TRAUMATIC BRAIN INJURY (TBI)

The Prehospital Care Library
La Bibliothèque de Soins Préhospitaliers

Traumatic brain injury is structural or physiological brain damage resulting from external force. Outcome is determined less by the primary impact and more by secondary injury in the ED.

ED priorities:

- Maintain cerebral perfusion
- Prevent hypoxia and hypotension
- Control rising intracranial pressure
- Avoid iatrogenic harm

Every episode of hypoxia or hypotension doubles mortality.

PRIMARY GOAL

Prevent secondary brain injury, caused by:

- Hypotension
- Hypoxia
- Hypercapnia or hypocapnia
- Hypoglycaemia
- Fever
- Raised intracranial pressure (ICP)

The injured brain has no reserve — small physiological insults cause disproportionate damage.

EARLY ED PRIORITIES (ORDER MATTERS)

1. Airway protection
2. Oxygenation
3. Cerebral perfusion
4. Neurological monitoring
5. Early neurosurgical involvement

Delays and "wait and see" management worsen outcome.

ASSESSMENT

A NEUROLOGICAL STATUS

- GCS (baseline, then serial)
- Pupils:
  - Size • Symmetry • Reactivity
- Focal neurological deficits (if assessable)

A falling GCS or new pupil asymmetry = **impending herniation until proven otherwise.**

B SYSTEMIC ASSESSMENT

- Look actively for:
  - Hypotension from bleeding
  - Hypoxia (chest injury, aspiration)
  - Associated C spine or polytrauma

Do **not** anchor on the head injury, systemic causes kill the brain.

PHYSIOLOGY THAT DRIVES MANAGEMENT

CEREBRAL PERFUSION PRESSURE (CPP)

CPP = MAP − ICP

In TBI:

- ICP tends to rise
- CPP falls rapidly if BP drops

Therefore: Blood pressure support is a brain saving intervention

HEMODYNAMIC & GAS EXCHANGE TARGETS

MINIMUM ED TARGETS

- SBP ≥100 mmHg (age 50–69)
- SBP ≥110 mmHg (age 15–49 or >70)
- SpO_2 ≥94%
- $PaCO_2$: normocapnia (if ventilated)
- Glucose: normoglycaemia

Permissive hypotension is absolutely contraindicated in TBI.

IMAGING STRATEGY

CEREBRAL PERFUSION PRESSURE (CPP)

- CT head urgently once stabilised
- CT should not delay airway control or blood pressure correction
- Normal CT does not equal benign clinical course

If CT not available, treat physiologically and clinically as TBI until proven otherwise, there is little to no place for X Ray or US in TBI management (Apart from X Ray if C Spine fracture is suspected)

ACUTE MANAGEMENT MEASURES

POSITIONING

- Head elevated 30°
- Neck midline, no collar obstruction to venous drainage
- Avoid tight ties / excessive PEEP

AIRWAY & VENTILATION

- Intubate early if:
  - GCS ≤8 • Loss of airway reflexes
  - Hypoventilation or hypoxia
- Avoid hypotension during induction
- **Normocapnia** is the goal

HYPEROSMOLAR THERAPY (RESCUE ONLY)

Indications:

- Clinical signs of raised ICP or herniation:
  - Falling GCS • Unilateral dilated pupil • Posturing

Options:

- Mannitol
- Hypertonic saline

These are bridging therapies, not definitive treatment.

SEIZURE CONTROL

- Treat clinical seizures immediately
- Low threshold for treatment in severe TBI
- Ongoing seizure activity worsens secondary injury

WHAT TO AVOID (COMMON, LETHAL ERRORS)

- Hypotension (even brief)
- Hypoxia
- Routine hyperventilation
- Excess fluids causing cerebral oedema
- Delayed neurosurgical discussion
- Masking neuro exam with unnecessary sedation

DEFINITIVE CARE

- TBI is a neurosurgical disease
- Early referral improves outcomes
- ED care determines survivability, not just disability

CHECKLIST
TRAUMATIC BRAIN INJURY

IMMEDIATE STABILISATION (ABCDE)

Airway

- [ ] Assess airway reflexes
- [ ] Intubate early if GCS ≤8 or deteriorating
- [ ] Avoid hypotension during induction

Breathing

- [ ] Oxygen to maintain SpO_2 ≥94%
- [ ] Monitor RR, chest injuries, aspiration risk

Circulation

- [ ] 2 IV lines
- [ ] Continuous BP monitoring
- [ ] SBP ≥100–110 mmHg
- [ ] Treat hypotension aggressively

Disability

- [ ] GCS (document clearly)
- [ ] Pupils (size/reactivity)
- [ ] Note focal deficits

Exposure

- [ ] Full trauma exam
- [ ] Prevent hypothermia

NEUROPROTECTIVE MEASURES

- [ ] Head elevated 30°
- [ ] Neck midline, avoid venous obstruction
- [ ] Normoglycaemia
- [ ] Treat pain and agitation cautiously

IMAGING

- [ ] CT head urgently when stable
- [ ] CT C spine if indicated
- [ ] Do not delay stabilisation for imaging

If no CT available, X Ray C Spine only.

HEMODYNAMIC TARGETS

- [ ] SBP ≥100–110 mmHg
- [ ] MAP adequate for perfusion
- [ ] SpO_2 ≥94%
- [ ] Avoid hypotension at all times

HYPEROSMOLAR THERAPY (IF INDICATED)

- [ ] Signs of raised ICP present
- [ ] Mannitol OR hypertonic saline given
- [ ] Used as bridge to definitive care

SEIZURE MANAGEMENT

- [ ] Treat active seizures immediately
- [ ] Monitor for subtle seizure activity
- [ ] Avoid hypoxia during treatment

WHAT TO AVOID

- [ ] Permissive hypotension
- [ ] Hypoxia
- [ ] Routine hyperventilation
- [ ] Excess sedation masking exam
- [ ] Delayed referral

DISPOSITION

- [ ] Early neurosurgical referral
- [ ] ICU admission for moderate–severe TBI
- [ ] Clear handover:
  - GCS trend
  - Pupillary changes
  - Hemodynamics
  - Interventions given
  - Imaging findings