Acute Neurological Disorders

Ventricular system with choroid plexuses that form cerebrospinal fluid
Meninges consist of three continuous connective tissue membranes covering the brain and spinal cord
General Effects of Neurological Dysfunction

- The effects of neurological damage from different causes have many similarities
  - Tumor in specific area of brain
  - Trauma to same area
  - Effects of increased pressure have the same effects regardless of cause

Local Effects

- Local effects are signs related to a specific area of the brain or spinal cord in which a lesion is located
  - Paralysis in right arm due to damage in particular section of the left frontal lobe
  - Loss of vision resulting from damage to the occipital lobe
  - With an expanding lesion, such as a growing tumor additional impairment is noted as adjacent areas become involved

Tentorium Cerebelli
Supratentorial and Infratentorial Lesions

- Supratentorial lesions occur in the cerebral hemispheres above the tentorium cerebelli.
  - Lesions here lead to specific dysfunction in a discrete area
  - The lesion must be large before it affects consciousness
- Infratentorial lesions are located in the brainstem or below the tentorium
  - A relatively small lesion may affect many sensory and motor functions resulting in widespread dysfunction
  - Also, respiratory, circulatory and level of consciousness may be impaired by a small lesion in this area

Left and Right Hemispheres

- Certain effects of brain damage are unique to the left or right hemisphere
  - In most people, damage to the left hemisphere can lead to loss of logical thinking ability, analytical skills, other intellectual abilities and communication skills
  - Right sided brain damage can impair appreciation of music and art and causes behavioral problems; spatial orientation and recognition of relationships may be deficient

Level of Consciousness

- Normally, a person is totally aware of surrounding activities and incoming stimuli and oriented to time, place and people
  - The person can respond quickly and appropriately to questions, commands or events
  - One of the early changes noted in those with acute brain disorders is a decreasing level of consciousness or responsiveness
Cerebral cortex and RAS in the brainstem determine the level of consciousness
- Usually extensive supratentorial lesions must be present in the cerebral hemispheres to cause loss of consciousness, whereas relatively small lesions in the brainstem can affect the RAS
- Systemic disorders, such as acidosis or hypoglycemia can depress the CNS and reduce the level of consciousness

Various levels of reduced consciousness
- Lethargy
- Confusion
- Disorientation
- Memory loss
- Unresponsiveness to verbal stimuli
- Difficulty of arousal
- Coma

Motor Dysfunction
- Damage to upper motor neurons in cerebral cortex (frontal lobe) or to the corticospinal tracts in the brain interferes with voluntary movements
- Causes weakness or paralysis on the contralateral side of the body
- Muscle tone and reflexes may be increased (hyperreflexia) leading to contractures in the affected limbs (spastic paralysis)
Damage to lower motor neurons in the anterior horns of the spinal cord causes weakness or paralysis on the same side of the body, at and below the level of damage. In the area of damage the muscles are usually flaccid (lack tone) and reflexes are absent (flaccid paralysis).

Sensory Deficits (Paresthesias)

Sensory loss may involve:
- Touch, pain, temperature, position and special senses of vision, hearing, taste and smell
- The specific site of lesion in the somatosensory cortex (parietal lobe) determines the deficit for skin senses

Visual Loss

Visual Pathway

Loss of Visual Field
### Language Disorders

- Aphasia refers to an inability to comprehend or to express language
- There are many types of aphasia
  - Expressive
  - Receptive
  - Global
- Dysphasia refers to partial impairment

- Dysarthria, in which words cannot be articulated clearly, is a motor dysfunction that usually results from cranial nerve damage or muscle impairment
- Agraphia, is impaired writing ability
- Alexia, impaired reading ability
- Agnosia is loss of recognition or association, e.g. visual agnosia indicates an inability to recognize objects visually

### Seizures

- Seizures or convulsions are caused by spontaneous excessive discharge of neurons in the brain
- Seizures may be precipitated by inflammation, hypoxia or bleeding in the brain
- Seizure may be focal, being related to a particular site of irritation but may become generalized
- Seizure disorders are chronic and considered later
Increased Intracranial Pressure

- Skull contains brain tissue, blood and cerebrospinal fluid
- Normally, the volume of each remains relatively constant and as a result, the pressure inside the cranium remains normal
- Because the brain is encased in a rigid skull, any increase in non-compressible fluid or any additional mass, such as a tumor causes increased pressure

The increased intracranial pressure results in less arterial blood entering the “high pressure area” and eventually the brain tissue itself is compressed.

- This decreases the function of neurons, first locally and later widespread loss of function.

Increased ICP is common in many neurological problems:
- Brain hemorrhage
- Trauma
- Edema
- Infection
- Tumors
- Accumulation of excess CSF
Transient Ischemic Attack (TIA) results from a temporary localized reduction in blood flow in the brain. It may result from:
- Partial occlusion of an artery
- Arteriosclerosis
- A small embolism
- Vascular spasm
- Local loss of autoregulation
TIA’s may occur singly or in a series
TIA’s can serve a useful purpose if used as a warning signal leading to diagnosis and treatment before a stroke occurs
Not all strokes are preceded by a TIA
The manifestations of a TIA are directly related to the location of the ischemia

Examples include
- Muscle weakness in an arm or leg
- Visual disturbances
- Numbness or parathesias in the face
- Transient aphasia or confusion
- The attack may last a few minutes or longer but rarely more than 1-2 hours

Cerebrovascular Accidents (CVA)
- A CVA, stroke or brain attack is an infarction of brain tissue from lack of blood
- Tissue necrosis may result from total occlusion of a vessel by atheroma or embolus or it may be a result of a ruptured vessel
- Five minutes or less of ischemia causes irreversible cell damage
Types of Strokes

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Belt Highway
St Joseph
4.4.2005

With A Stroke, Time Lost Is Brain Lost.
Learn the warning signs at www.StrokeAssociation.org
Or Call (816) 271-4098

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Colorized NMR showing disruption in blood flow to the left side (viewers right) of the brain.
**Risks for Stroke**

- Diabetes mellitus
- Hypertension
- Elevated cholesterol levels
- Hyperlipidemia
- Atherosclerosis
- A history of TIA’s
- Increasing age
- Heart disease

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**Head Injuries**

- Head injuries may include skull fractures, hemorrhage and edema or direct injury to brain tissue
- Injury can be mild or severe and life-threatening.
- Skull protects the brain but can also destroy it by means of bone fragments that penetrate or compress the brain tissue and by its inability to expand to relieve pressure

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**Types of Head Injuries**

- **Concussion** is a reversible interference with brain function usually resulting from a blow to the head; recovery usually occurs within 24 hours
- **Contusion** is a bruising of the brain tissue with rupture of small blood vessels and edema that usually results from a blunt blow to the head
- **Closed head injury** occurs when the skull is not fractured in the injury, but the brain tissue is injured and blood vessels may be ruptured by force exerted against the skull.
- **Open head injuries** are those involving fractures or penetration of the brain by missiles or sharp objects.

- **Contrecoup** injury occurs when an area of the brain contralateral to the site of direct damage is injured as the brain rebounds off the skull.
Hematomas

- A hematoma is a collection of blood in the tissue that develops from ruptured blood vessels.
- Hematomas and hemorrhages are classified by their location in relation to the meninges:
  - Epidural (extradural) hematoma
  - Subdural hematoma
  - Subarachnoid hemorrhage
  - Intracerebral hematoma
Spinal Cord Injuries

- Usually results from fracture or dislocation of the vertebrae
- Causes compression, stretching or tearing of the spinal cord
- Supporting ligaments and intervertebral discs may be damaged also
- Most injuries occur in two areas of the vertebral column: C1 to C7 and T12 to L2

Dermatome Map

Testing dermatomes can be useful in assessing the extent of damage and recovery. A dermatome map is used to assess which spinal segments are functioning.

Common Types of Spinal Cord Injuries

- Cervical spine injuries involving hyperextension or hyperflexion of the neck with possible fracture
  - Leads to disc and ligament damage
  - Loss of alignment of the vertebrae
  - Causes compression and stretching of cord
- Dislocation of any vertebra may crush or compress spinal cord and interfere with blood supply
Compression fractures cause injury to the cord when great force is applied to the top of the head or to the feet and transmitted up or down the spine.
- Shattered bone is compressed and exerts pressure horizontally against the cord.
- Sharp edges of the bone fragments may lacerate nerve fibers and blood vessels.
- Spinal cord damage may also occur from penetration injuries such as stab wounds or bullet wounds.

Classification of Vertebral Fractures
- Simple (single line break)
- Compression (crushed or shattered bone with multiple fragments)
- Wedge (displaced angular section of bone)
- Dislocation (vertebra forced out of its normal position)

Avoiding Secondary Damage
- Because spinal cord injuries are often unstable, immediate and appropriate immobilization is essential to prevent secondary damage.
Effects of Spinal Cord Injury

- Damage to cord may be temporary or permanent
  - Nerves in the spinal cord do not regenerate
  - Laceration of nerve fibers by bone fragments usually results in permanent loss of conduction in the affected nerve tracts
  - Complete transection or crushing of the cord usually results in irreversible loss of all functions at and below the level of injury
  - Partial transection or crushing may allow recovery of some functions

- Bruising is a reversible damage when mild edema and minor bleeding temporarily impair conduction of nerve fibers
  - Compression must be relieved quickly
  - Prolonged ischemia and necrosis lead to permanent damage

Cervical Injury

- When spinal cord injury occurs in the cervical region it may extend upward to involve C3 to C5
  - This interferes with the phrenic nerves to the diaphragm and affects respiration
  - Artificial ventilation may be required to maintain the patient
Etiology of Spinal Cord Injuries

- Most spinal cord injuries occur in young men from motorcycle and car accidents
- Second most common cause is sports related injuries (diving and football)
- Falls account for another major cause and elderly people make up much of this group

Signs and Symptoms—Two Stages in post-traumatic period

- Early period of spinal shock and increasing impairment:
  - All neurologic activity ceases at and below and slightly above the level of injury
  - No reflexes are present including skeletal muscle, sensory and autonomic systems
  - This may persist for days or weeks
  - Signs include flaccid paralysis, sensory loss at and below the level of injury, absence of all reflexes and loss of central control of autonomic function
Signs and Symptoms—Two Stages in post-traumatic period

Recovery and recognition of the extent of functional loss:

- This stage is indicated by the gradual return of reflex activity below the level of injury
- Hyperreflexia generally develops due to lack of the normal inhibitory impulses that come from the brain
- Spastic paralysis, sensory deficits and reflex control of bladder and bowel activity are present below the level of damage

Cervical injuries affect sensory and motor functions in arms, trunk and legs
- Respiratory function: intercostal and phrenic nerves
- Sympathetic nervous system function
- Blood pressure and body temperature may be unstable due to lack of central control of vasomotor tonus and diaphoresis (sweating)
Autonomic Dysreflexia

- Damage to the cervical spine can result in serious and potentially life threatening sympathetic responses
  - A sensory response like a distended bladder or decubitus ulcer can send impulses up the cord resulting in a massive response of the sympathetic nervous system which cannot be regulated by the brain (hypothalamus and cardiovascular reflex centers in the brainstem).

- The stimulus can activate the chain ganglia leading to excessive vasoconstriction and a sudden increase in blood pressure, headache and visual disturbances
  - Baroreceptors sense the increase in BP and stimulate bradycardia via vagus
  - Without immediate resolution a stroke or heart failure may follow

- Removing the cause of the stimulus and administering blood pressure lowering drugs
Terminology with Spinal Cord Injuries

- Paralysis of all four extremities is termed quadriplegia.
- Paralysis of the lower part of the truck and legs is termed paraplegia.
- NOTE that lumbar cord injury interferes with function of the lower extremities as well as sacral parasympathetic fibers.

Complications with Spinal Cord Injuries

- Muscle spasms
- Decubitus ulcers
- Respiratory and urinary infections
- Sexual dysfunction
- Reproductive dysfunction