NEUROLOGICAL DYSFUNCTIONS I
ASSESSMENT AND ↑ICP
NR 40  PROFESSOR THORNTON

Nervous System

Divisions:
- 1. CNS- brain and spinal cord
- 2. Peripheral Nervous system- out side spinal cord

Brain Structures and Function
3 Major divisions;
1. Forebrain
   - Cerebrum
   - Diencephalon (upper brainstem)
     - Thalimus and hypothalamus
2. Brainstem
   - Midbrain
   - Pons
   - medulla
3. Cerebellum

Cerebrum- responsible for high motor function and intelligence. Control complex functions. R and L hemispheres;
1. Right – integrates dimensional and perceptual information
2. Left – largely influences symbolic language

Cerebral Cortex
- 1. Frontal- largest- controls affect, judgment, personality and inhibitions, complex problem solving, language expression, emotions
- 2. Parietal- sensory- (except smell) interpretation of touch, pressure, temp. and position change
- 3. Temporal- taste, smell, and hearing, short term memory, interpretation of sound, comprehension of language
- 4. Occipital- vision interpretation

CEREBRAL LOBES
- Frontal lobe- complex problem solving, value judgments, language expression, emotions
- Parietal- interpretation of touch, pressure, temperature, position sense
- Temporal lobe- interpretation of sounds, comprehension of language
- Occipital- interpretation of visual images

Neuro A&P Review
Nervous System

- Cerebellum- chiefly involved in skeletal muscle function.
  - located in the posterior fossa.
  - Excitatory and inhibitory actions- smoothness of movement and coordination of movement-
  - controls fine movement, balance, position sense, and integrity of sensory input.

- Diencephalon- contains thalamus, hypothalamus and pituitary gland
  - Thalamus- relay for all senses except smell. All memory, sensation and pain passes through.
  - Hypothalamus- controls autonomic nervous system- works with Pituitary to control fluid balance, temperature regulation with vasoconstriction or vasodililation and hormones.
  - Pituitary- Stimulates the endocrine system- epi and norepi

Brain Stem- posterior fossa- contains the midbrain, pons and medulla oblongata.
  - Midbrain- connects the pons and the cerebellum with the central hemisphere- sensory and motor pathways, center for auditory and visual reflexes.
  - Pons- contains motor and sensory pathways- regulates breathing movements.
  - Medulla- transmits motor fibers from the spinal cord to the brain. Most fibers cross at this level- Heart, respiration and blood pressure. Passes through the foramen Magnum

FUNCTIONS OF THE BRAIN

Coverings of the Brain and Spinal Cord- Meninges
  - Dura mata- outer- external- membrane of the cranial bones
  - Arachnoid- Middle- CSF flows through the sub arachnoid space
  - Pia Mata- internal- vascular layer of connective tissue that is closely connected to the brain and spinal cord

CEREBRAL CIRCULATION
  - Carotid and vertebral arteries
  - Cerebral veins—jugular—superior vena cava
Cerebrospinal Fluid
Produced by choroid plexus, surrounds and cushions the brain and spinal cord

- **Blood Brain Barrier**-
  - Prevents large molecules such as albumin, substances bound to albumin, and some antibiotics from gaining access to the CNS (Mannitol – draws fluid from brain into systemic circulation by osmosis)

16 □ Cerebral Circulation

17 □ NEUROLOGICAL PHYSICAL EXAM
  - General Information-
  - Mental Status-
  - Illnesses or hospitalizations-
  - Medications-
  - Gait and Station-
  - Examination of Head Neck and Spine- "bruit" Stiff neck- nuchal rigidity-
  - Examination of Cranial Nerves (CN II-XII)

18 □ NEUROLOGICAL PHYSICAL EXAM
  - **Eye-PERRLA**-Pupils, Equal, Round, React to light and Accommodation
  - Consensual response
  - Brain stem function;
  - Dolls eyes (oculocephalic reflex)- the eyes fail to move together and remain fixed in the mid position as the head is turned.- indicator of brain stem function

19 □ Dolls Eye Testing

20 □ Dolls Eye Testing

21 □ NEUROLOGICAL PHYSICAL EXAM
  - Oculovestibular- cold caloric testing- cold water in ear lateral deviation toward the stimulus- lost in brain stem damage- done only on unconscious pts

22 □ NEUROLOGICAL ASSESSMENT: DISTURBANCES OF SENSATION

VOCABULARY
  - Proprioception
  - Paraesthesia
  - Anesthesia
  - Hyperesthesia
  - Stereognosis
  - Chorea
  - Athetosis
  - Myoclonus
  - Dystonia
  - Tic
  - Tremor

23 □ NEUROLOGICAL ASSESSMENT
  - Evaluation of Reflex Activity-
    - **Superficial (cutaneous) reflexes**
      - Corneal, gag, abdominal, plantar
    - **Deep tendon reflexes (DTR’s)**
      - Biceps, brachioradialis, triceps, patellar, Achilles
Grade DTR's using a 0-4 scale, diagram on a stick figure when charting:
- 0 = absent reflex
- 1+ = diminished reflex
- 2+ = normal
- 3+ = slightly increased
- 4+ = hyperactive

PROCEDURES FOR TESTING DEEP TENDON REFLEXES

BABINSKI RESPONSE

BABINSKI RESPONSE

NEUROLOGIC TESTS AND DIAGNOSTIC PROCEDURES
- Lumbar Puncture – performed to measure CSF pressure, sample CSF, inject medication
- Brain scan
- EEG – record the electrical impulses
- MRI
- Positron Emission Tomography PET (maps the brain's metabolic activity) gas or radioactive substance - metabolic changes - Alzheimers
- Single Photon Emission Computed Tomography (SPECT) - radioactive agent - abnormally perfused areas - stroke, epilepsy
- Transcranial Doppler

Neurological Assessment –

Neuro checks
- Level of Consciousness (LOC)
  - Alert
  - Lethargic
  - Obtunded - increased sensory input to produce an output -
  - Stuporous - no verbal response even to forceful painful stimulation
  - Akinetic Mutism - eyes may be open but patient unresponsive to stimuli

Levels of Consciousness -(LOC)
- Persistent Vegetative State - wakeful but devoid of conscious content without cognitive or effective mental function
- Locked In syndrome - alert and aware - unable to communicate verbally - eye movements only "Locked in a paralyzed body"
- Coma - no output when maximally stimulated
- Psychogenic Coma - related to hysteria, catatonia and severe depression

NEUROLOGICAL ASSESSMENT

Respiratory patterns;
- Cheyne-Stokes - increasing and decreasing respiratory rates and depth of respirations alternating with periods of apnea (that can last 10-60 seconds).
- Central Neurogenic hyperventilation - rapid, irregular deeper respirations
- Apneustic Breathing - Prolonged inspiration with a pause at full inspiration followed by expiration and a possible pause following expiration.
- Cluster Breathing - clusters of breaths with irregular periods of apnea between clusters.
- Ataxic breathing - irregular breathing with a random sequence of deep and shallow breaths – ventilatory assistance necessary

NEUROLOGICAL ASSESSMENT

Pupillary Patterns;
- PERRLA - size and response to light
Eye Movements;
- Pupillary changes occur ipsilateral
- Eye Movements-involuntary movements
  - Roving eye- eyes wander slowly or rove around.
  - Ocular bobbing- eyes slowly jumping up and down
  - Tracking- ability to follow object

32 NEUROLOGICAL ASSESSMENT
Motor Response;
- Monoplegia- paralysis of a single area
- Hemiplegia- paralysis of one side of the body
- Quadriplegia- paralysis of all four extremities.
- Paraplegia-paralysis of lower portion of body and both legs.
- Paresthesia- numbness and tingling- heightened sensation.
- Paresis- partial or incomplete paralysis.

33 NEUROLOGICAL ASSESSMENT
Posturing-
- DECORTICATE RIGIDITY- FLEXOR- arms, wrists and fingers are all flexed arms are adducted- across chest, legs fully extended and internally rotated. With plantar flexion of the feet.

34 Posturing
- DECELERATE RIGIDITY- EXTENSOR Brain severed from spinal cord- no associated movement. Legs are similar in position as in decorticate rigidity. The arms are also stiffly extended and adducted with hyper-pronation of the hands. Teeth are clenched and the posturing may be so intense the bed may shake as spasms of rigidity course through the body.

35 Posturing
- DECORTICATE RIGIDITY IS NOT AS SEVERE A PROGNOSTIC SIGN AS DECELERATE.
- DECELERATE RIGIDITY IN THE UPPER EXTREMITIES WITH FLACCIDITY IN LOWER EXTREMITIES IS MORE SERIOUS THAN CLASSICAL DECELERATE RIGIDITY.
- TOTAL FLACCIDITY IS ALSO A POOR PROGNOSTIC SIGN.

36 POSTURING

37

38

39 NEUROLOGICAL ASSESSMENT
Vital Signs; widely varying changes may be present, some due to course or complication of the disease
- Temp- hypo or hyperthermia may develop
- Cushings changes- classic signs of ↑ intracranial pressure. ↓ pulse and ↑ blood pressure
with a widening pulse pressure and slow respirations.

- Cushing changes are not a reliable warning
- May be difficult to differentiate from systolic hypertension and bradycardia.

- Observation for Seizures—focal (localized to a specific area or general)

**NEUROLOGICAL ASSESSMENT**

**Lab Data:**
- Blood glucose
- Electrolytes
- Serum Osmolality
- ABG’s
- Creatinine and BUN
- Liver function tests
- Toxicology
- CBC with diff
- Examination Of Cerebrospinal Fluid

**BRAIN DEATH CRITERIA**

- **Guidelines For Determination of Death by Irreversible Cessation of All Functions of the Entire Brain, Including the Brain Stem (Age Greater Than One Year)** NY STATE 1997

  - **NOTE:** All 9 items must be answered YES to declare brain death. YES-NO
    1. Have reasonable efforts been made to notify the patients' next-of-kim or other person closest to the individual that a determination of death based on cessation of brain function will soon be completed?

  2. Is the cause of the coma known and sufficient to account for the irreversible loss of all brain function? **NOTE:** Coma of unknown cause (e.g., no evidence of brain trauma, stroke, hypoxic/hypotensive injury) requires a diligent search for the cause of coma before brain death determination. Similarly, the magnitude of the brain injury must be commensurate with irreversible cessation of all brain function.

**BRAIN DEATH CRITERIA**

3. Are CNS depressant drugs, hypothermia (<32 degrees C) and hypotension (MAP <55 mm Hg) excluded as reversible causes of brain failure and has any effect of neuromuscular blocking agents been excluded as contributing to the results of the neurologic exam? **NOTE:**

- Specific levels of CNS depressants or neuromuscular blocking drugs are left to clinical judgment.
- Brain death cannot be declared in the setting of hypothermia (< 32.2 degrees C).
- Shock, as defined as a mean arterial blood pressure less than 55 mm Hg, prohibits the declaration of brain death. Pressors to support arterial blood pressure may be used (mean BP = (2 * BP diastolic + BP systolic) / 3).
- If levels of CNS depressants or neuromuscular blocking agents cannot be excluded as contributing to poor neurologic status but cerebral angiography demonstrates there is no intracranial blood flow, then proceed to item #4.

**BRAIN DEATH CRITERIA**

4. Is all movement attributable to spinal cord function (i.e., there are no other spontaneous movements or motor responses)? **NOTE:** Posturing and shivering in the absence of neuromuscular blockade or learned movements in response to pain in any extremity or the head preclude the diagnosis of brain death. Deep tendon reflexes including stereotypic triple flexor responses in the lower extremities are compatible with brain death. These include spontaneous slow movements of an arm or leg. Bizarre movements of entirely spinal origin may sometimes occur in brain dead patients. Also, coordinated movements can occur with shoulder elevation and adduction, back arching and the appearance of intercostal muscle contraction without detectable tidal volumes. Finally, in a few patients, the "Lazarus sign" may develop when the ventilator is permanently disconnected; the head and torso may flex and for a few seconds rise from the bed with arms outstretched, then falls back and the dead body remains permanently flaccid in the supine position.

**BRAIN DEATH CRITERIA**

5. Absent cough and/or pharyngeal reflexes?
6. Absent corneal and pupillary light responses?

7. Absent caloric responses to iced water after visual examination of the tympanic membranes?

47 **BRAIN DEATH CRITERIA**
   - Has an apnea test of a minimum five minutes duration showed no respiratory movements with a documented PCO2 greater than 55 mm Hg with a pH of less than 7.40?

   **NOTE:** Extreme caution should be exercised in the performance of the apnea test. The apnea test should be conducted only after all other evaluations are completed. An apnea test should be performed in such a manner as to minimize the risk of hypoxia or hypotension. Delivering a high concentration of oxygen to the airway (4L/min) before and during the apnea test reduces the risk of hypoxic complications. If mean arterial blood pressure falls significantly during the performance of an apnea test, it should be discontinued with an arterial blood sample drawn to determine whether PaCO2 has either risen above 55 mm Hg or increased by more than 20 mm Hg from the level immediately prior to the test. If so, this validates the clinical diagnosis of brain death.

48 **BRAIN DEATH CRITERIA**
   9. Have one of the following four criteria (A,B,C, or D) been established?

   A. Items 2 to 7 have been confirmed by two examinations separated by at least six hours, and item 8, the apnea test, validates the clinical diagnosis of death.

   B. Items 2 to 7 have been confirmed as YES.
      - An EEG shows electrocortical silence.
      - A second exam at least 2 hours after the first, confirms items 2 to 7 as YES, and the apnea test validates the clinical diagnosis of death.

   C. Items 2 to 7 have been confirmed as YES.
      - No intracranial blood flow is evident.
      - A second exam at least 2 hours after the first, confirms items 2 to 7 as YES, and the apnea test validates the clinical diagnosis of death.

   D. In the event that any of the items 2 to 7 cannot be determined because the injury or condition prohibits evaluation, (e.g. extensive facial injury precluding caloric testing), then the following criteria apply:
      - ALL items which are assessable are YES.
      - No intracranial blood flow is evident.
      - A second exam at least 2 hours after the first, confirms all assessable items as YES, and the apnea test validates the clinical diagnosis of death.

51 **INTERVENTIONS FOR PATIENTS WITH ALTERED NEUROLOGIC FUNCTION**
   - Safety
   - Ineffective Airway clearance
   - Risk for aspiration
   - Altered Protection
   - Impaired Physical Mobility
   - Skin integrity
      - Eye Care-tarsorrhaphy-
      - Mouth Care-

52 **INTERVENTIONS**
   - Maintain Nutrition and fluid balance-
NEUROLOGICAL ASSESSMENT

Increased Intracranial Pressure -

Causes and Mechanisms

1. Increases in intracranial blood volume
2. Increases in cerebral spinal fluid volume (CSF)
3. Increases in the bulk of brain tissue - swelling

Signs and Symptoms of Increased Intracranial pressure:

- Normal ICP = < 15 mm hg.
- Change in level of consciousness
- Visual
- Motor
- Headache
- Vomiting
- Restlessness

ICP DUE TO CEREBRAL EDEMA PEAKS IN 36-48 hrs
CAUSES OF ICP

Increase in brain volume
- Blood clot, pneumocephalis, edema, Increased cerebral blood flow
- ↑BP
- ↑PaCO2
- ↓PaO2

Vasodilation
- Nitroprusside
- Nitroglycerine

↑Intrathoracic pressure
- Coughing, straining suctioning, PEEP

Impairment of Cerebral Venous return
- Supine, head low and twisted neck

COMPENSATORY MECHANISMS FOR INCREASED ICP

1. displacement and reduction of volume of cerebrospinal fluid- absorption of CSF by arachnoid villi
2. reduction of volume of blood with eventual critical decrease in cerebral metabolism- pressure autoregulation as ICP ↑ vasoconstriction of cerebral arterioles works to a point
3. displacement of the tissues of the brain IE herniation of the brain stem

Hydrocephalus- production of CSF exceeds its absorption.

Progression of ICP

BRAIN HERNIATION

Glasgow Coma Scale

The GCS is scored between 3 and 15, 3 being the worst, and 15 the best.

A Coma Score of 13 or higher correlates with a mild brain injury, 9 to 12 is a moderate injury and 8 or less a severe brain injury.

If GCS ↓ by 2 points from baseline, send for CT
If GCS persists < 5 points over a number of days, prognosis is poor
If scale between 5-9 over time, don’t know which way client will go
>9 and recovery seen in 72 hours, probable full recovery
Management Of Clients With ICP

- ICP monitoring
  - Facilitates continual assessment of ICP and is more precise than relying on vague parameters.
  - Devices include the intraventricular catheter, subarachnoid screw or bolt and epidural monitor
  - ICP levels should be <15mm Hg, MAP >70mm Hg, and cerebral perfusion pressure (CCP) 70-90 mmHg.

- Calculate the cerebral perfusion pressure (CCP) using the following formula:
  - \( CPP = MAP - ICP \)
  - Normal CCP=70-80mmHg is probably the critical threshold. Mortality increases approximately 20% for each 10mmHg loss of CPP. In those studies where CPP is maintained above 70mmHg, the reduction in mortality is as much as 35% for those with severe head injury.

  - Assess client frequently for s/s of IICP
  - Assess device insertion site for s/s infection

INTERVENTIONS MANAGEMENT AND GOALS OF ICP

DX: Altered Cerebral Tissue Perfusion
- decrease brain edema-
  - osmotic diuretics- Mannitol, glycerol
  - Steroids - Dexamethasone (Decadron)
- Control temp- Thorazine to control shivering
- lower CSF volume- ventriculostomy drain
- Positioning- avoid Trendelenburg and extreme hip flexion. Hip flexion increases intra-abdominal pressure and increases ICP

- Decrease blood volume
  - hyperventilation with a respirator leads to respiratory alkalosis \( \rightarrow \) vasoconstriction- short term measure and limited to patients who don’t respond to other measures- PaCO2 maintained at 27-35mm Hg for 24 hrs and then return to normal or baseline
  - Monitor ABG’s
  - vasoconstriction leads to ischemia and as cerebral blood flow is ↓ for first 24 hrs after injury, may add injury to insult. Brain Trauma Foundation recommends not using hyperventilation until after 24 hrs, unless ICP persistently and severely ↑
  - Oxygen often given at 100% to ↓ metabolic activity.

- reduce cellular metabolic demands-Barbiturates – Barbiturate Coma mechanism that ↓ ICP unknown. pentobarbital sodium (nembutal)
  - drug titrated to maintain complete unresponsiveness
  - Client ventilated
  - Dangerous situation
    - Paralyzing Agents- Norcuron (vecuronium bromide)-
  - Other assessments

TYPES OF INTRACRANIAL PRESSURE MONITORING

VENTRICULOLOPERITONEAL SHUNT

INTERVENTIONS
Nursing Implications of ICP monitoring
- Potential for Infection
  - Strict sterile technique
  - Monitor burr hole site for infection
- Altered Cerebral Perfusion
  - Neuro checks
  - Monitor vital signs
  - Maintain pts head in neutral position
  - Assess ICP frequently

Diagnostic Testing
- CT Scan
- MRI
- Cerebral angiography

NEUROSURGERY
- Craniotomy-
  - 1. above the tentorium- Supratentorial
  - 2. below the tentorium-Infratentorial
  - 3. Transphenoidal-
  - 4. Burr Holes-
- Radio-Surgery

Surgical Approaches

STERIOTATIC
- Image Guidance (frameless stereotatic)
  - No frame or arc attachment
  - MRI done prior to surgery and a type of global positioning system is used to locate the lesion.

Newer Types of Surgery
Vascular Neurosurgery - 3-Dimensional angiography during surgery, endovascular embolization is an alternative to surgery. A catheter is inserted into an artery usually in the groin and threaded, using angiography, through the body to the site of the aneurysm. Using a guide wire, detachable coils are released into the aneurysm.

Bypass for cerebral vessels using deep hypothermic cardiac arrest. Brain is protected by deep hypothermia. Suspended animation, or deep hypothermic cardiac arrest used at a few hospitals to allow surgeons to operate on certain badly deformed blood vessels that cannot be repaired while full of blood. When the aneurysms are large and lie deep within the brain, the coursing blood makes repair work too dangerous.

A neurosurgeon in Kansas City, Mo., had given Mr. Rogers a 10 percent chance of survival using conventional anesthesia. The patient's temp was lowered to 60 degrees. At a body temperature of 60 degrees, almost 40 degrees below normal, the brain can survive an hour before damage.

"With normal blood pressure, operating on a giant aneurysm is like operating on a balloon," Dr. Solomon said. "It's tense and fragile and once you break it, the patient is lost. But with no circulation and no blood pressure, the situation is much better. The vessels collapse and become soft and manageable.

### SURGICAL MANAGEMENT

**Pre op management for cranial surgery**
- Anticonvulsants - to reduce the risk of convulsions - DILANTIN, Phenobarbital
- Reduce cerebral edema
- I&B, Foley
- head shave prior to surgery.
- Bowel prep only as ordered.
- Explain procedure and that they will be in ICU post op
- Antiembolism stockings
- No narcotics and Hypnotics

### INTERVENTIONS

**Post op Management**
- 1. adequate respiratory ventilation O2,
- 2. arterial line
- 3. Evaluate for cerebral edema and increasing intracranial pressure
- 4. Temp control
- 5. Medicate:
  - for headache,
  - Anticonvulsant meds (phenytoin and Valium for patient who have undergone supratentorial craniotomy.

### INTERVENTIONS

- 6. Prevent aspiration
- 7. Prevent complications
- 8. evaluate dressing for bleeding or leakage of CSF
- 9. stool softeners

### INTERVENTIONS

- **DO NOT**
  - 1. suction nose
  - 2. lower head of bed
  - 3. restrain
  - 4. take oral temp
  - 5. heavily sedate pt.
  - 6. administer narcotics unless **DOUBLE CHECKED**

### Post op Management for Transphenoidal Approach

- PC Hemorrhage - Nasal packing, Be aware that bleeding post op may manifest its self as frequent swallowing because blood leaks from the sinuses into the oropharynx
- Risk for Infection - antimicrobials.
- Pain analgesics
Cortisone
Fluid volume deficit - agents for control of Diabetes Insipidus (vasopressin).

Post op Management for Transphenoidal Approach:
- Assess visual acuity due to close proximity of optic chiasm.
- Oral care q 4 h.
- HOB up do not blow nose, bend or strain.
- Monitor for CSF leakage, post op meningitis, SIADH
- Vaporizer and HOB up for 2 weeks post op.