

HNE Area Intensive Care

Clinical Guideline

GUIDELINE APPROVED FOR : JHH ICU ONLY

TRAUMATIC BRAIN INJURY MANAGEMENT GUIDELINES

- **not be used for other neurological disease states.**
- **Any variation from the guidelines must be approved by the duty Intensivist.,**

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MANAGEMENT IN THE ED

The ICU doctor is designated the role of “airway doctor” within the trauma team. The patient should be assessed and resuscitated according to EMST/ATLS principles.

The major factors resulting in secondary brain injury are hypotension, hypoxaemia, and hypocapnia. Hypotension is particularly dangerous – a single episode of hypotension doubles the risk of mortality. The brain is particularly susceptible to secondary insults in the first 12-24 hours after injury. Initial resuscitation and management in the ED is *extremely* important.

AIRWAY

Indications for intubation:-

Severe TBI = GCS<9

Rapidly declining LOC

Altered LOC and “uncooperative”

Rapid sequence induction with cricoid pressure and in-line stabilisation of the cervical spine. Hard collar *in situ* until admitted to ICU.

BREATHING

Aim for $pO_2 > 100\text{mmHg}$ (ventilate with 100% oxygen)

pCO_2 36-40 mmHg

Always use end-tidal capnography. Aim for $ET\text{-}CO_2$ 30-35 mmHg initially. Check ABG ASAP to confirm desired pCO_2 .

CIRCULATION

Ensure normovolaemia.

Ensure Hb close to 100g/l.

Aim for MAP > 90 mmHg or systolic > 120 mmHg until ICP monitor placed to ensure adequate CPP. Use small increments of metaraminol initially, then noradrenaline infusion in ICU.

DISABILITY

Ensure neurological evaluation completed prior to intubation if possible including:-

GCS

Lateralising signs

Signs of spinal cord injury

Indications for mannitol in ED:

Dilated pupil

Deteriorating LOC

Dose = 5ml/kg (=1g/kg) of 20% mannitol

The head injury needs to be treated in the context of the ABCD priorities of overall trauma management. Bearing this in mind, it is *critical* that head injured patients have a head CT as rapidly as possible to facilitate *urgent* evacuation of mass lesions. Do not delay life saving surgery by doing unnecessary investigations or procedures eg. central lines.

If there is no need for urgent surgery (laparotomy, thoracotomy, or craniotomy), complete evaluation of the *entire* spine should occur on the initial evaluation in radiology. See [spine clearance protocol](#) for details. Early imaging facilitates timely diagnosis of fractures or spine clearance and prevents the need for secondary patient transport.

Indications for ICP Monitoring

GCS < 9 and an abnormal CT scan

GCS < 9 and a normal CT scan and 2 of :-

age > 40 years

Significant hypotension

Motor posturing

GCS > 8 and

severe extracranial injuries particularly if clinical neurological assessment will be compromised by prolonged anaesthesia or sedation.

The decision to monitor ICP will be made by the neurosurgeon and intensivist. While ICP monitoring is not urgent, it should be done as soon as possible, and certainly before any extended non-urgent surgery e.g. long bone fracture fixation.

INTENSIVE CARE MANAGEMENT

Routine management

BRAIN SPECIFIC:

All patients with an ICP monitor will require a central line and arterial line.

Maintain cerebral perfusion pressure (CPP) > 60 mmHg using noradrenaline regardless of ICP.

Ensure normovolaemia eg. CVP 8-12 mmHg and/or $\Delta_{\text{down}} < 5$ mmHg

Maintain Hb close to 100g/l.

Maintain $pO_2 > 100$ mmHg (check ABG if $S_pO_2 < 98\%$)

Maintain pCO_2 36-40 mmHg.

Monitor $_{\text{ET}}CO_2$ continuously if an Evita ventilator with capnography is available. Aim for $_{\text{ET}}CO_2$ 30-35 mmHg initially, thereafter correlate with pCO_2 using ABGs – ie. Calculate the $p_{\text{a-ET}}CO_2$ gap.

If $_{\text{ET}}CO_2$ becomes outside the desired range, check the ABG immediately.

Sedation 7-14 mls/hr of standard M&M for a 70kg patient.

If the patient is difficult to adequately sedate with M&M, the duty intensivist can consider a trial of propofol in addition to M&M – see [Options](#).

Nurse 20-30° head up – tilt the whole bed if the spine has not been cleared.

Ensure that ETT tapes are not causing jugular venous obstruction.

Remove the hard collar and maintain cervical spine immobilisation with sandbags pending spine clearance. If a cervical spine fracture has been demonstrated, seek advice from the neurosurgical team regarding the appropriate immobilisation technique.

Control BSL as per unit protocol.

Monitor temperature continuously aiming for normothermia. Give paracetamol if

T > 37.5°C (paracetamol dose = 1g q4h, max of 4g/day).

More aggressive maintenance of normothermia with ice can be used at the discretion of the duty intensivist. [ice in TBI](#)

Saline or Hartmann's should be used as maintenance fluid aiming for $Na^+ > 140$ mmol/l. Do not use dextrose solutions.

General

Early enteral nutrition as per ICU protocol.

Stress ulcer prophylaxis – ranitidine 50mg tds IV.

DVT prophylaxis as per ICU protocol. TEDs and calf compressors initially, then consultation with the neurosurgeons re clexane.

Frequent position changes and chest physiotherapy.
Bowel care as per unit protocol.

TREATMENT OF INTRACRANIAL HYPERTENSION

Intracranial hypertension needs to be treated when ICP > 20-25mmHg for greater than 5 minutes. Aim to “control” ICP < 20 mmHg ideally.

ALL PATIENTS:-

Ensure basic management measures are in place as above.
Ensure that CPP is maintained > 60 mmHg with noradrenaline.

Optimise sedation.

**Bolus of sedation = 5mg of morphine/midazolam. If the ICP falls, increase the background infusion rate.
Bolus of muscle relaxant = Vecuronium 10mg. If the ICP falls, increase the background infusion rate. Do not use relaxant infusions.**

These steps may be repeated until there is no response ie. sedation is optimised.

Don't give repeated boluses of sedation or relaxant if there is no response.

Ensure normothermia. If temperature > 37.5°C commence cooling with extensive ice packing. Remove ice packs when temperature < 36.5°C. The aim is to maintain the temperature around 37°C rather than induce hypothermia.

ICE in TBI

Osmotherapy:

Mannitol: If Na^+ < 155 mmol/l and CVP > 12 mmHg, give 100mls of mannitol. Do not give more than one dose in ICU.

HTS: If Na^+ < 155 mmol/l and CVP < 12 mmHg, give 30ml of 23.4% saline via central line over 10mins (this is a push dose - it must not be diluted, as this will make it less effective)

Expect a decrease in ICP within 20-30 minutes. HTS can be repeated every hour as long as Na^+ < 155 mmol/l. The Na^+ from the blood gas machine can be used to track the changes in Na^+ rather than doing multiple formal UECs. Do not use repeated doses of mannitol. There is no need to measure osmolality in the absence of repeated doses of mannitol.

Repeat CT scan to exclude a surgically remediable lesion and generally follow the evolution of the injury.
Discuss the result of the CT with the neurosurgical team.

If the ICP is not controlled with the above measures inform the duty intensivist.

If intracranial hypertension persists beyond this point, the patient may be eligible for the

DECRA study – consult the duty intensivist re patient suitability if this has not already been determined.

OPTIONS:- IF THE ABOVE MEASURES FAIL TO CONTROL ICP, THE DUTY INTENSIVIST WILL DECIDE WHICH OF THESE OPTIONS WILL BE UTILISED.

Consider ventricular drainage or decompressive craniectomy in consultation with the neurosurgeon.
Consider adding propofol 50-200 mg/hr to the sedation regime. Cease if there is not a favourable response.
Consider lowering the temperature target to 36.5°C. Start ice packing when T > 37°C and remove when T < 36°C.

Consider thiopentone. Give a bolus of 3 mg/kg. Repeat as required if there is a favourable response. If there is a response to several boluses, which is not sustained, consider a low dose thiopentone infusion of 100mg/hr. **Beware of hypotension.**

Higher dose thiopentone infusions are generally discouraged and must not be used unless directed by the intensivist. Antibiotics are not required as a matter of routine.

When ICP Controlled

ICP can be considered controlled when **ICP < 20 mmHg for 24-36 hours**. In this case cease all above measures to control ICP and reduce sedation. **Tolerate modest rises in ICP (up to 25-30mmHg)** if CPP is maintained spontaneously. If ICP rises unacceptably, resedate and reinstitute measures to lower ICP as above.

Consider removing the ICP monitor when the ICP is controlled and neurological assessment is possible (sedation has worn off). Don't remove the monitor without discussion with the neurosurgeons. If a monitor is required for longer than seven days, consider a replacement due to the risk of baseline drift and infection.

PAEDIATRICS

CPP TARGETS

Age	MAP pre ICP	CPP
<11 year	60 mmHg	40 mmHg
>11years	80 mmHg	60 mmHg

*** Recommendations from *Pediatr Crit Care Med* 2003 Vol 4 , No 3 (suppl)**

FLUIDS:

Great care needs to be taken to avoid hyponatraemia. Saline or Hartmann's is usually appropriate in the first instance with subsequent fluids guided by regular electrolyte measurement. BSL should be carefully monitored to avoid Hypoglycaemia

SEDATION: Standard dilution per weight as per Paediatric dosing calculator. 7-14mls/ hr (or more concentrated equivalent to reduce total volume).

HTS: Dose: 0.5 ml/kg of 23.4% saline.

PROPOFOL: Not to be used in children <12 years.

RETRIEVAL OF THE HEAD INJURED PATIENT:

Initial resuscitation at the referring hospital should be as per ED management outlined above.

Priorities should be:

1) Resuscitation of ABC as per EMST

2) Basic physiological aims from head injury perspective

MAP > 90 mmHg or SBP > 120 mmHg

ETCO₂ 30-35 mmHg, pCO₂ 35-40 mmHg

SpO₂ > 97%, pO₂ > 100 mmHg

3) Urgent retrieval for CT or evacuation of a known mass lesion – don't delay definitive treatment by putting in central and arterial lines etc.

4) Discuss complex cases with the intensivist

Good planning may enable the patient to go directly from the helicopter into the CT scanner or operating theatre.

All trauma retrievals should result in trauma team activation immediately on arrival at JHH.

Created: 9/2005 by Reviewed: 12/2006 by Dr McFadyen and Staff Specialist Forum
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Disclaimer: These guidelines are intended for and to be used only by experienced critical care staff under direct supervision of Hunter Health Area Intensive Care Specialists in designated Hunter Health Area Critical Care Areas. The Authors will not be responsible for inappropriate use of these guidelines.