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# INCREASED INTRACRANIAL PRESSURE (ICP)

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**Abstract**
Increased intracranial pressure (ICP) is a life-threatening condition that happens when there's an imbalance between your brain tissue, cerebrospinal fluid and brain blood volume. It has several possible causes. Signs often include headache, vomiting and vision changes. The sooner you get treatment for ICP, the better.

## Introduction

Increased intracranial pressure (ICP) happens when there's a rise in the pressure within your cranial vault. It can be sudden (acute) or develop slowly over time (chronic) and has several possible causes.
Your cranial vault is a rigid compartment for:

- Your brain.
- Cerebrospinal fluid (CSF). This is the fluid that cushions your brain and spinal cord.
- Blood.

Any increase in the volume of one of these three components will increase the overall pressure within your cranial vault.
Increased intracranial pressure typically leads to a decrease in blood flow in your brain, or to brain herniation (when brain tissue moves). Both of these are serious, life-threatening conditions.
Signs and symptoms of increased intracranial pressure in children and adults include:

- Headaches. They're typically worse in the morning or when you're lying down.
- Nausea and vomiting.
- Altered mental status, which can range from drowsiness to coma.
- Vision changes, like blurred vision, double vision and/or sensitivity to light (photophobia).
- Eye movement problems.
- Muscle weakness.
- Numbness.
- Seizures.

Signs of ICP in infants include:

- Drowsiness.
- Bulging of the soft spot (fontanelle) on the top of their head.
- Vomiting.

Increased intracranial pressure is a medical emergency. Go to the nearest hospital if you or your child have these symptoms.
Intracranial hypertension refers to a clinical condition characterized by elevated pressure within the cranial vault. Normal intracranial pressure (ICP) in adults typically ranges from 7 to 15 mm Hg in the supine position. Values above 20 to 25 mm Hg are generally considered pathological and may warrant intervention.



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The cranium, a rigid and nonexpandable structure, houses 3 primary components: brain tissue, cerebrospinal fluid (CSF), and blood. Any increase in the volume of one of these components leads to a rise in ICP. According to the Monro-Kellie doctrine, the total volume within the cranium remains constant. A volume increase in one component necessitates a compensatory decrease in one or both of the others. Clinically, such volume shifts can reduce cerebral blood flow or precipitate brain herniation. Failure of compensation leads to increased ICP, which can reduce cerebral perfusion pressure (CPP) and ultimately cause ischemia or herniation.

CSF, a clear liquid located within the subarachnoid space and brain ventricles, serves to cushion the brain and spinal cord. The choroid plexus in the lateral ventricles produces CSF, which then flows through the foramen of Monro into the third ventricle. From there, it passes through the cerebral aqueduct (aqueduct of Sylvius) into the fourth ventricle. CSF exits the fourth ventricle via the foramina of Magendie and Luschka, enters the subarachnoid space, and ultimately is reabsorbed into the superior sagittal sinus and other dural venous sinuses via arachnoid granulations.

Increased intracranial pressure (ICP) is a life-threatening, emergency condition caused by elevated pressure within the skull, often from brain injuries, tumors, hemorrhages, or swelling. Symptoms include severe headache, nausea/vomiting, confusion, vision changes, and lethargy. It requires immediate medical attention and, if untreated, can result in irreversible brain damage or death.

A healthcare provider will assess your symptoms and ask about your medical history. They'll also do a physical exam and a neurological exam.

Tests that can help confirm an ICP diagnosis and/or the underlying cause include:

- CT scan or MRI of your brain: These imaging tests can show issues like brain swelling, enlarged ventricles and brain herniation. They may also reveal the underlying cause of ICP.
- Funduscopic exam: This is a type of eye exam. It can reveal swelling of your optic discs (papilledema), which is a sign of ICP.
- Lumbar puncture (spinal tap): This procedure measures your cerebrospinal fluid pressure and can help diagnose certain causes of ICP.
- A provider can also measure your CSF pressure by drilling a small hole in your skull and placing a special device or tube (catheter) in your cranium.

The management of elevated ICP is a critical component of care in patients with acute neurological deterioration. Such patients should be managed in an intensive care unit. Continuous neuro-observation, vigilant monitoring of vital signs, and timely interventions can prevent secondary brain injury and potentially fatal herniation syndromes.

All interventions should be viewed as temporizing measures aimed at preventing or reversing cerebral herniation until the underlying disease is treated or resolves. While recovery is possible with prompt and appropriate treatment, the prognosis is poor once there is evidence of uncal or tonsillar herniation accompanied by bilateral fixed pupils and loss of brainstem reflexes.

The primary goals of care include stabilizing the airway, ensuring adequate ventilation and oxygenation, and maintaining systemic circulation. Once cardiopulmonary stability has been achieved, specific steps should follow. The neck should remain in a neutral midline position, avoiding flexion or rotation to prevent restriction of jugular venous outflow. Elevating the head of the bed to approximately 30 degrees promotes venous drainage and lowers cerebral blood volume.



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Endotracheal intubation is indicated if the Glasgow Coma Scale (GCS) score is 8 or lower, when consciousness deteriorates, when airway reflexes are lost, or when impending herniation is suspected. Controlled ventilation may then be used to reduce ICP, with temporary targeting of a PaCO2 not lower than 35 mm Hg to induce cerebral vasoconstriction. Aggressive hyperventilation, targeting a PaCO2 below 30 mm Hg, should be reserved for acute herniation, as prolonged vasoconstriction can impair cerebral perfusion and precipitate ischemia.

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