KEY Traumatic Brain Injury with Increased Intracranial Pressure (adapted from Lewis text)

Patient Profile

D.G., a 19-year-old man, was brought to the emergency department after a motor vehicle accident in which he was the driver. He is transferred to the neuro-trauma intensive care unit with a diagnosis of traumatic brain injury (TBI).

Subjective Data

- Multiple family members and friends in the waiting room
- D.G.'s girlfriend died on scene
- Hospital chaplain present

Objective Data

Physical Examination

- Glasgow Coma Scale score, 4 ; (GCS less than 8 /intubate)
- Neurologic Assessment:
    - Pupils 4 mm and sluggish
    - Decerebrate posturing – What does this look like? (extension and rigidity of extremities)
    - Periorbital ecchymosis (What might this be a sign of?) basilar skull fracture
- Clear drainage from nares is positive for glucose (what is your concern here?) CSF leak and possible basilar skull fracture and potential for infection)

Diagnostic Studies

- Computed tomography (CT) scan: subdural hematoma compressing the ipsilateral ventricle and causing a midline shift – What is a Subdural hematoma?

Interprofessional Care

- Admission orders include:
    - Multiple line placements: arterial monitoring, central venous pressure line, ventriculostomy
    - Keep cerebral perfusion pressure (CPP) greater than 70 mm Hg - CPP = MAP - ICP
    - Begin standing orders for proprofol, midazolam, ranitidine, and phenytoin
    - Continuous cardiac monitoring
    - Urinary catheter with strict I & O measurements
    - Neuro checks every hour
    - Monitor lab values (arterial blood gases, complete blood count, electrolytes) every morning

Discussion Questions

1. Based on the assessment data, what are the nursing priorities for D.G.?
   Answer: The client with a GCS score of 4 and receiving propofol and is intubated, therefore airway, and breathing will take priority when coming on shift. Propofol is an anesthetic used to sedate patients. Intermittently the client's level of consciousness will need to be assessed. Additional monitoring includes arterial blood gasses, intracranial pressure (ICP), vital signs, and urine output.
   Rationale: The goal is to prevent any secondary brain damage from increased ICP and cerebral edema by instituting interventions to rapidly correct hypoxemia, hypotension, hypercarbia, hyperthermia, and hypoglycemia.

2. Indicate the expected outcome associated with each of the medications D.G. is ordered.
   Answer: Proprofol is a deeply sedating drug that allows for brain recovery and oxygen conservation in the acute early phases of TBI. Midazolam, a sedative, is given to decrease agitation and hyperactivity that can cause increased ICP. Ranitidine, an H_2 receptor antagonist, can prevent gastrointestinal ulcers and bleeding. Phenytoin and other antiseizure drugs are ordered to control or prevent seizure activity.
   Rationale: The goal in providing medications such as these is to allow the client an opportunity to rest and recover during the acute phase of the incident while the brain is swelling.

3. Describe the purpose and care of D.G.'s ventriculostomy.
   Answer: A ventriculostomy is a specialized catheter inserted into the lateral ventricle and connected to an external transducer that directly measures the pressure within the ventricles. It can also be used to facilitate the removal of cerebrospinal fluid (CSF). Because of the risk of infection, routine assessment of the insertion site, the use of aseptic technique, and monitoring the CSF for a change in drainage color or clarity are important. Antibiotics may be added as prophylaxis.
   Rationale: A ventriculostomy is a specialized catheter inserted into the lateral ventricle and connected to an external transducer/monitoring device that directly measures the pressure within the ventricles i.e. the ICP pressure. Normal ICP pressure is 5 to 15 mmHg. Normal CPP is 60 to 100 mmHg.

4. The resident on call writes an order to insert a nasogastric tube. Would you implement this order or question it? Why?
   Answer: Question it. A contraindication to NG placement is the possibility of a basilar skull fracture as evidenced by periorbital ecchymosis and drainage from nares that is positive for glucose.
   Rationale: An NG inserted into a client with a basilar skull fracture could inadvertently travel into the brain cavity. It can also, Increase the chance for infection since there is a CSF leak.

5. Describe independent nursing interventions to assist in controlling D.G.'s increased intracranial pressure.
   Answer: You would keep the head of bed elevated 10 to 15 degrees, with the head itself kept midline. Log roll him to avoid hip flexion. Monitor his ICP and allow it to return to baseline between nursing activities to prevent sustained increases in ICP. Limit endotracheal suctioning to no more than 10 seconds and suction only as needed. Provide a quiet and soothing environment. Speak softly, use a gentle touch, and avoid jarring the bed. Try to limit painful procedures and avoid tension on tubes, such as the urinary catheter. Maintain patient temperature in a normal range.
   Rationale: The goal is to help keep the client in a calm and relaxing environment so that the brain has time to heal during the initial swelling phase of the TBI. Anything that may spike one's blood pressure, such as movement, pain, or external stimuli, may decrease the blood flowing through the brain. The worst-case scenario would be for the brain to have so much swelling as to herniate and cause brain death.

Case Study Progress

Two hours after admission, D.G. is unresponsive to tactile stimuli. The left pupil is fixed and dilated to 7 mm. The trauma surgeon suspects D.G. has developed an epidural hematoma.

6. What emergency procedure can be done to evacuate an epidural hematoma?
   Answer: Because an epidural hematoma is considered a neurologic emergency, an emergency burr hole may be placed on the side of the pupillary dilation or contralateral to the side of the motor deficit. It would allow for the release of any accumulated fluid and blood. Or the patient is taken emergently to the OR.
   Rationale: The goal is to decrease the cerebral edema that is causing a decrease in blood flow. Manipulation (removing some via the ventriculostomy) of the CSF or blood volume is no longer an option because the swelling experienced by the client is too acute and requires immediate attention and intervention to relieve the pressure.

7. What additions or changes might you see in D.G.'s care?
   Answer: Because D.G. has deteriorated, options that may be implemented include placing him on high-doses of barbiturates (e.g., pentobarbital, thiopental)to , adjusting his ventilator settings to deliver a moderate hyperventilation (remember elevated Co2 dilates the blood vessels which could contribute to an increased ICP), or decreasing intracerebral fluid content with a Mannitol bolus (Mannitol is an osmotic diuretic and when used in neuro patient causes brain cells to become mildly dehydrated by drawing water inside the cells (intracellular water) out and into the bloodstream to be filtered out of the body by the kidneys) or hypertonic saline (example 3% saline - pulls fluid also, and can help decrease brain edema).
   Rationale: The goal is to decrease the cerebral edema by using medications and hyperventilation (blowing off carbon dioxide) to reduce brain swelling. Because the brain is swelling and becoming agitated, seizures are likely

to happen, so barbiturates and/or anti-seizure meds are used to decrease the likelihood of seen and unseen seizure activity.

8. What are the common complications of traumatic brain injuries?
   Answer: The two major complications from the cerebral edema accompanying a TBI are brain herniation and decreased cerebral perfusion. Other complications include neurogenic pulmonary edema, syndrome of inappropriate antidiuretic hormone secretion (SIADH), disseminated intravascular coagulation, gastrointestinal bleeding, meningitis, brain abscess, and reoccurrence of intracranial bleeding.
   Rationale: The client experiencing a TBI is at risk for multiple issues that include airway (because of intubation), breathing (pulmonary edema), cardiac (decreased heart rate while the blood pressure spikes and brain perfusion ceases), and neurologic deficits that can lead to a comatose state. The complications from TBI can become extensive and involve other organs as the client's condition declines.

9. What are the signs of Cushing's Triad?
   Answer: Increased Systolic BP and widening pulse pressure, decreased HR, irregular respiratory pattern

10. What are signs of increasing intracranial pressure? Answer: Changes in LOC, headache, seizures, decreased motor function – change in motor ability, posturing; vomiting not preceded by nausea, changes in speech, pupillary changes, papilledema, impaired eye movement, and of course changes in vital signs listed under Cushing's