Vancouver General Hospital ICU
Severe Traumatic Brain Injury Management Protocol

(Admission GCS < 8)

Monitoring & Goals	General ICU Care	Contraindicated
• $SaO_2 \geq 97\%$ • Central venous and arterial catheter • Jugular bulb: SjO_2ER 20 – 35% • Cerebral perfusion pressure (CPP) ≥ 60 mmHg • External ventricular drain (EVD): ICP ≤ 20mmHg • Brain tissue oxygenation - $P_{br}O_2 \geq 20$ mmHg • Glucose : As per ICU Insulin protocol • Hemoglobin ≥ 90 d/L • Serum Na > 140 mEq/L • Admission EEG within 48 hours of admission	• DVT Prophylaxis[1] • GI Prophylaxis • Nutrition as per ICU protocol • HOB 30 ° • Spine precautions[2] • Neck neutral, no compression[2] • CSF culture daily	• Corticosteroids • Albumin • Prophylactic Hyperventilation (pCO_2 < 25 mmHg)

$$ICP = P_{Brain} + P_{CSF} + P_{Vessels} + P_{Other}$$

LEVEL 1			
a) RASS goal 0 to -3[3] b) Temperature 36–37.5°C[4] c) *Consider s*eizure prophylaxis[5]	EVD Closed Monitor ICP q1h	SjO_2 & $P_{br}O_2$ guided therapy (see below)	
↓ ICP ≥ 20 for > 5 minutes (not stimulated), open EVD and drain CSF, then close EVD ICP < 20: return to Level 1 ICP ≥ 20: proceed to Level 2			
LEVEL 2			
a) RASS goal -4 to -5[3] b) Serum sodium 145 – 155 mEq/L[6] c) *Consider* Paralysis[7] d) Temperature 34 - 36 °C[4]	Open EVD until ICP < 20 then close Check ICP q1h	SjO_2 & $P_{br}O_2$ guided therapy (see below)	Consider new or progressive (neurosurgery & consider CT head)
↓ ICP ≥ 20 for > 5 minutes (not stimulated), open EVD and drain CSF, then close EVD ICP < 20: return to Level 2 ICP ≥ 20: proceed to Level 3			
LEVEL 3 – To be discussed with ICU Attending			
a) Temperature 33-34°C[4] b) Mannitol[9] c) Barbituate Therapy[10]	Open EVD until ICP < 20 then close Check ICP q1h	SjO_2 & $P_{br}O_2$ guided therapy (see below)	Decompressive craniectomy + / - lobectomy
HERNIATION			
Mannitol 1g/kg IV	Open EVD	pCO_2 25 - 30 mmHg	Call Neurosurgery[11]

SjO_2 and $P_{br}O_2$ GUIDED THERAPY (Ensure correct position of catheters[12])

	SjO_2ER <20%	SjO_2ER 20-35%	SjO_2ER >35% and/or $P_{br}O_2$ < 20 mmHg
ICP ≤ 20mmHg	Observe	Observe	a) pCO_2 40-45 mmHg b) ↑ CPP to 70-80 mmHg c) Hb ≥ 90 d/L
ICP ≥ 20mmHg	a) Decrease ICP ≤ 20 b) pCO_2 30-35 mmHg	Decrease ICP ≤ 20	a) Decrease ICP ≤ 20 b) ↑ CPP to 70-80 mmHg c) Hb ≥ 90 d/L

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Appendix 1.

[1] DVT Prophylaxis
- Apply Sequential Compression Devices (unless lower extremity long bone trauma)
- Timing of Heparin or Low Molecular weight heparin to be discussed with Neurosurgery team

[2] Ensure C spine precautions – As guided by imaging and ICU attending
- C – spine collar and endotracheal tube tie not constricting jugular venous flow
- Consider removing collar and maintain c-spine precautions with sandbags
- Consider loosening endotracheal tube tie

[3] Sedation
- Amnesia: Propofol 0-80mcg/kg/min infusion (implement ICU Propofol monitoring)
  and / or Midazolam 0-40 mg/hour infusion
- Analgesia: Morphine 0-20 mg/hour infusion *or* Hydromorphone 0-2 mg/hour infusion

[4] Use of antipyretics (acetaminophen) & external cooling devices (cooling blanket)

[5] Phenytoin 18 mg/kg IV load (round to closest 50mg) and then 5mg/kg/d IV (round to closest 50mg) divided every 8 hours x 7 days

Indications:
- Depressed skull fracture
- Penetrating trauma
- Witnessed seizure
- Concomitant epidural, subdural or intracerebral hematoma

[6] If serum sodium < 140 mEq/L then consider 3-5 ml/kg 3% Hypertonic Saline IV bolus followed by hypertonic saline 3% infusion (1-2ml/kg/h IV infusion)

Change maintenance lines to Normal Saline

Feeds with low free water (Resource 2.0)

[7] Rocuronium 0.5 mg/kg IV every hour when necessary

[8] EEG – assess for non-convulsive status epilepticus

[9] Mannitol 0.25g/kg every 6 hours (keep serum osmolality < 320 mosmol/L)
1g/kg bolus if herniation

[10] Pentobarbital 10mg/kg load then 1mg/kg/h infusion
- Consider weaning other sedative infusions and neuromuscular paralysis

[11] Consider CT head and emergent operative intervention

[12] X-Ray position of Jugular Bulb - obtain lateral C Spine X-ray
- Correct position is at level of mastoid process

Positioning of Licox brain tissue oxygenation
- Increase FiO_2 to 100% for 5 minutes, check for increase in $P_{br}O_2$ in 2 minutes
- If $P_{br}O_2$ increases within 2 minutes, then catheter in appropriate position
- If $P_{br}O_2$ does not increase then contact MD for further assessment