My Patient Has Abdominal Pain

PoCUS of the Biliary Tract and the Urinary Tract
Objectives

- PoCUS for Biliary Disease
- PoCUS for Renal Colic
- PoCUS for Urinary Retention
Biliary Disease

- A patient presents with right upper quadrant abdominal pain

- PoCUS questions:
  - Does the patient have gallstones?
  - Does the patient have cholecystitis?
  - Can the common bile duct be identified and is it dilated?
Anatomy

- Venous system
- Portal system
- Gallbladder
- Biliary tree
Venous System

- 3 main veins: left, middle and right
- Normally right hepatic vein drains directly into IVC
- Middle and left have a common trunk
- No fibrous sheath therefore less reflective
Portal System

- Splenic, Superior Mesenteric and Inferior Mesenteric veins join to form Portal vein
- Surrounded by hyperechoic fibrous walls of portal tracts
- Portal tracts contain branch of portal vein, hepatic artery and biliary duct
- Normal intrahepatic biliary ducts not visible on ultrasound
Portal System

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Gallbladder

• Pear shaped anechoic cyst

• GB fossa – posterior inferior right lobe

• Fossa closely related to Main Lobar Fissure (MLF)

• MLF – thin hyperechoic line from portal vein to neck of GB

• Variable size
Biliary Tree

- Right and left Hepatic ducts combine to form CHD

- CHD and cystic duct combine to form CBD

- In short axis plane - look for ‘Mickey Mouse Sign’
Gallbladder PoCUS

- Patient supine
- Curvilinear transducer in longitudinal plane
- Start at subxiphoid position and move laterally along costal margin to midclavicular line
- Rotate transducer to visualise GB in longest axis

pic of Lax GB

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Gallbladder PoCUS

- Rotate transducer 90° anticlockwise to scan in the transverse plane

- Visualise:
  - Neck
  - Body
  - Fundus
Gallbladder PoCUS Modifications

• Ask patient to breath in and hold

• Ask patient to ‘push their belly out’

• Ask patient to lie on left side

• Oblique intercostal transducer position
Gallbladder PoCUS

- PoCUS GB assessment
  - How big is it?
  - How thick is the GB wall - GB wall thickness
  - Is there any fluid around the GB wall?
  - Is there anything in the GB?
  - Does it hurt when pressure is applied by the transducer over the GB?
Gallbladder PoCUS

- PoCUS GB assessment
  - Size - (Contracted, Easily visible, Distended)
  - GB wall thickness - (anterior wall, < 3mm)
  - Pericholecystic space - (presence of fluid)
  - Internal contents - (stones, sludge, polyps)
  - Sonographic Murphy’s sign

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Cholecystitis

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Pericholecystic fluid
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What do you see?
Gallbladder PoCUS

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Multiple small gallstones
Gallbladder PoCUS

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2 or 3 pics of stones
Gallbladder PoCUS

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Gallbladder PoCUS

- **Pitfalls**
  - Bowel loop vs contracted GB full of stones
    - Loop of bowel can mimic GB full of stone
    - Bowel gas produces ‘dirty acoustic shadow’ and GB wall not seen
    - Wall Echo Sign (WES) - GB wall identified, due to presence of bile between wall and stones, ‘clean acoustic shadow’
  - Dirty shadow = air filled bowel loop
  - Clean shadow + GB Wall +/- bile = WES
Common Bile Duct PoCUS

- Normal CBD is not easily visualised in the non fasted ED patient

- Gallbladder stones + Abnormal LFTs suggest obstructed biliary system even if CBD cant be identified with PoCUS

- CBD PoCUS may be useful in following circumstances:
  - Identification of dilated CBD mandates LFT analysis, even if gallstones not seen in gallbladder
  - Identification of a normal CBD, in the presence of gallbladder stones is reassuring, although patient vitals and LFT analysis still required to determine disposition
CBD PoCUS

- Short Axis
  - Identify neck of GB
  - Identify Portal vein
  - Look for ‘Mickey Mouse’
  - CBD is left ear
• Long Axis

  • Rotate to align with long axis portal vein

  • Identify CBD (*) lying anterior to portal vein (^)

  • Right hepatic artery may be seen crossing between portal vein and CBD

  • Colour flow may help distinguish CBD from vascular structures
CBD PoCUS

- Long Axis
  - Measure internal diameter
  - Normal < 6-8mm
A patient presents with left flank pain and microscopic hematuria.

PoCUS questions:
- Does the patient have hydronephrosis?
- Does the patient have other pathology?
Anatomy

- Paired retroperitoneal organs
- Length 10 cm (9-13)
- T12 to L3
- Right kidney more caudal than left
- Moves 3 cm with respiration
- Surrounded by perinephric fat and Gerota's fascia
- Gerota’s fascia is covered anteriorly by the peritoneum
Anatomy

- **Capsule** - white, hyperechoic and smooth
- **Cortex** - mid-gray, slightly less echogenic than liver or spleen
- **Medullary pyramids** - dark, hypoechoic
- **Sinus** - white, hyperechoic due to fat
- **Pelvis** - black, anechoic due to urine (when seen)
- **Ureter** -
Anatomy

- **Capsule** - white, hyperechoic and smooth
- **Cortex** - mid-gray, slightly less echogenic than liver or spleen
- **Medullary pyramids** - dark, hypoechoic
- **Sinus** - white, hyperechoic due to fat
- **Renal Pelvis** - black, anechoic due to urine (when seen)
Renal PoCUS

- Patient supine
- Liver is the acoustic window for the right kidney
- Find hepato-renal interface in coronal plane (eFAST)
- Centre on kidney and rotate transducer anticlockwise to maximum long axis
- Measure maximum long axis (9-13cm)
Renal PoCUS

- Patient supine
- Liver is the acoustic window for the right kidney
- Find hepato-renal interface in coronal plane (eFAST)
- Centre on kidney and rotate transducer anticlockwise to maximum long axis
- Measure maximum long axis (9-13cm)
Renal PoCUS
Renal PoCUS

- Identify renal structures
Renal PoCUS

- Identify renal structures
  - A - Capsule
Renal PoCUS

- Identify renal structures
  - A - Capsule
  - B - Renal Cortex
Renal PoCUS

- Identify renal structures
  - A - Capsule
  - B - Renal Cortex
  - C - Medullary Pyramids
Renal PoCUS

- Identify renal structures
  - A - Capsule
  - B - Renal Cortex
  - C - Medullary Pyramids
  - D - Renal Sinus
Renal PoCUS

- Rotate transducer 90° anticlockwise for short axis view
- Identify renal structures
- Repeat process on the left starting from spleno-renal interface
Renal PoCUS Modifications

- Views may be improved by rolling patient onto side

- Although this more posterior approach lacks liver / spleen acoustic windows
Renal PoCUS Modifications

- Views may be improved by rolling patient onto side
  - Although this more posterior approach lacks liver / spleen acoustic windows
Renal PoCUS Modifications

- Avoid Rib Shadows
  - Utilise respiratory movement
  - Align transducer with rib space
Renal Colic

- Can we reliably see renal / ureteric stones with PoCUS?

- Can PoCUS detect any other associated signs of renal colic?
Renal Colic

• Can we reliably see renal / ureteric stones with PoCUS?
  • No

• Can PoCUS detect any other associated signs of renal colic?
Renal Colic

- Can we reliably see renal / ureteric stones with PoCUS?
  - No

- Can PoCUS detect any other associated signs of renal colic?
  - Yes - Hydronephrosis
  - And if it is present PoCUS will reliably detect it
PoCUS Hydronephrosis

• Diagnostic utility of PoCUS hydronephrosis in renal colic?
  • If the requirement is to identify all cases of renal colic, then it’s not great..

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Table 1. Accuracy of bedside ultrasound for detecting hydronephrosis or stones in patients with flank pain compared with CT or IVPU

<table>
<thead>
<tr>
<th>Reference</th>
<th>Std</th>
<th>Year</th>
<th>N (95% CI)</th>
<th>Prevalence of disease</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV (95% CI)</th>
<th>NPV (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydronephrosis</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Rosen</td>
<td>IVP</td>
<td>1998</td>
<td>83</td>
<td>69 (58 to 78)</td>
<td>72 (59 to 83)</td>
<td>73 (52 to 88)</td>
<td>85 (71 to 94)</td>
<td>54 (37 to 71)</td>
</tr>
<tr>
<td>Henderson ‡</td>
<td>IVP</td>
<td>1998</td>
<td>108</td>
<td>58 (49 to 67)*</td>
<td>97 (89 to 99)*</td>
<td>73 (59 to 84)*</td>
<td>84 (73 to 90)*</td>
<td>94 (81 to 98)*</td>
</tr>
<tr>
<td>Gaspari and Horst</td>
<td>CT</td>
<td>2005</td>
<td>101</td>
<td>51 (42 to 60)*</td>
<td>87 (79 to 92)</td>
<td>82 (74 to 81)</td>
<td>84 (72 to 91)*</td>
<td>86 (73 to 94)*</td>
</tr>
<tr>
<td>Watkins</td>
<td>CT</td>
<td>2007</td>
<td>57</td>
<td>68 (56 to 79)</td>
<td>80 (65 to 89)</td>
<td>83 (61 to 94)</td>
<td>91 (75 to 98)</td>
<td>65 (43 to 83)</td>
</tr>
<tr>
<td><strong>Stones</strong></td>
<td></td>
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<tr>
<td>Moak</td>
<td>CT</td>
<td>2012</td>
<td>107</td>
<td>36 (27 to 45)</td>
<td>76 (59 to 88)</td>
<td>78 (66 to 87)</td>
<td>66 (50 to 79)</td>
<td>86 (74 to 92)</td>
</tr>
</tbody>
</table>

*Our calculation.
†Cases that were checked against another gold standard imaging technique. All patients received a 500 ml saline bolus prior to scan which may have improved sensitivity. Six cases showed calcifications or filling defect on IVP. These were counted as non-hydrou for calculations. IVP, intravenous pyelography; NPV, negative predictive value; PPV, positive predictive value.

PoCUS Hydronephrosis

• But, do we need to identify all patient with stones at the time of presentation to safely manage patients with suspected renal colic in ED?
PoCUS Hydronephrosis

- But, do we need to identify all patients with stones at the time of presentation to safely manage patients with suspected renal colic in ED?

No
How can use PoCUS to help us manage these patients

- The majority of patients with renal colic are low risk with an excellent prognosis even without treatment.

- Larger stones (> 6mm) are more likely to require intervention.

- Larger stones are more likely to result in hydronephrosis.

- 20% of patients with obstructing stones don’t have hematuria but will have hydronephrosis.
PoCUS Hydronephrosis

- **Grade I**: Dilatation of the renal pelvis (< 5-7mm) without dilatation of the calices.

- **Grade II**: Dilatation of the renal pelvis (< 10mm) and calices.

- **Grade III**: Dilatation of the renal pelvis (> 10mm) and blunting of calices. Without parenchymal narrowing.

- **Grade IV**: massive dilatation of the renal pelvis (> 10mm) and calices. With parenchymal narrowing.
PoCUS Hydronephrosis

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PoCUS Hydronephrosis

Normal

Mild

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PoCUS Hydronephrosis

Mild

Moderate
Always scan the Abdominal Aorta…..!

Always scan both kidneys for comparison

- Bilateral hydronephrosis may suggest alternative diagnoses

Infusion of 500ml bolus has been shown to improve sensitivity of PoCUS

- Renal colic patients can be dehydrated
Bladder PoCUS

- VUJ Stone
- Ureteric Jets
  - Nice to see but presence or absence not helpful
Proposed Management Pathway

• Needs to be validated

• Hydronephrosis or Hematuria picked up 100% of > 6mm Stones


Modified from Dalziel; Noble, Emerg Med J. 2013;30(1):3-8

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Other Pathology

- Simple Renal Cyst
  - Common - increases with age (10 - 30%)
  - Anechoic
  - No debris
  - Usually peripheral
  - Thin wall
Other Pathology

- Polycystic Kidney
- Renal Tumour
- Bladder Tumour
Urinary Retention

• A patient presents with lower abdominal pain and incontinence of urine.

• PoCUS questions:
  • What is the bladder volume?
  • How can PoCUS assist with urethral and suprapubic catheterisation?
Bladder PoCUS

- Scan in transverse and longitudinal
- Start just above symphysis
- Angle transducer until bladder visualised
- Easy to differentiate urinary retention from empty bladder
- Can use machine calculator to estimate bladder volume
- Post void measurements can be useful
Suprapubic Drainage

- Confirm diagnosis
- Realtime needle guidance
- Can be used to simply aspirate / symptom relief
- Or proceed to standard Seldinger technique