

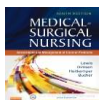
Acute Intracranial Problems

Beena Davis, RN, MSN
N243

Objectives

- Increased ICP: Causes, clinical manifestations, therapeutic, nutritional, and nursing management
- Mechanism of increased ICP
- Mechanism of unconsciousness
- Head injury: Types, clinical manifestations, treatments, therapeutic, and nursing management
- Intracranial tumors: Types, clinical manifestations, therapeutic management
- Major medications used to treat cerebrovascular disorders
- Psychosocial impact of neurological problems on the elderly patient

Required Reading



Med Surg Textbook

p# 1335-1355 Chapter 56

p# 1356-1381 Chapter 57

p# 1539-1544 Chapter 61



Study Guide

p# 250-260 Chapter 56, 57

p# 274 Chapter 61



Pharmacology Textbook

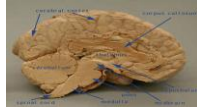
p# 292-303, 304-313, 508-509

626-628, 752-757, 917

Reading Assignments

- Students will be held responsible for reading the following topics (Neuro Modules) on their own time. These topics may not be discussed in lecture, but may be on quiz, exam, and final exam:

- Neuro anatomy and physiology (including 12 Cranial Nerves)
- Labs/Diagnostic Tests
- Cranial Surgery
- Rehabilitation
- Peripheral Nerve Problems & Therapeutic Nursing Management (see the syllabus for details)



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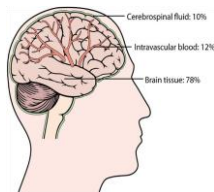
Cerebrospinal Fluid (CSF)

- Circulation: Ventricles, subarachnoid space
- Function: Cushioning for brain & spinal cord
- Formation: Choroid plexus in the ventricles
- Absorption: Arachnoid villi
- Resemblance: Ultrafiltrate of blood

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Intracranial Pressure (ICP)

- Hydrostatic force measured in the brain CSF compartment
- Normal ICP is the total pressure exerted by the skull components
- Factors that influence ICP:
 - Arterial & venous pressure
 - Intraabdominal & intrathoracic pressure
 - Posture
 - Temperature
 - Blood gases (CO₂ levels)



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Cerebral Blood Flow (CBF)

- Amount of blood in mLs passing through 100g of brain tissue in 1 minute
- Factors influence:
 - O_2 , CO_2 , pH
- Global CBF= 50 mL/min/100 g of brain tissue:
 - White matter (25 mL/min)
 - Gray matter (75 mL/min)
- Brain uses 20% of body's O_2 & 25% of its glucose
- Autoregulation of CBF



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Calculations for ICP

- Normal ICP = 5-15 mmHg
- Normal CPP = 60-100 mmHg
- Normal MAP = 70-105 mmHg (↓ 70, ↑ 150)
- $MAP = \frac{SBP + 2(DBP)}{3}$
- $CPP = MAP - ICP$
- $CPP = Flow \times Resistance$

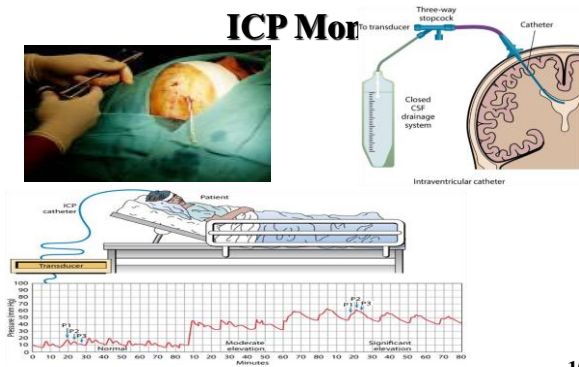
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Monitoring of ICP

- Indications:
 - Neurological insults
 - Patients with GCS of 8 or less
 - Abnormal CT or MRI
- Methods of Measuring ICP
 - Ventriculostomy
 - Fiberoptic catheter
 - Subarachnoid bolt or screw

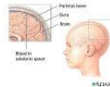
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ICP Mon



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Increased ICP



- ↑ ICP is life-threatening (above 20mmHg)
- Significance: Diminishes CPP, ↑ risks of brain ischemia and infarction, poor prognosis
- Causes:
 - Mass lesion
 - Cerebral edema

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Mechanism of Increased ICP

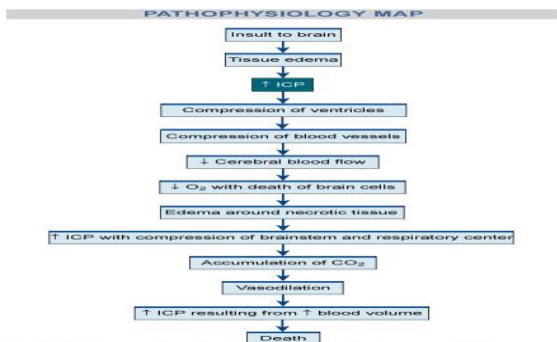


Fig. 57-3. Progression of increased intracranial pressure (ICP). Mosby items and derived items © 2011, 2007 by Mosby, Inc., an affiliate of Elsevier, Inc.

Clinical Manifestations

Change in level of consciousness

- The most sensitive and reliable indicator of neurological status
- Result of impaired CBF which deprives the cells of the cerebral cortex and the reticular activating system (RAS) of oxygen
- EEG

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Clinical Manifestations (cont'd)

Change in vital signs

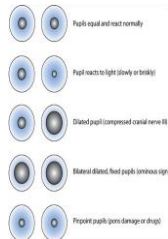
- **Cushing's Triad:**
Systolic hypertension with widening pulse pressure, bradycardia with a full and bounding pulse, & irregular respirations
- Change in body temperature

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Clinical Manifestations (cont'd)

Ocular signs

- Ipsilateral pupil dilation
- Sluggish or no response to light
- Inability to move the eye upward
- Ptosis of the eyelid
- Blurred vision
- Diplopia
- Changes in extraocular eye movement
- Papilledema



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Clinical Manifestations (cont'd)

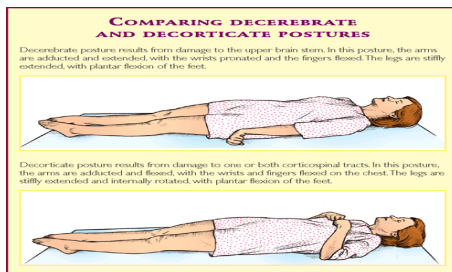
Decrease in motor function

- Contralateral hemiparesis or hemiplegia
- Painful stimuli: Localize or withdraw
- Noxious stimuli:
 - Decorticate posturing (Flexion of arms, wrists, and fingers with adduction in upper extremities. Extension, internal rotation, and plantar flexion in lower extremities)
 - Decerebrate posturing (All 4 extremities in rigid extension, with hyperpronation of forearms and plantar flexion of feet)

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Clinical Manifestations (cont'd)

Decrease in motor function



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Clinical Manifestations (cont'd)

Headache

- Continuous but worse in the morning
- Straining or movement may increase the pain

Vomiting

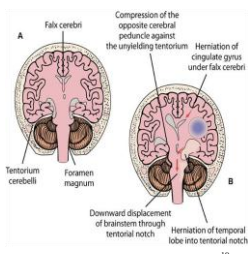
- Usually not preceded by nausea
- A nonspecific sign of ↑ICP
- Unexpected, sometimes projectile



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Complications

- Inadequate cerebral perfusion and cerebral herniation
 - Tentorial (central) herniation
 - Uncal herniation
 - Cingulate herniation



Management of ↑ ICP

- Collaborative care
 - Surgery
 - Non surgical interventions
 - Drug therapy
 - Nutritional therapy
- Nursing management

Management of ↑ ICP (cont'd)

Non surgical interventions

- Drug therapy
 - Osmotic diuretics: (Mannitol)
 - Hypertonic saline
 - Corticosteroids: (Dexamethasone)
 - Barbiturates: (Pentobarbital)
 - Antipyretics: (Acetaminophen)
 - Anticonvulsants: (Phenytoin)
 - Sedatives: (Propofol)
- (See the pharmacology book for details)

Management of ↑ ICP (cont'd)

Non surgical interventions...

- Nutritional therapy
 - Early feeding
 - Nutritional supplements
 - 0.9% NS IV

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Nursing Management of ↑ ICP

Assessment

- Glasgow Coma Scale (GCS): E4 M6 V5=15
- Severe Injury =3-8
- Moderate Injury =9-12
- Minor Injury =13-15

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Nursing Management (cont'd)

- Neurologic assessment
 - Pupils: size, shape, movement, & reactivity
 - Evaluation of cranial nerves: III, IV, VI, V, VII
 - Motor strength
 - Vital signs
 - Respiratory pattern
(refer to p # 1366, Fig. 57-12)

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Nursing Management (cont'd)

- **Nursing Diagnoses**

- Ineffective tissue perfusion (cerebral) R/T reduction of venous and/or arterial blood flow and cerebral edema.
- Ineffective airway clearance R/T ↓LOC, immobility, or inability to mobilize secretions.
- Decreased intracranial adaptive capacity R/T decreased cerebral perfusion.
- Self-care deficit R/T neuromuscular impairment.

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Nursing Management (cont'd)

- **Nursing Interventions**

- Maintain respiratory function
- Fluid and electrolyte balance
 - (Read P# 1193-1195)
- Monitoring ICP
- Body position
- Protection from injury
- Psychologic considerations

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Conditions Associated with ICP

Hydrocephalus:

- Causes: Excess CSF production, obstruction of flow, or an inability to reabsorb the CSF
- Classifications:
 - Noncommunicating
 - Communicating
- Treatment: Ventriculostomy or Ventriculoperitoneal (VP) shunt.



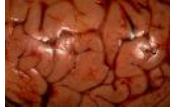
(Review this topic in your Pediatrics book)

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Conditions Associated with ICP (cont'd)

Cerebral edema: Increased accumulation of fluid in the extravascular spaces of brain tissue

- Causes
 - Mass lesions
 - Head injuries
 - Brain surgery
 - Cerebral infections
 - Vascular insult
 - Toxic or metabolic encephalopathic conditions



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Cerebral Edema: Types

Vasogenic

- Most common type
- Leakage of macromolecules from the capillaries into the surrounding extracellular space

Cytotoxic

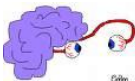
- Disruption of the integrity of cell membranes

Interstitial

- A result of hydrocephalus

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Consciousness



- A clear state of awareness of self and the environment in which attention is focused on immediate matters
- A state of awareness and orientation to time, place, and person
- A cerebral cortex function
 - Is controlled by the RAS
- Indicator of neurological change

30 30

Unconsciousness

- Abnormal state of complete or partial unawareness of self or environment
- Cause:
 - Interruptions of impulses from the RAS or alterations in functioning of the cerebral hemispheres
- Changes in consciousness:
 - Dramatic (coma): Due to direct compression, decreased O_2 /glucose, or toxic effects
 - Subtle: Flattening affect, change in orientation, or decrease in level of attention
- EEG: Decreased or absent neuronal activity



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Unconscious Patient: Immediate Considerations

- Assess respiratory & cardiovascular function
- No response to painful stimuli
- No swallow, cough, corneal, and pupillary reflexes
- Incontinent of urine and feces
- If brainstem and cerebellum remain intact, vital functions (heart, lung, GI) continue.
- Maintain intact function, incorporate a rehab framework, prevent complications and disabilities, and restore function as possible.

32 32

Head Injury

- Any injury or trauma to the scalp, skull, or brain.
- TBI
- Causes:
 - Motor vehicle collisions
 - Falls
 - Firearm-related injuries
 - Assaults
 - Sports-related trauma
 - Recreational injuries
 - War-related injuries



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Head Injury (cont'd)

- Factors that predict a poor outcome:
 - Intracranial hematoma
 - Older age
 - Abnormal motor response
 - Impaired/absent eye movements
 - \downarrow BP, \uparrow CO₂, \downarrow O₂, \uparrow ICP
 - GCS<8
- Deaths at 3 time points
 - Immediately
 - Within 2 hours
 - In 3 weeks

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Head Injury: Types

- Scalp lacerations
 - Profuse bleeding
 - Complications: Blood loss & infection
- Skull fractures
 - Type & severity: Depends on the velocity, the momentum, direction and shape of the injuring agent, and the site of impact
- Brain injuries/Head trauma
 - Diffuse (generalized)
 - Focal (localized)

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Skull Fractures

- Types of skull fractures and causes
 - Linear
 - Depressed
 - Simple
 - Comminuted
 - Compound
 - Closed or open



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Skull Fractures (cont'd)



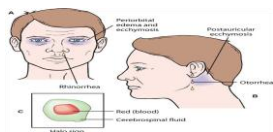
- Manifestations based on location
 - Frontal- CSF rhinorrhea or pneumocranium
 - Orbital- Raccoon eyes, optic nerve injury
 - Temporal- Battle's sign, CSF otorrhea, middle meningeal artery disruption, epidural hematoma
 - Parietal- Bulging of tympanic membrane, Battle's sign, CSF/brain otorrhea, deafness, facial paralysis, loss of taste
 - Posterior fossa - Occipital bruising resulting in cortical blindness, visual field defects, ataxia, or other cerebellar signs



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Skull Fractures (cont'd)

- Manifestations...
 - Basilar skull- Battle's sign, bulging of tympanic membrane, CSF/brain otorrhea, tinnitus, rhinorrhea, facial paralysis, vertigo
- Fluid leaking from ears/nose must be tested for CSF (Dextrostix (Tes-Tape strip) or halo/ring sign test)



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Brain Injuries

Diffuse Injury

(concussion, diffuse axonal)

- Concussion: A sudden transient mechanical head injury with disruption of neural activity and a change in the LOC (may or may not lose total consciousness)
- S/S:
 - Brief disruption in LOC
 - Retrograde amnesia
 - Headache



39 39

Brain Injuries (cont'd)

Diffuse Injury...

- Postconcussion syndrome: 2 wks to 2 months after the injury
- S/S:
 - Persistent headache
 - Lethargy
 - Personality and behavioral changes
 - Shortened attention span
 - Decreased short term memory
 - Changes in intellectual ability

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Brain Injuries (cont'd)

Diffuse Axonal Injury (DAI)

- Widespread axonal damage
- S/S:
 - ↓ LOC
 - ↑ ICP
 - Decortication or decerebration
 - Global cerebral edema

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Brain Injuries (cont'd)

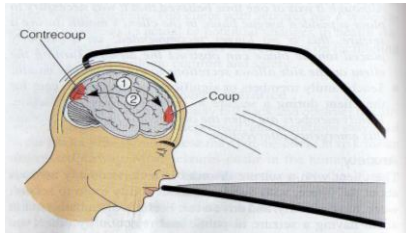
Focal Injury (contusions, lacerations)

Contusion: Bruising of the brain tissue within a focal area.

- Coup-contrecoup injury: Brain moves inside the skull due to high-energy or high-impact injury mechanism
 - Coup
 - Contrecoup
 - Complications: Hemorrhage, seizures

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Coup-Contrecoup



Lemone, P & Burke, K. (2008). Medical Surgical Nursing. Pearson Education Inc.

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Brain Injuries (cont'd)

Focal Injury...

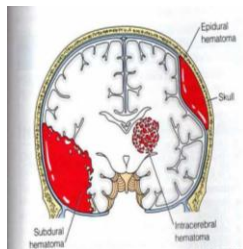
Lacerations: Actual tearing of the brain tissue

- Delayed responses: Hemorrhage, hematoma formation, seizures, and cerebral edema
- Intracerebral hemorrhage manifests as a space occupying lesion accompanied by:
 - Unconsciousness
 - Hemiplegia on the contralateral side
 - Dilated pupil on the ipsilateral side
 - Signs of ↑ICP

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Complications:Hematomas

- Epidural
- Subdural
- Intracerebral



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Epidural Hematoma



- Bleeding between the dura and the inner surface of the skull
- A neurologic emergency
- Associated with a linear fracture crossing a major artery in the dura, causing a tear
- Origin: Venous or Arterial
- Classic signs: Initial period of unconsciousness at the scene, with a brief lucid interval followed by a decrease in LOC
- Other s/s: Headache, N/V
- Immediate surgical intervention

46 **46**

Subdural Hematoma

- Bleeding between the dura mater and the arachnoid layer of the meninges
- Results from injury to the brain tissue and its blood vessels
- Venous (most common) or arterial origin
- Three classifications:
 - Acute: 24 to 48 hrs
 - Subacute: 2 to 14 days
 - Chronic: Weeks or months
- Treatment: Craniotomy

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Intracerebral Hematoma

- Occurs from bleeding within the brain tissue
- Occurs in 16% of head injuries
- Occurs within the frontal and temporal lobes (from the rupture of intracerebral vessels)
- Outcome: Size and location of the hematoma (key factor)

48 **48**

Management of Head Injury

- Emergency management
 - Patent airway, O₂ via non-rebreather mask
 - Stabilize cervical spine
 - Establish IV access
 - Intubate if GCS score <8
 - Control external bleeding
 - Assess for rhinorrhea, otorrhea, scalp wounds
 - Monitor VS, LOC, GCS, pupil size and reactivity
 - Prevent secondary injury

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Management of H I (cont'd)

- Surgical treatment
- Nursing management
 - Assessment
 - GCS score, Neurologic status, CSF leak, ↑ICP
 - Nursing Implementation
 - Health promotion
 - Acute intervention
 - Ambulatory and home care



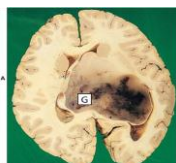
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Brain Tumors

- Primary: Arising from the tissues within the brain
- Secondary: Resulting from a metastasis from a malignant neoplasm elsewhere in the body

Types:

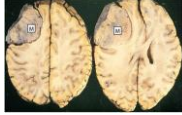
- Gliomas
- Meningioma
- Acoustic neuroma (Schwannoma)
- Pituitary adenoma
- Hemangioblastoma
- Primary central nervous system lymphoma
- Metastatic tumors



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Clinical Manifestations

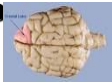
- Depends on the location, size, and mitotic rate of the cells of the tissue of origin
 - Headache–dull, constant, throbbing–worse at night
 - Seizures
 - Nausea and vomiting
 - Cognitive dysfunction
 - Memory problems
 - Mood or personality changes
 - Muscle weakness, sensory loss, aphasia
 - Visual-spatial dysfunction
 - Hydrocephalus & manifestations of \uparrow ICP



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S/S of Tumors to Lob

- Frontal Lobe
 - Hemiplegia, seizures, memory deficit,
 - ataxic gait, personality and judgment changes
- Parietal Lobe
 - Speech disturbance
 - Inability to write, spatial disorders
 - unilateral neglect (dominant side)
- Temporal Lobe
 - Seizures, dysphagia
- Occipital Lobe
 - Vision disturbances, seizures



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Therapeutic Management

- Surgical therapy (complete/partial removal)
 - Preferred treatment
- Ventricular shunts
- Radiation therapy and Stereotactic radiosurgery
 - Complications: Cerebral edema & \uparrow ICP



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Therapeutic Management (cont'd)

- Chemotherapy and Targeted Therapy

- Limitations: Crossing BBB, tumor cell heterogeneity, tumor cell drug resistance

- Chemotherapy-laden biodegradable wafers

- Temozolomide (Temodar)

- Bevacizumab (Avastin)

- Other: Novo TTF-100A System

- Nursing management: (read p#1378)



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Gerontologic Considerations

- Limitations imposed by disease and aging
- Promote independence
- Mental and physical deterioration
- Cognitive and emotional residual effects
- Motor and sensory loss
- Personality changes

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References



1. Kee, J. L., Hayes, E. R. & McCuiston, L. E (2014). Drugs affecting the central nervous system. In *Pharmacology: A Nursing Process Approach*. (8th ed.). St. Louis:Elsevier.
2. Lewis, S.L., Heitkemper, M.M., Dirksen, S.R., Camera, I.M., & Bucher. L. (2014). Acute intracranial problems. In *Medical Surgical Nursing: Assessment and Management of Clinical Problems*. (9th ed.).St. Louis:Elsevier.

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