General Surgery Clerkship

Abdominal Imaging Subsection

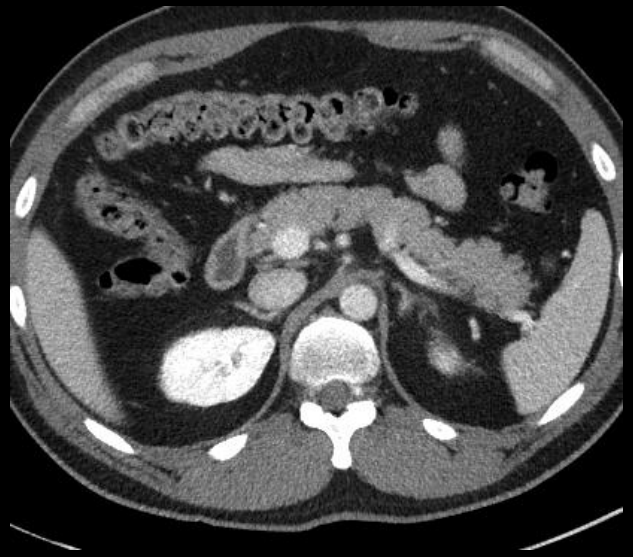
Surgical Imaging

- Imaging used routinely for acute abdomen - acutely ill with either diffuse or localized abdominal pain. May also have fever, leukocytosis, and other lab derangements depending on etiology (e.g. elevated bilirubin, creatinine, lactic acid)
- Imaging also used to look for postoperative complications
- How to work up with imaging?
  - CT is the workhorse of acute surgical imaging
  - US for gallbladder pathology, torsion (ovarian and testicular) and transplant evaluation (vascular flow in realtime)
  - Plain film may be used to serially follow ileus/SBO or quickly look for free air
  - Fluoro for anastomotic leaks, esophageal perforation, identifying site of obstruction, urethral injury, identify if abscess connects to bowel, etc…
  - MRI typically not used acutely except appendicitis in pregnant females

ORDERING CT

- With vs. without contrast
  - Contrast almost always helpful in the abdomen due to many closely apposed structures. If renal function is OK and no allergy to iodine, likely should order with contrast
  - EXCEPTION is when looking for renal stones. CT stone study = CT abdomen/pelvis without contrast

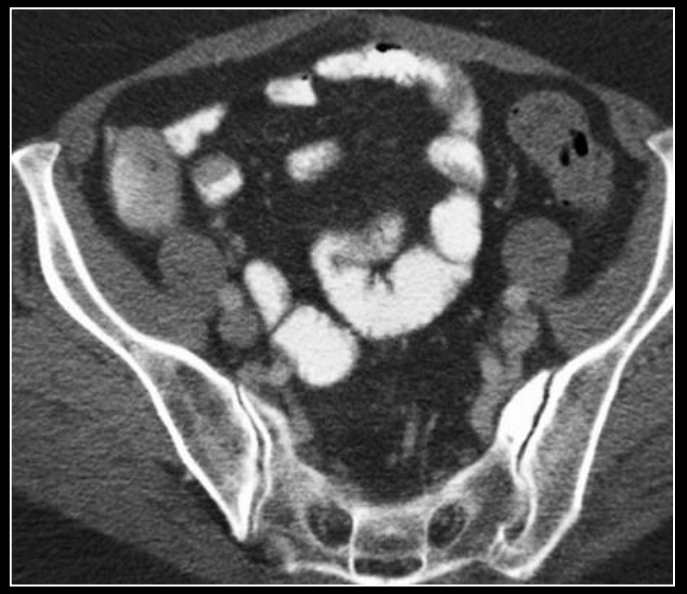
WITH



WITHOUT

ORAL CONTRAST

- Positive contrast = iodinated. Best to identify anastomotic leak. Bad if concern for ischemia, cannot see mucosa.
- Negative contrast = water or Volumen. Distends bowel and provides detail of mucosa. Cannot evaluate for leak.

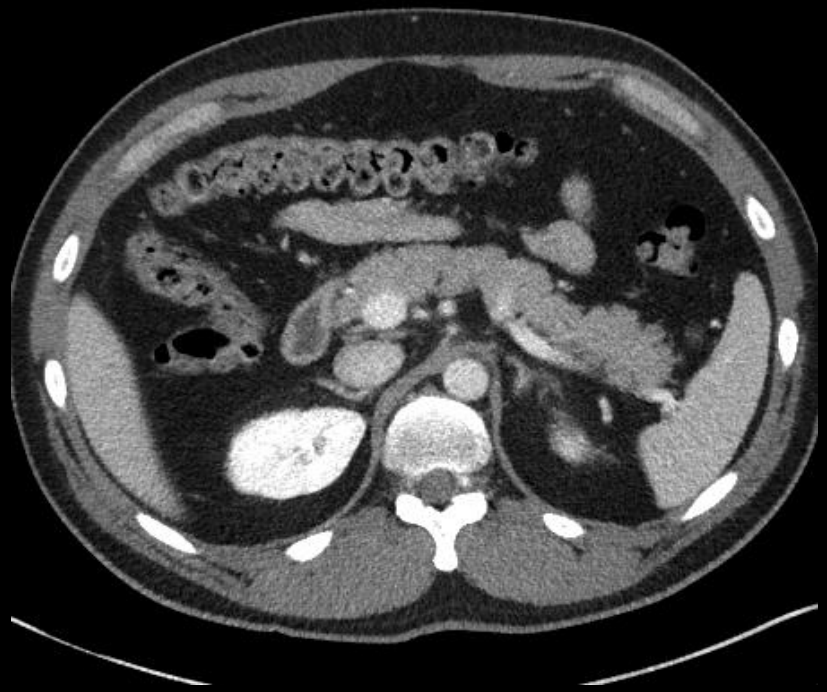


Positive

Negative

OPTIONS FOR IV CONTRAST

- Standard single-phase CT abdomen/pelvis with contrast
  - Portal venous phase (70-80 seconds)
  - Good for acute abdominal pain, many cancers, infection, bowel obstruction



- Bowel ischemia/GI bleeding protocol

1. Noncontrast

2. Arterial phase

3. Portal venous

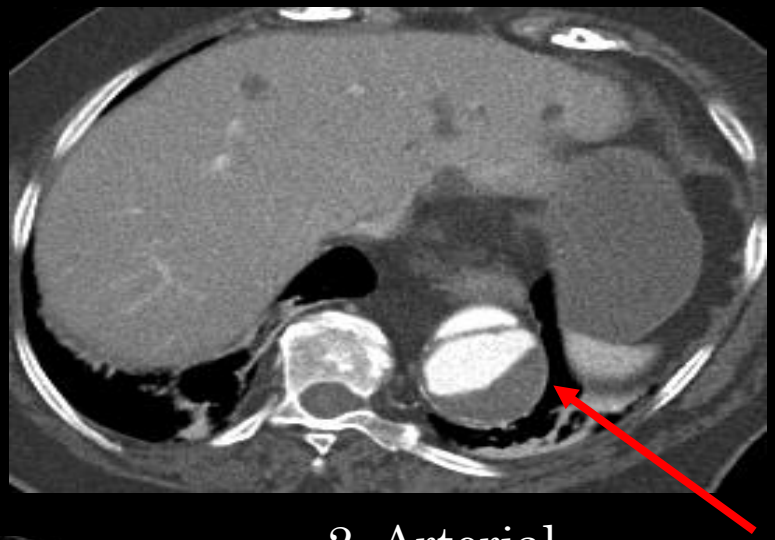
- Trauma protocol

1. Portal venous

2. Nephrographic (2 min delay)

- AAA/aortic dissection protocol (can include chest)

1. Noncontrast



2. Arterial

3. 5 min delay

- Don’t need to know details, but there are specific protocols for pancreas, liver, kidney, urinary collecting system (most commonly used to evaluate tumors of these organs). Just know they exist!

Case 1

- 65 year old female with no significant PMH presents to the ED with right upper quadrant pain.
- On abdominal exam, she had tenderness in the right upper quadrant of the abdomen. Negative Murphy's sign on ED examination.
- Labs were unremarkable.

RUQ US


LOGIQ
E9
CHI
Frq 3.0
Gn 52
S/A 3/1
Map F/0
D 11.0
DR 69
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CT Axial

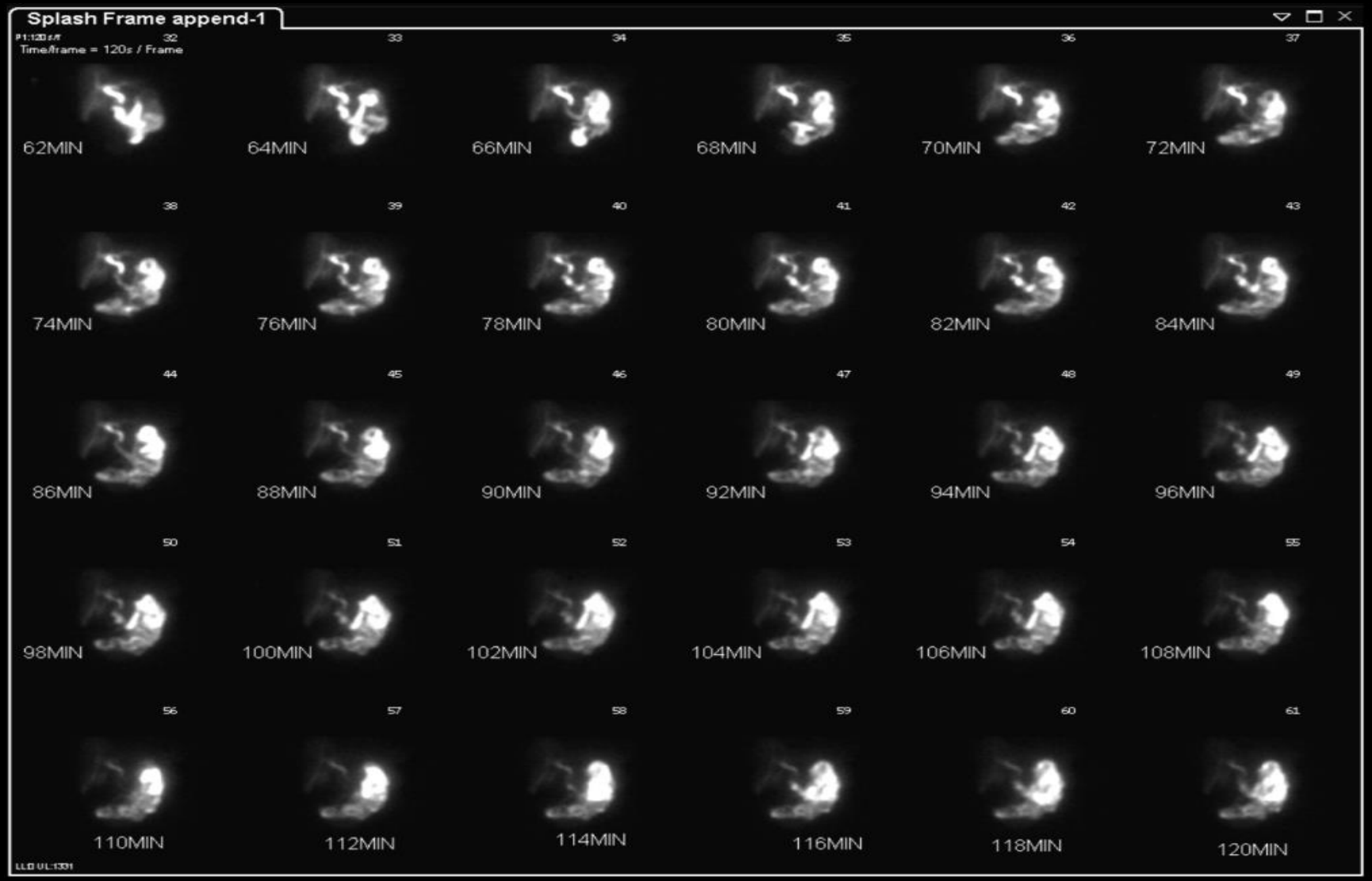
CT Coronal

Diagnosis?

Acute Calculous Cholecystitis

- Imaging findings
  - US: Sonographic “Murphy’s Sign”, gallstone impaction in gallbladder neck, pericholecystic fluid, gallbladder wall thickening, gallbladder distension
  - CT: Gallbladder wall thickening, pericholecystic fat stranding, increased enhancement of the gallbladder wall, gallstones
- Complications
  - Abscess formation
  - Gas in the gallbladder wall or lumen
  - Perforation
- Acalculous cholecystitis: absence of gallstones, otherwise similar findings as calculous cholecystitis
  - Typically occurring in critically ill (biliary stasis) and immunocompromised patients (opportunistic infection)
  - Higher risk for complications, due to atypical and insidious presentation.

HIDA scan used for equivocal cases



Companion case – emphysematous cholecystitis

Radiopaedia.org

Case 2

- 59 year old female presents to the ED with vomiting. She has had no flatulence or bowel movement over 3 days. She also has diffuse abdominal pain. No prior history of surgery.
- On examination, she has diffuse tenderness with palpation. Negative rebound tenderness.
- Labs: mild anemia, otherwise unremarkable.

Ct axial

Ct axial 2

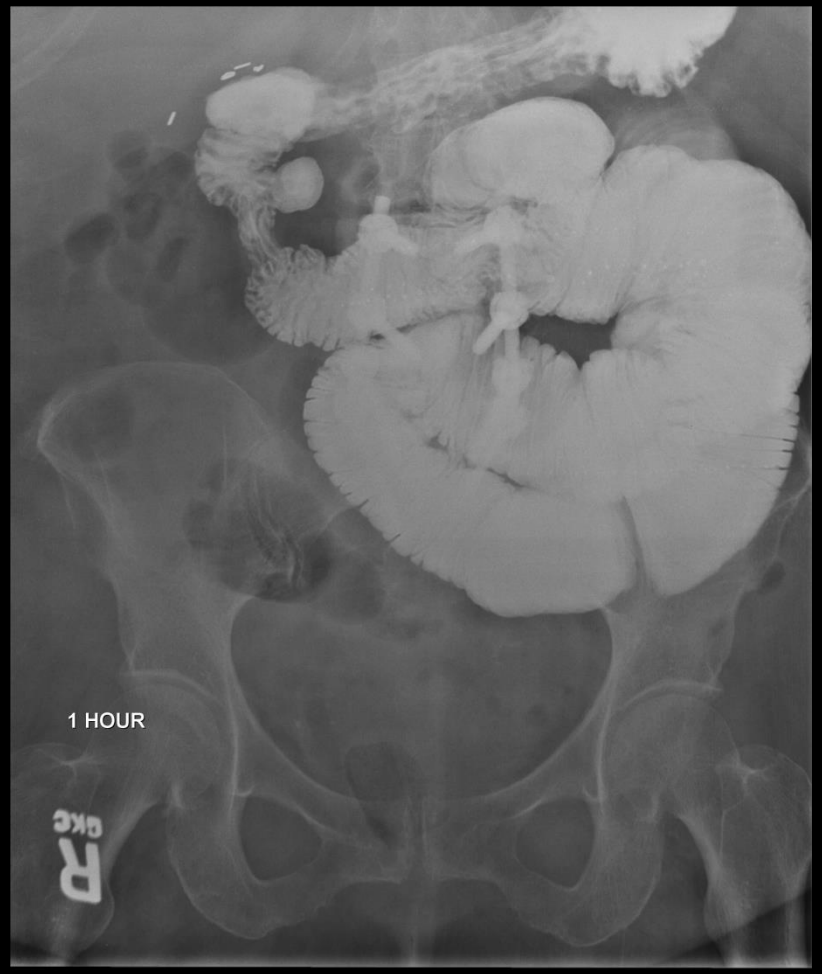
CT coronal

DIAGNOSIS?

Small bowel obstruction (internal hernia)

- Imaging findings
  - Radiography: dilated sloops of small bowel, air-fluid levels on upright and decubitus radiograph. Not very sensitive or specific.
  - CT: dilated loops of small bowel, transition point with decompressed loops of bowel distally.
- Etiology: adhesions, hernia (internal or external), malignancy (especially peritoneal carcinomatosis), other inflammatory causes.
- Close loop obstruction: obstruction at two different points involving mesentery.
  - Often due to twisting of the small bowel with stretched mesenteric vessels towards the site of torsion (swirling mesentery).
- Strangulation: imaging findings of decreased or absent bowel wall enhancement.
  - Pneumatosis and portal venous gas are grim indicators of bowel necrosis.

- Small bowel follow through can be used if transition point not seen by CT, patient not improving or want to differentiate SBO vs ileus

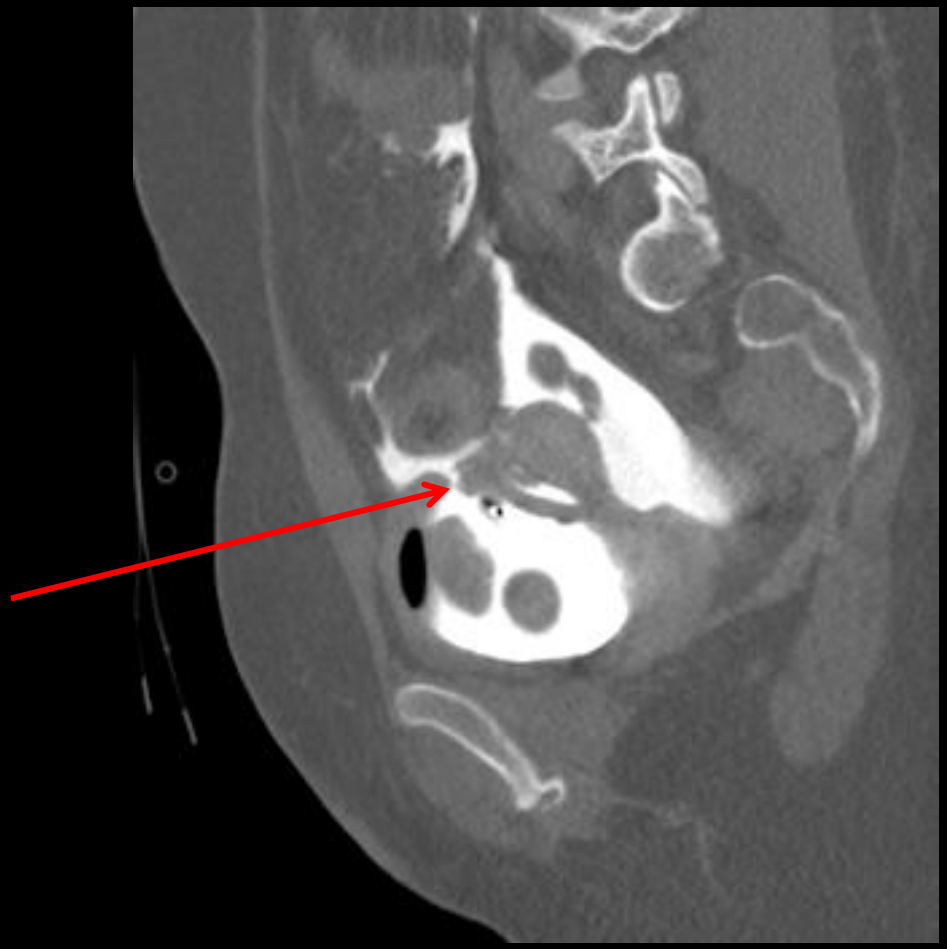


Case 3

- 23 year old female presents to the ED after MVA. She is noted to have pelvic fractures on initial trauma CT and is now complaining of hematuria.

CT cystogram coronal

CT cystogram sagittal



DIAGNOSIS?

Intraperitoneal bladder rupture

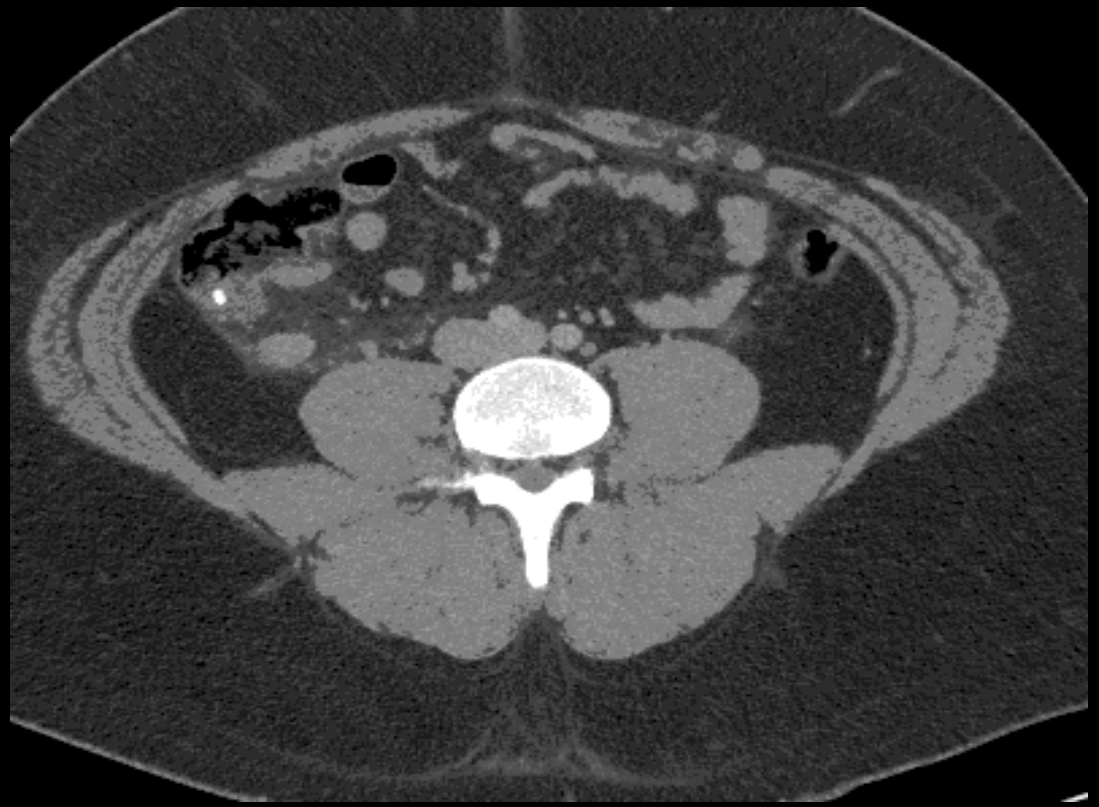
- Imaging findings:
  - CT cystogram: contrast instilled into bladder via Foley. If bladder is ruptured, contrast will spill outside of the bladder lumen. Contrast will surround and outline bowel loops (intraperitoneal) or be confined to the prevesical space, producing the classic “molar tooth” appearance (extraperitoneal)
- Etiology
  - Bladder rupture seen in setting of trauma with pelvic fractures, occasionally spontaneous if there is a predisposing condition
- Management
  - Intraperitoneal is less common. Injury usually at bladder dome. Typically requires surgical management.
  - Extraperitoneal is more common. Injury may be in bladder wall or neck. Typically is conservatively managed.

Companion Case – extraperitoneal bladder rupture

CASE 4

- 20 year old male with acute onset RLQ pain and anorexia, nausea/vomiting
- Guarding and rebound tenderness in RLQ on exam
- Mild leukocytosis; labs otherwise unremarkable

CT axial



DIAGNOSIS?

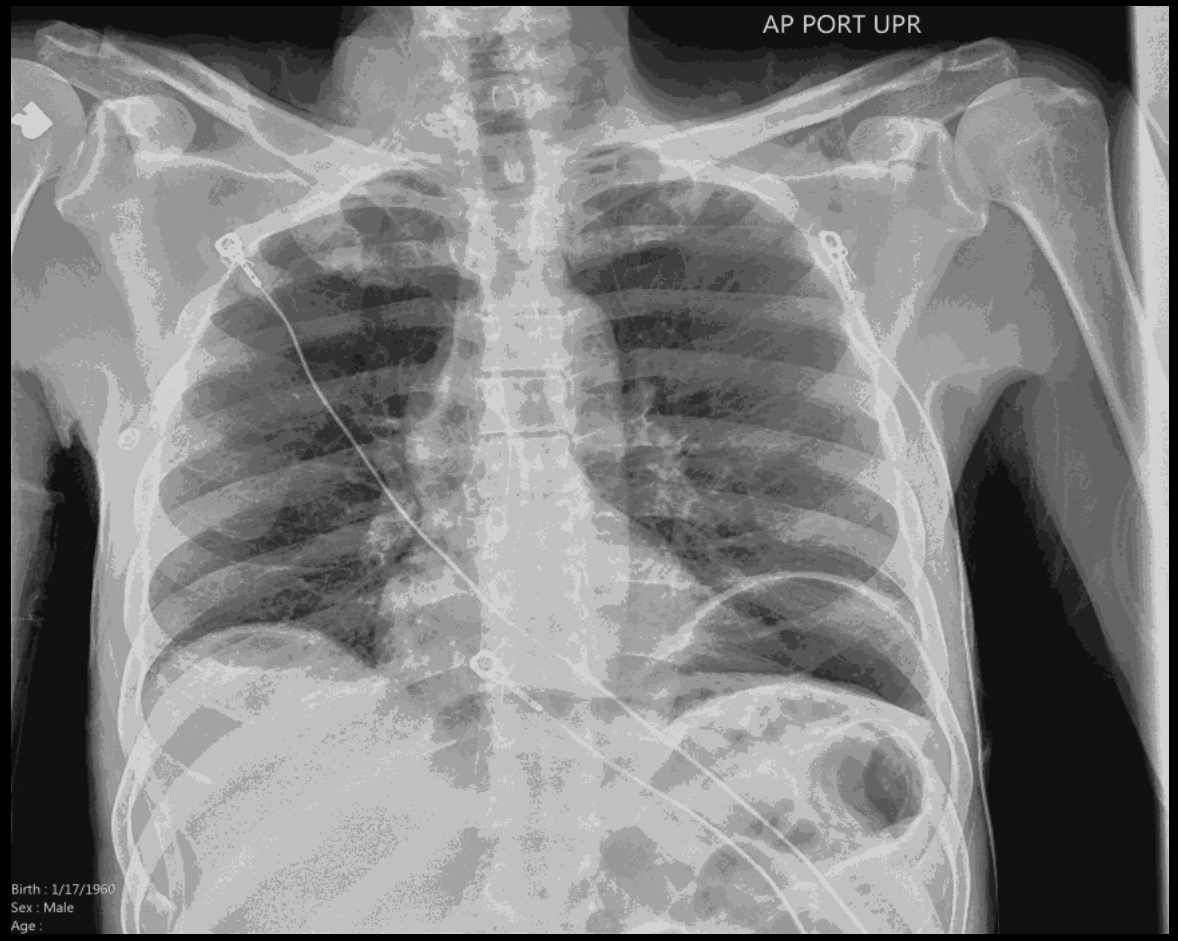
Acute appendicitis

- Imaging findings
  - Dilated, hyperenhancing appendix (> 7 mm). If necrotic or perforated, wall may be nonenhancing or have focal discontinuity
  - RLQ fat stranding and reactive thickening of peritoneal lining
  - +/- appendicolith
  - Look for abscess, perforation
  - If early appendicitis, imaging changes may only involve tip of appendix
  - US can be diagnostic in children and possibly pregnant women, MRI is an alternative in pregnant patients

CASE 5

- 45 year old male with long history of burning epigastric pain, especially after eating. Now presenting to ED with acute onset markedly worsened pain.
- Appears in distress on exam, significant epigastric tenderness and guarding

Acute abdominal series



CT axial

CT coronal

DIAGNOSIS?

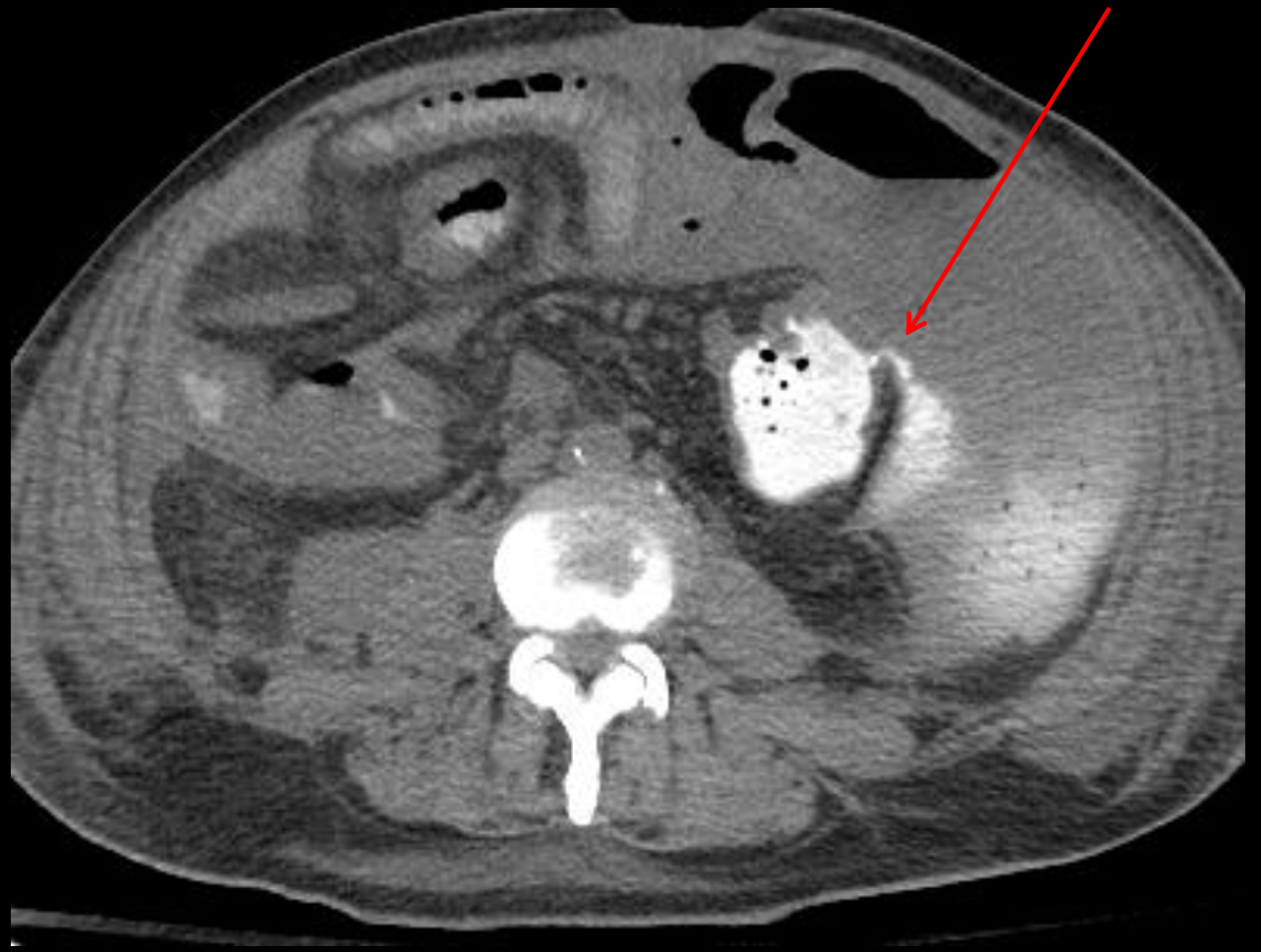
Perforated pyloric ulcer

- Imaging findings:
  - Pneumoperitoneum, typically larger volume than for bowel perforation
  - May see focal discontinuity in gastric/duodenal wall
  - Hx of gastric/duodenal ulcer often very helpful
- Consider benign causes: postoperative, G-tube placement, barotrauma
- Often, exact etiology must be determined surgically plus history and imaging

CASE 6

- 60 year old male with recent partial bowel resection now presenting with fever and tachycardia.
- On exam, mild tenderness in the left lower quadrant
- T 100.2, HR 120, WBC 18

CT axial



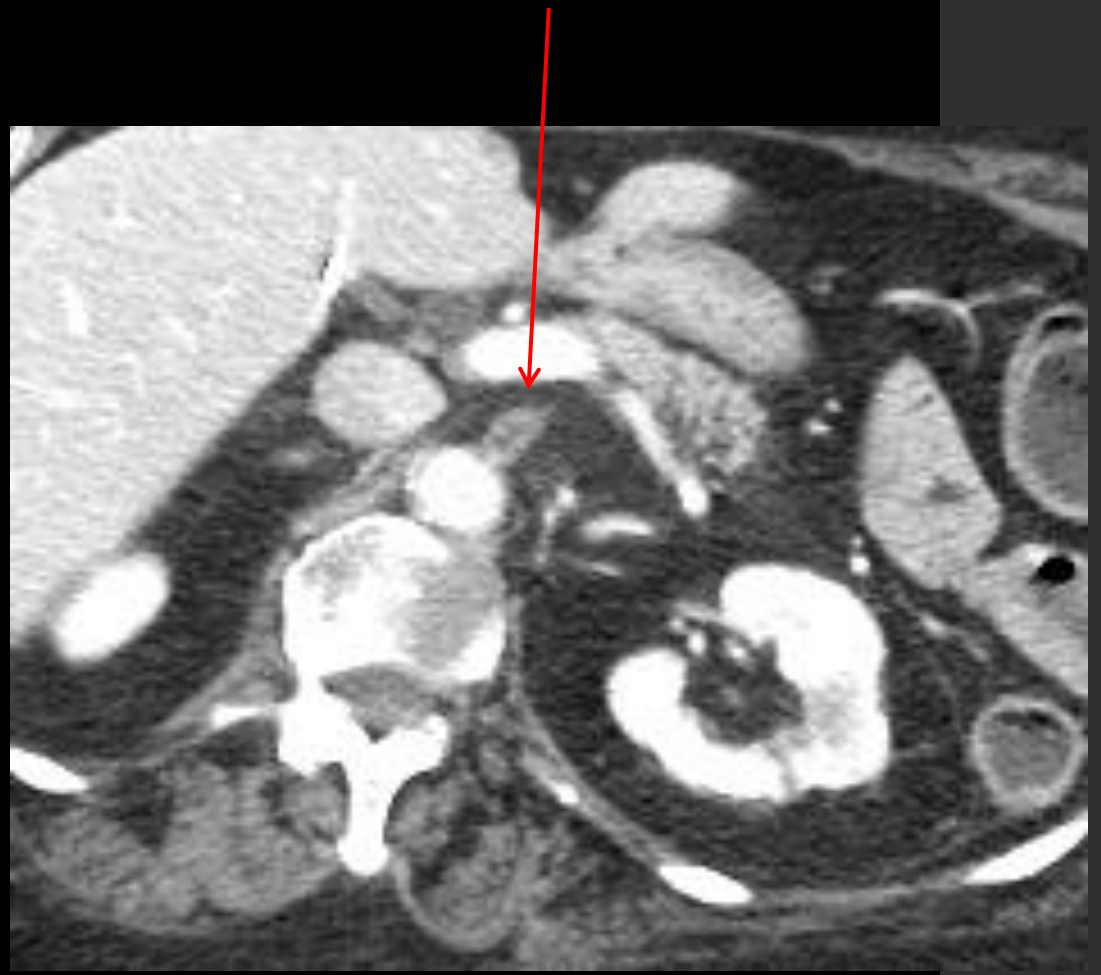
DIAGNOSIS?

Anastomotic leak

- Imaging findings:
  - Fluoroscopic enema – can be used for distal anastomoses in colon
  - CT with positive oral contrast – look for contrast spilling outside the lumen at the site of anastomosis (must wait long enough to allow contrast to opacify the anastomosis)
- Management
  - Serious postoperative complication, typically in the immediate (days to weeks) postoperative period
  - Sometimes managed expectantly with drain placement and ABX but may require surgical intervention

CASE 7

- 80 year old female with history of atrial fibrillation presents with diffuse abdominal pain and small volume bloody stool.
- On exam, diffuse abdominal tenderness, altered mental status
- WBC 25, lactic acid 5



DIAGNOSIS?

Left atrial thrombus with acute mesenteric ischemia

- Imaging findings
  - Acute – occlusion of major abdominal branch vessel (SMA, IMA) with resultant hypoperfusion of bowel (featureless, hypoenhancing). Can also see pneumatosis, portal venous gas
  - Chronic – more difficult imaging diagnosis, typically have advanced atherosclerotic disease involving mesenteric vessels. Typically don't see changes in bowel wall, as this is usually episodic after eating
- Clinical features
  - Classic presentation is pain out of proportion to exam, often with elevated lactic acid
  - If acute, mesenteric ischemia has a high mortality rate and typically requires resection of necrotic bowel as well as possible thrombolysis/thrombectomy
  - If chronic, typically manage risk factors conservatively. Sometimes stenting or other revascularization is attemped.