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Geriatric Emergency Medicine Fellowship Journal Club: To CT or Not

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INTRODUCTION

Head injury is an increasingly common presenting complaint for older adults in the Emergency Department (ED). From 2007 to 2013, the number of traumatic brain injury (TBI)-related ED visits in adults 65 years and older increased from approximately 220 000 to 485 000 cases in the United States.¹ Most of these injuries were fall-related. Fall-associated intracranial hemorrhages (ICH) in older adults are also increasing.² The mortality rate associated with traumatic ICH is 15% and ICH accounts for one-half of all fall-associated deaths in older adults.^{3,4} Clinical evaluation of geriatric trauma patients is complicated by frailty, polymorbidity, polypharmacy, anatomic and physiologic changes, and medication effects.⁵ Practice variation exists among emergency clinicians around when to obtain neuroimaging in older adults with falls, in part due to multiple clinical decision rules and misconceptions exist around their use. This article is a summary of the Journal Club on this topic held by the Geriatric EM Fellowship Journal Club series held on November 4, 2021, presented by the three authors. We review three articles that address the risk factors for ICH in older adults and that use clinical decision rules for guiding imaging in this population.

CASE

You are working an overnight shift at an academic center with 24-hour access to imaging and trauma consultants. EMS transports a 94-year-old woman from her long-term care home/skilled nursing facility (LTCH/SNF). She has a past medical history of stroke, hypertension, dyslipidemia, and hypothyroidism. Her medications are clopidogrel, amlodipine, atorvastatin, and levothyroxine. She had a witnessed fall and was seen to strike her head while being transferred by a personal support worker. There was no history of loss of consciousness, amnesia, or confusion as per the staff at her LTCH/SNF. According to her daughter who is at the bedside, her mother is not cognitively different from usual and both patient and daughter would like to return to her LTCH/SNF. The patient's chart states she is bed-bound due to severe congestive heart failure (Clinical Frailty Score of 8). She has a frontal hematoma on exam and no other injury. **Would you perform a head CT on this patient?**

Article 1
Stiell I, Clement C, Rowe B et al. Comparison of the Canadian CT Head Rule and the New Orleans Criteria in Patients with Minor Head Injury. JAMA 2005;294:1511-1518. https://pubmed.ncbi.nlm.nih.gov/16189364/
Presenters
Marie-Pier Lanoue MDCM, FRCPC(EM)
What Question Did this Investigation Aim to Answer?
In the adult population, can the Canadian CT Head Rule (CCHR) and the New Orleans Criteria (NOC) be used to predict neurosurgical intervention and clinically important brain injury (CIBI)?
What Study Design Did the Authors Choose?
<p>The authors performed a prospective cohort study from June 2000 to December 2002 at 9 community and academic EDs in Canada. Consecutive adult patients aged 16 years and older who presented to the ED with blunt head trauma resulting in mild TBI (GCS 13-15 and loss of consciousness, amnesia, or disorientation) were included. Patients presenting with minimal head injury were ineligible and excluded from this study. Minimal head injury was defined as: no loss of consciousness (LOC), no amnesia, or no disorientation.</p> <p>Clinically important brain injury was defined as every intracranial bleed except solitary contusion less than 5 mm, localized subarachnoid hemorrhage less than 1mm in thickness, subdural less than 4 mm in thickness and closed depressed skull fracture not involving the inner table. Emergency physicians collected data using a standardized NOC criteria form for every patient with a GCS of 15 and the CCHR criteria for every patient with a GCS 13-15. Emergency physicians underwent a 1-hour training session given by the principal investigator prior to the start of the study.</p>
How did the Authors Interpret the Results?
2707 individuals with a GCS of 13-15 were enrolled. The CCHR was evaluated on all of those individuals. 1822 individuals had a GCS of 15 and NOC criteria were collected. Patients were mainly men, age range from 16 to 99 years old, with only 11.8% of the NOC group being 60 years or older and only 6.8% of the CCHR group being 65 years or older. The main mechanism of injury was motor vehicle collision (MVC) accident and only 15% of the participants had a fall of less than 5 stairs as the mechanism causing head injury. The two most common clinically important brain injuries encountered were cerebral contusion and subarachnoid hemorrhage. In patients with GCS of 15, both CCHR and NOC had a sensitivity of 100% at predicting both neurosurgical intervention and clinically important brain injury. In patients with GCS 13-15, the CCHR had a sensitivity of 100% at predicting both neurosurgical intervention and clinically important brain injury.
Discussion / How Might this Study Affect your Clinical Practice in the Emergency Department?
<p>The CCHR and the NOC are two well-known clinical decision rules used in the ED. Despite their frequency of use, there are common misunderstandings about who to apply these rules. Many clinicians interpret the age cut-offs of the rules to imply that all older adults require head CT imaging. The CCHR is applied to individuals with a mTBI, defined as a blunt head trauma with a GCS of 13-15 and loss of consciousness, amnesia, or confusion. For the NOC, patients should have a minor head injury defined as a head trauma with loss of consciousness and a GCS score of 15, to meet the inclusion criteria of the rule. Minimal head injury doesn't meet the inclusion criteria of both NOC and CCHR. Patients 60 years and older aren't deemed to get neuroimaging if they sustained only a minimal head injury.</p> <p>REMEMBER: To meet the inclusion criteria for the CCHR, your patient must have sustained a mTBI, defined as a blunt head trauma with a GCS of 13-15 and loss of consciousness, amnesia, or confusion. To meet the inclusion criteria of the NOC, your patient must have sustained a head trauma with an episode of LOC and have a GCS of 15. If they didn't have those symptoms, they have a minimal head injury and were not included in the initial studies!</p> <p>When looking at the original study, we can conclude adults older than 65 years old who suffered a mild TBI are at increased risk of intracranial hemorrhage. However, if our patient didn't suffer from loss of consciousness, amnesia, or disorientation, and therefore would be defined as having a minimal head injury such that neither the CCHR nor the NOC would be utilized to aid in clinical imaging decisions. ED physicians should use their clinical judgment to decide if imaging is required in those situations. It is important to note that this study examines adults from all age groups and only a small percentage of them were older. Also, the main mechanism of injury was a car accident and not a fall from own height like we tend to see in the older population. Likely due to injury mechanism, most CIBI encountered were cerebral contusions and subarachnoid hemorrhages, as opposed to subdural hematomas which are more commonly seen in older adults.</p>

Article 2
De Wit K, Parpia S, Varner C et al. Clinical Predictors of Intracranial Bleeding in Older Adults Who Have Fallen: A Cohort Study. JAGS 2020;68:970-976. https://pubmed.ncbi.nlm.nih.gov/32010977/
Presenters
Kira Gossack-Keenan MD
What Question Did this Investigation Aim to Answer?
What clinical variables can be used to predict intracranial bleeding in adults aged 65 and older with a fall within the last 48 hours?
What Study Design Did the Authors Choose?
<p>This was a prospective cohort study across 3 Canadian ED. Inclusion criteria were age 65 or older and a fall (on level ground, off a bed, chair, or toilet, or from 1-2 steps) within the last 48 hours. History of head injury was not a requirement. Patients were excluded if they were transferred from another site, left the ED against medical advice, or if living outside the medical record catchment area.</p> <p>The primary outcome was intracranial bleeding diagnosed either by CT at the index visit, or within the follow-up period. All patients were followed for 42 days with electronic medical records (EMR) review (regardless of CT at index visit) to look for delayed bleeding. Other data collected included patient comorbidities, medications, Glasgow Coma Scale, signs of head injury, and neurologic abnormalities. Multivariable logistic regression was then used to determine predictors of intracranial hemorrhage (ICH).</p>
How did the Authors Interpret the Results?
<p>The four clinical factors found to be most strongly independently associated with ICH were: new abnormality on neurologic examination, head laceration or bruise, chronic kidney disease and Glasgow Coma Scale (GCS) reduced from normal. No association was found between anti-platelet or anti-coagulation usage and ICH.</p> <p>The authors interpreted this to mean that in addition to currently accepted indications, any patients with new neurologic abnormalities or signs of head trauma (laceration or bruise) should receive CT head imaging in the ED.</p>
Discussion/How Might this Study Affect your Clinical Practice in the Emergency Department?
<p>This study is particularly applicable to patients with a fall without a clear history of head injury. Signs of external head trauma should be a key factor in pushing clinicians to obtain head imaging. This study also provides important data to discuss with oriented patients in shared decision-making regarding head imaging after a fall.</p> <p>Although an association with anti-platelet or anti-coagulation usage and increased risk of bleeding was not found, further research is needed to examine this lack of association. This study should not be used to justify decisions not to obtain head imaging in patients receiving these medications. Further study is also needed to explore a potential positive association between the presence of chronic kidney disease and the risk of ICH.</p>

Article 3
Fournier N, Garipey C, Emond M et al. Adapting the Canadian CT head rule age criteria for mild traumatic brain injury. <i>BMJ</i> 2019;36:617-619. https://pubmed.ncbi.nlm.nih.gov/31326953/
Presenters
Marie-Pier Lanoue MDCM, FRCPC(EM)
What Question Did this Investigation Aim to Answer?
In the adult population with a mild Traumatic Brain Injury (mTBI), does changing the age cutoff for imaging from 65 years old to 75 years old make us miss clinically important brain injury?
What Study Design Did the Authors Choose?
The authors performed a retrospective cohort study from 2010 to 2014 in a Level 1 trauma center ED in Quebec, Canada. They recruited patients aged 65 years and older who presented to the ED less than 24 hours after a blunt head trauma resulting in mild TBI (GCS 13-15 + loss of consciousness, amnesia, or disorientation). Those who had had a CT head performed were included. Patients with coagulopathy, taking anticoagulants, those who did not undergo head CT, and those who presented to the ED > 24 hours after their trauma were excluded. Medical records were assessed by 5 research assistants and 5% of those were reviewed by an additional research assistant for interobserver agreement. Clinically important brain injury was assessed by the radiologist and was defined as every intracranial bleed except solitary contusion less than 5 mm, localized subarachnoid hemorrhage less than 1mm in thickness, subdural less than 4 mm in thickness and closed depressed skull fracture not involving the inner table.
How did the Authors Interpret the Results?
A total of 104 patients met the inclusion criteria. The mean age was 76.9 years and 57.7% of those included were male. 30.7% (32 patients) had a CIBI and 25% of those (8 patients) had no positive CCHR criteria except for age, showing that age is still a risk factor for CIBI after a mTBI. The CCHR kept its 100% sensitivity with an age criterion increased to 75 years old. When going above this limit, some cases of CIBI were missed (3 cases – 9.4% would have been missed with an age criterion of 80 years old). In their cohort of patients, increasing the age criteria to 75 years old would reduce by 25% the use of CT brain in the 65-74 years old age group and missed zero CIBI.
Discussion/How Might this Study Affect your Clinical Practice in the Emergency Department?
The Canadian CT Head Rule is used worldwide for clinical decisions regarding whether or not to image patients with brain injury. This article further emphasizes the inclusion criteria of mTBI (amnesia, loss of consciousness, or disorientation) of the CCHR. It also demonstrates how age is indeed a risk factor for intracranial hemorrhage. However, it starts an interesting debate of what is old in 2021? In 2001 when the first CCHR studies came out, those > 65 years old were excluded. But with the aging of the population, we see more and more robust older adults. Do the “old” criteria need to change? This study seems to show that “old” is 75 years and older, which would allow us to decrease our usage of the CT brain in the ED for the 65-74 years age group, which will decrease their length of stay in the ED. It is important to keep in mind that this study was done in a single academic and trauma center with a neuroradiologist and the presence or absence of CCHR criteria was determined by the research assistant from the patient record. Meaning that if the clinician didn't note a criterion on the chart, it was considered negative by the research team. This could affect sensitivity.

CASE CONCLUSION

You go and assess your patient, with the daughter at the bedside. You conclude that your patient didn't suffer a mTBI (mild traumatic brain injury), but instead had minimal head trauma and thus doesn't fit the inclusion criteria from the CCHR or NOC. You share decision-making with the patient and the daughter, explaining to them that the apparent frontal hematoma puts her at increased risk of intracranial bleeding and could be an indication for brain imaging. After a discussion regarding goals of care, both the patient and the daughter thank you but decline imaging and the patients returns back to her LTCH/SNF.

KEYWORDS

Head trauma, imaging, CT head

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Marie-Pier Lanoue and Kira Gossack-Keenan are co-principal authors and shared conceptualizations, writing and revision of this article. Don Melady, the senior author, provided oversight for the project.

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