

IS HEAD CT ALWAYS NECESSARY? EXPERIENCES WITH THE CANADIAN HEAD CT RULE IN THE EMERGENCY DEPARTMENT SETTING

JE LI CT GLAVE UVIJEK POTREBAN? ISKUSTVA S PRIMJENOM KANADSKOG PRAVILA ZA CT GLAVE U HITNOM BOLNIČKOM PRIJAMU

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Abstract

Introduction: Head injuries are among the most common reasons for patient presentation to the Emergency Department and represent a significant diagnostic challenge. Computed tomography (CT) is considered the gold standard in the initial assessment of patients with head trauma due to its availability and high sensitivity in detecting intracranial injuries. However, the widespread and often indiscriminate use of CT contributes to emergency department overcrowding and prolonged patient length of stay. In an effort to rationalize CT utilization, several clinical decision-making tools have been developed, among which the Canadian Head CT Rule (CCHR) holds a prominent role. The aim of this retrospective study was to evaluate the use of the Canadian Head CT Rule (CCHR) in patients presenting to the Emergency Department and to assess its potential in rationalizing indications for head CT without compromising patient safety.

Materials and methods: This retrospective observational study analyzed patients admitted with head injuries over a one-year period, with data collected from medical records. The results were analyzed using descriptive statistical methods and presented as absolute and relative values.

Results: The study sample included 272 patients with head injuries who underwent head CT in the Emergency Department. Based on the presence of exclusion criteria for the application of the Canadian Head CT Rule (CCHR), 54 patients were excluded from the study, resulting in a final sample size of 218 patients. Exclusion criteria included age under 16 years, anticoagulant therapy, and seizure occurring immediately after the injury. Of the total sample, 65% were male and 35% female. The most common positive finding within the CCHR criteria was amnesia lasting longer than 30 minutes, present in 81 patients, whereas signs of skull or basilar skull fracture were the least common, observed in only 5 patients. In 70% of performed head CT scans, there was an indication for imaging according to the CCHR criteria. In the remaining 30% of cases, CT imaging was not indicated according to the CCHR. Overall, CT findings were normal in 82% of patients, while 18% had pathological findings. Among patients with normal CT findings, an indication for CT according to the CCHR was present in 89% of cases. Among patients with pathological CT findings, the CCHR did not indicate CT imaging in 11 % of cases.

Conclusion: This analysis demonstrates that the CCHR has high sensitivity but limited specificity. The large number of normal CT findings despite fulfilled criteria suggests potential overutilization of imaging. On the other hand, the substantial proportion of pathological CT findings in patients for whom the CCHR did not indicate CT confirms

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that the rule should not be applied in isolation. The CCHR is a valuable decision-making tool, but it should always be combined with thorough clinical assessment.

Keywords: computed tomography; emergency medicine; head trauma

Sažetak

Uvod: Ozljeđe glave jedan su od najčešćih razloga dolaska pacijenata u Centar urgentne medicine te predstavljaju značajan dijagnostički izazov. Kompjuterizirana tomografija (CT) predstavlja zlatni standard u inicijalnoj dijagnostici pacijenta s traumom glave zbog svoje dostupnosti i visoke osjetljivosti u detekciji intrakranijalnih ozljeda. Međutim, široka i često nekrična primjena CT-a dovodi do prevelikog opterećenja hitnih službi te produženog boravka pacijenata u urgentnom centru. S ciljem racionalizacije uporabe CT-a razvijeni su klinički alati za donošenje odluka, među kojima Canadian Head CT Rule (CCHR) zauzima istaknuto mjesto. Cilj ove retrospektivne studije bio je analizirati uporabu CCHR skora kod pacijenata u Centru urgentne medicine, te procijeniti njegov potencijal u racionalizaciji indikacija za CT glave bez ugrožavanja sigurnosti pacijenta.

Materijali i metode: Riječ je o retrospektivnoj opservacijskoj studiji kojom su analizirani pacijenti zaprimljeni zbog ozljede glave u toku jedne godine, a podaci su prikupljeni na osnovu medicinske dokumentacije. Rezultati su analizirani deskriptivnim statističkim metodama te prikazani u obliku apsolutnih i relativnih vrijednosti

Rezultati: Ukupni uzorak je obuhvatio 272 pacijenata sa ozljedom glave kojima je urađen CT glave u urgentnom centru. Na osnovu prisustva isključujućih kriterija za primjenu Canadian CT head rule CCHR) operacione skale iz istraživanja su isključena 54 ispitanika, te ukupan uzorak za ovo istraživanje iznosi 218. Isključujući kriteriji su životna dob ispod 16 godina, uzimanje antikoagulanasa i epi-napad neposredno nakon ozljede. Od ukupnog uzorka, 65 % su činili muškarci, a 35 % žene. Najčešći pozitivan odgovor u CCHR skoru kod naših pacijenata bilo je prisustvo amnezije za period duži od 30 minuta koji je bio prisutan kod 81 pacijenta, dok je najrijeđe prisutan bio znak preloma lobanja/baze lobanje – u svega 5 pacijenata. Kod 70 % učinjenih CT snimanja zbog ozljede glave, postojala je indikacija po CCHR skoru. U proostalih 30 % CT snimanje nije bilo indicirano po CCHR skoru. U ukupno 82 % pacijenata CT nalaz je bio uredan, dok je u 18% CT nalaz bio patološki. Kod pacijenata koji su imali uredan CT nalaz, u 89 % slučajeva je postojala indikacija za CT snimanjem. Među pacijentima koji su imali patološki nalaz CT-a, u 11 % slučajeva CCHR skor nije indicirao CT.

Zaključak: Ova analiza pokazuje da CCHR ima visoku osjetljivost, ali ograničenu specifičnost. Veliki broj urednih CT nalaza unatoč ispunjenim kriterijima ukazuje na moguću prekomjernu uporabu snimanja. S druge strane, zabilježen je visok procent patoloških nalaza kod kojih CCHR nije indicirao CT što potvrđuje da pravilno ne smije biti primijenjeno izolirano. CCHR je vrijedan alat u donošenju odluka, ali ga je potrebno kombinirati s kliničkom procjenom.

Ključne riječi: hitna medicina; kompjuterizirana tomografija; trauma glave

Introduction

Head injuries represent one of the most common reasons for visits to emergency services and emergency departments worldwide. In general, head injuries are among the most frequent types of both open and closed traumatic injuries in humans. They are also encountered across all age groups. It is important to emphasize that the pathophysiology, initial diagnostic approach, and management of head injuries differ significantly among different age populations (1). Regardless of these differences, computed tomography (CT) remains the gold standard for the diagnosis of head injuries (2). Although CT is therefore an indispensable diagnostic tool in emergency departments and acute care settings, the justification for its

widespread use continues to be questioned. To some extent, owing to its broad availability and ease of application, CT has become a form of triage method in the urgent diagnostic evaluation of traumatic injuries. Consequently, numerous clinical decision-making tools have been developed to guide diagnostic assessment. Several diagnostic scoring systems and algorithms have been designed to identify patients who genuinely require CT imaging, while simultaneously reducing unnecessary CT utilization without compromising patient safety.

The Canadian Head CT Rule (CCHR) is currently one of the most commonly cited and widely used clinical decision tools in emergency medicine settings (3). The CCHR was developed



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at the Ottawa Hospital Research Institute and is intended to facilitate the identification of patients at increased risk of clinically significant traumatic brain injury among individuals presenting with head trauma. Compared with previously developed algorithms, such as the New Orleans Criteria, the CCHR has demonstrated higher specificity, which is why it is considered one of the most broadly applicable diagnostic tools in cases of minor head injury (4).

Head injuries represent one of the most common reasons for patient presentation to Emergency Departments.

It is important to note that the CCHR is structured as a clinical assessment tool consisting of 10 questions, with the first three representing the so-called “exclusion criteria.” These exclusion criteria include patients younger than 16 years of age at the time of injury, patients receiving chronic anticoagulant therapy, and patients who experienced a post-traumatic seizure immediately following the head injury. The presence of one or more of these factors renders the CCHR inapplicable in the specific clinical case, and its use in such patients is therefore not recommended. In these populations, serious traumatic brain injury cannot be reliably identified using the CCHR. Furthermore, the CCHR is intended for patients with clinically minor head injuries. It is not designed for use in polytraumatized patients or in patients with severe traumatic brain injury.

The aim of this study was to evaluate whether implementation of the CCHR in patients presenting to our Emergency Department could reduce the use of head CT for diagnostic purposes without compromising patient safety.

Although computed tomography (CT) is widely available, it is frequently overutilized in the evaluation of head trauma, often without a clear clinical indication.

Materials and methods

This retrospective observational study analyzed all patients presenting with minor head injury to the Emergency Department of Cantonal Hospital Bihać over a one-year period. It is important to emphasize that the Canadian Head CT Rule (CCHR) was not applied prior to patient admission or before the decision to perform CT imaging. Instead, the CCHR was applied retrospectively, meaning that the CCHR score was calculated for all patients who had already been examined, treated, and underwent head CT imaging due to head trauma. Data were obtained through review of medical records and the hospital information system. Personal patient data and

patient initials were not used in the study. The use of medical documentation was approved by the institutional director through an internal administrative authorization. The results were statistically analyzed and presented in the form of tables, graphs, and descriptive text.

Results

The total number of patients admitted to the Emergency Department of our hospital due to head trauma was 272. This number represents patients who underwent computed tomography (CT) imaging of the head following the initial clinical assessment and examination for head injury. During the retrospective application of the Canadian CT Head Rule (CCHR), exclusion criteria were taken into consideration. Accordingly, the CCHR could not be applied to 54 patients, as these included individuals younger than 16 years of age, patients receiving long-term anticoagulant therapy, and patients who experienced a seizure immediately following head trauma. Consequently, the total number of cases eligible for CCHR score calculation was 218.

Regarding sex distribution, male patients predominated, accounting for 65% of the study population, while female patients comprised 35%. Following the application of the CCHR in patients who underwent head CT imaging, the frequency of individual parameters considered by the CCHR when determining recommendations for CT imaging was analyzed. The most frequently positive variable among our patients was retrograde amnesia lasting longer than 30 minutes prior to injury, which was identified in 37.2% of cases. Other parameters were observed less frequently, with suspected open or depressed skull fracture being the least common criterion, present in only 2.3% of cases.

Within our study sample, at least one positive CCHR criterion was identified in 71% of patients following application of the score, whereas no positive CCHR criteria were present in 29% of patients. Considering the methodology and recommendations of the CCHR, head CT imaging was indicated in 70% of patients, while no indication for CT imaging was present in 30% of cases.

Although all patients underwent head CT imaging, normal CT findings were reported in 82% of patients. Pathological CT findings, indicating the presence of intracranial injuries, were identified in 18% of cases. Analysis of patients with normal CT findings demonstrated that, following application of the CCHR, CT imaging had not been indicated in 89.2% of cases. Conversely, among patients with pathological CT findings, retrospective application of the CCHR demonstrated that head CT imaging would not have been indicated in 10.8% of patients.

Detailed results are summarized in Table 1.

Discussion

Analysis of the results obtained in our study clearly demonstrated that patients with head injuries were predominantly younger males. This finding is consistent with

Table 1. Patient demographics overview

Sociodemographic characteristics	Age		50,47±21,63 (16-89)
	Gender	Male	141 (64,7%)
		Female	77 (35,3%)
CCHR criteria	Age >65 years	No	152 (69,7)
		Yes	66 (30,3)
	GCS		14,79±1,08 (3-15)
	GCS <15	No	203 (93,1%)
		Yes	15 (6,9%)
	Vomiting >2 puta	No	178 (81,7%)
		Yes	40 (18,3%)
	Retrograde amnesia >30 min.	No	137 (62,8%)
		Yes	81 (37,2%)
	Dangerous injury mechanism	No	187 (85,8%)
		Yes	31 (14,2%)
	Signs of skull fracture or basilar skull fracture	No	213 (87,7%)
		Yes	5 (2,3%)
	At least one of CCHR criteria is met	No	62 (28,4%)
		Yes	156 (71,6%)
According to CCHR Head CT was indicated		Head CT was not indicated	65 (29,8%)
		153 (70,2%)	
CT results		Normal CT	178 (81,7%)
Pathological CT		40 (18,3%)	

recent international studies confirming that males are more frequently affected by head trauma.(5)

Taking into account the exclusion criteria that render the Canadian CT Head Rule (CCHR) inapplicable in specific cases of head injury, the total number of patients who underwent head computed tomography (CT) imaging in our Emergency Department was 272. Since the CCHR was applied retrospectively to patients who had already undergone clinical evaluation and head CT imaging, we were able to exclude patients receiving anticoagulant therapy, patients younger than 16 years of age, and patients who experienced seizures immediately following the injury. As there were 54 such patients, the final sample on which the CCHR was retrospectively applied consisted of 218 patients.

It is important to emphasize that, in our Emergency Department, head CT imaging is indicated only in patients whose clinical presentation raises suspicion of significant traumatic brain injury. Patients with very mild head trauma are generally not referred for CT imaging. Considering that head injuries are globally among the most common reasons for Emergency Department visits (6), the findings of our analysis are consistent with the expected prevalence of traumatic head injuries.

We demonstrated that the CCHR is a highly sensitive clinical decision-making tool, with CT imaging indicated in more than two-thirds of our cases.

Following the analysis of sociodemographic characteristics, the CCHR was retrospectively applied to each individual case in order to assess whether the rule would inaccurately classify patients or accurately identify those requiring CT imaging of the head. It should be emphasized that the CCHR is structured as a clinical decision-making tool in which the presence or absence of specific symptoms in patients with minor head injury is evaluated, after which recommendations regarding CT imaging are generated based on the recorded findings. Analysis of symptoms in our study population demonstrated that the most common positive CCHR criterion was the presence of retrograde amnesia lasting longer than 30 minutes prior to the traumatic event, which was observed in 37.2% of patients. In clinical practice, this symptom was most commonly identified through the patient's inability to reconstruct the events preceding the injury, which was interpreted as retrograde amnesia. The duration of retrograde amnesia has been shown in most studies to correlate with the severity of brain injury (7), thereby justifying the use of head CT imaging in such patients.

However, in nearly 11% of cases, the CCHR would not have recommended CT imaging despite the presence of findings revealing significant intracranial injury.

The second most frequent positive CCHR criterion in our sample was age greater than 65 years. Previous studies have clearly demonstrated that elderly patients are at increased risk of more severe intracranial injury; therefore, the CCHR appropriately recommends CT imaging in this patient population. (8) As illustrated graphically, the least frequently encountered CCHR criterion in our cohort was suspicion of an open or depressed skull fracture.

Subsequently, we analyzed the number of patients for whom the CCHR, based on the previously entered criteria, would recommend CT imaging of the brain. It is important to reiterate that all patients included in our sample had already undergone head CT imaging, while the primary objective of the study was to evaluate the potential of the CCHR to safely reduce the number of unnecessary CT examinations. In our cohort, the CCHR would have recommended CT imaging in 70% of cases, whereas CT imaging would not have been indicated in 30% of patients. Based solely on this finding, it could be argued that CT imaging may have been unnecessary in approximately 30% of cases. However, it is evident that the CCHR cannot be used as a triage tool. Previous studies have demonstrated its effectiveness only when interpreted in conjunction with clinical findings. (9)

We then analyzed head CT findings in our patient cohort. It should be clarified that CT findings without evidence of traumatic pathology were classified as normal CT findings, whereas pathological CT findings were defined as those demonstrating any form of traumatic injury involving the skull and/or brain. Normal CT findings were observed in 82% of patients, while pathological findings were present in 18% of cases. The proportion of CT scans demonstrating traumatic pathology correlates with findings from studies with larger patient samples (10) and therefore cannot be interpreted as evidence of unnecessary or indiscriminate CT utilization in patients with head trauma.

Perhaps the most important aspect of the study was the evaluation of the ability of the CCHR to identify patients with intracranial pathology. Among patients with normal CT findings, the CCHR would nevertheless have recommended CT imaging in 78% of cases. However, among patients whose CT findings demonstrated some form of intracranial injury, application of the CCHR alone would not have indicated CT imaging in 10.8% of cases. This finding suggests that these cases would potentially have been missed.

This result strongly emphasizes that the CCHR should be regarded as a clinical decision-support tool rather than a screening method and, as such, should not be used

independently or in isolation from comprehensive clinical assessment that considers the broader clinical context of the patient. Therefore, while the CCHR demonstrates potential in reducing the number of unnecessary CT examinations in patients with mild head injury, it also has limitations regarding its specificity. (11)

Conclusion

Based on the results of our study, it can be concluded that head injuries, as one of the most common reasons for Emergency Department visits, represent a significant diagnostic challenge. Although head CT remains the gold standard in the evaluation of head trauma, its use is often non-selective.

The Canadian CT Head Rule (CCHR) is a highly sensitive clinical decision-making tool whose application may contribute to reducing the number of unnecessary head CT examinations. However, the CCHR is not a triage method and should not be applied in isolation, as a substantial proportion of pathological CT findings could otherwise remain undetected.

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