

Canadian CT Head Injury/Trauma Rule

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Abstract

The Centers for Disease Control and Prevention estimates that there are approximately 3 million patients seen in United States (US) emergency departments for head trauma annually. Head computed tomography (CT) utilization in emergency departments has continued to increase dramatically with approximately 16 million head CTs performed in 2022, more than double the number performed in 2007. While different studies provide varying estimates, the data suggests that approximately one third of head CTs performed are unnecessary or avoidable. Over 90% of head CTs obtained in patients with mild head trauma are negative and less than 1% require neurosurgical intervention. The Canadian CT Head Injury/Trauma Rule identifies high and moderate risk features to help determine when CT imaging is indicated to help reduce overutilization.

I. HOW TO USE

When to Use

The Canadian CT Head Rule (CCHR) is a well-validated clinical decision tool that allows clinicians to safely determine which patients with minor head trauma are likely to have intracranial injuries requiring neurosurgical intervention without obtaining CT imaging. It can be applied to non-intoxicated patients, ages 16-64, with minor head injury (GCS 13-15) and without known pharmacologic anticoagulation or coagulopathies, seizure after the injury, or obvious high-risk mechanism of injury. The CCHR is estimated to be 70% sensitive for “clinically important” brain injury in alcohol intoxicated patients (Easter 2013) so additional caution should be exercised with this patient population.

Pearls / Pitfalls

The Canadian CT Head Rule (CCHR) was developed to help physicians determine which minor head injury patients should receive CT imaging. The original validation trial and multiple subsequent studies have found the CCHR’s High Risk Criteria to be 100% sensitive for injuries requiring neurosurgical intervention. It has been found to be 83-100% sensitive for detecting “clinically important” brain injuries not requiring neurosurgical intervention. It is important to note that the original validation trial excluded patients on oral anticoagulants and anti-platelet agents, those over 64, and those under 16, so

further study is needed to determine whether the CCHR maintains its sensitivity and specificity in these patient populations.

Patients with minimal head injury (i.e., no history of loss of consciousness, amnesia, or confusion) generally do not need a CT scan. For example, patients over 65 years may not need a CT scan just based on their age if they do not have the history mentioned above. When a patient fails the CCHR, use clinical judgment to determine whether a CT scan is necessary.

Several studies found the CCHR to be the most consistent, validated, and effective clinical decision rule for minor head injury patients (Harnan 2011, Alzuhairy 2020, Kaffle 2025). Compared to the other clinical decision tools for head injury/trauma, the New Orleans Criteria (NOC) has in some studies been found to be more sensitive than CCHR but markedly less specific and thus has significantly less potential to reduce unnecessary CT scans. The NEXUS-II was found to be both less sensitive and less specific in the reviewed comparison studies.

Points to keep in mind

The CCHR has high sensitivity for clinically significant head CT findings while maintaining high specificity, thereby reducing unnecessary CT scans. While there is only one US validation study for the CCHR, it demonstrated 100% sensitivity for identifying injuries requiring neurosurgical intervention. Additional validation studies outside the US have shown variation in the sensitivity and specificity of the rule.

One retrospective study found that applying the CCHR would have actually resulted in an increase in the number of patients undergoing CT scan (Boyle 2004) due to practice patterns in that particular location. This is largely not the case in the US. Other retrospective studies identified injuries on CT imaging that would have been missed by the application of the CCHR. However, none required surgical intervention and none were associated with statistically significant morbidity or mortality.

The CCHR has limited sensitivity (about 70%) for detecting “clinically important” brain injury in alcohol intoxicated patients (Easter 2013), so the CCHR should be utilized with caution in this patient population.

There are recent limited studies investigating the application of the CCHR in patients >65, patients on antiplatelet and anti-coagulant agents, and intoxicated patients, however, data is inconclusive and further validation is necessary.

There is ongoing debate about whether the goal should be to identify all intracranial injuries or only clinically-important ones that would require neurosurgical intervention and whether it is acceptable to miss any intracranial injuries, even if they would not have required intervention.

Why Use

There are approximately 3 million patients seen in US emergency departments for head trauma annually. The majority of these patients have minor head injuries that will not require hospital admission or neurosurgical treatment. Head CT utilization in emergency departments has more than doubled between 2007 and 2022. Standardized risk stratification of patients with minor traumatic brain injury (mTBI) has consistently been shown to decrease healthcare burden by improving resource utilization. Studies have shown that CCHR has the potential to reduce unnecessary CTs by around 30% leading to a reduction in radiation exposure as well as a reduction of overall healthcare costs.

II. NEXT STEPS

Advice

Use the CCHR alongside clinical judgment, mechanism assessment, neurologic exam, anticoagulation status, and overall patient reliability. If any of the high- or moderate-risk criteria are met, consider obtaining a CT scan. Discuss findings with patients to support shared decision-making, especially when imaging is deferred. Clinical decision tools should not be used as substitutes for clinical judgment, especially if used in isolation. The CCHR should not delay imaging in unstable patients or those with obvious severe injury.

Management

If CT is indicated based on CCHR criteria, consider obtaining a non-contrast head CT without delay.

If CT is not indicated or you decide not to obtain one based on your clinical judgment or shared decision making with the patient it is important that you provide clear discharge instructions and counsel on concussion symptoms, symptom management, and expected post-concussive course so the patient does not worry that a CT was necessary. Make sure to educate them on red flag symptoms and give strict return precautions for symptoms such as intractable headache, repeated vomiting, confusion, seizure, or neurologic deficit, and ensure reliable follow-up.

Critical Actions

Risk of clinically important brain injury increases when high- or medium-risk CCHR criteria are present.

This tool can be used as one factor in determining a course of care and may assist in communicating risk with the patient. It should not be used in isolation when determining management.

Before applying the rule, ensure that inclusion criteria are met, a complete neurologic examination is performed and documented, and signs of skull fracture are actively assessed. When imaging is deferred, ensure that shared decision-making is documented and patients receive written and verbal return precautions.

III. EVIDENCE

Evidence Appraisal

The original study included a convenience sample of 3121 patients, aged 16 years or greater, who presented to 10 Canadian emergency departments with blunt head trauma resulting in witnessed loss of consciousness, disorientation, or definite amnesia and a GCS of 13 to 15 (Stiell 2005). Of these patients, 8% had a clinically important brain injury and 1% required neurosurgical intervention. In the validation trial, CCHR was 100% sensitive for both clinically important brain injuries and injuries requiring neurosurgical intervention and was 76.3% and 50.6% specific for these injuries respectively. Subsequent studies have nearly all found the CCHR to be 100% sensitive for identifying injuries that require neurosurgical intervention; specifically, the “high risk criteria” have consistently shown 100% sensitivity at ruling out this group. A 2015 systematic review found the risk of severe intracranial injury in patients with minor head trauma to be 7.1%; in the absence of any CCHR criteria, they found this risk decreased to 0.31%.

A few recent studies attempting to validate the CCHR in various clinical settings and different patient populations suggest varying sensitivity for detecting both

clinically important intracranial injury (using the same definition as the original and validation studies) and injury requiring neurosurgical intervention ranging from 62% to 100%. However, these studies have limitations due to differences in methodology compared to the original validation study.

Applying the CCHR would allow physicians to safely reduce head CT imaging by around 30% (estimates range from 6-80% with studies most consistently showing about a 30% reduction). Specificity of the CCHR is estimated to be around 64-70% across the literature. The CCHR has consistently been shown to have higher specificity than other similar clinical decision rules, such as the New Orleans Criteria or NEXUS-II, suggesting a greater potential for reducing unnecessary imaging, thereby reducing radiation exposure and healthcare costs.

There is some newer data to suggest the CCHR may be applicable to some higher risk patient populations not included in the original validation (i.e., adults ≥ 65 , patients on anticoagulation or antiplatelet therapies) but further research is needed to determine which ones and with what limitations.

Formula

Apply only to patients presenting within 24 hours of injury with a GCS score of 13-15 and at least one of the following:

- Loss of consciousness
- Amnesia to the head injury event
- Witnessed disorientation

Exclusion criteria: (If any of the following are true, the CCHR does not apply)

- Age <16 years
 - On anticoagulant/antiplatelet medications or with bleeding disorders
 - Seizure after injury
- If any of the following are present, CCHR cannot rule out the need for imaging. Consider CT.

High-risk criteria: Rules out need for neurosurgical intervention - CT required

- GCS <15 at 2 hours post-injury
- Suspected open or depressed skull fracture
- Any sign of basilar skull fracture (hemotympanum, racoon eyes, Battle's Sign, CSF otorrhea/rhinorrhea)
- ≥ 2 episodes of vomiting
- Age ≥ 65 years

Medium-risk criteria: In addition to above, rules out "clinically important" brain injury - CT recommended (positive CT's that normally require admission)

- Retrograde amnesia to the event ≥ 30 minutes

- "Dangerous" mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, or fall from ≥ 3 feet or ≥ 5 stairs)

Patients who meet none of these criteria are at very low risk for clinically important brain injury.

Facts & Figures

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