Head Injury

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Emergency Care Institute NSW
Head injury in the emergency department

A common presentation

• 80%  Mild Head Injury  = GCS 14 – 15

• 10%  Moderate Head Injury = GCS 9 – 13

• 10%  Severe Head Injury  GCS = 3 – 8
Aetiology

Traumatic Injuries
Major Causes of Traumatic Brain Injuries

- Falls 28%
- Struck by... (incl. Sports) 19%
- Motor Vehicle Accident 20%
- Assault 11%
- Other 21%
- Suicide 1%

Source: National Center for Injury Prevention and Control, CDC
The following groups of patients are at particular risk:

• The elderly (risk of falls, cerebral atrophy)
• Infants (large head size, compressible skull, risk of non-accidental injury)
• Patients with a bleeding diathesis (e.g. on warfarin)
• Chronic alcoholics (at risk of falls and assaults, cerebral atrophy, coagulopathy due to chronic liver disease)
Some sobering facts

• Traumatic brain injury (TBI) is still the major cause of death under 45 years of age.
  Chirurg. 2009 Feb;80(2):153-64 [Diagnosis and treatment of traumatic brain injury.]

• Patients > or =65 years who survived mild TBI have decreased functional outcome at 6 months compared with younger patients

• Female sex (particularly those age > or =55 y) is associated independently with higher mortality in isolated severe TBI
ADULT TRAUMA CLINICAL PRACTICE GUIDELINES

Initial Management of Closed Head Injury in Adults

2nd Edition

NSW GOVERNMENT Health
## Risk factors indicating potentially significant mild head injury

<table>
<thead>
<tr>
<th>Risk Factor</th>
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<tbody>
<tr>
<td>GCS 15 at 2 hours post injury</td>
</tr>
<tr>
<td>Deterioration in GCS</td>
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<tr>
<td>Focal neurological deficit</td>
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<tr>
<td>Clinical suspicion of skull fracture</td>
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<tr>
<td>Vomiting (especially if recurrent)</td>
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<tr>
<td>Known coagulopathy/bleeding disorder</td>
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<tr>
<td>Age &gt;65 years</td>
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<tr>
<td>Post traumatic seizure</td>
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<tr>
<td>Prolonged loss of consciousness (&gt;5 min.)</td>
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<tr>
<td>Persistent post traumatic amnesia (AVPAS &lt;18/18')</td>
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<tr>
<td>Persistent abnormal alertness/behaviour/cognition</td>
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<tr>
<td>Persistent severe headache*</td>
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<tr>
<td>Large scalp haematoma or laceration **</td>
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<tr>
<td>Multi-system trauma**</td>
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<td>Dangerous mechanism**</td>
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<tr>
<td>Known neurological/neurological deficit **</td>
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<td>Delayed presentation or representation **</td>
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</table>

*particularly if prior to 4 hours post injury  **not definitive* clinical judgment required

## What should be done when patients with closed head injury acutely deteriorate?

**Early signs of deterioration**
- Coma
- Agitation
- Drowsiness
- Vomiting
- Severe headache

**Late signs of deterioration**
- Decrease in GCS by two or more points
- Dilated pupils
- Focal neurological deficit
- Seizure
- Cushing's response—bradycardia and hypertension

**Clinical approach**
- Reassess ABCDEs and exclude non head injury cause
- Supportive care of ABCDEs
- Early intubation if indicated
- Immediate CT scan
- If clinical or CT evidence of raised ICP, haemorrhage consult with network neurological and retrieval services re:
  - Short term hyperoxygenation to PaCO₂: 30-35
  - Bolus of mannitol (1g/kg)
  - Local burn field/contactorcy when more than 2 hours from neurological care
  - Prophylactic anti-convulsants

## When should patients with closed head injury be transferred to hospitals with neurological facilities?

**Potential indications**
- Patient with severe head injury
- Patient with moderate head injury if:
  - Clinical deterioration
  - Abnormal CT scan
  - Normal CT scan but not clinically improving
  - CT scan unavailable.
- Patient with mild head injury if:
  - Clinical deterioration
  - Abnormal CT scan
  - Normal CT scan but not clinically improving within 4-6 hours post injury
  - Mild head injury with CT scan unavailable, particularly if:
    - Persistent GCS <15
    - Deterioration in GCS
    - Focal neurological deficit
    - Clinical suspicion of skull fracture
    - Persistent abnormal mental status

**Clinical approach**
- When in doubt consult your network neurological service.
- Patients with closed head injuries should be observed in facilities that can manage any complications that are likely to arise. Clinical judgment regarding risk of deterioration is required and neurological consultation may be appropriate.
- Patients with closed head injuries should be transferred to the nearest appropriate hospital with neurological facilities if there is significant risk of intracranial injury. The transfer of patients to hospitals with CT scan facilities but without neurological services should be avoided.
Remember the C spine

- Small but significant incidence of concomitant C spine injury
- Not related to severity of head trauma
Anatomy and Physiology

What are the unique features of brain anatomy and physiology, and how do they affect patterns of brain injury?
Anatomy and Physiology

Effects

- Rigid, non-expansile skull filled with brain, CSF, and blood
- Cerebral blood flow (CBF) usually autoregulated
- Autoregulatory compensation disrupted by brain injury
- Mass effect of intracranial haemorrhage
Secondary Brain Injury

Once the primary brain injury has been recognized, the main objective of the management of acute traumatic brain injury is the prevention of secondary brain injury.

Secondary injury is potentially preventable and reversible, and occurs after the time injury. It is a cascade of physiological and biochemical events that occur after primary injury and worsen outcome. Mechanisms of injury include oedema, hypoxia, hypotension, and metabolic disturbance.
Associated With Worse Outcome

- Hypocapnia
- Hypotension
- Acidosis
- Hypoxia
- Hyperglycaemia
- Hypothermia
Classification of head injuries

By mechanism of injury
- blunt and penetrating
- Blunt trauma can be of high or low velocity (eg, motor vehicle crashes, falls, and blunt assault.)

By morphology
Diffuse injuries
These range from simple concussion with an excellent prognosis to diffuse axonal injury with associated grim prognosis

Focal injuries
- Basal skull fractures have an associated risk of CSF leak.
- Clinical symptoms (eg, raccoon eyes, Battle’s sign, otorrhea, and rhinorrhea) should increase the index of suspicion in identifying basal skull fractures.
- Extradural
- Subdural
- Intracerebral

By clinical impact: GCS level
Extradural haemorrhage (aka epidural hemorrhage)

Uncommon.

— Lenticular shaped opacity on CT
— Most commonly (80%) due to tearing of middle meningeal artery due to a temporal fracture
— Classically (i.e. <50%) have lucid period after injury before subsequently deteriorating (“talk and die”).
Extradural Haematoma
Subdural haemorrhage

More common

— especially in the presence of cerebral atrophy (e.g. elderly and alcoholics)
— Concave shaped on CT
— Due to tearing of veins draining cerebral cortex.
— May present as acute or chronic
Subdural haematoma
Intracerebral hemorrhage

— Ranging from contusions to haematoma.

— Can evolve over time.
Intracerebral Haematoma / Contusion

Large Frontal Contusion with Shift
Diagnosis
SAH around basal cisterns
Diffuse Brain Injury

Normal CT  Diffuse Injury
21 yr male intoxicated fall and hit neck on table vertigo and l arm numbness
CT angio C7 level
CT angio
L vert artery dissection

Occluded at origin
Filling defect C2-3 to C5
GCS

GCS is used both for the initial assessment and classification of closed head injuries and for serial assessment of closed head injuries.

Initial GCS on admission to hospital is used to classify head injuries into the broad prognostic groups of mild (GCS 14-15), moderate (GCS 9-13) and severe (GCS 3-8).

There is good quality evidence to relate initial GCS score to outcome.
Head injury classification

- 80% Mild Head Injury = GCS 14 – 15
- 10% Moderate Head Injury = GCS 9 – 13
- 10% Severe Head Injury GCS = 3 – 8
Minor Head Injury - Assessment

- Do the ABCDE’s initially
- Initial period of clinical observation: at least 4 hours
- Assess for risk factors
- CT-scan if GCS <15 at 2 hrs. post injury or any other RF detected
- (Consider) Admission in present of any RF
- In case of doubt or deterioration consult neurosurgical service regarding further management and disposition
- D/C with head injury device at 4 hrs post injury if clinical improving with either normal CT-scan or no RF’s
Risk Factors

- Persistent GCS <15 at 2 hrs. post injury
- Prolonged loss of consciousness (>5 mins)
- Prolonged anterograde or retrograde amnesia (>30 mins)
- Post traumatic seizure
- Focal neurological deficit
- Clinical suspicion of skull Fx
- Repeated vomiting (>2 occasions)
- Persistent severe headache
- Age > 65 years
- Known coagulopathy
- Deterioration in GCS
- Multi system trauma
- Dangerous mechanism
- Intoxication
- Known neurological/neurosurgical impairment
- Delayed presentation
- Failure of clinical improvement
Minor Head Injury

GCS 14 -15

High Risk
= any RF present

Low Risk
= no RF, normal CT-scan
Indications for CT-scan

• Mild head injury with at least 1 risk factor present

• Any moderate head injury

• Any severe head injury
## CT scan?

<table>
<thead>
<tr>
<th>These patients <strong>should not routinely have CT scanning</strong> if they have <strong>all</strong> of the following features:</th>
<th>These patients <strong>should have early CT scanning</strong> if available, if they have <strong>any</strong> of the following features:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On initial assessment:</strong></td>
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<tr>
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<td>• Age &lt;65 years</td>
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<tr>
<td>• No post traumatic seizure</td>
<td>• Witnessed seizure</td>
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<tr>
<td>• Nil or brief loss of consciousness (&lt;5min)</td>
<td>• Prolonged loss of consciousness (&gt;5min)</td>
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<td>• Nil or brief post traumatic amnesia (&lt;30min)</td>
<td>• Prolonged post traumatic amnesia (&gt;30min)</td>
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<td><strong>On serial assessment:</strong></td>
</tr>
<tr>
<td>• No large scalp haematoma</td>
<td>• Decrease in GCS</td>
</tr>
<tr>
<td>• Isolated head injury</td>
<td>• Persistent GCS &lt;15 at two hours post injury</td>
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<tr>
<td>• No dangerous mechanism</td>
<td>• Persistent abnormal alertness/behaviour/cognition</td>
</tr>
<tr>
<td>• No known neurosurgery / neurological impairment</td>
<td>• Persistent post traumatic amnesia (A-WPTAS &lt;18/18)</td>
</tr>
<tr>
<td>• No delayed presentation or representation.</td>
<td>• Persistent vomiting (≥2 occasions)</td>
</tr>
<tr>
<td><strong>After a period of observation (until at least four hours post time of injury):</strong></td>
<td>• Persistent severe headache</td>
</tr>
<tr>
<td>• GCS 15/15</td>
<td>• Post traumatic seizure</td>
</tr>
<tr>
<td>• No post traumatic amnesia (A-WPTAS 18/18)</td>
<td><strong>Clinical judgement required if:</strong></td>
</tr>
<tr>
<td>• Normal mental status including alertness, behaviour and cognition.</td>
<td>• Initial GCS 14 within two hours of injury**</td>
</tr>
<tr>
<td>• No clinical deterioration during observation.</td>
<td>• Large scalp haematoma or laceration</td>
</tr>
<tr>
<td>• Clinically returning to normal</td>
<td>• Associated multi-system injuries</td>
</tr>
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<td><strong>NOTE</strong>: Includes patients with abnormal GCS due to drug or alcohol ingestion.</td>
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</table>
Minor Head Injury - Discharge

- **Clinical criteria**
  - Normal alertness/behaviour/cognition
  - Normal CT-scan or no indication for CT-scan
  - Clinical improving after observation

- **Social criteria**
  - Responsible person available to take home and observe
  - Patient able to return easily in case of deterioration
  - Discharge advice is understood

Written Discharge Advice
Guide to use of the Abbreviated Westmead Post Traumatic Amnesia Scale (A-WPTAS)

As an aid to clinical care, the A-WPTAS is to be used within 24hrs of injury and at a GCS 13-15. Patients must have an eye opening score of 4 (spontaneous) and a valid motor response of 1 (moving command) to be suitable for A-WPTAS. If not, use the standard Adult Emergency Department Observation Chart or the Adult Neurological Observation Chart.

**Glasgow Coma Scale**

Eyes open: Speak in a clear, strong voice. Must open eyes spontaneously (without encouragement) to be suitable for use of the A-WPTAS.

Verbal response (orientation questions): A thorough examination is the core of the A-WPTAS. Must answer all questions formed to be classified as oriented [8]. Obtain the patient’s attention and ask the following questions:

- **Question 1**: What is your name?
- **Question 2**: What is the name of the place?
- **Question 3**: What is the name of this place?
- **Question 4**: Where is the pain?
- **Question 5**: Why are you here?
- **Question 6**: What are you doing here?
- **Question 7**: What is the time?

**Best Motor Response**: Give simple command e.g. “wriggle your fingers.” Must be able to obey commands (b) to be suitable for use of the A-WPTAS.

**Picture recognition**

First assessment: Show the patient the target set of 5 pictures (page 1) for about 10 seconds and ensure that they can repeat the names of each picture (top, left to right). Tell the patient to name a picture for re-testing in 1 hour.

Subsequent assessments: Ask the patient: “What were the three pictures that I showed you earlier?”

**Picture recognition scoring**:

- For patients who pass recall at 3 pictures correctly, assign a score of 3.
- For patients who pass recall at 2 pictures correctly, assign a score of 2.
- For patients who pass recall at 1 picture correctly, assign a score of 1.
- For patients who fail recall, assign a score of 0.

**Total A-WPTAS scoring**

Add the total GCS score (A) with the total picture recognition score (B) to give the total A-WPTAS score out of 18.

**Admission and Discharge Criteria**

**Discharge**

A patient is considered to be out of PTA when they score 18/18 and can be considered for discharge. Both the GCS and A-WPTAS should be used in conjunction with clinical judgement.

- Once considered for discharge, refer the patient to GP if the patient scored 18/18 at any time.
- Provide discharge advice.

**Mild Head Injury Discharge Letter and Fact Sheet**

- **Yes**
- **No**

**Admission**

- Patients with persistent score ≤18/18 at 4 hours post injury should be considered for admission. Clinical judgement and consideration of pre-existing conditions should be used where the picture recall component of A-WPTAS is abnormal but the GCS is normal (15/15).
- If admitted, repeat the A-WPTAS assessment at 24h. If continues to have A-WPTAS score ≤18/18, consult the local brain injury rehabilitation service and consider use of the full (3-day) Westmead PTA Scale assessment.
ABBR EVATED WESTMEAD POST
TRAUMATIC AMNESIA SCALE (AMPTA)
INCORPORATING THE GLASGOW COMA SCALE
AND PICTURE RECOGNITION

TO BE USED WITHIN 24HRS OF INJURY AND BE GCS 13-15
OTHER CHARTS IN USE
Observation charts: Other

Clinical Review Criteria (In addition to Clinical Review Criteria in the SAGO chart)
- If there is a drop of 1 point in the GCS or the patient is no longer obeying commands
- Any new onset of limb weakness (a decrease of 1 point on the limb strength scale)
- Any new cranial nerve deficit
- Any persistent abnormal alacrity, behaviour, cognition, vomiting or severe headache at 4 hours post injury

If a patient has any one (1) or more clinical review criteria present, you must consult promptly with the nurse in charge and assess whether a clinical review is needed (refer to your local CERS protocol)

Rapid Response Criteria (In addition to Clinical Review Criteria in the SAGO chart)
- GCS drops by 2 points or more
- SCS still
- Changes in pupil size in association with pupil dilation / loss of light reaction
- Seizure activity

If a patient has any one (1) or more rapid response criteria present, call for a rapid response (refer to your local CERS protocol)

Documentation:
1. Write treatment, escalation process and outcome in the clinical record
2. Write data, signature and designation with each entry

Comments:

Target set of pictures:
- Clock
- Fork
- Scissors
- Teacup
- Toothbrush
- Sunflower
- Keys
- Dove

BARCODE
**Standard management of head injuries**

- Assess and stabilise ABCDEs
- Commence at least hourly clinical observations of vital signs, GCS, pupils, PTA and clinical symptoms.
- The initial assessment should be followed by a period clinical observation to detect risk factors for significant intracranial injury. The patient should be risk stratified into “low” or “high” risk groups based on the presence or absence of identified clinical risk factors.
- CT scan not routinely indicated unless one or more high risk factors are present.
- Discharge for home observation with head injury advice sheet at 4 hours post injury if clinically improving with either no risk factors indicating need for CT scan or normal CT scan if performed.
- Consider hospital admission and consult regional neurosurgical service if abnormal CT scan.
- Consider hospital admission for observation if clinically not improving at 4 hours post injury irrespective of CT scan result.
- Consider hospital admission for observation if elderly, known coagulopathy or socially isolated.
- Advise patients to see their local doctor if they do not return to normal within 48 hours so they can be reassessed and monitored for post concussion symptoms.
Moderate/ Severe Head Injury Management

• Do the ABCDE’s

• Depends on assessment and varies depending on findings, however all require
  – Neurosurgical consultation
Standard care for severe HI

- Initial systematic assessment and resuscitation of ABCDEs.
- Early intubation.
- Supportive care of ABCDEs with appropriate attention to positioning (30° head up), basic nursing care and avoidance of hyperventilation.
- Prevention of secondary brain injury by avoiding hypoxaemia (O₂ saturation <90%) and hypotension (systolic BP<90).
- Early CT scan to identify acute neurosurgical lesions.
- Early neurosurgical consult
- Early retrieval consult if transfer required
- Consider use of anticonvulsants to prevent early post traumatic seizures
- Consider ICP monitoring to guide management of cerebral perfusion pressure.
- Low threshold to repeat CT scan if patient condition changes
- ICU admission
- Routine repeat CT scan at 24 hours
- Brain injury rehabilitation consult

**Minimum supportive care aims:**
PaO₂ > 60, SaO₂ > 90, PaCO₂ 35 – 40, Systolic BP > 90, Head up 30°
When to transfer

Agitation
Drowsiness
Vomiting
Severe headache
Late signs of deterioration
  – Decrease in GCS by two or more points
  – Dilated pupil(s)
  – Focal neurological deficit
  – Seizure
  – Cushing’s response – bradycardia and hypertension
Discharge Criteria

Clinical criteria:

- GCS 15/15
- No persistent post traumatic amnesia (nb. A-WPTAS 18/18)
- Alertness / behaviour / cognition returning to normal
- Clinically improving after observation.
- Normal CT scan or no indication for CT scan.
- Clinical judgment required regarding discharge and follow up of elderly patients or patients with known coagulopathy or bleeding disorder due to increased risk of delayed subdural haematoma.

- Any patients who have minor CT abnormalities, who suffered significant clinical symptoms or who had prolonged post traumatic amnesia should be routinely referred to their GP for follow up of post concussion symptoms.
Summary

• Assess
  – Trauma approach
  – ? High or low risk: assess GCS and RF
• Manage
  – Avoid secondary brain injury
• High or low risk?
• Monitor, at least hourly obs
• Analgesia
• Seek assistance, early consultation, retrieval or transfer