

# Ultrasound

## Introduction to renal ultrasound



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# Tip sheet

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

Tip Sheet: USRenal (CPT 76775)

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  
Splenoarenal 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 – Splenoarenal space  
KID4 – Rectovesicle space

### Scanning Tips:

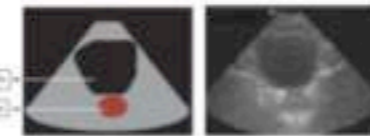
**Pyramids vs hydronephrosis?** Pyramids will be just below the cortex, and kidney will still have collapsed and and hyperechoic pelvis, and collecting system. Hydronephrosis should connect to a dilated renal pelvis.

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

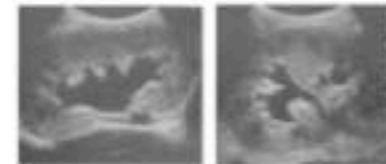
KID1 – views of parenchyma of kidney for eval of hydronephrosis



KID2 – Hepatorenal space  
KID3 – Splenoarenal space



KID4 – Rectovesicle space



**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 <http://ccm.anest.ufl.edu/education/ultrasound>

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

**Technical (image acquisition) and cognitive (image interpretation) elements required for competence in pleural ultrasonography** (based on Mayo, Paul et al. American College of Chest Physicians Statement on Competence in Critical Care Ultrasonography. Chest/135/4 April 2009)

- 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, homogeneous echogenicity, dependent fluid, nontransverse location
- Assessment of the urinary tract
- Bladder: identification of bladder, identification of urinary catheter, identification of abnormal bladder contents
- 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 hydronephrosis, measurement of kidney in longitudinal axis
- Assessment of aorta
- Identification of abdominal aorta (down to iliac bifurcation)
- Identification of abdominal aortic aneurysm

# Focused questions to ask?

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

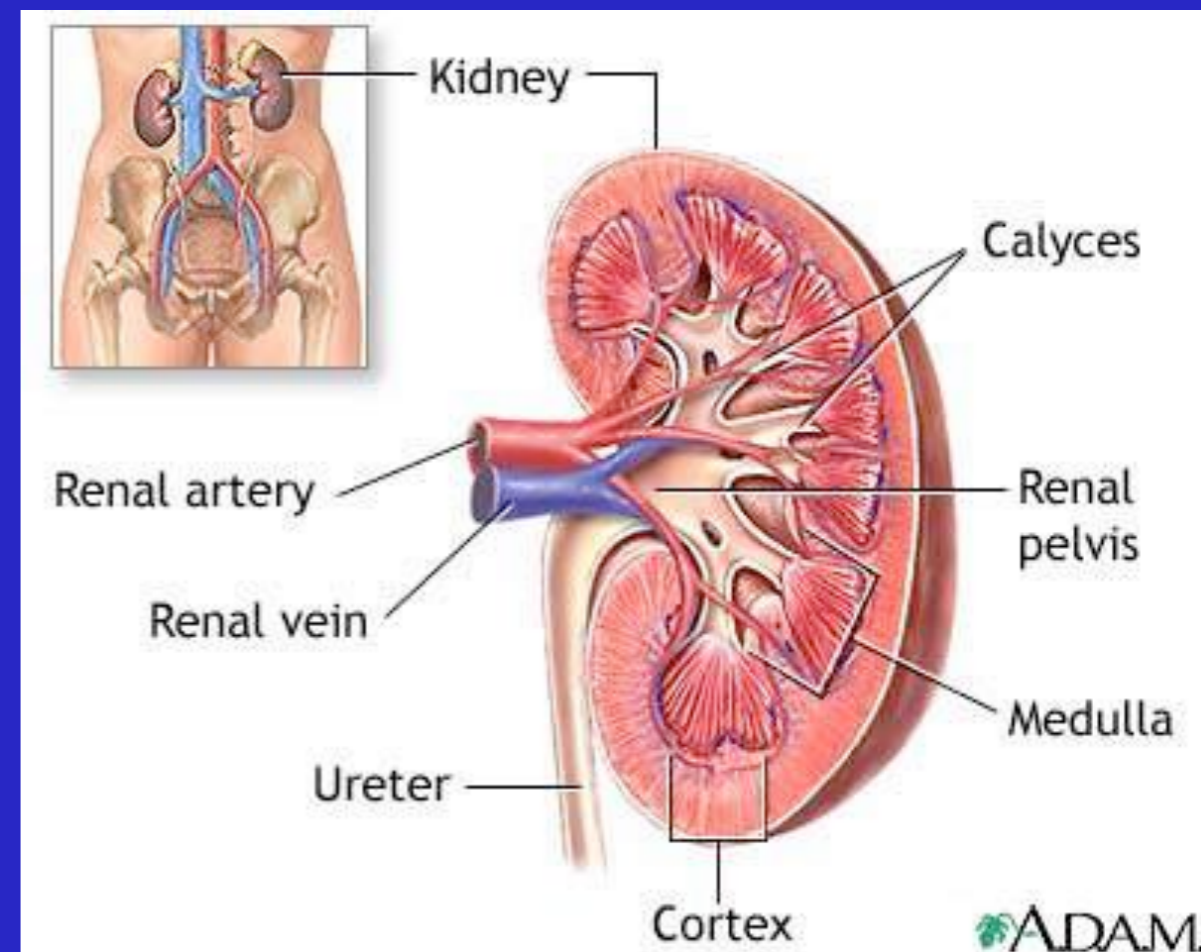
Renal cortex – homogenous with surrounding liver/spleen, less echogenic (bright)

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

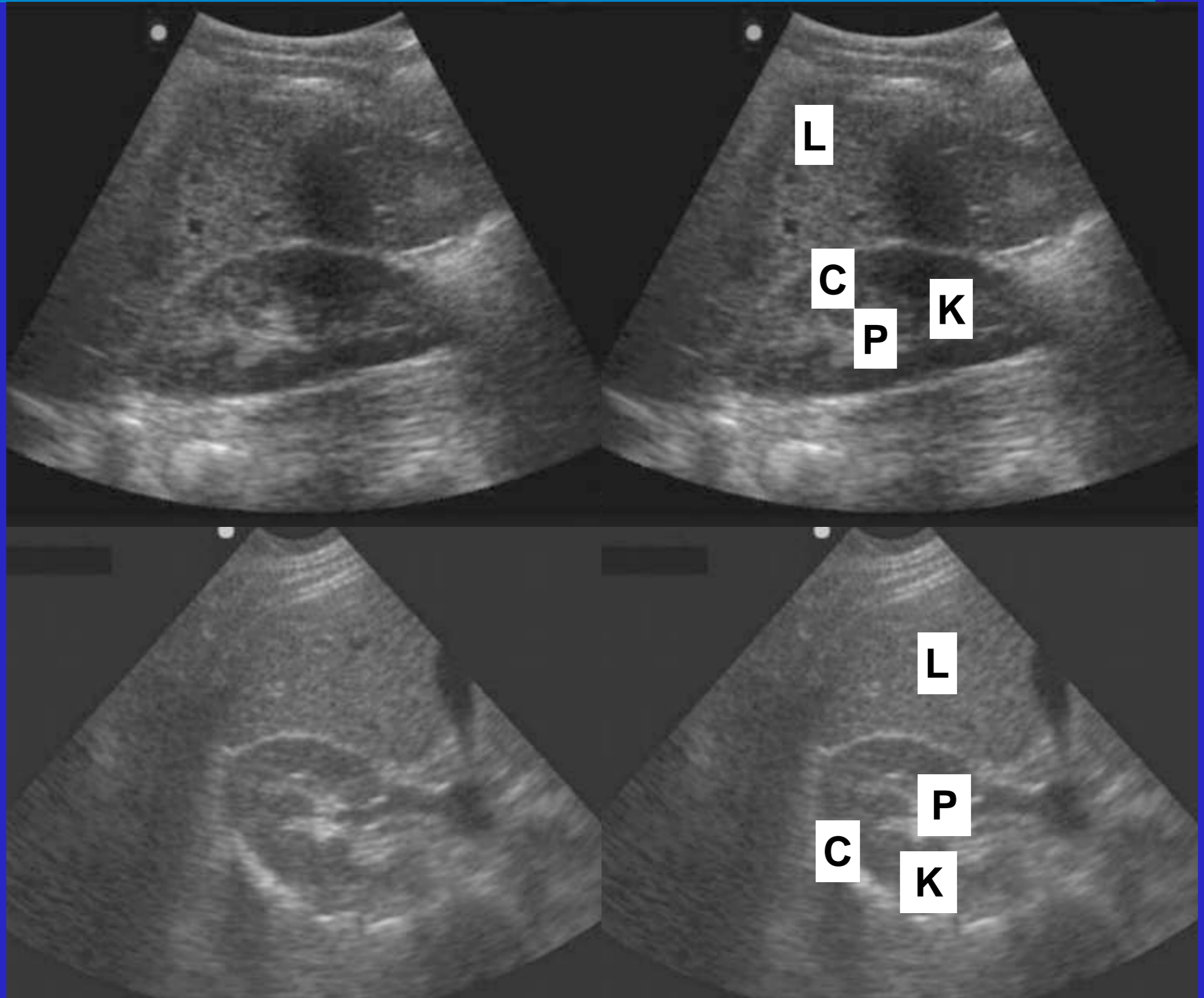


Noble et al. Textbook. Manual of Emergency and Critical Care Ultrasound.

# Normal findings

## Longitudinal

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



Noble et al. Textbook. Manual of Emergency and Critical Care Ultrasound.

# Bladder

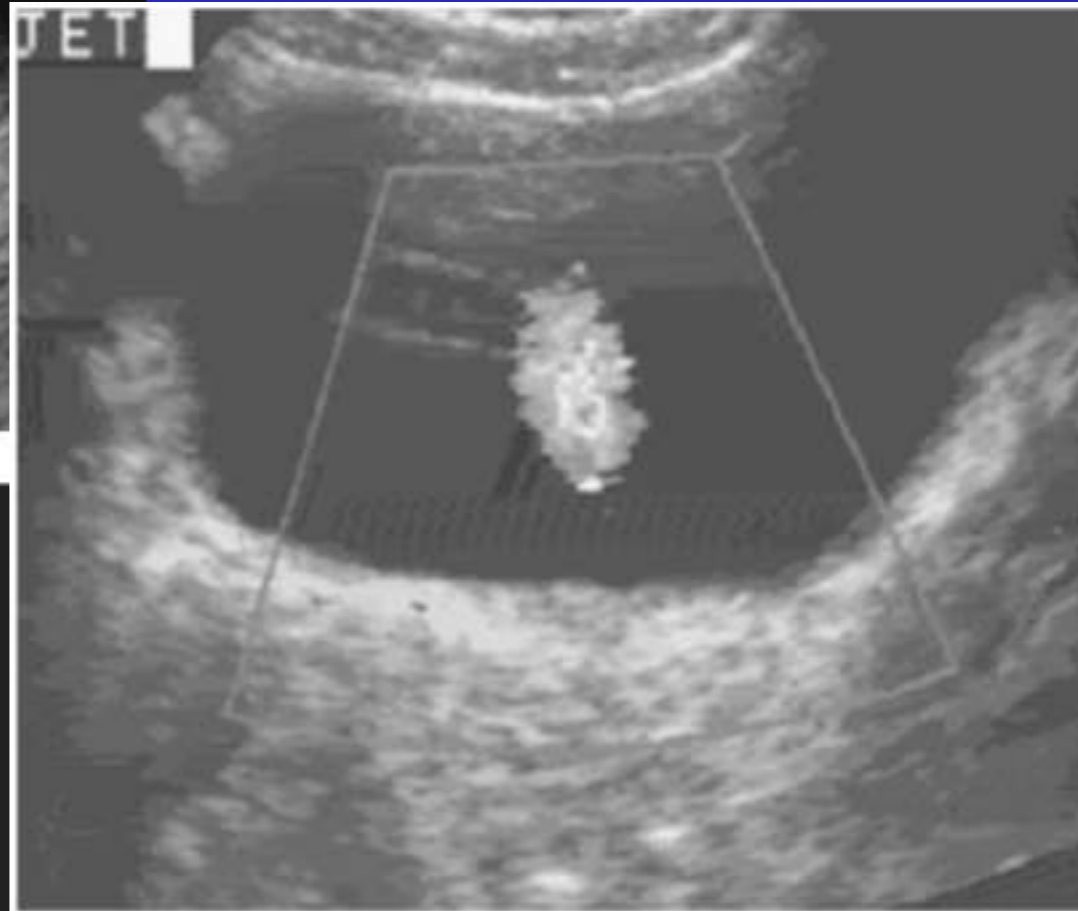
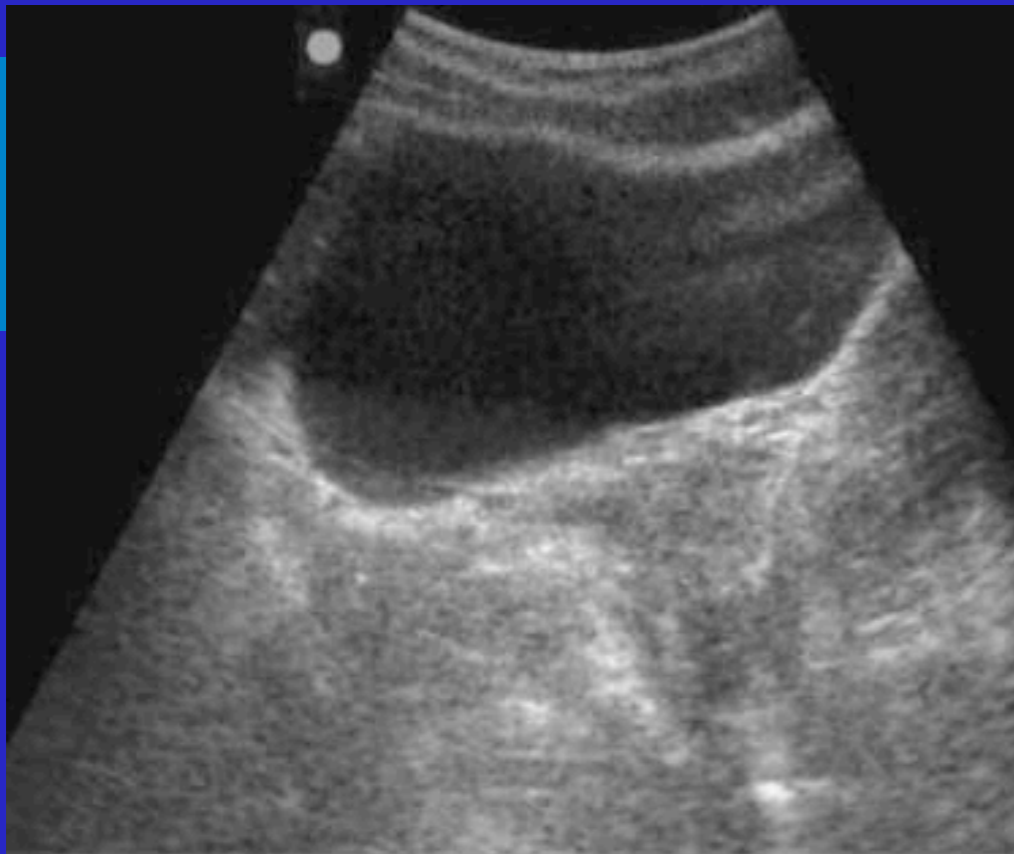
**Volume estimate ellipsoid or cylinder:  $0.75 \times \text{width} \times \text{length} \times \text{height}$  (not done often in ED or ICU)**

**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.

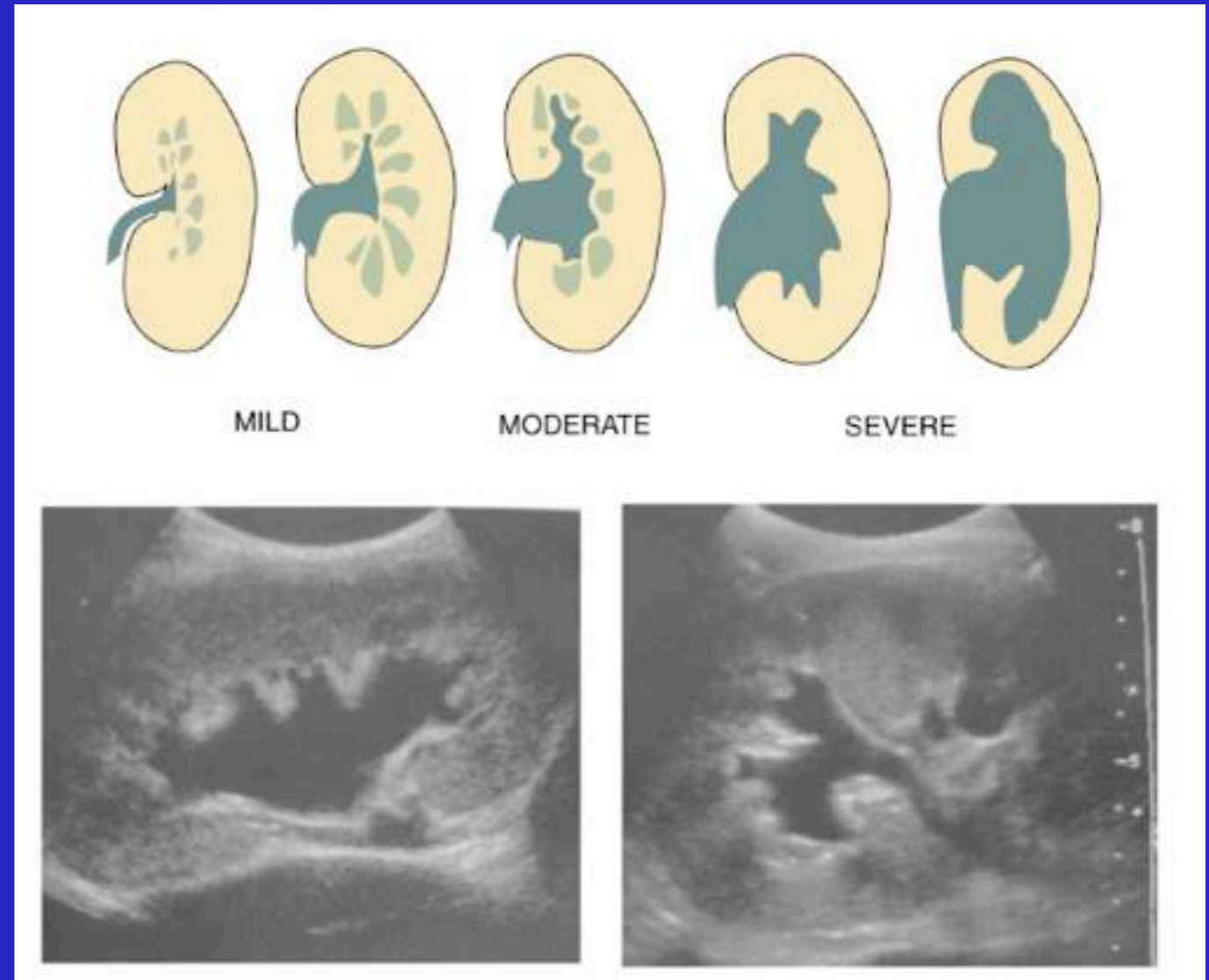
# Hydronephrosis

**Grade 1 – slight blunting of calyceal fornices**

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

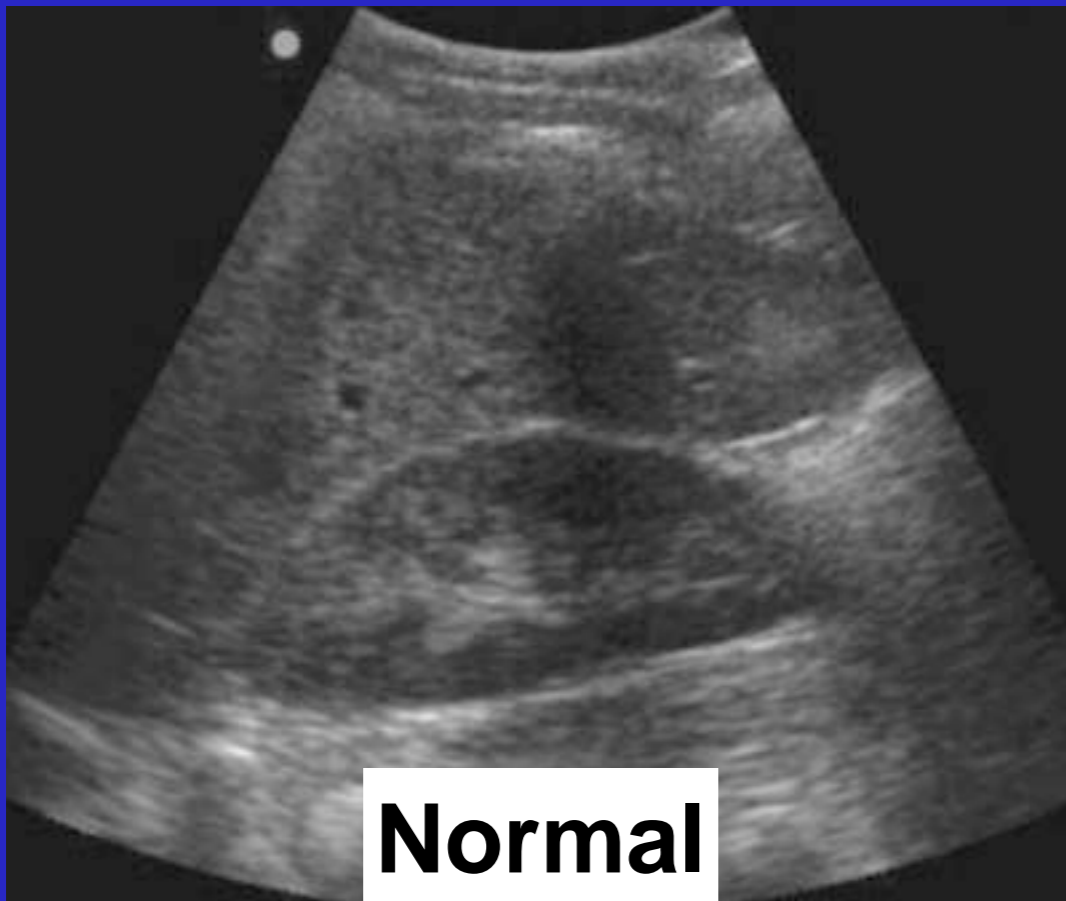
**Grade 3 – rounding of calyceal but no papillae**

**Grade 4 – extreme**



Noble et al. Textbook. Manual of Emergency and Critical Care Ultrasound.

# Hydronephrosis



**Figure 6.10**

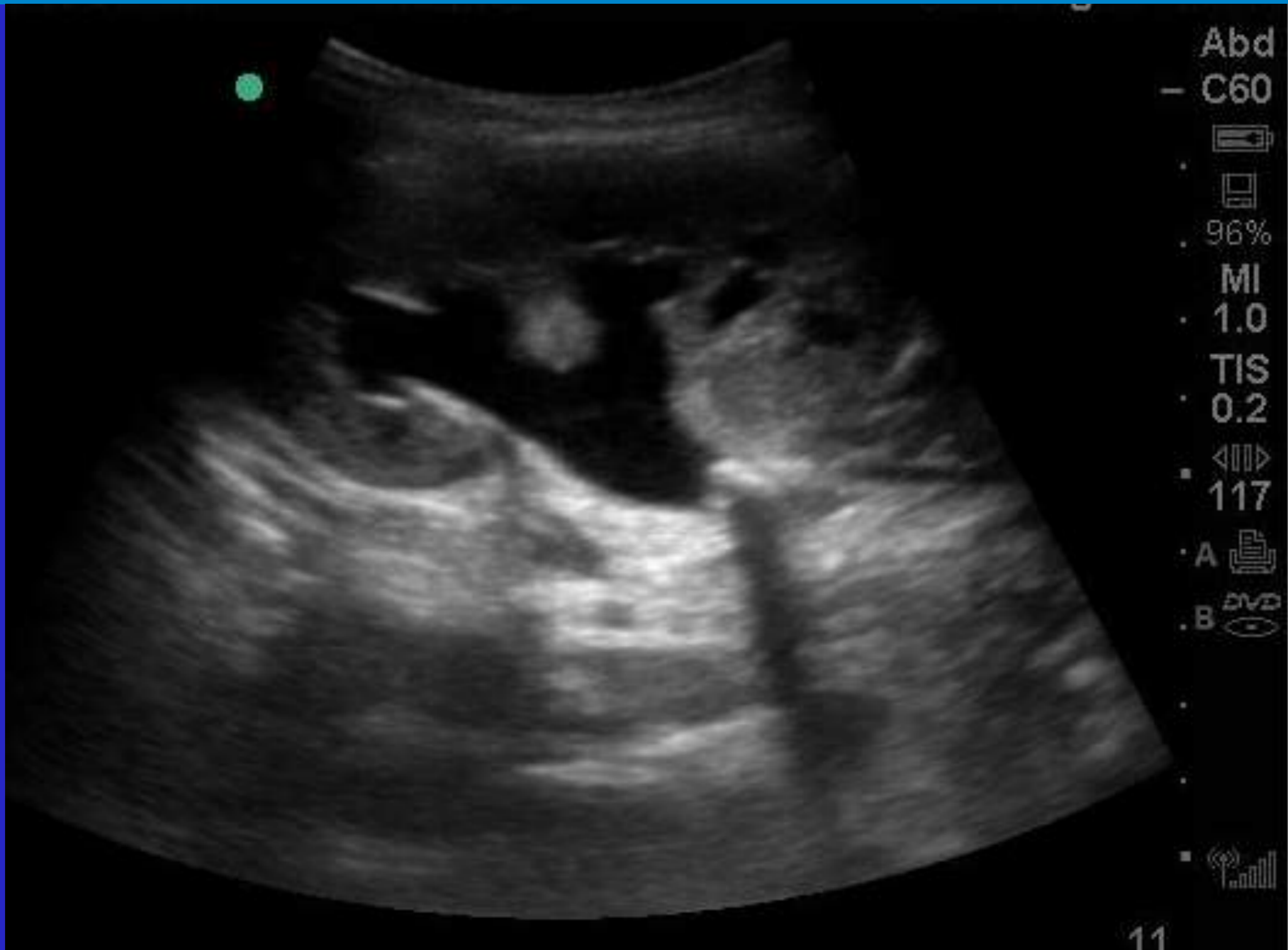
Dilated right renal pelvis with splaying of the renal calyces indicative of severe hydronephrosis.



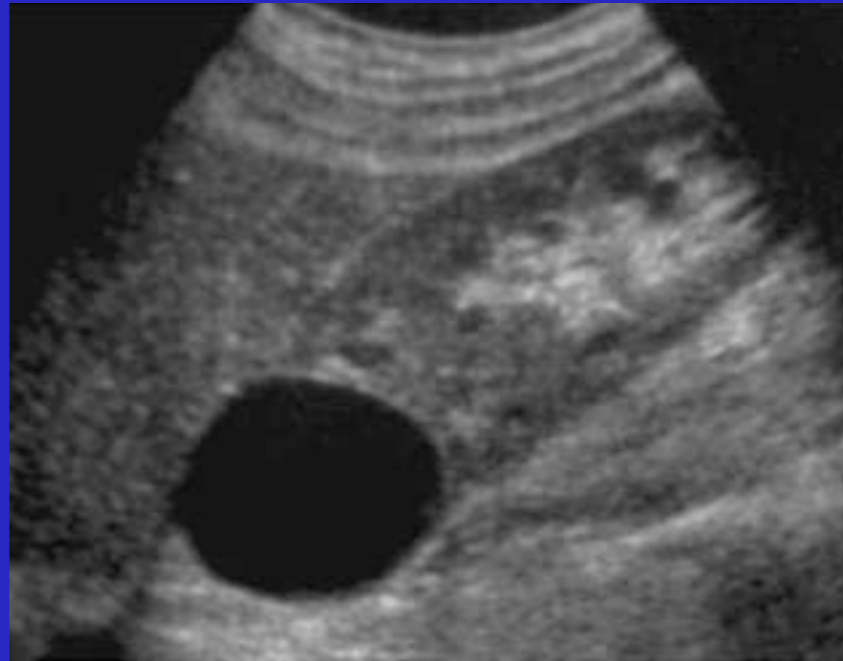
**Figure 6.11**

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



Noble et al. Textbook. Manual of Emergency and Critical Care Ultrasound.

# Scanning tips

## Scanning Tips:

*Pyramids vs hydronephrosis?* Pyramids will be just below the cortex, and kidney will still have collapsed and anechoic 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.

**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**





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Radiol Clin N Am 42 (2004) 397–415

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## 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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Pictorial Review

## Current and potential renal applications of contrast-enhanced ultrasound

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