (fluid from the nose), tinnitus or hearing difficulty, facial paralysis, and conjugate deviation of gaze wherein both eyes deviate to one side may be present. Otorhea and rhinorrhea should be tested to determine if there is a cerebrospinal fluid (CSF) leak. If the fluid is clear, it can be tested with a Dextrostix or Tes Tape to see if glucose is present.

Clinical Cues

If the fluid from the ear or nose is tinged with blood, a Dextrostix or Tes Tape will not give accurate results. Collect about a teaspoon of the fluid on a white gauze pad. Within a few minutes blood will move to the center and a yellow ring (halo) will form around it if the fluid is CSF (Figure 22–4).

A concussion can cause a brief disruption of the normal LOC, amnesia regarding the event, and headache. A contusion can cause an alteration in LOC and may cause seizures. Box 22–1 shows the downward progression of decreased LOC.

A subdural hematoma may be acute, subacute, or chronic, building up over time (Table 22–1). An acute intracerebral bleed causing hematoma formation is accompanied by unconsciousness, hemiplegia on the **contralateral** (opposite) side, and a dilated pupil on the **ipsilateral** (same) side. However, the symptoms indicating a slow buildup of pressure within the skull are more subtle and less easily detected.

Signs of epidural hematoma may include unconsciousness at the time of the injury, a brief lucid interval followed by decreasing LOC, headache, nausea and vomiting, and dilation of the ipsilateral pupil. The patient is observed for signs of increased ICP, as well as other focal changes (see the next section on Increased Intracranial Pressure).

Box 22–1 ***Decreasing Levels of Consciousness (LOC)***

- **Alert:** Responds appropriately to questions and commands with little stimulation. Attends to surroundings.
- **Confused:** Somewhat disoriented to surroundings, time, or people. Judgment may be impaired. Needs to be cued to respond to commands.
- **Lethargic:** Drowsy, but easily aroused; needs gentle touch or verbal stimulation to attend to commands.
- **Obtunded:** More difficult to arouse and responds slowly to stimulation. Needs repeated stimulation to maintain attention and to respond to the environment.
- **Stuporous:** Responds to vigorous stimulation only slightly; may only moan or mutter in response.
- **Comatose:** No observable response to stimulation.

Table 22–1 ***Types of Subdural Hematomas***

TYPE	OCCURRENCE AFTER INJURY	PROGRESSION OF SYMPTOMS
Acute	Within 24–48 hr	Quick; immediate deterioration
Subacute	48 hr–2 wk	Initial unconsciousness, gradual improvement and then deterioration over a few hours, dilation of pupils, *ptosis* (drooping eyelid)
Chronic	More than 20 days after injury; may be weeks or months later Injury often seems trivial More common in the elderly	Changes in temperament or personality, headaches, alteration in LOC May have other focal signs

Key: *LOC,* level of consciousness.
Adapted from Lewis, S.M., Heitkemper, M.M., & Dirksen, S.R. (2007). *Medical-Surgical Nursing: Assessment and Management of Clinical Problems* (7th ed.). St. Louis: Mosby.

Diagnosis

The diagnostic tests and examinations commonly used to determine the extent of head injury include a radiograph of the skull, a computed tomography (CT) scan, magnetic resonance imaging (MRI) with contrast, pos-

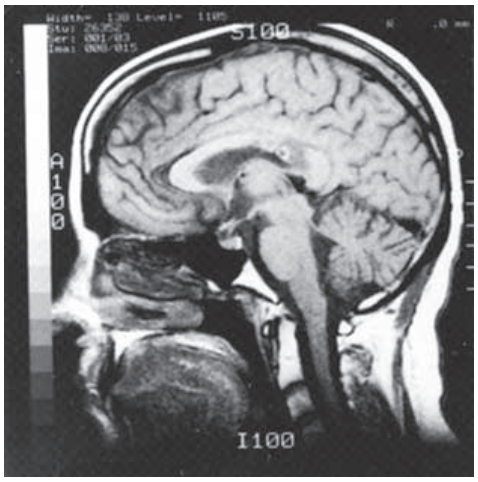


FIGURE **22–5** MRI: midline sagittal view of the brain.

FIGURE **22–6** Electroencephalogram (EEG).

itron emission tomography, evoked potentials, and electroencephalography (Figures 22–5 and 22–6) (see Chapter 21).

Think Critically About . . . Why should every patient who has sustained a head injury be assessed closely for 24 to 48 hours?

Treatment

The patient with a head injury usually is treated conservatively at first. If the injury causes an increase in ICP, or if the injury is a compound fracture of the skull, then surgical debridement of the wound and removal of splintered bone from the brain tissues or elevation of the skull fragment is performed. All measures to keep ICP from rising are instituted for serious head injuries.

A patent airway must be secured, and the head raised 30 to 45 degrees with the body in correct alignment. Elevation helps reduce ICP. Neurologic signs are monitored closely. An intravenous (IV) line is inserted for access for diuretic drugs if needed and for administration of fluid. Intravenous fluids are infused very slowly so that there is no fluid overload that increases the ICP. Diuretics are used to decrease vascular volume and keep ICP as low as possible.

Think Critically About . . . Why would a nurse check for a patent airway before performing a neurologic assessment on a patient with a head injury?

Surgical Intervention. Subdural hematoma is removed surgically either via bur holes or by craniotomy incision. The hematoma is evacuated by suction or surgical instruments. Epidural hematoma necessitates immediate, emergency craniotomy for access to the brain to stop the bleeding and evacuate the hematoma to prevent death from increased ICP. The craniotomy procedure is described in Chapter 23 along with surgeries of the brain.

Preoperative Period. The patient with a hematoma is quickly prepared for surgery. The operative site usually is not shaved until the patient is under anesthesia in the operating room. For planned surgery, a shampoo may be ordered the evening before surgery. Preoperative preparation is the same as for other surgeries. Any scalp lesions or other unusual conditions that are noted at this time should be reported. Usually the entire head is not shaved, only the operative area, and, if the patient has long hair, any hair that is cut off may be saved to be used as a hairpiece until the patient's hair grows back.

Postoperative Period. During the immediate postoperative period, the patient who underwent a craniotomy is in the intensive care unit for continuous monitoring. Essentially, care will be the same as that for any patient in danger of increasing ICP. Additional specific points in the postoperative care of the patient who has undergone intracranial surgery are as follows:

- Position the patient according to written orders from the attending surgeon. *Make no exceptions.* Positioning is important to prevent added increases in ICP.
- Keep the neck in midline and prevent excessive hip flexion to promote venous drainage from the head and keep ICP from rising (American Association of Neuroscience Nurses, 2005). EB
- Use nasal suctioning *only* if there is a written order allowing this as there may be a fracture that allows a pathway to the brain tissue.
- Watch carefully for signs of leakage of CSF from the nose, ear, and operative site, and report evidence of leakage immediately. Use aseptic technique in applying dressings to catch the drainage and prevent microorganisms from easily entering.
- Provide a quiet, nonstimulating environment.
- Administer only those treatments, comfort measures, and medications for which there are specific written orders.
- Report promptly any changes in the neurologic status of the patient.

Nursing Management for Head Injury

If it has been determined that there is indeed leakage of spinal fluid through the nose, ear, or an open head wound, special precautions must be taken to prevent infection and the physician must be notified. These precautions include the following:

- Keep the patient on absolute bed rest with the head of the bed elevated 30 to 45 degrees to promote venous drainage from the head.
- Cover a draining ear with a sterile gauze pad, changing it periodically to look for drainage.
- Instruct the patient *not* to blow her nose or pick at it; blowing may increase ICP, and picking may allow entry of microorganisms.
- Do not plug the nose or ear if there is drainage of CSF as this may increase ICP.
- Remind the patient that she is not to change her position in any way unless she has been told it is all right to do so, in order to prevent ICP from rising.

Continued neurologic assessments are an integral part of care. Specific nursing diagnoses are listed in Nursing Care Plan 22–1.

Observation of a patient treated in an emergency department for head injury and released to go home requires specific instructions (Legal & Ethical Considerations 22–1). Patient Teaching 22–1 includes instructions for the patient's family.

NURSING CARE PLAN 22–1

Care of the Patient with a Head Injury and Increased Intracranial Pressure

SCENARIO A 16-year-old boy who suffered a head injury in an automobile accident is groggy, but arousable.

***PROBLEM*/NURSING DIAGNOSIS** *Blow to skull.* Ineffective cerebral tissue perfusion related to increased intracranial pressure from head injury.

Supporting assessment data *Objective:* Nondepressed skull fracture. *Subjective:* Alteration in LOC, confused as to where he is, what day it is; somewhat combative; hit right side of head on dashboard.

Goals/Expected Outcomes	*Nursing Interventions*	*Selected Rationale*	*Evaluation*
Patient will not display further increase in ICP	Monitor neurologic status q 1 hr using Glasgow Coma Scale (GCS); notify physician of any pupil changes or signs of increasing ICP, such as widening pulse pressure, change in respiratory pattern, slowing of pulse, increase in temperature, or decrease in LOC.	GCS provides good estimate of neurologic status.	GCS maintaining at 11.
	Monitor for seizure activity; institute seizure precautions.	Increased pressure on brain tissue may cause cellular irritability and seizure activity.	No sign of seizure activity. Precautions in place; padded tongue blade at bedside.
	Keep head of bed (HOB) at 30 degrees and body in correct alignment; turn side to side q 2 hr if condition warrants.	Keeping head slightly elevated and in proper alignment helps promote venous drainage from the head.	HOB at 30 degrees; positioned in correct alignment with neck midline. Turned q 2 hr.
	Maintain IV infusion at 50 mL/hr.	Decreasing IV rate helps prevent increased ICP and maintains IV access.	IV infusion at 50 mL/hr; patent without redness or swelling at site.
	Administer diuretic as ordered.	Diuretic decreases vascular volume and intracranial volume, lowering ICP.	No diuretic ordered at this time.
	Keep room calm and softly lit; do not disturb more than necessary; talk to patient while giving care; allow rest periods between any invasive procedures; monitor intake and output; reorient patient frequently.	Invasive procedures raise intracranial pressure.	Room is tidy and softly lit; care procedures grouped at intervals allowing rest; I = 400 mL, O = 375 mL.

Key: *ADLs,* activities of daily living; *I,* input; *ICP,* intracranial pressure; *IV,* intravenous; *LOC,* level of consciousness; *O,* output.

NURSING CARE PLAN 22–1

Care of the Patient with a Head Injury and Increased Intracranial Pressure—cont'd

PROBLEM/NURSING DIAGNOSIS *Unable to bathe and dress self.* Self-care deficit related to confusion, grogginess, and increased ICP.

Supporting assessment data *Objective:* Falls asleep during attempts at bath, etc.; is confused about how to use ordinary objects such as toothbrush.

Goals/Expected Outcomes	Nursing Interventions	Selected Rationale	Evaluation
Patient will have adequate assistance with hygiene and dressing	Provide assistance with all ADLs.		Assisted with morning care.
Patient will resume self-care by discharge	Inspect skin when turning; place foam pad on bed.	Pressure-relieving devices helps prevent pressure ulcer formation.	No signs of reddened areas on skin. Foam pad on bed.
	Encourage self-care as LOC improves.		Continue plan. Not ready for self-care yet.

PROBLEM/NURSING DIAGNOSIS *Mother is very anxious.* Disabled family coping related to patient's decreased LOC and hospitalization.

Supporting assessment data *Subjective:* Mother states she is afraid son is going to die. *Objective:* Mother keeps trying to arouse the patient when she is in the room.

Goals/Expected Outcomes	Nursing Interventions	Selected Rationale	Evaluation
Mother's anxiety will decrease as she gains information about her son's condition and prognosis	Explain to family that confusion and grogginess are usual after head injury.	Knowledge decreases fear of the unknown.	Explained patient's condition to family and measures to keep ICP down. Mother seems less anxious. Discussed need for calm and positive talk in room.
	Explain that the danger is if the ICP keeps increasing; tell what measures are being done to minimize increasing ICP; explain all procedures; explain that calm, rest, and positive talk in the room will help.	Knowing the treatment plan decreases anxiety.	Continue plan.
	Call hospital chaplain or own minister if family desires.	Presence of spiritual advisor can decrease anxiety.	
	Keep family informed of changes in patient's condition.		

CRITICAL THINKING QUESTIONS

1. Why do you think that it is contraindicated for this patient to strain to have a bowel movement?
2. Why is it important to decrease stimuli and provide a calm, soothing environment for this patient? (Be specific.)

Think Critically About . . . Why is the patient with a head injury positioned with the head of the bed at 30 to 45 degrees elevation?

The long-term outcome for patients who have suffered a *severe* head injury are unpredictable. Recovery is a long process, and improvement may occur over many months for some patients. Disabilities may be lifelong.

INCREASED INTRACRANIAL PRESSURE

Etiology and Pathophysiology

Because the skull is a closed bony structure in the adult, it is unable to expand. **Any lesion or fluid accumulation that begins to take up space within the cranial cavity causes an increase in the pressure within the cavity.** Therefore, any swelling of the brain tissue from injury or surgery, leakage of blood from ruptured cerebral vessels, or tumors, abscesses, or any

Legal & Ethical Considerations 22–1

Documenting Patient Teaching

Because there are legal ramifications of inadequate patient/family teaching, document all teaching in the medical record and send home clearly written instructions. It is best to have the patient or family sign a form for the record that indicates that teaching and written instructions have been received.

Patient Teaching 22–1

Instructions for Care of a Patient with a Head Injury

Teach the family or significant other to do the following:

- For the first 24 hours, awaken the person every 2 hours to be certain he/she can be easily aroused.
- Question the person about where he/she is, who you are, what happened, and so on, to check orientation.
- Check the pupils to see that they are equal in size and that they will constrict; use a flashlight.
- Avoid strenuous activity for 24 hours.
- Apply icebag to areas of swelling—continue for 24 hours.

For 48 hours, watch for the following signs and report them to the physician or Emergency Medical Services if they occur:

- Change in level of consciousness (e.g., becoming more groggy, difficult to awake, confused)
- Projectile vomiting (vomit travels a distance) without nausea
- Unusual dizziness, sleepiness, loss of balance, or fall
- Change in vision (i.e., seeing double, blurred vision)
- Jerking movements of the eyes
- An increasing headache that feels worse when moving around
- Any twitching movements of arms or legs that cannot be controlled (seizures)
- A change in speech or ability to find words or converse
- Behavior that is odd for the individual

other space-occupying lesion within the skull presents an increased ICP risk. Pressure against cerebral veins and arteries interferes with the flow of blood, producing a local ischemia and hypoxia. Pressure against the cells themselves can interfere with their vital functions. If it rises very high and remains high for very long, ICP can cause death from inadequate cerebral perfusion or cerebral herniation. Brainstem injuries or pressure on the brainstem from increased ICP causes respiratory depression from pressure on the medulla oblongata. Carbon dioxide accumulates, causing vasodilation and further increases in ICP. Normal ICP is 0 to 15 mm Hg. Concept Map 22–1 shows the relationship between the causes and the pathologic occurrences of increased ICP.

Signs, Symptoms, and Diagnosis

When the body can no longer compensate for the increase in volume in the cranial vault, decompensation begins and clinical signs of increasing ICP become apparent.

The earliest sign of increasing ICP is lethargy and decreasing consciousness, accompanied by a slowing of speech and delay in response to verbal cues.

When ICP rises, it affects the oxygenated blood perfusion of the brain and hypoxia occurs. Nerve cells are particularly sensitive to hypoxia and cannot be replaced once they have been destroyed. Extended periods of hypoxia cause brain cell death. The body tries to compensate by raising blood pressure to force more oxygenated blood through the brain tissue. If ICP continues to rise, the brain tissue will herniate through the tentorial notch at the midline of the foramen magnum. This herniation results in pressure on the vital structures of the midbrain, pons, and medulla and causes changes in the vital signs and pupil reactions characteristic of increased ICP.

As brain tissue swells or fluid volume increases in the cranium, pressure is placed on the optic nerve. Pupils begin to react slowly; pupil size becomes unequal, progressing to dilation, and then the pupil size becomes fixed as reflexes disappear.

Clinical Cues

Abnormal pupillary responses can reverse to normal if the cause of increased ICP can be resolved in time.

The classic signs of increased ICP, with the first three called *Cushing's triad*, are:

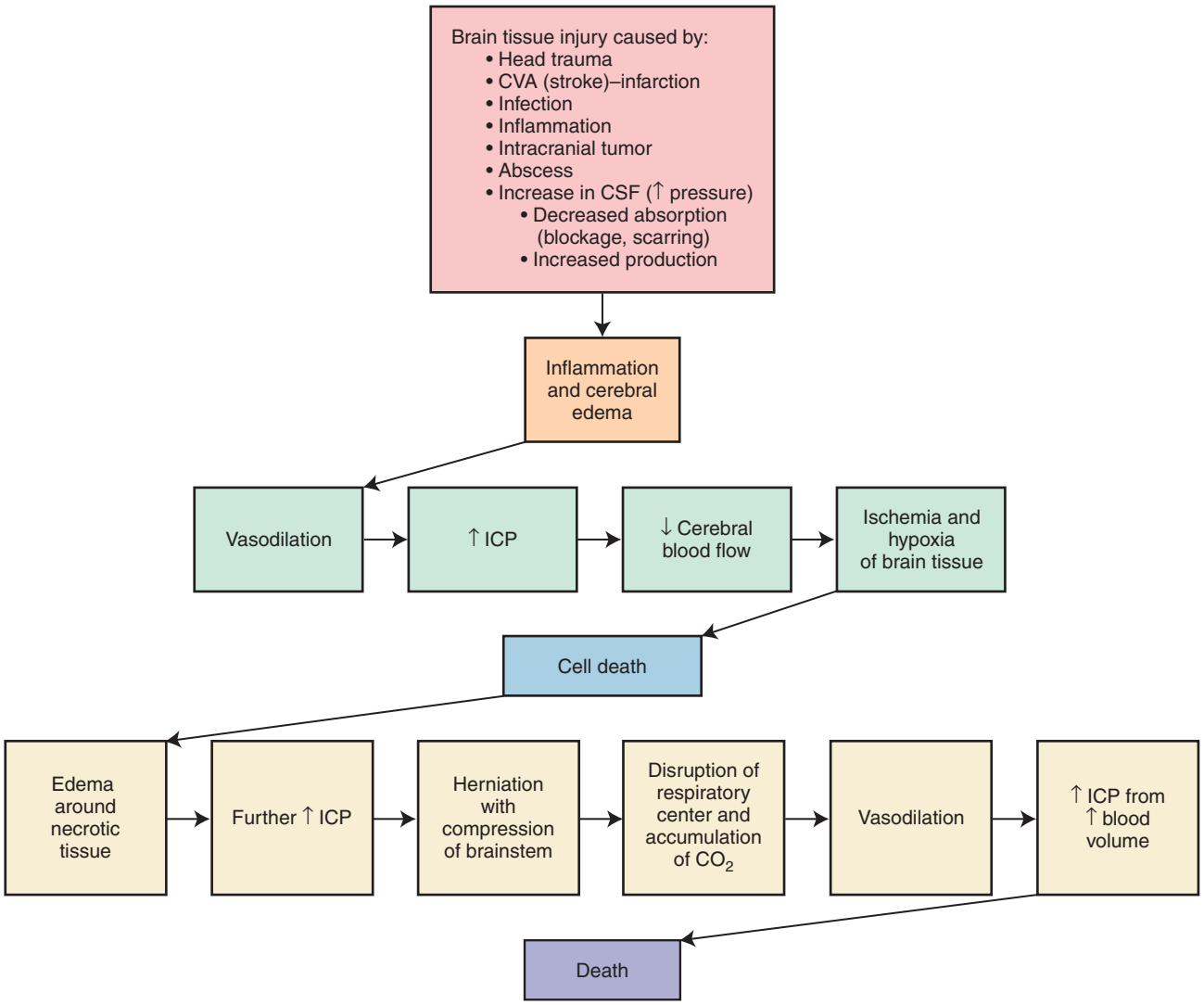
- Rising systolic blood pressure
- Widening pulse pressure
- Bradycardia with a full, bounding pulse
- Rapid or irregular respirations (Figure 22–7)

These tend to be late signs, as are pupil changes, and signal a severe emergency and the need for immediate action to try to prevent the patient's death.

Think Critically About . . . Why does increasing intracranial edema cause a double threat to the brain?

Treatment

The patient with greatly increased ICP is usually placed in an intensive care unit. Increased ICP is treated with supportive care to keep the pressure from rising further and with interventions to decrease the cranial blood or CSF volume. Osmotic diuretics (mannitol, glycerol, urea) are administered to remove fluid from the body, thereby reducing fluid in the brain.



CONCEPT MAP **22–1** Pathophysiologic changes from a brain injury that increases intracranial pressure (ICP) and can lead to death.

Systemic diuretics, such as furosemide (Lasix), also may be given. Dosage is determined by body weight, and electrolytes are monitored every 6 hours, as mannitol and diuretic action can cause electrolyte imbalances. An indwelling urinary catheter is inserted to monitor output. Electrolytes are monitored closely. Fluid balance is watched closely.

Dexamethasone (Decadron) may be given to decrease the inflammatory response and cerebral edema if the ICP is caused by a brain tumor or abscess (Meany, 2005). Histamine (H_2)-receptor blockers or proton pump inhibitors are administered to protect the gastric mucosa. The patient is positioned with the head of the bed at 30 to 45 degrees to promote venous drainage from the head. The head and neck must be kept positioned midline so that venous drainage into the body is not restricted. Hip flexion should be less than 90 degrees. Rolled washcloths, towels, or trochanter rolls can be used for positioning.

If ICP is dangerously high as indicated by a Glasgow Coma Scale score of 8 or less and an abnormal CT scan, the surgeon may insert an intraventricular catheter into the lateral ventricle, through which CSF can be drained in small amounts to relieve the pressure. A probe can also be positioned in the subarachnoid or epidural area to monitor the pressure. Cerebral perfusion pressure (CPP) must be kept above 60 mm Hg to ensure oxygenation of the brain tissue (CPP = mean arterial pressure − intracranial pressure). Normal CPP is 70 to 100 mm Hg. A monitoring device connected to the inserted probe may be used to measure cerebral blood flow. There are some new devices used to monitor cerebral oxygenation and blood flow (Table 22–2).

If the patient is on a ventilator and is extremely agitated, pancuronium bromide (Pavulon) to paralyze skeletal muscles, in combination with sedation, may be used to prevent further increases in ICP. Because carbon dioxide is a vasodilator and can increase blood

volume within the cranial cavity, hyperventilation is sometimes used to combat the increased ICP. This is accomplished by increasing the rate of controlled respiration. A CO_2 level between 25 and 30 mm Hg will improve oxygenation to the brain by causing vasoconstriction. This is a short-term treatment. Box 22–2 provides general guidelines for the care of patients with increased ICP.

Barbiturates are sometimes used along with continuous brain wave monitoring when patients do not respond to the more common therapies for reduction of ICP. Their purpose is to induce heavy sedation and slow metabolism, thereby decreasing ICP. In general, the short-acting barbiturates are used (e.g., pentobarbital [Nembutal] and thiopental [Pentothal]). Phenytoin (Dilantin) may be used to prevent seizures.

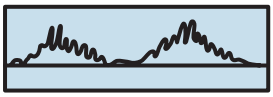
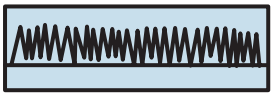
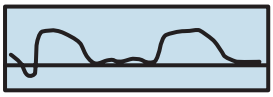
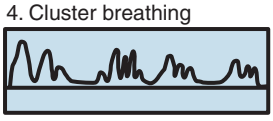
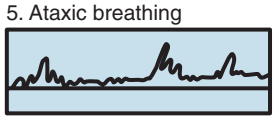
Pattern	Location of Lesion	Description
1. Cheyne-Stokes 	Bilateral hemispheric disease or metabolic brain dysfunction	Cycles of hyperventilation and apnea
2. Central neurogenic hyperventilation 	Brainstem between lower midbrain and upper pons	Sustained, regular rapid and deep breathing
3. Apneustic breathing 	Mid or lower pons	Prolonged inspiratory phase or pauses alternating with expiratory pauses
4. Cluster breathing 	Medulla or lower pons	Clusters of breaths follow each other with irregular pauses between
5. Ataxic breathing 	Reticular formation of the medulla	Completely irregular with some breaths deep and some shallow. Random, irregular pauses, slow rate

FIGURE 22–7 Common abnormal respiratory patterns associated with coma.

Temperature control is achieved by placing the patient on a hypothermia blanket for cooling if increased ICP has affected temperature regulation by pressure on the hypothalamus and the patient is feverish. Fever increases cerebral metabolism and cerebral edema.

Warmed blankets and tepid baths can be used to raise the temperature of the hypothermic patient and prevent shivering.

Complications

Damage to brain cells from injury and during periods of increased ICP may cause residual scarring and seizures. **Hydrocephalus** (excessive accumulation of CSF) may occur (see Chapter 23), causing motor deficits, cranial nerve deficits, or decreased cognitive ability. Rehabilitation efforts are focused on eliminating or decreasing deficits and promoting as much cognitive and physical function as possible (see Chapter 9).

Diabetes Insipidus. Diabetes insipidus may occur from injury or edema of the pituitary gland. Antidiuretic hormone is released in inadequate amounts, resulting in polyuria, and the awake patient may complain of **polydipsia** (excessive thirst). Intravenous vasopressin and fluid replacement are the preferred treatment. Carefully monitor intake and output and electrolyte balance.

NURSING MANAGEMENT

Assessment (Data Collection)

Early recognition of increasing pressure is extremely important to prevent permanent damage to the tissues of the brain, the cranial nerves, and the motor and sensory nerve pathways that are within the cranium. Careful neurologic assessment with monitoring of the patient's LOC, pupillary reactions, level of neuromuscular activity, and vital signs is essential to accurately evaluate the patient's progress. "Neuro checks" are performed every 15 minutes to every 2 hours for the acute patient (see Chapter 21). The following indications that ICP may be rising should be reported immediately:

- Extreme restlessness or excitability following a period of apparent calm
- Deepening stupor and decreasing LOC
- Headache that is unrelenting and increasing in intensity
- Vomiting, especially persistent, projectile vomiting

Table 22–2 ***Noninvasive Devices for Monitoring Cerebral Oxygen and Carbon Dioxide***

DEVICE	PARAMETER MEASURED	MECHANISM OF ACTION
INVOS Cerebral Oximeter	Oxygen saturation in the brain tissue	Sensors are placed on both sides of the forehead and infrared light passes through the skull and tissue to measure cerebral oxygenation
Capnometer	Expired end-tidal carbon dioxide ($EtCO_2$)	Measures the CO_2 in expired volume of breath

- Unequal size of pupils and other abnormal pupillary reactions
- Leakage of CSF from the nose or ear
- Changes in the patient's blood pressure, pulse, or respiration; widening pulse pressure; a slow, bounding pulse

Think Critically About . . . Why do you think an elderly person is at greater risk when a head injury or other cause of increased ICP occurs?

Nursing Diagnosis, Planning, and Implementation

The appropriate nursing diagnosis is "altered cerebral tissue perfusion related to effects of increasing intracranial pressure." Goals of care are:

- Maintain cerebral perfusion
- Reduce ICP
- Maintain adequate respiration
- Protect from injury
- Maintain normal body functions
- Prevent complications

The expected outcome would be "Patient will not experience brain damage from increased intracranial pressure."

Maintaining an open airway and adequate respiration may require suctioning and possibly intubation with mechanical ventilation. (If the patient has sustained a head injury, x-rays to rule out a basilar fracture are necessary before suctioning the nonintubated patient to prevent the possibility of the suction catheter entering the cranial vault.) The patient whose consciousness level is decreased and whose gag and swallowing reflexes are impaired is in danger of aspirating blood, vomitus, mucus, and other material into the air passages.

Position the patient on her side and ask her to exhale as you turn her to prevent a Valsalva maneuver, which could raise ICP. Instruct her not to grip the side rails or push with her feet or elbows against the mattress during repositioning for the same reason. Plan uninterrupted rest periods between activities that cause an increase in ICP, preferably 1 hour at a time. Provide a soothing environment free of noxious odors and noise. Keep the room temperature adjusted to normalize the patient's temperature; prevent shivering (American Association of Neuroscience Nurses, 2005). EB

Nutrition supplied early improves outcomes after brain injury and increased ICP as it promotes healing (Yanagawa, 2005). If the patient is unable to take food orally, supplementation is begun within 3 days after injury. Full nutritional supplementation should be in place by day 7. Nutrition is planned according to determined metabolic needs and fluid and electrolyte status. Metabolic needs are calculated based on age, weight, and height. EB

Unless the patient has a tracheostomy or an oral airway in place, she should be positioned on her side, not on her back, as the tongue may occlude the airway, and mucus cannot drain naturally. **The unconscious patient requires care for all basic needs.** See Table 21–9 and the section on common care problems for specific interventions in Chapter 21.

Box 22–2 *Guidelines for Patients with Increased Intracranial Pressure (ICP)*

DO

- Conduct neurologic checks at least once every hour unless more frequent monitoring indicated.
- Report changes immediately.
- Maintain a patent airway and adequate ventilation to ensure proper oxygen and carbon dioxide exchange.
- Elevate the head of the bed 15 to 30 degrees to facilitate return of blood from the cerebral veins.
- Use measures to maintain normal body temperature. Elevations of temperature raise blood pressure and cerebral blood flow. Shivering also can increase ICP.
- Monitor intake and output. Restrict or encourage fluids according to physician's order.
- Give passive range-of-motion exercises.
- Space activities apart.

DO NOT

- Allow patient to become constipated or perform Valsalva maneuver.
- Hyperextend, flex, or rotate the patient's head.
- Flex the patient's hips (as in female catheterization).
- Place patient in Trendelenburg's position for any reason.
- Allow patient to perform isometric exercises.

Evaluation

Data are gathered regarding the success of the nursing interventions. If the interventions are not helping the patient meet the expected outcomes, the interventions should be changed.

INJURIES OF THE SPINE AND SPINAL CORD

Etiology

A person may suffer from injury to the spinal cord in a number of ways. Injury in the cervical and lumbar areas is more frequent because these segments are more mobile. Automobile accidents, gunshot wounds, diving accidents, and other forms of trauma often inflict severe damage to the spinal cord, but tumors, degenerative disease, and infections also can impair the functions of the spinal cord and its branches. Generally speaking, spinal cord injuries are classified according to their anatomical location; that is, cervical, thoracic, lumbar, or sacral (Figure 22–8). Whatever the cause of spinal cord injury, motor and sensory losses may occur. The amount of loss of function and sensa-

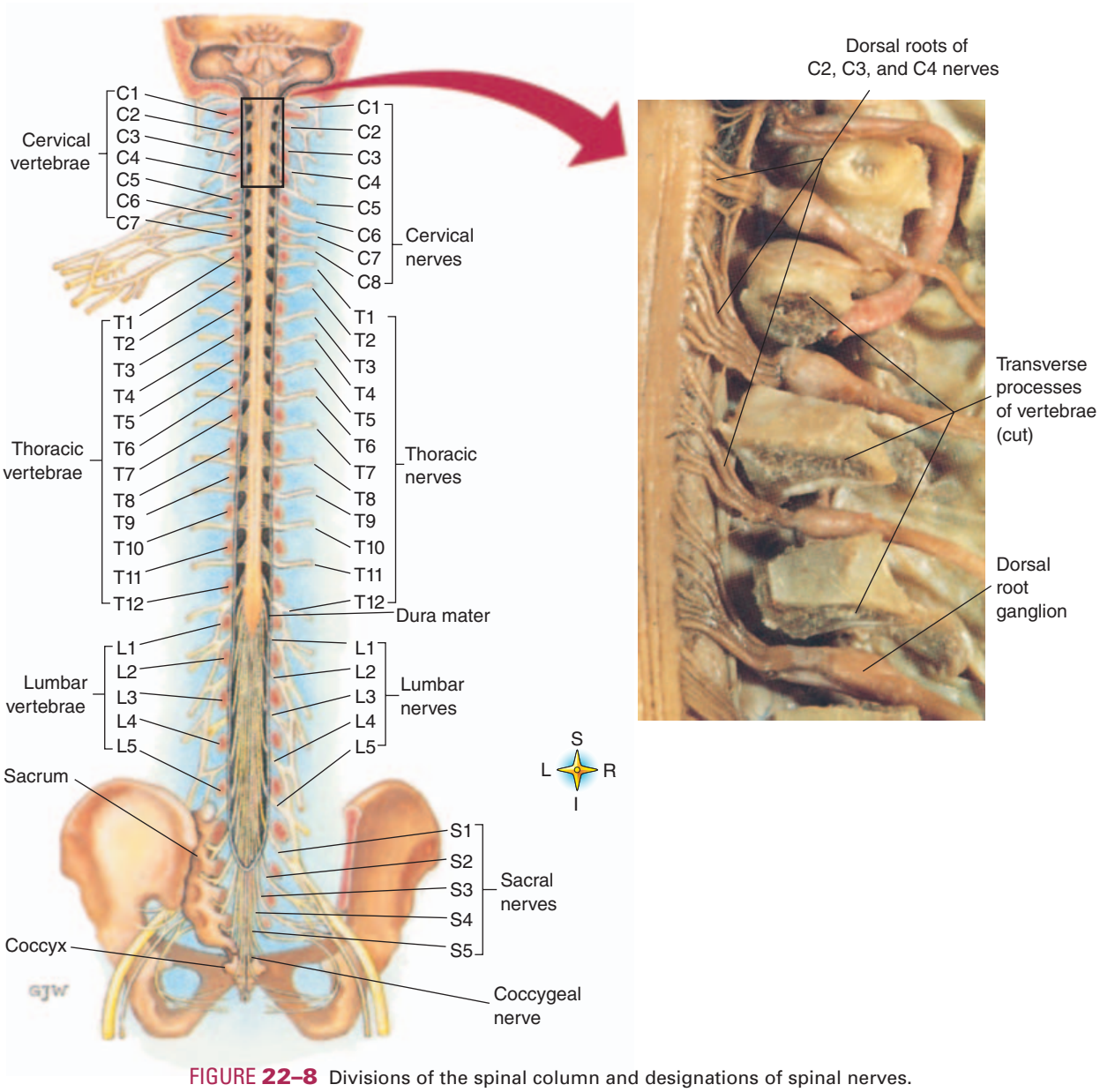


FIGURE **22–8** Divisions of the spinal column and designations of spinal nerves.

tion depends on the level and extent of injury to the spinal cord.

Pathophysiology

Fracture, dislocation, or **subluxation** (partial dislocation) of the vertebral column often results in spinal cord damage. Cord injury is caused by compression, pulling and twisting, or tearing of the cord, with four types of injuries occurring. Penetrating trauma from gunshot or knife wounds or other types of accidents may cause severance, compression, or contusion of the spinal cord. Extreme flexion or hyperextension of the neck, or falling on the buttocks, which causes flexion of the lower thoracic and lumbar spine, all may cause spinal cord damage (Figure 22–9). Tumor growth may compress or destroy spinal cord tissue. Whatever the cause of injury to the spinal cord, nerve transmission to the brain or from the brain may no longer occur below the level of the damage, resulting in paralysis.

Microscopic bleeding occurs in the gray matter immediately after spinal cord injury. Irritation of the cells causes edema to develop and spread along the next one or two cord segments. The edema peaks in 2 to 3 days and subsides in about 7 days after injury. The edema causes temporary loss of function and sensation. Hemodynamic instability with drops in blood pressure may cause decreased blood flow and hypoxia in the cord that increases the initial damage. The inflammatory process may injure the myelin covering the axons, and the chemical and electrolyte changes interrupt nerve impulse transmission.

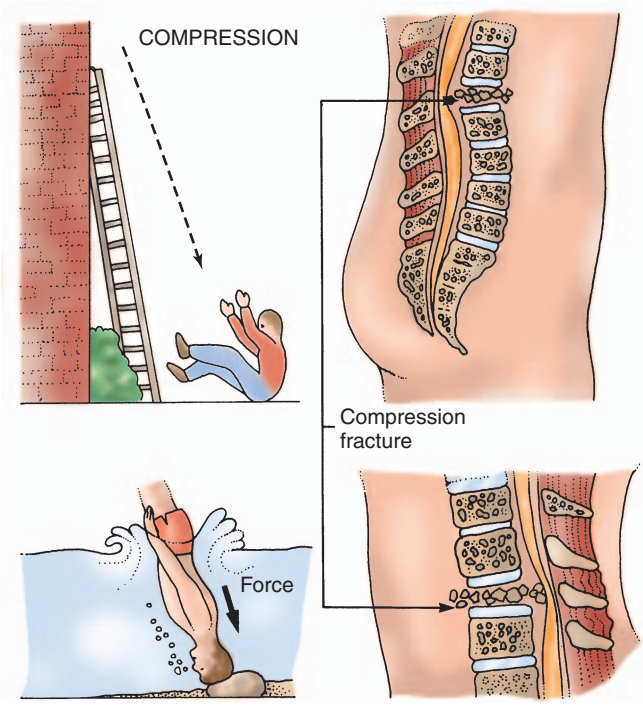


FIGURE **22–9** Accidents can cause vertical compression on the cervical or lumbar spine.

Signs, Symptoms, and Diagnosis

A complete severance, or damage to the entire thickness, of the cord results in a total loss of sensation and control in the parts of the body below the point of injury. If the cord is damaged in the cervical region, the paralysis and loss of sensory perception may include both arms and both legs (tetraplegia), also called **quadriplegia.** Severe injury to the cord above the level of the fifth cervical vertebra often is fatal if emergency care is not immediate because the phrenic nerves that innervate the diaphragm originate in the third, fourth, and fifth cervical segments. Branches of these nerves play a major role in the control of respiration, and when they are severed, respiration must be maintained by artificial means. If the damage is only partial (incomplete) there will be some losses, but not all motor and sensory innervation is lost (Box 22–3).

Interruption of the thoracic spinal cord through L1 and L2 causes **paraplegia** (paralysis of both legs). Table 22–3 presents activities possible at varying levels of cord injury.

Injury to the spinal cord that does not involve complete severance of the cord may result in a temporary paralysis, which may subside as the spinal cord recovers from the swelling and initial shock of the injury.

Diagnosis is by made by physical examination and testing of reflexes. CT scan or MRI may be performed to determine the extent of the damage and to see whether the cord is completely *transected* (severed). This helps determine if neurologic deficits are likely to be permanent. A myelogram may be performed when other tests do not reveal sufficient information.

Box 22–3 ***American Spinal Injury Association (ASIA) Impairment Scale***

A = **Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
B = **Incomplete:** Sensory but not motor function is preserved below the neurologic level and includes the sacral segments S4-S5.
C = **Incomplete:** Motor function is preserved below the neurologic level, and more than half of key muscles below the neurologic level have a muscle grade less than 3.
D = **Incomplete:** Motor function is preserved below the neurologic level, and at least half of key muscles below the neurologic level have a muscle grade of 3 or more.
E = **Normal:** Motor and sensory function are intact.

From American Spinal Injury Association, Atlanta, GA

Treatment

There are four main objectives in the treatment and nursing care of the patient with an injury of the spinal cord:

- To save the victim's life
- To prevent further injury to the cord by careful handling of the patient
- To repair as much of the damage to the cord as possible
- To establish a routine of care that will improve and maintain the patient's state of health and prevent complications, so that eventual physical, mental, and social rehabilitation is possible

As soon as an injury to the spinal cord occurs, the patient must be handled with extreme care (Safety Alert 22–1). Because a nurse or doctor may not be at the scene of the accident to supervise the moving of the victim, laypersons should learn the proper emergency care of such injuries. When an accident victim complains of neck or back pain, or cannot move the legs or has no feeling in them, treat the victim as if she has a spinal cord injury. **To avoid flexion of the neck, *no pillow or other kind of support is placed under the head. Do not move the victim unless life-threatening conditions require it.***

Transfer of the patient to the hospital should be done only by trained emergency medical technicians or others qualified to administer first aid and immobilize the spine. In the emergency department of the hospital, the patient's condition is stabilized and a thorough examination is conducted to establish the extent of her injuries. A large dose of methylprednisolone, a corticosteroid, may be given as soon as the examination and diagnosis of cord injury is made. If given within 8 hours of injury, it is thought to mini-

Table 22–3 *Level of Spinal Cord Damage, Function Present, and Activities Possible*

LEVEL OF INJURY	FUNCTION PRESENT/NEUROLOGIC DEFICIT	ACTIVITY POSSIBLE
C1-C3	No respiratory function; usually fatal unless immediate emergency help is available to establish respiration Quadriplegia	Respirations stimulated with phrenic pacemaker. Can manipulate electric wheelchair with breath, chin, or voice control.
C4	Loss of diaphragm movement; breathe with assistance Quadriplegia	May live if assisted respiration is begun immediately. Can use a mouthstick to turn pages, type, or write.
C5	Partial shoulder movement; partial elbow movement	Can turn head. Able to feed self with special adaptive devices. Able to move wheelchair for short distances, moves well with electric wheelchair. Can assist a bit with self-care.
C6	Retains gross motor function of arms; partial shoulder, elbow, and wrist movement possible Paraplegia	Needs adaptive devices; may be able to propel wheelchair. Independent in feeding and with some grooming with adaptive devices. Can roll over in bed. Can drive a car with hand controls. Can assist in transfer. Can self-catheterize the bladder.
C7	Shoulder, elbow, wrist, hand partial movements possible Paraplegia	Manipulates wheelchair with arms; transfers to and from chair; may drive specially fitted car. Excellent bed mobility. Independent in most ADLs.
C8	Normal arm movement; hand weakness Paraplegia	Bed and wheelchair independent. Can perform most ADLs and may achieve vocational and recreational goals. Performs self-catheterization.
T1-T10	Normal arm movement and strength; loss of bowel, bladder, and sexual function	May achieve walking with braces. Able to perform ADLs and achieve vocational and recreational goals.
T11 and below	Loss of bowel, bladder, and sexual function	Wheelchair not essential. Able to perform ADLs, work, and recreation activities.

Key: *ADLs,* activities of daily living.

Safety Alert 22–1

Prevent Further Spinal Injury

Anyone with a head injury is treated as if she has also suffered a spine injury until proven otherwise. The neck must be stabilized to prevent any movement. When no cervical collar is available, use a shirt, towel, coat, or other material rolled and placed around the neck as a collar to keep the neck as straight as possible, preventing it from flexing or hyperextending. If the victim must be moved to safety, she should be rolled like a log, as one straight piece, onto a flat surface, such as a piece of plywood or a door removed from its hinges. She is rolled as one piece onto her side, the flat surface placed beside her, and then she is carefully rolled back onto the board. This is done slowly and carefully to avoid twisting or bending the spinal column. The victim is kept still.

mize further damage and improve the return of both motor function and sensation (National Institute of Health, 2006). Use of a corticosteroid is controversial due to recent research about the lack of evidence of benefit versus the many side effects of the drug.

Normal saline is used for fluid replacement, and drugs such as dopamine (Intropin) may be given to sustain a sufficient blood pressure to prevent cord hypoxia. Pulmonary edema, and increased ICP if a head injury is present, are potential problems, and fluid balance is watched carefully.

Respiratory Management. Intubation and mechanical ventilation is often required to sustain life in patients with an injury at C5 or above. Patients with intact phrenic nerve innervation may receive a phrenic nerve stimulator that assists them to breathe by stimulating action of the diaphragm. Patients who can breathe when they first arrive at the hospital may be intubated because as cord edema progresses, respiration may become impaired. Mechanical ventilation relieves the muscle work of breathing and conserves the patient's energy during the emergent phase of the injury. An oral airway may be placed if a tracheostomy is unnecessary.

Immobilization and Surgery. Surgery on the spine with removal of bone fragments is performed to relieve pressure, provide stabilization, and prevent further injury. **Cervical spinal cord injury is usually treated with traction to immobilize the affected vertebrae and maintain alignment.** Traction can be accomplished by a head halter; skeletal traction using Crutchfield or Gardener-Wells tongs with ropes, pulleys, and weights (Figure 22–10); or a halo ring and fixation pins (Figure 22–11). The halo is often used for cord injury not requiring surgery and allows for early ambulation.

Selecting the type of bed to be used for a patient with spinal cord injury depends on many factors. Some physicians and nurses prefer placing the patient in a special lateral rotation bed designed to prevent the problems of immobility while maintaining traction (Figure 22–12). If halo traction is used and the patient

FIGURE **22–10** Crutchfield tongs for cervical traction.

FIGURE **22–11** Halo traction vest for cervical stabilization. Note the rigid shoulder straps and encompassing vest. Various vest sizes are available prefabricated. The halo ring superstructure and the vest are magnetic resonance imaging (MRI) compatible.

has an incomplete spinal cord injury, a standard orthopedic bed may be used. All measures to prevent the problems of immobility are instituted (see Chapter 9).

Urinary Management. An indwelling urinary catheter is inserted to prevent bladder distention and protect the skin from reflex bladder emptying. After the first week, a bladder management program will be initiated (see Chapter 21).

Psychological Care. The short-term and long-term psychological changes brought about by spinal cord injury and paralysis are difficult, if not impossible, to measure. Adjustment to such a drastic change in one's lifestyle is a continuous process that may well last a lifetime (see Chapter 9).

Grief and Mourning Response. Sustaining a spinal cord injury that causes permanent neurologic deficit brings with it many losses. Most patients experience

FIGURE **22–12** The Roto-Rest oscillating bed.

grief and mourning of the losses experienced and the changes that such losses bring to their roles and lifestyle. Table 22–4 presents a review of the stages of grief and the behaviors that might be seen. Use active listening, be supportive, and help the patient to focus on positive strengths and possibilities for the future.

Sexual Concerns. One area of concern to the patient and her family members that sometimes receives inadequate attention is that of sexual function and sexuality following spinal cord injury. Discussions of sexual conduct and the larger concept of human sexuality are not easily approached and participated in by many individuals. The nurse who wishes to help a patient deal with problems of sexuality must first come to terms with his own feelings and attitudes and clarify his own values. He should not be critical or judgmental in his discussions about the patient's sexuality. The patient and her partner must be encouraged to verbalize their concerns and questions and should be given guidance in alternative ways to express sexuality and meet sexual needs.

Complications

Spinal Shock (Neurogenic Shock). The disruption in the nerve communication pathways between upper motor neurons and lower motor neurons immediately causes spinal shock. It is characterized by flaccid paralysis, loss of reflex activity below the level of the damage, bradycardia, hypotension, and occasionally paralytic ileus. Vital signs become labile. Treatment is aimed at maintaining adequate blood pressure and heart rate.

Muscle Spasms. Immediately after a cord injury, the patient will usually have a flaccid type of paralysis. Later, as the cord adjusts to the injury, the paralysis will become spastic, and there will be strong, involuntary contractions of the skeletal muscles.

Table 22–4 ***Stages of Grief and Associated Behaviors***

STAGE OF GRIEF OR MOURNING	FREQUENT BEHAVIORS SEEN
Shock and denial	Complete dependence, withdrawal, excessive sleep, struggle for survival, unrealistic expectations.
Anger	Hostility toward caregivers and family, manipulative behavior, abusive language, refusal to discuss paralysis and losses, decreased self-esteem.
Bargaining	Bargaining with a higher power or fate: "If you'll let me walk again, I'll pray every day."
Depression	Sadness, "blue" mood, withdrawal, insomnia, agitation, refusal to participate in education for self-care, suicidal thoughts and comments.
Adjustment	Begins active participation in therapy and education for self-care, planning for future, expresses hope for future functioning, finds meaning in whole experience of injury and therapy, return of usual personality.

These muscle spasms, which may be violent enough to throw the patient from the bed or wheelchair, must be anticipated and the patient secured so that accidents can be avoided. If the upper extremities are involved, she is likely to tip over glasses, water pitchers, or anything within reach of her arms when seized with uncontrollable muscle spasms.

The patient and family may interpret these spasms as a return of voluntary function of the limbs and will have false hopes of complete recovery. The nurse or the physician must explain to them that these spasms are frequently seen in patients with spinal cord injuries.

To avoid stimulating the muscles when moving the patient and thereby precipitating a spasm of the muscles, avoid grasping the muscle itself. The palms of the hands are used to support the joints above and below the affected muscles. The administration of antispasmodic medications such as baclofen (Lioresal) may decrease the severity of the spasms (Table 22–5).

Autonomic Dysreflexia (Hyperreflexia). Autonomic dysreflexia (AD) is an uninhibited and exaggerated reflex response of the autonomic nervous system to some form of stimulation. It is a response that occurs in 85% of all patients who have spinal cord injury at or above the level of the sixth thoracic vertebra (T6), The response is potentially dangerous to the patient, because it can produce vasoconstriction of the arterioles with an immediate elevation of blood pressure. The sudden hypertension can, in turn, cause a seizure, retinal hemorrhage, or a stroke. Less serious effects include severe headache, changes in pulse rate, sweating and flushing above the level of the spinal cord lesion, and pallor and "goose bumps" below the level of injury.

It is important for nurses and others participating in the care of a patient with quadriplegia and other kinds of spinal cord disorders at or above the T6 level to be aware of the circumstances that can trigger AD, its manifestations, and the correct measures to take if it happens. The problem can occur any time after a spinal cord injury; in some cases it has first appeared as late as 6 years after the injury.

There are many kinds of stimulation that can precipitate AD. Most are related to the bladder, bowel, and skin of the patient. For example, catheter changes, a distended bladder, the insertion of rectal suppositories, enemas, and sudden changing of position can provide the stimulation that results in AD (National Spinal Cord Injury Association, 2006). EB

Clinical Cues

Careful attention must be paid to keeping the bladder from becoming overdistended. Check the catheter and drainage tubing for the indwelling catheter every couple of hours if the patient is on bed rest. Monitor output and time of voiding for the patient without an indwelling catheter and palpate the bladder for distention every few hours when voiding has not occurred.

Once the patient exhibits symptoms of AD, an emergency exists. Efforts should be made to lower blood pressure by placing her in a sitting position or elevating her head to a 45-degree angle. If the cause of the stimulation is known—for example, an impacted bowel, overdistended bladder, or pressure against the skin—the stimulus should be removed as gently and quickly as possible. The physician should be notified immediately so that the appropriate medications can be prescribed and administered. Patients who experience repeated attacks of AD may require surgery to sever the nerves responsible for the exaggerated response to stimulation (Agency for Healthcare Research and Quality, 2007). EB

Orthostatic Hypotension. Vasoconstriction is impaired after spinal cord injury, and the lack of muscle function in the legs causes pooling of blood in the lower extremities. Sudden change in position from supine to sitting or sitting to standing may cause dizziness and fainting. Compression stockings, moving slowly, and a reclining wheelchair may help prevent this problem.

Deep Venous Thrombosis. Decreased blood pressure combined with lack of muscle movement slows venous return to the heart. Thrombosis may occur. Compression stockings, sequential compression devices, and/or heparin injections may be needed to prevent deep venous thrombosis.

Table 22–5 ***Medications Commonly Used for Patients with Head and Spinal Cord Injury***

CLASSIFICATION	ACTION	NURSING IMPLICATIONS	PATIENT TEACHING
CORTICOSTEROID			
Methylprednisolone (Solu-Medrol)	Decreases inflammation by suppression of leukocyte migration to injury site; decreases capillary permeability.	Give as IV bolus. May cause insomnia, increased susceptibility to infection, and GI distress. May delay wound healing. Monitor electrolyte levels. H_2 receptor blocker or proton pump inhibitor often given concurrently to prevent stress ulcer.	Advise to report heartburn or stomach pain.
SKELETAL MUSCLE RELAXANT			
Baclofen (Lioresal)	Inhibits synaptic responses in CNS by decreasing GABA, thereby decreasing frequency and severity of muscle spasms.	Monitor for seizure activity. Observe for muscle weakness and fatigue. Assess for allergic symptoms: rash, fever, respiratory distress.	Advise not to drink alcohol as it increases CNS depression. Do not discontinue medication quickly or abruptly.
ADRENERGIC ACTION VASOCONSTRICTOR			
Dopamine (Intropin)	Acts on alpha receptors causing vasoconstriction in blood vessels, thereby raising blood pressure.	Monitor vital signs closely; assess for chest pain. Monitor I&O. Place patient on a cardiac monitor during therapy. May cause nausea, vomiting, or diarrhea. Be certain that IV access is patent as drug will cause necrosis if extravasation into the tissue occurs.	Explain purpose of drug is to raise blood pressure so that brain has adequate perfusion and oxygen. May cause headache.
OSMOTIC DIURETIC			
Mannitol	Increases osmotic pressure of glomerular filtrate; promotes diuresis.	Monitor vital signs closely. Track I&O, assess skin turgor and mucous membranes for signs of dehydration. Monitor electrolytes. Observe for nausea, backache, hives, and chest pain.	Explain that the drug will cause increased urine output and that this is its intended action.
NEUROMUSCULAR BLOCKING (PARALYZING) AGENT			
Pancuronium (Pavulon)	Inhibits transmission of nerve impulses, producing skeletal muscle relaxation for surgery, endotracheal intubation, and mechanical ventilation when patient is fighting the ventilator.	Be certain that alarms are properly set on the ventilator. Observe patient frequently. Keep Ambu bag at bedside. Monitor electrolytes and I&O. Observe for urinary retention. Observe for allergic reaction: rash, fever, pruritus. Protect the eyes with artificial tears and keep lids closed.	Explain that patient will be paralyzed and unable to move. Assure that she will be monitored at all times and that there are backup measures in place in case of power outage when ventilator wouldn't work.

Key: *CNS,* central nervous system; *GABA,* gamma-aminobutyric acid; *GI,* gastrointestinal; H_2, histamine$_2$; *I&O,* intake and output; *IV,* intravenous.

Infection. Impaired respiratory muscles with decreased cough and shallow respirations predisposes the patient with spinal cord injury to respiratory infection. Mechanical ventilation with intubation provides an avenue for microorganisms to enter the lungs and is a risk factor for infection. Urinary catheterization for loss of bladder control is a risk factor for infection as well.

Skin Breakdown. Lack of sensation and inability to move for repositioning places the patient at great risk for skin breakdown and pressure ulcers. Pressure-relieving devices, meticulous skin care with regular inspection, and manual repositioning are essential to prevent this problem.

Renal Complications. Urinary reflux from the bladder to the kidney often occurs due to impaired bladder function. Catheterization and immobility predispose to bladder infection, which may travel up the ureters to the kidneys. Permanent damage may eventually occur from the infections.

? *Think Critically About . . .* Can you name three care interventions that might trigger an episode of AD? How could you possibly avoid causing this reaction?

NURSING MANAGEMENT

There often is a tendency to treat a physically disabled patient as if she were less than a "whole" person with the same desires, hopes, and anxieties that all humans share. The nurse can serve patients by reacting to and

interacting with them in an open and honest manner. When the nurse feels unprepared to handle a certain problem, there is no reason not to readily admit embarrassment, confusion, or lack of information and seek assistance from other members of the health care team. Rehabilitation of patients with spinal cord injuries is discussed in detail in Chapter 9.

Assessment (Data Collection)

Continued assessment for signs of decreased oxygenation, blood pressure instability, infection, skin breakdown, gastrointestinal or nutrition problems, and urinary problems is essential. A daily review of systems and collection of data regarding physical status is performed. Assessment of a tracheostomy tube, traction devices and pins, correct placement and use of sequential compression devices or compression stockings, indwelling catheter, IV cannula, feeding tube, and the like is essential each shift.

FIGURE **22–13** Log rolling procedure using a lift sheet and three people.

Nursing Diagnosis

Nursing diagnoses appropriate for the patient with a spinal cord injury may include:

- Impaired gas exchange related to paralysis, diaphragm fatigue, or retained secretions
- Impaired physical mobility related to vertebral column instability, disruption of the spinal cord, and traction
- Decreased cardiac output related to hypotension and decreased muscle action causing venous pooling
- Imbalanced nutrition: less than body requirements related to increased metabolic demand from healing injuries, slowed gastrointestinal motility, and inability to feed self
- Impaired urinary elimination related to decreased innervation of the bladder
- Constipation related to loss of nerve stimulation to the bowel and immobility
- Risk for autonomic dysreflexia related to reflex stimulation of sympathetic nervous system
- Risk for skin impairment related to immobility and loss of sensation
- Risk for ineffective coping related to loss of control over bodily functions and altered lifestyle secondary to paralysis
- Disturbed body image related to paralysis and loss of control over bodily functions
- Interrupted family processes related to change in role within the family because of neurologic deficits
- Dysfunctional grieving related to neurologic deficits and changes in roles and lifestyle

Planning, Implementation, and Evaluation

Specific, individual expected outcomes are written for each nursing diagnosis supported by data gathered. Long-term goals are considered, and planning for rehabilitation begins with hospitalization. The patient will often be transferred to a rehabilitation facility for intensive rehabilitation and retraining in activities of daily living.

Care for the patient with a spinal cord injury can be very complex depending on the level of the injury. Often a head injury accompanies the trauma to the spinal cord. When a stabilization device is in place on the head, assessment and care of the pin sites is performed every shift initially and then twice a day. Sterile technique is used and is performed according to agency policy. Solutions such as sterile normal saline, hydrogen peroxide, or ointments such as povidone-iodine or bacitracin may be used. Weights used for cervical traction must be kept hanging free to be effective. Traction pull should never be interrupted. If the patient is wearing a halo fixation device, skin care must be given frequently and the skin checked to see that the jacket or cast is not causing pressure ulcers. One finger should be able to slip easily beneath the cast or jacket to be sure it is not too tight. The patient is never moved or turned by holding or pulling on the halo device. **The halo jacket is never unfastened unless the patient is supine as head movement will immediately occur.** Moving the patient as a unit, or "log rolling," must be done with extreme care to avoid twisting the vertebral column and further damaging the spinal cord (Figure 22–13, Assignment Considerations 22–1).

All the nursing measures designed to prevent the disabilities that may result from immobility, to promote healing, and to avoid complications are used to help the patient achieve the goals of rehabilitation. Bladder and bowel training programs, as well as instruction in moving from bed to chair and other aspects of self-care, may be necessary. Realistic goals should be set for the patient and every effort made to achieve them.

Assignment Considerations 22–1

Inappropriate Delegation

Although many tasks may be delegated to the certified nursing assistant (CNA) or UAP, moving or positioning the patient with neurologic injury or surgery should *not* be delegated. If given proper, complete instructions, the CNA or UAP may help log roll the patient with the nurse's help and supervision.

Implementation of actions requires encouraging the patient to do whatever she can for herself as soon as feasible. The overall goal is to promote as much independence as possible. A great deal of encouragement and praise are required. You can be a pillar of support for the patient.

Evaluation is ongoing to see if the interventions have been successful in achieving the expected outcomes. If they have not been successful, the plan is rewritten.

Rehabilitation

A full team of professionals will be involved in the care and rehabilitation of the patient with a spinal cord injury. The physical therapist, occupational therapist, psychologist, physician, respiratory therapist, pharmacist, and ancillary personnel will collaboratively plan the patient's care. The patient and family are often invited to participate in the planning process.

The use of robotics and computers is providing hope for some patients to walk again (Barker, 2005). A system called functional electrical stimulation (FES) is used to generate neural activity and overcome lost function. The system stimulates muscles to make walking motions. The patient is suspended in a harness to support body weight and is retrained to walk using a treadmill. Research is underway on a neuroprosthetic microchip implant that would help certain patients to walk again. A pacemaker for the bladder is under study for the treatment of urinary incontinence.

Communication between team members is crucial to the success of the individual plan. When the patient is discharged, all plans and specifics required for her care must be shared with home caregivers and home care nurses who will be involved in her care. Her primary physician must be fully briefed.

BACK PAIN AND RUPTURED INTERVERTEBRAL DISK ("SLIPPED DISK")

Etiology

Back pain is surpassed only by headache pain. Emergency physicians treat more than 6 million cases of back pain annually. In people under age 45, it is the most common cause of work absence and is the most costly health condition for employers. Carelessness and incorrect methods of lifting contribute to a large percentage of back problems. On-the-job accidents and resultant trauma to the spine are another cause. Obesity and lack of exercise, and poor lifting and moving techniques, contribute to the stress placed on the back muscles and to the occurrence of injury or the severity and duration of pain. Exercise promotes good muscle tone. Other risk factors include lack of exercise causing poor muscle tone, poor posture, cigarette smoking that decreases oxygenation to the disks and predisposes to degenerative disease, and stress. Repetitive heavy lifting also may cause back pain. This is often a factor for health care workers. Causes of musculoskeletal back pain include:

- Acute lumbosacral strain
- Instability of lumbosacral spine
- Osteoarthritis of the spine
- Intervertebral disk degeneration
- Herniation of the intervertebral disk

Preventing back pain and disorders begins with proper posture and the use of correct lifting techniques. Maintaining one's weight within normal limits also helps decrease back strain. Sufficient physical exercise that maintains the condition of the back muscles and specific exercises to strengthen the abdominal and back muscles can greatly decrease the repeated incidence of back pain.

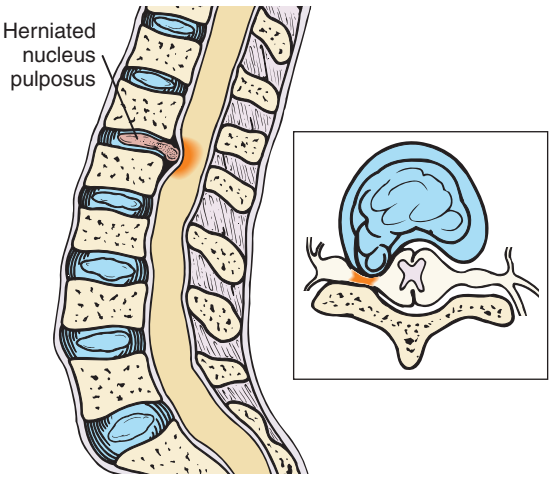


FIGURE 22–14 Herniated disk (nucleus pulposus) with compression of spinal cord.

Pathophysiology

The bodies of the vertebrae lie flat on one another like a stack of coins. Between the vertebral bodies there is a disk of fibrous cartilage filled with gelatinous substance (in the nucleus) that acts as a cushion to absorb shocks to the spinal column. This disk may be ruptured by an injury, such as strain caused by lifting a heavy object or wrenching or falling on the back. When the disk ruptures, part of the contents squeeze out from between the vertebrae and disk fragments may lodge in the spinal canal. The disk compression on the adjacent nerve root causes the pain (Figure 22–14). When protein from the disk contents leaks out into the canal, the body perceives it as a foreign substance, causing an inflamma-

tory response and pain. Thus the person suffers from what is sometimes called a "slipped disk." Another name for this condition is *herniated nucleus pulposus.*

Elder Care Points

The older person has decreased flexibility of the spine and, as age increases, degeneration of the spine. Many elderly suffer from osteoporosis and osteoarthritis. These factors make the elderly person more prone to back pain, especially if regular exercise is not performed to maintain flexibility and bone density.

Acute back pain usually occurs from activity that put stress (hyperflexion) on the tissues of the lower back. Back pain that is a result of muscle spasm is usually self-limiting and often resolves within 4 weeks. Chronic back pain is pain that lasts for more than 3 months or is a repeat episode. It may be due to degenerative disk disease or osteoarthritis, but lack of exercise, prior injury, and obesity are frequent factors.

The most common sites of disk rupture are L4-L5 and L5-S1. Herniation may also occur at C5-C6 or C6-C7.

Signs, Symptoms and Diagnosis

Sometimes a lumbar herniated disk causes pain radiating down the sciatic nerve into the buttock and below the knee. Muscle weakness and paresthesias may occur. Cervical herniated disk causes pain in the neck and shoulder, radiating down the arm with numbness and tingling in the hand. Muscle tightening and spasm in the area of injury is common.

Diagnosis requires a history and physical examination. The straight-leg-raising test is often used for low back pain. While supine, the leg is raised off the bed or examination table and the foot is flexed. The test confirms a disk problem if there is pain in the low back. Reflexes may be decreased or absent. The patient may experience muscle weakness or paresthesias in the legs or feet.

If conservative therapy does not relieve the pain, diagnostic x-rays, MRI, or CT scanning is performed. An electromyogram may be ordered to determine the degree of nerve irritation and to rule out other pathologic conditions.

Treatment

In most instances, the physician will treat back pain initially with conservative measures in the hope that surgical correction will not be necessary. If there is no sciatic pain, bed rest is not recommended as the research has shown that walking provides a quicker recovery. When sciatic pain is present, bed rest for 2 to 3 days is helpful. During this period, the patient is encouraged to get up and walk around every 2 to 3 hours while awake even if this causes pain (Hilde, 2005). Ice packs are applied for 5 to 10 minutes at a time each hour for the first 48 hours to reduce muscle spasm in the back. After 48 hours, heat may be more helpful as it relaxes strained muscles. Ultrasound treatments are often helpful. Heating pads, hot packs, and hot showers work well to relax the muscles (Complementary & Alternative Therapies 22–1). A study done at Johns Hopkins showed that wearing a portable heat wrap for 8 hours on 3 consecutive days decreased pain by 60% in a group of patients with back pain. Transcutaneous electrical nerve stimulation may help relieve the patient's pain. Back strengthening exercises are prescribed as soon as acute symptoms subside and are initially supervised by a physical therapist. The exercises are encouraged for a lifetime as muscles need to be toned to prevent back strain. Specially designed corsets or back braces are sometimes used to maintain proper alignment of the spine when the patient is allowed out of bed. The patient is cautioned not to lift anything heavier than 2 to 5 lb and not to twist when reaching for things. The patient should be up moving about frequently rather than sitting for long periods. High heels should be avoided.

Complementary & Alternative Therapies 22–1

Help for Pain

Acupuncture, acupressure, and massage therapy have all proven beneficial for back pain. Research from the National Institutes of Health has proven that acupuncture is effective for back pain. For those with chronic back pain, it certainly is worth trying. Massage and acupressure help relieve muscle spasm, especially when heat is applied to the affected muscles first.

Swimming or walking for short distances frequently is very beneficial. Standing for long periods is to be avoided, and when standing, the patient should shift weight from one foot to the other frequently. Adjustments and treatments by a chiropractor may also help relieve pain, although chiropractic treatment is not appropriate for all types of back injuries. Chiropractic help seems most effective if the pain has been present less than 16 days and the pain is all above the knee.

If pain continues beyond 3 to 4 weeks, there is evidence of neurologic deficit, or pain is worsening, surgery may be indicated.

Gentle yoga movements have been more successful in relieving pain than prescribed back exercises for many patients. For others, core body stretching and muscle strengthening works well.

Surgical Procedures. For those patients who cannot find relief through conservative measures, surgical removal of the damaged disk may be the only alternative. A diskectomy often is performed to decompress the nerve root. This is a microsurgical technique that utilizes a very small incision through which the herniated intervertebral disk material is dissected and extracted. If the area cannot be handled with microsur-

gery, an open incision diskectomy or laminectomy, which involves removal of the posterior arch of the vertebra along with the disk, is done. A laminectomy may be done in conjunction with spinal fusion.

A percutaneous laser diskectomy is an outpatient procedure. A tube is passed through the retroperitoneal soft tissues to the disk's lateral border. Local anesthesia and fluoroscopy are used during the procedure. A laser is utilized to cut away and destroy the herniated portion of the disk. Small stab wounds are used, there is minimal blood loss, and rehabilitation time is shorter.

A spinal fusion is necessary in some patients to stabilize the spine. In a spinal fusion, a piece or pieces of bone from the iliac crest or cadaver bone are grafted onto the vertebrae to strengthen them. Fixation with metal rods and screws may be employed to decrease spinal motion and irritability. A new device, the InFuse Bone Graft/LT-CAGE, is being used to avoid the need to use bone from the patient for grafting (Perina, 2006). Genetically engineered protein contained in the device stimulates new bone growth at the site.

A laminectomy may be done for conditions other than a ruptured disk—for example, for such degenerative diseases of the spine as Pott's disease (tuberculosis of the spine), for fractures of the spine, and for spinal dislocation. Once a laminectomy with a fusion has healed, the fused vertebrae are immobile.

Nursing Management

Preoperatively, a baseline neurologic assessment is performed and documented (Focused Assessment 22–1). Other preoperative care is the same as for other types of general surgery. The major concern after spinal fusion, laminectomy, or diskectomy is to keep the spinal column in alignment so that healing can take place and no further injury occurs to the spinal cord. Pillows are placed under the thighs when the patient is on her back and between the legs when on the side to maintain correct spinal alignment and decrease the pressure to the back. If the surgeon allows the patient to be turned to the side, log rolling is used to avoid twisting the spine (see Figure 22–14). Sometimes the surgeon will allow the patient to be positioned only on the back or sometimes the abdomen. Whenever the patient's position is changed, there should be ample people to help move her. The patient who has had cervical spine surgery is placed in a cervical collar and continues to wear a collar for several weeks.

When the laminectomy or spinal fusion patient is allowed out of bed, the physician sometimes orders a back brace or corset to support the spinal column until complete healing has occurred. The patient is not allowed to sit for any length of time for several weeks. She must walk or lie down. Standing for long periods is discouraged. The microdiskectomy patient is usually up and about the day after surgery. However, weeks to many months of exercises and physical therapy are necessary before recovery is complete.

Focused Assessment 22–1

Data Collection Following Spinal Surgery

Immediately postoperatively, assess every 15 to 30 minutes; after first 4 hours, assess every 2 to 4 hours postoperatively. Assess the following areas and compare findings with preoperative data:

SENSATION
- Check extremities for numbness and tingling.
- Check all anatomical surfaces of forearms and hands, upper and lower legs, and feet.

MOVEMENT
- Check for ability to move shoulders, arms, hands, legs, and feet.

MUSCLE STRENGTH
- Check each extremity for weakness by having the patient push against your hands while you apply downward pressure to the extremity.

WOUND
- Assess surgical (and donor) site for drainage, noting amount, color, and characteristics.
- Check carefully for signs of CSF leak at surgical site.
- Determine adequacy of analgesia.

PAIN
- Assess for site of pain, characteristics of the pain, and degree of pain on a scale of 1 to 10, with 10 being the worst pain.
- Reevaluate pain after administering analgesia for effectiveness.
- Monitor respirations and vital signs.

SKIN PRESSURE POINTS
- Check for reddened areas on bony prominences when turning patient.

Key: *CSF,* cerebrospinal fluid.

Clinical Cues

At the time of discharge, the instructions about not sitting or standing for any length of time should be reinforced. Patients tend to overdo when they get home and become very fatigued, have more pain, and become discouraged.

An IV opioid may be ordered for pain control the first 24 to 48 hours after surgery. It is usually administered by patient-controlled analgesia pump. Additional boluses for adequate pain control may be needed. Assess frequently for effectiveness of the pain medication. Once fluids are being taken, oral analgesia is started with acetaminophen with codeine, hydrocodone (Vicodin), or oxycodone (Percocet). Muscle relaxers may be given as well.

After spinal surgery a small fracture bedpan is used for toileting if the patient is not to be allowed up. The patient's back is firmly supported while she is resting

on the pan. The back and legs should be supported so that all of her body is on the same plane. When the patient is steady enough to be allowed out of bed, a bedside commode, or for the male patient, standing at the bedside is encouraged to promote complete bladder emptying. Provide privacy for toileting activity. If difficulty with voiding occurs, intermittent catheterization or an indwelling catheter will be required.

Interference with bowel function and paralytic ileus may occur after laminectomy or spinal fusion. Observe for nausea, abdominal distention, return of bowel sounds, and constipation. Stool softeners are used to help prevent constipation. Incontinence or difficulty with bowel evacuation may indicate nerve damage and should be reported to the surgeon.

Activity allowed varies according to the underlying pathology and the patient's progress. Be clear about activity orders, whether a brace or corset is to be worn, and whether such is to be put on while lying down, sitting, or standing.

If a bone graft has been performed, the donor site must be assessed regularly and care provided. Pain is usually greater at the donor site than at the spinal fusion site. If the fibula is the donor site, neurovascular assessments of the limb must be performed on a regular schedule as edema can occur.

Depending on the type of spinal surgery performed, many weeks to months are needed for complete recovery. The patient must learn to perform activities without twisting the spine (Patient Teaching 22–2).

Patient Teaching 22–2

Guidelines for the Patient with Low Back Pain or Spinal Surgery

DO

- Bend knees, with back straight, and crouch to lift an item off the floor.
- Carry items close to the center of your body.
- Perform your back exercises twice a day; periodically review the correct way to do them.
- Maintain appropriate body weight; lose weight if overweight.
- Use a lumbar pillow or roll when sitting and particularly when driving for long distances.
- Stop and walk around at least every 2 hours when on long trips.
- Consider how to safely perform a task before starting to do it.

DO NOT

- Lean over without bending the knees.
- Reach to lift items; lift heavy items higher than level of the elbows.
- Stand for long periods.
- Sleep with legs out straight without pillow cushioning under the thighs or between the legs when on the side.
- Bend from the waist to pick up an item.
- Twist to the side to lift things (e.g., groceries or things in the car or trunk).

Key Points

- Head injuries are open or closed and result in concussion, contusion, acceleration-deceleration injury, skull fracture, and tearing of cranial vessels.
- Subdural or epidural hematoma may result from a head injury; epidural hemorrhage is a life-threatening event.
- A significant head injury causes disruption in normal LOC.
- Drainage from the ear or nose should be evaluated to determine the presence of CSF.
- Symptoms of increasing ICP may be subtle or acute. Changes in LOC, in pupil size and action, and in vital signs are some of the signs and symptoms that occur.
- X-rays, CT scans, and MRI are the most common diagnostic tests for initially determining the extent of a head injury.
- Any lesion or extra fluid that begins to take up space in the cranial vault causes an increase in ICP.
- The earliest sign of increased ICP is decreasing LOC.
- Treatment of increased ICP includes maintaining a patent airway, administering diuretic agents to decrease edema, monitoring neurologic signs for increased ICP, regulating temperature, maintaining adequate blood pressure, and instituting nursing measures to prevent further increases in ICP (see Table 21–9, Nursing Care Plan 22–1).
- Neurologic assessment is performed every 15 minutes to 2 hours for the acute patient with injury or surgery to the brain.
- For maintenance of a patent airway, intubation or a tracheostomy and mechanical ventilation may be necessary.
- Early nutritional support is very important for both head injury and spinal cord injury patients.
- The unconscious patient requires care for all basic needs; the eyes must be protected from injury since the blink reflex may be absent.
- Complications of head injury and increased ICP include hydrocephalus and diabetes insipidus.
- The extent of permanent cord damage often cannot be assessed until many days after injury because of edema and resulting pressure on the cord that it causes.
- The degree of neurologic impairment and activities that the patient will still be able to perform depend on the level and extent of the injury (see Table 22–7).
- Autonomic dysreflexia is potentially very dangerous to the patient as it can severely elevate blood pressure.
- Traction provided by Crutchfield or Gardener-Wells tongs, or a halo ring and fixation pins, immobilizes the spine while healing takes place.
- The patient is included in establishing the long-term care plan, and the goal is to promote as much independence as possible.
- Back pain can be caused by muscle strain or herniated or ruptured intervertebral disk.

- Two controllable factors that contribute to back pain for many people include lack of exercise with poor muscle tone and obesity.
- Back pain should be treated conservatively before surgery is considered.
- A herniated lumbar disk can sometimes cause sciatic nerve pain that runs from the buttock down the leg to below the knee.
- Straight leg raising is a test for a ruptured lumbar disk.
- Treatment depends on whether or not a disk rupture is present and on the severity of the pain and disability.
- Conservative treatment includes rest, gentle exercise, ice or heat, analgesics, and muscle relaxants.
- Surgical procedures include microdiskectomy, laminectomy with or without fusion, percutaneous laser diskectomy, and spinal fusion.
- Postoperative care depends on the type of procedure performed.
- Patients are taught measures to prevent future episodes of back pain.

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NCLEX-PN EXAM STYLE REVIEW QUESTIONS

Choose the best answer(s) for the following questions.

1. A 75-year-old patient was admitted for apparent personality changes, decreased level of consciousness, and irritability. The physician suspects a possible subdural hematoma. A family member asked about the condition. An accurate explanation would be:

1. "It is the presence of bleeding in the brain parenchyma."
2. "Bleeding occurs between the skull and the dura mater."
3. "It is the collection of blood between the brain and the inner surface of the dura mater."
4. "It is the intermittent blockage of circulation in various areas of the brain."

2. The nurse is admitting a patient with a possible periorbital fracture. Which of the following clinical findings would likely confirm the diagnosis? *(Select all that apply.)*

1. Battle's sign
2. Partial blindness
3. Otorhea
4. Rhinorrhea
5. Swallowing difficulty

3. An appropriate nursing intervention to prevent further increases in intracranial pressure for a patient with head injury would be:

1. securing a patent airway.
2. positioning flat in bed.
3. performing passive range of motion exercises.
4. administering large amounts of fluids.

4. The nurse keeps the postcraniotomy patient's neck in midline position and ensures that there is no excessive hip flexion. The rationale for the nurse's action would be:

1. "This position helps restore neutral position of the joints."
2. "This position improves adequate venous drainage."
3. "This position promotes comfort and rest."
4. "This position prevents the formation of blood clots."

5. The nursing assistant is attending to the needs of a patient with head injury who is lethargic and has increased intracranial pressure. Which of the following actions by the nursing assistant indicates a need for further teaching?

1. Stopping the patient from blowing his nose.
2. Monitoring blood pressure.
3. Dangling the patient on the side of the bed.
4. Reporting soaking of the dressings.

6. _____ refers to the classic signs of increased intracranial pressure, including rising systolic blood pressure, widening pulse pressure, and full bounding slow pulse.

7. The surgeon inserts an intraventricular catheter into the lateral ventricle of a patient with increased intracranial pressure. When asked by a relative regarding the procedure, an accurate response by the nurse would be:

1. "The catheter allows direct visualization of the brain tissue."
2. "The catheter is used to monitor brain waves."
3. "The catheter is used to remove excess fluid inside the brain."
4. 'The catheter is used to infuse fluids and medications into the brain."

8. A 40-year-old man with a T4 spinal cord injury suddenly complains of severe headache, increased pulse rate, sweating and flushing above the level of the spinal cord lesion, and "goose bumps" below the level of injury. Immediate nursing actions should include which of the following? *(Select all that apply.)*

1. Place flat in bed.
2. Identify cause of stimulation.
3. Administer antihypertensives.
4. Provide measures to facilitate bowel movement.
5. Clamp indwelling catheter.

9. Which of the following nursing interventions promotes a soothing environment for optimum care of the patient with increased intracranial pressure?
   1. Provide continual background music.
   2. Provide periods of uninterrupted rest.
   3. Apply cooling blankets.
   4. Maintain constant cool airflow in the room.

10. A 30-year-old male patient was admitted to the emergency department after a motor vehicle accident. On examination, the patient was diagnosed with a T6 spinal cord injury. He had flaccid paralysis, slowed heart rate, low blood pressure, and no bowel sounds. The patient must be developing:
    1. autonomic dysreflexia.
    2. muscle spasms.
    3. spinal shock.
    4. diabetes insipidus.

CRITICAL THINKING ACTIVITIES

Read each clinical scenario and discuss the questions with your classmates.

Scenario A

Mary is a 22-year-old college student who has suffered a head injury in an automobile accident. She was healthy prior to her accident. The Emergency Medical Services team brought her to the emergency department (ED). She was stabilized in the ED, cervical spine injury was ruled out, and she was admitted to the neurologic intensive care unit. She is confused and groggy and has leakage of cerebrospinal fluid (CSF) from one ear and irregular respirations.

1. What assessments would you perform?
2. What specific nursing measures would you include in your care plan concerning the leaking CSF?
3. What measures would you take to provide appropriate respiratory care?

Scenario B

Gus Berrini is a 40-year-old truck driver who received a severe spinal injury when he was shot in the back by a hitchhiker. The bullet severed the spinal cord at the sixth thoracic vertebra.

1. What kinds of activities should Mr. Berrini eventually be able to perform?
2. How would you plan his care during the acute stage of his illness so that efforts at rehabilitation might be successful?
3. What other members of the health care team might participate in his care and rehabilitation?