INESSS
LE SAVOIR PREND FORME

MAY 2021

Assessment and Risk Management of Severe Neurological Complications Following Mild Traumatic Brain Injury

English summary

Une production de l'Institut national
d'excellence en santé
et en services sociaux (INESSS)

Québec

SUMMARY

Assessment and Risk Management of Severe Neurological Complications Following Mild Traumatic Brain Injury

Introduction

Traumatic brain injury (TBI) is generally defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force. The mildest form of TBI, mild traumatic brain injury (mTBI), is the most common and results in a significant number of medical visits, both in health clinics and in the emergency department. In patients with mTBI, the probability of severe neurological injury that requires neurosurgical intervention is very low (less than 1%). Although this probability is low, the consequences of such an injury can be fatal if not identified in time. The acute management phase, which involves the assessment and management of the risk of severe neurological complications, is an essential step in mitigating the health consequences of mTBI. Current recommended practices in Québec for the acute management of mTBI are outlined in two decision-making algorithms, one for adults and one for children.

As part of the revision of the Ministerial orientations guiding the offer of services to victims of mTBI, the Trauma and Critical Care Evaluation Unit of the Institut national d'excellence en santé et en services sociaux (INESSS) published a knowledge update on mTBI in 2018. This report highlighted the need to revisit the decision rules for identifying patients at risk for severe neurological complications, to review the relevance of including anticoagulation use or presence of coagulopathy as a risk factor, and to re-evaluate the criteria for transferring mTBI patients to neurotrauma centres. Revising transfer criteria has also been a concern of professionals in the field, who contend that many transfers could be avoided in patients with mTBI. It was in this context that the Ministère de la Santé et des Services sociaux (MSSS) asked INESSS to revise the decision-making algorithms for managing the risk of severe neurological complications following mTBI. This request is part of an effort to improve the quality of care and services and to optimize resource utilization for trauma patients.

Methodology

This guide is intended to support the assessment and management of the risk of severe neurological complications following mTBI for adults and children who visit a hospital emergency department. Specifically, the work aims to:

1. review the clinical criteria associated with a higher risk of severe neurologic complications following mTBI;
2. identify the type of injuries observed on CT that are clinically important and require management by specialized neurotrauma centres.
3. establish clinical criteria that justify the transfer of patients who have suffered mTBI to a specialized neurotrauma centre.

The methodology used includes a literature review as well as consultations with an expert committee and interviews with patients and informal caregivers. The scientific evidence extracted from the identified studies was summarized in the form of a narrative synthesis, from which proposals for modifications to the algorithms were drafted and submitted to the expert committee. Besides commenting on these proposals, the experts had the opportunity to provide contextual information on the organization of care for victims of mTBI in Québec. In parallel, six patients and caregivers participated in one-on-one interviews to provide their perspective on acute care for mTBI and referral to specialized resources. Following the consultation process, the proposals for modifications to the algorithms were formulated as recommendations, taking into account data from the literature, expert opinion, and the views of patients and informal caregivers.

Results

Literature Review Results

The Canadian CT Head Rule (CCHR) remains the most sensitive and specific decision rule for identifying patients at risk of neurosurgical injury in adult patients. The evidence also supports the recommendation that anticoagulant use or the presence of coagulopathy in adult patients who have sustained mTBI should be considered as risk factors requiring CT scanning. Few studies or practice guidelines have published clear recommendations regarding the establishment of transfer criteria based on the characteristics of injuries demonstrated on CT. Currently available data on injury characteristics do not allow for major changes to the present transfer criteria, except in the case of subarachnoid hemorrhage, which is no longer considered clinically important with regard to size but rather its complexity (diffuse versus focal).

For pediatric patients, the majority of practice guidelines identified recommend applying the Pediatric Emergency Care Applied Research Network (PECARN) decision rule to identify patients at low risk of clinically important intracranial injury. This recommendation is reinforced by the results of systematic reviews that show PECARN to be more sensitive and specific than other rules, including the Canadian Assessment of Tomography for Childhood Head Injury (CATCH) rule previously recommended by the algorithm. Very few studies have addressed the need for neurosurgical intervention according to injury characteristics in children. Specific transfer criteria are thus difficult to develop in these cases, beyond the presence of intracranial injury.

Issues Highlighted in Expert Committee Discussions

The experts emphasized the high volume of unnecessary CT scans in both adult and pediatric patients and the importance of discussing why a CT scan should or should not be performed with the patient or parent to avoid overuse. The experts also believe that tele-expertise could go a long way in reducing the volume of unnecessary transfers. They suggest that healthcare centres be given the option of a remote consultation before deciding about transferring to a neurotrauma centre, without making a recommendation until the relevant organizational guidelines are clearly defined.

Patient and Informal Caregiver Perspectives

The consultation with patients and informal caregivers underlined the importance of certain elements that should be addressed by the tools used to manage patients who have sustained mTBI. Notably, the consultation reinforced the clinical experts' observations on the need to integrate discussions with the patient in a more systematic manner and at all stages of the care episode. While the interviews focused on the acute phase of the episode of care, it was the post-acute phase of the care continuum that raised the most concerns among patients and caregivers: e.g., lack of information at discharge, access to post-acute services and management of persistent symptoms.

Conclusion

Within the framework of the revision of Ministerial guidelines on mTBI, the update of the algorithms aims at more efficient management of mTBI patients and better integration of patients in the decision-making process that concerns them, while ensuring quality of care. The recommendations from the present report will be included in decision-making algorithms that will be available on the INESSS website. An implementation and evaluation strategy that can be used by MSSS and healthcare facilities is proposed to pave the way for the changes introduced by these recommendations (e.g., training clinicians at first receiving centres who may not normally keep certain patients with such injuries at their facility) and to ensure that the algorithms will lead to the most appropriate care and services for patients.

While the lack of evidence on transfer criteria restricts the extent of changes to be made at this time and their impact on reducing the number of transfers, the dissemination and implementation of the revised algorithms will provide an opportunity to all physicians who might assess mTBI patients to refresh and update their knowledge and ensure that they have the proper evaluation tools. Work currently underway in Québec could also modify or nuance the algorithms' recommendations. The algorithms will therefore need to be updated in light of the results of this effort over the next few years.

Recommendations for ADULTS:

A1: Use of the Canadian CT Head Rule tool is recommended to assess the risk of short-term medical complications following mTBI in adults.

Sources: Cheng et al., 2017; DIP, 2018 [class II] ONF, 2017 citing NSW Ministry of Health guide, 2011 [grade A]; Webster et al., 2017; ACR, 2015 [generally appropriate]; Easter et al., 2015; CAR, 2012 [grade A]; Harnan et al., 2011.

🚩 A discussion with the patient is important to explain why he or she does or does not need a brain CT scan.

Source: Expert consensus.

A2: It is recommended that a patient with a clinically unimportant brain injury be observed for 6 hours following the initial CT scan. For a patient with a GCS score of 14 and a normal CT scan, observation is recommended for a minimum of 4 hours following mTBI and until baseline neurological status is restored.

Sources: Expert consensus; for the 4-hour period: NSW Ministry of Health, 2011; for the 6-hour period: Joseph et al., 2014b.

A3: For a patient who is not taking anticoagulants or has no coagulopathy and whose initial brain CT scan shows clinically unimportant brain injury, a follow-up CT is recommended only if neurological deterioration occurs.

Source: Almenawer et al., 2013.

A4: It is recommended that the use of anticoagulants or antiplatelet agents (except acetylsalicylic acid - aspirin) and the presence of coagulopathy be considered as risk factors requiring a brain CT scan following mTBI in adults.
Sources: DIP, 2018 [classes II and III]; Marincowitz et al., 2018; Minhas et al., 2018; van den Brand et al., 2017; NICE, 2014; Undén et al., 2013 [strong; moderate quality]; SFR and SFMN, 2013 [grade A]; NSW Ministry of Health, 2011 [grade A]; Pandor et al., 2011.

A5: If a patient taking anticoagulants or antiplatelets or with a coagulopathy has a normal initial CT scan result, the decision to carry out a follow-up CT will be based on clinical judgment, according to bleeding risk (e.g., INR > 3) or clinical deterioration.

Sources: ACS, 2018; ACR, 2015 [may be appropriate]; NSW Ministry of Health, 2011; Joseph et al., 2014b; Your et al., 2012 [grade C].

When injuries are observable on a brain CT scan in patients who take anticoagulants or antiplatelets or who have a coagulopathy, it is important to discuss the resumption of anticoagulant or antiplatelet therapy with a neurosurgeon.

Source: Expert consensus.

A6: In adult patients who have sustained mTBI, the following are recommended to be considered as clinically important brain injuries requiring neurosurgical consultation:

- Contusion/intraparenchymal hematoma ≥ 5 mm
- Diffuse SAH
- SDH ≥ 4 mm
- Epidural hematoma (any size)
- Intraventricular haemorrhage (except if isolated)
- Depressed fracture
- Diffuse pneumocephalus

A7: In adult patients who have sustained mTBI, the following are recommended to be considered as clinically unimportant brain injuries that do not require neurosurgical consultation:

- Single contusion/intraparenchymal hematoma < 5 mm
- Focal SAH (over a single gyrus or sulcus on the convexity)
- SDH < 4 mm
- Isolated intraventricular haemorrhage
- Skull fracture not through the inner table
- Small pneumocephalus

Without being a clinically important brain injury, SAH located in the sylvian fissure or basal cisterns should lead to suspicion of a ruptured aneurysm as the underlying cause of SAH.

Sources: Expert consensus (adapted from Stiell et al., 2001 using results from Marincowitz et al., 2018, Nassiri et al., 2017 (for SAH) and Joseph et al., 2014b).

A8: It is recommended that a patient who has sustained mTBI be referred to specialized neurotrauma services for consultation or neurosurgical intervention if a GCS score ≤ 13* is present.

*The GCS score must be assessed in such a way as to rule out confounding factors (e.g., intoxication). Because many mTBI cases with a GCS score ≤ 13 have an intoxication component, the following override rule applies to facilities for which an air medical evacuation (AME) is required:

1) Neurotrauma patients with a GCS score ≤ 13 and who present with a positive CT scan require transfer to neurotrauma services at the designated tertiary centre.
2) Neurotrauma patients with a GCS score ≤ 13 and an intoxication component, not associated with a dangerous injury mechanism, and presenting with a normal CT scan require transfer to neurotrauma services at the designated tertiary centre only if there is no improvement in their GCS score after 24 hours of observation.

Sources: Trauma network requirement, INESSS, 2018a; for the override rule: INESSS; 2011b.

A9: It is recommended that a patient who has sustained mTBI and has a clinically important brain injury have a neurosurgical consultation or have their case discussed with a neurosurgeon. The neurosurgical consultation can be done in person, after transfer, or remotely via tele-expertise depending on regional organizational arrangements.

Sources: NICE, 2014; NSW Ministry of Health, 2011 [consensus]; for tele-expertise: expert consensus.

The relevance of a transfer should be assessed according to the patient's specific situation (e.g., level of care, neurodegenerative disease).

Source: Expert consensus.

All requests for neurosurgical consultation or transfer to a neurotrauma centre must go through the emergency physician or trauma team leader (TTL) at that centre.

Source: Trauma network requirement, INESSS, 2018a.

The mandate of neurotrauma centres is to manage patients who are at risk of requiring neurosurgical intervention or specialized rehabilitation. As such, transfers to neurotrauma centres should be limited to this patient group.

Source: Expert consensus.

Recommendations for PEDIATRIC patients

P1: Use of the PECARN tool is recommended to assess the risk of short-term medical complications following mTBI in children.

Sources: ACR, 2019 [generally appropriate]; ACS, 2018; DIP, 2018 [class I]; Lumba-Brown et al., 2018a [grade B; moderate level of confidence]; Mastrangelo and Midulla, 2017; ONF, 2015 [level of evidence A]; Lorton et al., 2014; Lyttle et al., 2012; Vos et al., 2012 [grade A]

P2: A brain CT scan is recommended for a child who has sustained mTBI and is taking anticoagulants or has a coagulopathy.

Sources: Pandor et al., 2011; Astrand et al., 2016 [strong; very low level of evidence]; Joseph et al., 2014b; NICE, 2014; Farrell, 2013

In a child with a hydrocephalus shunt, a brain CT scan is only needed if the child is symptomatic or on the recommendation of the neurosurgeon.

Source: Expert consensus

If abuse is suspected, the child should be managed according to the algorithm specific to that situation (e.g., Canadian Paediatric Society, 2007).

Source: Expert consensus.

P3: It is recommended that the pediatric protocol be followed when performing a brain CT scan following mTBI in a child.

Source: Expert consensus.

A discussion with the child and parent is important to explain why the child does or does not need a brain CT scan.

Source: Expert consensus; Lumba-Brown et al., 2018a [grade B; moderate confidence level].

P4: When observation in the emergency department is indicated, it is recommended that the child be kept under observation for at least 4 hours after the injury and until the child's baseline neurological status returns.

Sources: Expert consensus; Bharadwaj and Rocker, 2016.

P5: For a child who is not taking anticoagulants or has no coagulopathy, a follow-up CT scan is recommended only if neurologic deterioration occurs.

Sources: Expert consensus; Astrand et al., 2016 [strong; very low level of evidence]; ACS, 2018; Hung et al., 2014; Donaldson et al., 2014; Vos et al., 2012 [grade C].

P6: If a child on anticoagulants or with a coagulopathy has a normal initial CT result, the decision to do a follow-up CT scan will be based on clinical judgment, according to bleeding risk (e.g., international normalized ratio >3) or clinical deterioration.

Source: Expert consensus.

P7: It is recommended that a child who has sustained mTBI be transferred to specialized neurotrauma services for consultation or neurosurgical intervention if a GCS score ≤ 13* is present.

*The GCS score must be assessed in such a way as to rule out confounding factors (e.g., intoxication). Because many mTBI cases with a GCS score ≤ 13 have an intoxication component, the following override rule applies to facilities for which an air medical evacuation (AME) is required:

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Sources: Trauma network requirement, INESSS, 2018a; for the override rule: INESSS; 2011b.

P8: It is recommended that a child who has sustained mTBI and has an intracranial brain injury have a neurosurgical consultation or have their case discussed with a neurosurgeon. The neurosurgical consultation can be done in person, after transfer, or remotely via tele-expertise depending on regional organizational arrangements.

Sources: NICE, 2014; Farrell et al., 2013; for tele-expertise: expert consensus.

All requests for neurosurgical consultation or transfer to a neurotrauma centre must go through the emergency physician or trauma team leader at that centre.

Source: Trauma network requirement, INESSS, 2018a.

The mandate of neurotrauma centres is to care for children who are at risk of needing neurosurgical intervention or specialized rehabilitation. As such, transfers to neurotrauma centres should be limited to this patient group.

Source: Expert consensus.

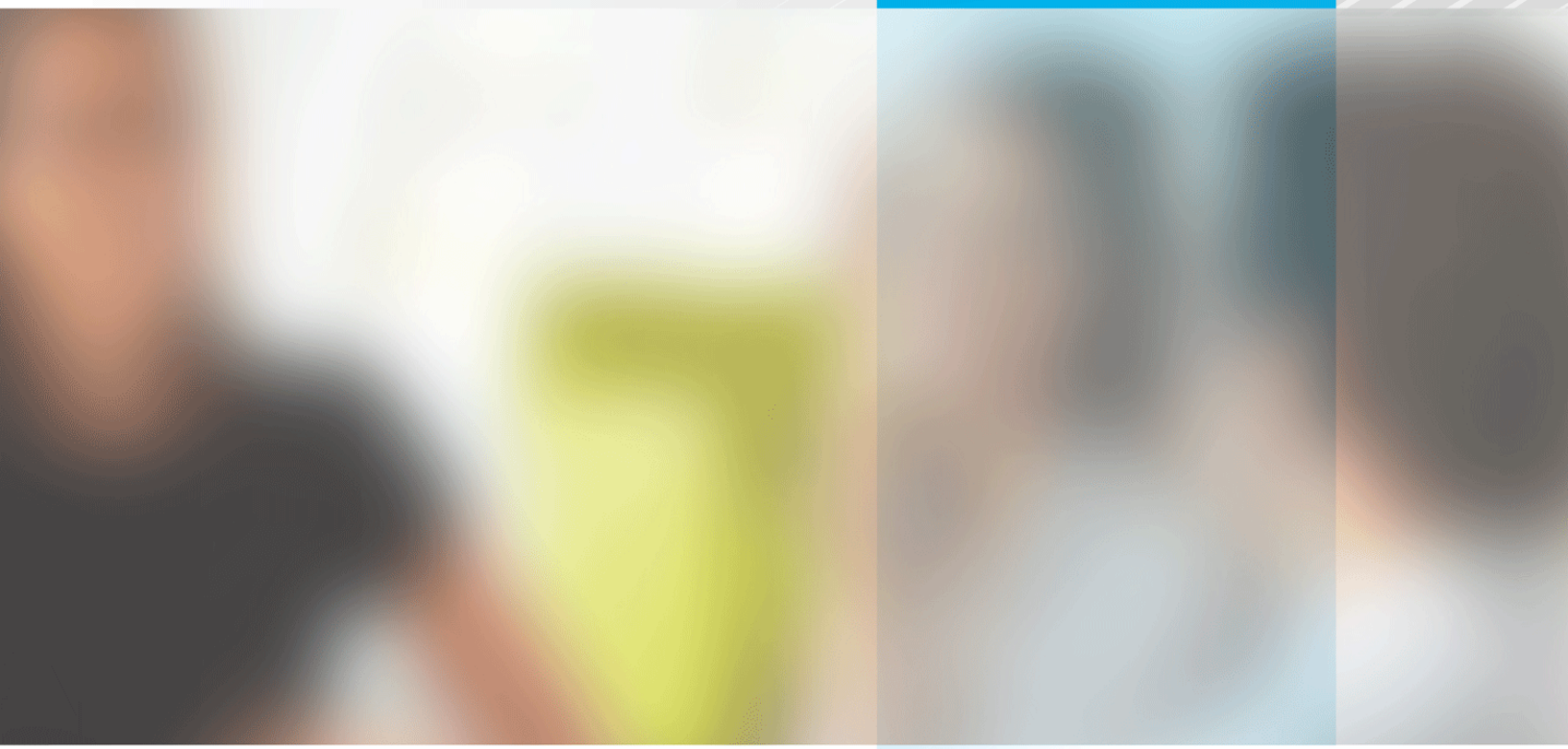
Discharge Recommendations (ADULT and PEDIATRIC Patients):

The following are recommended at the time of discharge:

- Making sure the patient has adequate support upon return to the community - e.g., adequate supervision at home.
- Providing verbal information and written materials to the patient and their informal caregiver/parent, including which situations require an urgent medical consultation following mTBI and management of persistent symptoms.

  Tools (pamphlets and videos) that offer advice to patients on resuming activities following mTBI are available on the INESSS website.
- Making sure that the provided information is well understood by the patient or their informal caregiver/parent.
- Informing the patient or their parent of the resources available in the region for people who have sustained mTBI, so that the patient can consult them in the event of symptoms that persist for more than 7 to 14 days after the trauma without improvement in the patient's state of health. It should be noted that some people, especially children and adolescents, may need more time to recover.

Sources: Royal Children's Hospital Melbourne, 2018; ONF, 2017 [evidence level C]; Astrand et al., 2016; Bharadwaj and Rocker, 2016; ONF, 2015 [evidence level B]; NICE, 2014; NSW Ministry of Health, 2011 [grade A for offering advice; expert consensus for social criteria for discharge]; for referral for persistent symptoms: forthcoming Ministerial guidance.



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