Diagnostic Imaging in Trauma: What Every Emergency Physician Should Know

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Learning Objectives

- To better understand the controversies with respect to the rational use of diagnostic imaging options in the management of trauma patients
- Review a sample of pertinent literature
- Ultrasound modalities for trauma assessment
Conflicts of Interest:

- I wish!?
- None to declare
CASE 1

- 42 yo male single vehicle into a ditch at 4 am on rural road
- Arrives to your Emergency Department 4:30
- VS: HR 80, RR 16, BP 115/80, Sats 97%
- IV’s X 2, O2, logrolled
- GCS 14, Smells of alcohol
- Injuries: Scalp Laceration
  Distal Radial fracture
  Pain “everywhere”
CASE 1

- Call Criticall for consultation with TTL

- “Why the hell are you calling me at 5 in the morning when you don`t even know whether or not this patient is injured?!”

- “Have you scanned anything?” No.

- “Alright, just pack him up and we`ll scan him when he gets here”

- Looks like my 8 am tee off time is screwed!
CASE 1

- Call Criticall for consultation with TTL

- “What have you done so far?”

- “Well, I’ve scanned the head, neck, chest, and abdomen and he’s got a small SAH, and a bit of a pulmonary contusion”

- “Why the hell did you scan everything?!! We’re just going to have to do it all over again when he get’s here!”

- Looks like my 8 am tee off time is screwed!
Dilemmas regarding Diagnostic Imaging in Trauma

- What Imaging do I need to do?

- ... a degree of imaging that is sensitive enough not to miss any significant injuries, yet that does not overuse resources, time and expose individuals to excess radiation
Diagnostic Imaging in Trauma

- Choice of Investigations based on numerous variables
  - Resources
  - Age
  - Injury identification/severity
  - Vital signs and physiologic parameters
  - Mechanism of Injury
  - Perception of “required” imaging
  - Do you have a good reason to send your patient to a Trauma Centre?
Diagnostic Imaging in Trauma

- What plain films should I do?

- Acuity of Injury: Perceived Minor vs Major?

- Mechanism: Canadian C spine rules
- More significant Injury?
  - CXR
  - Pelvis
  - Extremity

- Several articles supporting spine CT scanning in blunt trauma
Diagnostic Imaging in Trauma


- 3500 blunt trauma patients
- Inclusion criteria: pain and/or neurologic abnormality
- Average ISS = 17
- 7% fracture rate
- Sensitivity 99.3%
- Suggest CT to replace Plain film radiography
- Evidence that MRI should be used in cases of persistent pain even with normal CT
- EAST 2009 Guidelines, CJEM last month
Case 2

- Community Hospital
- 35 y.o. male motorcyclist strikes parked car
- Alert and oriented
- Complaining of Pelvic pain
- VSS
- CXR and Pelvic XR
Diagnostic Imaging in Trauma

- Should I CT Scan my patient?

- Individualized decision for each patient and scenario

- In general, if patient is going to a Trauma Centre: NO

- CT prior to transfer? Possible exception: CT Head
- Should not delay transfer
- If we are going to CT, how much?
Pan Scanning


- Pan scan protocol in blunt trauma patients with:
  - No visible evidence of chest/abdo trauma
  - Hemodynamically stable
  - Normal abdominal exam/unreliable
  - Significant mechanism
Diagnostic Imaging in Trauma

- Pan scan, Salim et al.
- 1000 patients
- 60% scanned due to mechanism alone
- Clinically significant abnormalities found in 3.5% - 19.6% depending on site imaged
- Change in management occurred in 18.9%
- Only 8/592 patients had laparotomy due to CT abdo findings in the mechanism of injury group
Conclusions?

- Large number of injuries in seemingly stable patients
- Similar incidence of injury in obtunded vs mechanism of injury groups
- Advocated liberal use of Pan scanning based on mechanism of injury
Pan Scanning?


- Patients were never examined!
- “Without obvious signs of injury” ?altered LOC/assaulted
- 5% incidence of cervical injury based on mechanism alone?
- 1 in 1250 lifetime mortality from cancer in 45 year old exposed to 15 mSv
- Pan scanning could result in premature deaths in 1200 people per year
- Advocates judicious respect for radiation exposure and importance of Hx, and Px exam
Pan Scanning

- Alternative approach?
Case 3

- 23 yo male BMX, jumped 15 feet on track
- Over handlebars, LOC at scene
- EMS to ER: VSS, Amnesia but GCS 15
- C/O shoulder pain and facial pain
- Rest of exam unremarkable
- Starts to c/o back and neck pain @ 1 hour
- Imaging?
- CT head, facial bones, c-spine
- Plain films: CXR, Pelvis and lumbar spine
Case 3

- CT: Facial bone #’s, ?? Widening c1-c2 posterior elements
- XR: Normal
- FAST, US chest negative
- Admitted to Neurosurgery for MRI neck
- No adverse outcomes
- MRI negative, Patient D/C home with no sequelae
Can we be more selective scanning trauma patients?


- 701 blunt trauma patients
- Prior to scanning, Emerg MD and Surgeon asked which CT they thought were necessary
- Patient then scanned
- Looked for significant missed injuries
• Gupta et al.
• 2804 scans performed
• 992 deemed “undesirable” by either ER or Surg or both
• 10% had abnormality, 0.3% lead to critical action
• Difference of opinion with respect to significance of injury: Surgeons wanted to know about ALL injuries

• Balance between clinical judgment, serial exam, risks and benefits of imaging, and buy in from admitting MD
Why shouldn’t we Pan Scan All-comers?

- Victims Of Modern Imaging Technology
- VOMIT

**Radiation Dosages (mSv)**
- 6 hour flight: 0.03 mSv
- CXR: 0.04 mSv
- CT Head: 3.0 mSv
- Background Radiation: 3.0 mSv
- CT C-spine: 4.9 mSv
- CT Chest/Abdo: 26 mSv
- Astronaut/year: 174 mSv

- Total radiation from trauma admission much greater
What’s worse?

- Predicted death rates due to Trauma vs Radiation?

- Looked at “Intermediate Risk” trauma population
  - ISS: 8

- Risk of mortality from trauma 6 fold greater than risk from radiation exposure

- Mortality greater in elderly patients (all died of CHI)
  - Recognize need to limit young patients’ radiation exposure with “intermediate risk” of traumatic injury

- The debate continues
Issues with imaging at your centre prior to transfer?

- Particularly a problem when there is an indication for transfer
- Delay in transfer time
- CT technique: contrast, reformats
- Technical difficulties with loading the images
- Forgot to send the images
- Shared networks coming
Diagnostic Imaging in Trauma


- Mail in survey of referring MD’s
- Reasons for delays in transfer
- 33% felt patient needed imaging prior to transfer regardless of patient acuity or that it would delay transfer
- Perception that the receiving facility would want imaging
- Legal issues

• Prospective cohort of 410 transferred trauma patients
• 53.2% had repeat imaging at the trauma centre

• Repeats done in older, sicker patients that had longer delays before transfer
Considerations for Diagnostic Imaging in Trauma

- Different populations: Age
- Acuity of Illness: physiologic, anatomic, LOC
- Mechanism of injury

- Less suspicion for injury - consider alternative to Pan scan
Ultrasound in Trauma

- FAST
- Pneumothorax
- Vascular Access
Focused Assessment with Sonography in Trauma (FAST)

- Focused Examination
- Emphasizes only ONE Finding
- Brief
- Easily Repeated
Morison’s Pouch
Morison’s Pouch
Ultrasound Detection of Hemoperitoneum

- Clinical Evidence
Ultrasound Detection of Hemoperitoneum

- Boulanger, et al., Journal of Trauma, 1996
- Prospective study
- 206 blunt trauma patients
- Mean ISS = 24.0
- Compared U/S, CT, DPL
Ultrasound Detection of Hemoperitoneum

- Boulanger et al.
- U/S time = 2 to 3 minutes
- U/S Sensitivity = 81% * (98%)
  Specificity = 98%

Conclusions: US is a rapid, accurate test for intraperitoneal fluid detection compared with CT and DPL
US Detection of Pneumothorax

- A Prospective Comparison of Supine Chest XR and Bedside US for the Diagnosis of Traumatic Pneumothorax (PTX). Blaivas, M. Academic EM, September 2005, 12,9
- Compared sens and spec of US vs Portable CXR
- 176 patients enrolled
- US first done by Emerg MD, then patient evaluated by trauma attending who was blinded to US result, but evaluated CXR
- Gold standard for PTX: CT or gush of air with chest tube placement
US Detection of Pneumothorax

- US Technique: 4 locations of view
  - 2\textsuperscript{nd} interspace midclavicular line
  - 4\textsuperscript{th} interspace at anterior axillary line
  - 6\textsuperscript{th} interspace at midaxillary line
  - 6\textsuperscript{th} interspace at posterior axillary line
US Detection of Pneumothorax

- 176 patients, 53 true positives on CT or Chest tube placement
- US detected 53 PTX, 1 false positive and one false neg
- CXR detected 40 PTX, 1 false neg

- Sensitivity of: US 98.1%  CXR 75.5%

- NPV of:   US 99.2%  CXR 90.4%
US Detection of Pneumothorax

- **Conclusions:** US is a very fast and sensitive tool for PTX detection
- **Limitations:**
  - Sub-Q air
  - Chronic lung disease
  - Pulmonary contusion
  - Operator proficiency

- Useful technique to practice at “home”
US guided vascular access

- Real Time US-Guided IJV Catheterization in the ED Increases Success Rates and Reduces Complications
- 2 hour instructional course
- 133 patients
- Inexperienced vs Experienced MD’s
- Overall: 15% increase in success with US
- Results more impressive in Inexperienced group
- Lower complication rates with US
US guided vascular access

- IJ Anatomy
- Roughly 25% IJ not in expected location

- Applicable to femoral lines as well
- Standard of care
Summary

- Diagnostic Imaging must be Individualized for each Trauma patient
- CT scanning should be limited in patients with a clear indication for transfer to a Trauma Centre
- For patients without a clear indication for transfer, consider selective scanning with adequate surveillance
- Consider US as a tool to aid in trauma evaluation
Why is the sky blue? How do magnets work? What’s the name of the plane that dropped the bomb? Who won the first Stanley cup? What would a chair look like if your knees bent the other way? How do you make a souffle? Why does everyone want to know about Mars? Who was the second man to walk on the moon? Do you dream in colour? Who will win this year’s Stanley cup? What is an echidna? Where is Kununurra? In German, what does “sitzpinkler” mean? Who cuts Justin Bieber’s hair? Who in the hell decided eating oysters was a good idea in the first place? Is there a colour darker than black? What does TAZER stand for? Is it illegal to remix music? What on earth is eating Gilbert Grape? Will Coke really dissolve a nail? Is it illegal for an underage woman to live with seven tiny men? How tall is Niagara Falls? What’s another word for thesaurus? How do you get rid of dreadlocks? Have you ever seen a picture of Ansel Adams? Who was Dorian Gray? What year was the telephone invented? What colour were the dinosaurs? Do you think I see the same colour of green that you do? How many kids does Angelina Jolie have? How do you kill a Mockingbird? How do they get the jelly into the donut? Who