ICP Control

The goal is ICP at ≤ 20mm Hg and cerebral perfusion pressure at 50 to 70 mm Hf. Cerebral venous drainage can be enhanced (thus lowering ICP) by elevating the head of the bed to 30°and by keeping the patient's head in a midline position.

Control of increased ICP involves several strategies:

- **Sedation:** Sedatives may be necessary to control agitation, excessive muscular activity (eg, due to delirium), or pain, which can increase ICP.
  Because sedatives can mask neurologic findings and changes, their use should be minimized and, whenever possible, avoided. Antipsychotics should be avoided if possible because they can delay recovery
- **Hyperventilation:** Hyperventilation causes hypocapnia, which causes vasoconstriction, thus decreasing cerebral blood flow globally. Reduction in PCO_2 from 40 to 30 mm Hg can reduce ICP about 30%. Hyperventilation that reduces PCO_2 to 28 to 33 mm Hg decreases ICP for only about 30 min and is used by some clinicians as a temporary measure until other treatments take effect. Aggressive hyperventilation to < 25 mm Hg should be avoided because it may reduce cerebral blood flow excessively and result in cerebral ischemia. Other measures may be used to control increased ICP
- **Hydration:** Isotonic fluids are used. Providing free water through IV fluids (eg, 5% dextrose, 0.45% saline) can aggravate cerebral edema and should be avoided. Fluids may be restricted to some degree, but patients should be kept euvolemic.
- **Diuretics:** Serum osmolality should be kept at 295 to 320 mOsm/kg. Osmotic diuretics may be given IV to lower ICP and maintain serum osmolality. These drugs do not cross the blood-brain barrier. They pull water from brain tissue across an osmotic gradient into plasma, eventually leading to equilibrium. Effectiveness of these drugs decreases after a few hours. Because osmotic diuretics increase renal excretion of water relative to Na, prolonged use of mannitol may result in water depletion and hypernatremia. Furosemide 1 mg/kg IV can decrease total body water, particularly when transient hypervolemia associated with mannitol is to be avoided. Fluid and electrolyte balance should be monitored closely while osmotic diuretics are used. A 3% saline solution is another potential osmotic agent to control ICP
- **BP Control:** Systemic antihypertensives are needed only when hypertension is severe (> 180/95 mm Hg). How much BP is reduced depends on the clinical context. Systemic BP needs to be high enough to maintain cerebral perfusion

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pressure even when ICP increases. Hypertension can be managed by titrating a nicardipine drip (5 mg/h, increased by 2.5 mg q 5 min to a maximum of 15 mg/h) or by boluses of labetalol (10 mg IV over 1 to 2 min, repeated q 10 min to a maximum of 150 mg).

- **Corticosteriods:** These drugs are usually helpful for patients with a brain tumor or brain abscess, but they are ineffective for patients with head trauma, cerebral hemorrhage, ischemic stroke, or hypoxic brain damage after cardiac arrest. Corticosteroids increase plasma glucose; this increase may worsen the effects of cerebral ischemia and complicate management of diabetes mellitus. After an initial dose of dexamethasone 20 to 100 mg, 4 mg once/day appears to be effective while minimizing adverse effects. Dexamethasone can be given IV or po. If ICP continues to increase despite other measures to control it, the following may be used:
- **Pentobarbital coma:** Pentobarbital can reduce cerebral blood flow and metabolic demands. However, its use is controversial because the effect on clinical outcome is not consistently beneficial, and treatment with pentobarbital can lead to complications (eg, hypotension). In some patients with refractory intracranial hypertension that does not respond to standard hypercapnia and hyperosmolar therapy, pentobarbital can improve functional outcome. Coma is induced by giving pentobarbital 10 mg/kg IV over 30 min, followed by 5 mg/kg/h for 3 h, then 1 mg/kg/h. The dose may be adjusted to suppress bursts of EEG activity, which is continuously monitored. Hypotension is common and is managed by giving fluids and, if necessary, vasopressors. Other possible adverse effects include arrhythmias, myocardial depression, and impaired uptake or release of glutamate.
- **Decompressive craniotomy:** Craniotomy with duraplasty can be done to provide room for brain swelling. This procedure can prevent deaths, but overall functional outcome may not improve much. It may be most useful for large cerebral infarcts with impending herniation, particularly in patients < 50 yr.