Radiologic Assessment of Penetrating Abdominal Trauma

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March 2002
Background

• All penetrating abdominal injuries must be surgically explored.

• Fact: Based on war experience, surgeons in the 1950s surgically explored all penetrating abdominal trauma. Studies during the 1960s began looking at selective observation of some patients. Today, aided by modern imaging, many patients can be observed.
Classification of Penetrating Trauma

• Gunshot wound (GSW) vs. stab wound (SW)
  – Over 95% of GSWs penetrating the peritoneum require laparotomy
  – About 50% of SWs go on to laparotomy

• Anterior vs. posterior stab wounds
  – 35% of anterior wounds do not have fascial penetration
  – Posterior wounds are more likely to cause retroperitoneal injury
Menu of Tests

• Plain film
  - useful but insufficient for trauma evaluation
• CT
• US
• Peritoneal Lavage
CT

Pros:

– can evaluate retroperitoneum, pancreas, liver, kidneys, duodenum
– roughly quantify hemoperitoneum
– grade injuries to solid organs and follow over time

Cons:

– insensitive at detecting bowel and diaphragmatic injuries (improved with triple contrast and coronal reconstruction)
– requires transporting patient to radiology, time consuming (poor for unstable patients)
Ultrasound

Pros:
- can be done rapidly in the trauma bay
  good for detecting free abdominal fluid or pericardial tamponade

Cons:
- inferior to CT for identifying and grading solid organ injury & retroperitoneal trauma
- also poor at diagnosing bowel injury
Diagnostic Peritoneal Lavage

Pros:
- can be done rapidly in the trauma bay
- can sometimes detect bowel contents

Cons:
- cannot quantify hemoperitoneum (small, self-limited lacerations may test positive)
- no indication of source of bleeding
- does not address retroperitoneal injuries
Algorithm

Abdominal Stab Wound

Unstable
- Ex Lap or FAST
- Local Wound Exploration
  - Discharge
  - Observe

Stable
- Anterior
  - Observe
  - DPL or CT
  - Observe
- Posterior
  - Ex Lap
  - CT
Our Patient, M.R.

• M.R. is an 18-yo male who presents to the ED with a stab wound to the right back.
• A&O, c/o RLQ and R back pain.
• Vitals: 180, 130/80, 18, 100% RA.
• Hct 36.
• No PMH/PSH.
Algorithm

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    - Discharge
    - Observe
  - Anterior
    - Observe
  - DPL or CT
    - Observe

- Stable
  - Posterior
    - Observe
    - CT
    - Ex Lap
Algorithm

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Stable
- Anterior
  - DPL or CT
    - Observe
- Posterior
  - CT
    - Ex Lap
Chest Film

Findings

- No PTX
- No left-sided effusion
- Normal mediastinum
- No abdominal free air

Limited evaluation as Right costophrenic angle cut off
Abdominal CT

Fluid consistent with Hematoma
Abdominal CT

Hematoma

Active Bleeding
Abdominal CT

Hematoma

Active Bleeding
Abdominal CT

Hematoma

Active Bleeding
Abdominal CT

Hematoma

Active Bleeding
Abdominal CT

- Hematoma
- Active Bleeding
- Kidney displaced anteriorly
Abdominal CT

Hematoma

Active Bleeding - vs - Collecting duct injury

Kidney displaced anteriorly
Abdominal CT

Active Bleeding - vs - Collecting duct injury
Abdominal CT

Active Bleeding vs Collecting duct injury
Abdominal CT

Path of stab wound
Pelvic CT

Ureters
Initial CT Findings

- Lacerations to liver and right kidney
- Intra-abdominal and retroperitoneal hemorrhage
- Active extravasation of contrast
- Patient clinically stable so nothing warranted immediate surgery
Algorithm

Abdominal Stab Wound

Unstable
- Local Wound Exploration
- Discharge
- Observe

Stable
- Anterior
- Observe
- Diagnostic Peritoneal Lavage
- Observe
- Ex Lap

Posterior
- Ex Lap or FAST
- CT
Further Evaluation of Renal Injury

- A CT urogram was ordered to determine whether the perirenal fluid was blood versus urine from a collecting duct injury.

- To determine the source of the perirenal contrast extravasation, a CT urogram was performed 12 hours later.
CT Urogram: 12 hours later

R Kidney
CT Urogram

R Kidney

Ureter

BIDMC PACS
CT Urogram

R Kidney

Ureter

Collecting system

BIDMC PACS
CT Urogram
CT Urogram

R Kidney

Collecting system
CT Urogram Findings

- Large right perirenal organizing hematoma
- No evidence of extravasation of contrast material
- No injury to right collecting system
M.R.’s Hospital Course

- His Hct stabilized at 26, tolerated regular diet.
- Hepatobiliary scan revealed no leakage.
- Discharged on hospital day 4 with follow-up in trauma clinic in one week.
Follow-up CT

Original CT

Follow-up CT at 11 days
Ultrasound Approach to the Unstable Patient
FAST

- **Focused Assessment with Sonography for Trauma**
- Performed early during resuscitation only to identify evidence of injury (hemoperitoneum).
- Four areas of attention: perihepatic, perisplenic, pelvic and pericardial.
- Well established for detecting surgical hemoperitoneum in patients with blunt trauma (Sn 81-88%, Sp 97-100%). A recent study for penetrating trauma showed Sn 46% and Sp 94%.
Perihepatic FAST

- Hepatorenal space (Morison’s Pouch) is the most dependent area of the right upper quadrant.
- Look for hypoechoic stripe between capsule of liver and Gerota’s fascia of kidney.

Transducer in the right mid- to posterior axillary line at the level of the 11th and 12th ribs.

http://www.trauma.org/radiology/FASTruq.html
Perihepatic FAST

Normal Perihepatic FAST

Positive Perihepatic FAST

Liver

Kidney

Liver

Blood

Kidney
Perihepatic FAST

Normal Perihepatic FAST

Positive Perihepatic FAST

http://www.trauma.org/radiology/FASTruq.html
Perisplenic FAST

- In the LUQ, the perisplenic area is dependent.
- Look for hypoechogenic area near the spleen and kidney.

Transducer in the left posterior axillary line region between the 10th and 11th ribs.

http://www.trauma.org/radiology/FASTluq.html
Perisplenic FAST

Normal Perisplenic FAST

Positive Perisplenic FAST

Blood

Spleen

Kidney

Spleen

Kidney
Perisplenic FAST

Normal Perisplenic FAST

Positive Perisplenic FAST

http://www.trauma.org/ortho/fastluq.html
Pelvic FAST

- In the pelvis, the rectovesicular or rectouterine area is most dependent (pouch of Douglas).
- Look for hypoechoic area near the bladder or uterus.

Transducer is midline just superior to the symphysis pubis.

http://www.trauma.org/radiology/FASTpelvis.html
Pelvic FAST

Normal Perihepatic FAST

Positive Perihepatic FAST

“Mickey Mouse ears”
Pelvic FAST

Normal Pelvic FAST

Positive Pelvic FAST

http://www.trauma.org/ortho/fastpelvis.html
Subxiphoid FAST

- The subxiphoid view inspects the heart for tamponade.
- Pericardial tamponade will appear as a hypoechoic region within the pericardial space between the visceral and parietal pericardia.

Transducer is to the left of the xiphoid process and angled upward under the costal margin.

http://www.trauma.org/radiology/FASTpericardium.html
Subxiphoid FAST

Normal Subxiphoid FAST

Positive Subxiphoid FAST

Tamponade
Subxiphoid FAST

Normal Subxiphoid FAST

Positive Subxiphoid FAST

http://www.trauma.org/radiology/FASTpericardium.html
Summary

• CT is the test of choice for assessing the degree of abdominal injury in a stable patient with penetrating abdominal trauma.
• US can be helpful in detecting free abdominal fluid in an unstable patient.
• Some patients can be successfully observed based on clinical and radiologic findings.
References

- Ng A. Trauma ultrasonography: the FAST and beyond. http://www.trauma.org/radiology/FASTintro.html
Acknowledgements

- Maria-Candida Albano, MD
- Ravi Thakur, MD
- Wayne Monsky, MD
- Gillian Lieberman, MD
- Pamela Lepkowski
- Larry Barbaras and Cara Lyn D’amour
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