

## Guideline for the management of TBI and raised ICP

### TIER ZERO: Basic TBI care

- Serial evaluation of neurological status and pupillary reactivity
- Endotracheal intubation and mechanical ventilation with sedation if indicated
- Head of bed elevation to 30-45°
- Ensure no cerebral venous drainage obstruction (check collar, ETT tape restricting venous drainage/not)
- Prevent pyrexia (treat to keep core temperature <38°C) - antipyretics, targeted temperature management.
- Maintain PaCO<sub>2</sub>- 4.7 -5.1 and PaO<sub>2</sub>- 12 -15 kPa
- Maintain normoglycaemia (6-10mmol/L)
- Maintain hemoglobin > 70 g/L
- Consider Arterial line and continuous monitoring of pressure

### Tier 1: Basic care. ICP target < 22mmHg

- Maintain CPP 60-70 mmHg, avoid CPP> 70
  - Maintain ventilator support to keep:
    - Oxygen saturations >96% (or PaO<sub>2</sub> >12 kPa) & PaCO<sub>2</sub> 4.7-5.1
  - Maintain sedation to prevent agitation, ventilator asynchrony:
    - Propofol and alfentanil first line (check baseline and daily CK)
    - Midazolam second line
    - RASS score 0 to -2 if ICP <15. Sedation may be increased (RASS -2 to -5) as necessary to lower ICP, consider use of BIS if appropriate
  - Antiepileptic medication (levetiracetam) if seizures observed / or risk factors present (review after 7 days, **continue only if indicated**)
  - If ICP target not being attained, consider:
    - Osmotherapy:
      - Mannitol (10 % 0.5g /kg over 15mins) or 5% Saline (2ml/kg over 15 mins)
      - If central venous access available – 5% saline preferred
      - Treatment limit - Serum Na < /= 155mmol/L for hypertonic saline & serum osmolality < /= 320mosmol/l for mannitol
- D/w NS team and consider repeat scan**
- CSF drainage via EVD/EVD insertion if not already in place. An EVD system zeroed at the midbrain with continuous drainage of CSF may be considered to lower ICP burden more effectively than intermittent use. (*Consider use of LiquoGuard*)
  - Consider EEG monitoring

### Tier 2: ICP >22 mmHg for >5 mins despite tier 1 management

- Check ICP line (please ensure correct zero'ing procedure followed)
- Deepen sedation to RASS -5 (consider BIS monitoring – If frontal contusions present use caution, alternative positions for electrode placement)
- Mild hypocapnia – target PaCO<sub>2</sub> 4.3- 4.6 kPa
- Neuromuscular paralysis (ensure adequately sedated/ BIS) - Atracurium bolus +/- infusion (only if bolus dose efficacious).
- Perform MAP challenge to assess cerebral autoregulation to guide MAP and CPP targets:
  - Ensure not hypovolaemic
  - Vasopressor induced increased MAP of 10 mmHg for maximum of 20 mins,
    - Record CPP, MAP, ICP at baseline during and after challenge.
    - Discuss results with senior member of team to assess the status of static pressure auto-regulation (sPAR) and setting of new MAP target.
  - If auto-regulation intact raise MAP with fluid boluses or vasopressor titration.
- Revisit measures in tier 1.

Ref: 1. A management algorithm for patients with intracranial pressure monitoring: the Seattle International Severe Traumatic Brain Injury Consensus Conference (SIBICC); Intensive Care Med. 2019 Dec; 45(12):1783-1794.

2. Guidelines for the Management of Severe TBI, 4th Ed. Brain Trauma Foundation.

3. Changing trends in the use of seizure prophylaxis after traumatic brain injury: A shift from phenytoin to levetiracetam Journal of Critical Care (2013) 28, 883.e9–883.

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### Tier 3: ICP persistently >22 mmHg despite tier 1 and tier 2 interventions

- Consider decompressive craniectomy
- Targeted temperature management to ensure normothermia
- Revisit measures in tiers 1 and 2.
- Barbiturate coma
  - Ideally requires continuous EEG /CFAM monitoring
  - Titrate to achieve ICP control
  - Do not exceed dose at which burst suppression achieved (use BIS/EEG)
  - If pupils become newly fixed and dilated after commencing, reduce or stop therapy
  - Only continue if beneficial effect on ICP demonstrated.
- **3 tier/step-wise approach:**
  - If treatment is escalated parameters and interventions from previous tiers should be maintained (if not specifically altered).
  - Not all parameters in a tier need to be met prior to escalating to the next tier.

### Indications for AED

1. Clinical or EEG evidence of post-traumatic seizures
2. High-risk of post-traumatic seizures (BTF guidelines suggest the presence of at least 1 risk factor)
  - GCS<10
  - Cortical contusion
  - Depressed skull fracture
  - Subdural, epidural or intracerebral haematoma
  - Penetrating head wound
  - Seizure within 24 hours of injury

#### In patients who were not taking anticonvulsants prior to injury,

- Give loading dose levetiracetam 20mg/kg
- Start levetiracetam 1g twice daily (Initial dose 12 hours after loading)
- Give via NG/PO route if absorbing feed, otherwise continue IV
- Review after 7 days -continue only if evidence of seizure activity persists -clinical/EEG

### Rise in ICP / Neuroworsening- consider:

- |                       |                               |                         |
|-----------------------|-------------------------------|-------------------------|
| • Expanding lesion    | • Medical comorbidity         | • Hypoxemia             |
| • Cerebral oedema     | • Medication effect           | • Hypercarbia           |
| • Increasing Ischemia | • Infection / sepsis          | • Dehydration           |
| • Seizure /post-ictal | • Renal / hepatic dysfunction | • Substance withdrawal  |
| • CNS infection       | •                             | • Hyperthermia          |
| •                     | •                             | • Electrolyte imbalance |

### MAP challenge:

- Perform MAP challenge to assess cerebral autoregulation to guide MAP and CPP targets:
- Ensure not hypovolaemic
- Record baseline parameters-ICP, MAP, CPP at beginning of challenge
- Vasopressor induced increased MAP of 10 mmHg for maximum of 20 mins,
- Observe the interaction between CPP, MAP, ICP at baseline during and after challenge.
- Record parameters at end of challenge
- Evaluate for sPAR – static pressure autoregulation status (disrupted sPAR presents as sustained increase in ICP with MAP elevation.
- Adjust target MAP back to baseline if disrupted sPAR or to new elevated target if intact sPAR.
- Discuss results with senior member of team to assess the status of static pressure auto-regulation (sPAR) and setting of new MAP target.

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