TRAUMATIC BRAIN INJURY MANAGEMENT - CICU SCH

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- This practice guideline outlines the management of infants and children in CICU with severe brain injury
- Manage with neurosurgery
- Monitor GCS for changes; notify intensivist and neurosurgery if ≥ 2 points change in GCS, pupil changes, limb strength, rising ICP, seizures, haemodynamic instability

CHANGE SUMMARY

- N/A – New Document

READ ACKNOWLEDGEMENT

- Clinical staff in CICU

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st April 2021	**Review Period**: 3 years
Team Leader:	Clinical Nurse Specialist	**Area/Dept**: CICU

Date of Publishing: 15 March 2021 3:55 PM Date of Printing: 15 March 2021

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OUTCOMES

- Minimising adverse complications of traumatic brain injury
- Best evidence-based practice management
- Early intervention and treatment
- Maintain adequate cerebral perfusion
- Prevent complications associated with long term

Abbreviations and glossary

CPP	Cerebral perfusion pressure
CVP	Central venous pressure
CTB	Computed tomography brain
DI	Diabetes insipidus
DVT	Deep venous thrombosis
ETT	Endotracheal tube
EVD	External ventricular drain
GCS	Glasgow Coma Scale
HTS	Hypertonic saline
ICP	Intracerebral pressure
MAP	Mean arterial pressure
SIADH	Syndrome of inappropriate antidiuretic hormone secretion
UA	Urinalysis
Hb	Haemoglobin
TBI	Traumatic brain injury

1 Pre CICU Management

Initial management as per facility guideline with clinical judgement for each presentation.

- *SCH Traumatic Injuries - Initial ED Management of an Injured Child*
- *NETS Traumatic Brain Injury Practice Guideline*

2 CICU Management

Neurological assessment

- Document Glasgow coma scale (GCS) hourly unless otherwise specified by medical officer
- Pupil; size, shape and reactivity
- Monitor for seizure activity
- Report changes of; ≥2 points in GCS score, limb strength and pupil size/reactivity to medical officer

Sedation and analgesia

- Adequate sedation should be charted as per calculated ICU resuscitation/infusion chart unless specified by medical officer
- Analgesia should be prescribed as per 'paediatric prescription for continuous opioid/ketamine infusions' ICU dilution unless specified by medical officer
- Pain and sedation scoring should be regularly reassessed using appropriate scale and documented on SCH 'ICU infusion: sedation & pain score' chart.
- Morphine or fentanyl and midazolam infusion are typically used as first line with ketamine, dexmedetomidine and propofol considered for further sedation by the intensivist. Further sedatives as required as per intensivist [1,2]

Propofol: use with caution due to incidence of propofol infusion syndrome[1,2,4]

Ventilation

- Provide oxygen to achieve SpO2 >94%
- Maintain PaCO2 within normal range (35-40mmHg) unless hyperventilation is indicated short term for raised ICP, see heading below[1,2,4]
- Consider sedation bolus prior to suctioning if ICP spikes anticipated[1,2,4]

Haemodynamics

- Aim normotension for age group if CPP can be maintained[1,2,4,5]
- Inotropes should be considered if patient is euvolaemic to maintain BP and CPP[1,2,4,5,6,7]
- Monitor for Cushing's triad; bradycardia, hypertension with widened pulse pressure and irregular respirations (in non-intubated patients)

CPP(mmHg) = MAP-ICP

CPP target range	
Age	Desired CPP
>10 years	>60mmHg
6-10 years	>50mmHg
0-5 years	>40mmHg

Vasoactive infusions – CICU – SCH

Access

Patients with ICP monitoring should ideally have arterial and central venous catheter (CVC) inserted.

Note; avoid internal jugular CVC where possible

Fluid therapy[1,2,7,9]

- Fluid resuscitation with 0.9% saline or plasmalyte is suggested
- Maintain euvolaemia with standard CICU maintenance fluid (plasmalyte +/- 5% glucose or sodium chloride +/- 5% glucose)
- Where possible reconstitute medication infusions with 0.9% sodium chloride

Note: Albumin in contraindicated in TBI fluid resuscitation as it is associated with higher mortality

- Monitor CVP where possible
- Maintain 0.5 – 1ml/hr of urine output
- Daily UA
- Monitor for signs of SIADH, DI or cerebral salt wasting; urine output, serum and urine sodium levels
- Consider EVD replacement if applicable

See bedside folder for Diabetes Insipidus management guide

Haemoglobin[1,2,10.11]

Low threshold for Hb is 70g/L, depending on clinical assessment a higher Hb may be targeted. Some evidence to suggest a higher Hb >70g/L improves outcomes.

Temperature[1,2,4]

- Continuously monitor temperature where possible with core temperature probe
- Aim normothermia (36-37℃) with the use of antipyretics and/or cooling blanket. Set blanket cooling temperature to 36.5℃. Cool as per policy, Change temperature incrementally by 1℃. Document on 'Cooling observations' chart.
- Neuromuscular blockage may be required to manage shivering
- Therapeutic hypothermia should be considered before barbiturates or surgical management for raised ICP's that are difficult to control with standard sedation and muscle relaxants.

Surface Cooling and Therapeutic Hypothermia – CICU

Seizures

- Follow SCH seizure management protocol (midazolam 0.15 mg/kg IV (max 10 mg))
- Consider commencement of levetiracetam or phenytoin for prophylaxis.[1,2]
- Consider continuous EEG monitoring in consultation with neurology if muscle relaxed
- Document seizures on The Sydney Children's Hospitals Network seizure chart

Seizures – acute Management in Infants and Children

EVD

If the patient has an EVD, drainage may be considered to decrease ICP acutely. EVD is transduced at the level of the tragus and the drain level is set by neurosurgery in cmH2O

- Assess accurate ICP hourly by turning tap off to drain and open to transducer. If rising ICP review at more regular intervals
- Monitor and document EVD volume output; report to medical officer if not draining and no oscillation, marked increase in volume and any change in CSF colour.
- Review policy for sampling and management
- CSF samples as per protocol

External Ventricular Drain: Patient Care - CHW

Spinal clearance

- Consult team on call for spine about spinal management
- Foam collar is the preferred collar, even for suspected cervical injury, unless ordered by neurosurgery or Spinal Care Team. Log roll as per policy

Log Rolling Patients In CICU With Suspected/Confirmed Spinal Cord Injury – SCH

Cervical Spine (suspected) Injury (paediatric): Patient Management

Further nursing care[1,2,4]

- Nurse 30° head up or tilt if spine not cleared
- Ensure minimal restriction of venous return from collar or tracheal tube securing device
- Consider sedation bolus prior to suctioning if ICP spikes anticipated
- Assess patient during interventions, consider cluster cares if not tolerating handling – cease interventions if ICP remains high
- Minimises noise, light and stimulation where possible
- Pressure injury management
- Contact relevant CNCs for trauma and neurosurgery and any other specialties that may be involved
- Regular parent updates and involvement in patient care where possible

Pressure Injury Prevention and Management

Corticosteroids[1,2,4,8]

Not recommended in management of TBI

Other routine management

- DVT prophylaxis (heparin or clexane/compression stockings/calf compressors)

Note: consider contraindications for anticoagulants in context of individual patient

- Stress ulcer prophylaxis as per Intensivist.
- Bowel care
- Early enteral nutrition as per SCH CICU bedside flowcharts

3 Treatment of Raised ICP

Ensure all above measure above are in place

Sedation and neuromuscular block[1,2,4]

- Initially treat with sedation bolus, consider increasing infusion rate if bolus effective.
- Bolus of muscle relaxant; if effective review current sedation and consider neuromuscular block infusion
- Hourly pupil observations required when muscle relaxed
- These interventions may reduce CPP and MAP requiring intervention to prevent cerebral hypoperfusion. Consider inotropes.
- Repeat above until sedation is optimised.

Peripheral nerve stimulation (train-of-four) monitoring in CICU - SCH

Neuromuscular Blockage agents (NMBA) – CICU - SCH

Medication	**Bolus dose IV** (Consider max doses at 100 kg equivalent)
Morphine	40-80microg/kg
Fentanyl	1microg/kg
Midazolam	50-100microg/kg
Propofol	0.5-1mg/kg
Rocuronium	1mg/kg
Ketamine	0.5-1mg/kg

Osmotherapy[1,2,3,4,9]

3% sodium chloride: IV is recommended for acute ICP rise. Dose is 2-3ml/kg over 10-20 minutes

Mannitol 20%: IV 0.25–0.5 g/kg (1.25-2.5ml/kg) over 20minutes; repeat every 2–6 hours if necessary. Higher dose of 1 g/kg (5ml/kg) may be considered.

Mannitol 10%: IV 0.25–0.5 g/kg (2.5-5ml/kg) over 20minutes; repeat every 2–6 hours if necessary. Higher dose of 1 g/kg (10ml/kg) may be considered.

Higher serum osmolarity may be tolerated in children and should be monitored closely if multiple osmotic agents given.

Note: In patients with difficult to control ICP a sodium level of 150 -155mmol/L maybe targeted. Ideally Serum sodium must be closely monitored and should be maintained LESS THAN 160mmol/L.

CT Brain

If frequent spikes in ICP or sustained raised ICP continues despite medical management a CTB should be repeated to exclude further injury requiring surgical intervention. Neurosurgery should be consulted.

Barbiturates

- Thiopental infusion should be considered to decrease cerebral metabolism and decrease ICP when other medical and surgical interventions have been exhausted and in discussion with intensivist.[1,2]
- Dosing as per AMH 3-5mg/kg bolus followed by with a rate of 1-4mg/kg/hr infusion . Anticipate hypotension with bolus dose.[3]
- Cease other sedation, continue analgesia and monitor haemodynamics closely
- Continuous EEG monitoring should be considered

Hyperventilation

Discussion with intensivist about possible hyperventilation is recommended if dilated unreactive pupils (uncal herniation) and should only be maintained for 5-10min at 30mmHg. Prolonged hyperventilation is linked to cerebral ischemia.[1,2,4]

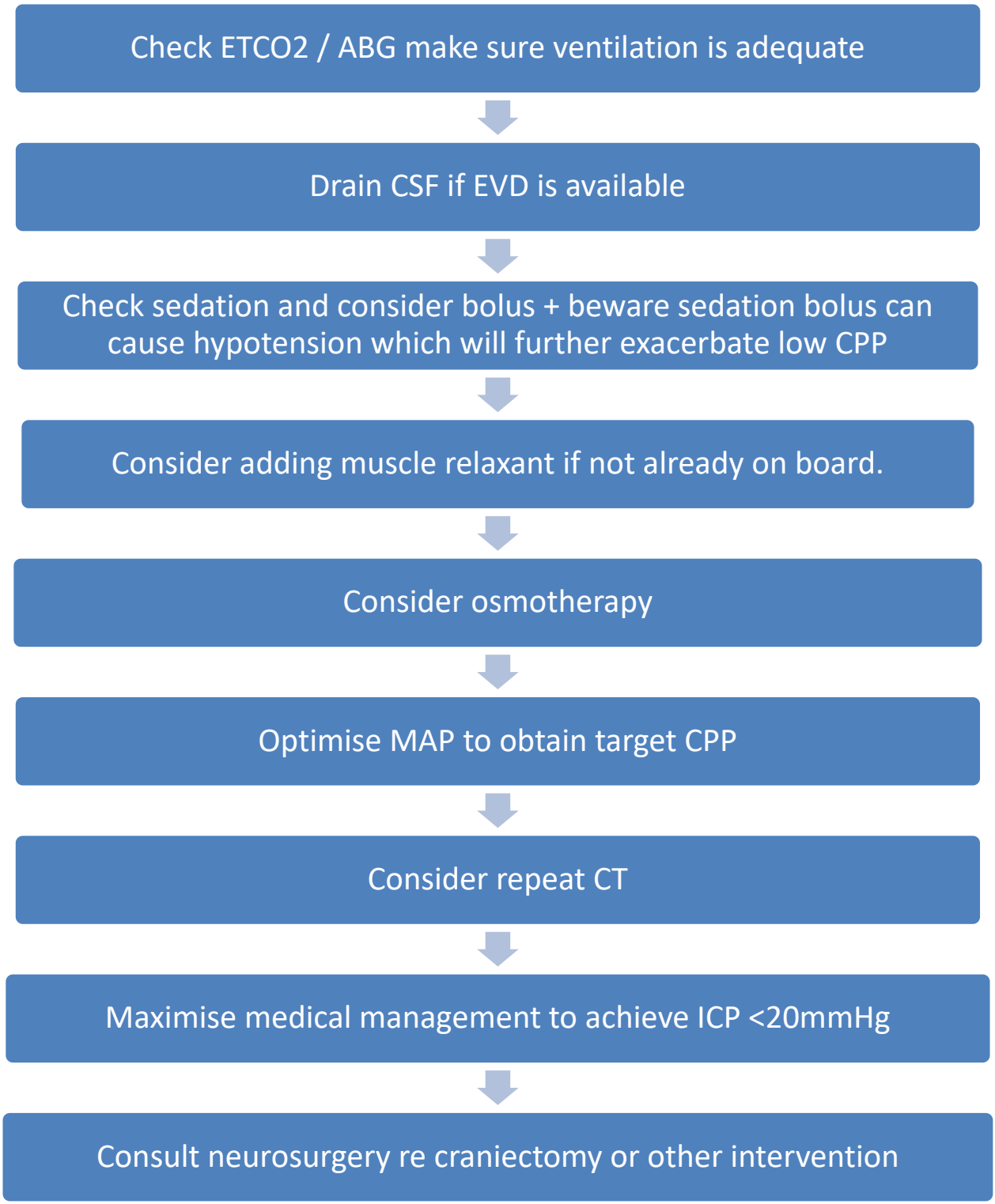
Surgical management[1,2,4,12]

A craniectomy may be considered by neurosurgery depending on CTB results or for refractory ICP elevation not responding to standard medical therapy. Evidence for consideration of early decompressive craniectomy to treat neurologic deterioration, herniation or intracranial hypertension.

4 Weaning therapy

Wean ICP management therapy and neuroprotection should be considered in discussion with intensivist and neurosurgery as ICP allows.

5 Treatment of raised ICP >20mmHg



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