Ultrasound

Introduction to renal ultrasound

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Tip Sheet

http://ccm.anest.ufl.edu/education/ultrasound

Tip Sheet: 

Indication: Renal ultrasound to determine presence or absence of hydronephrosis; evaluation for oligoanuria

Probe: Abdominal/phased array

Questions to ask yourself:

Is there hydronephrosis?
Is there bladder distention?

Right Kidney:
Kidney present: YES or NO
Both Poles visualized: YES or NO
Hydronephrosis: YES or NO
Hepatorenal space fluid visualized: YES or NO
Concern for Mass/Cyst: YES or NO

Left Kidney:
Kidney present: YES or NO
Both Poles visualized: YES or NO
Hydronephrosis: YES or NO
Splenorenal space fluid visualized: YES or NO
Concern for Mass/Cyst: YES or NO

Rectovesicle:
Foley present: YES or NO
Fluid in Bladder present: YES or NO
Fluid in rectovesicle recess: YES or NO
Concern for Mass: YES or NO

Images you should obtain:

KID1 – Right and left views of parenchyma of kidney for eval of hydronephrosis
KID2 – Hepatorenal space
KID3 – Splenorenal space
KID4 – Rectovesicle space

Scanning Tips:

Pyramids vs hydronephrosis?
Pyramids will be just below the cortex, and kidney will still have collapsed and high echogenic pelvis, and collecting system. Hydronephrosis should connect to a dilated renal pelvis.

Renal cyst vs hydronephrosis?
Cysts usually located at cortex or periphery, also more well rounded and do not connect with pelvis.

False positives: Pregnancy or BPH can have mild dilation due to external compression of ureters.

False negatives: Patients who are severely dehydrated, should repeat after hydration.
Competency requirements: ACCP abdominal

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University of Florida Critical Care Medicine Ultrasound Curriculum (Abdominal sonography competencies)


- Assessment for intraperitoneal fluid
- Identification of a relatively echo-free space surrounded by typical anatomic boundaries: abdominal wall, diaphragm, liver, gallbladder, spleen, kidney, bladder, bowel, uterus, spinal column, aorta, IVC
- Identification of abdominal wall, diaphragm, liver, gallbladder, spleen, kidney, bladder, bowel, uterus, spinal column, aorta, IVC
- Identification of characteristic dynamic findings of intraperitoneal fluid, such as diaphragmatic motion, floating bowel, bowel peristalsis, dynamic fluid motion, and respirophasic shape change, compressibility
- Characterization of fluid: anechoic, echogenicity (using liver/spleen as reference); homogeneous or heterogeneous; presence of strands/debris/septations
- Qualitative assessment of intraperitoneal fluid volume
- Recognition of specific limitations of ultrasonography to identify intraperitoneal fluid such as inadequate image quality due to technical limitations, hyperechoic, echo dense, anechoic fluid, gastroesophageal location

- Assessment of the urinary tract
- Differentiation of distended bladder from ascites
- Qualitative assessment of intravesicular volume, identification of overdistention
- Kidneys: identification of both kidneys, identification of presence or absence of hydrenephrosis, measurement of kidney in longitudinal axis

- Assessment of aorta
- Identification of abdominal aorta (down to iliac bifurcation)
- Identification of abdominal aortic aneurysm
Indications: to determine presence of hydronephrosis and/or evaluation for oligoanuria

Is there hydronephrosis?

Is the bladder distended?

We will have more as ultrasound research increases and specific uses in critical care are found

Ultrasound guided suprapubic taps
Anatomy

Renal cortex – homogenous with surrounding liver/spleen, less echogenic (bright)

Medulla – form the pyramids, even less echogenic than cortex

Pyramids – sometimes prominent and echogenic, anechoic spaces that do not touch each other

Size: 9–12 cm length, 4–5 cm width, within 2 cm of each other

Location: on left more superior and posterior due to smaller spleen and air from stomach
Technique and probe selection

Abdominal probe: 3.5 to 5 MHz

Views: longitudinal and transverse
Scan through entire kidney
Normal findings

Longitudinal

K = kidney
L = liver
C = cortex
P = pelvis

Bladder

Volume estimate ellipsoid or cylinder: 0.75 \times \text{width} \times \text{length} \times \text{height} (not done often in ED or ICU)

For clinical purposes (post void residual or detection of fluid) shown to be close enough

Detection of ureteral jets: Doppler on trigone of bladder – bilateral in patients with normal hydration goes against obstructive uropathy

Kiely. Br J Urology. 1987
Roehrborn. Urology. 1988
Ireton. J Urology. 1990
Chan. J Neuroscience. 1993
Figure 6.4
Transverse view of a filled bladder at the level of the trigone. Hyperechoic image in the center of the color Doppler field represents a ureteral jet. Courtesy of Emergency Ultrasound Division, St. Luke’s–Roosevelt Hospital Center, New York, New York.
Hydronephrosis

Grade 1 – slight blunting of calyceal fornices

Grade 2 – enlargement of calyceal fornices but easily visible shadows of papillae

Grade 3 – rounding of calyceal but no papillae

Grade 4 – extreme

Hydronephrosis

Figure 6.10
Dilated right renal pelvis with splaying of the renal calyces indicative of severe hydronephrosis.

Figure 6.11
Another image of severe hydronephrosis. In this image, the pyramids can be seen as distinct from the dilated renal pelvis. Image courtesy of Dr. Manuel Colon, Hospital of the University of Puerto Rico, Carolina, Puerto Rico.
Renal stones
Renal cysts
Scanning tips:

*Pyramids vs hydronephrosis?* Pyramids will be just below the cortex, and kidney will still have collapsed and and hyperechoic pelvis, and collecting system. Hydronephrosis should connect to a dilated renal pelvis.

*False positives:* Pregnancy or BPH can have mild dilation due to external compression of ureters.

*False negatives:* Patients who are severely dehydrated, should repeat after hydration.

*Renal cyst vs hydronephrosis?* Cysts usually located at cortex or periphery, also more well rounded and do not connect with pelvis.

Tell patient to take deep breath or use lateral decubitus positioning.
On the horizon – Transplant kidney
Oligoanuria in the ICU

Post biopsy
Intraoperative
Vascular compromise
Allograft dysfunction
On the horizon – Native kidney
Oligoanuria in the ICU

Postoperative complications

Acute urinary obstruction

Pyelonephritis

Renal vein/artery thrombosis

Renal trauma

Sepsis
Emergency Doppler evaluation of the liver and kidneys

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RENAL DOPPLER ULTRASOUND: A NEW TOOL TO ASSESS RENAL PERFUSION IN CRITICAL ILLNESS

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Clinical Radiology
Pictorial Review
Current and potential renal applications of contrast-enhanced ultrasound

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