

## Pharmacological Management of ICP

- A. Sedative agents – decreases oxygen and glucose demands; limits increases in ICP caused by agitation, restlessness, posturing, asynchrony with mechanical ventilation, and painful procedures.

Important to remember – Comatose patient is not anesthetized

- B. Neuromuscular blockades – decrease body's metabolic needs and controls shivering and posturing that may increase ICP (note: patient must be sedated, intubated, and on vent with use)

Agents used: Tracrium, Pavulon, Succinylcholine

- C. Analgesia – treats and minimizes pain, prevents iatrogenic increases in ICP

Agents used: Ativan, Versed, Propofol (Diprivan), Morphine, Haldol

(note: if narcotics are used, effects can be reversed with Narcan for detailed accurate neurological assessments)

- D. Diuretics

Mannitol – Osmotic diuretic

Drug of choice in an emergency setting when brain herniation is impending.

Used to treat patients with increased ICP and cerebral edema

Not recommended for initial resuscitation because of diuretic effect (remember one of the goals of resuscitation is to prevent hypotension by restoring and maintaining vascular volume)

Action – decreases ICP by increasing intravascular-to-extravascular osmotic gradient, causing a shift in fluid from brain tissues to the intravascular space. This also improves CBF by decreasing blood viscosity. Mannitol also causes a decrease in CSF production.

Caution – rebound phenomenon – need an intact blood-brain barrier. Acidosis or damaged blood-brain barrier would allow Mannitol to cross barrier → tissue is now hyperconcentrated in R/T cerebral vasculature → produces rebound increased ICP.

Caution – important to avoid dehydration

Administration – IV bolus better than continuous, give 0.25 – 1.0 Gm/Kg rapid IV (give rapidly as does crystallize; usually give large amounts as is supplied)

Onset of action 10-20 minutes, lasts up to 6 hours

SE – can cause rapid electrolyte changes and decrease in BP

NI – monitor vital signs, CVP (for hypovolemia), electrolytes, asses for FVD

Lasix – Loop diuretic

Action – decreases CSF production, decreases H<sub>2</sub>O in brain tissue by decreasing overall body water

Advantage – less likely to cause dehydration

Administration – 0.5 – 1 mg/Kg IV; most often given with Mannitol, requiring dose adjustment of decreased amount

Example of order:

50 Gm Mannitol IV bolus followed in 20 minutes with 20 mg Lasix IV bolus

- E. Antiemetics – used to prevent vomiting, which would increase ICP
- F. Benzodiazepines – used to prevent alcohol S&S of withdrawal (cause of TBI may have been alcohol related)
- G. Corticosteroids – used in past, but are not effective in treatment of increased ICP. With no current evidence to support improved outcome from TBI, should not be used.
- H. Anticonvulsants – used to control seizures. Seizures increase cerebral metabolic rate, increase CBF, increase CBV (cerebral blood volume) = increased ICP. Seizures also increase oxygen consumption by cerebral tissues and increase release of neurotransmitters = increase in secondary injury  
Guidelines – do not prophylactically treat all patients. Treat if early posttraumatic seizures occur within first 7 days after TBI. If late posttraumatic seizures occur, treat same as any patient with a new onset of seizures.  
Note - long term use of anticonvulsants will result in neurobehavioral and other SE that may complicate recovery  
Drugs of choice – Dilantin, Phenobarb
- I. Barbiturates – controversial, high dose barbiturate therapy used for refractory high ICP (that which is not responding to conventional treatment – approx. 10-15% of severe TBI)  
Action – decreases cerebral metabolism and CBF → lowering CBV and ICP. Also acts as an anticonvulsant, may suppress sub-clinical seizure activity. Postulated that acts as scavengers of free radicals and therefore prevents cell membrane damage and destruction  
Complications – Many! Suppresses the myocardium, therefore often requires cardiac support. Also causes hypotension and hypothermia, as well as decreased cardiac output.  
Agents used – Pentobarbital (long-acting); Pentothal (short-acting)
- J. Neuroprotectants  
New category of investigational drugs  
Most are directed at outcomes associated with cerebral ischemia, and seek ways to decrease secondary injury and long-term morbidity  
*Example of how one type of neuroprotectants may work – free radicals are released during trauma. These metabolic byproducts are not cleared in these patients (normally they are broken down into harmless  $O_2$  and  $H_2O$ ) = accumulation = brain cell damage. Other harmful effects of amino acids released during ischemia create a hypermetabolic state. Goal is to minimize brain damage by control of cerebral metabolic rate.*  
Administration – variable. Some need to be given soon after the injury to be effective.  
Many long term studies are still in progress.