

1 Diagnosis/Assessment of Concussion/mTBI

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Diagnosis of concussion/mTBI (see Definition) is the first critical step in successful management leading to improved outcomes and prevention of further injury. Patients commonly present to the Emergency Department (ED) or their primary care provider's (PCP's) office following trauma and may be unaware that they have sustained concussion/mTBI. A high level of suspicion is required particularly when there is evidence of direct trauma to the head or mechanism of injury¹ that is frequently associated with mTBI, such as motor vehicle collision, falls, assaults and nonintentional strike by/against an object, including sport and recreational injury.² Patients may present in a post-traumatic amnesic (PTA) state, where they may have a Glasgow Coma Scale (GCS) score of 15/15; however, they may be variably oriented and not able to form continuous memories.

The purpose of the initial medical assessment is to establish the diagnosis of concussion/mTBI by ruling out more severe forms of TBI, cervical spine injuries and medical and neurological conditions that can present with concussion-like symptoms.³ The need for neuroimaging should also be determined using the Canadian CT Head Rule (Figure 1.1).^{4,5} Despite the current research on advanced neuroimaging studies (such as DTI and fMRI),⁶ CT scans represent the most appropriate and widely available diagnostic imaging test to rule out acute intracranial hemorrhage. Patients who did present symptoms compatible with a concussion/mTBI following a head injury may also be completely asymptomatic by the time they are medically assessed. Once the medical assessment has excluded more severe forms of TBI, these patients should be presumed to have sustained a concussion/mTBI and be managed accordingly.

The severity of a person's symptoms in the initial few days after a TBI is the strongest and most consistent predictor of slower recovery, and demonstrates clinical utility in tracking recovery.⁷ Therefore, symptoms should be formally documented at the time of the initial assessment for the purpose of subsequent comparative analysis in the event of persistent symptoms. Blood-based biomarkers⁸ are still considered investigational and therefore are not recommended for use in diagnosing/assessing patients in the ED or PCP's office.

When establishing the diagnosis of concussion/mTBI, PCPs should also prepare patients and their support person for possible delayed complications by providing both verbal and written information. Namely, given that the majority of patients will be symptomatic acutely post-concussion/mTBI, education about anticipated symptoms and duration may assist patients in anticipating and understanding their recovery.⁹ For instance, patients are likely to initially experience reduced cognitive functioning post-injury, which typically resolves in a few days but in some instances may persist for weeks to months.¹⁰ Provision of information regarding mTBI symptoms and expectations for recovery, as well as instructions for follow-up, have been shown to be one of the more effective strategies in preventing the development of persistent symptoms post-concussion/mTBI. Follow-up by a PCP should be arranged for all patients with a diagnosed concussion/mTBI especially for those with risk factors outlined in [Table 1.1](#). The PCP, or ED physician, if necessary, can monitor progress and ensure that patient symptoms are resolving along expected timelines and make timely arrangements for specialty referral when indicated. In both the initial assessment and the follow-up period, the ED physician or PCP should also attempt to explore and document risk factors (see [Table 1.1](#)) that may potentially

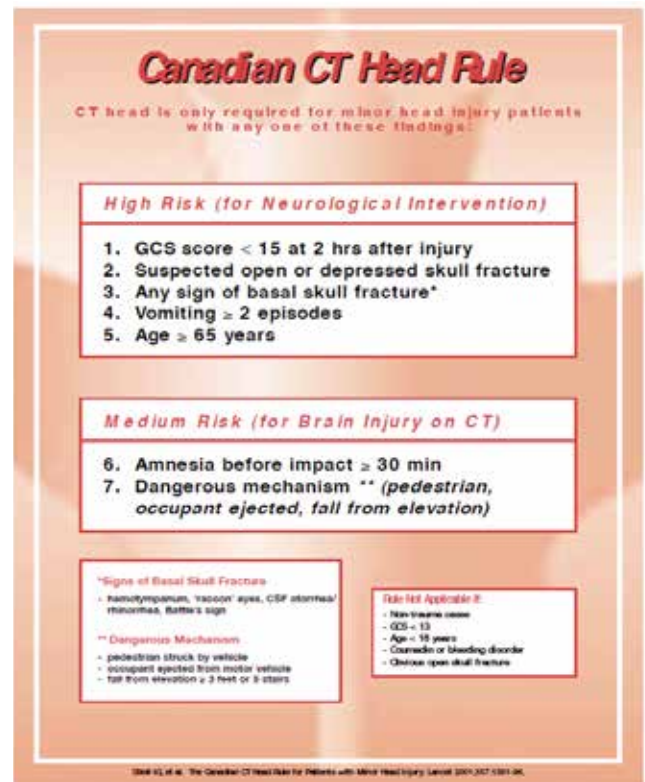


Figure 1.1 Canadian CT Head Rule
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delay recovery following concussion/mTBI, and consider closer monitoring of recovery or an acceleration of intervention strategies if needed. See [Algorithm 1.1](#), which outlines the key steps for diagnosis/assessment and initial management.

Table 1.1. Risk Factors Influencing Recovery Post mTBI

<p>Medical Factors: Pre-existing/ concurrent medical conditions or post- injury symptoms that are associated with poor outcomes post mTBI</p>	<ul style="list-style-type: none"> • History of previous traumatic brain injury • History of previous physical limitations • History of previous neurological or psychiatric problems • Skull fracture • Early onset of pain and in particular headache within 24 hours after injury • Confounding effects of other health-related issues, e.g., pain medications, disabling effects of associated injuries, emotional distress • Anxiety • High number of symptoms reported early after injury i.e., high score on the Rivermead or Post Concussion Symptom Questionnaire <ul style="list-style-type: none"> - Vestibular/vestibular-ocular abnormalities - Pre-injury sleep disturbance or post-injury changes - Reduced balance or dizziness - Nausea after injury - Memory problems after injury - Post-traumatic amnesia (PTA)
<p>Contextual Factors: Personal, psychosocial, or environmental factors that may negatively influence recovery post mTBI</p>	<ul style="list-style-type: none"> • Injury sustained in a motor vehicle accident • Potential influence of secondary gain issues related to litigation and compensation • Not returning to work or significant delays in returning to work following the injury • Being a student • Presence of life stressors at the time of the injury • Higher levels of symptom reporting is associated with mood symptoms and heightened self-awareness of deficits • Older age • Lack of social supports • Lower education/low social economic status • Female gender • Lower Resilience • Returning to a contact/ risk of contact sport activity

Adapted from the Motor Accidents Authority of NSW, *Guidelines for Mild Traumatic Brain Injury following a Closed Head Injury* (MAA NSW, 2008)

Table 1.2. Key Features of mTBI Assessment in an Emergency Department or Doctor's Office

<p>(a) A medical history encompassing a review of:</p> <ul style="list-style-type: none"> • Current symptoms and health concerns • Setting and mechanism of injury • Severity/duration of altered consciousness and immediate symptoms • Presence of co-occurring injuries • Pre-existing medical and mental health conditions • Potentially contributing psychosocial factors
<p>(b) An examination including an assessment of:</p> <ul style="list-style-type: none"> • Mental status and cognition • Physical status • Cranial nerves • Extremity tone, strength, and reflexes • Gait and balance
<p>(c) An assessment of the patient's clinical status, including whether there has been improvement or deterioration since the time of injury. This may require additional information from others, including eyewitnesses to the injury.</p>
<p>(d) Determination of the need for urgent neuroimaging to exclude a more severe brain injury (see Figure 1.1), such as a structural abnormality or hemorrhage.</p>

Adapted from the NSW Ministry of Health. *Closed Head Injury in Adults - Initial Management* (PD2012_013).

RECOMMENDATIONS FOR DIAGNOSIS/ASSESSMENT OF mTBI		GRADE
1.1	Concussion/mTBI should be recognized and diagnosed as soon as possible to improve positive health outcomes for patients. Concussion can be recognized in the community by a non-medical professional, whereas diagnosis should be made by a physician/nurse practitioner. ^a	A
1.2	On presentation, the primary care provider should conduct a comprehensive review of every patient who has sustained concussion/mTBI (see Appendix 1.1). The assessment should include taking a history, examination and cognitive screen for post-concussive symptoms, and review of mental health (see Table 1.2). ^a	A
1.3	The need for early neuroimaging should be determined according to the <i>Canadian CT Head Rule</i> (see Figure 1.1). For patients who fulfill these criteria, CT scanning is the most appropriate investigation for the exclusion of neurosurgically significant lesions, such as hemorrhage. Plain skull x-rays are not recommended. ^b	A
1.4	The presence of post-traumatic amnesia should be specifically assessed for during the acute assessment and its impact on the patient's capacity should be considered when planning management (see Appendix 1.2). ^a	A
1.5	<p>Patients presenting to hospital/ clinic acutely with concussion/mTBI can be safely discharged for home observation after an initial period of in-hospital observation if they meet the following clinical criteria:</p> <ul style="list-style-type: none"> • Normal mental status (alertness/behaviour/cognition) with clinically improving post-concussive symptoms after observation until at least four hours post-injury. • No clinical risk factors indicating the need for CT scanning or normal CT scan result if performed due to presence of risk factors. • No clinical indicators for prolonged hospital observation such as: <ul style="list-style-type: none"> • clinical deterioration • persistent abnormal <i>Glasgow Coma Scale</i> (GCS) or focal neurological deficit • persistent abnormal mental status • vomiting/ severe headache • presence of known coagulopathy • persistent drug or alcohol intoxication • presence of multi-system injuries • presence of concurrent medical problems • age >65^b 	A
1.6	<p>Patients with concussion/mTBI can be safely discharged for home observation after an initial period of observation if they meet the following discharge advice criteria provided in written and oral form:</p> <ul style="list-style-type: none"> • Discharge summary prepared by/for primary care provider. • Written and verbal brain injury advice (see Appendices 1.3 and 1.4) given to patient (and support person) covering: <ul style="list-style-type: none"> • Symptoms and signs of acute deterioration and when to seek urgent follow-up (e.g., worsening or new symptoms). • Lifestyle advice to assist recovery. • Typical post-concussive symptoms and reassurance about anticipated recovery.^b 	C

a. Adapted from the *Motor Accidents Authority NSW, Guidelines for Mild Traumatic Brain Injury following a Closed Head Injury (MAA, NSW, 2008)*.

b. Adapted from the *NSW Ministry of Health. Closed Head Injury in Adults - Initial Management (PD2012_013)*

1.7	If the patient re-attends an emergency department/urgent care service with symptoms related to the initial injury, the following should be conducted: <ul style="list-style-type: none"> • Full re-evaluation, including an assessment for ongoing post-traumatic amnesia (PTA) and/or clinical deterioration. • CT scan, if indicated • Emphasis and encouragement to the patients to attend their primary care provider (PCP) for follow-up after discharge, if a PCP is not available it may be necessary to refer to follow-up at the ED. • Provide written and verbal advice (see Appendices 1.3 and 1.4) to the patient (and support person) as stated in recommendation 1.6. • Extra consideration should be given to persons considered part of a vulnerable population (youth, age >65, psychiatric illness), as they may need closer follow-up.^a 	C
1.8	Somatic, cognitive/ communication and emotional/behaviour symptoms following concussion/mTBI should be documented using a standardized assessment scale (see Appendices 1.5 and 1.6) at the initial appointment as well as follow-up appointments until symptoms resolve. ^a	C

a. Adapted from the Motor Accidents Authority NSW, *Guidelines for Mild Traumatic Brain Injury following a Closed Head Injury (MAA, NSW, 2008)*.

RESOURCES		
APPENDICES		
1	Acute Concussion Evaluation - Physician/Clinician Office Version	Appendix 1.1
2	Abbreviated Westmead Post-Traumatic Amnesia Scale (A-WPTAS)	Appendix 1.2
3	Brain Injury Advice Card (Long Version)	Appendix 1.3
4	Brain Injury Advice Card (Short Version)	Appendix 1.4
5	Rivermead Post Concussion Symptoms Questionnaire	Appendix 1.5
6	Post Concussion Symptom Scale	Appendix 1.6
7	Other Links/ Resources	Appendix F
TABLES		
1	Risk Factors Influencing Recovery Post mTBI	Table 1.1
2	Key Features of mTBI Assessment in an Emergency Department or Doctor's Office	Table 1.2
FIGURES		
1	Canadian CT Head Rule	Figure 1.1
ALGORITHMS		
1	Initial Diagnosis/Assessment of Adult mTBI	Algorithm 1.1

References

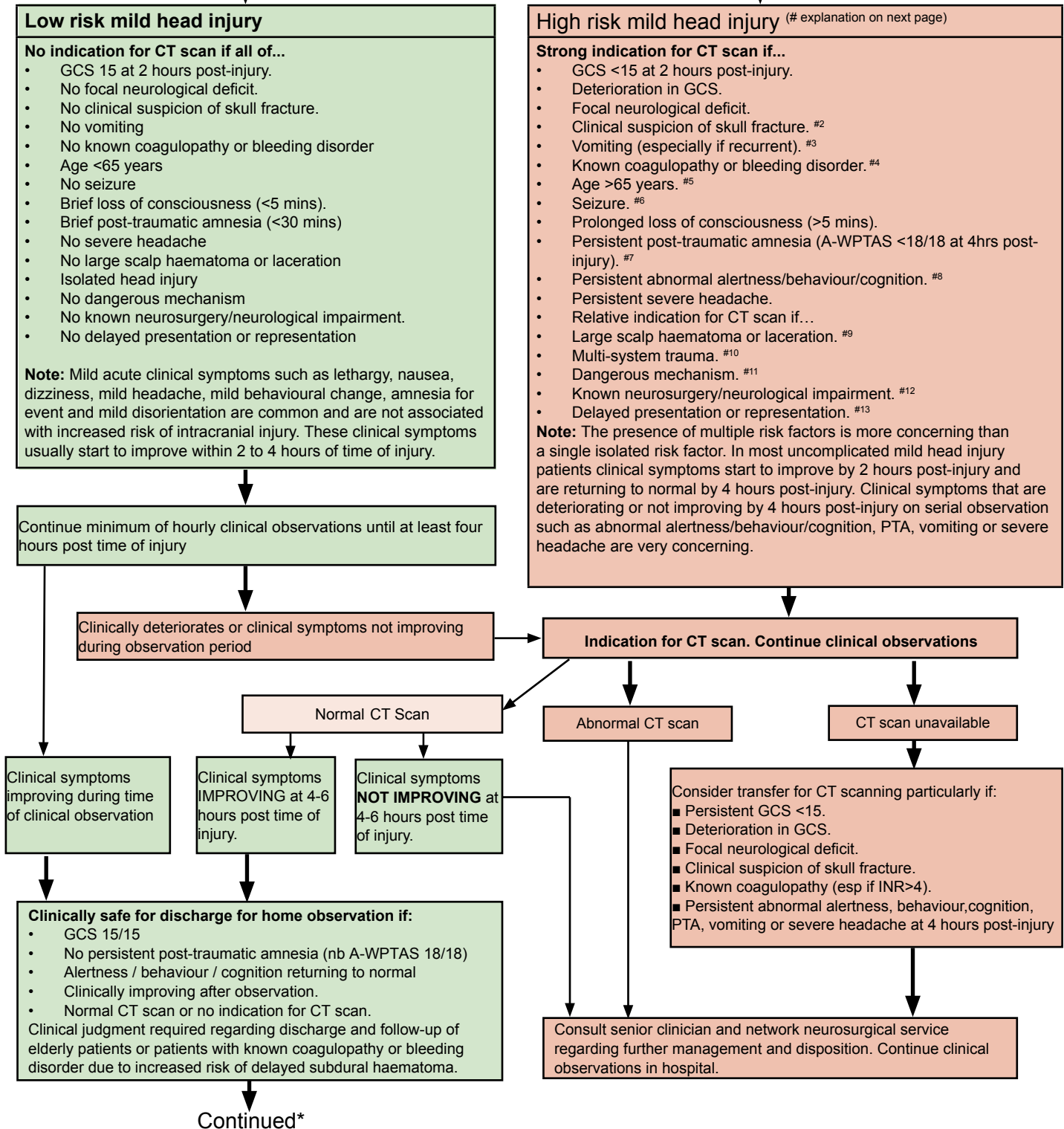
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Algorithm 1.1

Initial Diagnosis/Assessment of Adult mTBI*

Initial GCS 13-15 on arrival following blunt head trauma
Stabilise ABCDEs and assess clinical risk factors.

Commence minimum of hourly clinical observations of vital signs, GCS, pupils, PTA and clinical symptoms



* Adapted from the NSW Ministry of Health. Closed Head Injury in Adults - Initial Management (PD2012_013)

Algorithm 1.1

Initial Diagnosis/Assessment of Adult mTBI* Continued

Continued*



Clinically safe for discharge for home observation if:

- Responsible person available to take home and observe.
- Able to return if deteriorates.
- Discharge advice is understood.



Discharge for home observation if above criteria met:

- Provide written patient advice sheet
- Provide discharge summary for GP
- All patients should be advised to see their GP for follow-up if they are not feeling back to normal within 2 days
- 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 due to an increased risk of post concussion symptoms.

Explanatory notes for risk factors:

1. Using GCS<15 at 2 hours post-injury allows clinical judgement for patients who present soon after injury or who have drug or alcohol intoxication. Drug or alcohol intoxication has not been shown to be an independent risk factor for intracranial injury but persistent GCS<15 is a major risk factor and mandates CT.
2. Clinical suspicion of skull fracture includes history of focal blunt assault or injury; palpable skull fracture; large scalp haematoma or laceration; signs of base of skull fracture – haemotympanum / CSF leak / raccoon eyes / Battles sign.
3. Recurrent vomiting more concerning than isolated vomiting but both are indications.
4. Known coagulopathy is both a strong indication for early CT scan and to check the INR. Early reversal of anticoagulation if abnormal CT scan and consider reversal if initially normal CT scan with high INR (>4) depending on clinical situation.
5. Elderly patients have increasing risk of intracranial injury with increasing age; routine CT scanning indicated unless totally asymptomatic patient with no other risk factors.
6. Brief generalised seizures immediately following head injury are not significant risk factors. Prolonged, focal or delayed seizures are risk factors for intracranial injury.
7. Post-traumatic amnesia may manifest as repetitive questioning or short term memory deficits and can be objectively tested using the A-WPTAS. PTA > 30 mins is a minor risk factor and PTA > 4 hours a major risk factor for intracranial injury.
8. Abnormal alertness/behaviour/cognition detects subtle brain injury better than GCS and should be part of the bedside assessment. Family may help establish what is normal.
9. Multi-system trauma – beware patient with unstable vital signs or distracting injuries or who receive analgesia or anaesthesia, as significant head injury is easily missed.
10. Clinical judgement required as to what is a large scalp haematoma or laceration.
11. Dangerous - MVA ejection / rollover; pedestrians / cyclists hit by vehicle; falls >own height or five stairs; falls from horses / cycles etc; focal blunt trauma, eg bat / ball / club.
12. Known neurosurgery/neurological impairment – conditions such as hydrocephalus with shunt or AVM or tumour or cognitive impairment such as dementia make clinical assessment less reliable and may increase risk of intracranial injury.
13. Delayed presentation should be considered as failure to clinically improve during observation. For representation consider both intracranial injury and post concussion symptoms and have a low threshold for CT scanning if not

For a narrative description and recommendations related to this algorithm, please refer to [Section 1](#).

* Adapted from the NSW Ministry of Health. *Closed Head Injury in Adults - Initial Management (PD2012_013)*