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Head Injuries and Cirrhosis: Does Everyone Need a CT Scan?

Urgent message: The decision of whether or not to image a patient with a head injury has significant implications—for the patient *and* the urgent care provider. Understanding which patients are at greatest risk for serious head injury, indications for testing, and options for management/disposition is essential.

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Case

A 47-year-old male with a history of alcohol abuse and cirrhosis presents to an urgent care center after hitting his head on a cement column during "a minor altercation" with a family member. When he developed a 3x3 cm hematoma on the posterior scalp, his family became concerned and transported him to your facility.

Per reports from the family, the patient was alert and oriented and maintained his cognition throughout the transport. He could recall the event without amnesia and denied any loss of consciousness (LOC). His Glasgow Coma Scale (GCS) score on arrival was 15. He stated that he did consume alcohol earlier in the morning, but denied being intoxicated on presentation to the urgent care. His level of alertness and ability to answer all questions appropriately during the history and physical exam corroborated this claim. His pupils were equal, round, and reactive to light and he had no evidence of basilar skull fracture. He had no lacerations on exam. His hematoma was not weeping, expanding, or bleeding. He was noted to have mild scleral icterus. His Canadian CT Head Rule (CCHR) score was 0 on arrival. He did not meet the standard for New Orleans Criteria (NOC) use due to the fact that he did not lose consciousness. He did not seek medical care for his cirrhosis routinely, though he was a daily alcohol drinker. His chronic medical conditions were not under control.

Shortly after initial evaluation, the patient was found to be "sleeping" and "snoring." His vital signs remained stable. The tech tried to wake the patient, but he was unarousable. The physician then entered the room and on exam the pupils were found to be unequal, with the left pupil larger than the right. His oxygen saturation was noted to be in the 70s. The staff began to assist his

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ventilation and called 911.

Once in the ED, his airway was secured by endotracheal (ET) intubation and he was taken immediately to the computed tomography (CT) scanner, which revealed a large subdural hematoma (SDH) with a significant midline shift. In addition, he was found to have a significant coagulopathy. He was given fresh frozen plasma (FFP), platelets, and vitamin K.

Despite intervention, he died 3 days after the initial injury.

Here, we review the criteria for imaging in patients with head injuries, and discuss the major risks associated with even minor head injury mechanisms in cirrhotic patients.

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Traumatic Brain Injuries

Intracranial bleeding can be characterized as an epidural hematoma (EDH), intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), or SDH. They can be spontaneous or traumatic. Causes of nontraumatic intracranial bleeds are numerus and include hypertension, vascular malformation, and bleeding disorders. Traumatic brain injuries (TBI) can be caused by a blunt injury or penetrating injury and can result in any of the different types of intracranial bleeds.

TBIs can range from inconsequential to fatal. They are, however, one of the leading causes of mortality in the United States. Many of the deaths from TBI occur in the elderly population,[1] including approximately 50,000 deaths per year resulting from TBI.

Cirrhotic patients comprise a high-risk population within this group. They are a higher risk subset of the population due to their propensity for falls and varying degrees of coagulopathy.[1] In fact, ground-level falls are the most common injury mechanism among cirrhotic patients.[1-3] Following a ground-level fall in a cirrhotic patient, the risk for progression of an intracranial bleed is typically higher due to the coagulopathy that accompanies cirrhosis.[1,4] TBI in a cirrhotic patient is also associated with worse in-hospital outcomes. Cirrhotics with TBIs have been shown to have longer stays in the intensive care unit (ICU) and increased ventilator days.[5] They have also been found to have a nearly two-fold increased mortality (34% vs 18.1%).[5]

CCHR and NOC

Two decision rules currently exist to aid practitioners in deciding which adult patients with a head injury should or should not have a CT scan of their head. The CCHR and the NOC are validated clinical decision-making rules.

The CCHR rule was developed to assist providers in ruling out clinically significant brain injury on CT or the need for neurosurgical intervention in those who present with minor head injury.[6] High risk factors are as follows:

- GCS <15 at 2 hours postinjury
- suspected open or depressed skull fracture
- any sign of basilar skull fracture
- ≥two episodes of vomiting
- age >65 years[6]

If the patient is positive for any of these, the rule cannot be used to rule out the need for imaging. There are also medium risk criteria detailed in the CCHR, which include two additional points:[6]

- amnesia for events 30 minutes prior to impact
- dangerous mechanism

It is important to note that high-risk patients such as our patient with a bleeding diathesis were excluded from the study, meaning the CCHR should not be applied to these cases.

The NOC can also be used as a clinical decision-making aid. It should be applied to patients with a head injury and loss of consciousness who present with a GCS of 15 and a normal brief neurologic exam.[7] The criteria include:

- the presence of a headache
- vomiting
- age >60
- alcohol or drug intoxication
- persistent anterograde amnesia
- visible trauma above the clavicle
- seizure[7]

As with the CCHR, if all NOC are negative the guidelines would suggest that the patient not undergo a CT scan of the head. Cirrhotic patients were not excluded in the NOC. In this study, it was documented in the

Table 1. Canadian CT Head Rule vs New Orleans Criteria

Canadian CT Head Rule (CCHR)[6] CT imaging is only required for patients with minor head injury with any one of the following findings. The criteria apply to patients with minor head injury who present with a Glasgow Coma Scale score of 13–15 after witnessed loss of consciousness, amnesia, or confusion.	*High-risk for neurosurgical intervention* • Glasgow Coma Scale score <15 at 2 hours after injury • Suspected open or depressed skull fracture • Any sign of basilar skull fracture (hemotympanum, periorbital ecchymosis, otorrhea or rhinorrhea, Battle sign) • ≥2 episodes of vomiting • Age >65 years *Medium risk for brain injury detection by CT imagine* • Amnesia before impact of ≥30 minutes • Dangerous mechanism (eg, pedestrian vs motor vehicle, ejection from motor vehicle, or fall from an elevation of ≥3 feet or five stairs
New Orleans Criteria (NOC)[7] CT imaging is required for patients with minor head injury with any one of the following findings. The criteria only apply to patients who have a Glasgow Coma Scale score of 15.	• Headache • Vomiting • Age >60 years • Drug or alcohol intoxication • Persistent anterograde amnesia • Visible trauma above the clavicle • Seizure

phase one questionnaire if the patient had a bleeding disorder, but no labs were performed looking exclusively at the risk of bleeding. Childs class and MELD scores were not calculated for these patients either.

The sensitivities of both criteria have been found to be roughly equivalent. There have been studies where each of the two clinical decisions rules have outperformed the other in their sensitivity for predicting the need for neurosurgical intervention and for having positive CT findings. However, the specificity of the CCHR generally outperforms the NOC. One study found that the sensitivity and specificity for the need for neurosurgical intervention were 100% and 60%, respectively, for the CCHR.[8] In comparison, the sensitivity and specificity of the NOC were 82% and 26%, respectively.[8] Another recent study showed that the CCHR was significantly associated with important CT findings while the NOC were not.[9]

Based on this recent evidence it appears that the CCHR is better for predicting those with positive CT findings and those who require neurosurgical intervention.

Additional Factors in Determining Who to Scan

There are other factors, in addition to the CCHR and NOC, that can be used to determine which patients should receive a CT scan after sustaining a TBI. Patients <60 years of age have a decreased risk of mortality from TBI with SDH.[10] Patients >60 had a 25%-63% increase in mortality when compared with younger patients.[10] Mechanism of injury and type of trauma showed no influence in rate of mortality for younger or older patients.[10]

Another factor is the severity of the trauma. The less severe the trauma, the lower the risk of mortality from TBI with SDH.[10]

Finally, the length of time since the injury occurred should be considered. Patients with surgical management <4 hours after the time of injury reported only 30% mortality, vs 90% mortality in patients who did not have surgical management until >4 hours after the time of injury.[10,11] Neurological status of the patient upon arrival to the urgent care is another indicator for the necessity of a CT scan; the more neurologically intact, the less likely the risk of mortality due to TBI with SDH.[10]

Patients presenting with a history of coagulopathy such as cirrhosis should have a CT scan performed. If CT scan is unavailable at the location, the patient should be transferred emergently. Cirrhotic patients have a twofold increase in mortality compared with noncirrhotic counterparts with TBIs.[5]

Physical Examination

Neurological

A patient presenting with a chief complaint of head injury or suspicion for TBI should have a good neurological examination completed upon arrival to the urgent care. This exam should include testing of mental status,

cranial nerves (CN), sensation, strength, and motor function.

Mental status

The mental status can often be assessed simply upon walking into the room, based on the patient's level of consciousness. If the patient is alert, the mental status exam can be expanded to include attention, concentration, memory, language, mood, thought, etc.[12] A GCS should be administered to patients suspected of having a TBI. The GCS score is an independent value that allows one to confidently use both the CCHR and NOC prediction rules.

Cranial nerves

To assess the CNs, first examine the eyes. The pupils should be equal, round, and reactive to light. This will test CN II. Evidence of anisocoria should be acted on quickly, especially in a patient with a GCS <15 or signs of more severe TBI. If anisocoria is present and the patient is alert and oriented, ascertain whether this is their typical baseline. One approach is to coordinate with family members; another is to review the record for prior documentation of anisocoria.

CNs III, IV, and VI are evaluated with extraocular movements when the patient tracks a finger or object. CN V can be assessed by lightly touching the patient's face in the three distinct distributions of CN V. Facial strength and symmetry occur due to CN VII and should be tested by having the patient smile and raise their eyebrows. CN VIII is auditory function and can be assessed by rubbing one's fingers on either side of the patient's head near their ears. Examine the soft palate for symmetrical movement and the uvula for midline placement when assessing CN IX and X. To test the spinal accessory nerve, CN XI, have the patient shrug their shoulders and perform rotation of the neck to the left and right. To assess CN XII, have the patient protrude their tongue and move it side to side.

Sensory

A sensory examination should also be conducted; this may include testing of light touch, pain, temperature, vibration, stereognosis, graphesthesia, point localization, two-point discrimination, and extinction.[12] If TBI is present, the patient's own ability to cooperate with the examiner for all these tests may also be inhibited.

Motor

The motor exam includes gait, coordination, involuntary movements, pronator drift, strength, muscle bulk, muscle tone, and assessing upper vs lower motor neuron lesions.[12] Pronator drift is tested by having the patient close their eyes, extend their arms fully while keeping them supinated, and watching for 5-10 seconds for any signs of pronation of the extremities or downward drift of the arms.[12] Pronator drift may be a sign of an intracranial bleeding.

The deep tendon reflexes, plantar response, and superficial reflexes can all be evaluated.[12] Repeat neurological examinations may be performed to assess for decompensation if there is a notable delay between time of injury and initial exam.[13] A delayed bleed is thought to be related to the bleeding of microvessels that are damaged during the initial injury.[13] Changes in the neurological examinations are one key way that we can assess for changes that mandate advanced imaging.

"Only 12% of cirrhotics with TBI underwent neurosurgical intervention, compared with 25% of those without cirrhosis. This was a statistically significant difference."

Neurosurgical Interventions

As with the initial CT scan, timing is important with regard to neurosurgical intervention. Patients with earlier surgical interventions have markedly reduced mortality rates.[10] Even when the diagnosis is known and the patient has the opportunity to be operated on within the critical 4-hour window, improvement is not guaranteed.

A study by Langness, et al showed that only 12% of cirrhotics with TBI underwent neurosurgical intervention, compared with 25% of those without cirrhosis.[1] This was a statistically significant difference between the two groups. It was also observed that cirrhotics who underwent emergent neurosurgical decompression had mortality rates similar to noncirrhotics undergoing neurosurgical intervention, suggesting that the risk of operating on a cirrhotic is high.[1]

In the case described above, neurosurgical decompression was not performed as his Childs class score and MELD score made him a poor surgical candidate. The timing of the intervention would have been close to the 4-hour postinjury mark, but the patient had already herniated at this point and the outcome of surgery would have likely been poor.

Another limiting factor may be lack of medication and blood products for transfusion. Prothrombin concentrate complex (PCC) was requested by the receiving neurosurgery team, to be used for reversal of our patient's coagulopathy; the patient was treated with vitamin K, platelets, and FFP, but PCC was not available. There is one study showing PCC to be superior to FFP in normalizing the INR and decreasing hematoma expansion, but it did not report on its effect on meaningful clinical outcomes.[14]

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In a study that took place from 2004 to 2009, the most common cause for complication, and ultimately mortality, in TBI patients with a history of cirrhosis was hemorrhage during or after surgery.[15] Of the patients who underwent a procedure, 84.4% experienced a complication and 68.8% experienced rebleeding.[15] The complication rate, rebleeding rate, and mortality rate all increased from Childs class A to Childs class C cirrhotics.[15] In a separate study, preoperative and perioperative management and correction of coagulopathy improved survival rates of cirrhotics undergoing neurosurgical intervention.[16]

Conclusion

Patients with a head injury present extensive challenges regarding the decision to image, and disposition. Concern is for development of an EDH, SDH, ICH, or SAH. Hypocoagulable patients, due to an underlying process such as cirrhosis or medications, are at high risk for bleeding and poor outcomes.

Physicians in urgent care settings should be encouraged to use the validated clinical decision rules (CCHR and NOC) when evaluating a patient presenting with a chief complaint of head injury. However, they must use extreme caution if electing to use the NOC to rule out the need for CT scan in a hypocoagulable patient. Of note, the CCHR should not be applied to the cirrhotic patient since they were excluded from the study.

The physician in the urgent care setting must be thorough with neurological examinations and repeat them frequently when concern as to the severity of TBI exists.

If a CT scan is indicated, it should be done quickly; if it shows any type of intracranial bleed, the timing of neurosurgical intervention is critical.

Overall, trauma and hypocoagulable patients are a very deadly combination. Extreme care needs to be taken in any patient who presents to an urgent care center with the combination of these two diagnoses.

It is our recommendation to strongly consider CT scan of every patient with cirrhosis who presents to urgent care after any type of head trauma. This case illustrates how quickly these patients can deteriorate.

If the urgent care location does not have the ability to perform a CT scan, the patient should be transported quickly to a facility that can both perform a CT scan and has a neurosurgeon available to operate, if needed. ■

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