

Joint Trauma System



Radiology: Imaging Trauma Patients in a Deployed Setting

Part of the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Training Series



Purpose



This CPG provides general imaging guidelines for radiologists and emergency providers when performing trauma patient assessment in a deployed setting.

Presentation is based on the [JTS Radiology: Imaging Trauma Patients in a Deployed Setting CPG, 13 May 2017 \(ID: 01\)](#). It is a high-level review. Please refer to the complete CPG for detailed instructions. Information contained in this presentation is only a guideline and not a substitute for clinical judgment.

Agenda



1. Summary
2. Background
3. Imaging Options
4. Special Situations
5. Performance Improvement (PI) Monitoring
6. References
7. Appendices
8. Contributors

Summary



- Imaging is a critical component in the evaluation of military trauma patients.
- There are multiple modalities available depending on location and need.

Background

- Medical imaging plays a critical role in the rapid diagnosis, triage, and management of complex poly-trauma patients.
- High quality medical imaging can be performed in a deployed or wartime setting.
 - Pre-operative imaging can provide life saving information.
 - Aggressive resuscitation and speed of computed tomography (CT) scan often allow for imaging prior to the operating room in significantly injured patients.



CT with IV contrast of patient with penetrating trauma with associated liver and right kidney injury (area of red arrow). Penetrating fragment is bright white object.

Background



■ Equipment Limitations

- ❑ Anterior Posterior (AP) Projection is adequate on most portable units.
- ❑ Many portable units, especially at role 2, have limited penetration of soft tissue making lateral views of limited quality.

■ Radiation Safety

- ❑ Recommended minimal distance for unshielded medical team members from radiograph is 6 feet.
 - Cross table films produce much higher radiation exposures and should be obtained only when necessary.
 - Team members should don shielding prior to patient's arrival under personal protective equipment.
- ❑ Radiologists should carefully monitor mAs and kVp settings to minimize radiation dose while achieving sufficient diagnostic image quality.

Background



■ Role of Radiologist

□ During the trauma evaluation:

- Radiologist can free other providers by doing the Focused Abdominal Sonographic Assessment for Trauma (FAST).
- Can also provide preliminary interpretations of portable radiographs.

□ Once CTs are obtained on trauma patients, the radiologist is required to evaluate images and other providers will need to perform FAST and interpret radiographs.

■ Images taken of evacuated patients should be sent electronically ahead of time and a CD created to send with the patient.

□ Attempt to update patient information with accurate information as soon as possible to ensure images can be reviewed.

Radiographs

■ Radiograph

- Initial radiographic evaluation begins with supine AP chest and pelvic radiographs.
 - Identifies major cardiopulmonary injury.
 - Identifies major fracture dislocations of the pelvis.
- Other areas of the body can be imaged to easily identify metallic fragments to determine sites of injury.



Radiograph of chest of patient with penetrating injury. Fragments seen from sternum to apex of right lung. Right hemothorax present.

Specific Radiographs

■ Other Specific Radiographs

□ Cervical Spine Radiograph

- Largely replaced by CT
- Only perform when a CT not available

□ Extremity Radiograph

- Can be obtained when extremity injury suspected
- Obtaining these should not delay more diagnostic imaging with CT

□ Retrograde Urethrogram

- Useful for identification of urethral injury
- Can be obtained by injecting contrast through a Foley catheter placed at tip of urethra



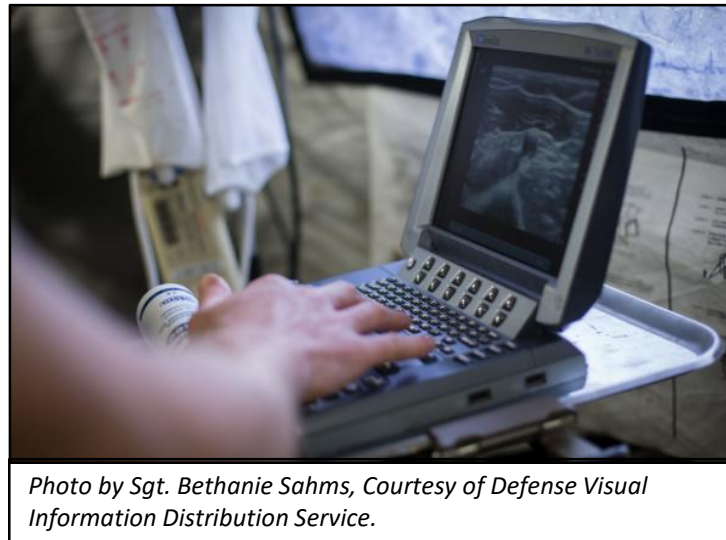
Fracture of ulna
seen on radiograph.

*Source: Emergency War
Surgery 5th Edition*

FAST Examination

■ FAST Examination

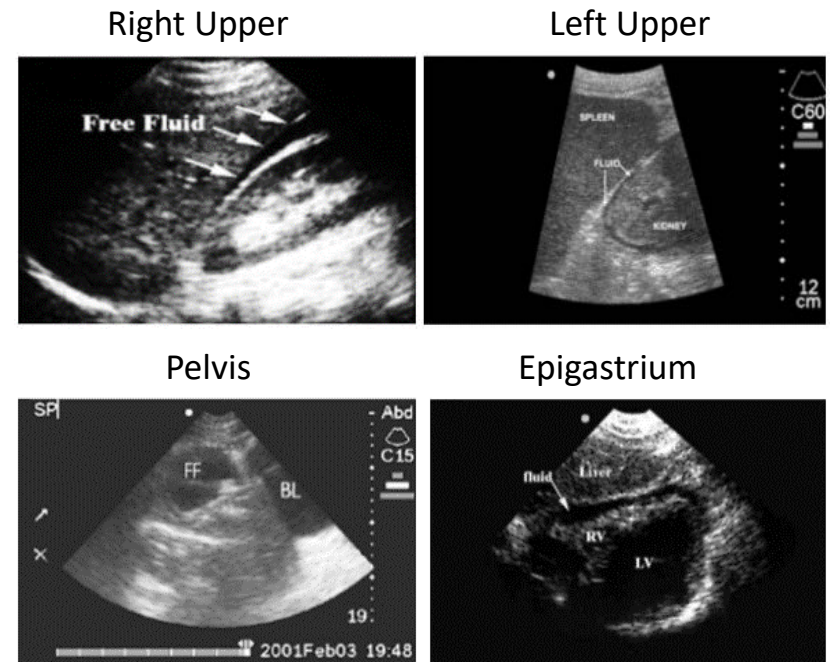
- Adjunct to the primary trauma survey
 - Sensitivity of 56% and specificity of 98%
 - Negative scan cannot be relied upon to rule out injury



FAST Examination

- FAST Examination *(continued)*
 - Most commonly performed and interpreted in real time with portable machine using a standard 3-7 MHz curved array ultrasound probe
 - Evaluating intraperitoneal fluid in:
 - The right upper quadrant between the liver and kidney
 - The left upper quadrant between the spleen and kidney
 - The pelvis at the level of the bladder
 - Epigastrium for cardiac activity and hemopericardium
 - May also aid in identifying pneumothorax and assessment of heart after resuscitation.

Abnormal FAST Exam Findings



Source: *Emergency War Surgery 5th Edition*

Trauma CT Scan



■ Trauma CT Scan

- ❑ Provides additional information by identifying unsuspected and potentially clinically significant injuries.
 - If at all possible obtain a trauma CT before going to the OR.
 - Can be obtained after continued resuscitation and surgical intervention.
- ❑ CT Protocol includes:
 - Non-contrast CT through head and face to include the entire mandible at 1 mm axial slice thickness.
 - Contrast enhanced CT from the level of the circle of Willis through the bottom of the pelvis.
 - Optional: Scan performed through the lower extremities to evaluate for skeletal and vascular injuries.

Contrast CT



■ CT Contrast Injection

- ❑ Typical dose: 150 cc of Isovue 300 or 340
- ❑ Use dual phase injection: 80 cc at 1.4 cc/sec followed immediately by 70 cc at 3.5 cc/sec for the pan scan.
- ❑ CT scan started is started 2-3 seconds before completion of contrast injection.

■ Intravenous (IV) Access for CT

- ❑ An 18g antecubital IV is typically used.
 - More distal upper extremities should typically not be used.
 - Recheck IV function prior to use to ensure function and avoid contrast extravasation.
- ❑ Central line and large lumen resuscitation catheters can usually handle contrast power injection.
 - Discontinue infusion of fluid/blood products through lines prior to use for contrast.
- ❑ Do not use interosseus needles for contrast injection.

Special Contrast Options



■ Delayed Images

- Routinely performed for further evaluation of solid organ injury, identification of active extravasation or pseudoaneurysm formation, or excretion within the ureters and bladder.

■ CT Cystogram

- 50 cc of IV contrast diluted into 500 cc of saline infused through indwelling urinary catheter (300 cc minimum) and clamp catheter for CT examination.
- Can follow routine trauma CT with 1 mm thick images through the pelvis with the bladder filled.

■ Rectal Contrast

- Useful for evaluating flank or rectal injuries below the peritoneal reflection.
- If needed, can infuse 50 mL of IV contrast in 1 L of saline or water through a Foley catheter placed in the rectum.

Special Situations



■ CT Language Settings

- Be familiar with languages available on CT scanner for patient breathing instructions.
- May have to use interpreters to record messages if different languages commonly used in coalition or by host country.

■ Military Working Dogs

- Examinations should be coordinated with veterinarians.

■ MRI has been available in theater, but use in acute management of combat trauma has not been established.

PI Monitoring



■ Intent (Expected Outcomes)

All trauma patients arriving at a Role 3 hospital will receive proper and expeditious radiologic screening of injuries.

■ Performance/Adherence Measures

Identify missed injuries with appropriate radiographic imaging and/or reading.

■ Data Source

- Patient Record
- Department of Defense Trauma Registry (DoDTR)
- Theater Image Repository

References (1 of 2)



1. Como JJ, Diaz JJ, Dunham CM, et al. Practice management guidelines for identification of cervical spine injuries following trauma: Update from the Eastern Association for the Surgery of Trauma Practice Management Guidelines Committee. *J Trauma*. 2009;67:651-659.
2. Joint Trauma System, Cervical and Thoracolumbar Spine Injury Evaluation, Transport, and Surgery in the Deployed Setting CPG, 05 Aug 2016.
[http://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_\(CPGs\)/Cervical_Thoracolumbar_Spine_Injury_Evaluation_Transport_Surgery_Deployed_Setting_05_Aug_2016_ID15.pdf](http://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_(CPGs)/Cervical_Thoracolumbar_Spine_Injury_Evaluation_Transport_Surgery_Deployed_Setting_05_Aug_2016_ID15.pdf) Accessed Mar 2018.
3. Watchorn J, Miles R, Moore N. The role of CT angiography in military trauma. *Clinical Radiology*. 2013;68:39-46.
4. Scalea T, Rodriguez A, Chiu W, et al. Focused Assessment with Sonography for Trauma (FAST): Results of an International Consensus Conference. *J Trauma*. 1999;46:466-472.
5. ATLS 9th Edition, American College of Surgeons, 2012.
6. Smith, I. M., Naumann, D. N., Marsden, M. E., Ballard, M., & Bowley, D. M. Scanning and war: Utility of FAST and CT in the assessment of battlefield abdominal trauma. *Ann Surg*. 2015 Jan 29 [epub].
7. Cha JY, Kashuk JL, Sarin EL, et al. Diagnostic peritoneal lavage remains a valuable adjunct to modern imaging techniques. *J Trauma*. Aug 2009;67(2):330-4; discussion 334-6.
8. Kumar S, Kumar A, Joshi MK, Rathi V. Comparison of diagnostic peritoneal lavage and focused assessment by sonography in trauma as an adjunct to primary survey in torso trauma: A prospective randomized clinical trial. *Ulus Travma Acil Cerrahi Derg*. 2014 Mar;20(2):101-6.
9. Ferrada P, Evans D, Wolfe L, Anand RJ, Vanguri P, Mayglothling J, Whelan J, Malhotra A, Goldberg S, Duane T, Aboutanos M, Ivatury RR. Findings of a randomized controlled trial using limited transthoracic echocardiogram (LTTE) as a hemodynamic monitoring tool in the trauma bay. *J Trauma Acute Care Surg*. 2014 Jan;76(1):31,7; discussion 37-8.
10. Kirkpatrick AW, Sirois M, Laupland KB, Liu D, Rowan K, Ball CG, Hameed SM, Brown R, Simons R, Dulchavsky SA, Hamilton DR, Nicolaou S. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: The extended focused assessment with sonography for trauma (EFAST). *J Trauma*. 2004 Aug;57(2):288-95.

References (2 of 2)



11. The Royal College of Radiologists. Standards of practice and guidance for trauma radiology in severely injured patients. London: The Royal College of Radiologists, 2011.
12. Gibb, I., Denton, E. Guidelines for imaging the injured blast/ballistic patient in a mass casualty scenario. (NHS Improvement System)NHS, London; June 2011.
13. Graham R. Battlefield Radiology. British Journal of Radiology. 2012 (85); 1556-1565.
14. Macha D, Nelson R, Howle L, et al. Central Venous Catheter Integrity during Mechanical Power Injection of Iodinated Contrast Medium. Radiology. 2009;253:870-8.
15. Nguyen D, Platon A, Shanmuganathan K, et al. Evaluation of a Single-Pass Continuous Whole-Body 16-MDCT Protocol for Patients with Polytrauma. AJR. 2009;192:3-10.
16. Shanmuganathan K, Mirvis S, Chiu W et al. Penetrating Torso Trauma: Triple-Contrast Helical CT in Peritoneal Violation and Organ Injury-A Prospective Study in 200 Patients. Radiology. 2004;231:775-784.
17. Morgan DE, Nallamala LK, Kenney PJ, Mayo MS, Rue LW,3rd. CT cystography: Radiographic and clinical predictors of bladder rupture. AJR. 2000;174:89-95.
18. Joint Trauma System, Clinical Management of Military Working Dog CPG, 12 Dec 2018.
[https://jts.amedd.army.mil/assets/docs/cpgs/JTS Clinical Practice Guidelines \(CPGs\)/Military Working Dog Clinical Practice Guidelines 12 Dec 2018 ID16.pdf](https://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_(CPGs)/Military_Working_Dog_Clinical_Practice_Guidelines_12_Dec_2018_ID16.pdf) Accessed Jan 2019.
19. Joint Trauma System, Use of MRI in Management of mTBI in the Deployed Setting CPG, 05 Apr 2018.
[https://jts.amedd.army.mil/assets/docs/cpgs/JTS Clinical Practice Guidelines \(CPGs\)/MRI Management mTBI Concussion Deployed Setting 05 Apr 2018.pdf](https://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_(CPGs)/MRI_Management_mTBI_Concussion_Deployed_Setting_05_Apr_2018.pdf) Accessed Jan 2019.

Appendices



- **Appendix A:** Detector Trauma CT Protocol
- **Appendix B:** 64 Detector Pediatric (MWD) IV Contrast Injection Protocols
- **Appendix C:** Additional Information Regarding Off-Label Uses in CPGs

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