Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.

**Creative Commons – Zero Waiver**

- **Creative Commons – Attribution License**
- **Creative Commons – Attribution Share Alike License**
- **Creative Commons – Attribution Noncommercial License**
- **Creative Commons – Attribution Noncommercial Share Alike License**
- **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.
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?
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
Probe (low frequency, high penetration)

4.5 MHz

3.5 MHz (higher depth of penetration)
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
Gall Bladder – Imaging Technique

ALWAYS ULTRASOUND YOUR AREA OF INTEREST IN MULTIPLE PLANES

Longitudinal

Oblique

Source Undetermined

Source Undetermined
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
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

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

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

“Double Barrel Sign”
Cholelithiasis

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

CXR – NAD
UA – Negative
LFT’s – WNL

90% N 8% L
Case Study #1 – Ultrasound

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

Impression?

Plan?
Case Study #1

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

Diagnosis: Acute Cholecystitis
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

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
Case Study #2 – Dx/Plan

- Symptomatic cholelithiasis
- General Surgery Referral

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

Gall Bladder

CBD 5 mm
(-) Sonographic Murphy’s

Source Undetermined
Wall Echogenic Shadow (WES)

- ‘Chock full of stones’
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

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?

Source Undetermined
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

Wall thickness
5 mm

Pericholecystic Fluid

Posterior Acoustic Shadowing

Stone

Gb
PV
IVC
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

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 stasis (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

ALWAYS ULTRASOUND YOUR AREA OF INTEREST IN MULTIPLE PLANES
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

Source Undetermined
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


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
• 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

Jiju Kurian Punnoose (wikimedia commons)
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?

  - Evaluated primarily our ability to detect stones (not recognition of sonographic evidence of cholecystitis)
    - Sensitivity 86% Specificity 97%

  - Metanalysis of ultrasound literature
    - Cholelithiasis
      1. 91 % sens
      2. 97% specificity

  - Sensitivity 90%
  - Specificity 85%
Obtain Labs: CBC, EPI, LFT, Lipase, UA

Manage Pain:
- Ketorolac 30 mg IV
- Demerol 25 mg IV
- Phenergan 12.5 mg for vomiting

Perform E.D. Ultrasound

Stones Present

Pain > 6-24 hrs
Fever
Increased WBC
Nausea / Vomiting?

Yes: Formal US
Surgery Consult

No: Outpatient US
Surgery Clinic

Stones not present

High suspicion of gall bladder disease?

Yes: Formal US

No: Other condition

Stones present

Pain > 6-24 hrs
Fever
Increased WBC
Nausea / Vomiting

Yes: HIDA Scan

No: Surgery Consult

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

Source Undetermined
• 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?

  - Evaluated primarily our ability to detect stones
    - Sensitivity 86%
    - Specificity 97%

  - Evaluated ability to detect acute cholecystitis (Gall stones + sonographic murphy’s)
    - Sensitivity 91%
    - Specificity 66%