Evaluation of Head Injury in the Emergency Department

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KEYWORDS

• Older adult • Head injury • Emergency department

KEY POINTS

- Low-energy, ground-level falls are the most common cause of intracranial bleeding in older adults.
- The Canadian CT Head Rule and the Falls Rule identify older adults who require computed tomography after head injury or falling.
- Evidence to date suggests that warfarin users have a slightly higher risk of intracranial bleeding after head injury, but direct oral anticoagulants users do not.
- Maintain a high level of suspicion for cervical spine injury in older adults that have fallen, even in those without neck pain.

INTRODUCTION

Older adults (people aged 65 years and older) are at risk of traumatic intracranial bleeding because there is loss of the elastic integrity of the cerebral bridging veins and brain atrophy, allowing rapid movements of the brain with trauma. In addition, older adults are much more likely to fall due to multiple overlapping conditions that contribute to a higher risk of falls. Traumatic intracranial bleeding is much more prevalent in older adults compared to the younger population.[1] Although the incidence of traumatic intracranial bleeding among younger adults is decreasing, the incidence in older adults is increasing[2] and has a much worse prognosis.[3,4] In younger adults, traumatic intracranial bleeding results from high-energy impacts such as motor vehicle accidents and falling from heights. In contrast, 80% of traumatic intracranial bleeding diagnoses in older adults result from low-energy falls from standing or sitting.[5]

Falling from standing height is the most common cause of traumatic intracranial bleeding.[2,6–8] Emergency department (ED) visits for fall-associated intracranial

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bleeding in older adults have increased.[2,7,9,10] There is a growing population of older adults with multimorbidity,[11–13] frailty,[14,15] and polypharmacy[11–13] at risk of falls who are less able to withstand brain trauma. Between 15% and 20% of older adults who sustain an intracranial hemorrhage from a ground-level fall die, and the mortality rates are worsening rather than improving.[16,17] There has been little research explaining this trend, which could be due to many factors including longer life expectancy and a growing population living with frailty. There is a dearth of evidence to guide prognostication and management of intracranial bleeding in older adults.

OUTCOMES FROM HEAD INJURY IN OLDER ADULTS

Emergency physicians should be aware of the important complications of head injury in older adults, the most obvious complications being intracranial bleeding and death. A population study reporting on older adults presenting to Canadian EDs with a head injury found the overall incidence of intracranial bleeding to be 6%.[18] A meta-analysis reported that 5% of older adults presenting to the ED after a fall were diagnosed with intracranial bleeding.[19] Delayed intracranial bleeding after normal brain imaging is not common, occurring in less than 1% of older adults presenting with a head injury.[20]

Traumatic brain injury in older patients differs from that seen in younger adults. Falls are the most common mechanism of head injury in older adults, and it is not always clear whether intracranial bleeding is caused by the fall preceding the diagnosis, or whether prevalent, ongoing intracranial bleeding was the cause of the fall. This is especially true in older adults who have fallen repeatedly; therefore, "fall-associated intracranial bleeding" is probably the most correct term to use.

In older adults, neurosurgical intervention is generally reserved for large subdural hematomas.[21] In a prospective database cohort study, Tverdal and colleagues[22] reported that adults aged 75 years and above had an odds ratio of 0.41 (0.22–0.77) and those aged 90 years and above had an odds ratio of 0.1 (0.02–0.43) of neurosurgical intervention compared with younger patients.

Not all types of intracranial bleeding in older adults have the same prognosis. The mortality following traumatic subdural bleeding in older adults has been reported to range between 20% and 70%.[23] In contrast, the mortality following isolated traumatic subarachnoid bleeding is much lower, quoted to be less than 1%.[24] Mortality rates can also be difficult to interpret since many older adults sustain a head injury when the fall is provoked by a medical illness, and death may be secondary to coexisting acute medical conditions. Mortality rates are further confounded by baseline frailty, which is a strong predictor of both community-dwelling mortality[25] and falls.[26,27]

There is uncertainty about the functional impact of a traumatic brain injury in older adults. Here we define traumatic brain injury as an head injury associated with an alteration in brain function, a period of decreased or loss of consciousness, amnesia, neurologic deficit, or altered mental status.[28] One study showed that older adults have worse functional, physical, and cognitive outcomes following hospitalization for traumatic brain injury compared to younger adults.[29] A meta-analysis reporting on only 2305 patients found that 62% of older adults who were admitted for a traumatic brain injury had an unfavorable Glasgow Outcome Score at 12 months.[30] There was significant heterogeneity in this outcome with one study reporting unfavorable outcome following mild traumatic brain injury to be only 2.5%.[31] A cohort study following 161 older adults reported that only 54% completely recovered after traumatic brain injury and 33% had moderate or severe disability.[32] However, a study recruiting older adults with a history of self-reported "serious head injury" found no

difference in neuropsychiatric functioning compared to those who had not.[33] Because there has been so little research in this domain, there is no internationally recognized list of complications following traumatic brain injury in older adults (other than hospitalization, neurosurgery, and death). As a result, we do not have evidence-based ways to identify those at risk of deteriorating function and no recognized effective evidence-based interventions.

CHALLENGES ASSESSING PATIENTS WHO HAVE FALLEN

Overall, falls are the most common mechanism of head injury among all ED patients. Falls account for 4 fold more head injuries than motor vehicle accidents.[10] The clinical assessment of older adults who present after a fall can be challenging for several reasons. First, in over 10% of cases, it is not possible for the treating physician to determine whether the patient hit their head.[34] Cognitive impairment, delirium, deafness, and communication problems can interfere with history taking, and falls are frequently unwitnessed. Although the presence of a laceration or bruise is positively associated with intracranial hemorrhage, the absence of a bruise or laceration does not exclude it.[35] Second, neurologic examination can be difficult to conduct because of disabilities such as reduced visual acuity, deafness, cognitive impairment, and higher prevalence of baseline neurologic disability. For example, unilateral limb weakness may be from a prior stroke, may be worse compared to baseline, or may be a new finding. Even when objective scales such as the Glasgow Coma Scale for level of consciousness are applied, without caregiver or family input, it can be challenging to determine whether the patient is at their baseline level of alertness.

EVIDENCE-BASED APPROACH TO DIAGNOSIS OF INTRACRANIAL BLEEDING

The Canadian CT Head Rule (**Fig. 1**) is the most validated clinical decision rule designed to be applied to head-injured ED patients who experienced loss of consciousness, amnesia, or disorientation following a head injury.[36–38] The Canadian CT Head Rule identifies patients at risk of clinically important brain injury and indicates that all patients aged 65 years or older should have brain imaging. The rule is also highly sensitive when applied to patients without a history of loss of consciousness, amnesia, or disorientation.[39] However, the clinical utility of the rule has not been established when the history of head injury is unclear. Other less well-validated head injury rules include age 60[40,41] or 65 years[42] as an indication that brain imaging is required in the ED.

The recently derived Falls Decision Rule (**Fig. 2**) identifies patients at an increased risk of clinically important fall-associated intracranial bleeding and aligns with previous findings indicating all older adults presenting to the ED after a fall should have brain imaging if they hit their head.[34] The Falls Decision Rule provides additional guidance that brain imaging is required even in the absence of head injury in the following circumstances: when the history of head injury is unclear, when a new neurologic deficit is detected on clinical examination, when the patient cannot recall the events of the fall, or when the Clinical Frailty Scale[43,44] indicates at least mild frailty (scoring 5 or more on the Clinical Frailty Scale). To summarize, the best available evidence suggests that all older adults who present to the ED after a head injury or a possible head injury should have brain imaging (most commonly head computed tomographic [CT] scanning). Brain imaging should also be considered to rule out fall-associated intracranial bleeding if there is a new neurologic deficit, the patient cannot recall the fall, or the patient has a Clinical Frailty Scale score of 5 or more.

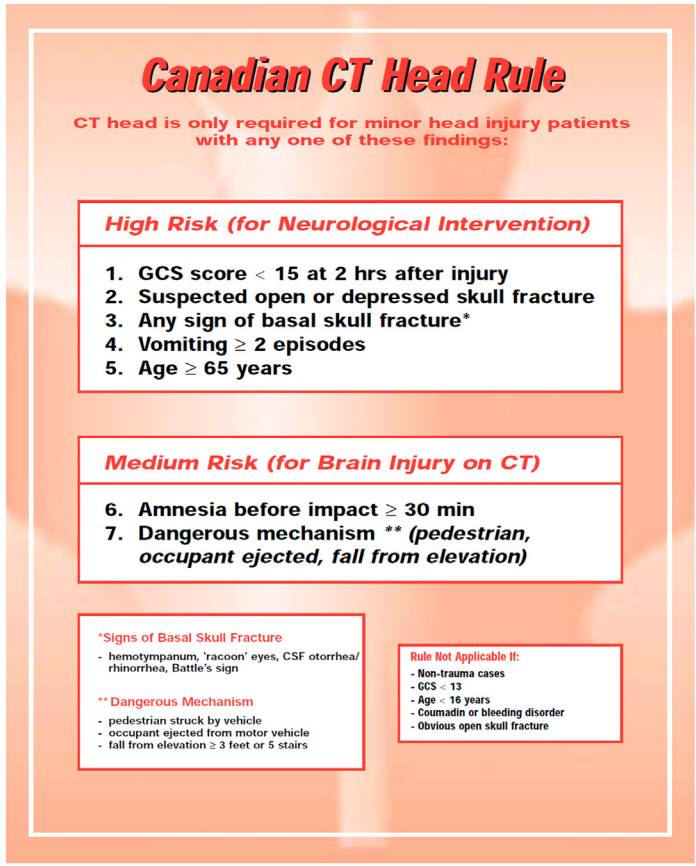

Fig. 1. Canadian CT Head Rule poster. CSF, cerebrospinal fluid; GCS, Glasgow Coma Scale. (*Reprinted with permission from* Elsevier. The Lancet, 2001; 357: 1391-96.)

HOW DO ANTICOAGULANT OR ANTIPLATELET MEDICATIONS CHANGE THE APPROACH TO TESTING FOR TRAUMATIC BRAIN INJURY?

Mounting evidence suggests that direct oral anticoagulants (DOACs) do not increase the risk of intracranial bleeding in head trauma. A matched cohort study of over 8000 head-injured older emergency patients prescribed DOACs reported an adjusted odds ratio (aOR) for intracranial bleeding of 0.94 (95% confidence interval [CI]: 0.83–1.05) compared to those not prescribed anticoagulation.[18] In contrast, the aOR for patients prescribed warfarin was 1.43 (1.20–1.69) compared to patients not prescribed anticoagulation. Multiple prospective studies support these findings,[34,35,45,46] meaning there is no indication to perform brain imaging to diagnose traumatic brain injury in an older adult who did not hit their head on falling, simply based on their use of a DOAC medication.

Although less well studied, a recent meta-analysis of studies reporting on the rate of intracranial bleeding among head-injured patients taking antiplatelet medications and those who were not prescribed antiplatelet medications reported an increased risk ratio of 1.51 (1.21–1.88).[47]

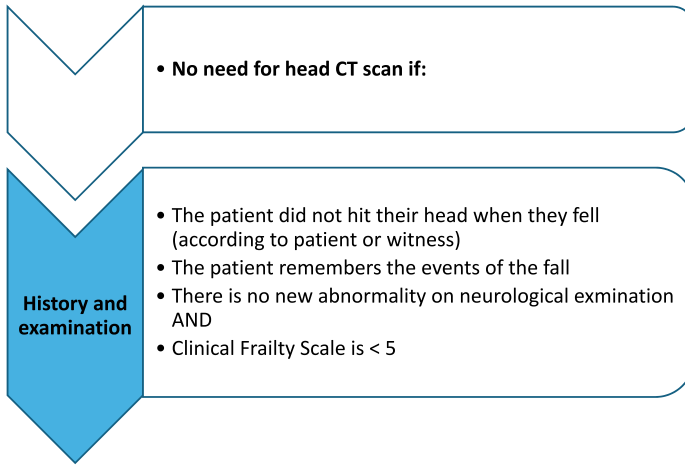

Fig. 2. The Falls Decision Rule. (*Data from* de Wit K, Mercuri M, Clayton N, Mercier É, Morris J, Jeanmonod R, Eagles D, Varner C, Barbic D, Buchanan IM, Ali M, Kagoma YK, Shoamanesh A, Engels P, Sharma S, Worster A, McLeod S, Émond M, Stiell I, Papaioannou A, Parpia S; Network of Canadian Emergency Researchers. Derivation of the Falls Decision Rule to exclude intracranial bleeding without head CT in older adults who have fallen. CMAJ. 2023 Dec 3;195(47):E1614-E1621.)

A population-level study[18] reported no difference in the rate of delayed intracranial bleeding among older emergency patients managed for head injury while taking a DOAC (1.0%) compared to no anticoagulation (also 1.0%). The delayed intracranial bleed rate for warfarin was 1.8% (aOR 1.5, 1.1–2.1). This finding was at odds with a meta-analysis reporting higher rates of delayed bleeding among those on DOACs (2.4%, 1.3%–3.9%) and warfarin (2.3%, 1.3%–3.7%).[48] A recent meta-analysis reported the pooled rate of delayed intracranial bleeding among patients prescribed a single antiplatelet to be 0.8% (0.2%–1.5%) and double antiplatelet medications 2.6% (0.0%–7.6%).[49]

Overall, the evidence on the rate of delayed intracranial bleeding among head-injured people who are prescribed antithrombotics is limited.

THE NEED FOR CERVICAL SPINE IMAGING

When an older adult presents with a head injury, the clinician should consider the possibility of cervical spine injury. In the general adult population, the incidence of cervical spine injury associated with clinically significant head injury is 4% to 8%.[50,51] McCallum and colleagues[52] conducted a systematic review that estimated the prevalence of cervical spine injury in adults aged 65 years and older after low level falls. They found 21 studies (N = 17,192) and reported a pooled prevalence of 3.8%. There is significant morbidity and mortality associated with cervical spine fractures in older adults.[53,54] They are more likely to have high cervical spine fractures that are clinically unstable 50% of the time.[55] As discussed previously, there are a multitude of reasons that completing an accurate history and reliable physical examination of an older adult can be difficult. With respect to neck injuries, detection by examination is particularly challenging as it has been found that up to 21% of older adults with cervical spine fracture may be completely asymptomatic. In a trauma database cohort study of older (55 years of age or older) adults, the sensitivity and specificity of reported pain on

history or physical examination were 79.2% (CI: 72.4%–85.0%) and 59.6% (CI: 56.3%–62.8%), respectively, for cervical spine fracture. Neurosurgical intervention for the fractures was undertaken in 22% and 19% of the symptomatic and asymptomatic patients, respectively, while 61% of patients with neck pain and 47% without neck pain were treated with hard cervical collar.[56]

Trauma guidelines advocate for CT of the cervical spine over plain radiography in older patients with trauma.[57] Cervical spine CT angiography is recommended for screening when there is clinical suspicion of blunt cerebrovascular neck injury. Because of the increased incidence of spinal stenosis and degenerative disc disease, central cord syndrome or spinal cord injury is more common in the geriatric population, and MRI is recommended to evaluate when there is a concern for cord compression or neck pain or tenderness out of proportion with CT findings.[58]

And, finally, a word on immobilization prior to imaging. Expedient imaging is recommended, as use of cervical collars can lead to skin breakdown in as little as 2 hours, and prolonged immobilization is associated with delirium and pneumonia.[59] There is a lack of quality evidence on outcomes associated with prehospital immobilization in adults with suspected cervical injuries,[60] and as a result, perspectives on the use of hard collars are varied. Hard collars may not be appropriate for all older adults with fixed spinal kyphotic postures or cognitive impairment, and providing soft padding in a position of comfort may be acceptable.[61]

CLINICS CARE POINTS

- The Canadian CT Head Rule and the Falls Rule identify older adults who require CT after a head injury or falling
- Evidence to date suggests that warfarin users have a slightly higher risk of intracranial bleeding after head injury, but DOACs users do not
- Delayed intracranial bleeding after normal CT is rare
- Maintain a high level of suspicion for cervical spine injury in older adults that have fallen, even in those without neck pain

DISCLOSURE

The authors have no conflicts of interest.

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