Nervous System Pathology
Nervous System

- Central Nervous System
  - CNS
  - Brain & Spinal cord
Nervous System

- Peripheral Nervous System
  - PNS
  - Spinal and cranial nerves

The Heat Reflex
CNS

- Close relationship with endocrine system
  - Regulation and integration of body functions
PNS

- Close relationship with musculoskeletal system
  - Control of skeletal muscles
Anatomy of the Brain

- **Meninges**
  - Outer covering of connective tissue
    - Dura – dense collagenous tissue
  - Middle - loose connective tissue strands and blood vessels
    - Arachnoid
  - Inner – contiguous with the brain (external surface of brain)
    - Pia
Anatomy of the Brain

- Cerbro-spinal fluid (CSF)
  - Surrounds brain and spinal cord
  - Protects the brain
  - Allows exchange of substances between the blood and the brain
CNS: Anatomy

- Brain
  - Cerebrum
    - 2 hemispheres connected by the corpus collosum
  - Cerebellum
  - Brainstem
    - Midbrain
    - Pons
    - Medulla oblongata
CNS: Anatomy

- Cerebrum 4 lobes and their functions
  - Frontal
    - Motor, behavior, emotion, higher intellectual functioning
  - Parietal
    - Sensory
  - Occipital
    - Visual center
  - Temporal
    - Hearing & olfaction
CNS: Anatomy

- Basal ganglia
  - Inhibitory stimuli to thalamus
  - Coordination of skeletal muscle
  - Blocks unwanted muscle contraction
  - Produce neurotransmitter substances
CNS: Anatomy

- Thalamus
  - Integrates sensory stimuli
  - Determinant of consciousness

- Hypothalamus
  - Connects parts of the brain
    - Regulates body function
      - Temperature, HR, BP, thirst, appetite
      - Source of neurosecretory substances stimulating the pituitary to produce hormones to regulate endocrine glands
CNS: Anatomy

- Brainstem
  - Integration of complex motor patterns
  - Control of breathing, heart rate, BP, arousal and consciousness
CNS: Anatomy

- Cerebellum
  - Major regulator of motor activities
  - Maintenance of balance
  - Regulates muscle tone
  - Coordination of voluntary movement
    - Limb/eye coordination
CNS: Anatomy

- Spinal cord
  - Grey and white matter
    - Non-myelinated and myelinated nerve fibers
  - Grey matter
    - Anterior horn
      - Peripheral nerves
      - Extend to muscles – motor impulses
    - Posterior horn
      - Sensory nerves to viscera
CNS: Anatomy

- Spinal cord
  - White matter
    - Myelinated nerve fibers
      - Descending tracts – motor tracts
      - Ascending tracts – sensory tracts
CNS: Anatomy

- Corticospinal Tract
  - Anterior and lateral white matter
    - Axonal extensions of cortical and subcortical neurons of the brain
      - Upper motor neuron lesions
    - Axons of cerebral nerves that connect with distal neurons in the anterior horn of the SC
      - Lower motor neuron lesions
CNS: Anatomy

- Sensory spinal tracts
  - Posterior spinal tracts
    - Axonal extensions of neurons in spinal ganglia
      (external to the spinal cord, connected by dorsal roots)
PNS: Anatomy

- Spinal nerves and peripheral nerves
  - Spinal nerves
    - Anterior root = axons of LMNs
    - Posterior root = spinal ganglia and cytoplasmic extensions
  - Sensory and motor neuron circuit
    - Reflex movements
Autonomic Nervous System

- Regulates involuntary body functions
  - Urinary system, GI tract, body temp
- Divided into:
  - Sympathetic
    - Vasoconstriction and hypertension
  - Parasympathetic
    - Vasodilation and hypotension
Autonomic Nervous System

- Sympathetic nervous system
  - “Fight or Flight”
  - Stress, exercise

- Parasympathetic nervous system
  - Active during rest
  - Body replenishing resources
Major Diseases of the Brain

- **Common**
  - Headache
  - Migraine
  - Neck and back pain
  - Seizures

- **Unrecognized**
  - Depression
  - suicide
CNS

- Brain Death
  - Inability to respond to any stimulus
    - No spontaneous respiration
    - Absence of postural reflexes
    - Fixed & dilated pupils
    - Flat EEG for 10 minutes
    - Repeated testing for 24 hours with no change
    - No evidence of hypothermia
Developmental Diseases of the Brain

- Etiology – idiopathic (for most)
  - Genetic and chromosomol abnormalities
  - Abnormal morphogenesis of the brain and spinal cord
    - Tay Sachs - genetic…mental and motor deterioration & blindness
      - Chemical insufficiency
    - Trisomy of Chromosome 21 Down Syndrome
      - Cognitive difficulties
Developmental Diseases of the Brain

- Etiology – idiopathic (for most)
  - Genetic
  - Abnormal morphogenesis of the brain and spinal cord
    - Calcification and Hydrocephalus
    - Anancephaly
    - Spinabifida
Anencephaly

- Neural tube defect
- Lack of brain development
  - No cerebral hemispheres and other parts of brain
- Etiology: unknown
- Prognosis: poor
Spinabifida

- Neural tube defect in development of spinal column
- 3 types
  - Spinabifidia occulta
  - Meningocele
  - Myelomeningocele
- Etiology: unknown
Spinabifida

- Spinabifida occulta
  - Incomplete fusion of the posterior vertebral arch
  - Does not visibly protrude
  - May have depression or dimple in skin, tuft of dark hair, soft fatty deposits, port-wine nevi
  - Usually does not cause neurologic dysfunction
  - May impact bowl and bladder, or cause foot weakness
Spinabifida

- Meningocele
  - External protrusion of the meninges
  - Rarely causes neurological deficits
  - Spinal cord intact
Spinabifida

- **Myelomeningocele**
  - Protrusion of meninges and spinal cord
  - Clinical manifestations:
    - Flaccid or spastic paralysis
    - Bowel and bladder dysfunction
    - Musculoskeletal deformities
    - Hydrocephalus
Spinabifida

- Diagnosis can be made in utero
  - Delivery usually by c-section

- Treatment:
  - Can surgically close defect
    - Prenatal
    - Post natal
    - However, existing neurological defects cannot be reversed
Cerebral Palsy

- Global term covering many levels of impairment of neuromotor system
- Etiology: damage of infant brain before, during, post birth
- Symptoms:
  - Vary depending on part of brain involved
  - Musculoskeletal problems
  - Neurological problems
CNS

- Disorders of consciousness, perception & responses (hypoarousal)
  - Lethargy
    - State of drowsiness
  - Stupor
    - Unresponsive but aroused with pain
  - Coma
    - Unarousable unresponsiveness
      - except with deep pain
      - Withdrawal reflex response
Intracranial Hemorrhages

- **Epidural – coma**
  - Occur between skull and dura
  - Ruptured meningeal artery or bone fracture

- **Subdural – headache**
  - Occur between dura and arachnoid
  - Boxers, frequently falling elderly

- **Subarachnoid – high death rate** (mortality rate)
  - Between arachnoid and pia – brain surface
  - Traumatic contusion to the brain
Traumatic Brain Injury
Traumatic Brain Injury

- **Concussion**
  - Transient loss of consciousness after blunt head trauma

- **Contusion**
  - Disruption of cerebral and/or meningeal blood vessels due to blunt head trauma
  - Typically hemorrhagic
  - Coup-countercoup lesion
    - Coup- site of impact
    - Countercoup- opposite pole as result of deceleration of the brain by the skull
Traumatic Brain Injury

- Open head injury
  - Meninges breached and the brain is exposed
  - Gun shot
Traumatic Brain Injury (TBI)

- Signs & Symptoms
  - Diminished or altered state of consciousness
  - Motor deficits
  - Possible dizziness & seizures
  - Severe headache & dilated pupils
  - Cognitive or behavioral impairments
Brain Injuries

- Interfere with orientation to time, place, and people
- Decreased level of consciousness or responsiveness
- May be:
  - Lethargic
  - Confused
  - Disoriented
  - Difficult to arouse
  - Coma
Brain Injuries

- Behavioral impairments
  - Flat affect
  - Sexual inappropriateness
  - Perseveration
  - Irritability
  - Lack of inhibition regarding social behaviors
  - Inappropriate emotions
Brain Injuries

- **Motor deficits**
  - Flaccidity
  - Posturing
  - Tremor
  - Monoplegia, hemiplegia
Traumatic Brain Injury

- Medical management
  - Crainotomy to aspirate accumulated fluid to relieve pressure

- Prognosis
  - due to complex nature of injury, predicting outcomes is difficult
Traumatic Brain Injury

- PT
  - Depends on level of consciousness
  - Low consciousness
    - Maintain ROM, prevent contractures
    - Sensory stimulation for arousal
    - Promote early return of functional mobility
Traumatic Brain Injury

- PT
  - Higher consciousness
    - Prevent overstimulation if confused or agitated
    - Familiar functional activities
    - Balance and postural control
    - Safety
    - Allow independence and reintegration
Cerebrovascular Disease

- Atherosclerosis of cerebral vessels
  - Same morphologic features as atherosclerosis in other sites
  - Global ischemia
    - Widespread atherosclerotic narrowing of entire cerebral vascular system leads to multiple foci of ischemic necrosis
    - Cause minor neurological deficits, but over time result in progressive mental deterioration
Cerebrovascular Disease

- Cerebral vascular accident (CVA)
  - Devastating vascular event which results in destruction of surrounding brain tissue
  - Leading cause of serious long term disability
CVA Risk Factors

- Hypertension
- Diabetes mellitus
- Cardiovascular disease
- Elevated blood lipids
- Obesity
- Cigarette smoking
- Age
- Race
- Sex
Warning Signs of CVA

- Sudden weakness or numbness in face, arm, leg
- Sudden dimness or loss of vision
- Sudden difficulty speaking or understanding speech
- Sudden severe headache
- Unexplained dizziness, unsteadiness, falls
CVA

- CVA can be:
  - Ischemic
    - Common causes: thrombosis and embolic occlusion of major vessel
  - Hemorrhagic
    - Bleeding from an arterial source into brain
    - Regarded as most deadliest subtype
Ischemic CVA

- Caused by interruption of blood flow due to thrombosis
  - Brain tissue surrounding infarct is edematous
    - Phase of maximal cerebral swelling
  - Infarct area - necrotic
  - Area surrounding infarct - get reperfused in several days
- Presentation depends upon site of occlusion
Transient Ischemic Attack (TIA)

- “mini stroke”
- Focal neurologic symptoms that resolve in 24 hrs
- Etiology and symptoms same as stroke
- Can be predictive of future CVA
Hemorrhagic CVA

- With advancing age, arteries narrow and become brittle
- If BP is elevated, an artery may burst
- Also complication of head trauma
- Results in hematoma
- Most deadly of stroke subtypes
- Rupture of aneurism
Cerebral Vascular Accidents

- R Hemisphere
  - Creativity & esthetics
    - Appreciation for music & art
    - Spatial orientation
    - Recognition of relationships
      - Parent, child, brother, etc.
    - Neglect of contra-lateral side of body
  - Behavioral problems
  - Language impairments
Cerebral Vascular Accident

- L hemisphere
  - Analytical skills, logic
    - Loss of logical thinking ability
    - Intellectual activities
    - Communication activities
    - Overestimate their abilities
Cerebral Vascular Accident

- Damage to Upper Motor Neurons in the cerebral cortex frontal lobe or cortico-spinal tracts interferes with voluntary movement.

- Damage results in weakness or paralysis on the opposite side of the body due to the crossover of cortico-spinal tracts in the medulla.
CVA

- L hemiparesis = R CVA
- R hemiparesis = L CVA
Cerebral Vascular Accident

- **Sensory Deficits**
  - Site of the damage determines the deficit
    - Touch
    - Pain
    - Temperature
    - Position
    - Vision
    - Hearing
    - Taste & smell
Cerebral Vascular Accident

- Visual Loss
  - Hemianopsia
    - Loss of visual field on the side opposite to that of the damage
    - L damage = loss of R visual field