Neurological System

Objectives:

1. Compare the functions of the two divisions of the autonomic nervous system.

2. Describe the techniques used with the physical assessment of the nervous system.

3. Discuss the risk factors for stroke.

4. Compare and contrast the pathophysiology of strokes caused by thrombus, embolism, and intracranial hemorrhage.

5. Describe the acute and rehabilitative nursing management of the stroke patient.

6. Review subdural, subarachnoid, and epidural hematomas.

7. Discuss the pathophysiology and nursing management of alcohol withdrawal.

Readings:


   http://findarticles.com/p/articles/mi_qa3689/is_200307/ai_n9256847

3. “Sorting out the 3 D’s Delirium, dementia, depression” Nursing 2004
   http://www.nursingcenter.com/prodev/cearticleprint.asp?CE_ID=508060 or
   http://findarticles.com/p/articles/mi_qa3689/is_200406/ai_n9434201

4. “Stroke” Mayo Clinic, July, 2006,
   http://www.mayoclinic.com/health/stroke/DS00150
Please use the following outline, along with the readings, to fulfill the objectives of the course.

**Neurological System**

**Normal Nervous System**

A. Central nervous system

1. brain
   a. cerebrum
      - right & left hemispheres
      - lobes - frontal, temporal, parietal, occipital
   b. basal ganglia - modulates initiation, excitation, execution, and completion of voluntary movements
   c. thalamus - motor relay center
   d. hypothalamus - regulates autonomic nervous and endocrine systems
   e. limbic system - involved in emotions, aggression, feeding behavior, and sexual response
   f. brain stem
      - midbrain
      - Pons
      - medulla - vital centers for respiratory, vasomotor, and cardiac function
      - reticular formation - relays sensory information, influences the excitatory and inhibitory control of the spinal motor neurons and controls vasomotor and respiratory activity
      - reticular activating system (RAS) - arousal, component of consciousness
   g. cerebellum - posterior part of the cranial fossa; coordinates voluntary movement and maintains trunk stability and equilibrium
   h. ventricles & cerebral spinal fluid - 135 ml of cerebrospinal fluid - provides cushioning, allows for fluid shifts, carries nutrients, resembles an
ultrafiltrate of blood plasma

2. spinal cord
   a. ascending tracts
   b. descending tracts

3. Protective structures
   a. Meninges
      - thick Dura Mater = outer layer
      - Arachnoid layer = middle layer
      - subarachnoid space - CSF fluid
      - Pia Mater = inner layer
   b. skull - rigid, bony covering

B. Peripheral nervous system
   1. somatic - voluntary
   2. visceral - involuntary
      a. afferent
      b. efferent = autonomic nervous system - controls involuntary functions of cardiac muscle, smooth (involuntary) muscle, and glands; provides dual and often reciprocal innervation to many structures
      - parasympathetic
      - sympathetic - fight or flight
      - sympathetic & parasympathetic function together to maintain a relatively balanced environment

C. Building blocks of nervous system is the neuron
   1. neurons primary functional unit
      a. non-mitotic - cannot replicate
   2. neuroglia - supportive to neurons; provide nourishment, protection
      a. mitotic - can replace themselves
   3. Common characteristics of neurons
      a. excitability
      b. conductivity
      c. ability to influence other neurons, muscle cells, and glandular cells

Assessment

A. Health history
   a. trauma
   b. medications - especially sedatives, narcotics, tranquilizers, mood-
elevating drugs, anticoagulants
  c. familial diseases
  d. symptoms - weakness, speech alterations, loss of consciousness
  e. surgeries
  f. sleep/rest
  g. coping/stress tolerance
  h. nutrition
  i. activity/exercise

B. Physical Exam
  a. Mental status - change in level of consciousness first sign of neurological problem
     1. mental status - general appearance and behavior
     2. state of consciousness - alert, oriented to person, place, & time, general knowledge, insight, judgement, problem solving, calculation
     3. mood & affect - agitation, anger, depression, euphoria
     4. thought content - illusions, delusions, paranoia
  b. Cranial nerves
  c. Motor system - assessment of bulk, tone, power of major muscle groups; balance, coordination, strength
  d. Sensory system
     -test 4 extremities for
     - light touch
     - pain/temperature
     - Romberg test
     - corticales sensory function - 2 point discrimination
  e. Reflexes - contraction of skeletal muscle occurs when tendon is stretched

C. Diagnostic studies
  a. Lumbar puncture - CSF is normally clear, colorless, free of RBCs
  b. Cerebral angiography - when vascular lesions or tumors suspected
  c. Computed tomography (CT scan) - non-invasive series of x-rays scanning different levels/planes
     - Intravenous injection of contrast may be used to improve images
     - illustrates "slices" of the brain
     - can show hemorrhage, tumors, cysts, edema, infarction, brain atrophy, hydrocephalus
     - does not illustrate structures in posterior fossa and base of brain as clearly as MRI
  d. Magnetic Resonance Imaging (MRI)
-used to evaluate brain and spinal cord
-can show edema, hemorrhage, infection, blood vessels, neoplasms, bone lesions
-evaluate patient for any metal - no metal can go into MRI room
-yields greater contrast in the images of soft tissue structures than the CT scan

e. EEG
-recording of the electrical activity of the brain to diagnose epilepsy, mass lesions, cerebrovascular lesions, brain injury
f. Electromyography & nerve conduction studies
g. Carotid Duplex - combined ultrasound and doppler technology
h. Transcranial Doppler Sonography - records blood flow velocities of intracranial blood vessels

**Intracranial Pressure**

**A. Skull is closed box with 3 essential volume components**
1. brain tissue
2. blood
3. cerebral spinal fluid

**B. Monro-Kellie Doctrine:**
1. if volume added to cranial vault, and equal volume needs to be displaced from it for the intracranial pressure to remain equal
2. other factors that influence intracranial pressure (ICP)
   a. arterial pressure
   b. venous pressure
   c. abdominal and intrathoracic pressures
   d. posture
   e. temperature (hypothermic)

**C. Normal ICP** - pressure exerted by the total volume from the 3 compartments
1. in a lateral recumbent position ICP = 80-180cmH2O (water manometer)
   2. 30 degree elevation of HOB, ICP is 0-15 measured intracranially with a pressure transducer

**D. Cerebral blood flow**
1. amount of blood in mililiters which travels through 100grams of brain
tissue in 1 minute
2. global cerebral blood flow = 50ml per 100gm brain tissue
   a. white matter = 25ml/min
   b. gray matter = 75 ml/min
3. brain requires a constant supply of oxygen and glucose
   a. brain uses 20% of body's O2 and 25% of body's glucose
4. Cerebral Perfusion Pressure (CPP) is the pressure needed to ensure blood flow to the brain
   a. Mean Arterial Pressure (MAP) - ICP = CPP
   b. CPP below 30 = cellular ischemia and is incompatible with life
5. Factors affecting CPP
   a. Oxygen tension
   b. CO2 tension
   c. pH (hydrogen ion concentration)

Cerebral arteries dilate when the cerebral oxygen tension falls below 50
   this dilation decreases cerebral vascular resistance in an effort to raise the O2 tension
   if the O2 tension is not increased, then anaerobic metabolism occurs and an accumulation of lactic acid develops
   in an acid environment, there is an increased vasodilation and a further increase in blood flow
   d. an increase in PaCO2 is the most potent vasodilator - it relaxes smooth muscle and decreases cerebral vascular resistance which increases the cerebral blood flow
   e. an increase in ICP can progress to loss of consciousness, change in neurological function, brain herniation, and death

**Mechanisms for increased ICP**
- hematoma
- contusion (brain bruise)
- rapidly growing tumor
- cerebral edema associated with brain tumors
- hydrocephalus
- head injury
- brain inflammation
- metabolic coma
Complications of Increased ICP
- Brain herniation
  - cingulate (lateral)
  - central or transtentorial (downward)
  - uncal (lateral and downward)
- compression of brainstem and cranial nerves can be fatal

Clinical Manifestations of Increased ICP
- depend on cause, rate, location
  1. Change in Level of Conscious (LOC)
  2. Changes in vital signs
    a. Cushings Triad
      - Increased systolic blood pressure (widening pulse pressure)
      - Bradycardia with full bounding pulse
      - Irregular respiratory pattern
  3. Ocular signs
    a. compression of the oculomotor nerve (CNIII) results in
dilation of the ipsilateral pupil, sluggish or no response to light, inability to
  move eye upward, and ptosis of lid

A fixed unilaterally dilated pupil is a medical emergency that
indicates transtentorial herniation of the brain

  b. signs of dysfunction of the optic nerve (CNII), troclear
     (CNIV), abducens (CNVI) result with blurred vision, diplopia, & changes in
extraocular movement
  4. Decrease in motor functions
    a. contralateral hemiparesis or hemiplegia
    b. Decorticate (flexor) posturing
    c. Decerebrate (extensor) posturing
  5. Headache from the compression of intracranial structures
  6. Vomiting not preceeded by nausea

Therapeutic Management of ICP

  1. identify and treat underlying cause and support brain function
  2. ensure adequate oxygenation to support brain function
    a. goal to maintain PaO2 100mmHg or greater
    b. mild hyperventilation to maintain PCO2 of 30-35 which leads to
constiction of cerebral blood vessels which will decrease ICP
  3. Surgery to relieve pressure
4. Diuretics
   a. osmotic - mannitol
   b. loop - lasix, edecrin
5. Elevation of HOB 30 degrees
6. Maintenance of fluid balance
7. Normothermia
8. adequate sedation - a decrease in cerebral metabolism decreases cerebral blood flow which decreases ICP
9. nutrition with glucose

Head Trauma

A. Types of injury
   1. closed head injury = non-penetrating
      a. concussion = mild
      b. contusion = bruise
      c. hematoma = can be epidural (arterial bleed) or subdural (venous bleed)

      Epidural - bleeding between the dura and inner surface of the skull; is a neurological emergency; symptoms - unconciousness, decrease in LOC, headache, nausea and vomiting

      Subdural - bleeding between dura mater and arachnoid layer of meningeal covering of the brain; usually venous in origin; much slower to develop

      Acute subdural: within 24-48 hours after injury
      Subacute subdural: develops within 48hours to 2 weeks after injury
      Chronic subdural: not evident for weeks to months after injury, over 20 days. Often seen in the elderly (where they have a decrease in brain mass and therefore have more "room" within the skull for the hematoma before symptoms are evident)

   2. open head injury =
      a. scalp, skull, or dura injury

   3. incidence - more common in men, particularly under the age of 35

   4. Clinical manifestations: usually due to increased intracranial pressure
      a. change in level of consciousness
b. change in pupillary response - unilateral dilatation, sluggish response to light, comatose  
c. visual disturbances - blurred or double vision  
d. vital signs  
   - blood pressure increases  
   - pulse pressure widens  
   - pulse decreases  
   - temperature elevated  
   - respirations decrease or variable  
e. posture changes (decerebrate or decorticate)  
f. changes in reflexes  
   - corneal - decreased or absent  
   - gag - decreased or absent  
   - Babinski - positive  
   - deep tendon reflex (DTR) - hyper or hypoactive  
g. headache with nausea and vomiting  
h. seizures  

5. Diagnostic tests:  
a. skull xray  
b. CT Scan  
c. MRI  
d. angiography  

6. Treatment: see increased intracranial pressure  

**Stroke/CVA**  

A. **Definition**: Syndrome of cerebral circulation disruption which results in neurological deficits  

B. **Incidence**: 10% of U.S. deaths, third leading cause of death, about 2 million people a year  

C. **Etiology/Classification**:  
   1. **Ischemic**  
      a. Thrombosis - 50% - formation of a blood clot in narrowing lumen of the artery  
         - most common cause  
         - stroke by thrombosis usually occurs in sleep  
         - symptoms usually peak in 72 hours and are often secondary to
developing edema
   - Transient ischemic attacks - prodomal warnings with temporary parathesias, paresis, aphasia (TIA)
   b. Embolism - 2nd most common cause
      - majority of emboli originate in the endocardial layer of the heart
        - chronic Afib
        - Myocardial Infarction
        - valvular disease
        - valve replacements
        - Rheumatic Heart Disease
      - prodomal warning less common

c. Strokes caused by ischemia are now being treated with anti-thrombotic medication (clot busters - like myocardial infarction)
   - treatment needs to occur with in 3 hours after the onset of symptoms
   - CT needs to be diagnostic of ischemic stroke (not hemorrhagic)
   - no recent surgery, no history of head injury
   - patient needs to get to the emergency room and seek treatment ASAP

2. Hemorrhagic Stroke - bleed from a weakend vessel with in the brain
   a. intracerebral hemorrhage
      - mortality - 50-60%
   b. subarachnoid hemorrhage
      - approximately 1/3 occur during sleep
      - 1st symptom headache

3. Predisposing factors:
   a. HTN, stress
   b. smoking
   c. heart disease
   d. diabetes
   e. obesity

4. Clinical signs:
   a. headache
   b. nausea and vomiting
   c. dizziness, vertigo
   d. signs of increases ICP
   e. seizures
   f. visual changes
   g. motor changes - hemiplegia, dysarthria, dysphagia
h. sensory changes - perceptual deficits, aphasia
i. emotional changes
g. symptoms are dependant on the area of the brain damaged

5. **Diagnostic exams:**
a. CT
b. MRI
c. Cerebral blood flow studies
d. angiogram
e. lumbar puncture

6. **Treatment:**
a. depends on etiology - ischemic or hemorrhagic
b. neuro checks to assess for further changes
c. may receive medication to dissolve clot or may have surgery to evacuate hematoma if large
d. control hypertension
e. possibly IV Heparin to prevent further problems
f. rehabilitation
g. swallowing evaluation

**Parkinson's Disease**

A. **Definition:** chronic, degenerative process of neurons in the brain - which causes a loss of control and regulation of movement

B. **Causes:** unknown, but seems to be related to a decrease in dopamine, arteriosclerosis and genetic inheritance

C. **Incidence:** usually has a slow progression starting in persons over the age of 60
   1. more males than females; about 1+million cases in U.S.

D. **Signs and Symptoms**
   1. tremors - head, hands, feet, voice/mouth
   2. muscle rigidity - movements lack fluidity
   3. mask like look to the face
   4. restlessness, pacing
   5. fatigue, weakness, depression
   6. autonomic nervous system dysfunction - drooling, dysphagia
E. **Diagnostic tests:**
   1. history, examination, handwriting evaluation
   2. electromyogram (EMG)

F. **Complications**
   1. unable to meet ADLs
   2. safety/falls

G. **Treatment**
   1. medications
      a. anticholinergic = atropine, cogentin, artane - control tremors
      b. antoparkinsonian = dopamine precursor (levodopa) & dopamine releasing agents
   2. diet - high calorie and protein, soft, small frequent meals and 2000cc of H20 daily
   3. Nursing actions
      - safety education
      - teaching about energy conservation and pacing activities
      - support family
      - may require tube feedings

**Multiple Sclerosis**

A. **Definition:** chronic, degenerative disease caused by a demyelination of CNS white matter
   1. primarily affects adult in their prime of life
   2. incidence: between 250,00-350,000 people in the U.S. have MS
   3. more prevalent among caucasions, particularly those of northern European descent
   4. occurs more often among women than men
   5. myelin sheath surrounding azons become damaged, interrupting conduction of electrical impulses

B. **Causes:** unknown, may be autoimmune and/or related to viral infection
   1. researchers suggest that in genetically susceptible people the disease results from an abnormal autoimmune response to some agent, possibly a virus or environmental trigger

C. **Signs & symptoms** - neurologic symptoms vary with lesion location in the brain
   1. gait disturbances
2. optic neuritis
3. persistant binocular double vision or other vision problems
4. presence of Lhermitte's sign - an electric-shock-like sensation along the spine upon flexion of the head
5. hyperreflexia
6. positive Babinski reflex
7. weakness, fatigue
8. tremor
9. pain
10. bladder, bowel and sexual dysfunction
11. spasticity, paralysis
12. cognitive changes
13. dysarthria, dysphagia
14. depression

D. Diagnostic tests
1. MRI detects placques in about 90% people with MS; while MRI is sensitive in pinpointing intracranial abnormalities such as demyelinated plaques, these studies are highly nonspecific
2. three specific findings support the diagnosis
   -lesions abutting lateral ventricles
   -lesion diameter more than 0.6cm
   -lesions in the posterior fossa
3. Visual-Evoked responses (VERs) detect asymptomatic plaques in the optic nerves. Abnormal responses are seen in 85% of patients with definite MS and 58% of patients with probable MS
4. Brain-stem auditory evoked responses (BAERs) detect suspected pontine lesions of the brain stem
5. Somatosensory evoked responses (SSERs) document sensory abnormalities in people with normal findings on clinical examination by detecting plaques in the sensory pathways of the spinal cord and brain
6. Laboratory tests of CSF may reveal oligoclonal bands (OCBs), the specific antibodies produced by plasma B cells in people with MS

E. Prognostic Indicators
1. four categories
   a. relapsing-remitting
      -episodes of acute worsening of neurologic function, followed by periods without disease progression. Some patients experience residual effects.
   b. primary-progressive
      -continuous worsening of disease that is not interrupted by distinct
relapses. Some patients experience occasional plateaus and temporary minor improvements
   c. secondary-progressive
      - the relapsing-remitting course eventually becomes progressive
   d. progressive-relapsing
      - progressive disease from the onset, with acute relapses and continuing disease progression
  2. In general, women have a better prognosis than men
  3. Symptoms associated with brainstem damage, such as nystagmus, tremor, ataxia, dysarthria, poor recovery after exacerbations, and a high incidence of attacks, indicate a poor prognosis
  4. Patients with onset of disease before age 35, those with monoregional attack, and those with complete recovery after an exacerbation often have better outcomes

F. Treatment
   1. Interferons
   2. Glatiramer acetate
   3. High-dose I.V. corticosteroids
   4. I.V. immunoglobulins
   5. low dose chemotherapy