

Increased Intracranial Pressure (ICP)

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Introduction

- The cranium contains :
 - brain tissue (1400 g)
 - blood (75 mL)
 - CSF (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

Introduction

- 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

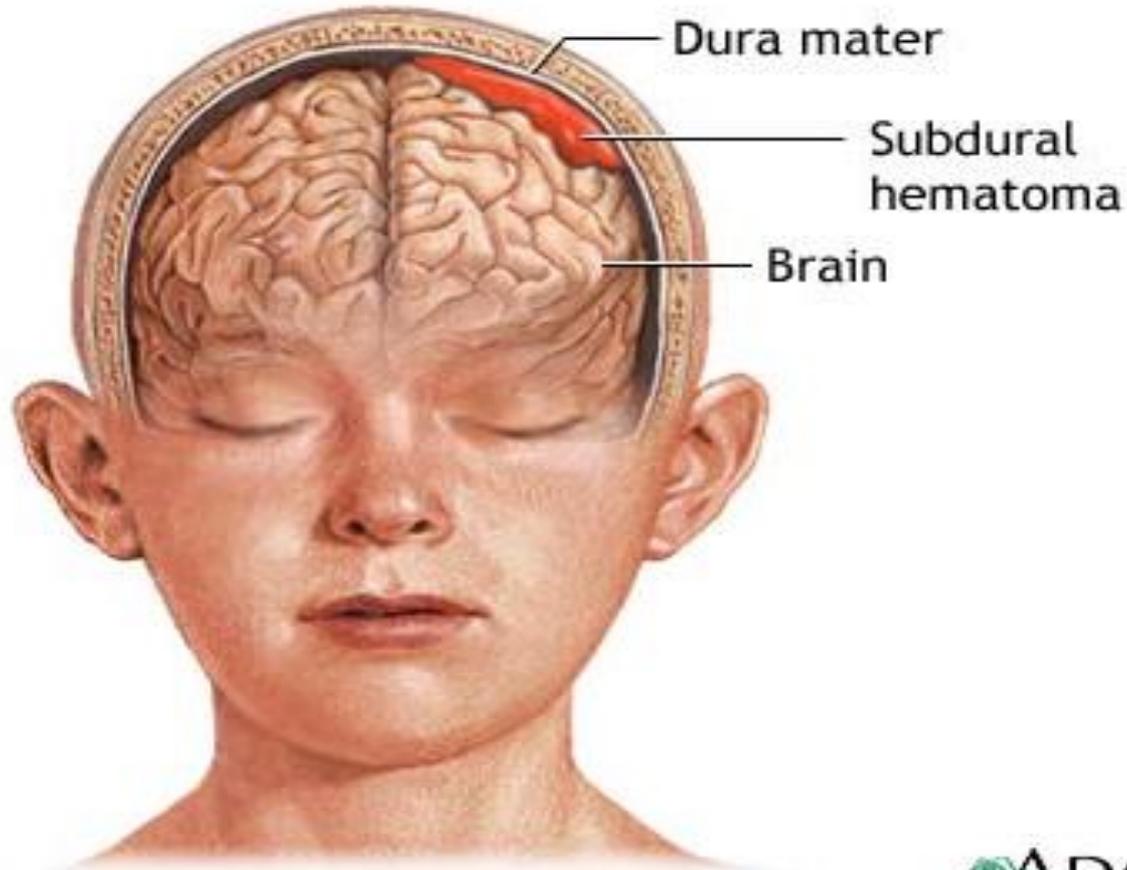
Introduction

- Causes of increased ICP :
 - riseing in CSF pressure
 - increased pressure in brain matter
 - bleeding into the brain
 - bleeding into the fluid around the brain
 - swelling within the brain matter

Pathophysiology

- Increased ICP is a syndrome that affects many patients with acute neurologic conditions. An elevated ICP is most commonly associated with **head injury**, secondary effect in other conditions, such as **brain tumors**, **subarachnoid hemorrhage**, and **toxic and viral encephalopathy**.
- Increased ICP from any cause decreases cerebral perfusion, stimulates further swelling (edema), and shifts brain tissue through openings in the rigid dura, resulting in brain herniation (next slide), a frequently fatal event.





ADAM.

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.

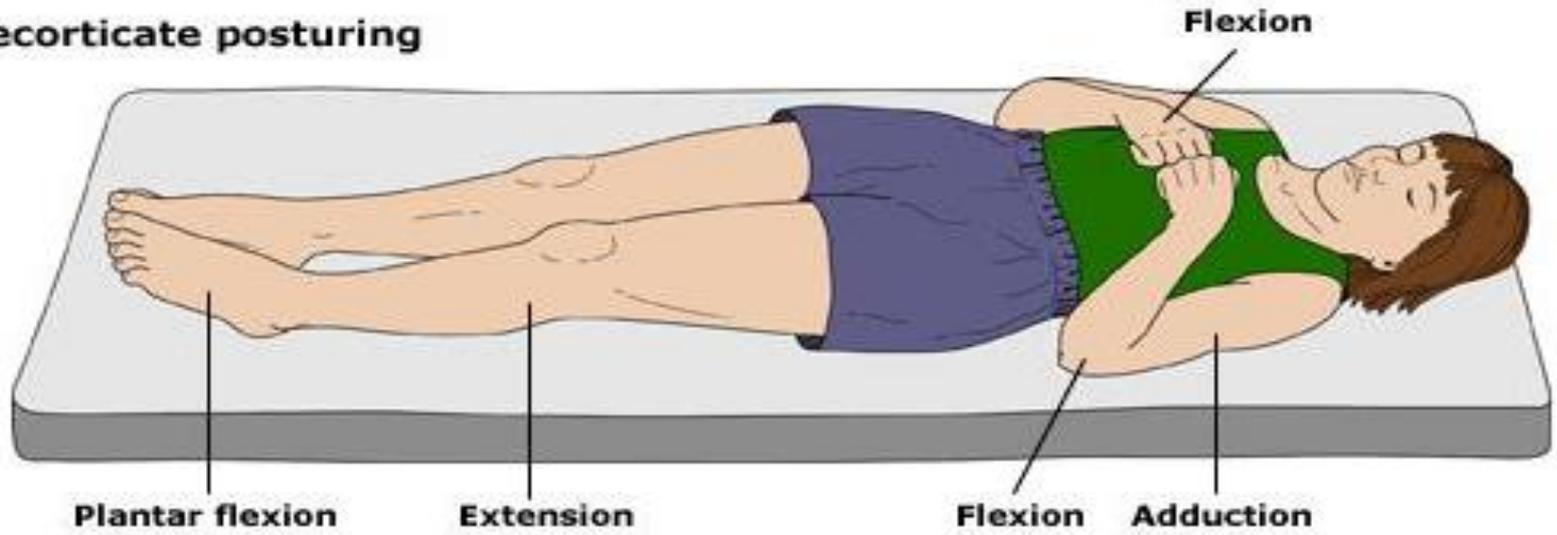
Clinical Manifestations

- When ICP increases to the point at which the brain's ability to adjust has reached its limits, neural function is impaired; this may be manifested by clinical changes **first in LOC** and **later by abnormal respiratory** and **vasomotor responses**. **Slowing of speech** and **delay in response to verbal suggestions** are other early indicators.
- Restlessness (without apparent cause), confusion, or increasing drowsiness, has neurologic significance.
- **These signs may result from :**
 - **compression due to swelling from hemorrhage or edema**
 - **expanding intracranial lesion (hematoma or tumor)**
 - **combination of both**

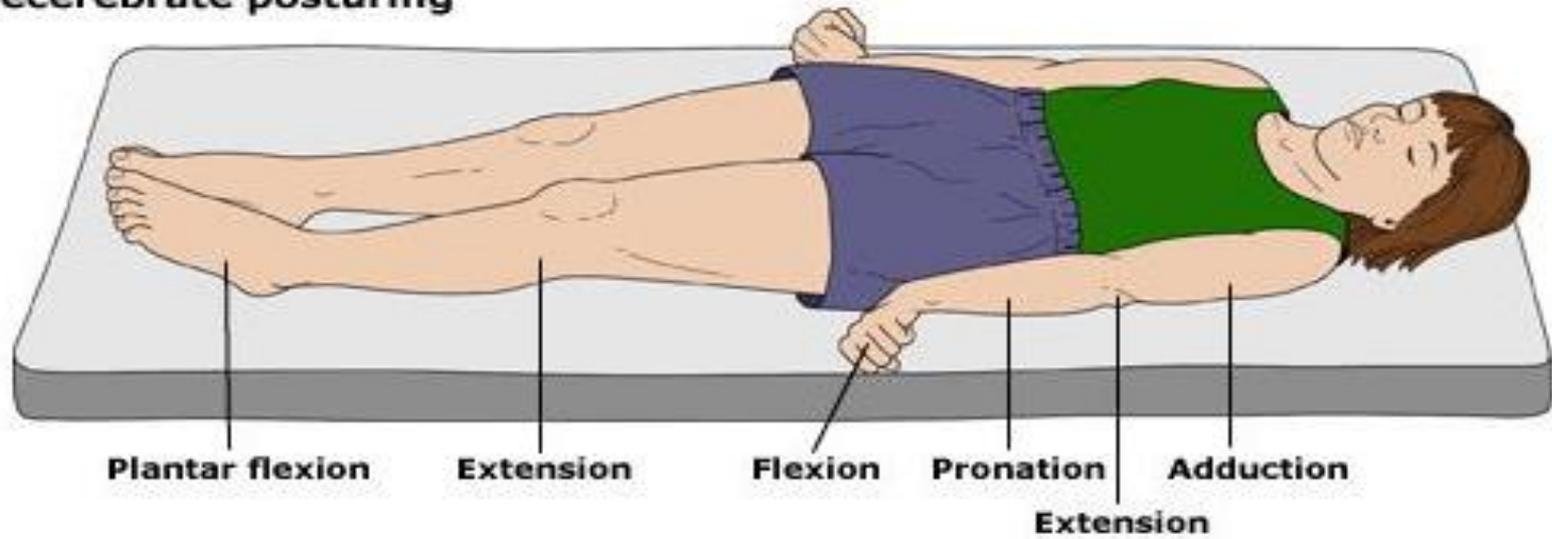
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- As ICP increases, the patient becomes stuporous (reacting only to loud auditory or painful stimuli)
- At this stage serious impairment of brain circulation is probably taking place, and immediate intervention is required
- As neurologic function deteriorates further, the patient becomes comatose and exhibits abnormal motor responses in the form of decorticate or decerebrate posture (see next slide).
- When the coma is profound, with the **pupils dilated and fixed** and **respirations impaired**, **death** is usually inevitable

Decorticate posturing



Decerebrate posturing



Assessment

- # Obtain a **history** of events leading to the present illness
- # The **neurologic examination** :
 - ☺ evaluation of mental status
 - ☺ 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

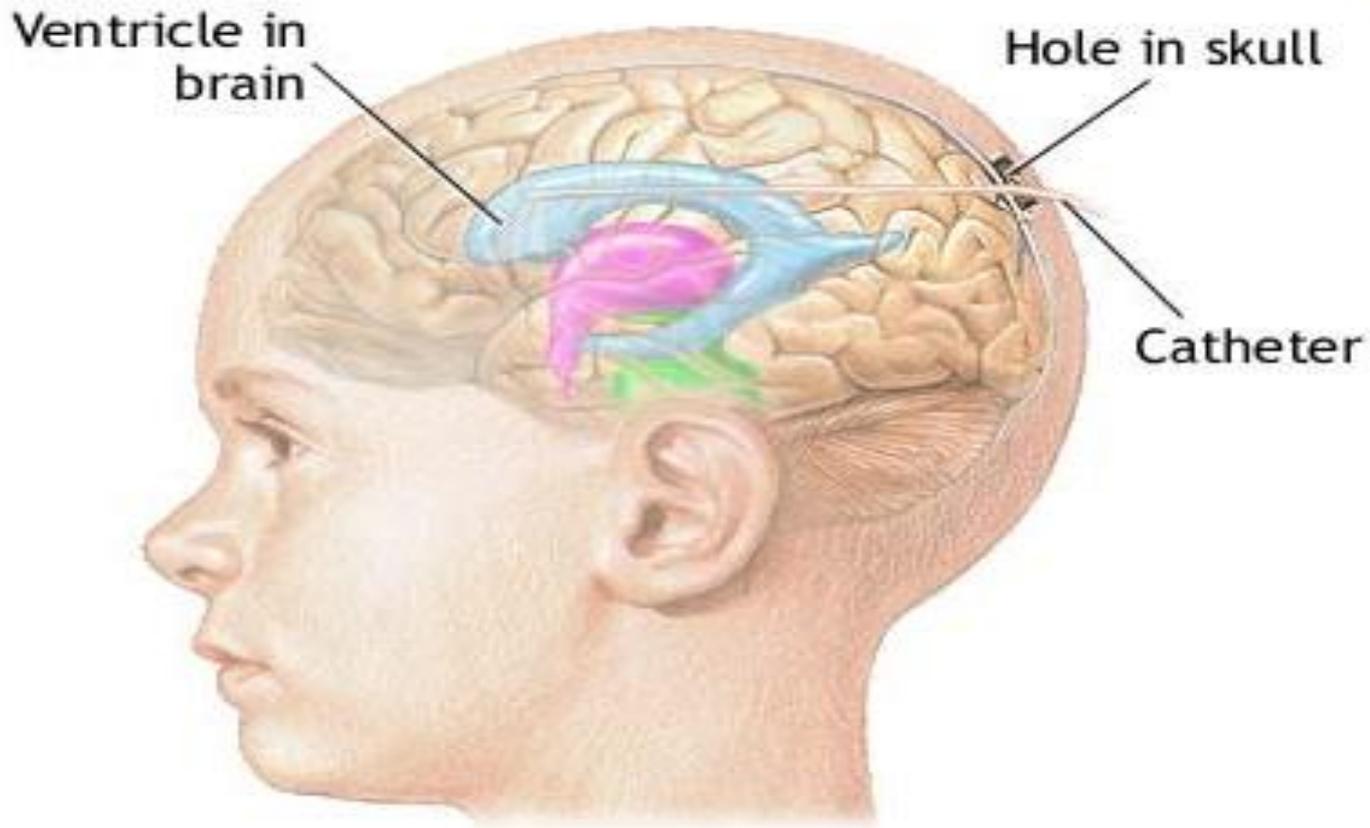
Eye opening response	Spontaneous	4
	To voice	3
	To pain	2
	None	<u>1</u>
Best verbal response	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	<u>1</u>
	Best motor response	Obeys command
Localizes pain		5
Withdraws		4
Flexion (decorticate)		3
Extension (decerebrate)		2
None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

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 (next slide).
- **Lumbar puncture** is avoided in patients with increased ICP because the sudden release of pressure can cause the brain to herniate.

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



 ADAM.

Intracranial pressure monitoring is performed by inserting a catheter into the head with a sensing device to monitor the pressure around the brain.

Medical Management

2- *Decreasing cerebral edema:*

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

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

- ▶ $CPP = MAP - ICP$
- ▶ by manipulating cardiac output
- ▶ Inotropic agents such as dobutamine
- ▶ Normal CPP = 80 mmHg (nearer DBP)

Medical Management

3- *Lowering the volume of CSF and cerebral blood:*

- ▶ ventriculostomy

4- *Controlling fever:*

- ▶ fever increases cerebral metabolism

5- *Maintaining oxygenation:*

- ▶ Arterial blood gases must be monitored
- ▶ optimizing the hemoglobin saturation

Medical Management

6- *Reducing metabolic demands:*

- ▶ administration of high doses of barbiturates when the patient is unresponsive to conventional treatment
- ▶ administration of pharmacologic paralyzing agents: the patient cannot respond or report pain

7- *Hyperventilation:*

- ▶ Monitor PaCO₂ (normal range 35 to 45 mm Hg)
- ▶ reduce ICP (by cerebral vasoconstriction and a decrease in cerebral blood volume)

8- *surgical intervention*

– *Optimizing cerebral tissue perfusion*

- Maintain head alignment and **elevate head of bed 30 degrees**. The rationale is that hyperextension, rotation, or hyper flexion of the neck causes decreased venous return.
- **Avoid extreme hip flexion** as this increases intra-abdominal and intrathoracic pressures, leading to rise in ICP.
- **Avoid the Valsalva maneuver** (straining at stool) as it raises ICP. Administer stool softeners as prescribed. If appropriate, provide high fiber diet.
- Note abdominal distention. Avoid enemas and cathartics (sorbitol, magnesium citrate, sodium sulfate).



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