Abdominal & Flank Pain
Avoiding the Lethal Traps By Using Ultrasound

AAA and Renal Ultrasound

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Case

- You work at a single coverage community ED
- It is 2 am
- JJ is a 57 yo man
- CC: Abdominal pain, moderate, mid abdomen, radiates to right flank and RUQ. No fever.
- PMH/PSH
  - HTN, kidney stones
  - s/p appy
- Exam
  - Vitals: BP 160/90, HR 90, RR 20, T 37.6
  - Exam: abd mod diffuse TTP, no G/R; ? mild flank TTP R>L

Now What?

- Labs?
- Imaging?
- It is 2 am
- Labs:
  - WBC 12K, crit 38
  - UA: 0-2 WBC, 5-10 RBC
  - Cr: 1.4
- Pain control, serial exams...
- But what if you had bedside ultrasound...
- ... and knew how to use it?
- 3 am: BP drops to 100/60 after dilaudid
- ?Vagal? Are you sure?
Alternate Universe Case
Outcomes

Abdominal Aortic Aneurysms
Abdominal Aortic Aneurysms

- Definition: dilatation of the wall of the abdominal aorta. Rupture is usually fatal.
- Asymptomatic AAA is present in up to 5% of ED and ambulatory care patients. It often remains completely asymptomatic until it ruptures.
- Physical exam is unreliable: an abdominal pulsating mass is often not palpable (cited as only around 39% sensitive for AAA).
- Often misdiagnosed as low back pain or renal colic.

AAA: Background

- Consider US on any patient who presents with abdominal, flank, or back pain, especially if elderly and with a history of hypertension.
- Primary risk factors: atherosclerosis, vascular disease.
- Board review bonus:
  - Others include: trauma, syphilis, cystic medial necrosis and connective tissue disorders such as Marfan’s.

ED Goal-Directed Ultrasound

- Shown to be accurate in multiple studies, with up to 100% concordance between the ED rapid bedside study and the formal radiology report (Schlager, 1994...).
- Rapid diagnosis of suspected AAA is critical in order to mobilize emergent surgical consultation.
- If a patient is unstable and unable to get a confirmatory CT scan, the ultrasonographic finding of the aneurysm alone is often sufficient to get the patient to the operating room.

- The abdominal aorta enters the abdomen at tip of the xiphoid/T12 vertebral body
- Bifurcates into the iliac arteries 1-2 cm above the umbilicus/superior iliac crests/L4
- Abdominal aorta is retro-peritoneal, with spine directly behind
- Runs left & parallel to the IVC
- Diameter should be < 3 cm.
Longitudinal Anatomy

- In epigastrium, the celiac artery and SMA may be seen projecting off of the anterior wall of the aorta.
- SMA is surrounded by thick connective tissue which makes it easier to see.

Transverse Anatomy

- At the level of the epigastrium, the aorta is a large circular or oval pulsating structure.
- Structures often visualized here include the thick walled SMA and the splenic vein, with a snake-like appearance, running between the SMA and the liver.
- The pancreas surrounds the splenic vein.

Longitudinal Aorta

- TIP: If having trouble seeing the vessel, try using color.
**Transverse Aorta**

- **TIP:** Pitfall: don’t mistake the spinal canal for the aorta

**Retroperitoneal Structure**

- RETROPERITONEAL hemorrhage from a ruptured AAA is usually not seen (sensitivity ~ 4%).
- INTRAPERITONEAL hemorrhage MAY be seen with trauma FAST views, but do not expect this.
- The presence of the aneurysm alone is often sufficient to mobilize resources.

**Aneurysm**

- Ultrasound (L) and CT (R) of 9cm AAA
- Note the AAA is visible on both; however the hemorrhage is much easier to see in the CT (Simon, Snoey)
Indications for AAA US

- Suspicion for AAA
- Unstable patients with abdominal, back, or flank pain
- Part of the undifferentiated hypotension protocol, as patients may be asymptomatic or unable to communicate
- Consider CT in stable patients

Technique

- Use a 2.5-3.5 MHz freq transducer; patient is usually supine
- Place the probe at the epigastrium. Locate the pulsatile abdominal aorta
- Obtain views in both transverse and longitudinal orientations over the entire length of the abdominal aorta (epigastrium to umbilicus), through to the bifurcation into the iliacs

Alternate Scanning Techniques

- Try to move bowel gas; change pressure/angle probe
- Apply pressure with a wider footprint probe; move pannus aside
- Consider coronal approach:
  - Place the probe at Morison’s pouch
  - Increase the depth to obtain visualization

Pitfall! Measuring Technique

- Measure diameter from outside wall to outside wall; otherwise you will underestimate the AAA size.
- Measure in transverse orientation first as it is less susceptible to tangential measuring error.
Aneurysms

- > 3cm in width (or 1.5 x the proximal normal segment)
- < 5cm in width: expansion proceeds at 0.2-0.4 cm/year... then accelerates.
- Fusiform > saccular
- Usually located below renal arteries (95%); often extend to the iliac arteries (40%)

Fusiform Aneurysm

Saccular Aneurysm

- Most aneurysms are fusiform; however sacular aneurysms such as the one shown are a pitfall because they are much harder to visualize (Simon/Snoey)
Aorta: More Pearls and Pitfalls

- Retroperitoneal bleeding: hard to see with US
- Focus on identifying the aneurysm
- Base therapy on the rest of the clinical status
- Look carefully for echogenic thrombus. A false lumen can fool you into underestimating the size of the AAA, or not recognizing it at all
- Include the thrombus when measuring the AAA
- A grey-scale system is sufficient, but color flow can help visualize the vessel

More Pearls and Pitfalls

- Sometimes body habitus and gas makes this study impossible, even using advanced techniques. Consider CT in stable patients.
- Retroperitoneal masses, LAN, and previous repair can obstruct view.
- With age the aorta often becomes tortuous and takes a winding path. Take care to follow it along its entire length.
- Beware the spinal canal!

More Pearls and Pitfalls

- Do not mistake the IVC for the abdominal aorta.
- Confirm by turning both longitudinally and transversely. If in doubt, attempt to find the SMA, which has a bright target of connective tissue around it
- Aorta has a thick wall and is hard to compress; IVC easier to compress
- The IVC will have respiratory variation and is tear shaped

More Pearls and Pitfalls

- When you think renal colic, consider AAA in the differential.
- Beware: large AAA’s can compress the ureter and cause obstructive hydronephrosis.
- Fistulas can result in hematuria...
- So... visualize the aorta as well as the kidneys.
Alternate Reality... Hydronephrosis

But what if this is what you saw, instead?

ED Renal Ultrasound

Applications include the evaluation of:
- possible renal colic
- renal failure
  - post-obstructive?
  - med renal disease?
- urinary retention
- as part of the FAST exam
- bladder: pre-cath

Renal Colic Evaluation

- Sensitivity of CT for renal colic: 86-100%
  - advantages: great visualization, determination of other causes of pain, can pick up small stones even without hydro
  - disadvantages: significant radiation exposure, especially given recurrent nature of renal colic
- Sensitivity of US for renal colic: 93% (using IVP as gold standard)
  - best at evaluating obstructing stones: hydro
  - sensitivity approaches 95% when combined with KUB (Palma et al)

Anatomy of the Kidney

- Calyces
- Renal Pelvis
- Renal Artery
- Renal Vein
- Medulla
- Cortex
- Ureter
Hydronephrosis

- prev image: http://www.childrenscentralcal.org/HealthE/P03091/P08232/Pages/home.aspx
- above image: http://www.cornellpediatrics.org/perinatal/perinatal_services/urology.html

Renal Ultrasound Technique

- Use a 2.5-3.5 MHz freq transducer; patient usually starts supine but rolling onto the left or right sides can really help
- Place the probe in the same location as for the FAST exam (Morison’s and LUQ) first. Then adjust to ensure visualization of both the upper and lower poles

Renal Ultrasound Technique

- Visualize entire kidney, medial to lateral, superior pole to inferior pole
- After visualizing the kidneys, don’t forget to look at the bladder. An overly distended bladder can cause hydro
- Visualization of the ureteral jets can also assist in the assessment of ureteral obstruction

Ureteral Jet
• Normal longitudinal view of left kidney, showing inferior pole

• Normal transverse view of left kidney

• Long. view of right kidney (hydro present)

• Transverse view of right kidney (hydro present)
Renal: More Pearls & Pitfalls

- Dehydration may delay devel of hydro
- Conversely, full bladder can lead to BL hydro; empty bladder if not sure
- Persistent BL hydro suggests urinary obstruction
- Hydro in pregnancy is common, R>L
- Look at ureteral jets to assess for unilateral ureteral obstruction
- Cysts, extra-renal pelvis can give false+

Back to our case...

- JJ with AAA: you were able to transfer to a center with a vascular surgeon in time
- JJ with obstructing renal colic: you kept him overnight for a urology evaluation in the morning; he did well and had rapid follow-up