

UAMS MEDICAL CENTER
TRAUMA and CRITICAL CARE SERVICES MANUAL

SUBJECT: Imaging of Adult Trauma Patients

SUPERSEDES: New

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RECOMMENDATION(S): Benjamin L. Davis, MD

APPROVAL: 6/27/2019

CONCURRENCE(S): All

EFFECTIVE: 6/27/2019

PURPOSE: To outline practice expectations regarding injured trauma patients at UAMS (presumed to be >15 years of age).

GUIDELINES: Please see 2018 American College of Surgeons Trauma Quality Improvement Program Best Practices Guidelines in Imaging.

1. **CHARACTERIZATION OF SPECIFIC INJURIES BY RADIOLOGY;** data to be included in preliminary and final radiology reports per injury type;
 - a. Rib Fractures
 - i. Number of fractures
 - ii. Location of fractures
 - iii. Degree of displacement
 - iv. Presence of flail segment (>2 contiguous ribs with 2 fractures each)
 - v. 3-D chest recons to be generated at the request of trauma surgeon/designee
 - b. Liver
 - i. Size & depth of hematoma/laceration
 - ii. Lobe/segment involved including
 - iii. Proportion of devascularized/ischemic segment of any lobe
 - iv. Presence/absence of vascular injury
 - v. Liver Injury Grade
 - c. Spleen
 - i. Size & depth of hematoma/laceration
 - ii. Presence/absence of vascular injury
 - iii. Spleen injury grade
 - d. Kidney
 - i. Size of hematoma/laceration
 - ii. Involvement of cortex/collecting system
 - iii. Presence/absence of vascular injury
 - iv. Urinary extravasation
 - e. Brain
 - i. Size, number, and location of hematoma
 - ii. Presence/absence/displacement of skull fracture
 - iii. Presence of stroke or edema
2. **RADIATION EXPOSURE**
 - a. Lifetime risk of malignancy from radiation exposure likely exceedingly small
 - b. Bedside US (extended FAST) most helpful in unstable pts

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- i. ED may conduct FAST exam at their discretion on stable patients, provided no delay in emergency care is caused
 - c. MRI too slow and risky for routine use
 - i. see spine and brain imaging guidelines for use in those populations
- 3. **IV CT CONTRAST** – to be used in ALL situations concerning for visceral or vascular injury
 - a. Exception; contrast allergy – pretreat 4 hours before contrast, or skip contrast if can't wait
 - i. Pretreatment for less than 4 hours isn't helpful
 - ii. Shellfish allergy NOT a contraindication to IV contrast in trauma
 - iii. If non-contrast CT is used in this manner, REAL-TIME interpretation by radiology looking for mediastinal, retroperitoneal, and intraperitoneal air and fluid >30 Hounsfield units should be performed, AND IV CONTRAST USED DESPITE THE RISK if any of the above are found
- 4. **SEDATION FOR IMAGING IN TRAUMA PATIENTS**
 - a. Caution with Haldol in TBI 2/2 decreased sz threshold
 - b. Should be overseen only by physicians with moderate sedation privileges
 - c. If GCS is <9, patient should be intubated before proceeding to CT scanner
 - d. If sedation is needed for combativeness/agitation, but patient is otherwise protecting airway, consider ketamine IV in accordance with pharmacy dosing
 - e. Propofol should be avoided in fresh trauma patients due to risk of new/worsening hypotension. The following should be kept in mind;
 - i. Propofol may “unmask” hemorrhagic shock
 - ii. Outcomes are worse in TBI patients with even one hypotensive episode
- 5. **BRAIN IMAGING**
 - a. Anyone with: LOC, GCS<15, or amnesia
 - b. Negative head CT has 99.97 npv for need for NSGY intervention
 - i. safe for discharge unless precluded by other injuries
 - c. Repeat CT 4 hrs for anyone with a positive initial scan and persistent alteration
 - i. Stat exam if declining MS
 - ii. 2nd CT possibly warranted for admission GCS <13
 - d. Antiplatelet and anticoagulants MAY indicate repeat head CT even if original, especially if neurological status deteriorates.
- 6. **CERVICAL SPINE** – PLEASE SEE SEPARATE “Cervical Spine Evaluation and Clearance Clinical Management Guideline”

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- a. Please note that NEXUS and CCR are less sensitive in older adults and more liberal imaging is warranted (21% of pts >55yoa had no pain despite fractures on CT C-spine)
 - b. Please note that NEXUS was created before CT scanning was common practice and when CT technology was less sensitive, unclear whether NEXUS misses injuries that would be found on modern CT imaging
7. **THORACOLUMBAR SPINE** – PLEASE SEE SEPARATE SPINE INJURY AND SPINAL CORD INJURY GUIDELINES. Keep in mind that;
- a. Physical exam is unreliable for spine fracture – low imaging threshold, especially if altered mental status or high energy mechanism
 - b. C-spine injury? → image rest of spine too
 - c. MRI if concern for cord injury
 - d. Negative TL – imaging → no indication for MRI because isolated unstable ligamentous injury extremely rare; MRI only if SCI suspected
8. **BLUNT CEREBRAL VASCULAR INJURY** – PLEASE SEE SEPARATE BCVI GUIDELINE
9. **PENETRATING NECK INJURY**
- a. Airway control is paramount if:
 - i. Stridorous
 - ii. Expanding hematoma
 - iii. Other airway concerns
 - b. Hard signs of vascular or aerodigestive injury indicate neck exploration, and soft signs MAY indicate exploration
 - i. Hard Signs
 1. Active arterial hemorrhage
 2. Expanding hematoma
 3. Bruit or thrill
 4. Hemodynamic instability
 5. Unilateral upper extremity pulse deficit
 6. Massive hemoptysis/hematemesis
 7. Air bubbling in wound
 8. Airway compromise
 9. Signs of cerebral ischemia (stroke)
 - ii. Soft Signs
 1. Non-pulsatile, non-expanding hematoma
 2. Venous Oozing
 3. Dysphagia

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- 4. Dysphonia
- 5. Subcutaneous emphysema
- c. If no hard signs, CTA neck is indicated regardless of zone “no zone approach”
 - i. Consider traditional angiography if CTA is limited by artifact (eg bullet)
 - ii. Panendoscopy (laryngoscopy, bronchoscopy, EGD is still gold standard unless CTA definitively shows a non-concerning bullet trajectory
 - iii. If swallow study performed, use water-soluble contrast

10. CHEST

- a. Plain chest x-ray is still critical as an adjunct to the primary survey
- b. Any traumatic injuries on CXR indicate contrasted CT Chest
- c. CT chest with contrast also indicated for high energy blunt trauma
- d. Extended FAST exam is the test of choice for suspected pericardial effusion
- e. No role for oral contrast in trauma unless prior suspicion of esophageal perforation

11. PENETRATING THORACIC TRAUMA

- a. Cardiac – unstable patients with suspected cardiac injuries should be taken immediately to the operating room
 - i. stable – FAST, CXR, consider CT
- b. Chest tubes before imaging if clinically indicated is still ok in unstable pts
 - i. CXR first in stable pts
 - ii. Radiopaque markers for wounds
 - iii. Consider rpt cxr in 3-6 hours if initial is negative (delayed pneumothorax)
- c. Transmediastinal injury
 - i. Unstable – proceed immediately to the operating room
 - ii. Stable
 - 1. eFAST/pericardial window
 - 2. IV CT chest and esophagram/angio/bronch/egd as findings dictate

12. ABDOMEN

- a. All FAST exams without positive findings should be called “inconclusive” as **NEGATIVE FAST DOES NOT RULE OUT ABDOMINAL INJURY**
- b. Indication for laparotomy is the only absolute contraindication to CT Scan of abdomen
 - i. Peritonitis
 - ii. Evisceration
 - iii. Hypotension + positive FAST
 - iv. Traumatic GI Bleeding

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- v. Penetrating mechanism of injury (exceptions for select mechanisms & trajectories at the sole discretion of the trauma attending or designee)
- vi. Consider plain films to determine trajectory if patient condition/time allows
- c. Flank Injuries – indications for operation as above. Select patients may receive FAST and triple contrast (oral, rectal, and IV) CT scan at the sole discretion of the trauma attending or designee
- d. Bowel Injury is suggested by;
 - i. “moderate” free fluid in the absence of solid organ injury (especially interloop fluid)
 - ii. Thickened bowel wall with stranding is highly suggestive of bowel injury
 - iii. Options for suspected bowel injury
 - 1. Exploratory laparotomy
 - 2. Diagnostic laparoscopy
 - 3. Observation with repeat CT abdomen, serial abdominal exams
- e. Pancreatic Injuries
 - i. May not appear on CT abdomen for up to 24 hours, should maintain index of suspicion in blunt trauma patients with failure to advance diet or new abdominal pain
 - ii. Laceration of > ½ of pancreatic diameter suggests duct injury
 - iii. If concern persists despite CT imaging, consider MRCP/ERCP

13. GU IMAGING

- a. Renal imaging if gross or microscopic hematuria (>5rbc per HPF), mechanism
- b. Delayed imaging 4-5 min after arterial phase allows full examination of kidneys and collecting ducts – this is currently routinely performed at UAMS
- c. Intraop IVP should be considered if considering nephrectomy and no prior imaging proves viability of second kidney
- d. Negative CT, even with delayed phase, does NOT exclude ureteral injury
- e. CT or plain retrograde cystography indicated for:
 - i. Gross hematuria
 - ii. pelvic ring fx
 - iii. inability to void
 - iv. post-renal oliguria/azotemia
 - v. suprapubic pain
 - vi. urinary ascites
- f. Retrograde urethrogram indicated for:
 - i. meatal blood
 - ii. pain with or inability to void
 - iii. straddle mechanism

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- iv. ballotable prostate (rare, and normal prostate does NOT rule out injury)
- g. Penile fracture – US if PE inconclusive
- h. Scrotal injury – US if PE inconclusive

14. PREGNANCY

- a. ALARA
- b. No contraindication to contrast
- c. No gadolinium in MRI
- d. Risk of ionizing radiation small compared to missed injury, and therefore choice of imaging should not be affected by pregnancy status
- e. Shield fetus whenever possible
- f. CT remains imaging modality of choice regardless of trimester
 - i. Exposure to fetus < 50 mGY not associated with fetal abnormality or loss
 - ii. Fetal dose from CT abdomen is 25 mgy (as low as 13 in modern scanners)
 - iii. 1/1700 chance of dying as a result of a cancer from this radiation

15. GERIATRICS

- a. Low threshold for head and c-spine
 - i. 21% of c-spine fxs will be asymptomatic in pts > 55yoa
- b. Lower threshold for imaging in general secondary to
 - i. higher risk of occult injuries
 - ii. less tolerance of missed injuries
 - iii. and lower lifetime risk from radiation
- c. Age is not an independent risk factor for acute renal failure from contrast
- d. GFR > 60 is very low risk (creatinine may be misleading in low skeletal muscle mass)
 - i. If <60, proceed, consider hydration as well as use of contrast
- e. Best practice is to get pelvis plain films for all geriatric trauma patients

REFERENCES: American College of Surgeons Trauma Quality Improvement Program Best Practices Guidelines in Imaging, 2018