



# Top Emergency Radiology Ultrasound QA Issues

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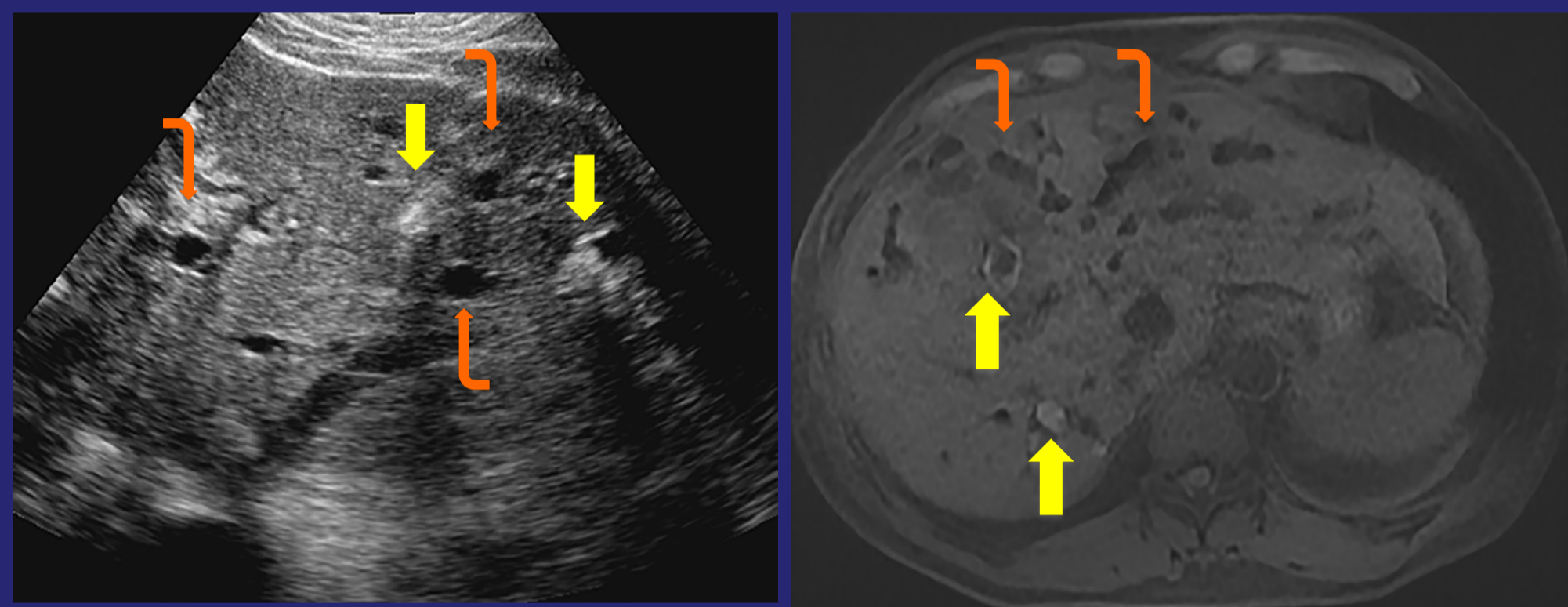
## Introduction

- We reviewed our Quality Assurance (QA) database, an online system for reporting and managing QA events at our institution (urban, tertiary care), and identified all abdominal ultrasound (US) cases performed on emergency department (ED) patients.
- 76 total cases submitted over 9-year period
- Cases were then categorized with the top five categories presented here

## Liver Lesions

9 Liver cases – 5 missed liver lesions ( 3 missed HCC; 1 missed cholangiocarcinoma, 1 missed abscess vs HCC); 2 misdiagnosed (1 recurrent pyogenic cholangitis (RPC), 1 abscess vs tumor); 1 incomplete evaluation; 1 no follow up recommended

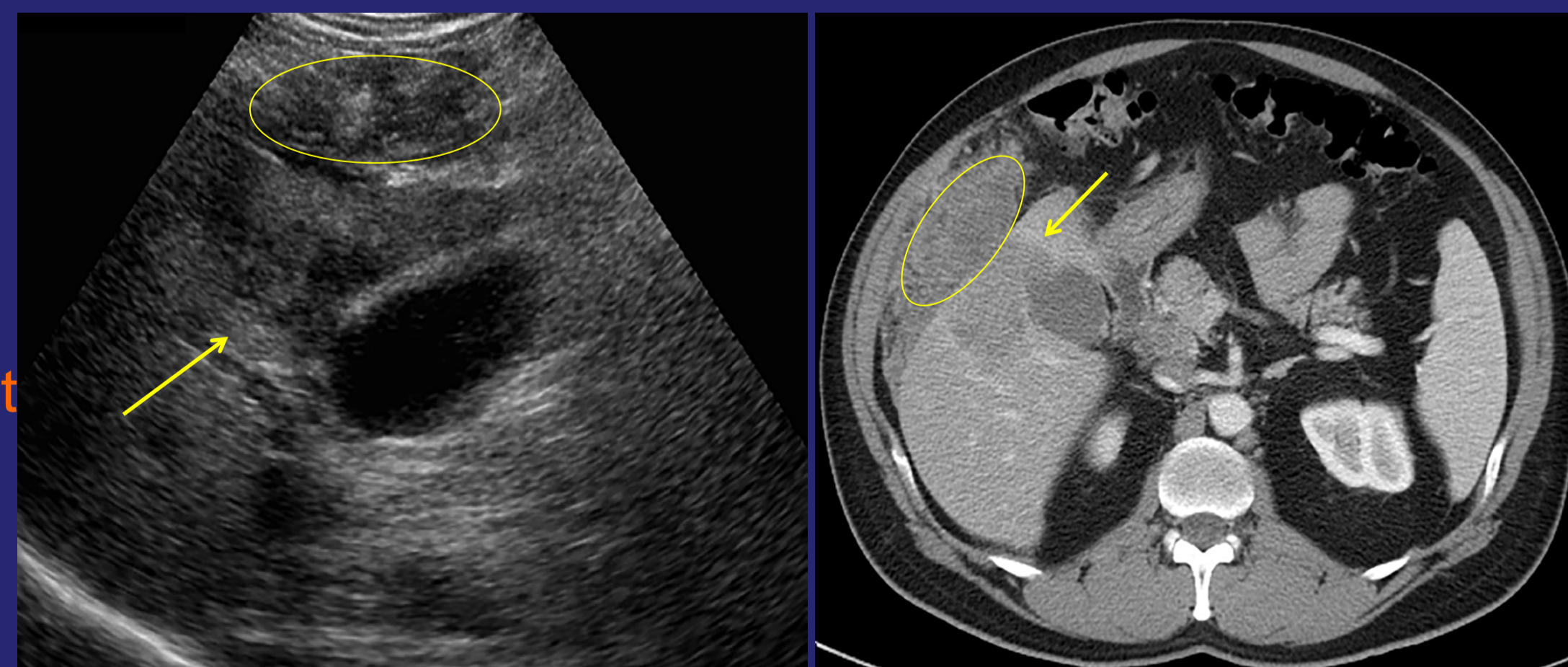
51 y.o. ♂, RUQ pain, h/o ERCP with stone removed in China 1 year ago



US: Multiple hyper- and hypo-echoic 'lesions' called hemangiomas or cysts.  
MRCP: Intrahepatic biliary dilatation (curved arrows) and intraluminal calculi (straight arrows) were demonstrated, compatible with RPC

- Consider RPC in patients with appropriate demographic background who present with RUQ pain, fever, jaundice.
- US: dilatation of the biliary tree with intrahepatic calculi -> 90% of patients. Pneumobilia also common.

47 y.o. ♂, 3 weeks intermittent RUQ pain



Biopsy proven cholangiocarcinoma with extrahepatic extension (circle) on CT missed on preceding ultrasound with hypoechoic regions adjacent to gallbladder (arrow) attributed to focal fatty sparing.

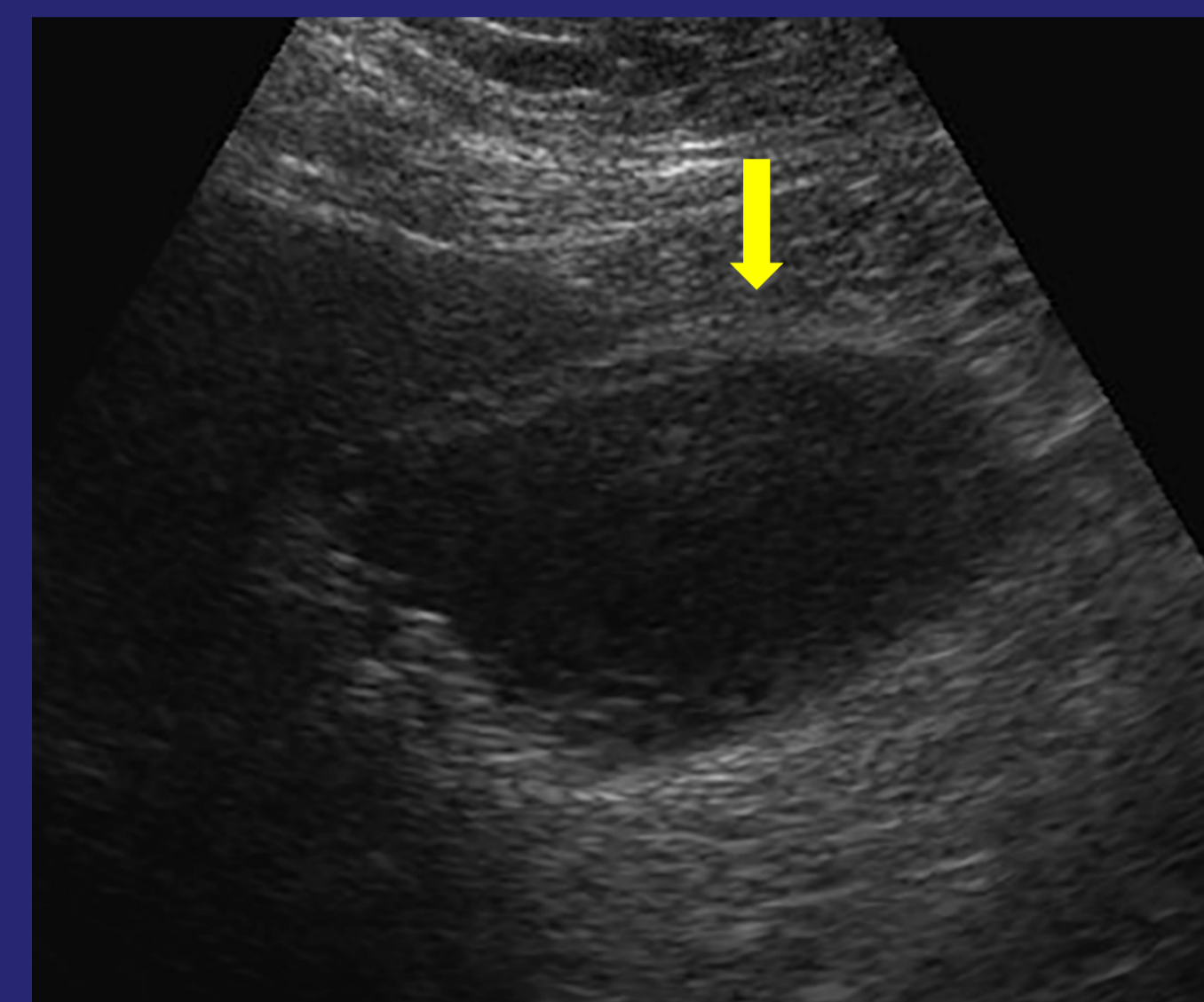
- Evaluate liver contour for irregularity.
- Extrahepatic, perihepatic region = potential blind spot

## Acute Cholecystitis

12 Acute cholecystitis cases including 5 gangrenous at cholecystectomy – in 8 gallbladder (GB) wall edema missed or deemed not significant; 3 made findings but undercalled acute cholecystitis; 1 missed pericholecystic fluid

63 y.o. ♀ with RUQ pain

Interpreted as cholelithiasis without evidence of cholecystitis. Gallbladder wall edema (arrow) was missed, and no mention of gallbladder distention or Sonographic Murphy sign. Follow up HIDA scan showed acute cholecystitis which was confirmed on pathology.

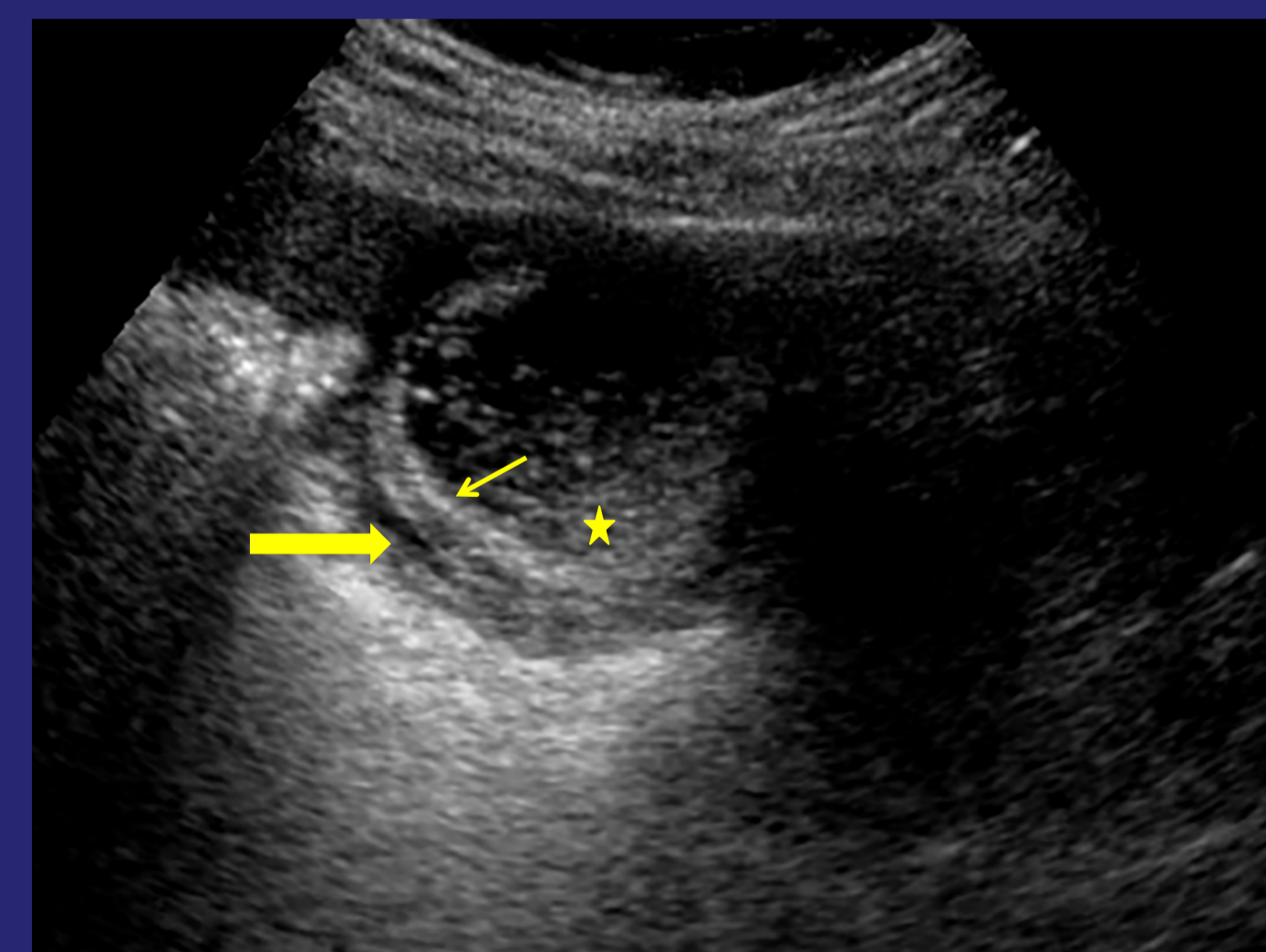


**PEARLS:** Sonographic signs of acute cholecystitis include:

- GB distention – convex wall
- Wall edema – Sensitive but not specific, can be seen in systemic disease. Most missed finding in our QA cases - important sign if third spacing has been excluded.
- Stones – acalculous cholecystitis only 10% of acute cholecystitis
- Pericholecystic fluid
- Sonographic Murphy sign

68 y.o. ♀, 2 days RUQ pain

US report noted non-mobile gallbladder neck stone, sludge (star) possible wall thickening (thin arrow), mild distention, and pericholecystic fluid (thick arrow), but hedged on the diagnosis of acute cholecystitis. Intraoperatively, gangrenous cholecystitis was diagnosed.



**PEARLS:** Gangrenous cholecystitis can be tricky to diagnose

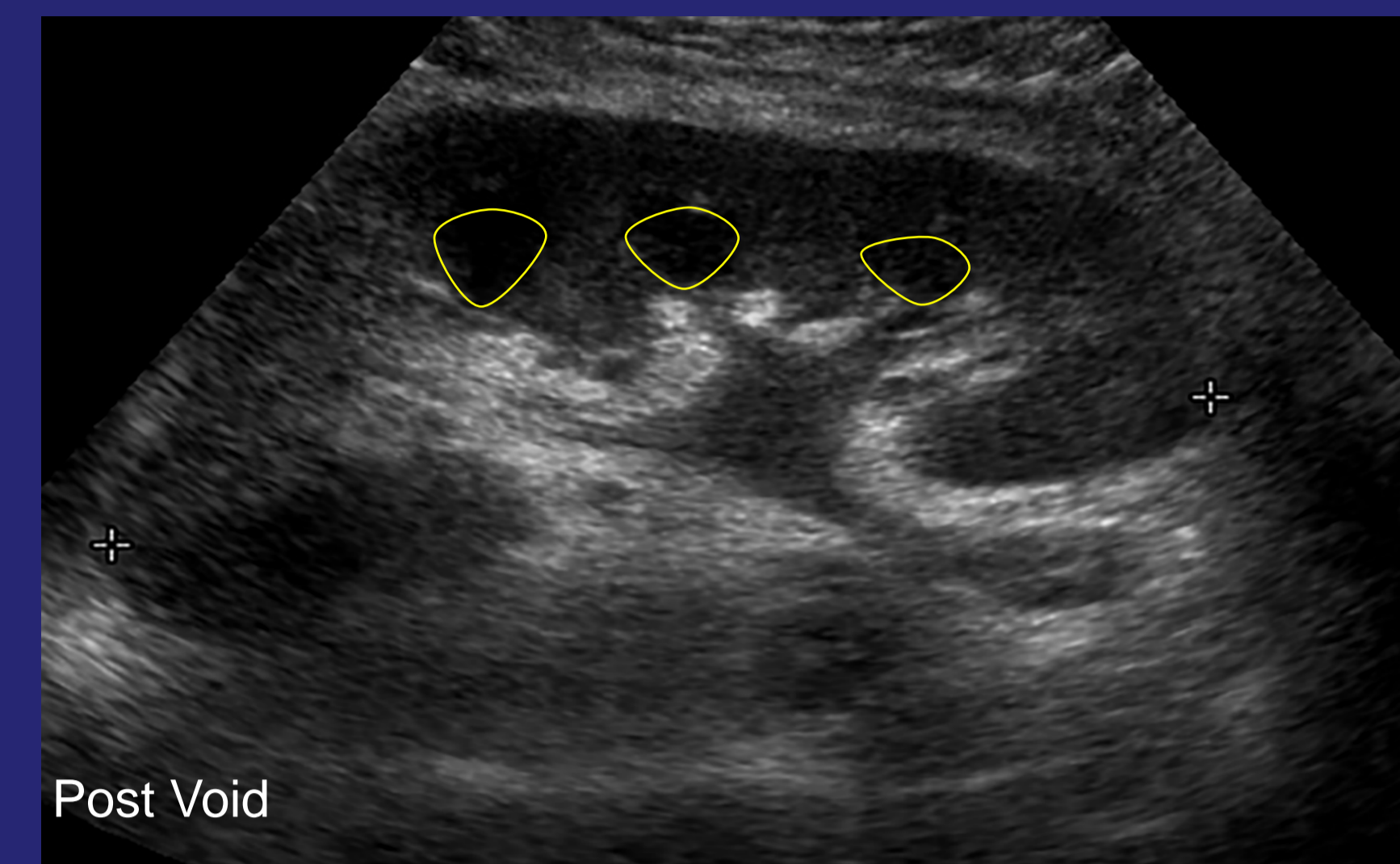
- Sonographic Murphy sign frequently negative, possibly due to denervation of gallbladder wall secondary to necrosis
- Gallbladder may not be distended if already perforated – look for pericholecystic abscess
- Can see sloughed or irregular mucosa
- Air in the wall of the gallbladder → emphysematous cholecystitis

## Renal Transplant

8 Renal transplant cases: 4 incorrect resistive indices; 1 missed hydronephrosis; 1 AV fistula overcall; 1 renal vein thrombosis overcall; 1 iliac artery called main renal artery

35 y.o. 7 mos s/p renal transplant with nausea, vomiting, pain over transplant

Interpreted as mild fullness of the renal pelvis. Dilated renal calices (circles), compatible with grade 1 hydronephrosis not diagnosed

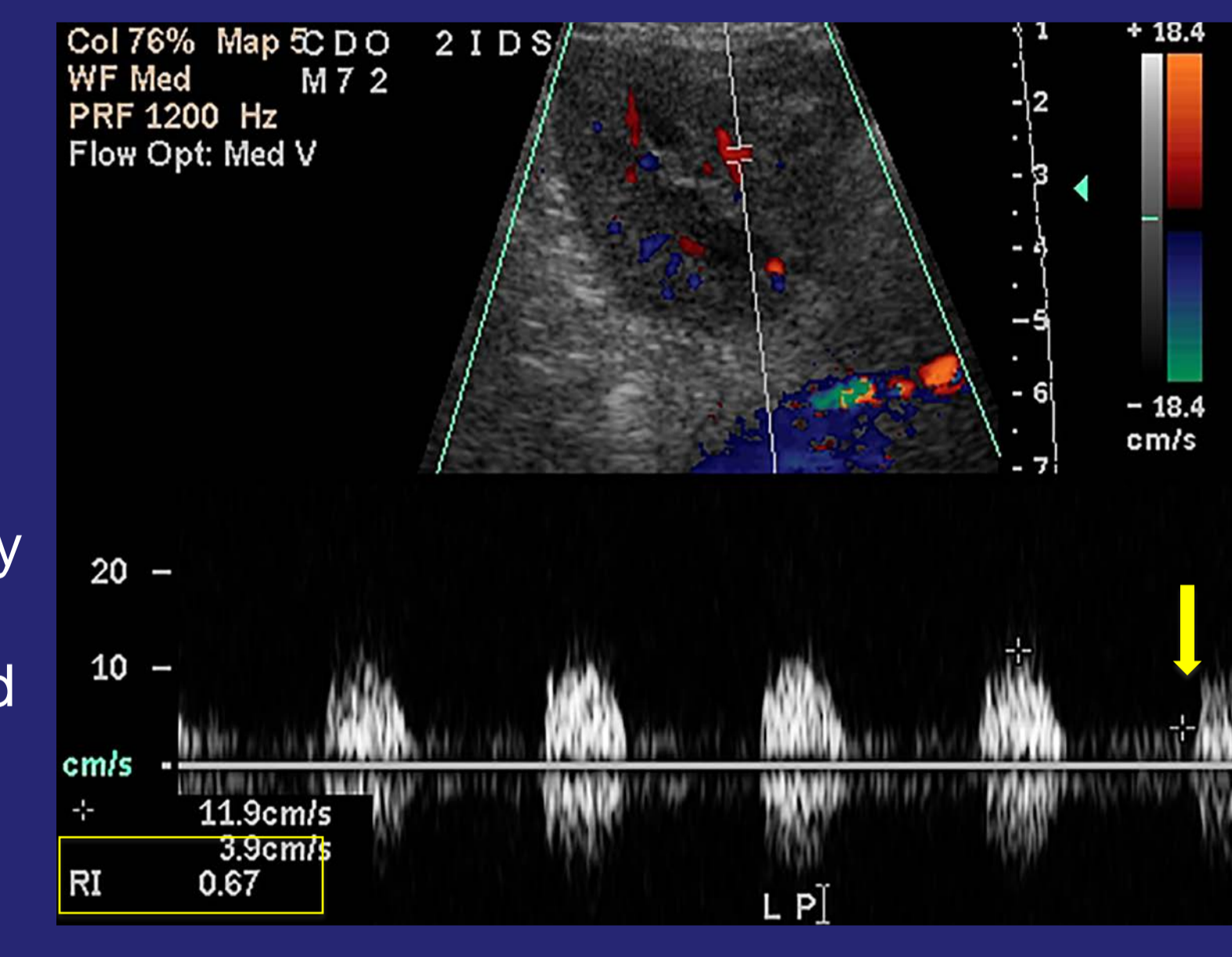


**PEARLS:** Hydronephrosis

- Ultrasound: sensitive for detecting hydronephrosis, but not specific. Can be due to obstruction or rejection.
- Need to image post-void. Hydronephrosis may resolve after full bladder is emptied.

72 y.o. s/p renal transplant, ARF and uremia

Noise mistaken for diastolic flow (arrow) resulting in inappropriately normal resistive index (box). RI actually elevated – acute rejection



**PEARLS:** Resistive Indices (RI)

- To measure RIs, obtain waveform of arcuate or interlobar arteries - measure ratio of systolic/ diastolic velocity
- Normal mean RI = 0.6, with ≤ 0.7 considered within normal range
- Elevated RI is nonspecific marker of renal transplant dysfunction, cannot reliably differentiate between obstruction, rejection, acute tubular necrosis or immunosuppression toxicity.

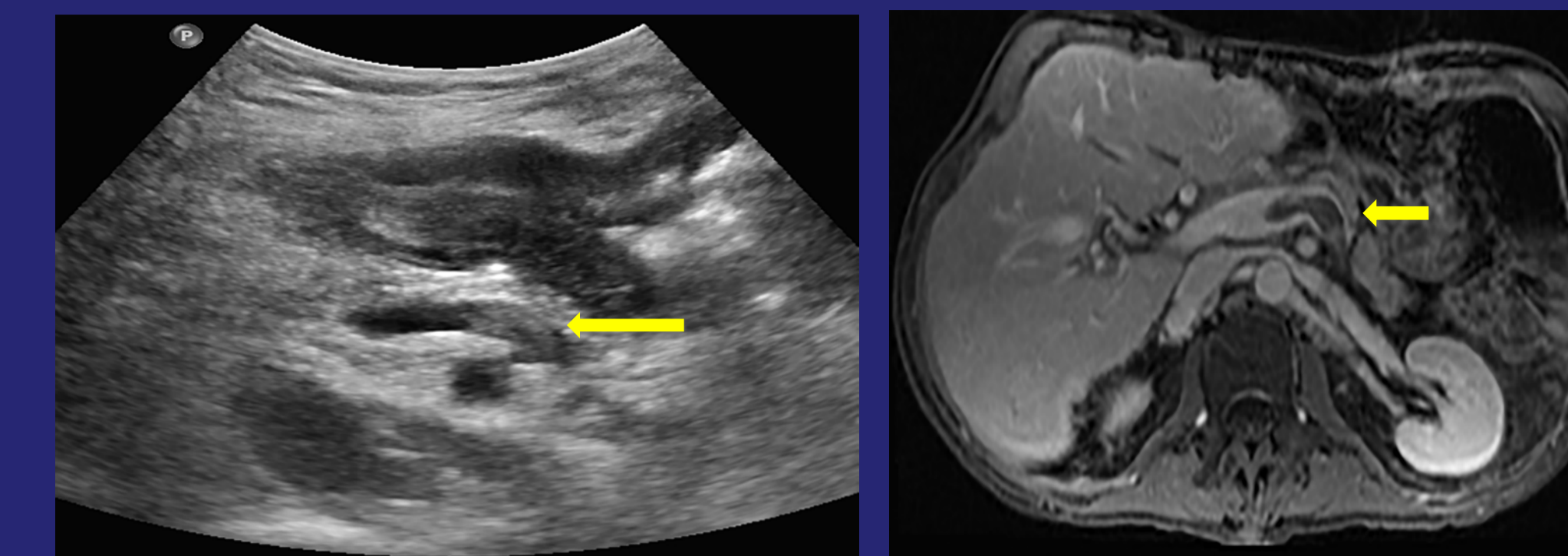
## Conclusions

- We found the top five emergency radiology abdominal ultrasound QA issues of which to be aware are misdiagnoses related to acute cholecystitis, liver lesions, renal transplant related, and portal vein thrombosis as well as technical factors that may hinder appropriate diagnosis.
- Radiologist awareness of the ultrasound imaging feature of these entities and pitfalls in diagnosis is imperative to help to avoid errors.
- Optimizing technical aspects of abdominal ultrasound is key to making these diagnoses.

## Portal Vein Thrombosis

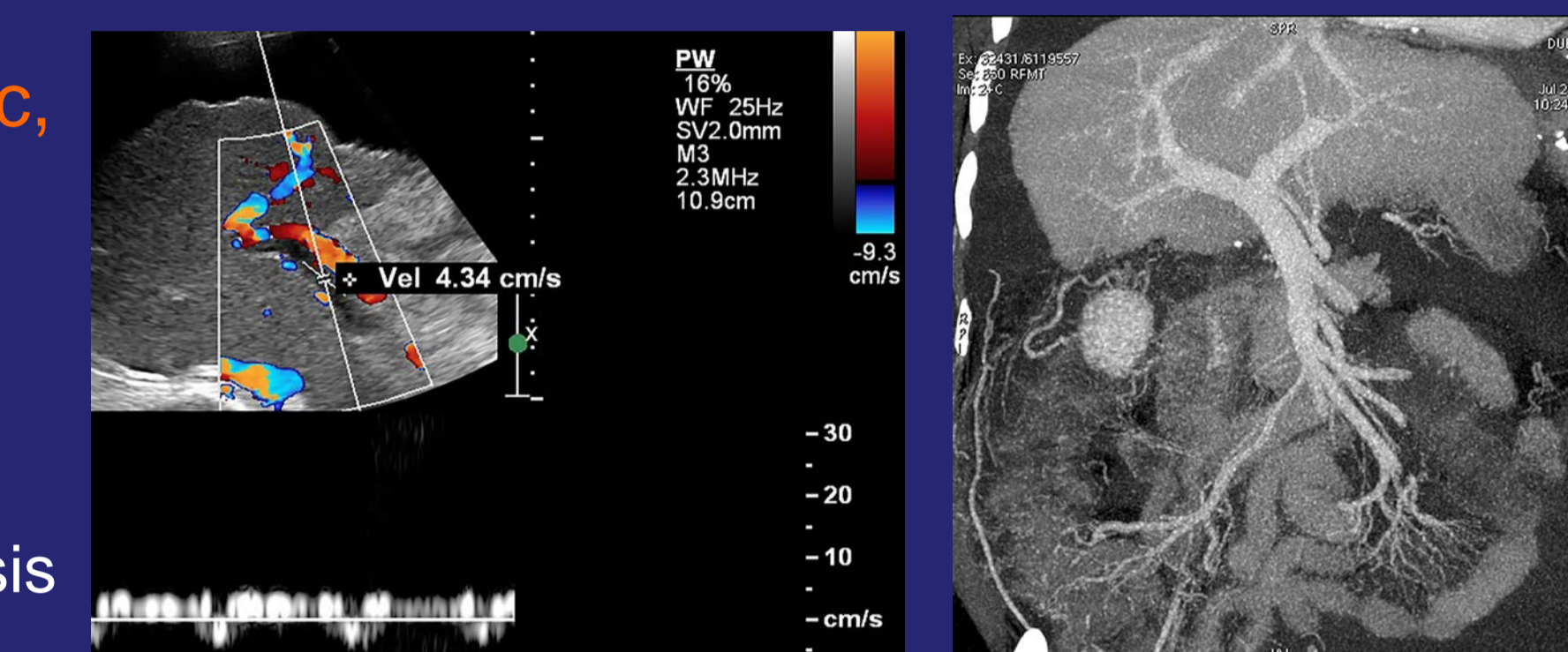
6 Portal vein thrombosis cases: 3 missed thrombosis; 2 overcalled with slow flow; 1 tumor thrombus called bland

40 y.o. ♂ s/p liver transplant with fever



Thrombus at the confluence of the splenic and portal veins (arrow) missed on US (left), detected on subsequent MRI (right)

51 y.o. ♂ cirrhotic, abdominal pain, jaundice



US (left) called occlusive/near occlusive thrombosis of main and right portal veins. Scale, however, is improperly set too high. MIP of CT (right) from same day shows no thrombus.

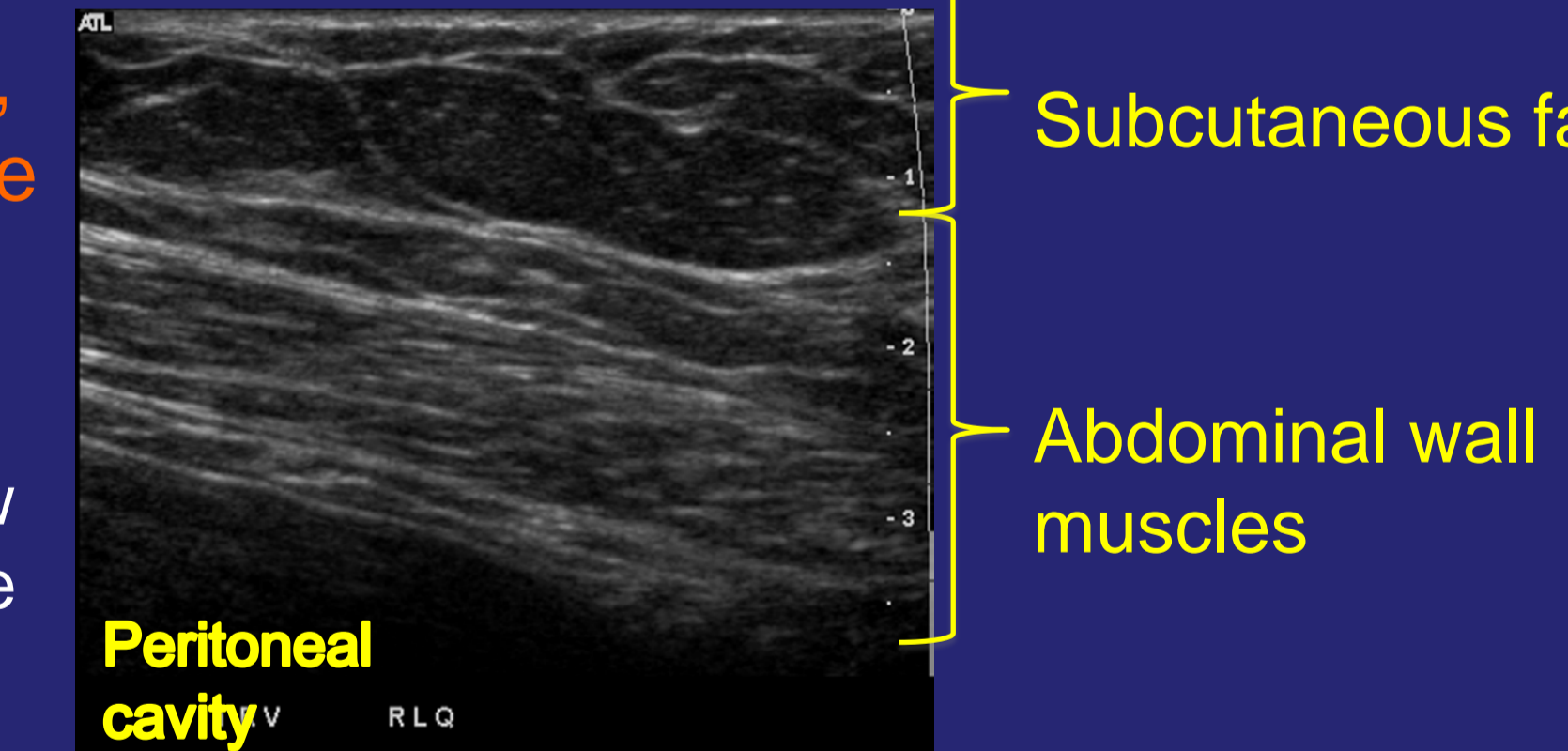
**PEARLS**

- Assess entire portal vein if possible
- Adjust scale - slow flow can give false positive
- Suspect tumor thrombus if portal vein is expanded. Look for blood flow within the thrombus.

## Technical Factors

9 Technical: 5 vascular (not angle corrected/incorrect scale); 3 did not follow standard protocol- incompletely imaged organ (kidney) → missed tumor; 1 wrong depth → not deep enough to see appendix

36 y.o. pregnant ♀, RLQ pain - Evaluate appendix



To see appendix, must set depth of view deep enough to image into peritoneal cavity.

**PEARLS**

- Follow a standard protocol → helps prevent missed findings
- Adjust depth and focus to cover the structure you wish to evaluate
- Vascular:
  - Angle correct to measure appropriate velocities
  - Decrease scale to evaluate for slow flow

## References

- Akbar S, et al. Complications of renal transplantation. *RadioGraphics* 2005; 25:1335–1356.
- Brook O, et al. Lessons learned from quality assurance: errors in the diagnosis of acute cholecystitis on ultrasound and CT. *AJR* 2011; 196:597–604.
- Heffern E, et al. Recurrent pyogenic cholangitis: from imaging to intervention. *AJR* 2009; 192: W28–W35.
- Jeffrey R, et al. Gangrenous cholecystitis: diagnosis by ultrasound. *Radiology* 1983; 148:219–221
- Pieters P, et al. Evaluation of the portal venous system: complimentary roles of invasive and noninvasive imaging strategies. *Radiographics* 1997; 17:879–895.
- Tublin M, et al. The resistive index in renal Doppler sonography: Where do we stand? *AJR* 2003;180:885–892.