Lecture# 1

semester# 2

(Introduction to Nervous System, ICP)

:by

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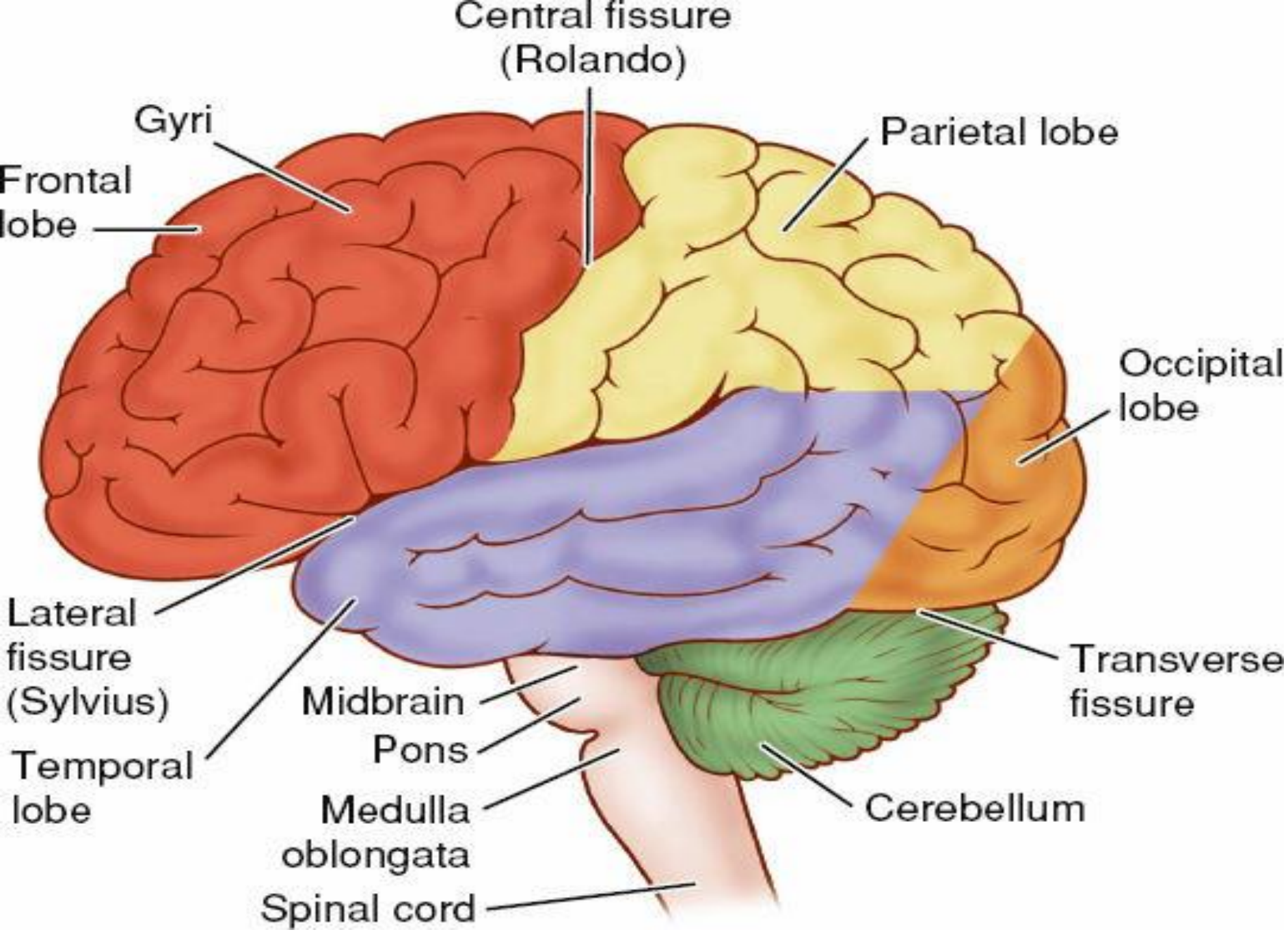
Introduction:

The nervous system consists of two major parts:

I- Central nervous system (CNS), including the brain and spinal cord, and

II-Peripheral nervous system, which includes the cranial nerves, spinal nerves, and autonomic nervous system.

The function of the nervous system is to control motor, sensory, autonomic, cognitive, and behavioral activities.



View of the external surface

Divisions

I. **Central nervous system (CNS)** : brain and spinal cord – interprets incoming sensory information and sends out instruction based on past experiences

Brain:

 Cerebrum-Largest part of brain: outer layer called cerebral cortex composed of dendrites and cell bodies : controls mental processes:

highest level of functioning.

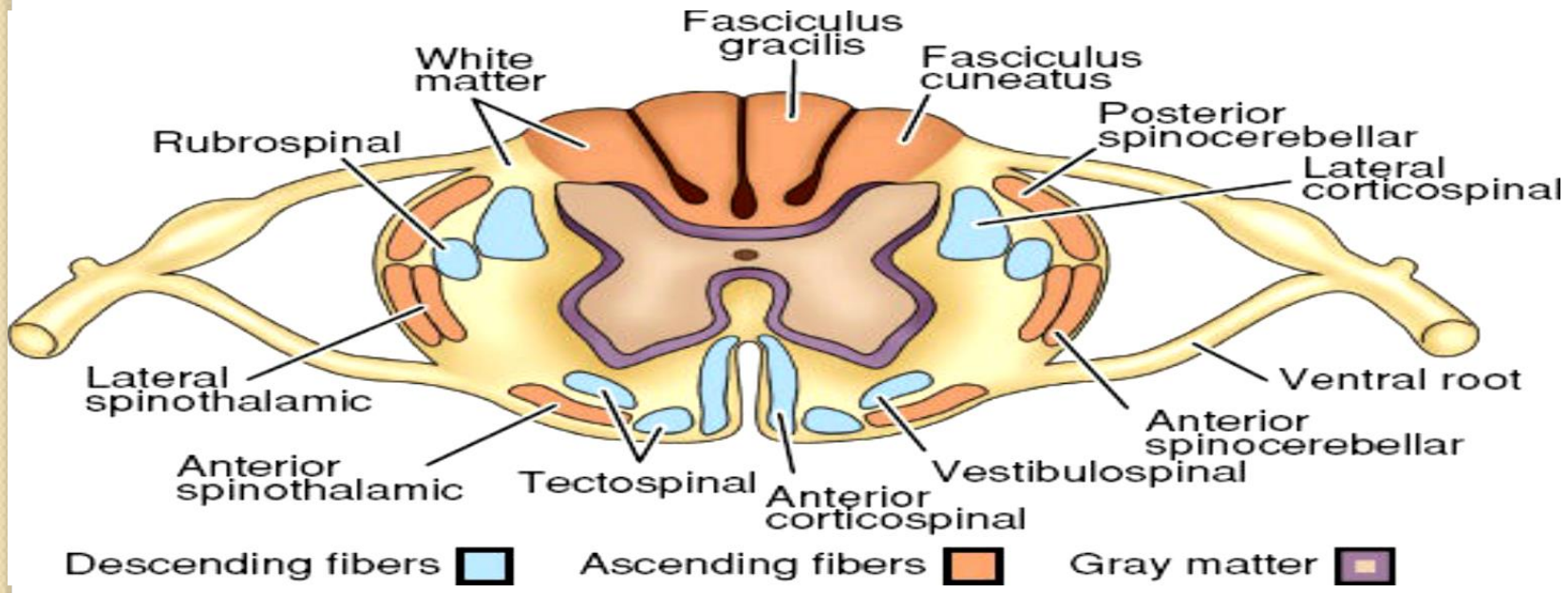
 Cerebellum: controls muscle tone coordination and maintains equilibrium.

 Brainstem:

 Connects the cerebrum with the spinal cord

Spinal Cord:

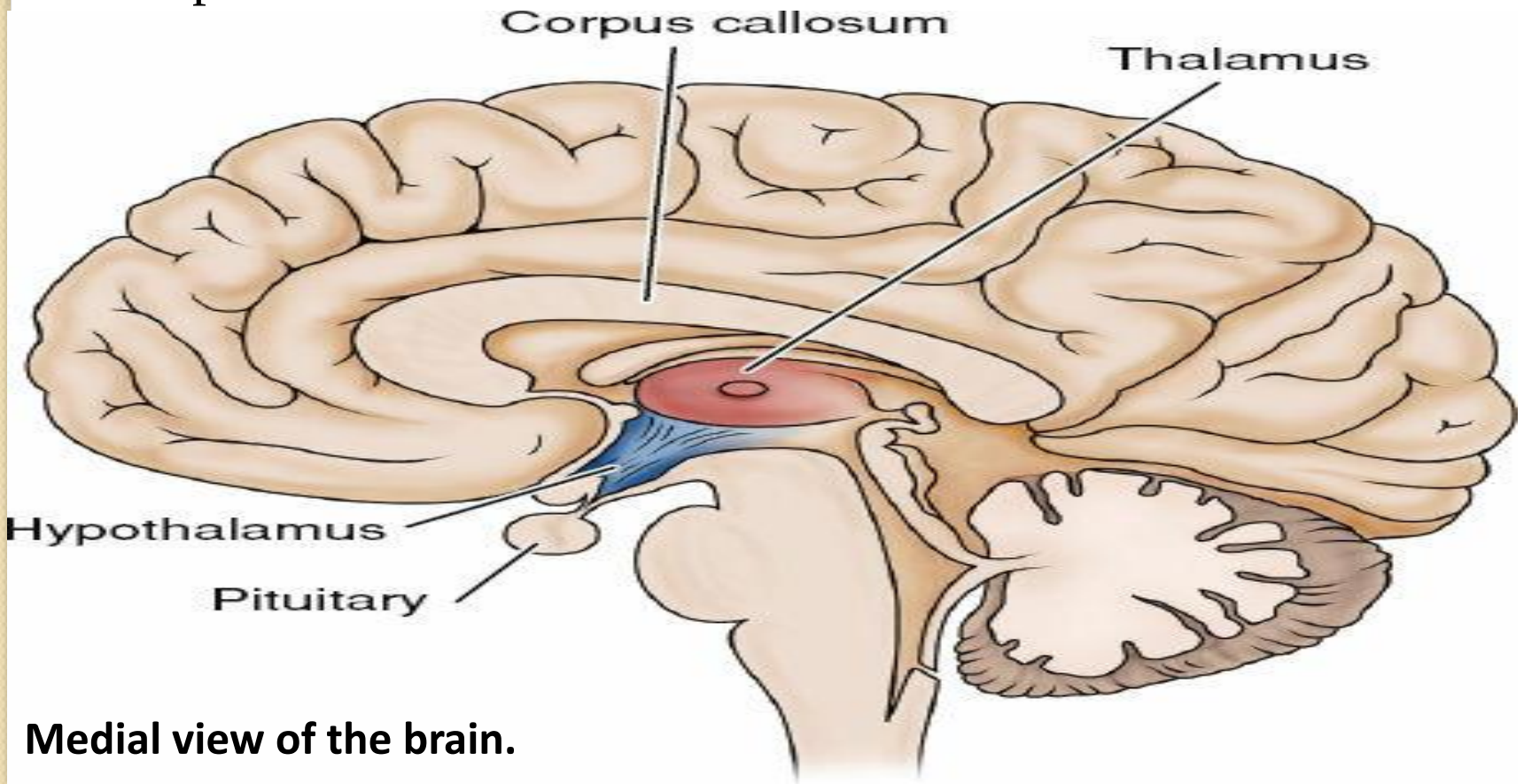
- Inner column composed of gray matter, shaped like a H, made up of dendrites and cell bodies: outer part composed of white matter, made up of bundles of axons called tracts.
- Functions: sensory tract conducts impulses to brain ;motor tract conducts impulses from brain: center for all spinal cord reflexes.



Cross-sectional diagram of the spinal cord showing major spinal tracts.

 Hypothalamus: regulates the autonomic nervous system: controls blood pressure: helps maintain normal body temperature and appetite: controls water balance and sleep

 Thalamus: acts as a relay station for incoming and outgoing nerve impulses: produces emotions o pleasantness and unpleasantness associated with sensations.



Medial view of the brain.

Protection for CNS:

A. **Bone**- vertebrae surround cord: skull surrounds the brain

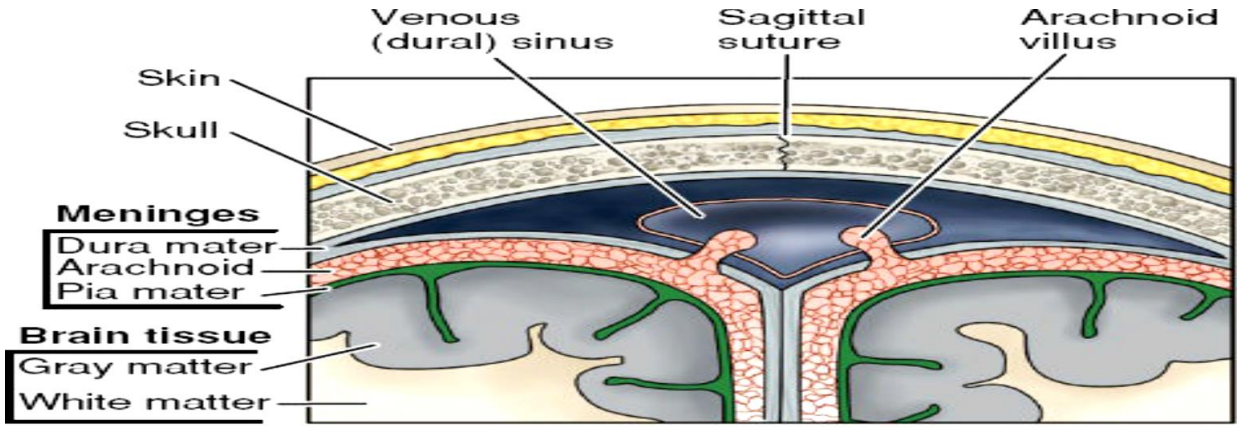
B. **Meninges**: three connective tissue membranes that cover the brain and spinal cord.

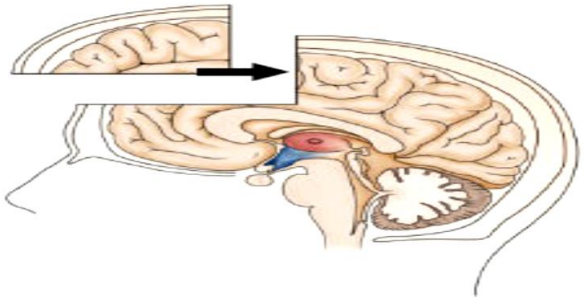
1. Dura mater: white fibrous tissue: outer layer

2. Arachnoid: delicate membranes: middle layer : contains subarachnoid fluid.

3. Pia mater: inner layer contains blood vessels.

C. **Cerebrospinal Fluid**: acts as a shock absorber: acts in exchange of nutrients and waste materials.





Meninges and related structures

II. Peripheral nervous system (PNS):

The peripheral nervous system includes the cranial nerves, the spinal nerves, and the autonomic nervous system.

A. Cranial Nerves: Twelve pairs of cranial nerves emerge from the lower surface of the brain and pass through openings in the base of the skull. Three cranial nerves are entirely sensory (I, II, VIII), five are motor (III, IV, VI, XI, and XII), and four are mixed sensory and motor (V, VII, IX, and X).

B. Spinal Nerves: The spinal cord is composed of 31 pairs of spinal nerves: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal.

Cranial Nerve	Type	Function
I (olfactory)	Sensory	Sense of smell
II (optic)	Sensory	Visual acuity and visual fields
III (oculomotor)	Motor	Muscles that move the eye and lid, pupillary constriction, lens accommodation
IV (trochlear)	Motor	Muscles that move the eye
V (trigeminal)	Mixed	Facial sensation, corneal reflex, mastication
VI (abducens)	Motor	Muscles that move the eye
VII (facial)	Mixed	Symmetry of facial expression and muscle movement in upper and lower face, salivation and tearing, taste, sensation in the ear
VIII (acoustic)	Sensory	Hearing and equilibrium
IX (glossopharyngeal)	Mixed	Taste, sensation in pharynx and tongue, pharyngeal muscles, swallowing
X (vagus)	Mixed	Muscles of pharynx, larynx, and soft palate; sensation in external ear, pharynx, larynx, thoracic and abdominal viscera; parasympathetic innervation of thoracic and abdominal organs
XI (spinal accessory)	Motor	Sternocleidomastoid and trapezius muscles
XII (hypoglossal)	Motor	Movement of the tongue

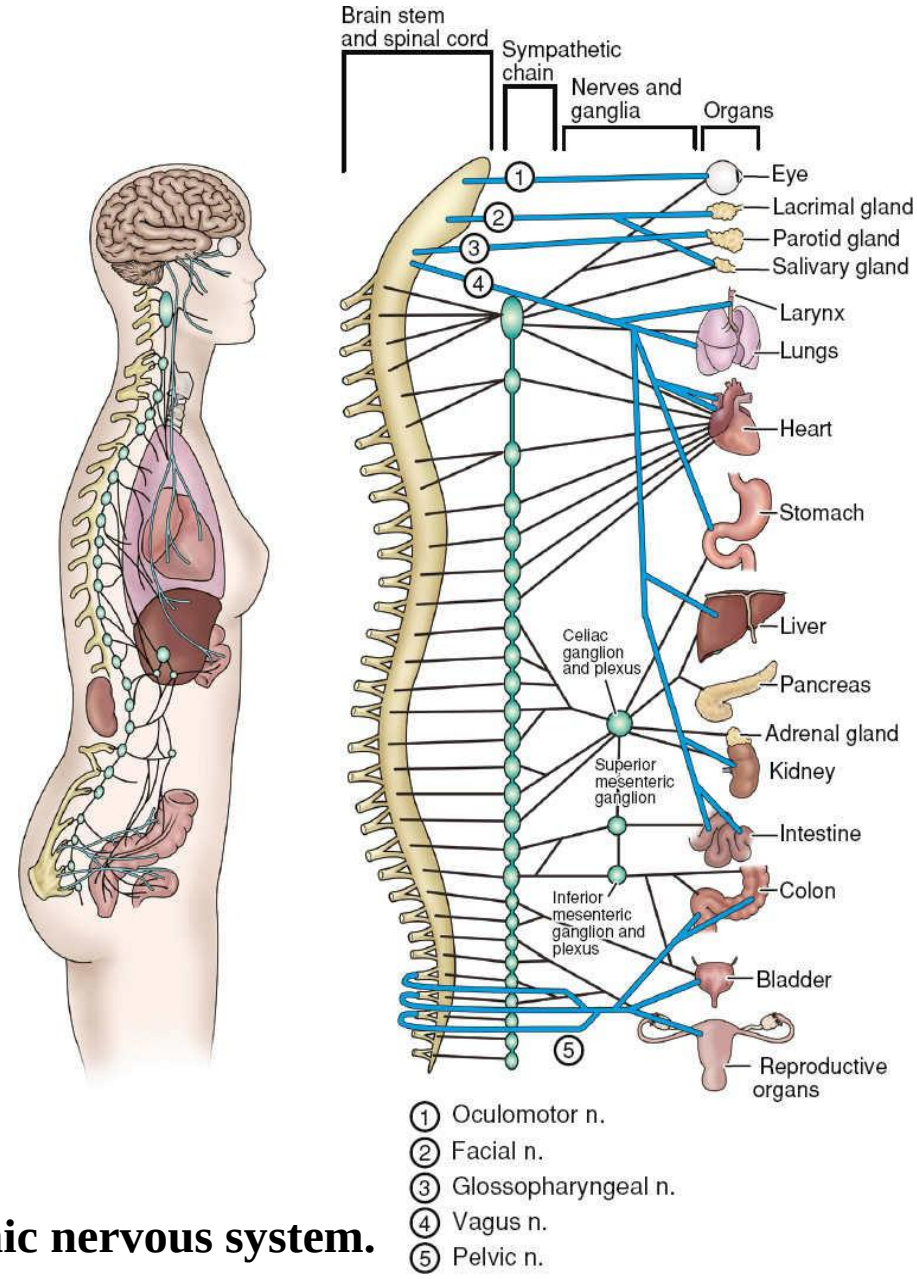
Adapted from Bader, M., Littlejohns, L. R., & Olson, D. (2016). *AANN core curriculum for neuroscience nursing* (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

C. Autonomic nervous system (ANS):

Regulates the activities of internal organs such as the heart, lungs, blood vessels, digestive organs, and glands. Maintenance and restoration of internal homeostasis is largely the responsibility of the autonomic nervous system. There are two major divisions:

1. Sympathetic-flight or fight response: increases heart rate and blood pressure; dilates pupils.

2. Parasympathetic : dominates control under normal conditions: maintains homeostasis.



Anatomy of the autonomic nervous system.

Cont..

- **Neurons or nerve cells**

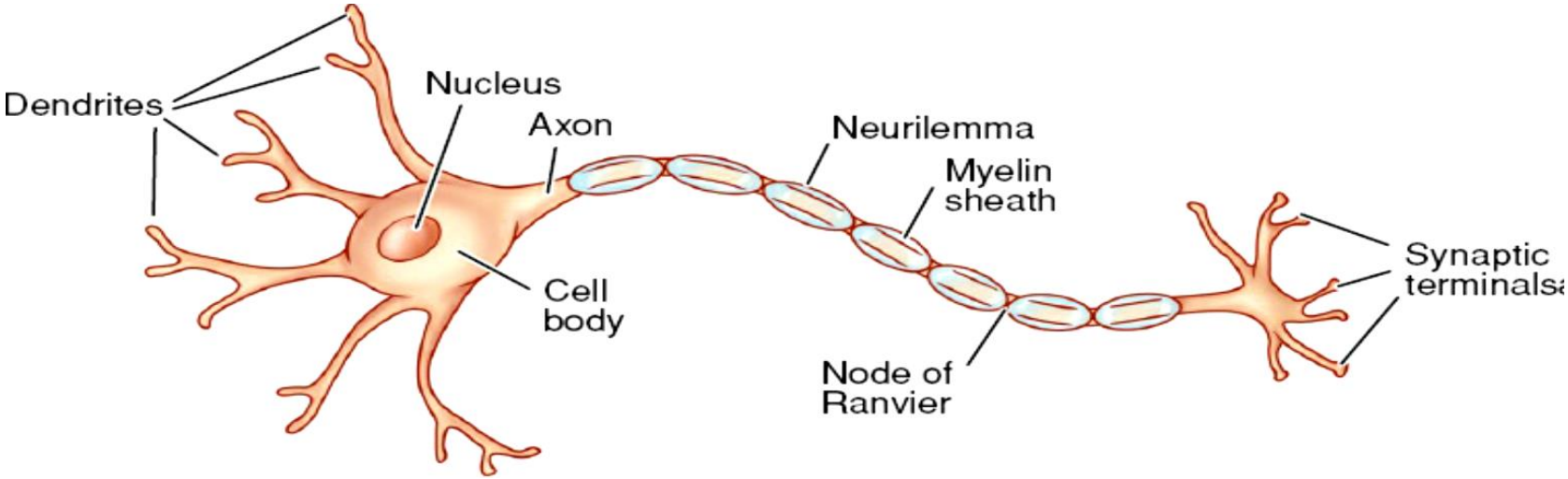
Respond to a stimulus, connect it into a nerve impulse (irritability), and transmit the impulse to neurons, muscle, or glands (conductivity), consists of three main parts

Neurons main parts

1. Cell body: contains nucleus and one or more fibers or process extending from the cell body

2. Dendrites: conduct impulses toward cell body: neurons has many dendrites

3. Axons: conduct impulses away from cell body: neuron has one axon



Types of neurons

1. Motor (efferent): conduct impulses from CNS to muscle and glands.

2. Sensory (afferent): conduct impulses toward CNS.

3. Connecting (interneuron): Conduct impulses from axon to dendrites.

Neurological Terms:

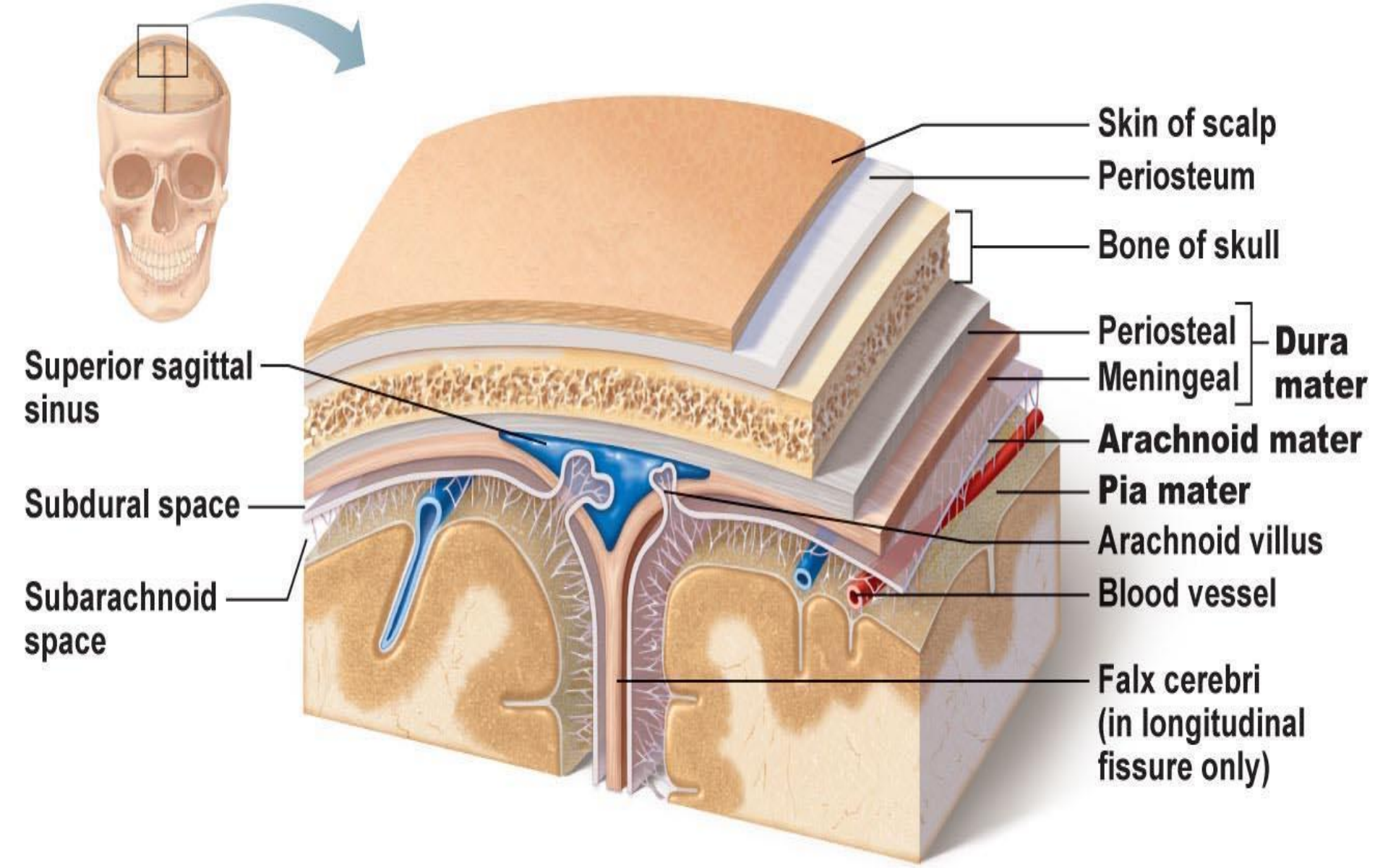
- Anesthesia- complete loss of sensation
- Aphasia-loss of ability to use language
- Ataxia- uncoordinated movements
- Coma- state of profound unconsciousness
- Convulsion- involuntary contractions and relaxation of muscles
- Diplopia- double vision
- Nystagmus- involuntary, rapid movements of the eyeball
- Papilledema- swelling of optic nerve head
- Paresthesia- abnormal sensation without obvious cause, with numbness and tingling
- Vertigo- dizziness

Intracranial pressure ICP

The cranium contains :

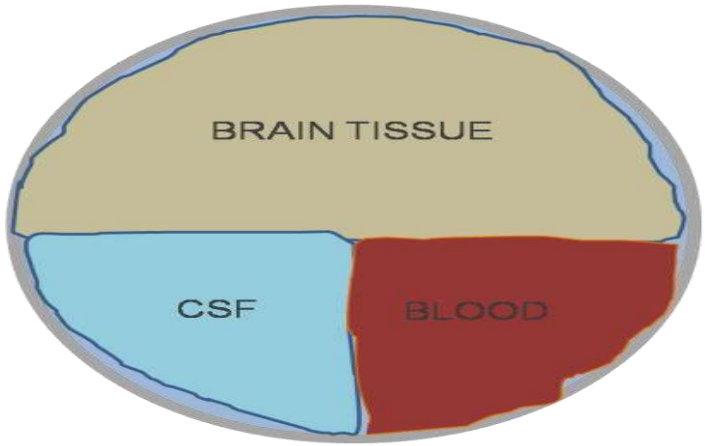
- brain tissue (1400 g)
- blood (75 mL)
- CSF cerebrospinal fluid (75 mL)

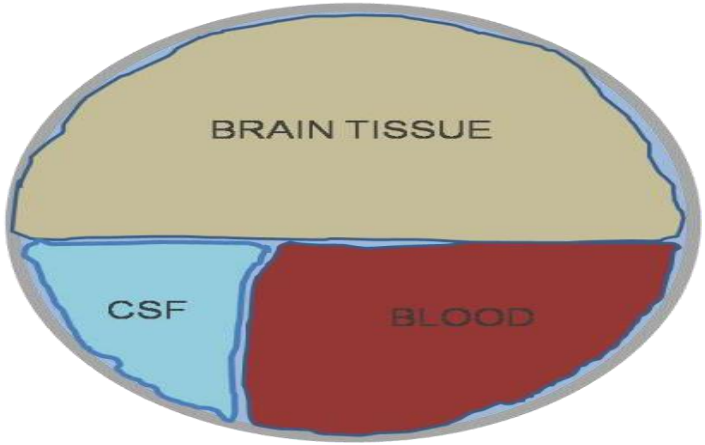
- The volume and pressure of these three components are usually in a state of **equilibrium** and produce the ICP
- **Normal ICP =10 to 20 mm Hg**
- Increase in ICP is a serious medical problem. The pressure itself can damage the brain or spinal cord by pressing on important brain structures and by restricting blood flow into the brain



Causes and pathology of increased ICP :

ICP is most commonly associated with **head injury**, it also may be seen as a secondary effect in other conditions, such as **brain tumors**, **subarachnoid hemorrhage**, and **toxic** and **viral encephalopathies**. Increased ICP from any **cause decreases cerebral perfusion**, stimulates further swelling (edema), and may shift brain tissue, resulting in **herniation,** a dire and frequently fatal event.





Subdural hematoma develops when blood vessels that are located between the membranes covering the brain (the meninges) leak blood after an injury to the head. This is a serious condition since the increase in intracranial pressure can cause damage to brain tissue and loss of brain function.

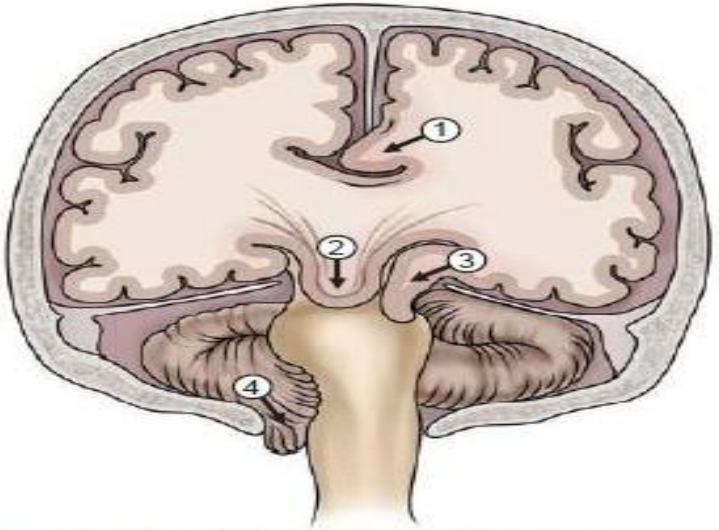
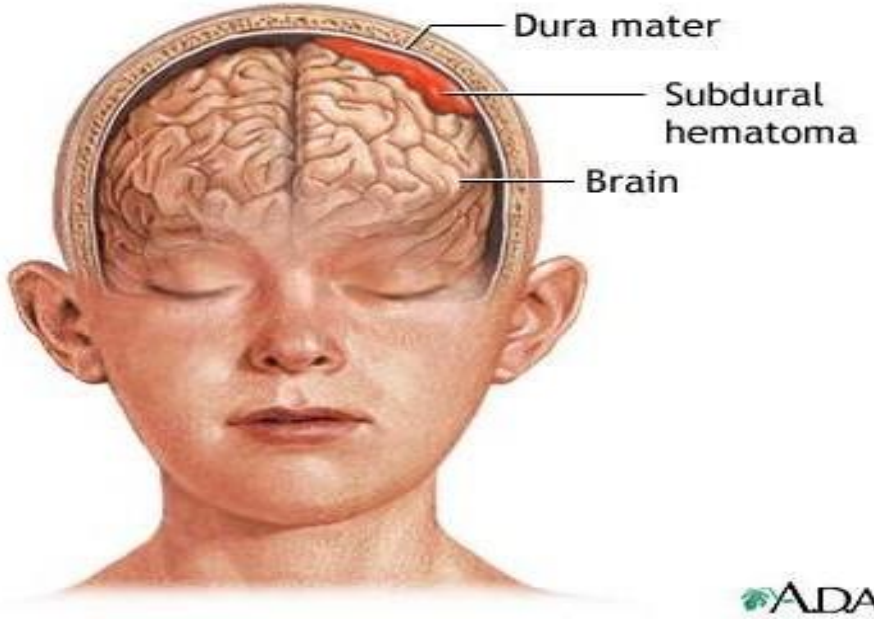


Figure 61-2 Brain with intracranial shifts from supratentoria lesions. *1,* Herniation of the cingulate gyrus under the falx cere bri. *2,* Central transtentorial herniation. *3,* Uncal herniation o the temporal lobe into the tentorial notch. *4,* Infratentorial her niation of the cerebral tonsils. Adapted from Porth, C. M. & Matfin, G. (2009). *Pathophysiology: Concepts of altered health states* (8th ed.). Philadelphia: Lippincott Williams & Wilkins.



Clinical Manifestations

1. Lethargy is the earliest sign of increasing ICP. Slowing of speech and delay in response to verbal suggestions are early indicators.
2. Sudden change in condition, such as restlessness (without apparent cause), confusion, or increasing drowsiness, has neurologic significance.
3. As pressure increases, patient becomes stuporous and may react only to loud auditory or painful stimuli. This indicates serious impairment of brain circulation, and immediate surgical intervention may be required.
4. When coma is profound, pupils are dilated and fixed
5. Decreased cerebral perfusion pressure (CPP) can result in a Cushing's response and Cushing's triad (bradycardia, bradypnea, and hypertension)

Assessment

- Obtain a history of events leading to the present illness
- neurologic examination :
  - ✓ Level of consciousness (LOC)
    - eye opening
    - verbal and motor responses
    - pupils (size, equality, reaction to light)
  - ✓ cranial nerve function
  - ✓ cerebellar function (balance and coordination)
  - ✓ reflexes
  - ✓ motor and sensory function
- Glasgow Coma Scale (next slide), which is a tool for assessing a patient's LOC. Scores range from 3 (deep coma) to 15 (normal)

Glasgow Coma Scale

Eye opening response	Spontaneous	**4**
	To voice	3
	To pain	2
	None	1
Best verbal response	Oriented	**5**
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1
Best motor response	Obeys command	**6**
	Localizes pain	5
	Withdraws	4
	Flexion (decorticate)	3
	Extension (decerebrate)	2
	None	1
Total		3 to 15

Assessment and Diagnostic Findings

- The patient may undergo cerebral angiography, computed tomography (CT) scanning, or magnetic resonance imaging (MRI).
- Transcranial Doppler studies provide information about cerebral blood flow. The patient with increased ICP may also undergo electrophysiological monitoring to monitor the pressure.
- Lumbar puncture is avoided in patients with increased ICP because the sudden release of pressure can cause the brain to herniate.

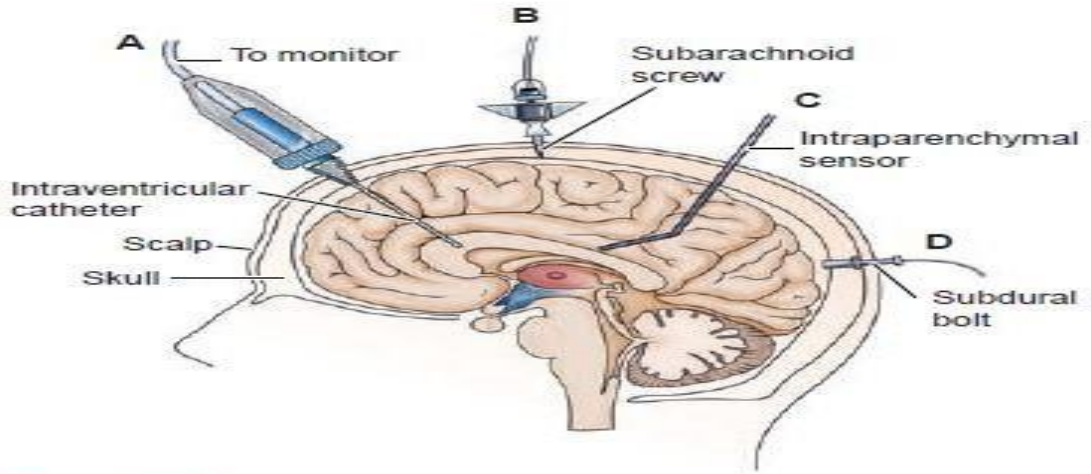


Figure 61-3 Intracranial pressure monitoring. A device may be placed in (A) the ventricle (B) the subarachnoid space (C) the intraparenchymal space or (D) the subdural space.

Medical Management

Increased ICP is a true emergency and must be treated immediately through:

1- Invasive monitoring of ICP to :

- ► early identifying increased pressure
- ► quantify the degree of elevation
- ► initiate appropriate treatment
- ► provide access to CSF for sampling and drainage
- ► evaluate the effectiveness of treatment

2 -Decreasing cerebral edema :

- • Osmotic diuretics (mannitol)
- • Corticosteroids (e.g. dexamethasone) in brain tumor

3 -Maintaining cerebral perfusion:(>70 mm Hg)

- • by manipulating cardiac output
- •Inotropic agents such as dobutamine

Nursing Diagnoses

1. Ineffective airway clearance related to diminished protective reflexes (cough, gag)
2. Ineffective breathing patterns related to neurologic dysfunction (brain stem compression, structural displacement)
3. Ineffective cerebral tissue perfusion related to the effects of increased ICP
4. Risk for infection related to ICP monitoring system (fiberoptic or intraventricular catheter)

Nursing Interventions

- ❑ Maintaining a Patent Airway
  - Maintain patency of the airway; oxygenate patient before and after suctioning.
  - Discourage coughing and straining.
  - Auscultate lung fields for sounds every 8 hours.
  - Elevate the head of bed to help clear secretions and improve venous drainage of the brain.
- ❑ Achieving an Adequate Breathing Pattern
- ❑ Optimizing Cerebral Tissue Perfusion
- ❑ Maintaining Negative Fluid Balance
- ❑ Preventing Infection

Thanks
For Listening