ACR Appropriateness Criteria Head Trauma

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Abstract

Neuroimaging plays an important role in the management of head trauma. Several guidelines have been published for identifying which patients can avoid neuroimaging. Noncontrast head CT is the most appropriate initial examination in patients with minor or mild acute closed head injury who require neuroimaging as well as patients with moderate to severe acute closed head injury. In short-term follow-up neuroimaging of acute traumatic brain injury, CT and MRI may have complementary roles. In subacute to chronic traumatic brain injury, MRI is the most appropriate initial examination, though CT may have a complementary role in select circumstances. Advanced neuroimaging techniques are areas of active research but are not considered routine clinical practice at this time. In suspected intracranial vascular injury, CT angiography or venography or MR angiography or venography is the most appropriate imaging study. In suspected posttraumatic cerebrospinal fluid leak, high-resolution noncontrast skull base CT is the most appropriate initial imaging study to identify the source, with cisternography reserved for problem solving.

The ACR Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed every three years by a multidisciplinary expert panel. The guideline development and review include an extensive analysis of current medical literature from peer-reviewed journals and the application of a well-established consensus methodology (modified Delphi) to rate the appropriateness of imaging and treatment procedures by the panel. In those instances in which evidence is lacking or not definitive, expert opinion may be used to recommend imaging or treatment.

Key Words: Appropriateness Criteria, head trauma, traumatic brain injury, vascular, cerebrospinal fluid leak, neuroimaging

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The ACR seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply individual or society endorsement of the final document.

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SUMMARY OF LITERATURE REVIEW

Introduction/Background

Head trauma is a common neurologic condition and is associated with significant long-term morbidity and mortality. Neuroimaging plays a critical role in the management of head trauma, from identifying patients with traumatic brain injury (TBI) and determining which of those injuries require immediate treatment to assisting in patient prognosis [1,2]. The Glasgow Coma Scale (GCS) score is commonly used to stratify the severity of TBI into mild (GCS scores of 13-15), moderate (GCS scores of 9-12), and severe (GCS scores of 3-8) [1-3]. Head trauma in pediatric patients is addressed in the ACR Appropriateness Criteria® on head trauma in children [4].

Overview of Imaging Modalities

CT and MRI are the most widely available neuroimaging modalities in assessing head trauma. Advanced MRI techniques are discussed further in the section on imaging of subacute and chronic TBI. CT angiography (CTA) and MR angiography (MRA), as well as conventional catheter angiography, are addressed in the section on imaging of suspected intracranial arterial injury. CT venography (CTV) and MR venography (MRV) are addressed in the section on imaging of suspected intracranial venous injury. CT cisternography is addressed in the section on imaging of suspected posttraumatic cerebrospinal fluid (CSF) leak.

The advantage of CT in evaluating patients with head injury is its sensitivity for depicting intracranial mass effect, ventricular size and configuration, bone injuries, and acute intracranial hemorrhage regardless of location (ie, parenchymal, subarachnoid, subdural, or epidural spaces) in a rapid and efficient manner that is widely available and compatible with other medical and life-support devices. Multiplanar reformats may add value in detecting certain intracranial hemorrhages, especially along bone surfaces that approximate the transverse plane of axial images [5,6]. CT is also more sensitive than MRI in detecting bony injuries. The use of a dedicated bone algorithm, multiplanar reformats, and 3-D rendering may improve the detection of nondisplaced skull fractures. The limitation of CT is a decreased sensitivity to detect small and predominantly nonhemorrhagic lesions, such as contusion or subtle diffuse axonal injury (DAI), subtle injuries adjacent to bony surfaces, and early cerebral edema, which can be seen in hypoxic-ischemic encephalopathy in patients with moderate or severe acute closed head injury. Potential risks of unnecessary exposure to ionizing radiation warrant judicious patient selection for CT scanning as well as radiation dose management [7].

MRI (including a blood-sensitive sequence such as T2*) is more sensitive than CT in detecting all stages of intracranial hemorrhage, nonhemorrhagic contusions, injuries in the posterior fossa and brain stem, and DAI [1,2,8-12]. The addition of susceptibility-weighted imaging in MRI for head trauma further increases sensitivity for the detection of microhemorrhages and hemorrhagic axonal injury [13,14]. Limitations of MRI lie in its longer acquisition time, relatively circumscribed availability, and potential incompatibility with certain medical devices [1,2,15].

The use of intravenous contrast offers no significant advantage in nonvascular neuroimaging for head trauma and is generally not indicated [16].

Skull radiography has been supplanted by CT in characterizing skull fractures in the setting of acute TBI, though it may be useful in limited circumstances, such as radiopaque foreign bodies [17].

Discussion of Imaging Modalities by Variant

Variant 1: Minor or Mild Acute Closed Head Injury (GCS Score ≥ 13), Imaging Not Indicated by NOC or CCHR or NEXUS II Clinical Criteria (see Appendix 1) (Initial Study); and Variant 2: Minor or Mild Acute Closed Head Injury (GCS Score ≥ 13), Imaging Indicated by NOC or CCHR or NEXUS II Clinical Criteria (see Appendix 1) (Initial Study). One of the challenges facing physicians is determining which patients with minor or mild acute closed head injury can safely avoid noncontrast head CT. The New Orleans Criteria (NOC) [18], Canadian CT Head Rules (CCHR) [19], and National Emergency X-Ray Utilization Study (NEXUS) II [20] are clinical guidelines with high sensitivity for identifying patients with minor or mild acute closed head injury who can safely avoid noncontrast head CT [21-23]. All guidelines have trade-offs between sensitivity and specificity for the detection of significant findings in patients with head injury [24,25]. The guidelines proposed by each of these studies are listed in Appendix 1.

Although noncontrast head CT results are normal in the majority of patients with minor or mild acute closed head injury, it remains the primary modality for detecting clinically relevant brain injuries in this patient population. Although noncontrast head CT has a high negative predictive value in triaging patients, this does not mean