Nordter Consensus Conference
Penetrating Trauma & Mass Casualties

Oct 18-20, 2017
Sigtuna/Stockholm

Art Work: Bertil Vallien
REPORT FROM CONSENSUS MEETING
OCT 18-19, 2017
IMAGING OF PENETRATING TRAUMA
STAB INJURIES, GUNSHOT WOUNDS, IMPALEMENT INJURIES
GUEST SPEAKERS

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**EXPERTS**

**NORDIC TRAUMA SURGEONS/CLINICIANS**

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**NORDIC INTERVENTIONAL RADIOLOGIST**

Wojciech Cwikiel, interventional radiologist, Lund

**TRAUMA RADIOGRAPHERS**

Helen Milde, radiographer Sahlgrenska University Hospital, Gothenburg

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IT IS RECOMMENDED THAT ALL PATIENTS HAVE a non-contrast head CT

WHAT RADIOLOGY EXAMS SHOULD BE PERFORMED

» Head CT without contrast (use scout to localize foreign objects)
» In salvageable patients CTA from vertex to aortic arch (neck CTA) to detect vascular injuries
   – Facial vascular injuries are included
   – BCVIs are diagnosed
» In case of GSW, consider additional DSA if metal artifacts and CTA is inconclusive
» CTV in selected cases if sinus rupture is suspected (such as in penetrating posterior fossa injuries)
» Wound marks are not required
ISOLATED PENETRATING NECK INJURY

- WHICH PATIENT SHOULD GO TO RADIOLOGY
  - Hemodynamically stable patients with suspected or obvious platysma violation without “hard signs”* (see next slide)

- WHAT RADIOLOGY EXAMS SHOULD BE PERFORMED
  - Consider radiographs to localize foreign objects (bullets) if CT is not possible.
  - CT scout can be used to identify the foreign objects
  - CTA from vertex to at least aortic arch (neck CTA).
    - Note: CTA will reveal AV-fistulas as well
  - In Zone I and II injuries, consider including chest as 15-20% have chest injuries
  - Wound marks are recommended**
  - If CT is inconclusive with regard to airway injury, consider laryngoscopy and/or bronchoscopy
  - In case of suspected cervical esophageal injury, endoscopy preferred to esophagography
    - In case of high suspicion and inconclusive endoscopy, consider esophagography (swallow study)

**Based on local practice (e.g. vitamin E-capsule)
* **Hard signs** include active hemorrhage, expanding or pulsatile hematoma, bruit or thrill in the area of injury, shock unresponsive to initial fluid resuscitation, massive hemoptysis or hematemesis, and air bubbling through the injury site
PENETRATING TORSO (TRUNK) INJURY

- **EMERGENT SURGERY** when needed

- **IMAGING IN ER**
  - Unstable patients have eFAST# and chest X-ray
    - Cave: Box of death. Large hemothorax may conceal hemopericardium
    - Wound marking recommended by e.g. paperclip *
    - If CT is not available, stable patients may have eFAST and chest X-ray on ER
      - Pre-CT-imaging is, however, not encouraged

- **WHAT RADIOLOGY EXAMS SHOULD BE PERFORMED IN STABLE PATIENTS** (to help to decide to operate or not, and to guide the surgeon and/or interventionist)
  - Use CT scouts to localize foreign bodies in GSW to define the optimal FOV
  - CT chest-abdomen with i.v. contrast, especially if the entry wound is below intermammary line in stab wounds and almost always with GSW.
    - Consider triple contrast CT. (Level II Evidence). (See also exemples on indications and contraindications on next slide.)
    - late arterial (to visualize arterial injuries) to lesser trochanters+ venous phase upper abdomen.
    - Add late phase (5-10 min delay) if kidney and ureter are in injury trajectory. Radiologist’s supervision required
    - CT cystogram should be performed in urinary bladder injuries
    - Wound marking strongly recommended, paper clip/E-vitamin capsule etc.*

*Based on local practice
# eFAST = FAST + bilateral anterior and lateral chest views (rule in hemopericardium, hemo- and pneumothorax)

- CO₂ DSA can be used in unequivocal cases with suspected vascular injuries
- Peroperative angiogram is not discussed here
- Angioembolization is part of management and not discussed here
USES/INDICATIONS IN HEMODYNAMICALLY STABLE PATIENTS

- Tangential or superficial wounds: Exclusion of peritoneal or pleural penetration
- Thoracoabdominal wounds/anterior abdominal wounds: For gastric, small bowel, or colonic injury, high-grade solid organ injury, pancreaticobiliary injury, major vascular injury, and diaphragmatic injury
- Transpelvic gunshot wounds: For rectal or bladder injury, and intra-versus extraperitoneal involvement; evaluate for major vascular injury; performed for surgical planning or to evaluate potential candidates for nonoperative management
- Back and flank wounds: For retroperitoneal injury potentially involving colon, kidneys, ureters or major vessels
- Precordial, parasternal, periclavicular and transmediastinal wounds: For cardiac injuries, closed aortic or great vessel injuries, and aerodigestive tract injuries
- Other: For wounds not amenable to local wound exploration (ie, gunshot wounds, obese or muscular patients, back and flank injuries, wounds above costal margin, long obliquely oriented wounds) (7,9,32,34,43); For severe distracting pain, neurologic injury, or intoxication, which may confound physical examination; For patients with neurologic or extremity injuries which require surgical intervention and cannot be closely monitored

CONTRAINDICATIONS

- Absolute:
  - Hemodynamic instability not responsive or transiently responsive to fluid resuscitation (sometimes defined as systolic blood pressure, 90 mmHg after 2 liters of intravenous fluid). CT would delay life-saving care. Emergent laparotomy or thoracotomy is needed
- Relative:
  - Pneumoperitoneum on radiograph: Air may result from perforated hollow viscera but can also be introduced into the abdominal cavity through wound track or from pneumothorax migrating through a diaphragmatic defect
  - Peritonitis: Subjective sign. May be masked or mimicked by severe pain. Classically from hollow visceral perforation but can sometimes result from solid organ injuries
  - Hematuria: May indicate surgical renal injury or ureteral injury. However, many renal injuries that can be managed nonoperatively may still present with hematuria. CT is often used for grading penetrating renal injuries
  - Hematochezia: Usually indicative of hollow visceral injury requiring laparotomy; however, hematochezia may result from extraperitoneal rectal injury, which can be treated laparoscopically in select cases. Preoperative CT can often be used to distinguish between extra- and intraperitoneal rectal injury
  - Hematemesis: If the patient is hemodynamically stable, CT may occasionally be used to determine injuries before surgical intervention

Exsanguinating or acutely ischemic and site of injury is known -> no vascular imaging

CTA is the diagnostic study of choice when vascular imaging is required (Level 1 evidence)

This applies, however, imaging outside OR. In such cases, imaging is conventional angiography

Wound marking is recommended
MASS CASUALTIES

- DISASTER PLAN SHOULD BE IN PLACE AND COORDINATED
  » Strategies to maintain effective communication (vertically and horizontally)

- RADIOLGY IS AN INTEGRAL PART OF THE RESPONSE TO MAJOR INCIDENTS (MI)

- MAINTAIN CT CAPABILITY AND CAPACITY DURING THE RECEPTION PHASE OF A MI

- TRAUMATIC BRAIN INJURY MANAGEMENT IS ESPECIALLY DEPENDENT ON CT

- PATIENT FLOW
  » Identification of patients, how to identify unknown patients
  » Identify and eliminate bottlenecks
  » Removal of patients from radiology department after scans

- ROLE OF FAST/eFAST
  » Triage for CT in the initial phase

- WHAT CT PROTOCOLS TO USE
  » Traumaprotocol should be available on all scanners, techs should be trained
  » Ideally one standardized protocol for all for maximum efficiency
  » Consider WBCT in all patients requiring CT in mass casualty events (especially blast events)

- IMAGE, READING AND REPORTING FLOW
  » Basic imaging data to PACS, reading directly from modality console/workstation
  » Quick, concise documentation, standardized reporting* (consider backup paper-based system)
  » Life-threatening findings must be reported immediately

- RADIOLGY PLAYS A SIGNIFICANT PART IN TERTIARY SURVEYS AND MULTIDISCIPLINARY ASSESSMENT, AND SHOULD BE PLANNED FOR IN TERMS OF LOAD MANAGEMENT

*based on local practice
The Future ?