

Radiology for Trauma and the General Surgeon

Patrick K. Kim, MD

KEYWORDS

- Trauma radiology • Trauma radiography • Ultrasonography • FAST
- Computed tomography • CT • Radiation effective dose

KEY POINTS

- Plain film radiography and ultrasonography (focused assessment for sonography in trauma [FAST] and extended FAST [E-FAST]) are important modalities for the initial evaluation of patients with trauma. In meta-stable or unstable patients, the combination of chest radiograph, pelvis radiograph, and FAST or E-FAST rapidly triages the torso.
- Computed tomography (CT) has become standard for imaging blunt trauma. It is unclear whether a pan-CT scan approach or selective CT scan approach is superior.
- CT is used increasingly for less stable patients because it may improve decision making about invasive procedures.
- CT angiography has become the modality of choice for imaging suspected vascular injuries of the neck and extremities.
- The impact of ionizing radiation (effective dose) of CT scans to individual patients may be infinitesimal but there may be implications at the population level. Imaging strategies in trauma should be evaluated continuously.

INTRODUCTION

Radiographic imaging is integral to the evaluation of injured patients. Conventional radiography (plain film), ultrasonography, and computed tomography (CT) are nearly universally present and immediately available in most modern facilities. In particular, ultrasonography and CT have ever-increasing roles in trauma and general surgery. Other modalities, such as conventional angiography, fluoroscopy, MRI, and nuclear medicine are important adjunct modalities. This article focuses on plain film, ultrasonography, and CT, the modalities used most often in the early phases of evaluation.

No imaging modality is perfect. Each modality has limitations, risks, and costs. The optimal use of diagnostic radiology incorporates patient physiology, mechanism of

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Division of Traumatology, Surgical Critical Care and Emergency Surgery, Department of Surgery, Perelman School of Medicine at the University of Pennsylvania, Penn Presbyterian Medical Center, 51 North 39th Street, Medical Office Building, 1st Floor, Philadelphia, PA 19104, USA
E-mail address: Patrick.kim@uphs.upenn.edu

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injury, physical examination, and an understanding of the strengths and limitations of various modalities.

PLAIN FILM

Conventional radiology (plain film) is a well-established initial modality for radiographic evaluation. Chest radiograph (CXR) and pelvis radiograph (PXR) remain recommended by Advanced Trauma Life Support as a routine in the evaluation of blunt trauma.¹ CXR is familiar, readily available, and rapid. For patients with trauma, single-view anteroposterior CXR may show a life-threatening injury requiring immediate treatment, such as pneumothorax or hemothorax, which may require tube thoracostomy. Other findings may include pulmonary contusion or aspiration, abnormal mediastinal width or contour (potentially indicating traumatic aortic injury), abnormal diaphragm contour, rib fractures, retained bullets or other objects, and extrathoracic injuries. CXR has high specificity but low sensitivity for pneumothorax, missing up to half of pneumothoraces.² The PXR is an appropriate initial modality in the assessment of patients with blunt trauma with hip or pelvic symptoms, abnormal hemodynamics, or unreliable examination. PXR identifies significant pelvic fractures, pelvic diastasis, hip fractures, and dislocations, all of which may require immediate treatment (eg, pelvic binder for open-book pelvic fracture, reduction of hip dislocation). In examinable patients with absent signs, symptoms, and hemodynamic issues, and if CT abdomen/pelvis is planned, then PXR is low yield.^{3,4}

ULTRASONOGRAPHY

Ultrasonography is rapidly becoming a favored modality in initial trauma assessment. Focused assessment for sonography in trauma (FAST) is well validated and established in the early assessment of patients with blunt abdominal trauma or penetrating precordial/trans thoracic injuries.⁵ As originally described, FAST comprises 4 standard views: subxiphoid pericardial, right upper quadrant, left upper quadrant, and pelvic views. The basic objective of FAST is to determine the presence or absence of hemoperitoneum. FAST has the benefits of being readily available (often performed by the surgeon or other bedside provider), noninvasive, repeatable, and without radiation. Highly operator dependent, FAST can detect intra-abdominal fluid volumes as low as 225 to 400 mL.⁶ However, FAST has limited utility for diagnosing solid organ injuries, hollow visceral injuries, and retroperitoneal injuries, because these processes are potentially, but not necessarily, associated with hemoperitoneum. Furthermore, body habitus and subcutaneous or intraluminal air may decrease image quality. The role of FAST in hemodynamically stable patients with blunt trauma is minimal if CT abdomen and pelvis is indicated. If CT abdomen and pelvis is not indicated, then negative FAST, especially if repeated after an interval of time, is an appropriate component of evaluation.

The use of additional views to inspect the pleural spaces to rule out pneumothorax is known as extended FAST (E-FAST).⁷ E-FAST has consistently shown excellent sensitivity and specificity in the diagnosis of pneumothorax compared with CXR.⁸ In addition, E-FAST can be supplemented with dedicated views of the posterior pleural spaces to assess for hemothorax in addition to pneumothorax.

CAVITARY TRIAGE

Physiology should drive decision making regarding choice of initial imaging. Cavity triage is the concept of rapid CXR, PXR, and FAST (or E-FAST) during or after primary

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