Project: Ghana Emergency Medicine Collaborative

Document Title: Right Upper Quadrant Ultrasound

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Right Upper Quadrant Ultrasound for the Complete Idiot

Grand Rounds
Jeff Holmes
October 31, 2007

Core Competencies:

- Patient care

  - Be able to discuss pertinent ultrasound findings with the patient

- Medical knowledge

  - Differentiate between normal vs. abnormal RUQ ultrasound findings

- Practice-based learning and improvement

  - Practice looking for the four key findings when imaging the gall bladder

- Interpersonal and communication skills

  - Discuss pertinent ultrasound findings with the patient. *Communicate skillfully*. Be *interpersonal*

Core Competencies

- Professionalism

  - Close the curtain during the exam, offer the patient a towel, say thank you. Don’t call your ultrasound lecture audience idiots.

- Systems Based Practice

  - State when a patient may still require an outpatient ultrasound even after an emergency department bedside ultrasound

Case Study

B Pod, 23:30

HPI: 40 YOF with 8 hr period of intermittent N/V, steady RUQ pain

PMHx: HTN

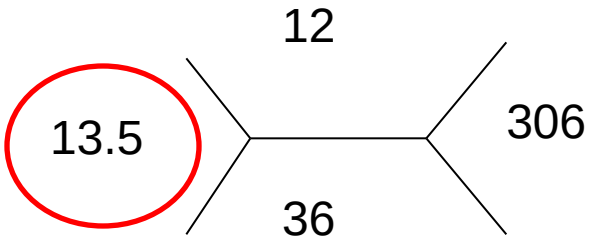
Meds: HCTZ

All: NKDA

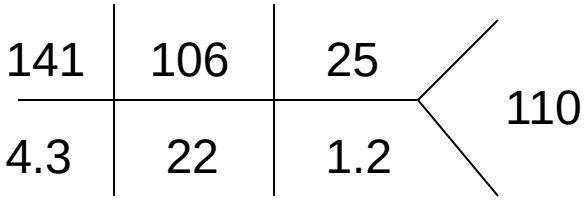
PE: T 101.3F, 20, 110, 160/88, 98% RA

Very tender RUQ

Labs/Imaging



90% N 8% L

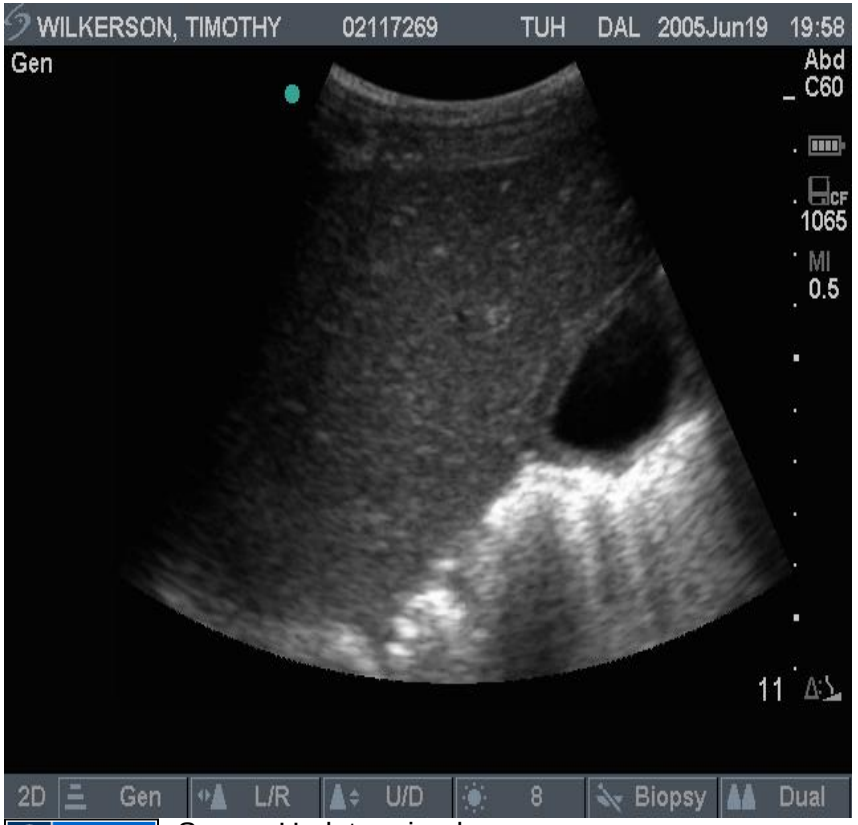


CXR – NAD
UA – Negative

AST 60 (10-40)
ALT 80 (9-60)
Alk Phos 140 (40-115)
Tbili 1.4
Dbili 0.3

RUQ Ultrasound

- No stones
- 5 mm wall thickness
- No pericholecystic fluid
- CBD < 3 mm
- Tenderness with compression of ultrasound probe over fundus
- No stones . . . still think she has acute cholecystitis?
- Do we think about other diagnosis?
- Do we wake up the radiologist for to do a formal ultrasound for him/herself?
- Or…..do you just suck at RUQ ultrasound?



Source Undetermined

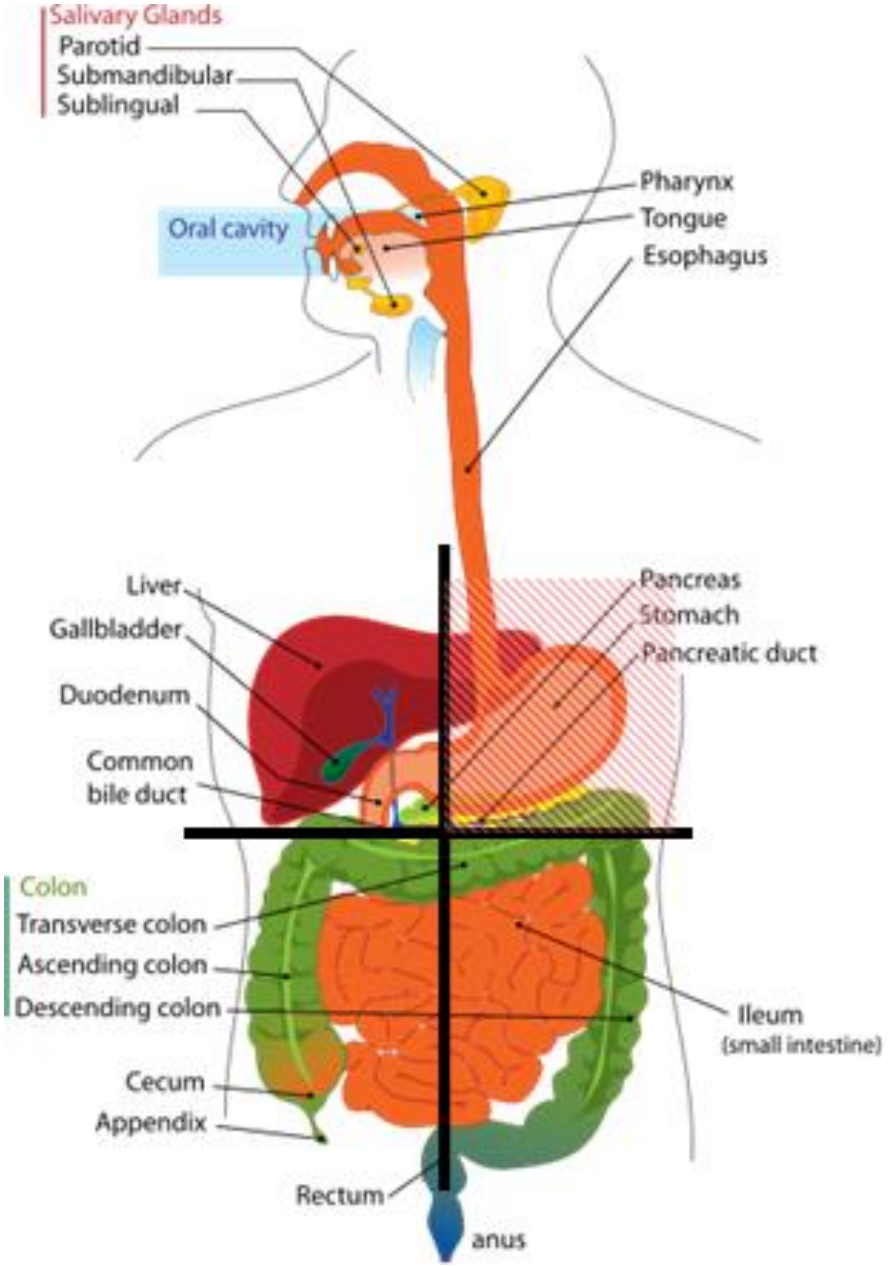
Goals

- State the indications of an ED bedside RUQ ultrasound
- Describe the technique of obtaining views of the gallbladder and common bile duct
- State how to troubleshoot difficulty in finding the gallbladder and common bile duct
- Differentiate normal vs abnormal RUQ ultrasound findings

Indications for RUQ US

- Evaluation of possible biliary colic
- Evaluation of possible cholecystitis
- Evaluation of acute jaundice
- Evaluation of possible hepatomegaly
- Detection and evaluation of ascites

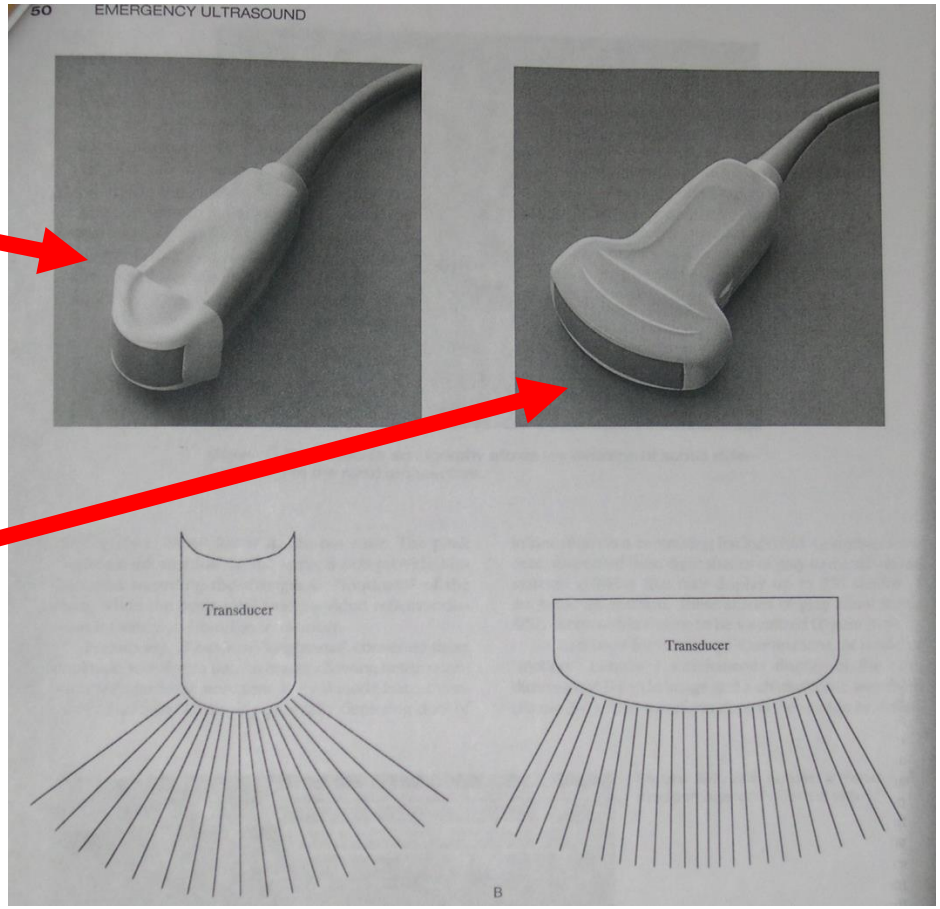
Anatomy



Probe (low frequency, high penetration)

4.5 MHz

3.5 MHz
(higher depth
of penetration)



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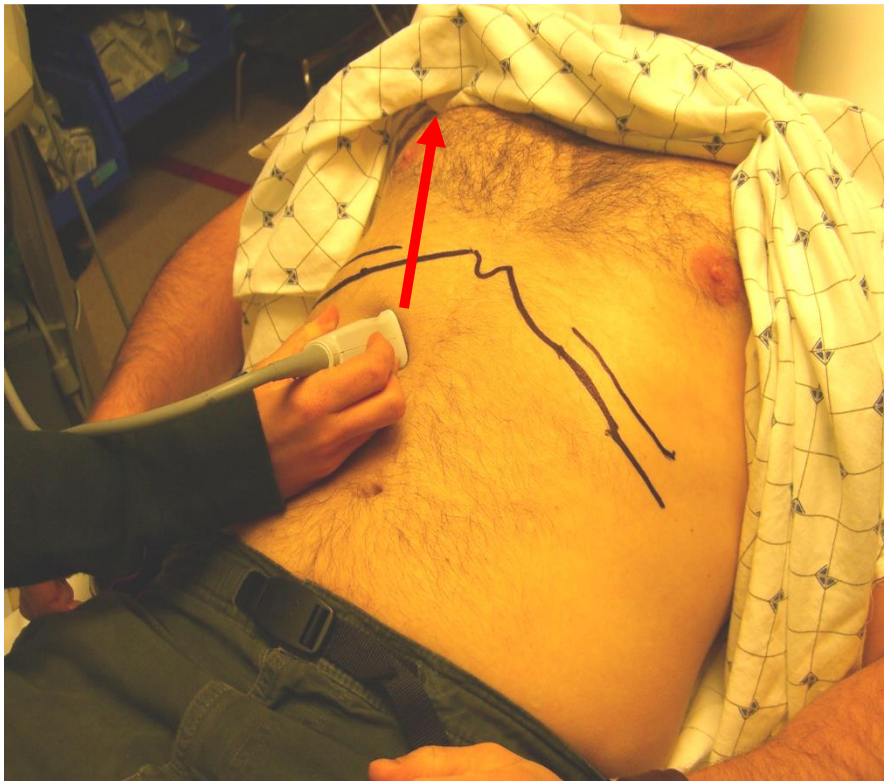
Technique - Patient Positioning

- NPO ideal
- Supine
- Left lateral decubitus
- Upright sitting position

Gall Bladder

- Right costal margin, mid-clavicular, aim toward right shoulder
- Sweep until longitudinal image obtained
- Demonstrate communication of presumptive GB with main portal triad
- *“In absence of gallstones, this is the only way to prove the image obtained is the GB and not a loop of bowel or oblique section through vena cava.”*
  - O. John Ma



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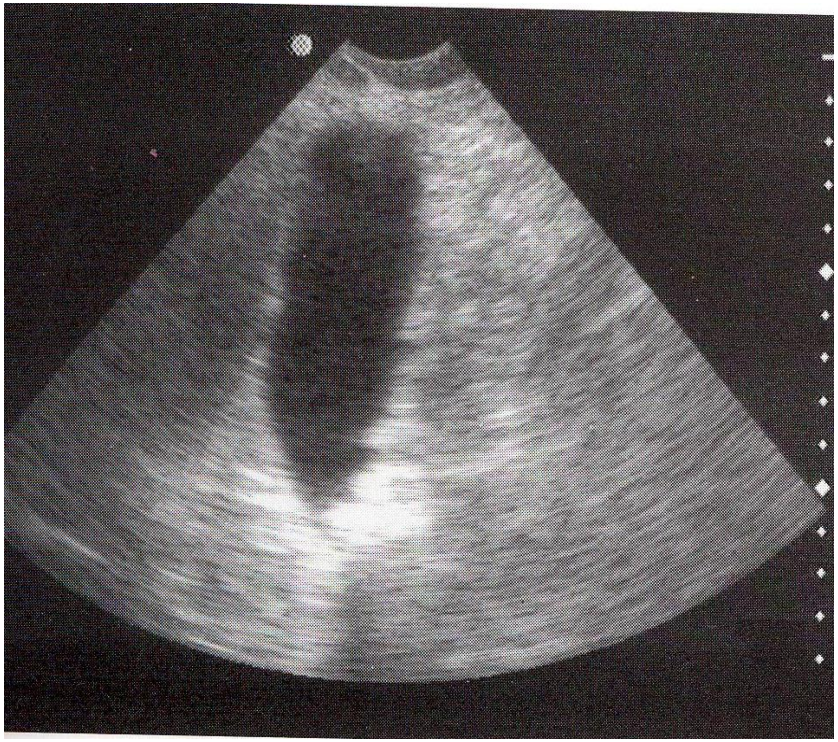
Gall Bladder – Imaging Technique



Longitudinal

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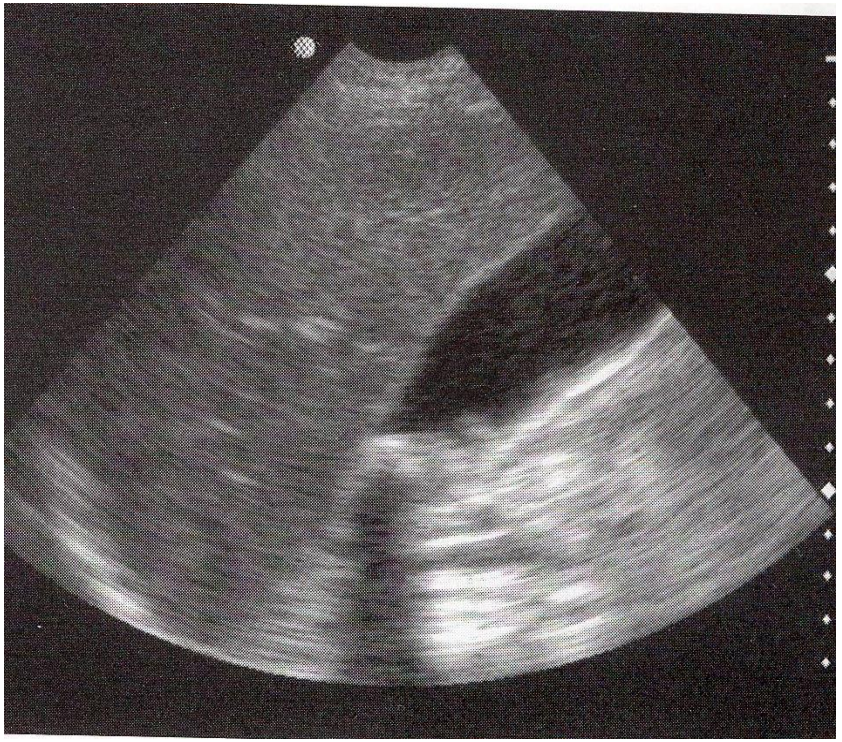

Oblique

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ALWAYS ULTRASOUND YOUR AREA OF INTEREST IN MULTIPLE PLANES

Summary – Imaging Gall Bladder

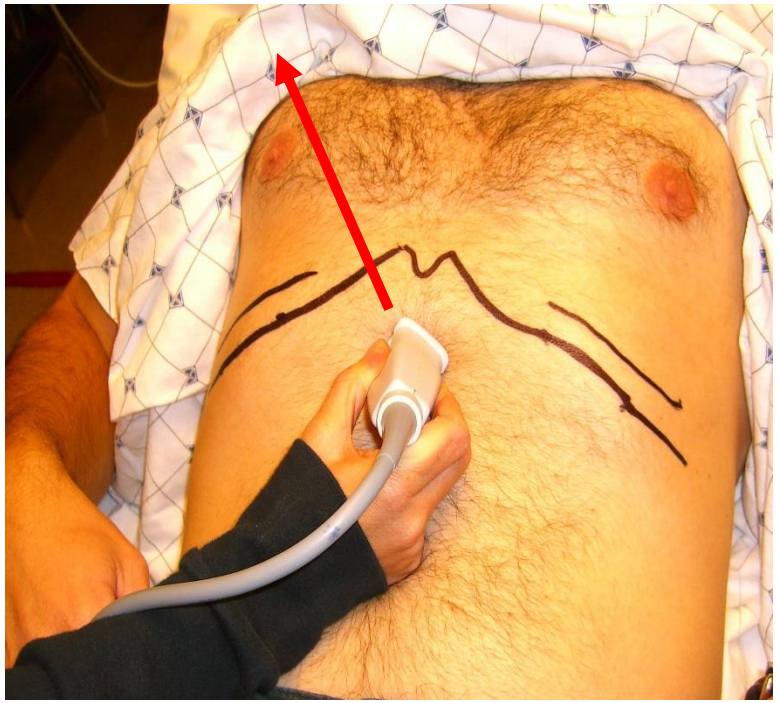
- *Maneuvers to maximize view ? ? ? . . .*

  deep breath, intercostal view, lateral decubitus
- *Always view gall bladder . . .*

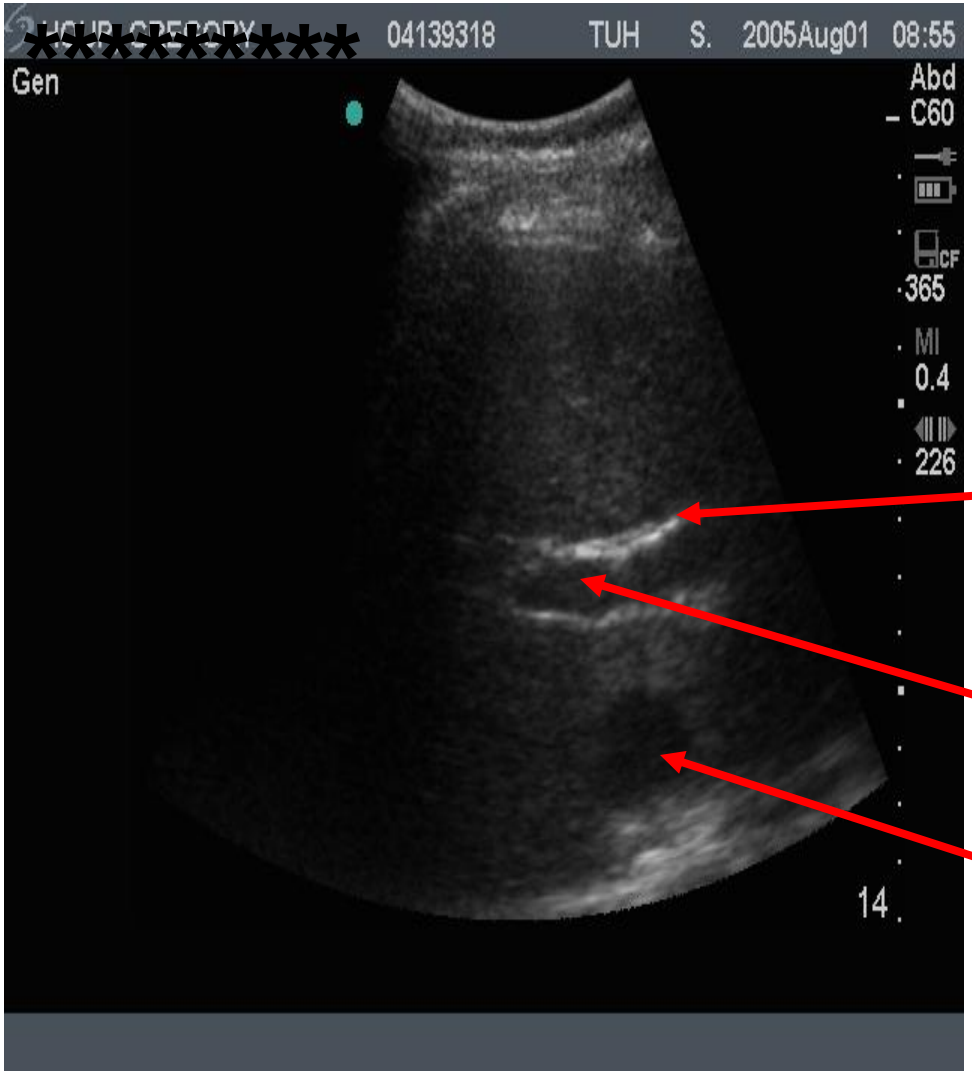
  in multiple planes

Common Bile Duct Imaging

- Probe in right epigastrium with indicator pointing toward right axilla
- Identify IVC
- Find longitudinal view of portal vein that courses into liver (lives on top of IVC)
- Thin anechoic line cephalad to portal vein is CBD



Common Bile Duct Imaging



Common Bile Duct

Portal Vein

IVC

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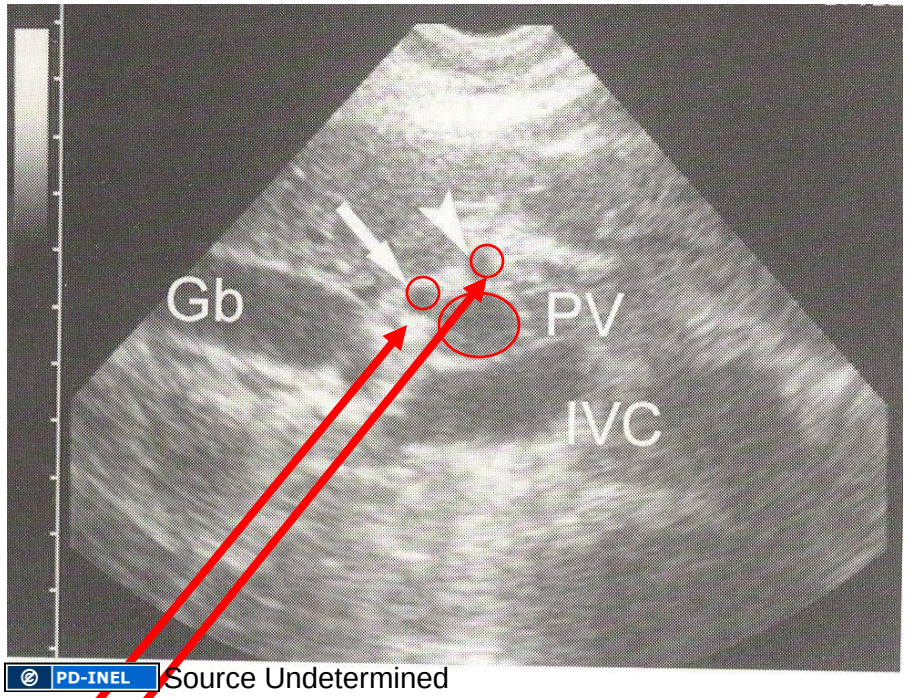
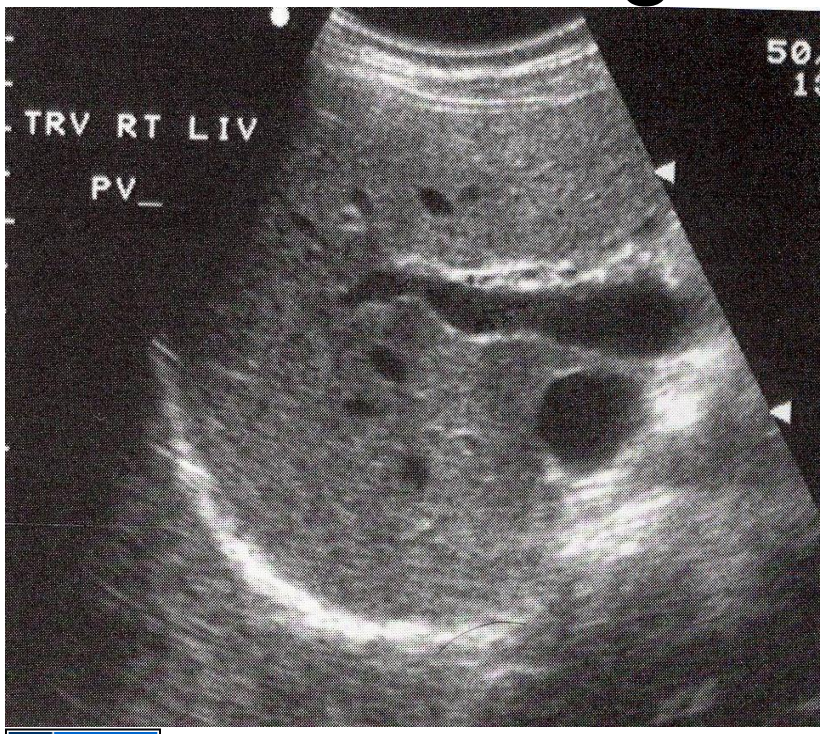
Common Bile Duct Imaging

- Rotate probe 90 degrees to see transverse image of portal triad (‘mickey mouse sign,’ found in minority of patients)



Finding Common Bile Duct – Tracing back from Liver



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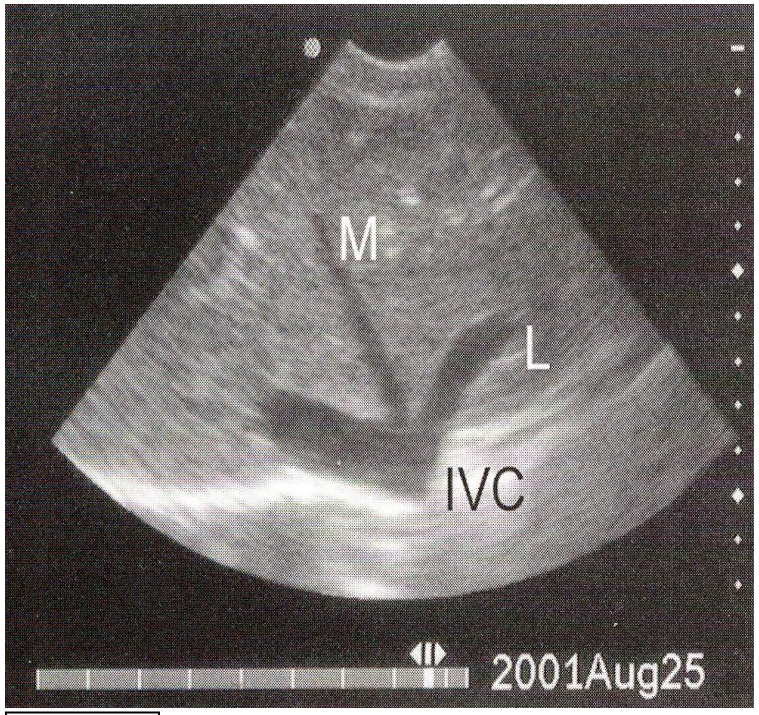
Trace peripheral braches of hyperechoic portal venous system toward main portal vein



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Hepatic branches with thin hypoechoic walls converge on IVC

Summary - Finding the CBD

- Common bile duct lives on top of . . .

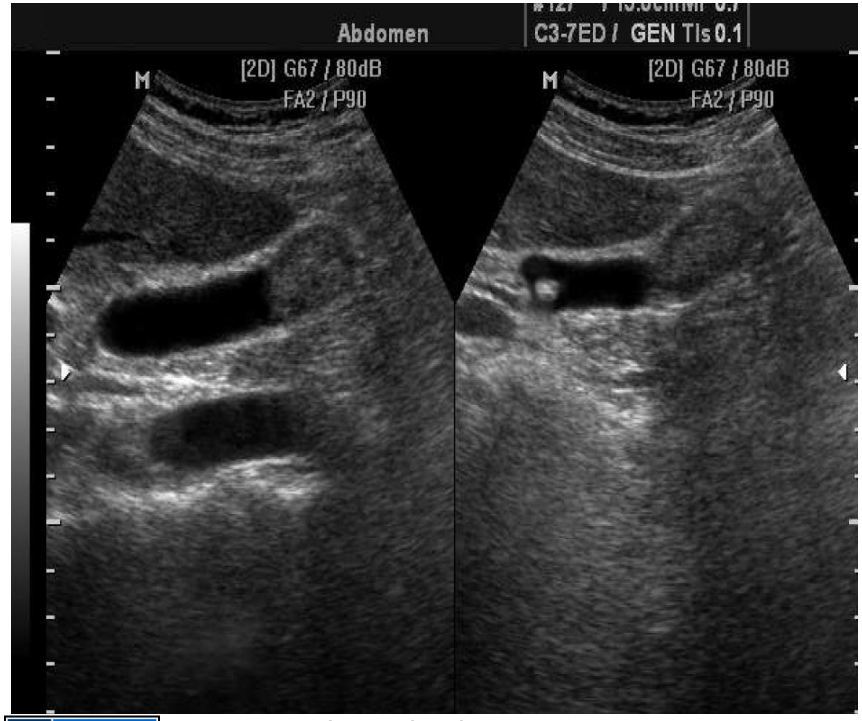
the portal vein

- Portal vein easily distinguished by 3 ways . . .

1. *Hyperechoic walls*
2. *Lives on top of IVC*
3. *Does not communicate with IVC*

Common Bile Duct

- Age ≤ 50 5 mm
- Age < 60 6 mm
- Age < 70 7 mm…
- >10 mm always abnormal



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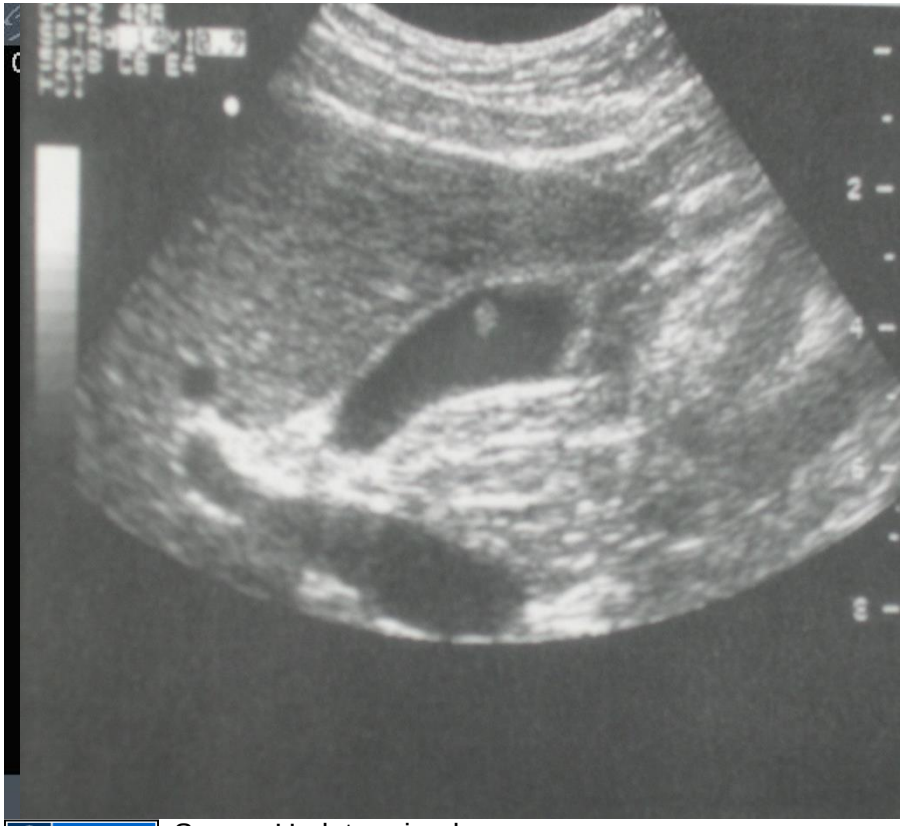
"Double Barrel Sign"

Cholelithiasis

- Sonographic findings
  - Echogenic
  - Gravitational dependence (‘Rolling Stones’)
  - Acoustic shadowing (if >5mm)



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“Gall Bladder Polyp”

Evaluation for Acute Cholecystitis

- **Anterior wall thickness** (normally < 3 mm)
- **Gallstones**
- **Pericholecystic fluid**
- **Common Bile Duct Dilation**

and don't forget . . .

- **Murphy's sign** (pain with compression of gallbladder fundus)

Puzzled?

- Agenesis, s/p cholecystectomy
- French fries in the waiting room?
- Have patient take deep breath and hold it
- Too much gas
  - Intercostal view
  - Roll patient into lateral decubitus position

Case Study # 1

B Pod, 23:30

HPI: 40 yo female with 8 hr period of intermittent N/V, steady RUQ pain

PMHx: HTN, Morbid Obesity

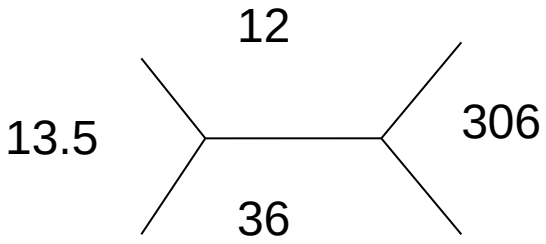
Meds: HCTZ

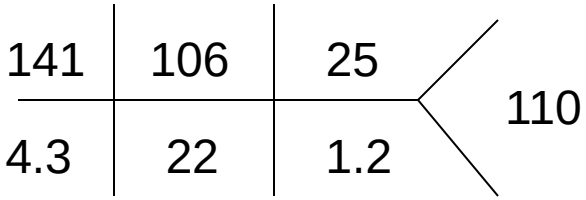
All: NKDA

PE: T 101.3F, 20, 110, 160/88, 98% RA

Mildly tender RUQ

Case Study #1 -Labs/Imaging





90% N 8% L

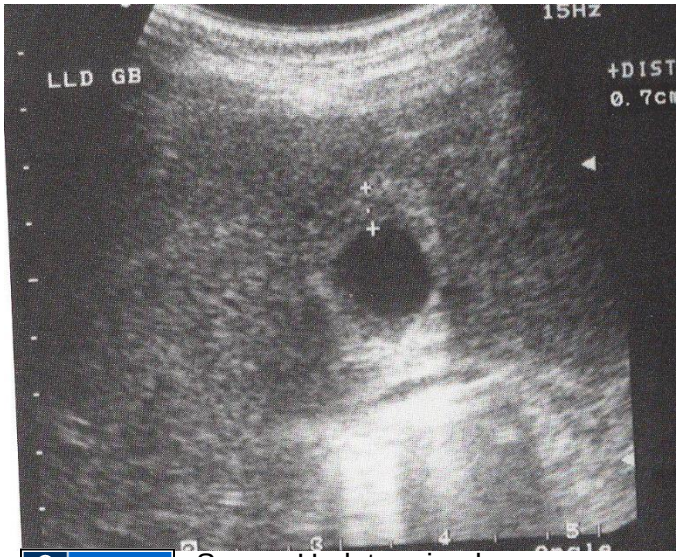
CXR – NAD
UA – Negative
LFT's – WNL

Case Study #1 – Ultrasound

- No stones/sludge
- 7 mm wall thickness
- No pericholecystic fluid
- CBD < 3 mm
- (+) Murphy's Sign

Impression?

Plan?



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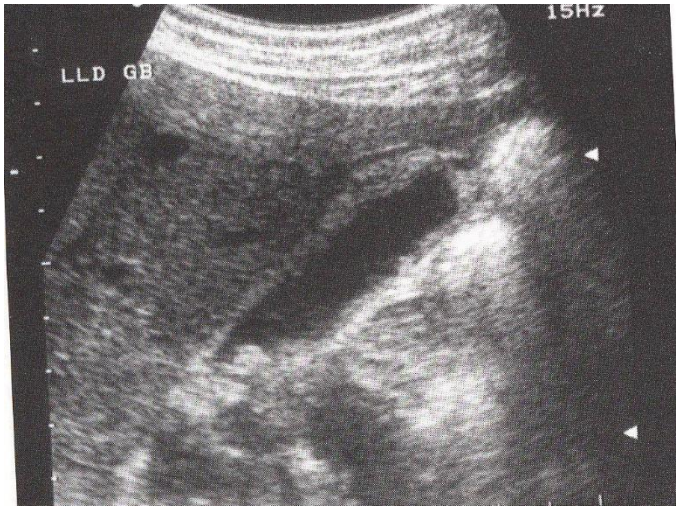

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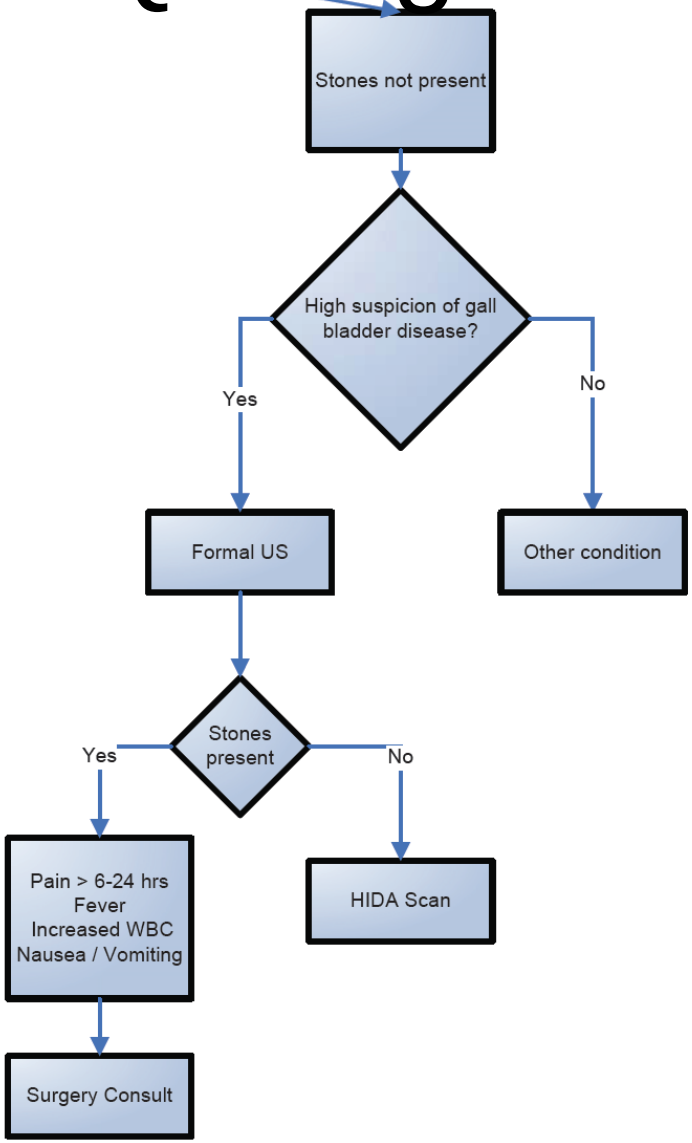
Case Study #1

Formal Ultrasound: 3 mm stone in cystic duct, 5 mm anterior wall thickness, positive murphy's sign

Diagnosis: Acute Cholecystitis

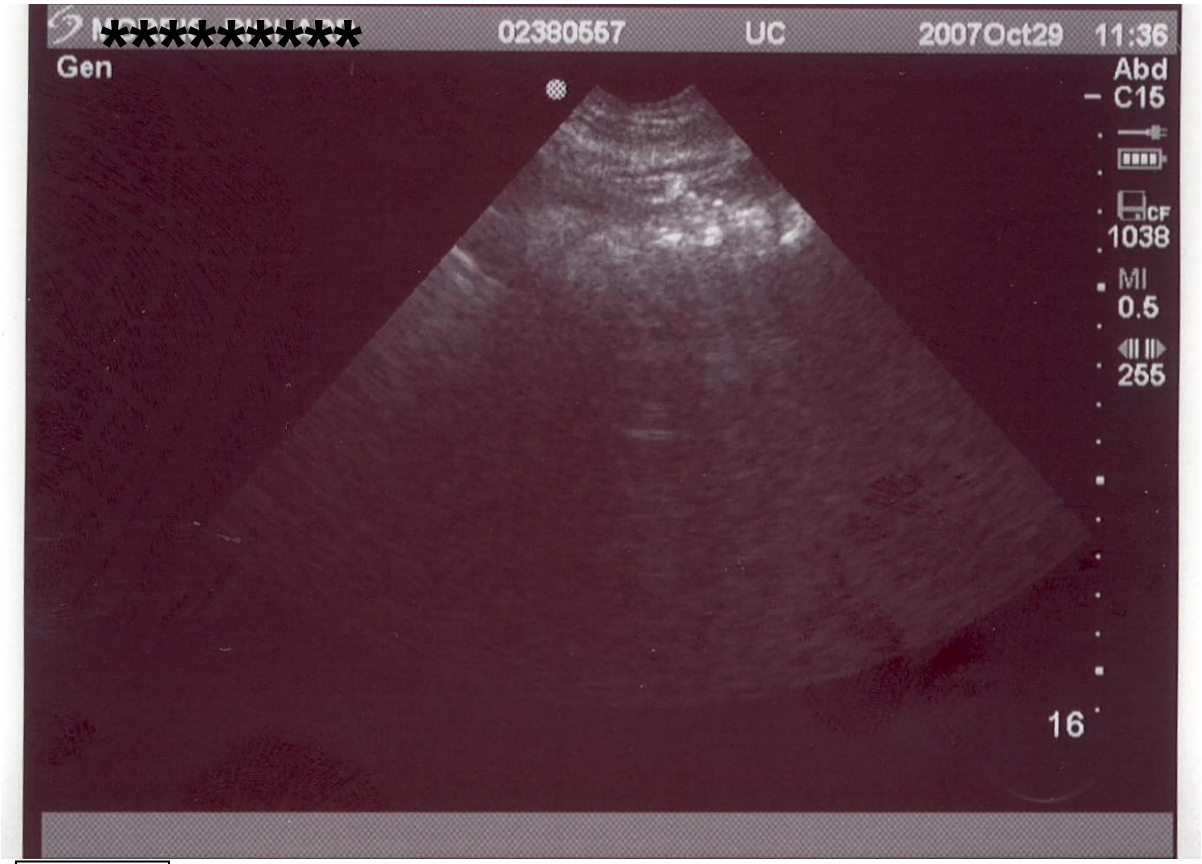
CPQE Algorithm



Case Study # 2

- N.R.J., 35 yo M
- CC: R flank pain x 4 hours, denies hematuria, CP/SOB
- PE: 97.0F, 90, 16, 130/80, 97%
- Denies abdominal TTP
- CBC nl, UA negative

Case Study #2 – Ultrasound



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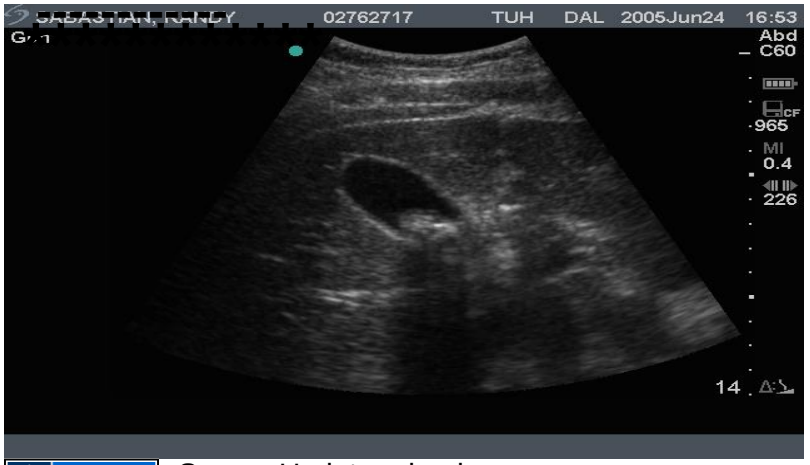
Troubleshooting??

Case Study #2 – Troubleshooting Bowel Gas

- Tell your patient to pass gas (after you've left the room)
- Intercostal view
- Left lateral decubitus position



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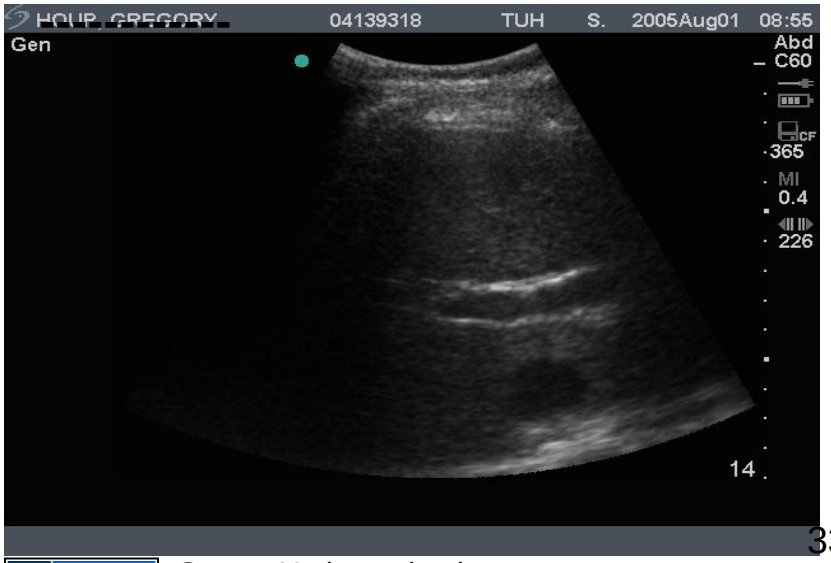

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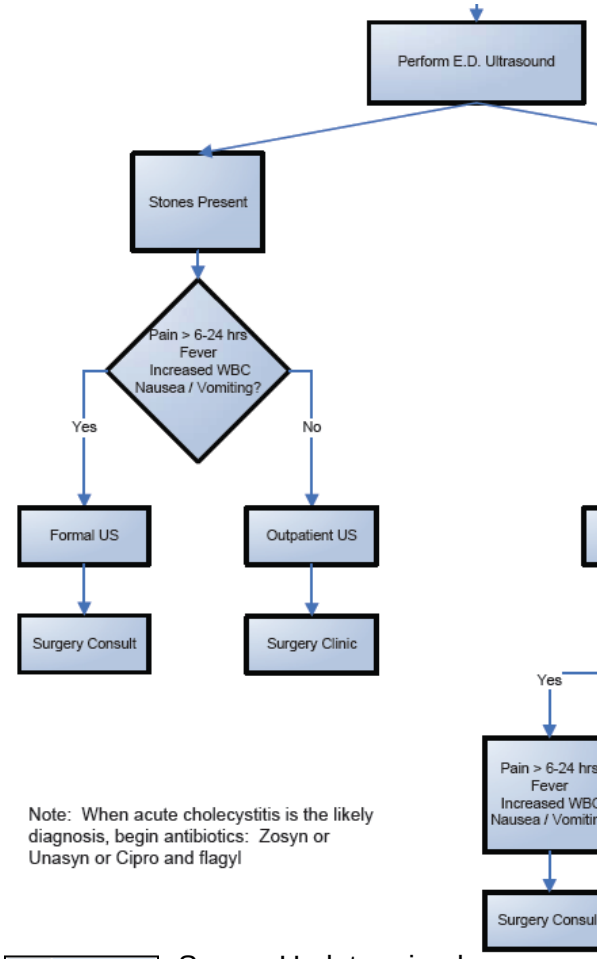
Case Study #2 – Dx/Plan

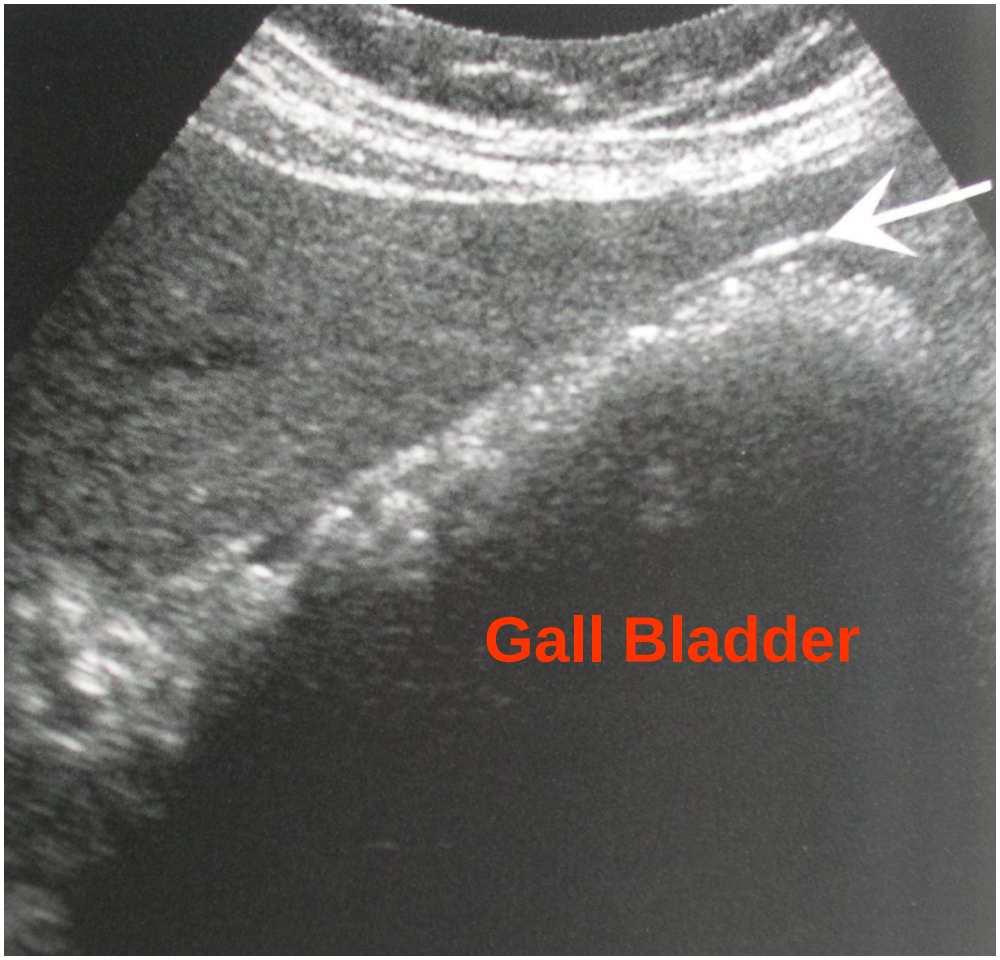
- Symptomatic cholelithiasis
- General Surgery Referral



Case Study #3

- 65 yom, Al Frankenstein
- CC: Steady RUQ pain x 4 hours, denies hematuria, CP/SOB
- 98.0, 94, 18, 130/80, 97%
- Denies abdominal TTP
- CBC nl, UA negative, LFT nl

Case Study #3

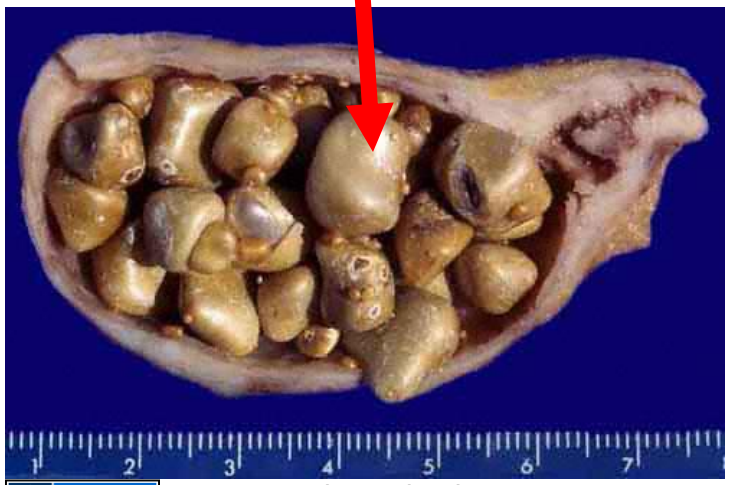


PD-INEL Source Undetermined

CBD 5 mm
(-) Sonographic Murphy's

Wall Echogenic Shadow (WES)

- ‘Chock full of stones’



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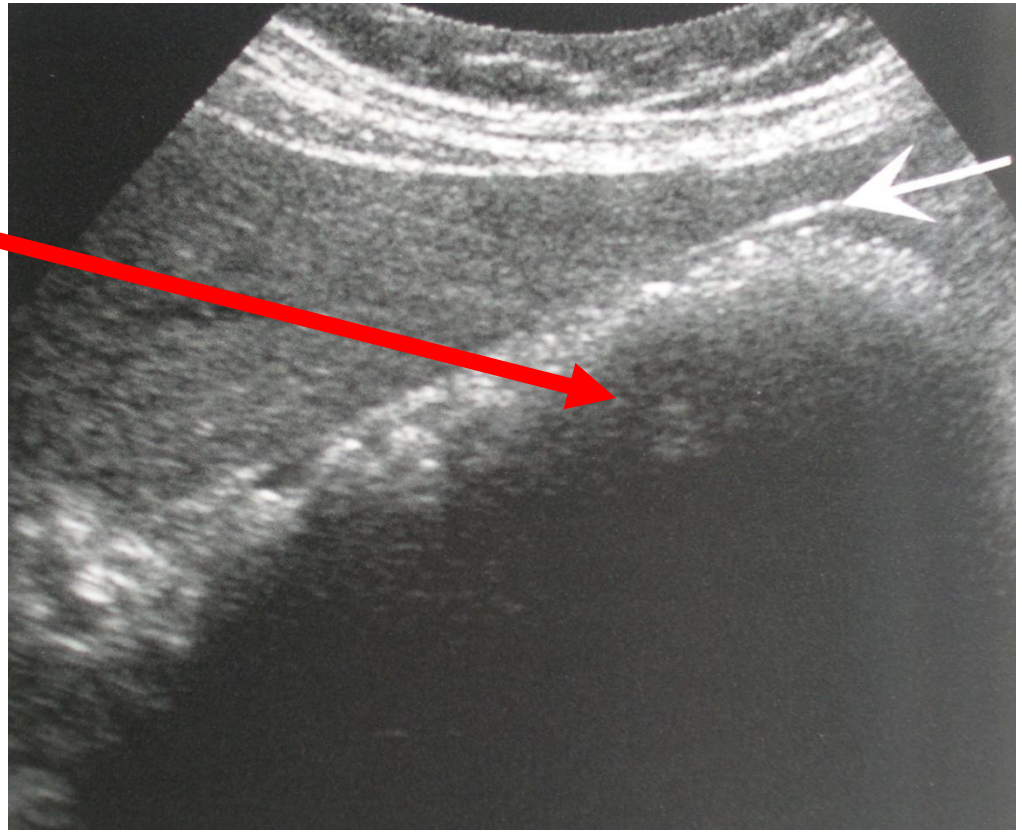


PD-INEL Source Undetermined

Case Study # 3 - Dx/Plan

- Bag O' Stones (symptomatic cholelithiasis)
- Formal Outpatient US
- General Surgery Referral

Case study #4

HPI: 65 yo male with 4 hour period of epigastric pain, nausea/vomiting, denies fevers

PMHx: HTN, CHF, CAD, insulin

Meds: Lasix, Digoxin, IDDM, Metoprolol, ASA

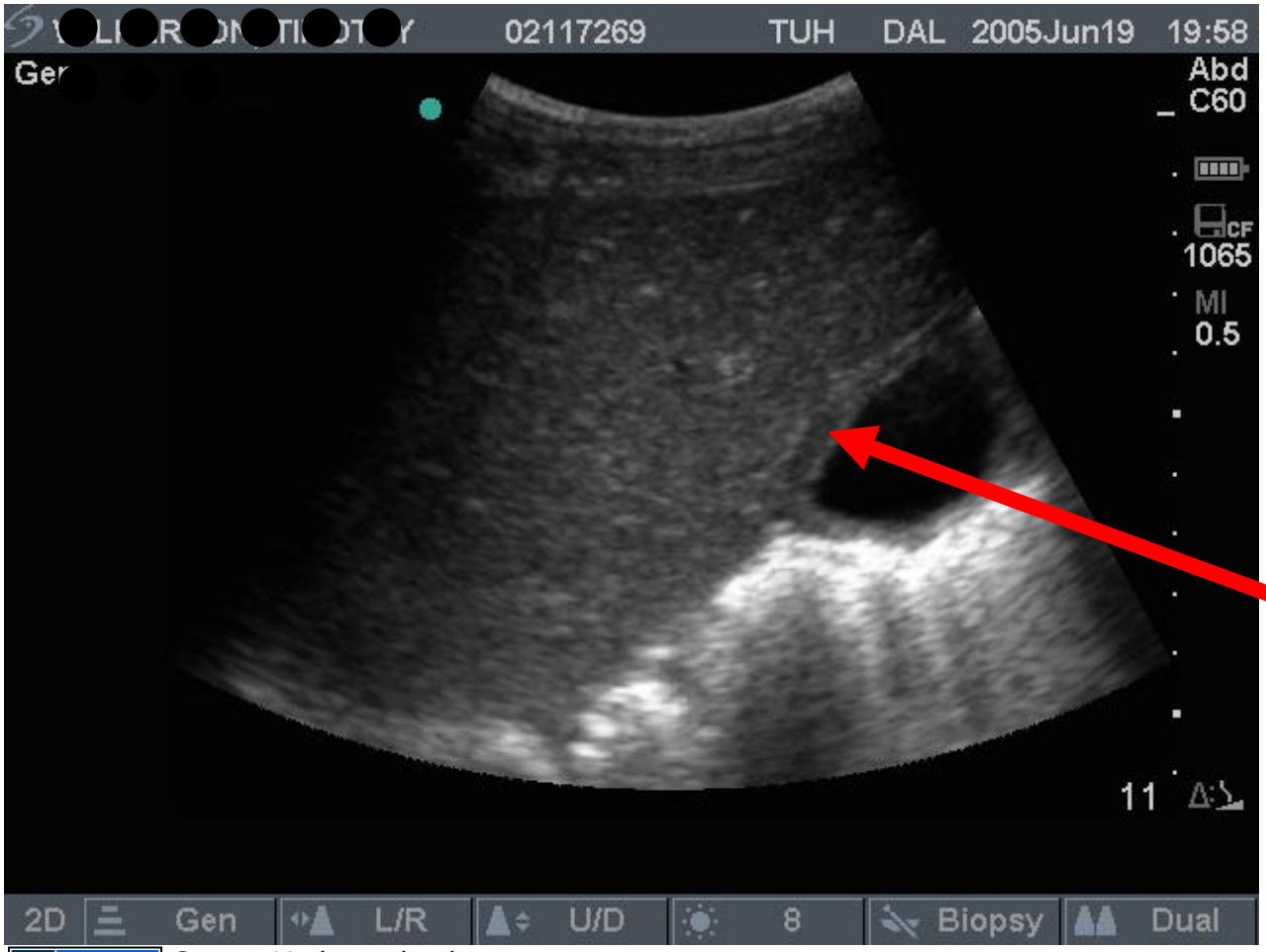
All: NKDA

PE: T 97.4, 16, 90, 138/70, 98% RA

Nontender epigastrium

Labs: CXR clear, LFT's/CBC WNL

Case Study # 4 Ultrasound



PD-INEL Source Undetermined

CBD < 4 mm
(-) Sonographic Murphy's

Wall thickness
5 mm

DDx for GB Wall Thickening

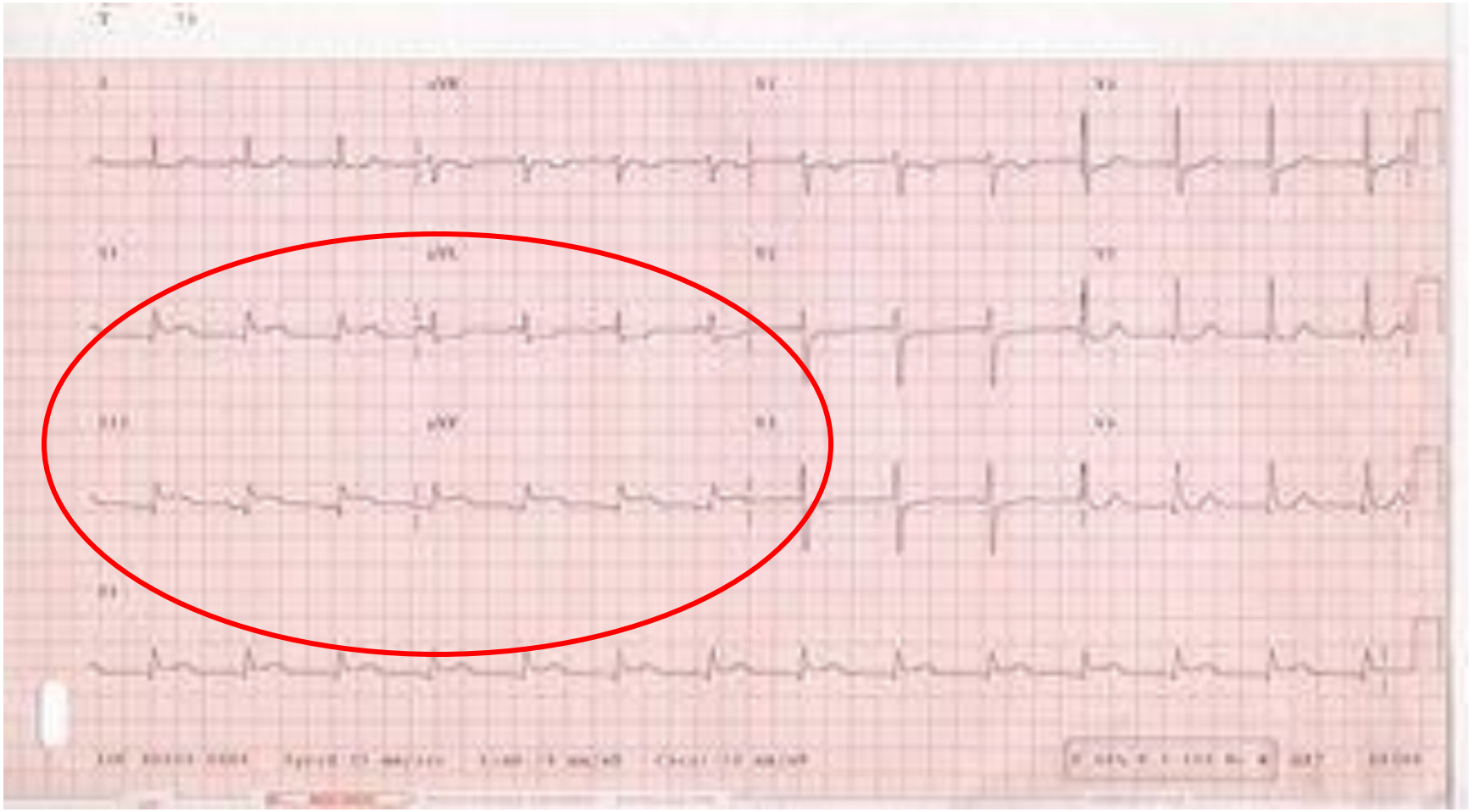
Local Inflammation

- Acute Cholecystitis
- Chronic Cholecystitis
- Acute Hepatitis
- Pancreatitis
- Perforated Duodenal Ulcer

Fluid Overload States

- Ascites
- Hypoproteinemia
- CHF
- ESRD

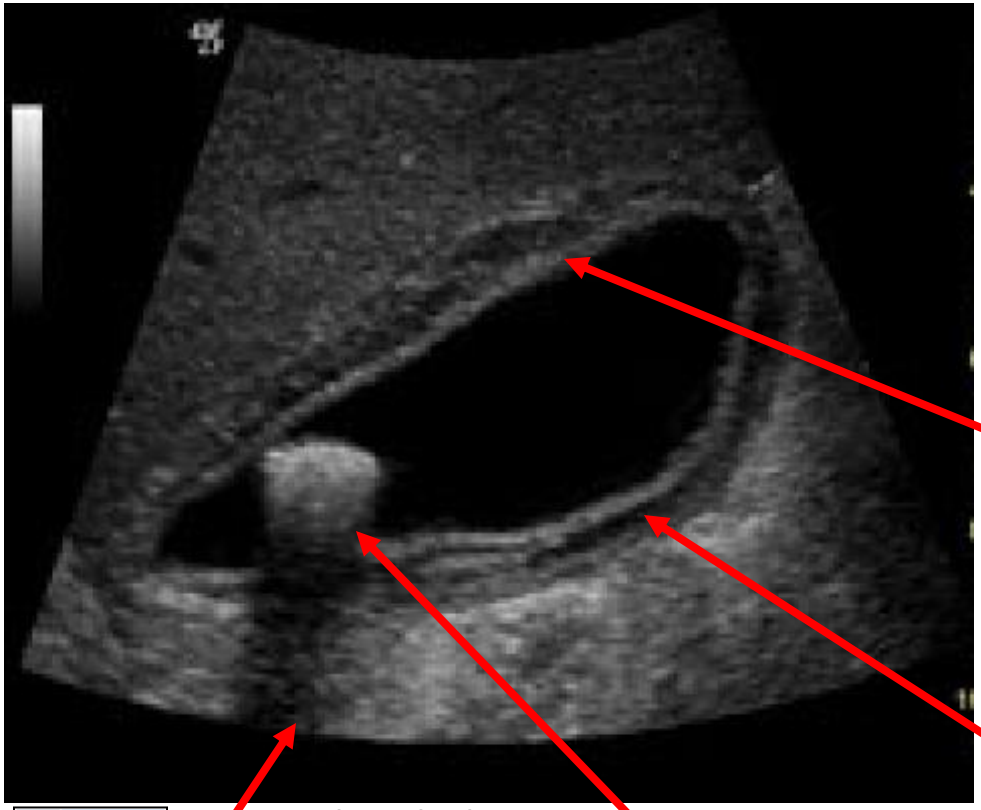
Case Study #4 - Diagnosis?



Case Study #5

- CC: AMS
- HPI: 75 yo from NH with 1 d h/o AMS
- PMHx: IDDM, COPD, HTN
- VS: 102F, 24, 100/50, 95%
- PE: Diffuse min abd TTP, Lungs CTAB
- UA: Tr Leu, Nit neg, 6 wbc wbc, 3 rbc, tr bact, 4 sq
- CXR: clear
- WBC 10, 90% PMN's
- LFT's pending

Case Study # 5



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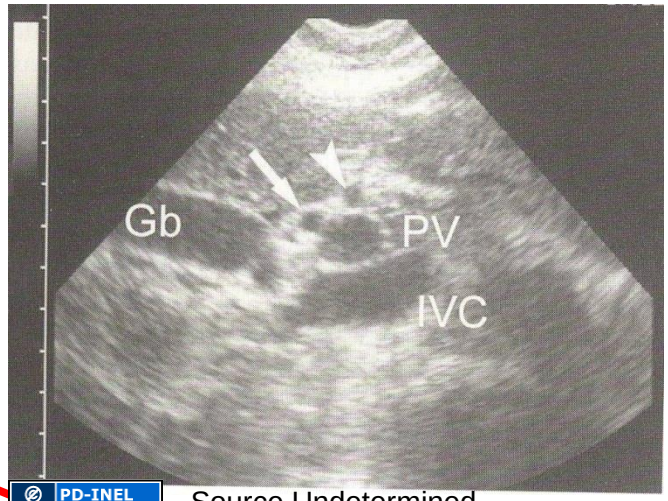

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Wall thickness 5 mm

Pericholecystic Fluid

Posterior Acoustic Shadowing

Stone

Case Study #5 – Dx/Plan

- Acute Cholecystitis
- Antibiotics, fluid, pain medication, admit to general surgery

Case Study #6

- 40 yo WM

CC: Abdominal pain x 5 hours

PMHx: Sunburns easily

Meds: None

All: Garlic

PE: 97.0, 88, 16, 112/68, 98%

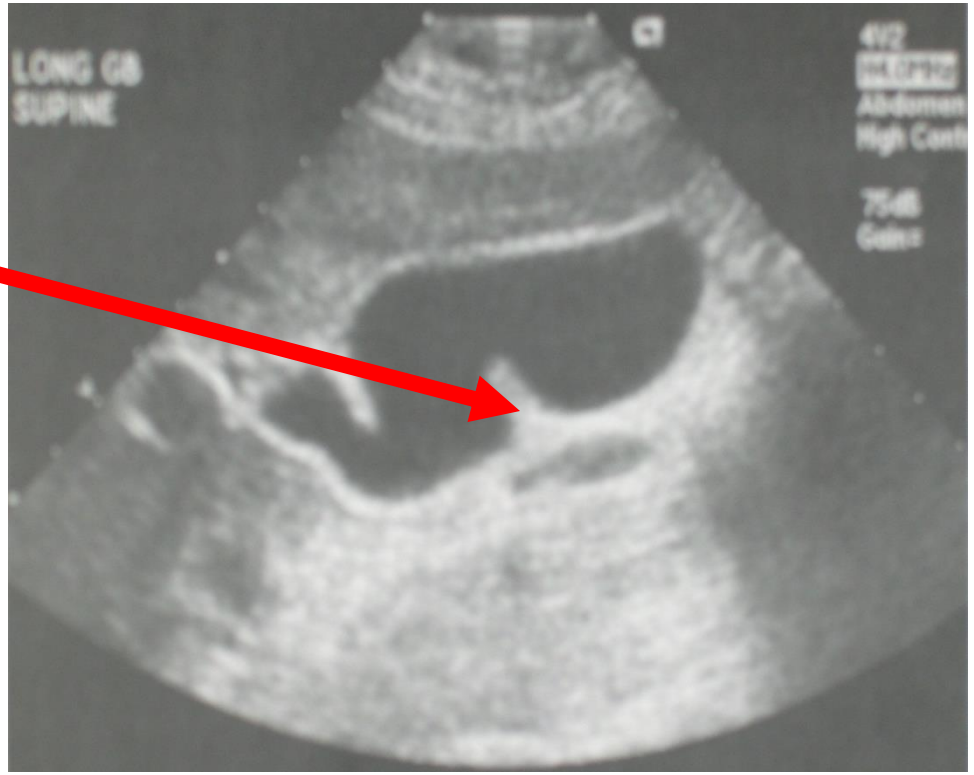
Diffuse Abdominal TTP

Labs: Lipase/LFT wnl

CBC WNL

Case Study #6
RUQ Ultrasound

- Do not change position when patient is rolled
- Mucosal Folds
- No acoustic shadows
- Immobile



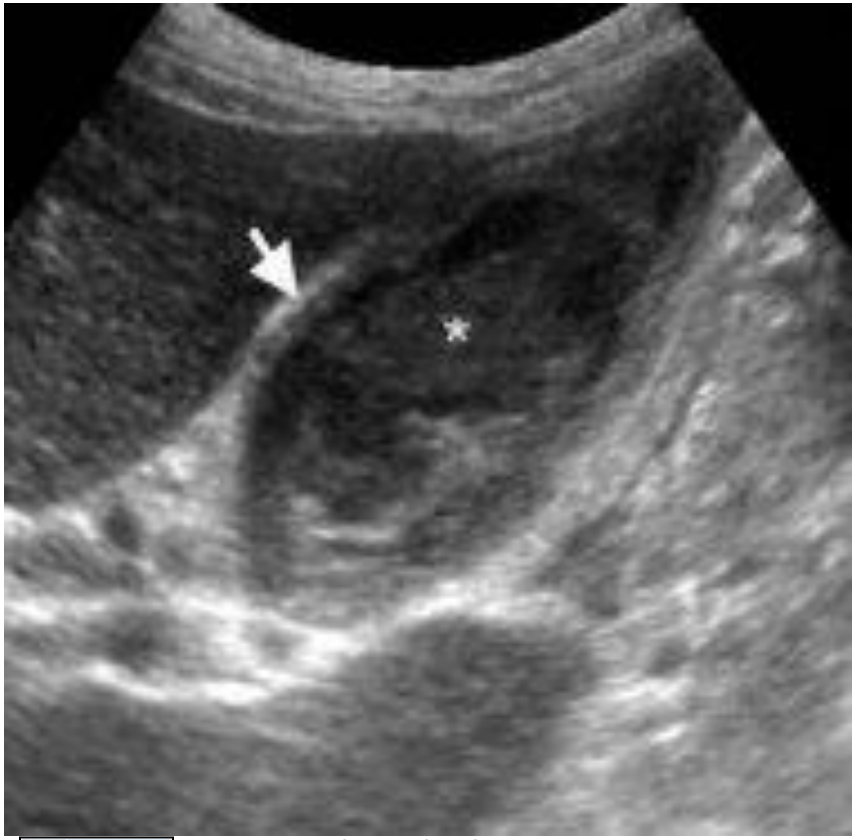
Case Study #6 - Diagnosis

Acute Intermittent Porphyria

Case Study # 7

- SICU
- 65 yo AAM POD #15 exlap grade IV liver lac from MVC, ARDS from pulmonary contusions
- Fever 102F
- CBC 15.8

Case Study # 7
RUQ US



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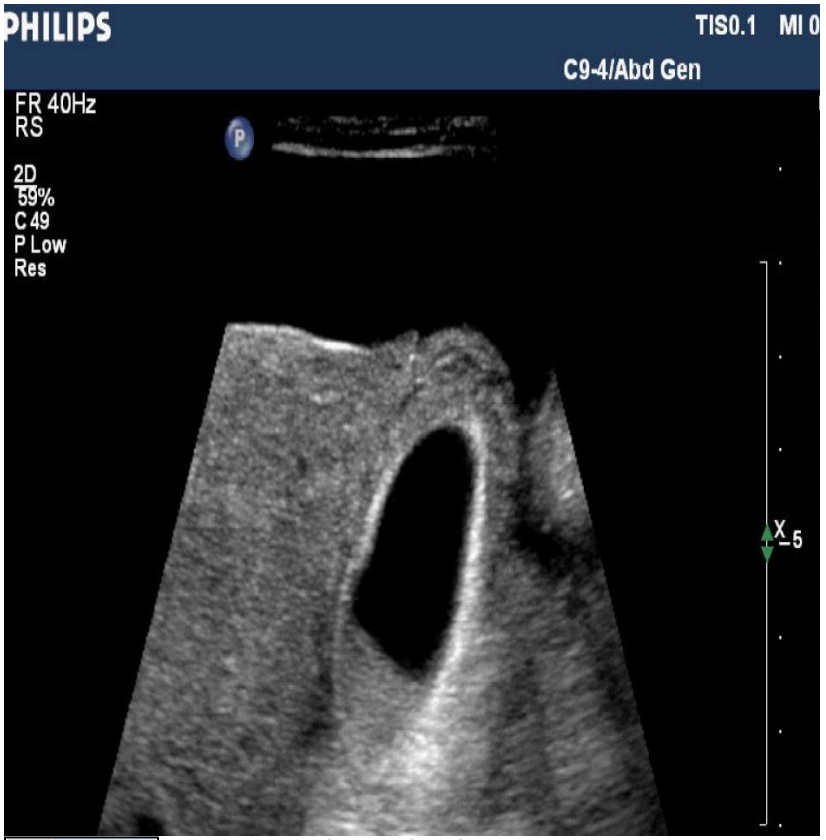

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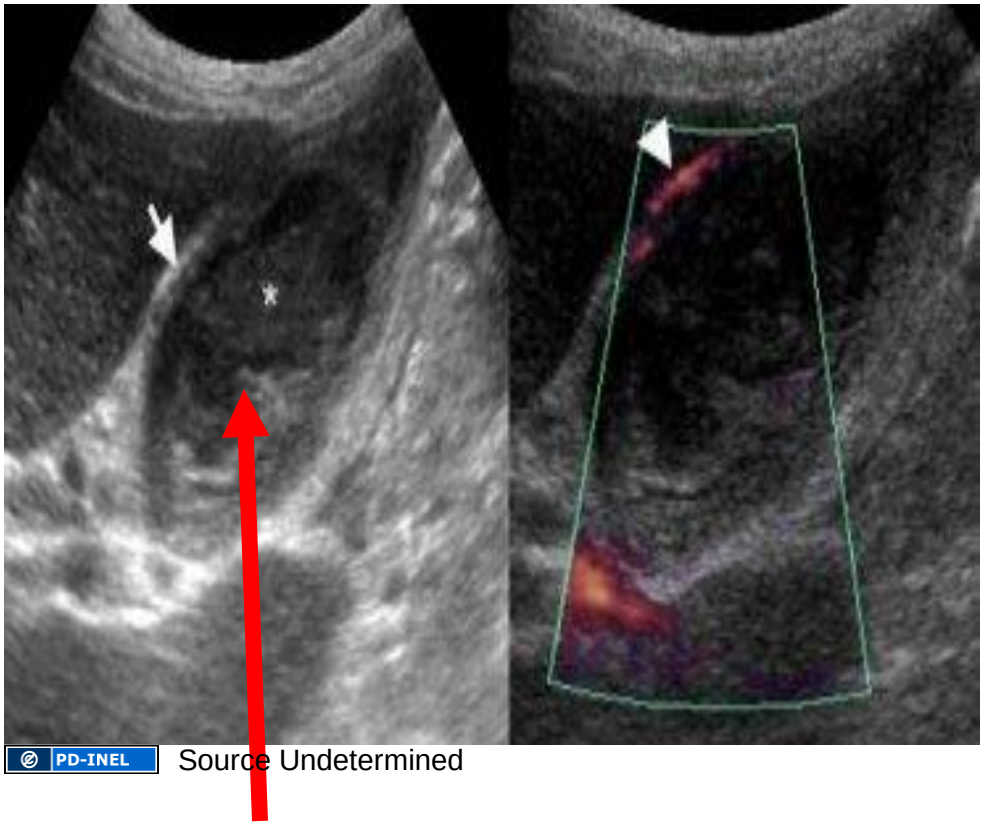
CBD < 6 mm

Case Study #7
Acalculous Cholecystitis

- 5 – 14% of cholecystitis
- More common in elders
- Frequently post op from nonbiliary surgery, state of biliary statis (limited oral intake)
- Dependent layer of variable non shadowing echogenecity



Biliary Sludge

Case Study #8

- 17 you WM

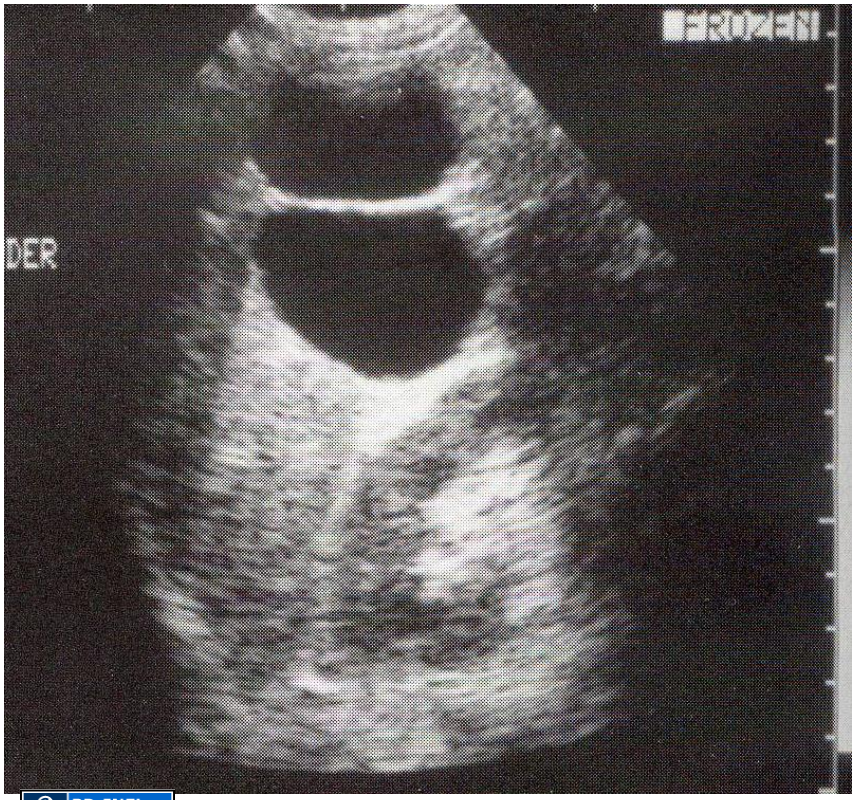
CC: Epigastric abdominal pain after eating

PMHx: Hypertrichosis

PE: 99.0, 76, 12, 120/80, 98%

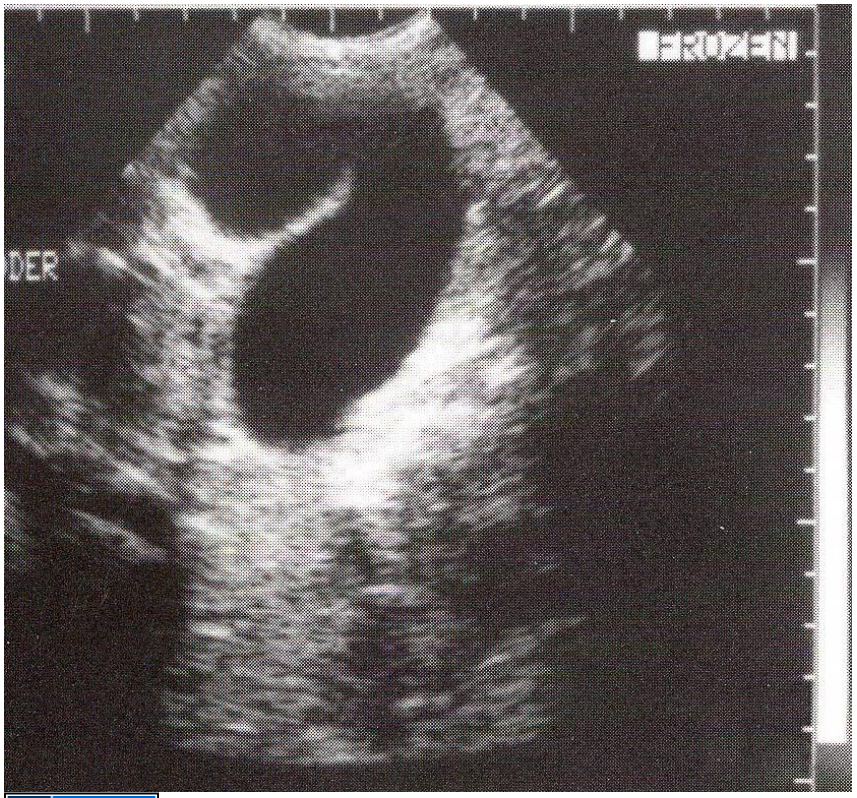
Denies Abd TTP

Case Study # 8
RUQ US



PD-INEL Source Undetermined

Transverse



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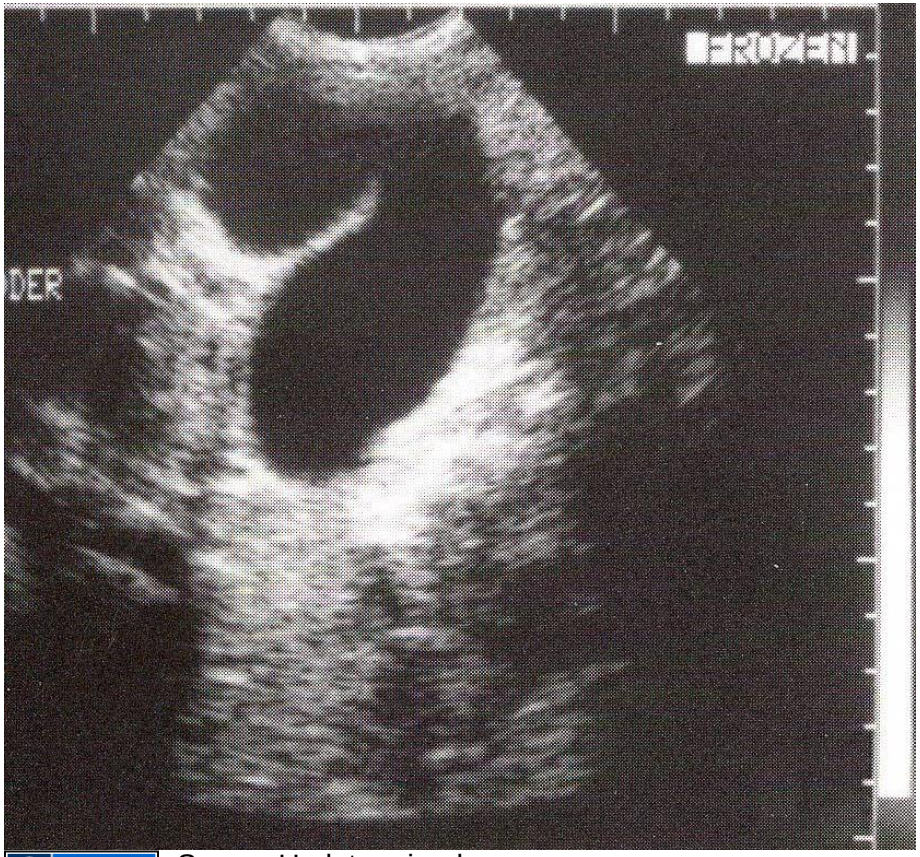
Longitudinal

ALWAYS ULTRASOUND YOUR AREA OF INTEREST IN MULTIPLE PLANES

Case Study # 8
Phyrgian Cap



PD-INEL Source Undetermined

Case Study #8 Diagnosis

Indigestion from large bag of Sheep Rinds Eaten for Lunch

Case Study #9

CC: Abdominal pain x 4 months; "I feel a tumor in my belly"

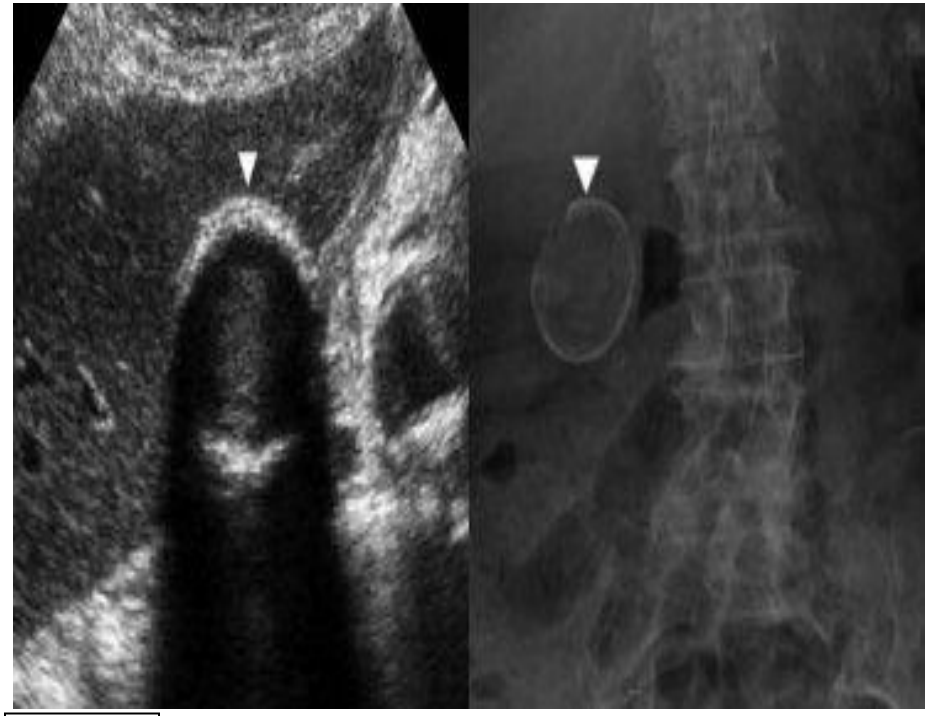
35 yo WF

PMHx: Schizophrenia

Meds: Risperdal

PE: 97.0, 76, 12, 130/80, min TTP RUQ

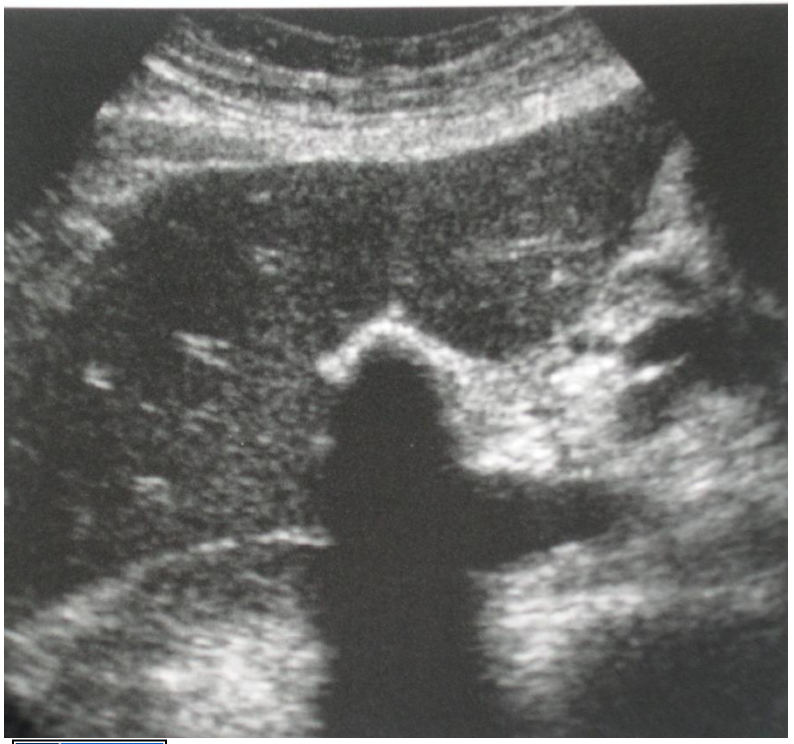
Labs: CBC wnl, LFT's wnl



CBD < 4 mm

Case study # 9
Porcelain Gall Bladder

- Linear or punctate calcifications within gall bladder wall
- Rare disorder in which chronic cholecystitis produces mural calcification.
- Refer to general surgery as prophylactic cholecystectomy has been advocated in some because of its association with gallbladder carcinoma



Case Study # 10

- 55 yo WM with 10 h sharp RUQ pain

PMHx: HTN, Diabetes

Med: Lisinopril, Metformin

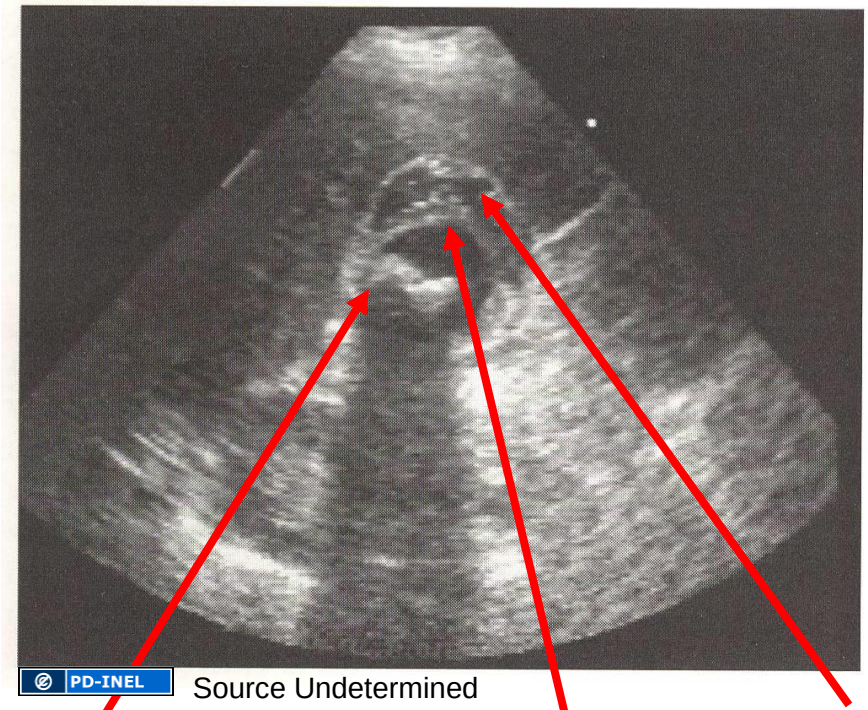
PE: 102F, 100, 20,

100/60, 98% RA

Very TTP RUQ

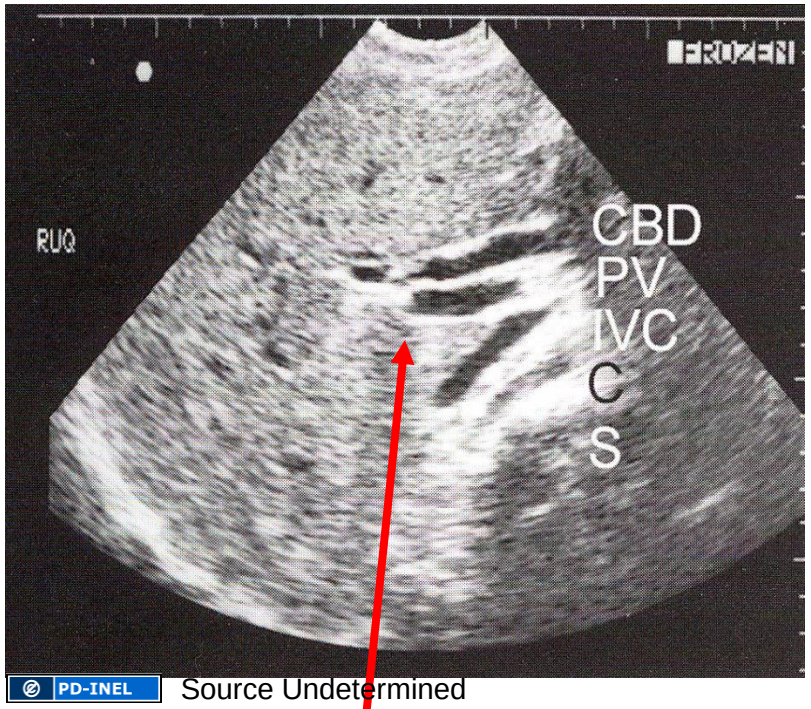
Case Study # 10

Acute Cholecystitis



Cholelithiasis

Thickened GB wall



Pericholecystic fluid

"Double barrel"

Summary

- Anatomy
  - CBD runs with PV --> Lumen over lumen
  - Portal vein is hyperechoic and runs over IVC
- 5 key findings
  - Stones?
  - Wall >3mm?
  - Pericholecystic fluid?
  - CBD dilated? (>5mm at 50, >6mm at 60…)
  - Murphy's Sign?
- Maneuvers
  - Inspiration, intercostal, L lat decubitus
- With high suspicion for acute cholecystitis and an indeterminate scan, get a formal RUQ US

References

- Cook T, Hunt, et al. Emergency Ultrasound Course manual. (Revised Apr, 2005)
- Greenberger NJ, Isselbacher KJ. Diseases of the gallbladder and bile ducts. In *Harrison's Principles of Internal Medicine*, 14th ed, McGraw-Hill, 1998.
- Khalili K, Wilson SR. The biliary tree and gallbladder. In *Diagnostic Ultrasound*, Rumack CM, Wilson SR, Charboneau JW, eds. Mosby, Inc, 2005; 193-212.
- Lanoix R, Leak L, et al. A preliminary evaluation of emergency ultrasound in the setting of an emergency medicine training program. Am J Emer Med 2000; 18(1):41-45.
- Roy, S. Hepatobiliary. In *Emergency Ultrasound*, Ma OJ, Mateer JR, eds. McGraw-Hill, 2003; 143-162.
- Schlager D, Lazzareschi G. A prospective study of ultrasonography in the ED by emergency physicians. Am J Emer Med 1994; 12(2):185-189.

Pitfalls

- *Absence of gallstones on U/S does not exclude diagnosis of biliary colic*
  - Symptomatic patients

    +

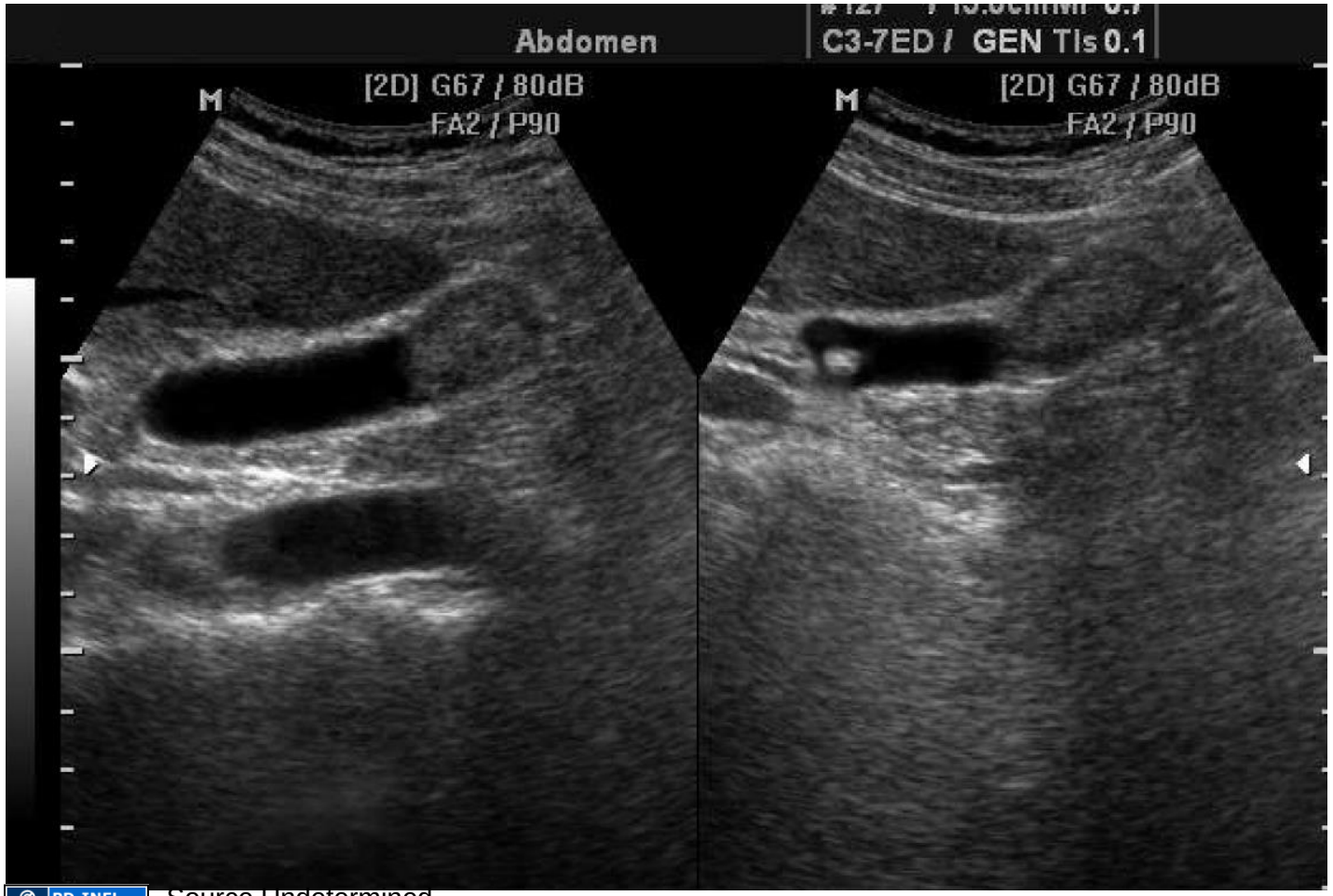
    Unremarkable RUQ US = Formal u/s in ED

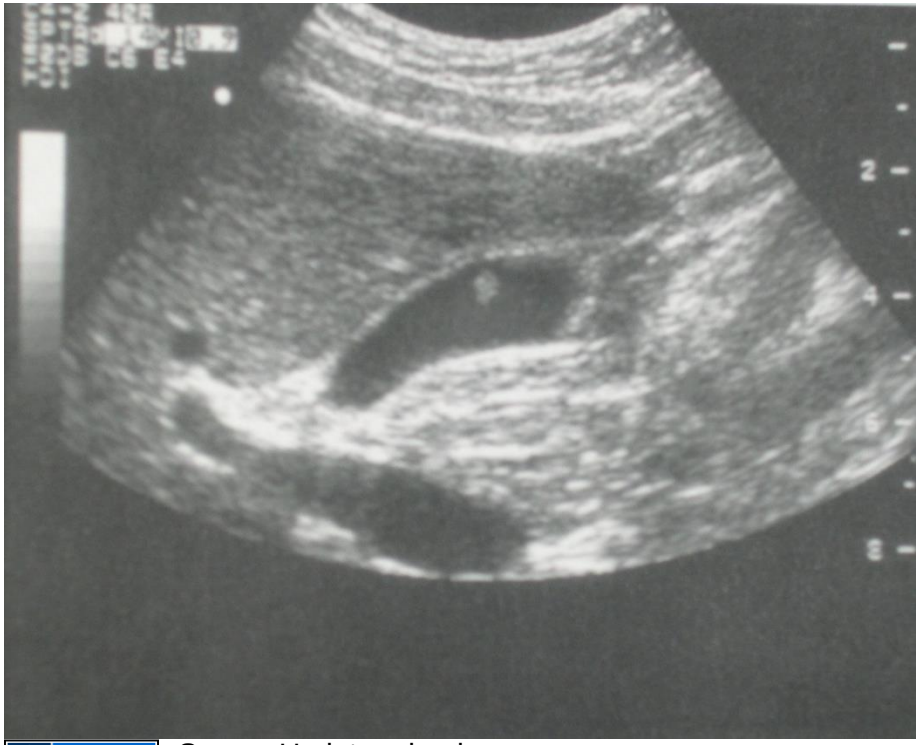
    +

    High clinical suspicion

  - Patients with a high suspicion for biliary colic, no stones and low clinical suspicion for acute cholecystitis should follow up with primary care physician to arrange a formal outpatient ultrasound examination

Choledocholithiasis





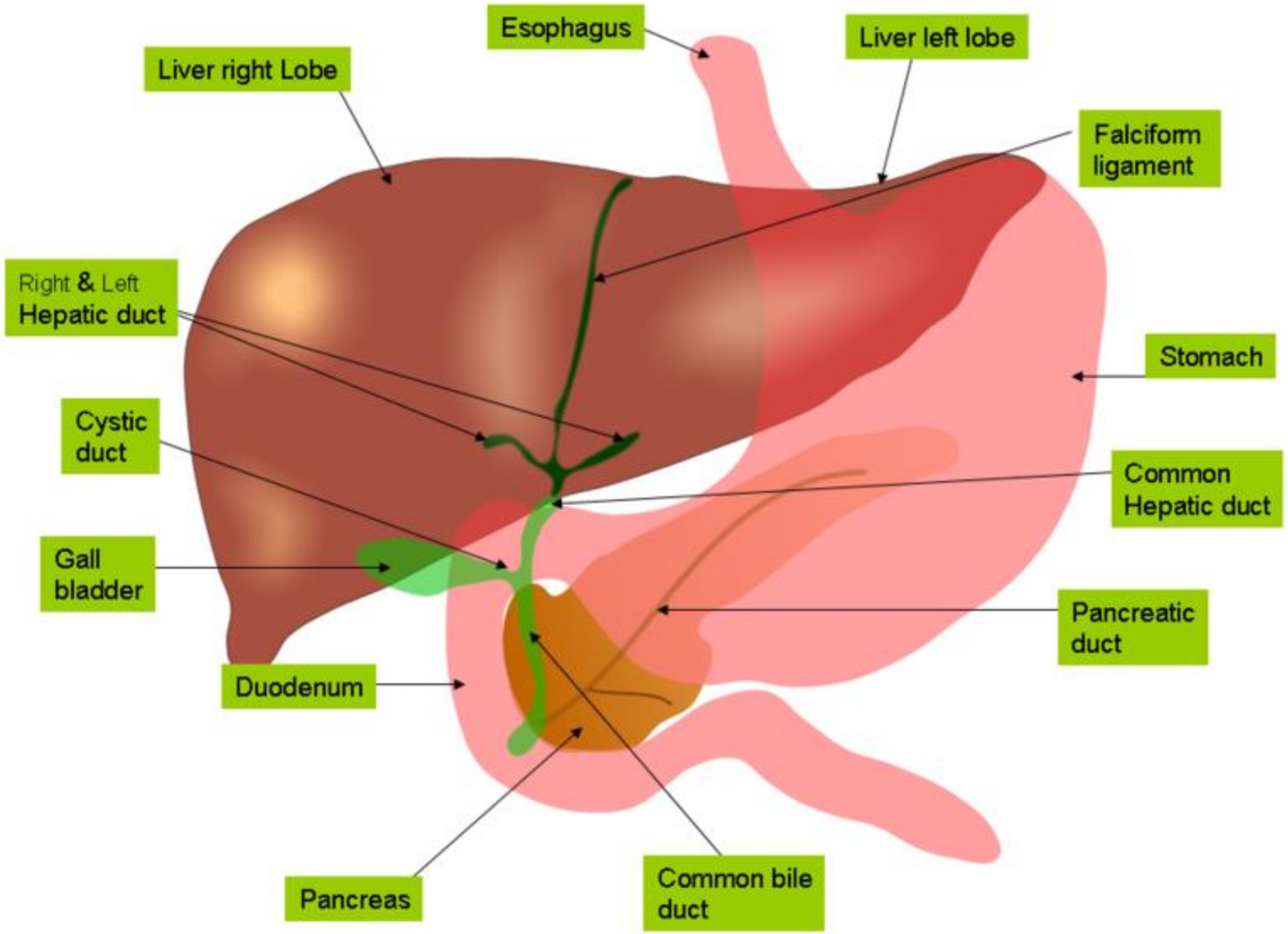
PD-INEL Source Undetermined

- Acute cholecystitis
  - Gallstones + sonographic murphy's
    → PPV 92.2%
  - Gallstones + gallbladder wall thickening
    → PPV 95.2%

Summary

- Stones, wall thickening, pericholecystic fluid, CBD dilation
- Roll your patient or use the liver as an acoustic window for a better picture
- If a bedside ED RUQ ultrasound doesn’t show stones but the clinical picture fits, obtain formal ultrasound during ED visit

Anatomy – Gall Bladder



Outline

- Anatomy
- Indications for bedside emergency department ultrasound
- Technique and troubleshooting
- Case studies

Common and Emergent Abnormalities

- Cholelithiasis
  1. Echogenic foci
  2. Acoustic shadowing beneath gallstone (may not be present if less than 4 mm)
  3. Range from fine sand particles to golf ball
  4. Layer in most dependent portion (change position when patient changes position)

Cholecystitis

- Wall thickness > 4 mm (nonspecific sign)
- Pericholecystic fluid
- Cholelithiasis
- CBD dilated
- Sonographic Murphy's sign

How good are we?

- Schlager et al. *Am J Emer Med,* 1994.
- Evaluated primarily our ability to detect stones (not recognition of sonographic evidence of cholecystitis)
  - Sensitivity 86% Specificity 97%

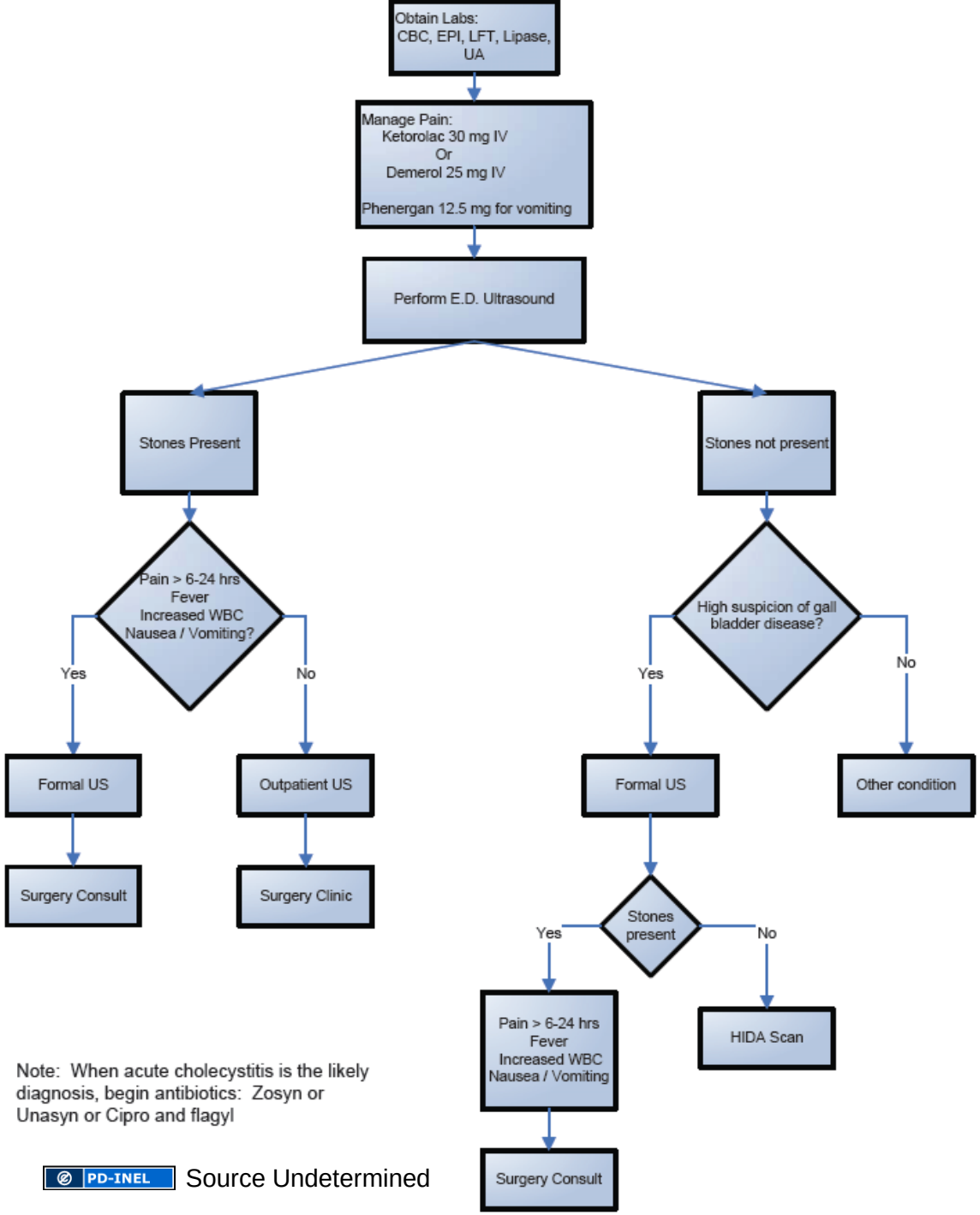
- Shea et al. *Arch Int Med*, 1994.

  - Metanalysis of ultrasound literature

  - Cholelithiasis

    1. 91 % sens
    2. 97% specificity

- Lanoix et al. *Am J Emer Med*, 2000.
  - Sensitivity 90%
  - Specificity 85%



Note: When acute cholecystitis is the likely diagnosis, begin antibiotics: Zosyn or Unasyn or Cipro and flagyl

- Acute cholecystitis
  - Gallstones + sonographic murphy's
    → PPV 92.2%
  - Gallstones + gallbladder wall thickening
    → PPV 95.2%

Bears and Gall Bladders?

- Bile from bears has been used in traditional Chinese medicine for centuries for liver disease, inflammatory conditions, and to dissolve kidney and gall stones.
- Some studies scientific basis for the medical efficacy of bear bile.
- Bears are the only mammals that manufacture the bile salt *ursodeoxycholic acid*, which has been shown in Western laboratory tests to be effective in treating some liver diseases.

How good are we?

- Schlager et al. *Am J Emer Med,* 1994.
- Evaluated primarily our ability to detect stones
  - Sensitivity 86%
  - Specificity 97%

- Rosen, et al. *Am J Emer Med, 2001.*
- Evaluated ability to detect acute cholecystitis (Gall stones + sonographic murphy's)
  - Sensitivity 91%
  - Specificity 66%