Chapter 27 Clients with Neurosensory System Disorders

Structure and Function of the Nervous System

° Central nervous system (CNS) [corresponds to Figure 27-1]
  o Brain and spinal cord are command and integrating centers of the nervous system
  o CNS site of thought, reasoning, memory; and analysis of information from PNS

° Peripheral nervous system (PNS) [corresponds to Figure 27-2]
  o Cranial nerves – impulses to and from the brain
  o Peripheral nerves - convey impulses to and from the spinal cord; vast number of receptors gather information about outside world.
    - Sensory (afferent/ascending) pathways carry sensory impulses toward CNS
    - Motor (efferent/descending) pathways carry impulses to skeletal muscles, glands, effector organs (like heart or pancreas, which are innervated by specific components of the nervous system)

° Functional division of the PNS
  - Somatic nervous system
    ↑ Regulates voluntary control of skeletal muscles (like lifting this book).
  - Autonomic nervous system
    ↑ Regulates automatic (involuntary) control of organ systems (like cardiac muscle and glands)
    ↑ Subdivided into sympathetic (arousing) and parasympathetic (calming, rebalancing)

° Nervous tissue
  o Two principal types of cells—neurons and supporting cells
  o Neurons
    - Transmit nerve impulses from one part of body to another
    - Detect environmental changes and initiate body responses to maintain balance
    - Neurons differ structurally yet have common features [corresponds to Figure 27-3]
      ↑ Cell body containing nucleus
      ↑ One or more processes, or fibers, extending from cell body
      ↑ Dendrites that conduct electrical currents toward the cell body; can be hundreds to one cell
      ↑ Axons that carry nerve impulses away from the cell body; one fiber to one cell
    - Neurotransmission
      ↑ When impulse reaches axonal terminals, it stimulates the release of chemicals (neurotransmitters) into the extracellular space (called the synapse or synaptic cleft). Neurotransmitters [corresponds to Table 27-1]:
        - Help impulse to cross the synapse, or
        - Stop impulse from crossing synapse
Some neurons are physically joined by gap junctions, where electrical currents can flow directly from neuron to neuron.

- Supporting cells - neuroglia – support and protect cells
  - Myelin sheath - whitish fatty material:
    - Covers, protects, and insulates most long nerve fibers
    - Increases transmission rate of nerve impulses.
    - Indentations called nodes of Ranvier formed by Schwann cells.
    - Neurilemma part of Schwann cell outside myelin sheath

With disorders of the myelin sheath, multiple sclerosis and Guillain-Barré syndrome may result.

- Brain tumors (gliomas)
  - Neuroglia are structurally very similar to neurons. However, they are not able to conduct nerve impulses and they never lose their ability to divide.
  - Because neuroglia can divide, most brain tumors are formed by neuroglia and are known as gliomas.

- Neuron cell bodies
  - Clusters of neuron cell bodies in CNS are called nuclei.
  - They need protection within bony skull or vertebral column, because these neurons do not undergo cell division after birth.
  - The cell body carries out most metabolic functions of these neurons. If it is damaged and dies, it is not replaced.
  - Terms: ganglia, tracts
  - White matter - collections of myelinated tracts
  - Gray matter- mostly unmyelinated fibers and cell bodies.

- Afferent and efferent neurons
  - Sensory or afferent neurons carry impulses from sensory receptors to the CNS
  - Motor or efferent neurons carry impulses from the CNS to viscera and/or muscles and glands

- Nerve impulses – electrical
  - Neurotransmission
    - Electrical and chemical impulses
      ▲ Change in electrical potential of plasma membrane
      ▲ Release of neurotransmitters [corresponds to Figure 27-4]
    - A nerve impulse is a self-propagated electrical charge transmitted along the membrane of a nerve fiber.
    - A nerve impulse is much like electrical impulses carried along a telephone line [corresponds with Figure 27-5]
    - Stimulus must occur for electrical impulses to flow through nervous system
    - The potential response is called the action potential.
      ▲ If stimulus is too weak, membrane remains at rest.
      ▲ All-or-nothing response-- either conducted over entire axon or does not happen at all.
- Polarization, normal state of resting neuron
- Depolarization, with generation of action potential
- Repolarization, return to resting state
- These 3 steps describe movement of nerve impulse along unmyelinated fibers.
- Reflex arc [corresponds to Figure 27-6]

  o Reflexes - involuntary responses to stimuli
  • Reflex always goes in same direction and occurs over neural pathways called reflex arcs
  • Reflexes either autonomic or somatic
    † Autonomic - regulates activity of smooth muscles, heart, and glands. (such as digestion, elimination, blood pressure, and sweating)
    - Sympathetic nervous system - "fight-or-flight" response to get body moving in emergencies or exciting situations.
    - Parasympathetic nervous system calms and restores the body. It returns the body to normal balance. [corresponds to Figure 27-7]
    † Somatic – includes all reflexes that stimulate the skeletal muscles
  • Nervous system disorders are suspected whenever reflexes are exaggerated, distorted, or absent.
  • Reflex changes may be early sign of pathologic condition

Brain
  ° Four major regions [corresponds to Figure 27-1]
    o Cerebral hemispheres
    o Diencephalon (interbrain)
    o Brainstem
    o Cerebellum
  ° Cerebral hemispheres
    o Right and left hemisphere with deep grooves (fissures) that separate large regions of the brain.
    o Gyri (elevated ridges) and (sulci) shallow grooves between gyri
    o Fissures divide each cerebral hemisphere into lobes --frontal, parietal, temporal, and occipital.
      • Right hemisphere controls left side of body; organizes visual or spatial information such as art, music, and surrounding physical environment
      • Left hemisphere controls right side of body; responsible for speech, problem solving, reasoning, and calculations.
    o One side always dominant.
    o Functions of hemispheres occur in outermost gray matter of cerebrum, called cerebral cortex
    o Gray matter called basal nuclei also found deep within white matter.
    o Cerebral white matter is deeper in the hemisphere. It is composed of fiber tracts carrying impulses to or from the cortex.
The corpus callosum connects two hemispheres.

Diencephalon or Interbrain
- On top of brainstem; consists of thalamus, hypothalamus, and epithalamus.
- Thalamus relays sensory impulses upward to the sensory cortex.
- Hypothalamus regulates body temperature, water balance, and metabolism; center for thirst, appetite, sex, pain, and pleasure.
- Epithalamus: pineal body and choroid plexus

Brainstem
- Midbrain, pons, and medulla oblongata
- Pathway for ascending and descending tracts and contains areas of gray matter; center for visual and auditory reflexes
- Pons controls respiration.
- Medulla oblongata controls heart rate, BP, respiration, coughing, swallowing, vomiting.
- Reticular activating system associated with consciousness and sleep/wake cycles.

Cerebellum
- Two hemispheres, outer cortex of gray matter, inner region of white matter.
- Provides precise timing for skeletal muscle activity, controls balance, posture, and equilibrium.

Meninges [corresponds to Figure 27-8]
- Three protective membranes that cover brain and spinal cord
  - Dura mater - outer layer, double layered where it covers the brain
  - Arachnoid mater - middle meningeal layer with threadlike extensions that attach it to innermost membrane
  - Pia mater - innermost membrane follows every fold of brain and spinal cord

Cerebrospinal Fluid, CSF
- Similar to blood plasma
- High in glucose
- Few white cells and no red blood cells
- Normal volume is 125 ml to 150 ml
- CSF forms a watery cushion in and around the brain and spinal cord, protecting them from blows and other trauma.
- The cerebrospinal fluid provides nutrient exchange and waste removal.

Blood-brain barrier
- Least permeable capillaries in body, protects brain
- Only water, glucose, and essential amino acids pass through these capillaries easily
- Urea, toxins, proteins, and most drugs prevented from entering

Spinal Cord
- Continuation of the brainstem
- Extends to the first or second lumbar vertebra
- Ends in cauda equina, a collection of spinal nerves
31 pairs of spinal nerves that arise in the cord
Dermatome - area of skin innervated by branches of single spinal nerve
[corresponds to Figure 27-9]

Peripheral Nervous System
- Spinal nerves [corresponds to Figure 27-10]
  - Connect the CNS with rest of the body.
    - Cervical, 8 pairs
    - Thoracic, 12 pairs
    - Lumbar 5 pairs
    - Sacral, 5 pairs
  - Contain sensory and motor fibers
    - Sensory fibers in the dorsal root
    - Motor fibers in the ventral root
    - Both roots attach to the spinal cord.
- Cranial nerves [corresponds to Table 27-2 and Figure 27-11]
  - 12 pairs, begin in the brain or in the brainstem; sensory, motor, or both.

Autonomic Nervous System
- Controls body activities automatically, maintains body balance (homeostasis); called involuntary nervous system

Blood Supply of the Central Nervous System [corresponds to Figure 27-12]
- Brain
  - Internal carotids and the vertebral arteries
  - Circle of Willis provides alternate route for blood flow when one artery is obstructed.
- Spinal cord
  - Blood supply branches off the vertebral arteries and from various regions of the aorta.

Collaborative care
- Assessment of cranial nerve function [corresponds to Table 27-2]
- Diagnosis may involve extensive testing.
  - Imaging techniques
    - X-rays of the head and vertebral column
      - Vertebral column x-rays for spine injury, and back or neck pain; vertebral fractures, traumatic dislocation, subluxation, herniated disk [corresponds to Figure 27-13] or other lesions, and collapsed vertebrae
      - Degenerative changes: scoliosis, spondylolisthesis, and foraminal stenosis
    - Computed tomography (CT)
      - Scanning in successive layers by narrow x-ray beams [corresponds to Figure 27-14]
      - Sometimes with radiopaque medium (dye)
      - Best for rapid diagnosis of type, location, and extent of injury; can be repeated every 2 to 3 days.
↑ Client teaching: client must lie completely still with the head immobilized during the test
↑ Post procedure the client is encouraged to drinks fluids to help rid the body of the contrast dye.
• Magnetic resonance imaging (MRI)
↑ Type of tomography based on magnetic behavior of protons (hydrogen nuclei) in body tissues.
↑ Provides better definition of mass lesions, better visualization of the posterior fossa and brainstem, and an increased ability to detect subtle change in tissue water content; superior for detailed cross sections
↑ Takes more time than the CT scan and is not usually performed in acute or unstable clients
↑ Because of strong magnets, MRI is contraindicated with pacemakers, implanted insulin pumps, transcutaneous nerve stimulators, spinal cord stimulators, cochlear implants, staples from prior surgeries, and penile prostheses.
• Cerebral angiography
↑ Infusion of radiopaque substance into cerebral arterial system via femoral artery; provides information on patency, size, irregularities, and/or occlusion of cerebral vessels.
↑ Used to evaluate cerebral aneurysms and arteriovenous malformations; considered most accurate in evaluating carotid artery stenosis.
↑ Preprocedure teaching, determine any allergies to iodine-based dye, and history of bleeding disorders.
↑ Usually client kept NPO (nothing by mouth) after midnight preceding the test.
↑ Post procedure bed rest 12-24 hours; VS and neurologic assessments done q 15 minutes for the first hour, then q 30 minutes for the second hour and then q hour for the next 4 hours.
• Lumbar puncture
↑ Hollow needle with stylet into lumbar subarachnoid space, strict aseptic technique [corresponds to Figure 27-15]
↑ In adult, needle between L3 and L4, or L4 and L5 vertebrae.
↑ Measures CSF pressure; examines the CSF for blood; collects CSF for laboratory testing; visualizes parts of nervous system by injection of air, oxygen, or radiopaque material; and evaluates spinal dynamics for signs of blockage or CSF flow.
↑ Preprocedure - client should be well hydrated.
↑ Client placed on side with both knees and head flexed at an acute angle, ensures most space for insertion of needle; or, sitting up and leaning over the bedside table.
↑ Post procedure, client lies flat 6-12 hr
Nurse monitors client’s neurologic and vital signs, encourages fluids, and administers analgesics post procedure.

- **Myelography**
  - Combines fluoroscopy and radiography, visualizes spinal subarachnoid space; lumbar, thoracic, or cervical area; or whole spinal axis.
  - For diagnosis of spinal cord tumor, herniated intervertebral disk, or ruptured disk.
  - Lumbar puncture, radiopaque solution injected and distributed to various tissues and structures to be examined.
  - Meal prior to myelogram is omitted, client should be well hydrated.
  - Following procedure force fluids up to 3 liters in 24 hours, keep head of bed elevated 16-30 degrees for 12 hours.

- **Electroencephalogram - (EEG) graphic record of brain wave activity.**
  - Provides important diagnostic data about abnormal electrical activity in the brain
  - For diagnosing epilepsy and determining cerebral death; evaluating drug and alcohol intoxication and cerebral blood flow; identifying trauma, and for brain irritation secondary to infection.
  - Preprocedure teach client about EEG, 17 to 21 electrodes are attached to client’s head
  - Nurse withholds stimulants, antidepressants, tranquilizers and anticonvulsants for 24-48 hr prior to the test; recordings may be made while client is asleep.
  - The client must remain quiet with eyes closed without moving unless requested to hyperventilate briefly; no post procedure care required.

- **Electromyography**
  - Measures and records electrical properties of skeletal muscle and nerve conduction, performed with skeletal muscle at rest and with voluntary muscle contraction.
  - EMG provides important diagnostic data about neuromuscular diseases and other pathologic conditions that affect neuromuscular transmission.
  - Used to evaluate amyotrophic lateral sclerosis, myasthenia gravis, and muscle inflammatory disorders.
  - Preprocedure EMG, teach about the procedure: small needle electrodes inserted into muscle to be examined; some discomfort expected; no special post care is necessary.

- **Laboratory studies**
  - **Urine specific gravity (usually 1.010-1.025 but can range from 1.005-1.303).**
    - Abnormal findings that indicate dehydration, pituitary tumor, or tumor that causes the syndrome of inappropriate antidiuretic hormone (SIADH); increased >1.020.
• Levels >1.030 indicate a decrease in renal blood flow and fever.
• Decreased levels <1.005 indicate overhydration, diabetes insipidus (DI)
• Levels 1.001 to 1.005 indicate renal failures and hypothermia
  o Urine osmolality
    • Measure osmotic pressure of urine; used to monitor electrolyte and water balance and to evaluate dehydration.
    • Urine osmolality more accurate test than specific gravity in determining urine concentration.
    • Especially useful in workup of renal disease, SIADH, or DI.
    • Substances interfering with urine osmolality test are: diuretics, radio contrast dye, barbiturates, morphine, and anesthetics.
    • Urine osmolality should always be evaluated in conjunction with plasma osmolality.
    • Serum osmolality is an indicator of serum concentration and measures the amount of dissolved particles in the serum such as electrolytes, urea, or sugar.
    • CVA or brain tumor can interfere with test interpretation.
    • Abnormal findings include SIADH and DI.

  ° Nursing care for neurosensory deficit:
    o Assess:
      • Mental status [corresponds to Box 27-1]
      • Cranial nerve function
      • Language and speech
      • Meningeal signs
      • Sensory and motor status
    o Monitor airway status and check for airway patency.
    o Encourage self-care.
    o Keep environment clean and clutter free.
    o Position client for proper alignment.
    o Reinforce client teaching.

Cerebrovascular Disorders
  ° Transient ischemic attack (TIA) – temporary loss of blood supply to brain; warning signal of future CVA
  ° Cerebrovascular accident (CVA) sudden nonconvulsive focal neurologic deficit, medical emergency
    o Also called CVA, stroke, or brain attack [corresponds to Box 27-2]
    o Common clinical manifestations of cerebrovascular disease:
      • Numbness
      • Speech difficulties
      • Blurred vision
      • Headache
      • Dizziness
      • Loss of consciousness
      • Hemiplegia (one sided paralysis)
Causes: cerebral blood vessel occluded by a thrombus or emboli, or by hemorrhage; ischemia from decreased oxygen to area of brain supplied by damaged vessel; temporary or permanent loss of neurologic function.

Types of CVAs [corresponds to Table 27-3]

Risk factors for CVA [corresponds to Box 27-2]
- With lack of oxygen to brain for more than 10 minutes:
  - Brain cells die.
  - Damage to brain irreversible.
- Adequate collateral circulation reduces damage.
- Severe disability or death results from large area of infarction.

Cerebral aneurysm [corresponds to Figure 27-12 and Figure 25-20]
- Usually in Circle of Willis; most common cause of nontraumatic subarachnoid hemorrhage
- Manifestations: usually none unless aneurysm presses on cranial nerve; often not seen until acute subarachnoid hemorrhage, intracerebral hemorrhage, or both
- Treatment: surgery if possible
- Nursing care for clients with cerebral aneurysm: monitor neurologic status closely; report decrease in LOC immediately; encourage rehabilitation after surgery

Hydrocephalus – excess fluid in cranial vault, subarachnoid space, or both
- Cause: congenital; or, obstruction in ventricular system of imbalance in fluid, secondary to adhesions from inflammation (meningitis), compression by a mass, high venous pressure
- Manifestations: usually nonspecific but include decreased level of consciousness
- Treatment: treat underlying cause with diuresis, drainage, shunt, or removal of cause

Nursing Process Care Plan: Client with Cerebrovascular Accident (CVA)/Stroke
- Nursing care:
  - Teach awareness of affected side after a CVA
  - Encourage client to do passive range of motion with the affected limbs
  - Prevent ulcer formation
    - Turn clients q 2 hours while in bed.
    - Assist clients with paresis or paralysis to reposition in a chair or wheelchair.
    - Assist with ADLs as needed. Teach client to use adaptive equipment for eating and dressing.
  - Encourage clients to do as much as possible for themselves, celebrate accomplishments.

Seizure disorders – sudden, explosive, disorder, discharge of cerebral neurons [corresponds to Box 27-3]
- Epilepsy – primary seizure disorder
  - Manifestations: convulsive movements; EEG abnormalities
Classifications [corresponds to Table 27-4]
Terms: tonic-clonic, partial seizure, generalized seizures
Status epilepticus – prolonged seizures with recovery between attacks, medical emergency

Nursing care for clients with seizure disorders – prevent complications, protect client from injury; time seizures; prepare to suction throat after seizure if necessary; reassure and reorient client after seizure

Infections of the Neurologic System [corresponds to Table 27-5]

- Meningitis – inflamed meninges and spinal cord
  - Bacterial more severe than viral
  - Manifestations: headache, fever, stiff neck, altered mental status, nausea and vomiting, photophobia; skin rash with bacterial meningitis; Kernig’s and Brudzinski’s signs (see Figure 44-4)
  - Treatment: antibiotics specific to organism
  - Complications seizures, sepsis, cranial nerve dysfunction, cerebral infarction, coma, death; may leave visual impairment, hearing loss, cranial nerve palsy, paralysis

- Encephalitis – inflamed gray and white matter of brain and spinal cord, mild to fatal
  - Causes: virus, bacteria, fungi, parasites; or after effect of systemic viral diseases
  - Manifestations: fever, headache, seizures, stiff neck, and change in LOC
  - Treatment: treated as meningitis

- Brain abscess – infection extending into cerebral tissue or carried into brain from body; usually secondary to middle ear, face, or skull infection, or penetrating wound
  - Manifestations: headache, chills and fever, malaise, irritability, seizures, or paralysis; later, confusion, stupor, increased ICP
  - Treatment: based on underlying infection; antibiotics, drainage, or surgical removal
  - Nursing care of clients with brain abscess: detect complications, watch for IICP; neurologic checks q 2 hr; report changes in LOC, pupil size, speaking ability, or movement.

- Lyme disease – spirochete transmitted by bite of infect deer tick
  - Manifestations: 3 stages:
    - Usually “bulls eye” rash; signs of meningitis and neuritis
    - Complications such as heart block, Bell’s palsy, meningitis, encephalitis, polyradiculitis, or eye inflammation
    - Arthritic symptoms in large joints, chronic joint pain
  - Treatment: prompt removal of ticks; vaccine for those with frequent exposure; antibiotics for first two stages

- West Nile virus – virus transmitted from birds to humans by mosquitoes
  - Causes viral encephalitis – mild to fatal
• Manifestations: mild fever, headache, body ache, skin rash, swollen lymph glands; later neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis
  • No treatment or vaccine

° Nursing care for clients with CNS infections:
  o Elevate head of bed as ordered.
  o Instruct client not to cough or hold breath when turning
  o Monitor gag reflex and respirations
  o Administer analgesics as ordered.
  o Keep bed in low position, side rails up and padded.
  o Monitor I&O.
  o Perform range of motion.
  • Any changes are reported to the charge nurse.

Neurosensory Trauma
° Traumatic brain injury (TBI)
  o Insult to brain producing physical, intellectual, emotional, social, and vocational changes
  o A leading cause of disability and death in US; 3 times more common in males than females; average age 15-30 yr.
  o Motor vehicle accidents (MVAs) are major source of TBIs; then falls, sports injuries, and violent assaults; most occur evenings, nights, and weekends.
  o Classification of traumatic brain injuries
    • Blunt injuries
    • Penetrating injuries
  o Mechanism of injury affects outcome:
    • Deceleration forces - head hits immovable object
    • Acceleration forces- moving object hits head
    • Acceleration-deceleration forces- head hit with moving object and hits immovable object, moving brain within the cranium
    • Rotational forces - movement of brain side-to-side, twisting motion inside cranium, often occurs with acceleration-deceleration forces.
    • Deformation forces - direct blows to head, changing shape of head.
  o Coup and contrecoup [corresponds to Figure 36-12]
    • Coup injury = focal cerebral injury directly under area of impact
    • Contrecoup injury = cerebral injury opposite the point of impact
  o Mild traumatic brain injury
    • Mild concussion affects attention span and memory without loss of consciousness.
    • Manifestations: from temporary confusion and disorientation to confusion lasting several minutes; possible loss of consciousness, usually < 6 hours (duration is indicator of severity)
    • Post-concussive syndrome (occurs 1 week to 1 year after initial injury)
      † Headache
Dizziness
↑ Irritability
↑ Emotional lability
↑ Fatigue
↑ Poor concentration
↑ Decreased attention span
↑ Memory difficulties
↑ Intellectual dysfunction

Moderate to severe brain injury
- Usually results in cerebral contusion (bruising of the surface of the brain) where brain hit bony protuberances of skull
- Manifestations: loss of consciousness, stupor, confusion
- Treatment: outcome depends on area and severity of injury.
  - Contusion in deeper structures of brain - poor prognosis
  - Coma - deepest form of unconsciousness, symptomatic response to underlying cause
  - May last minutes, days, weeks, or years; often has fatal outcome
    - No attempt to avoid noxious stimuli
    - Possible reflex posturing in comatose state
    - Leads to many complications r/t inactivity and bedridden status

Hematoma
- Three main types of hematomas resulting from trauma, frequently associated with a cerebral contusion [corresponds to Figure 27-17]
  - Epidural
  - Subdural
  - Intracerebral
- Hematoma is complication in 1/3 to 1/2 of all TBIs, surgically significant hematoma in 1/4 of all skull fractures
- Epidural hematomas
  - Bleeding into epidural space between skull and dura mater
  - Cause: fracture may cause a tear in middle meningeal artery resulting in epidural hematoma.
- Subdural hematomas
  - Highest mortality rate, most common type of hematoma
  - Cause: rupture of bridging veins crossing the subdural space, associated with contusions and intracerebral hematomas; usually found around top and sides of head
  - 3 types:
    - Acute subdural hematoma
      - Presents within 48 hr after injury usually with cortical or brainstem injury and represents a mass lesion
      - Manifestations: mimic rapidly expanding lesion or increased ICP
      - Significant mortality
- Treatment: surgical intervention within 4 hr; decreases mortality

↑ Subacute subdural hematoma
- Occurs between 24 to 48 hours to 2 weeks after the injury, associated with moderate TBI
- Manifestations: steady decline in level of response.
- Treatment: surgical removal necessary for improvement.

↑ Chronic subdural hematoma
- Manifestations: occurs 2 weeks to several months after injury, often bilateral
- Cause: low impact injury (falling or bumping head)
- Higher incidence in older adults, chronic alcohol abusers, or anticoagulant warfarin users
- Chronic subdural hematoma acts as a space-occupying lesion that progressively enlarges.
- Treatment with Burr holes and gradual drainage of hematoma

• Intracerebral hematomas
  ↑ Hematomas 25 ml or larger considered a mass lesion; develop deep within hemispheres from contused areas that run together and are surrounded by edema
  ↑ Cause: penetrating wounds i.e. gunshot, deep-depressed fractures and diffuse axonal injuries.
  ↑ Treatment: early surgical intervention necessary to prevent death.

° Increased intracranial pressure [corresponds to Table 27-6]
  o Intracranial pressure (ICP)
    • ICP = pressure exerted by CSF circulating in brain and spinal cord; determined by ratio of brain tissue, CSF, and intravascular blood.
    • Normal limits--0 to 15 mm Hg; with normal compensation, increase in one component causes decrease in another
    • ICP rises when a state of equilibrium can not be maintained
  o Rise in pressure called increased intracranial pressure (IICP).
  o Term: cerebral edema
  o IICP causes decreased cerebral blood flow, leading to ischemia.
    • Manifestations, regardless of underlying cause:
      ↑ Level of consciousness (LOC)
      ↑ Pupil response
      ↑ Speech
      ↑ Motor function
      ↑ Vital signs.
      ↑ These changes may develop slowly or rapidly and may be labeled as early or late [corresponds to Box 27-4]

° Spinal Cord Injury (SCI)
  o Damage to vertebral or neural tissues by:
    • Compressing the tissues
• Pulling or exerting a traction
• Tension on the tissues
• Or shearing tissues so that they slide into one another.

o Forces causing injury may be exerted by:
  • Hyperextension
  • Hyperflexion [corresponds to Figure 27-18]
  • Vertical compression
  • Rotation of the spine.

o Manifestations: localized hemorrhaging and edema, followed by reduced vascular perfusion and development of ischemic areas.

o Treatment: possible surgery, stabilization, immobilization; corticosteroids to decrease edema; drugs to maintain heart rhythm and blood pressure; prevent muscle spasm, gastric ulcer, or thrombophlebitis; reduce pain

o Hemorrhages and edema greatest at level of injury and for two segments above and below

o Complete vs. incomplete
  • Complete SCI = total loss of motor and sensory functions below level of injury.
  • Incomplete SCI = varying degrees of loss of function below level of injury
  • Level of injury determines paraplegia or tetraplegia (formerly called quadriplegia) results. [corresponds to Figure 27-19]
  • Paraplegia = paralysis of the lower part of the body; damage done at the thoracic level
  • Tetraplegia = paralysis of arms, trunk, legs, and pelvic organs; damage from high cervical injuries.
  • For either, complications can occur immediately or later

  o Spinal shock
    • Temporary loss of reflex activity below level of SCI, usually occurs within 30-60 minutes
    • Manifestations: loss of motor function, sensation, spinal reflexes, and autonomic function.
    • Treatment: supportive; lasts for 1 to 6 weeks, then reflex activity returns.

  o Autonomic dysreflexia
    • Exaggerated sympathetic response in SCI at or above T6
    • May occur any time after spinal shock resolves, is a medical emergency
    • Triggered by a full bladder or fecal impaction resulting in a hypertensive crisis.
    • Treatment: must receive immediate treatment, or may result in seizures, CVA, or death
    • Manifestations:
      ↑ Systolic pressure 300 mm Hg
Possible severe headache, blurred vision, sweating above level of lesion with flushing of skin and pale, cold, dry skin below it, goose-bumps, and bradycardia (30-40 BPM).

- **Treatment:**
  - Elevate head of the bed 45 degrees, administer antihypertensive medications as ordered.
  - Empty bladder or bowel (usually relieves the response)

- **Brain tumors (intracranial tumors)**
  - Benign or malignant, can occur in any structural area of the brain; occur in all age groups with peak incidences in early childhood and in the fifth, sixth, and seventh decades of life.
  - Growth rates of brain tumors vary
  - Rapid growth of glioblastomas [corresponds to Figure 27-20]
  - Very slow growth - some meningiomas.

- **Classification**
  - Named for tissues in which they arise.
  - Primary - originate from brain cells and structures
  - Secondary – metastatic - originate outside the brain
  - Accessibility to surgery (Tumors that are benign but surgically inaccessible may have poorer prognosis than malignant tumor that is surgically accessible.)

- **Manifestations:**
  - Neurologic deficits caused by focal disturbances (from compression of tissue and invasion) and IICP.
  - Herniation (if untreated, can result in infarction, hemorrhage, and cerebral death)

- **Spinal Cord Tumors**
  - Comparatively rare, named to reflect cell type, growth rate, and structure of origin.
  - Classified as intramedullary and extramedullary tumors [corresponds to Table 27-7]
  - Manifestations: severity determined by growth rate and degree of compression
    - Spinal cord can accommodate slower-growing tumors by compressing itself into a slender, ribbon-like tissue.
    - A fast-growing tumor may produce sudden cord compression, edema, and severe neurologic deficits.

- **Care of clients with neurological trauma**
  - Assess:
    - Level of consciousness - most important [corresponds to Box 27-1]; also Glasgow Coma Scale [corresponds to Table 12-2]
    - Pupil size and accommodation
    - Lateralized weakness or loss of function of the extremities.
  - Monitor cognitive function.
  - Implement safety measures as needed to prevent injury
  - Encourage client to perform ADLs
• Turn client often and on a regular schedule
• Support limbs with pillows as needed
• Assist client and family to cope with difficult diagnosis, rehabilitation, and life altering event
• Client and family would begin to accept diagnosis and cope effectively.

Degenerative Neurologic Disorders
° Parkinson’s disease - common, slowly progressive, degenerative disorder
  o Cause: dopamine deficiency. (dopamine carries messages that tell the body how and when to move.)
  o Primary manifestations:
    • Early symptoms: painful muscle cramps in toes or hands; stiff, heavy, tired, or aching limbs
    • Tremors
      ↑ A pill rolling action of the thumb and forefinger, occurs at rest and lessens with movement.
      ↑ Tremor commonly unilateral but can spread to other body segments.
      ↑ Increased by stress and anxiety.
    • Rigidity - attributed to an increase in muscle tone at rest.
      ↑ Stiff trunk, head and shoulders; no arm swing when walking.
      ↑ Cogwheel rigidity - jerky quality of motion
    • Akinesia/bradykinesia - difficulty initiating movement/ moving very slowly.
    • Sitting or lying motionless for long periods (increases risk for pneumonia, deep vein thrombosis, constipation, and pressure ulcers)
    • Postural abnormalities due to loss of normal postural reflexes; unable to maintain upright trunk while standing or walking; small shuffling steps
    • Involuntary flexion of head and neck
    • Once movement is initiated, it accelerates; individual is at risk of falling.
  o Secondary manifestations of Parkinson’s disease:
    • Difficulty with fine motor function
    • Monotonic voice
    • Mask-like face
    • General weakness and muscle fatigue
    • Cognitive changes
    • Depression
  o Manifestations associated with autonomic dysfunction:
    • Drooling
    • Seborrhea
    • Dysphagia
    • Excessive perspiration
    • Constipation
• Orthostatic hypotension
• Urinary hesitation and frequency.

○ Treatment:
  • Symptom control, not cure
  • Drug therapy (levodopa), plus dopamine agonists, anticholinergic drugs, antihistamines, and amantadine; regimen has numerous side effects; more drugs under development

° Multiple sclerosis (MS) relatively common, chronic, progressive, degenerative disease with destruction of myelin sheath and conduction pathways of the CNS [corresponds to Figures 27-22A-C]
  • Peripheral nervous system not involved
  • Cause: usually preceded by viral insult to the nervous system with subsequent abnormal immune response in the CNS; individuals are genetically susceptible; women affected slightly more often than men
  • Onset usually between 20-40 years
  • Severity, duration, and prognosis vary:
    • Relapsing/remitting - 65% of the cases relapse over 1-2 weeks, resolve over 4-8 weeks, return to baseline.
    • Relapsing/progressive disease – 15% of cases similar to the relapsing/remitting form but with less recovery, baseline not returned to and the individual is left with significant residual disability.
    • Chronic progressive disease – 20% of cases characterized by spinal cord and cerebellar dysfunction, symptoms of the spinal cord and cerebellum are the initial manifestations
    • Stable MS is sometimes a term used for individuals who have had neither active clinical disease nor any subjective deterioration in their condition in the last year.

○ Categories of manifestations:
  • Sensory
    ↑ Paresthesia -- numbness, burning, prickling, tingling; pain
    ↑ Decreased proprioception – (sense of temperature, depth, and vibration)
  • Motor
    ↑ Paresis
    ↑ Paralysis
    ↑ Dragging of the foot
    ↑ Spasticity
    ↑ Diplopia
    ↑ Incontinence or retention of bladder and/or bowel
  • Cerebellar
    ↑ Ataxia
    ↑ Loss of balance and coordination
    ↑ Nystagmus
    ↑ Speech disturbances
    ↑ Tremors
Vertigo
- Miscellaneous
- Fatigue
- Sexual dysfunction such as impotence or decreased genital sensation
- Neurobehavioral disorders such as depression or euphoria

Treatment:
- Corticosteroids, interferon, imuran

Nursing care focuses on preventing complications and injuries.

Amyotrophic lateral sclerosis (ALS)
- Degenerative disease of the upper and lower motor neurons, not accompanied by inflammation; rapid in progression; called Lou Gehrig's disease; results in progressive muscle weakness that leads to respiratory failure and death 2-5 years after onset
- Amyotrophic means without muscle nutrition; disease involves progressive muscle wasting
- Lateral sclerosis refers to scarring in the lateral column of spinal cord

Manifestations of ALS:
- Initially, muscle weakness and fatigue of single muscle group
- Muscles of the hand, next shoulder and upper arm, lower limbs usually affected last (feel heavy and subject to fatigue and cramping)
- Muscle spasticity and hyperreflexia
- Fasciculations--involuntary contraction or twitching of muscle fibers.
- Brainstem signs evidenced by atrophy of the tongue and causing dysarthria
- Dyspnea if the respiratory muscles are involved
- Fatigue
- Not affected are: intellectual ability, sensory function, vision, and hearing
- Bowel and bladder function is not usually affected until very late in the disease.

Tests for ALS
- An electromyelogram (EMG) will demonstrate fibrillations
- Blood creatine phosphokinase (CPK) may be elevated

Treatment: no cure; ant glutamate riluzole (Rilutek) slows deterioration; symptom relief, prevention of complications, maintenance of maximal function, supporting quality of life

Alzheimer's disease (AD)
- Chronic neurologic disorder with progressive and selective degeneration of cerebral and certain subcortical neurons
- Physiology [corresponds to Figure 27-23]
- Can occur in persons > 40 years, but most common in those > 65 years; affects both sexes, but more common in women
- Very slow onset, generally progressive deteriorating course
On autopsy
- Cerebral atrophy [corresponds to Figure 27-23B] and cellular degeneration
- Neurofibrillary tangles and amyloidal plaque deposits in temporoparietal and anterior frontal regions.

Manifestations of Alzheimer’s:
- Progressive impairment of short and long-term memory. Eventually individual cannot compensate for memory loss and inability to perform ADL.
- Stages of AD [corresponds to Table 27-8]
- Impaired abstract thinking, impaired judgment, and personality change.
- Loss of global cognitive functions.
- End stages
  - Bedridden, emaciated, aphasic (unable to communicate) and apraxic (unable to make purposeful movement), loss of control of sphincters
  - Complete loss of cognitive functions and emotional responses
  - Actual cause of death is usually infection such as aspiration pneumonia.

Treatment:
- No cure
- Drugs to increase brain acetylcholine levels; to inhibit cholinesterase (Aricept), to manage psychotic episodes (Risperdal and Seroquel)
- Support for individual and family

Nursing care:
- Assess for mobility, risk for injury, effects of disease on ADLs.
- Encourage the client to participate in prescribed exercise program, and to perform self-care within abilities.
- Allow the client time to communicate.
- Try to anticipate client’s needs. Provide a communication board or paper pad and pen if indicated.
- Place client in upright position for all meals; keep suction equipment at the bedside.
- Assist client to eat and/or provide utensils that facilitate self-feeding.
- Weigh the client daily.

Peripheral Nervous System Disorders
  - Myasthenia gravis (MG)
    - Chronic autoimmune disorder that affects transmission of nerve impulses to muscles; affects all striated muscles, especially oculomotor, facial, laryngeal, pharyngeal, and respiratory muscles
    - Peak in women 20-30 years old; peak in men 60-70 years old
    - Manifestations:
• Intermittent double vision, droopy eyelids, facial muscle weakness that increases with activity and decreases with rest
• Altered mobility and facial expression, possible drooling
• Altered voice quality
• Breathlessness if diaphragm is involved
• Manifestations of myasthenia crisis (myasthenic or cholinergic):
  ↑ Acute weakness of respiratory muscles
  ↑ Generalized muscle weakness
  ↑ Apprehension and restlessness
  ↑ Tensilon test to distinguish between myasthenic (insufficient acetylcholine) or cholinergic (excess of acetylcholine)

○ Treatment:
  • Individualized management to try to achieve a symptom-free quality of life
  • Cholinesterase inhibitor drugs, long-term immunosuppression, IV immune globulin, plasmapheresis
  • Thymectomy helpful sometimes

○ Nursing care: preventing complications and detecting crisis early
  • Assess VS q 4 hr
  • Monitor respiratory status, muscle weakness, restlessness, SOB, and increased anxiety
  • Report changes immediately
  • Be prepared to assist with ventilation

○ Guillain Barré syndrome (GBS) – acute inflammatory neuropathy
  • Thought to be autoimmune response to viral infection (virus usually precedes by 10-14 days)
  • Affects any age, both sexes
  • Destroys myelin sheath, leads to edema and inflammation of peripheral nerves; affects motor component
  • Remyelination occurs slowly, taking up to 2 years
  • Complete functional recovery in 85% of cases

○ Manifestations:
  • Usually lower extremity weakness in ascending pattern to upper extremities and face
  • Flaccid paralysis and respiratory failure can occur within 48 hours, but usually slower progression (2-3 weeks)
  • Autonomic dysfunction with hyper/hypotension, dysrhythmias, circulatory collapse

○ Treatment:
  • Preventing complications of immobility, infection, and respiratory failure
  • Mechanical ventilation if needed
  • Plasmapheresis to remove abnormal antibodies

○ Nursing care: immediate respiratory needs and preventing complications of immobility; emotional support; encouragement in rehabilitation phase

○ Huntington’s disease (HD)
Term: chorea  
Inherited, relatively rare, degenerative disorder  
Onset usually between 30-50 years  

Manifestations:  
- Most commonly chorea (dancing or writhing of limbs or facial muscles), usually beginning in face and arms, later throughout body  
- Dementia and behavioral changes; progressive dysfunction of intellectual and thought processes; loss of working memory; reduced capacity to plan and organize; slow thinking; apathy  
- Restlessness and irritability  
- Euphoria or depression  

Treatment:  
- No known cure; some movement control with dopamine agonists (haloperidol or risperidone)  
- Genetic counseling (each child has 50% chance of developing disease)  
- Death usually occurs > 15 years after diagnosis  

Nursing care for client with Huntington disease: focus on emotional support; encourage counseling and support groups  

Neurofibromatosis or von Recklinghausen’s disease  
Group of genetic disorders affecting cell growth of neural tissues  
Type I:  
- Manifestations: varies from few coffee-colored spots on skin to numerous nonmalignant or malignant neurofibromas, scoliosis, seizures, gliomas, neuromas, hypertension, and mental retardation  
- Treatment: no cure; treatment varies with placement and severity of tumors; radiation therapy and surgery may be helpful  

Type 2:  
- Manifestations: intracranial and spinal tumors, especially at 8th cranial nerve  
- Treatment: palliative only  

Nursing care for clients with degenerative disorders:  
- Teach client and family about the disease and give emotional support.  
- Assist with ADLs.  
- Provide safe environment.  
- Orient client as needed.  
- Monitor mobility and ability to perform self-care.  
- Position client with head elevated for meals.  
- Encourage family to develop plan for care.  

Cranial Nerve Disorders  
Bell's palsy  
- Acute paralysis of the facial cranial nerve VII [corresponds to Figure 27-26]
o Cause unknown in about 75% of the cases, thought to be inflammatory reaction
o Affects all ages and both sexes; more frequent in young adults, older adults, and individuals with diabetes, hypertension, and lipid abnormalities; has been associated with Lyme disease.
o Manifestations:
  • Occurs suddenly, with unilateral facial paralysis that peaks within 2-5 days and resolves gradually over 1-2 months.
  • Some report pain behind ear on affected side 1-2 days prior to paralysis.
  • May have impaired taste for up to 2 weeks, may experience distortion of sound.
  • Paralyzed side mask-like and sags, constant eye tearing, possible drooling.
o Treatment:
  • Prednisone helpful for first week after onset of symptoms. Analgesics are given for pain.
  • Gentle massage, moist heat, and electrical stimulation of the nerve, exercises can be helpful.
  • Recovery depends on nerve regeneration and is complete in 80% of those affected.
o Disorders of the fifth cranial nerve (trigeminal nerve)
o Fifth cranial or trigeminal nerve - mixed nerve, both motor and sensory fibers, so disorders present as sensory abnormalities, motor weakness, or both.
  • Complete disruption of function rarely occurs, but disorders of isolated (especially sensory) parts of the nerve are common.
o Trigeminal neuralgia (tic douloureux)
  • Most common disorder of fifth cranial nerve
o Manifestations:
  • Excruciating pain in maxillary and/or mandibular division of the trigeminal sensory root [corresponds to Figure 27-27]
  • Pain episodic, initiated by stimulation (light touch; facial movements i.e. chewing, talking, yawning; tooth brushing; shaving; or a light breeze to the face).
  • Face may be contorted during attack until the pain eases.
  • Unilateral, generally last < 2 seconds, can recur and incapacitate the individual for hours.
  • Anxiety about having another attack may compromise ability to cope or perform ADLs.
  • Bouts of pain may occur for several weeks or months, followed by a spontaneous remission (days to years); length of remission seems to shorten with age
o Treatment:
  • Drug therapy (Tegretol)
  • Injection with alcohol or phenol
- Surgery

- Glossopharyngeal neuralgia
  - Manifestations: like trigeminal neuralgia in having unknown cause and sudden intense pain without sensory or motor loss, but more rare.
  - Pain originates in the throat around the tonsilar area; may also be localized in ear or radiate from throat to ear
  - Treatment: drug therapy with phenytoin or carbamazepine or spraying the throat with a topical anesthetic.
  - For long-term relief, intracranial surgery may be necessary.

- Isaac's syndrome
  - Neuromyotonia or continuous muscle fiber activity syndrome.
  - Rare neuromuscular disorder caused by continuous signaling of end regions of peripheral nerve fibers that activate muscle fibers.
  - Hereditary or acquired
    - Acquired form may be in association with peripheral neuropathies or be autoimmune condition.
  - Manifestations:
    - Progressive muscle stiffness
    - Continuous vibrating or twitching of muscles
    - Cramping
    - Increased sweating
    - Delayed muscle relaxation
    - Symptoms can occur even during sleep or when under general anesthesia.
    - Often development of weakened reflexes and muscle pain.
    - Stiffness usually most prominent in limb and trunk muscles, although symptoms can be limited to the cranial muscles.
    - Speech and breathing may be affected.
  - Treatment:
    - Phenytoin and carbamazepine, anticonvulsants,
    - Plasma exchange may provide short-term relief with some forms of acquired Isaac’s syndrome

- Tourette’s syndrome - considered inherited disorder; may involve abnormal metabolism of dopamine and serotonin or other neurotransmitters; may be chronic or transient
  - Manifestations:
    - Primary manifestation is repetitive motor and verbal tics - sudden, involuntary movements or vocalization.
    - Motor tics can include shoulder shrugging, eye blinking, head jerking, hand movements, lip-licking, and grimacing.
    - Common vocal tics include sniffing, throat clearing, grunting, making loud sounds, or saying words.
  - Treatment:
    - Conservative, symptomatic treatment is tried first; symptoms may resolve without therapy.
Non-neuroleptic drugs, such as Catapres and Klonopin, are the first drugs tried; then neuroleptic drugs, such as Haldol, Prolixin, and Risperdal.

Meniere’s disease
- A disorder of the eighth cranial nerve involving both the vestibular and cochlear branches; affects both sexes with equal frequency; occurs most in the fifth decade of life
- Manifestations:
  - Recurrent attacks of vertigo with tinnitus and deafness.
  - Initially tinnitus and deafness are not evident but become more apparent with increased severity as attacks continue.
  - Meniere’s is associated with rotational or whirling. Vertigo (acute dizziness and lack of balance)
  - Vertigo may last a few minutes to hours and be so severe that the individual is unable to stand or walk.
  - Nausea, vomiting, a full feeling in the ears, and rotational or horizontal nystagmus (involuntary movement of the eyes) with slow movement on the same side
  - In most individuals the vertigo ceases with complete deafness.
  - The attacks vary in frequency and severity
  - Remission may occur between a series of bouts.
  - Hearing is lost gradually until there is complete unilateral deafness. In 10% of the individuals affected there is bilateral deafness.
- Diagnosis by audiometry and caloric testing.
- Treatment
  - Treatment is bed rest during an attack
  - A salt restricted diet has been found valuable in controlling the vertigo
  - Drugs such as diuretics and a vestibular suppressant such as meclizine
  - Surgical destruction of the labyrinth in severe cases

Peripheral neuropathy
- Cause: most commonly diabetes mellitus; alcoholism
- Manifestations: weakness, paresthesias, impaired reflexes, and autonomic symptoms in hands and feet
- Treatment: varies by underlying cause; usually drug-induced neuropathies resolve when drug is discontinued
- Disorders related to vision [corresponds to Table 27-9, Table 27-2, Figure 27-28]
  - Ethnic variations in hearing and vision [corresponds to Box 27-5]
  - Help client identify pain triggers; follow up with referrals as needed.

Headaches
- Migraine headache
  - Terms: aura, photophobia, phonophobia
  - Manifestations: initially unilateral and localized in frontotemporal and ocular area; becomes throbbing, diffuse
○ Lasts several hours to whole day, intensifies with activity

○ Tension-type headache
  ○ Associated with chronic contraction of neck and scalp muscles
  ○ Manifestations: bilateral tightness or pressure not intensified by activity
  ○ Lasts 30 minutes to days
  ○ Chronic form at least 15 days

○ Cluster headache
  ○ Seen mostly in men 20-40 years
  ○ Lasts 15 minutes to 3 hours, occurs in clusters of 1 to 8 daily lasting weeks or months
  ○ Manifestations: occurs during night after 1-2 hours of sleep; often pain behind eye or in sinus area
  ○ Can be triggered by alcohol or vasodilators

○ Treatment of headaches [corresponds to Table 27-10]

○ Nursing care for clients with headaches:
  ○ Focus on pain management techniques; keep environment quiet; encourage client to identify triggers and to manage stress
  ○ Assess neurologic status q 2-4 hr

Critical Thinking Care Map: Caring for a Client with Epilepsy