ACR Appropriateness Criteria Blunt Chest Trauma

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Imaging is paramount in the setting of blunt trauma and is now the standard of care at any trauma center. Although anteroposterior radiography has inherent limitations, the ability to acquire a radiograph in the trauma bay with little interruption in clinical survey, monitoring, and treatment, as well as radiography's accepted role in screening for traumatic aortic injury, supports the routine use of chest radiography. Chest CT or CT angiography is the gold-standard routine imaging modality for detecting thoracic injuries caused by blunt trauma. There is disagreement on whether routine chest CT is necessary in all patients with histories of blunt trauma. Ultimately, the frequency and timing of CT chest imaging should be site specific and should depend on the local resources of the trauma center as well as patient status. Ultrasound may be beneficial in the detection of pneumothorax, hemothorax, and pericardial hemorrhage; transesophageal echocardiography is a first-line imaging tool in the setting of suspected cardiac injury. In the blunt trauma setting, MRI and nuclear medicine likely play no role in the acute setting, although these modalities may be helpful as problem-solving tools after initial assessment.

The ACR Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed every 2 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, blunt trauma, CT, chest radiography, ultrasound, echocardiography, MRI

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SUMMARY OF LITERATURE REVIEW

Introduction/Background

Blunt trauma is very common in the United States and is a significant cause of mortality in younger adults; most cases are related to high-energy mechanisms, such as motor vehicle accidents, motor cycle collisions, and falls [1]. According to World Health Organization data, 1.21 million people worldwide died from car accidents [2]. In the United States, it is estimated that trauma is responsible for approximately 100,000 deaths annually.

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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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Accidents (unintentional injuries) are the fifth most common cause of death after heart disease, cancer, chronic lower respiratory diseases, and cerebrovascular accidents. In the United States, accidents (including motor vehicle accidents) continue to be the most common cause of death among people aged 15 to 44 years, accounting for approximately 40,000 deaths in 2010. Among people aged 15 to 24 years, motor vehicle accidents are by far the most common cause of death [3].

Approximately 25% of deaths from blunt trauma arise from chest injuries, although up to 50% of deaths are at least partially related to thoracic injuries [4]. It is essential to diagnose and treat emergent thoracic injuries quickly, and imaging plays an essential role in diagnosing these injuries. The imaging manifestations of thoracic trauma are diverse and include musculoskeletal, pleural, pulmonary, and mediastinal findings. The most devastating injury to the thorax from blunt trauma is acute aortic injury or transection, and the most common thoracic injury is a rib fracture; see previous ACR Appropriateness Criteria® for these specific indications. This set of guidelines discusses imaging in blunt thoracic trauma in the broadest sense (see Variant 1).

Chest Radiography

Anteroposterior (AP) chest radiography is a standard part of the trauma workup at most level I trauma centers across the United States [5]. This is often combined with AP pelvic radiography and lateral horizontal-beam cervical spine radiography to quickly assess patients for emergent injuries and to triage patients. A multitude of injuries can be detected or inferred from chest radiography; these include acute aortic injury, pulmonary injury, pneumothorax, hemothorax, extrapleural hematoma, large-airway rupture, hemidiaphragmatic rupture, or musculoskeletal injury [6-8]. The most devastating of these is acute aortic injury, and chest radiography continues to be an appropriate primary screening modality in its assessment, as noted in "ACR Appropriateness Criteria Blunt Chest Trauma—Suspected Aortic Injury" [9]. In addition, patients with blunt trauma are often intubated and have other lines and tubes inserted as well. AP chest radiography is essential to quickly exclude obvious misplacement of lines and tubes that may be difficult to detect in the setting of multitrauma.

Although they seem to be essential to the care of critically ill blunt trauma patients, AP chest radiographs in the trauma setting are often of low quality. If patients are in severe pain or are unconscious, full inspiration is usually not possible. Overlying material is the rule rather than the exception, and motion artifact is common. The mediastinum may appear falsely enlarged because of AP projection. Given these shortcomings, many studies have shown that AP chest radiography misses many injuries that are evident on CT [10-18].

A single-center study evaluating occult pneumothoraces (identified on CT but not on AP chest radiography) in the setting of blunt trauma showed that up to 55% of pneumothoraces detected on CT were occult on AP chest radiography. This was likely an underestimation, given that patients who had apparently normal results on AP chest radiography were often not evaluated with chest CT, as is common at many trauma centers. The authors used the clinical radiology reports for the initial review of data but reassessed radiographs with occult pneumothoraces to ensure that the pneumothorax was not simply missed on the initial review [17]. Another study found that occult pneumothoraces were actually visible on AP chest radiography in 12% to 24% of cases in a blinded retrospective review

Variant 1. First-line evaluation. High-energy mechanism

Radiologic Procedure	Rating	Comments	Relative Radiation Level
X-ray chest	9	Chest x-ray and CT/CTA are complementary examinations.	☢
CT chest with contrast	9	Ideally, this procedure should be performed with CTA. Chest x-ray and CT/CTA are complementary examinations.	☢☢☢
CTA chest with contrast	9	Chest x-ray and CT/CTA are complementary examinations.	☢☢☢
CT chest without contrast	5		☢☢☢
Ultrasound chest	5		O
CT chest without and with contrast	2		☢☢☢
MRI chest without and with contrast	2		O
MRI chest without contrast	1		O

Note: Rating scale: 1, 2, and 3 = usually not appropriate; 4, 5, and 6 = may be appropriate; 7, 8, and 9 = usually appropriate. CTA = CT angiography.