



# Renal Ultrasonography

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آقای میانسالی با سابقه بیماری فشارخون و دیابت، به علت تهوع استفراغ و درد شکم به پزشک مراجعه کرده است. آزمایشی به همراه دارد که امروز انجام داده است و در آن کراتینین ۸ رویت می شود

بیمار ذکر می کند که از ۲ روز پیش ادرار نداشته است

در این فکر هستید که بیمار را برای دیالیز آماده کنید

قبل از تصمیم گیری نهایی بیمار را معاینه می کنید  
در معاینه شکم توده‌ای در هیپوگاستر به دست می‌خورد

در سونوگرافی انجام شده بر بالین بیمار مثانه با حجم زیاد رویت می‌شود. کلیه‌ها نیز به صورت دو طرفه دارای هیدرونفروز متوسط هستند.

سوند فولی تعبیه میشود و با خارج شدن ادرار درد شکم بیمار نیز برطرف می شود  
در آزمایشات بعدی کراتینین در حال کاهش است

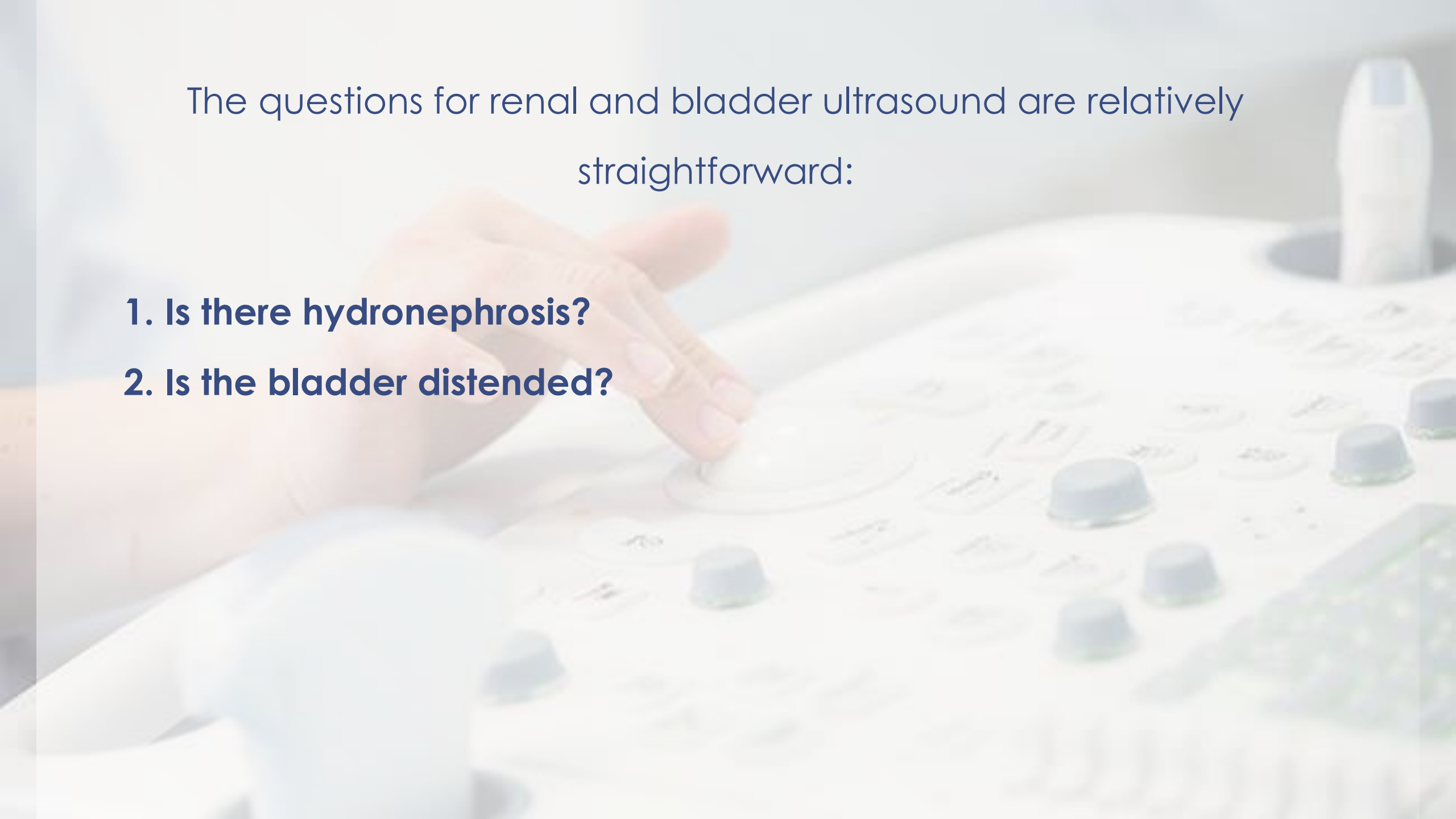


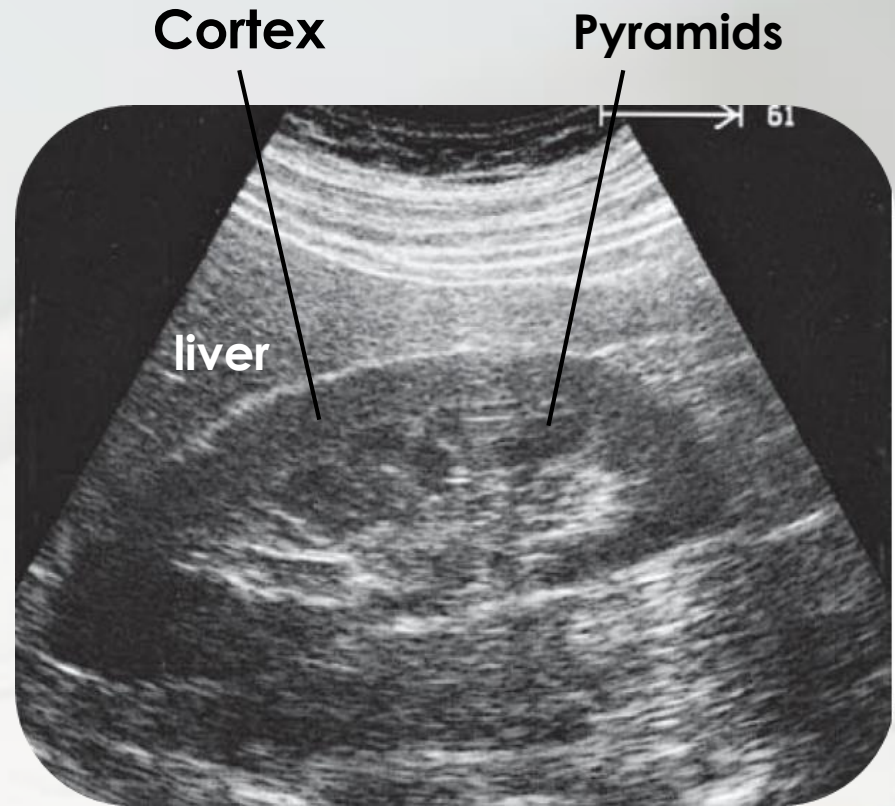
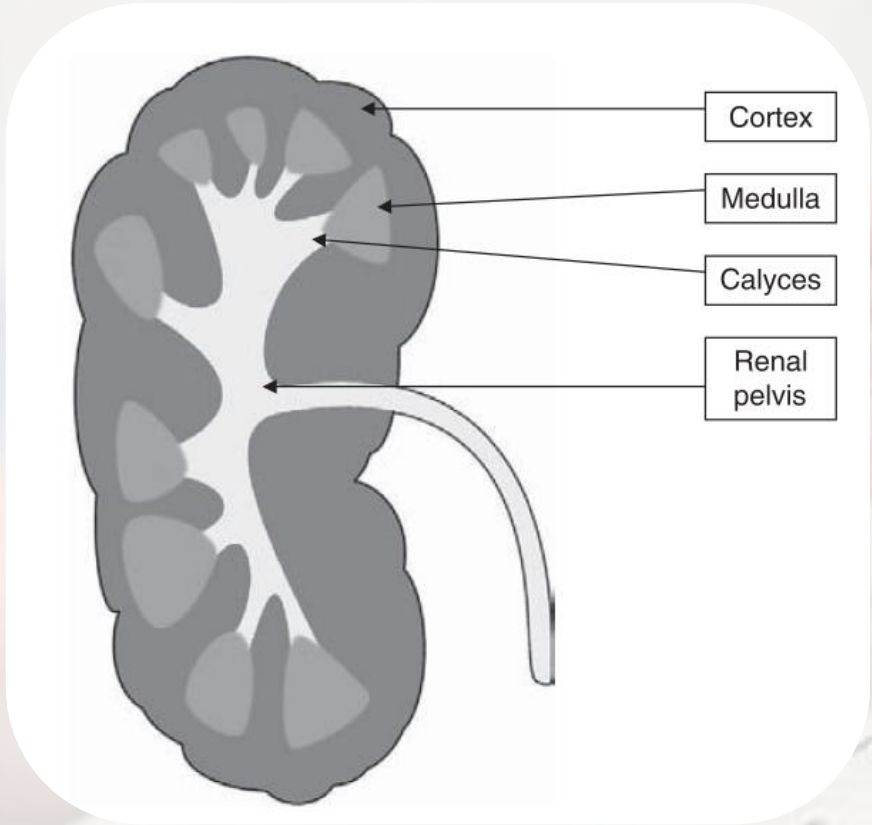
# Point of care Renal Ultrasonography

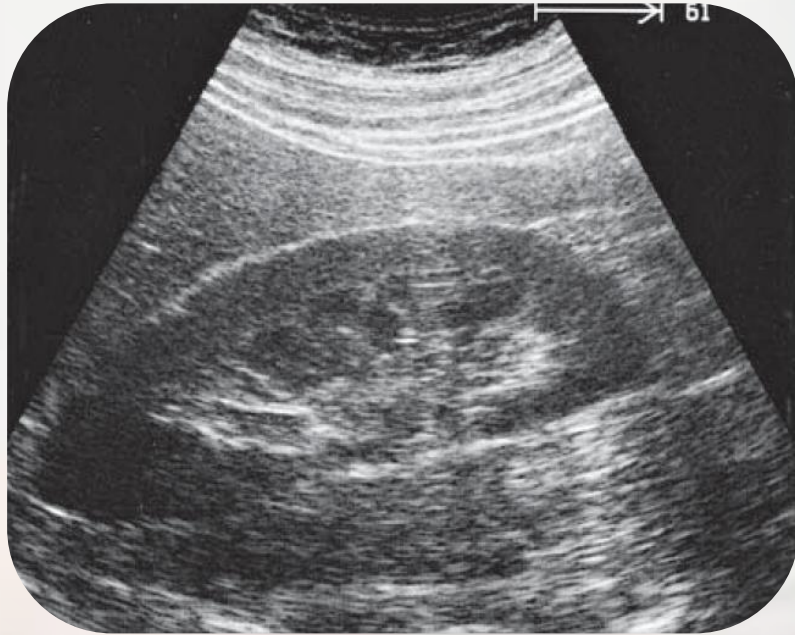


The questions for renal and bladder ultrasound are relatively straightforward:

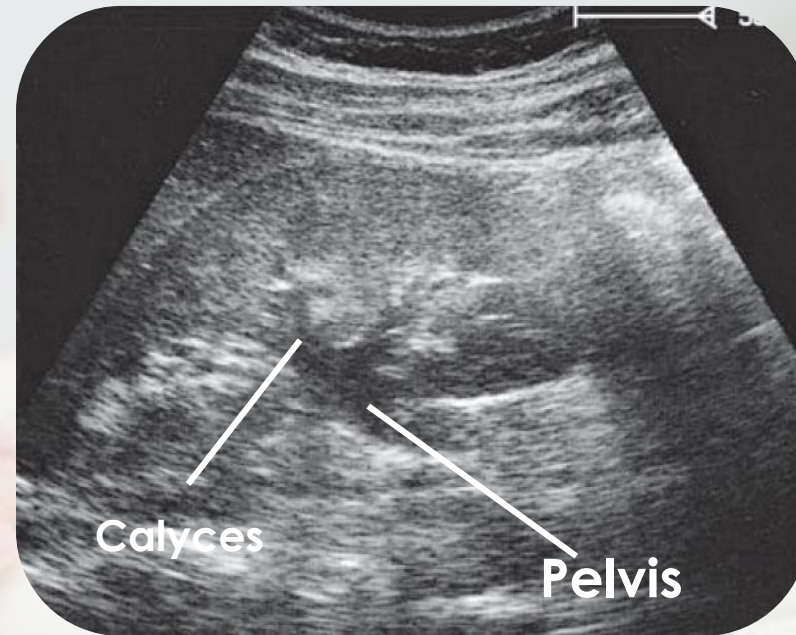
- 1. Is there hydronephrosis?**
- 2. Is the bladder distended?**





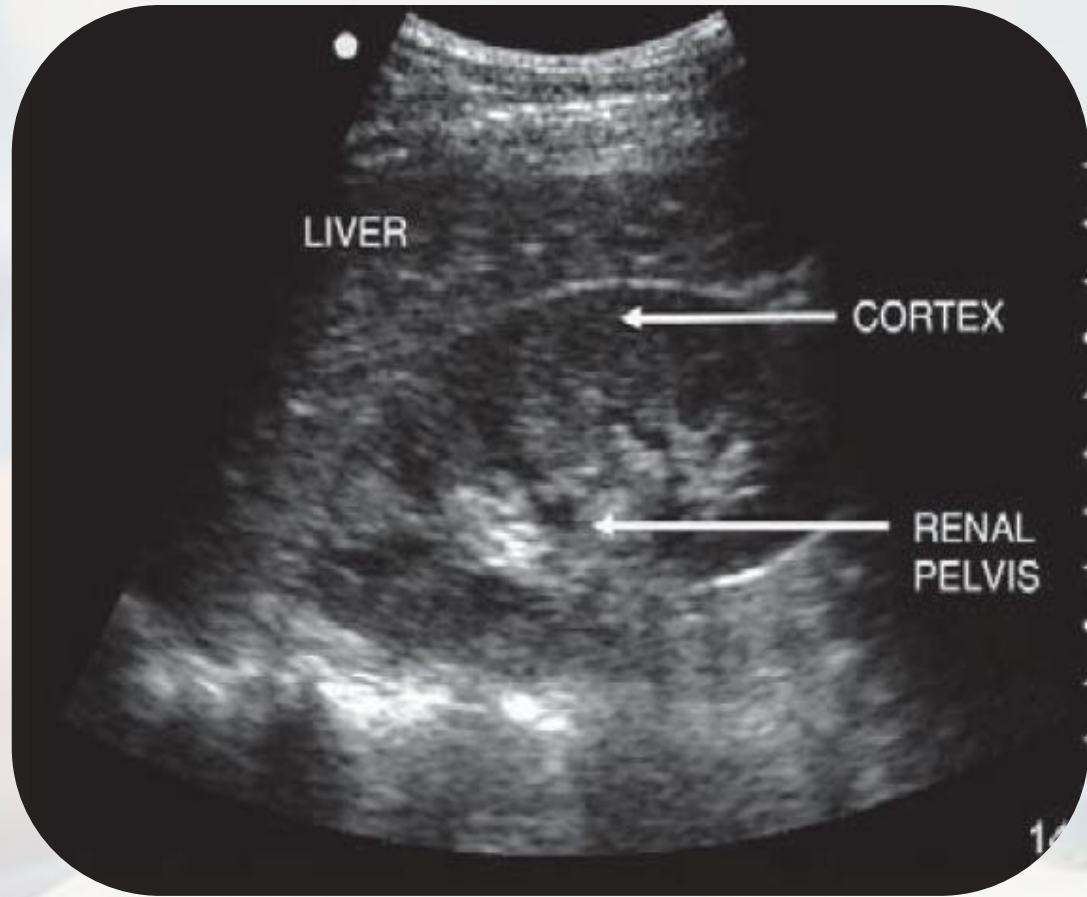


**Medullary pyramids**



**Collecting system**





# Technique

- **Probe selection**

Curvilinear/ Phased array

- **Views**

longitudinal

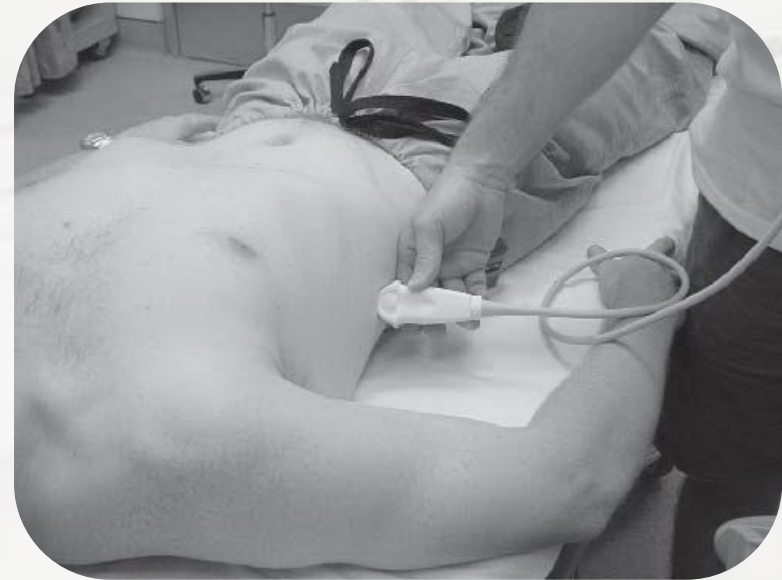
Transverse



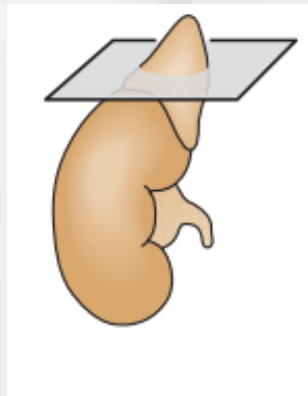
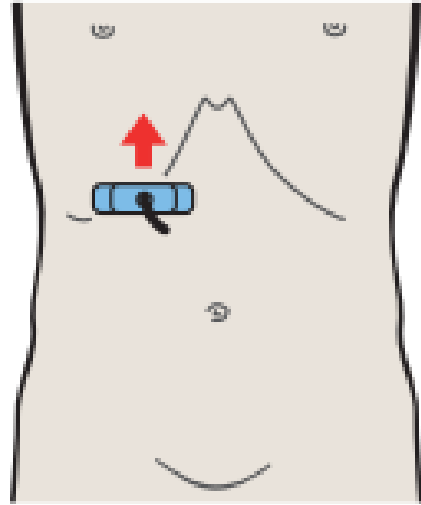
# Patient Position

The patient will lie **supine**

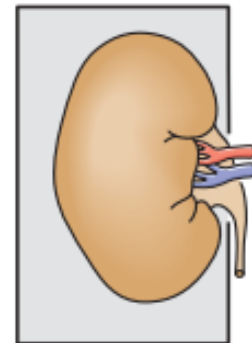
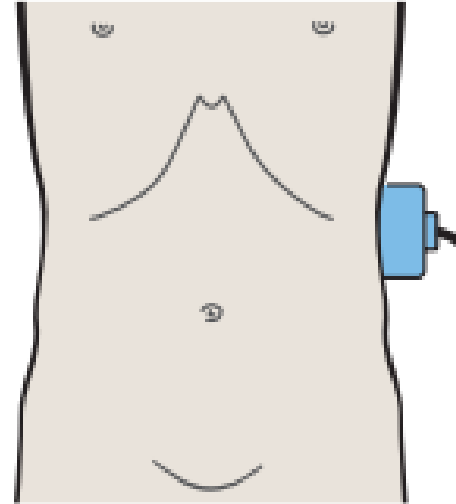
Place the machine on the patient's **right side** so you can scan with your right hand and manipulate ultrasound buttons with your left hand



## Transverse position of probe



## Longitudinal position of probe







**Transverse view of kidney**



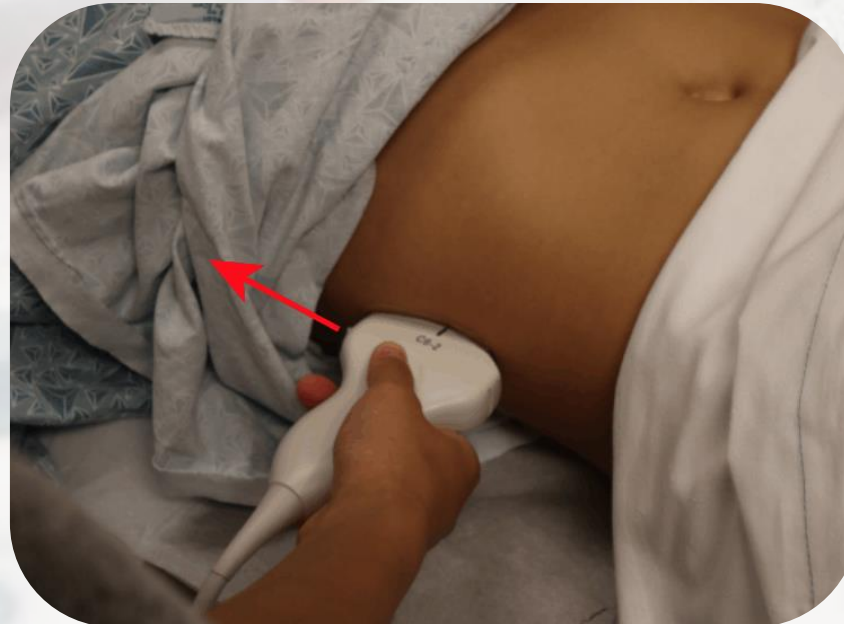
**Longitudinal view of kidney**

## In Longitudinal view

Place your probe at the **Right Midaxillary Line** around the 10th to 11th intercostal space for Right kidney

**Posterior axillary Line** around the **8th to 10th intercostal space** for left kidney

Point the probe indicator **towards the patient's head**



**Right kidney in Midaxillary line**

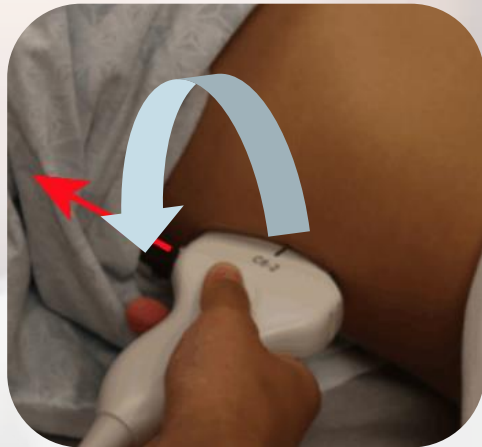


**Left Kidney in Posterior axillary line**

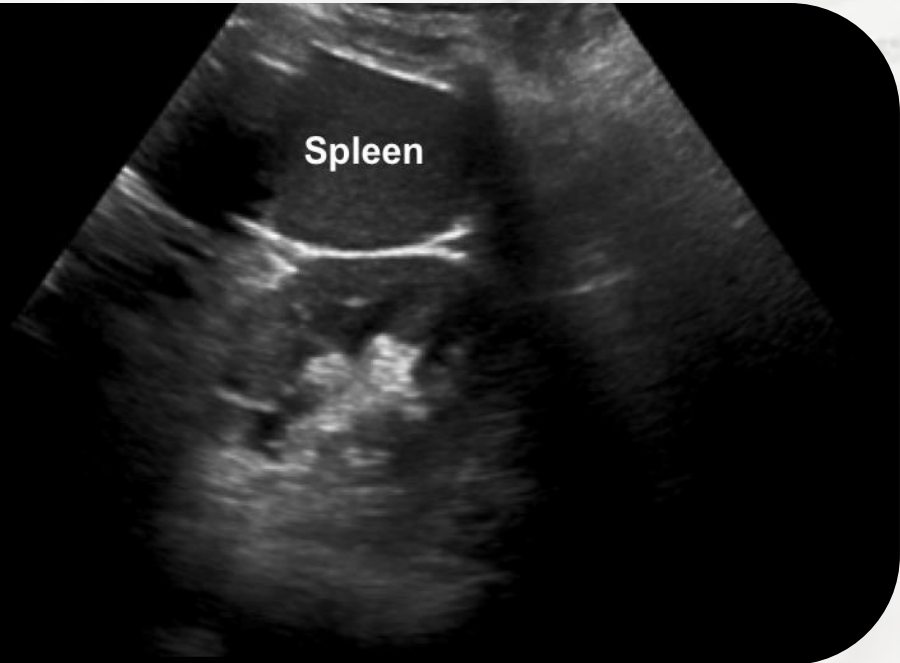
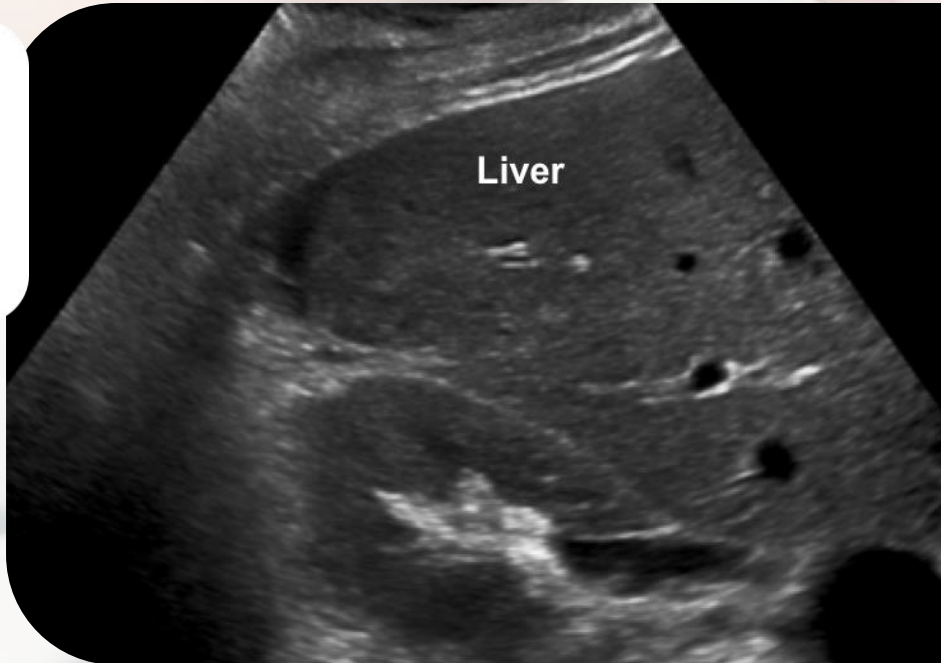
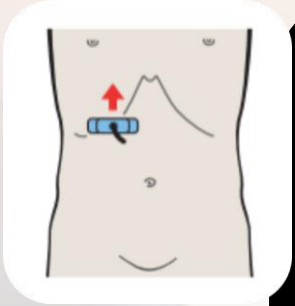
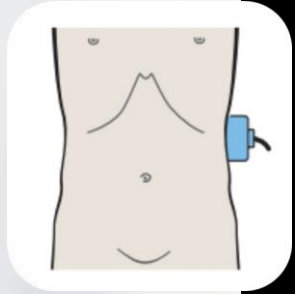


## In Transverse view

Maintaining the longitudinal view of the kidney, center the kidney on your screen, and then **rotate your probe 90 degrees**

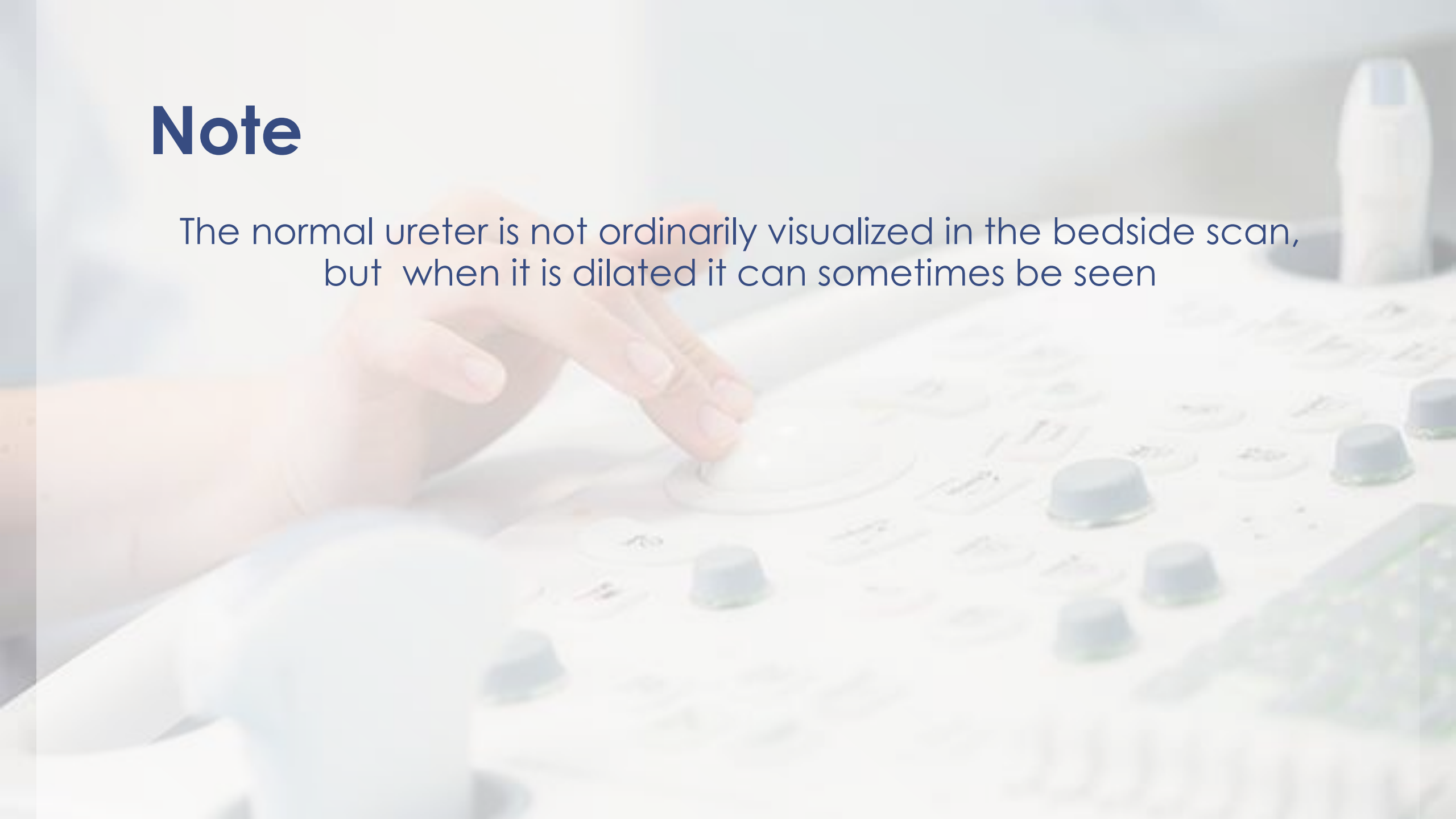






# Note

The normal ureter is not ordinarily visualized in the bedside scan, but when it is dilated it can sometimes be seen



**Is there hydronephrosis?**





Normal Kidney



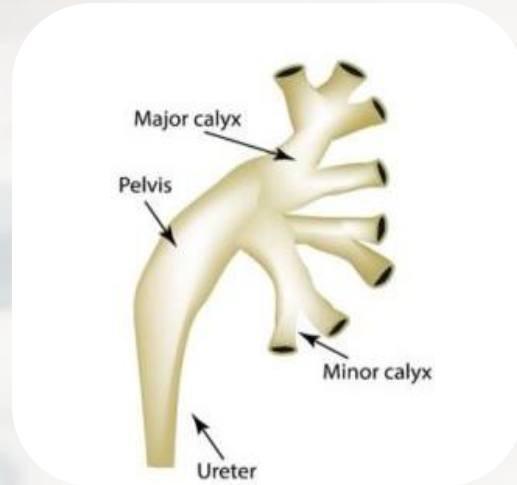
Mild Hydronephrosis



Moderate Hydronephrosis



Severe Hydronephrosis







**Grades of hydronephrosis**



## *Mild hydronephrosis*

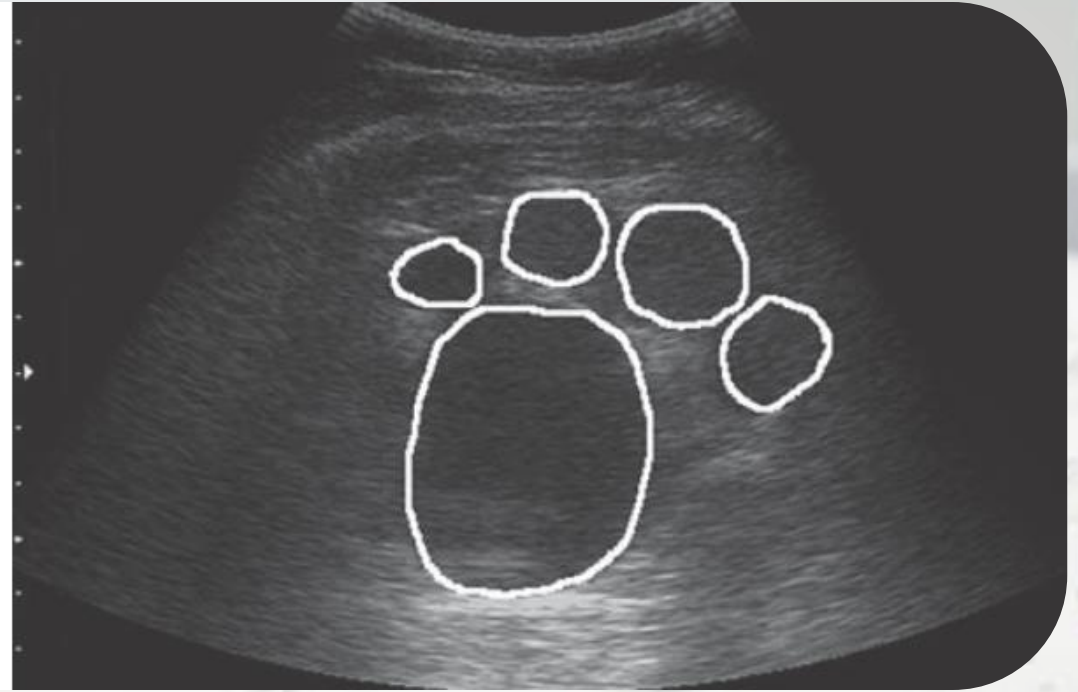
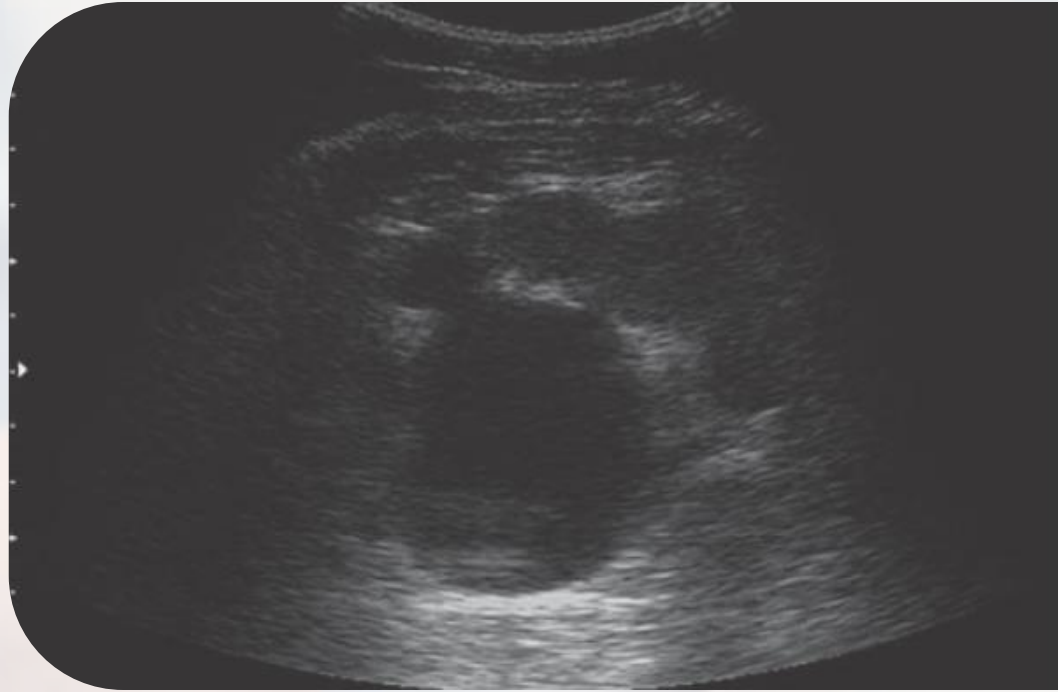
There is **dilatation of the renal pelvis** and **calyces** but the pelvicalyceal pattern is retained and the cortex remains unaffected.



### *Moderate hydronephrosis*

**Medullary pyramids start to flatten** due to back pressure in addition to dilatation of pelvicalyceal system and **outpouching of the calyces**, which is sometimes referred to as 'cauliflower appearance'

Cortical thickness is preserved



**Sever hydronephrosis**  
**Note the central lucency reminiscent of a bear's paw**





### ***Severe hydronephrosis***

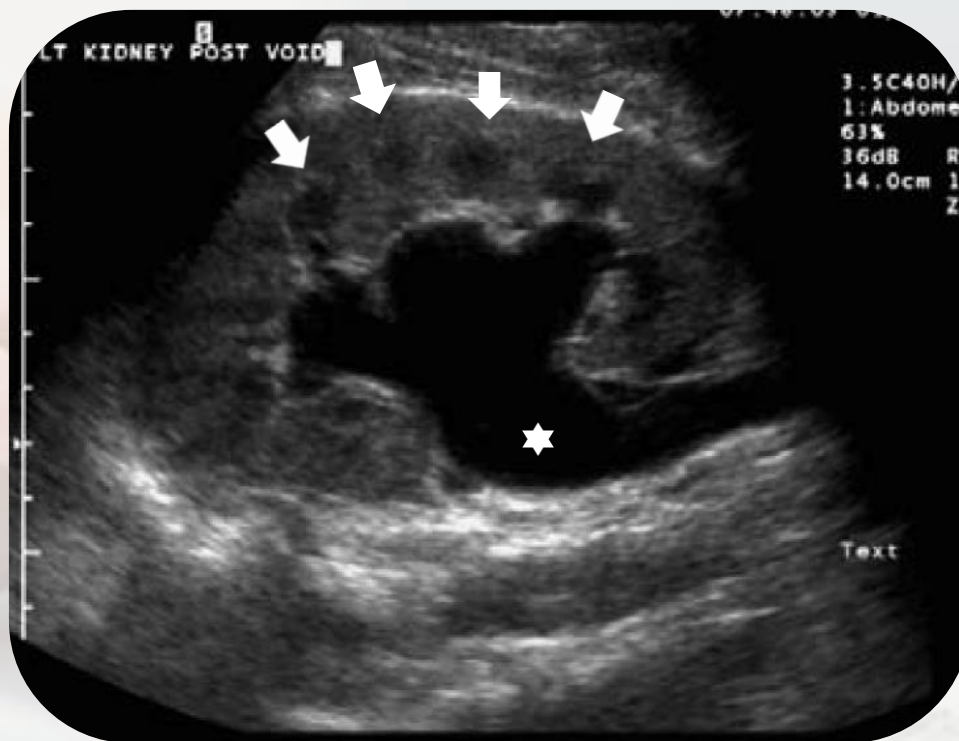
Renal pelvis and calyces appear **ballooned** and cortico-medullary differentiation is lost, making the cortex thin

The kidney looks like a fluid filled bag

Pyramids



Renal Pelvis



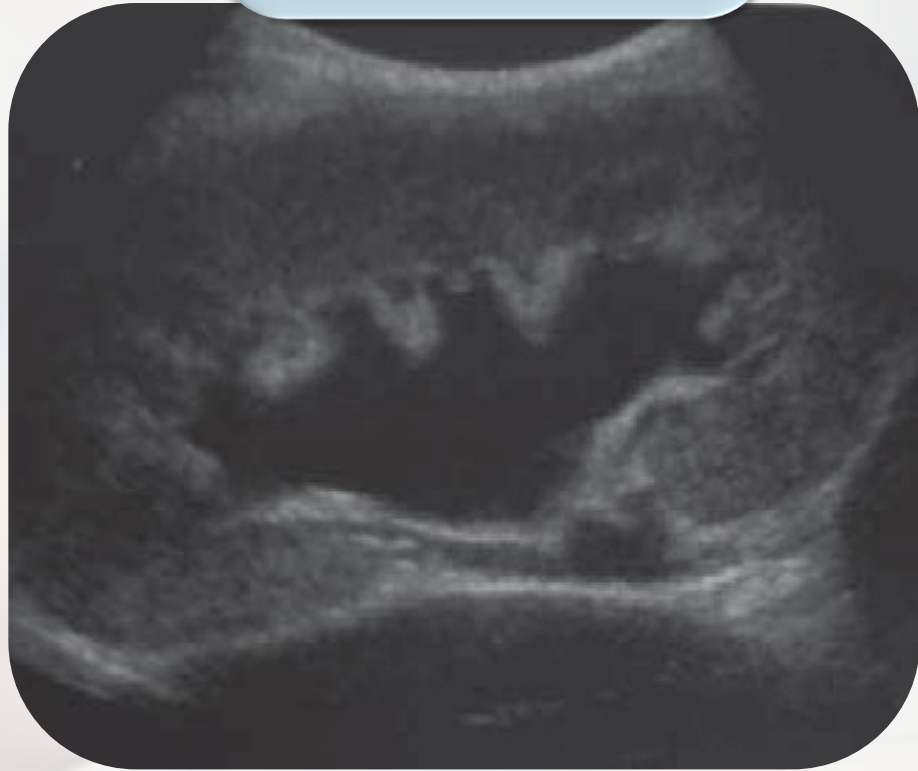
Severe hydronephrosis



Dilatation of the **renal calyces**

**Renal pelvis** with increased renal size was observed

Longitudinal View

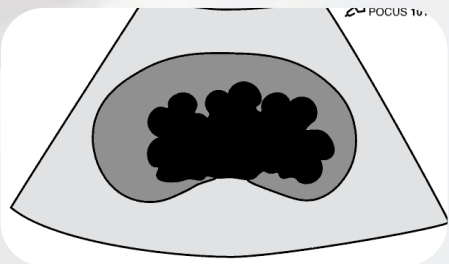
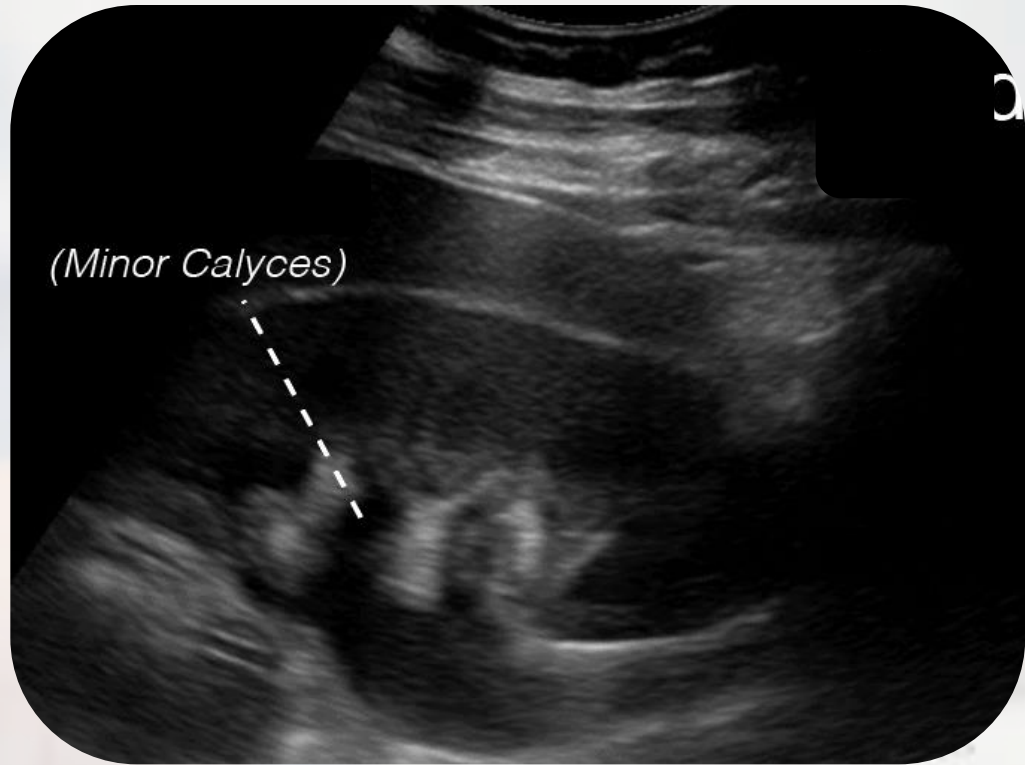


Transverse View

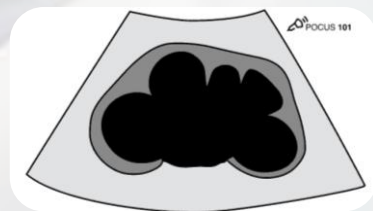
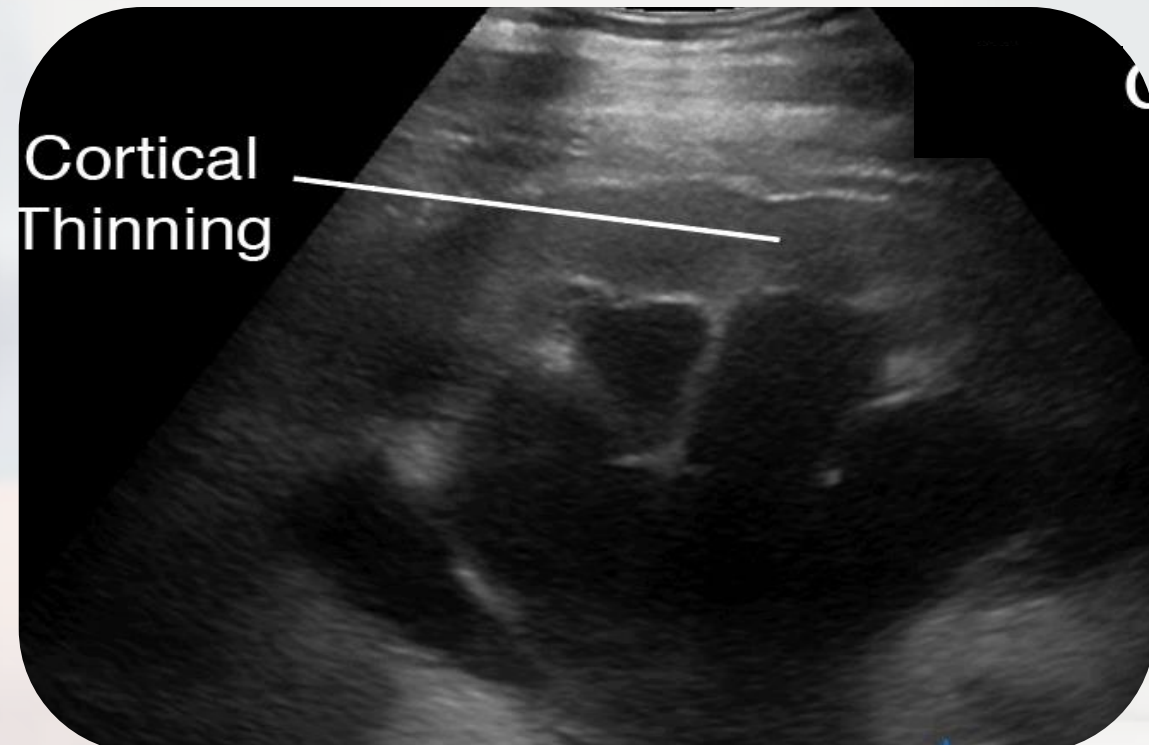


Longitudinal and transverse views of the kidney with **moderate hydronephrosis**

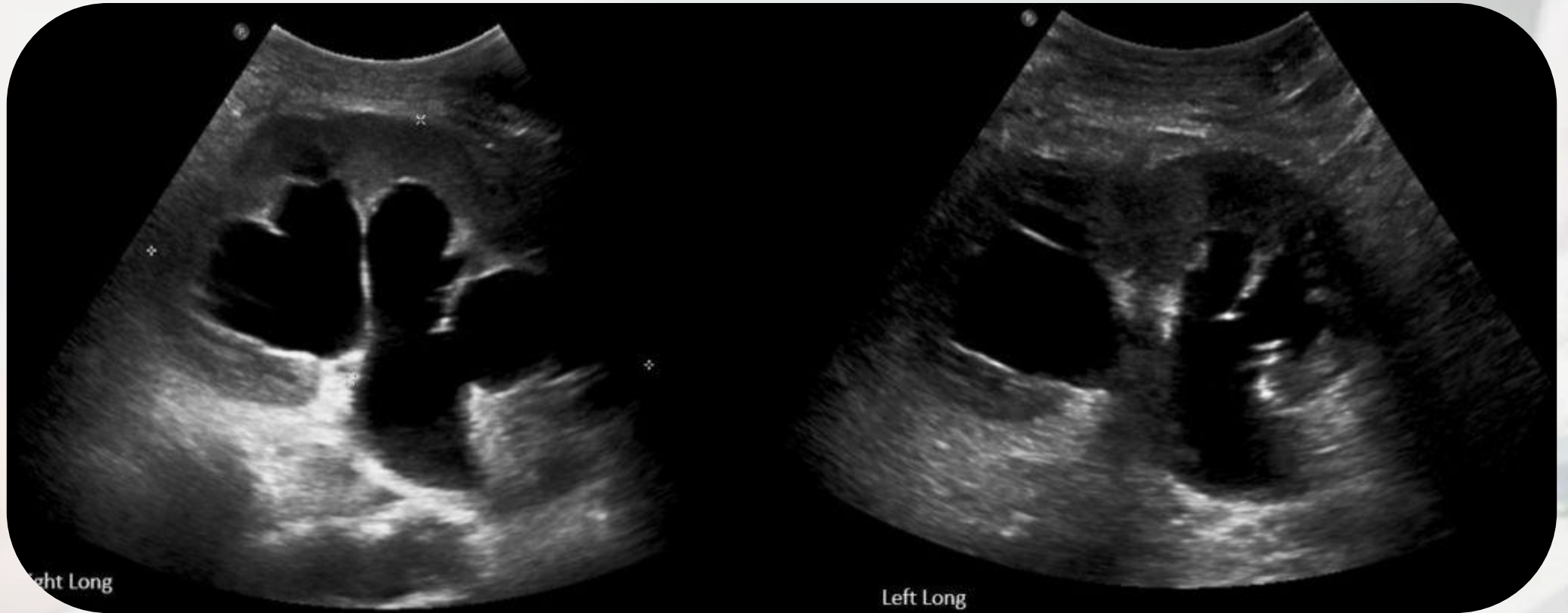




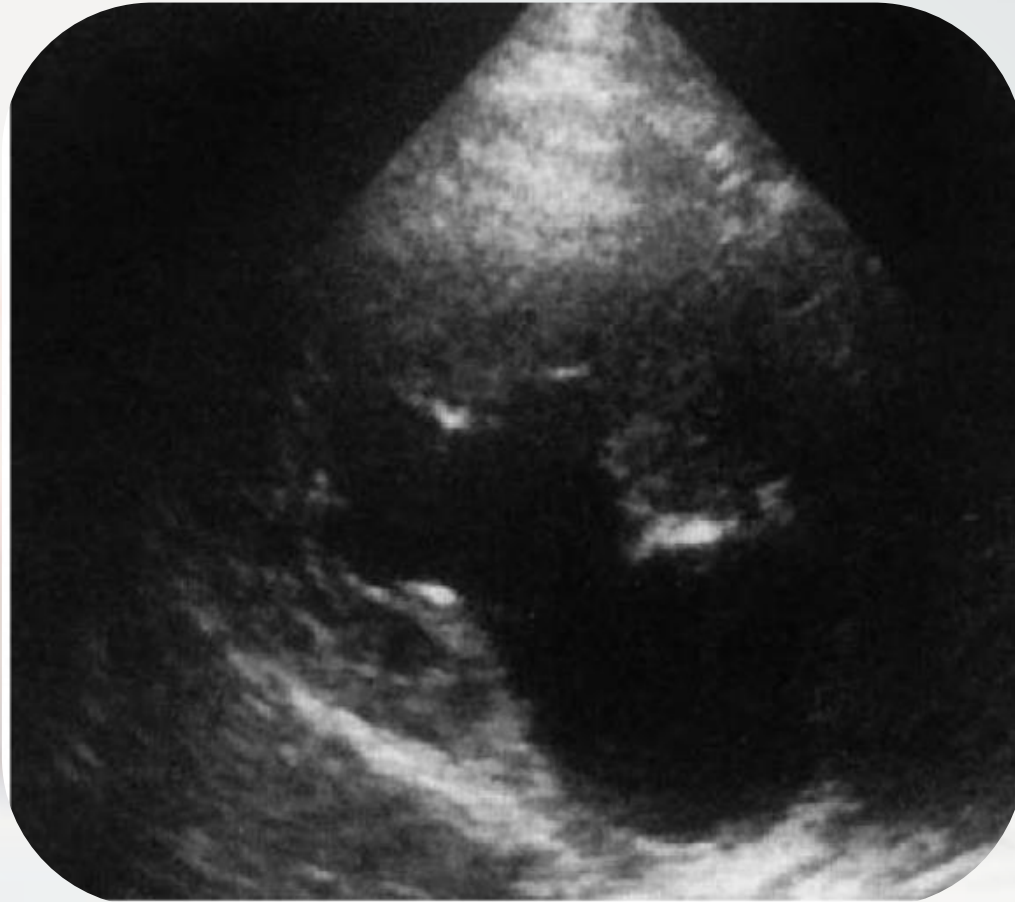
**Moderate hydronephrosis**



Severe hydronephrosis



**Bilateral severe hydronephrosis in a patient with cervical cancer**



**A very dilated proximal ureter and renal pelvis**



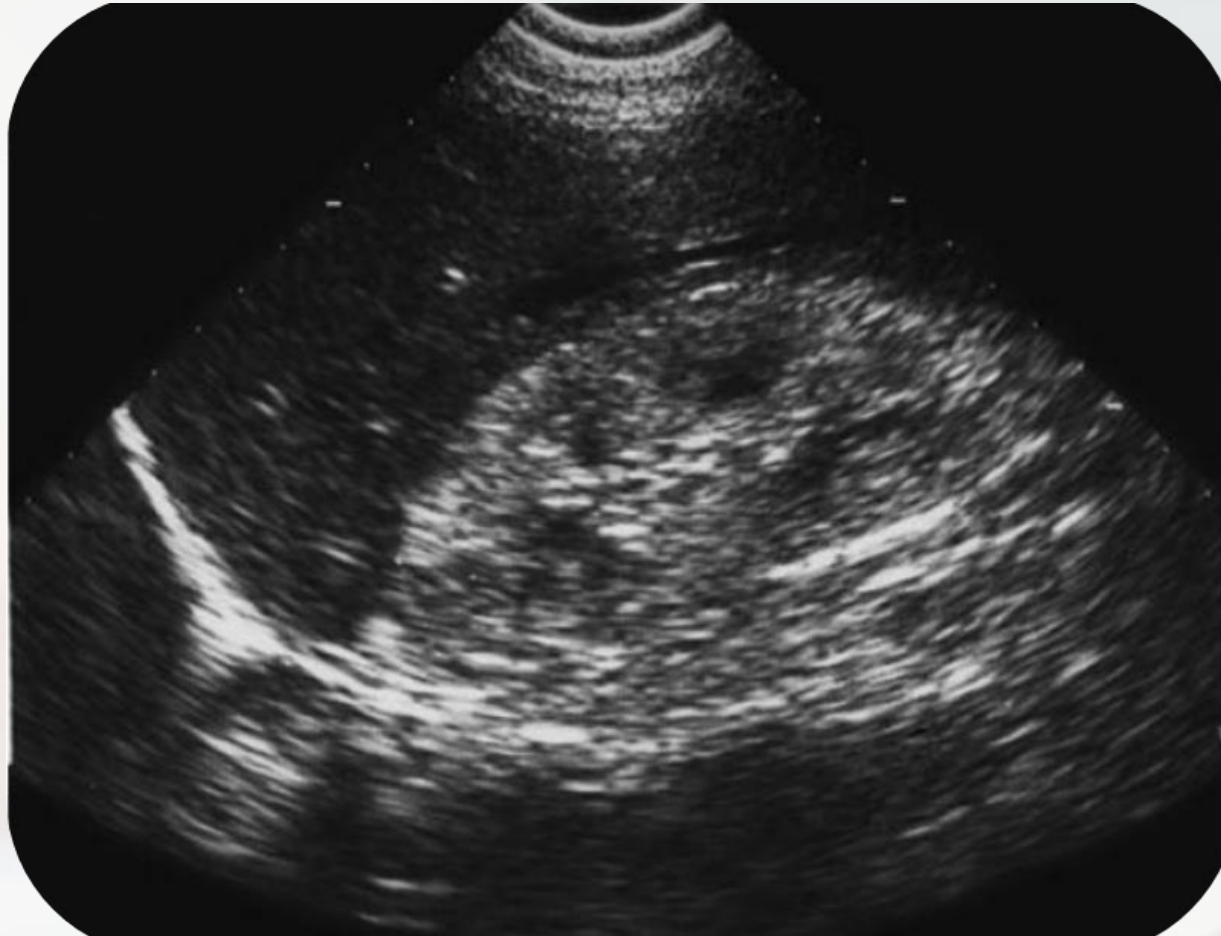
**Note**



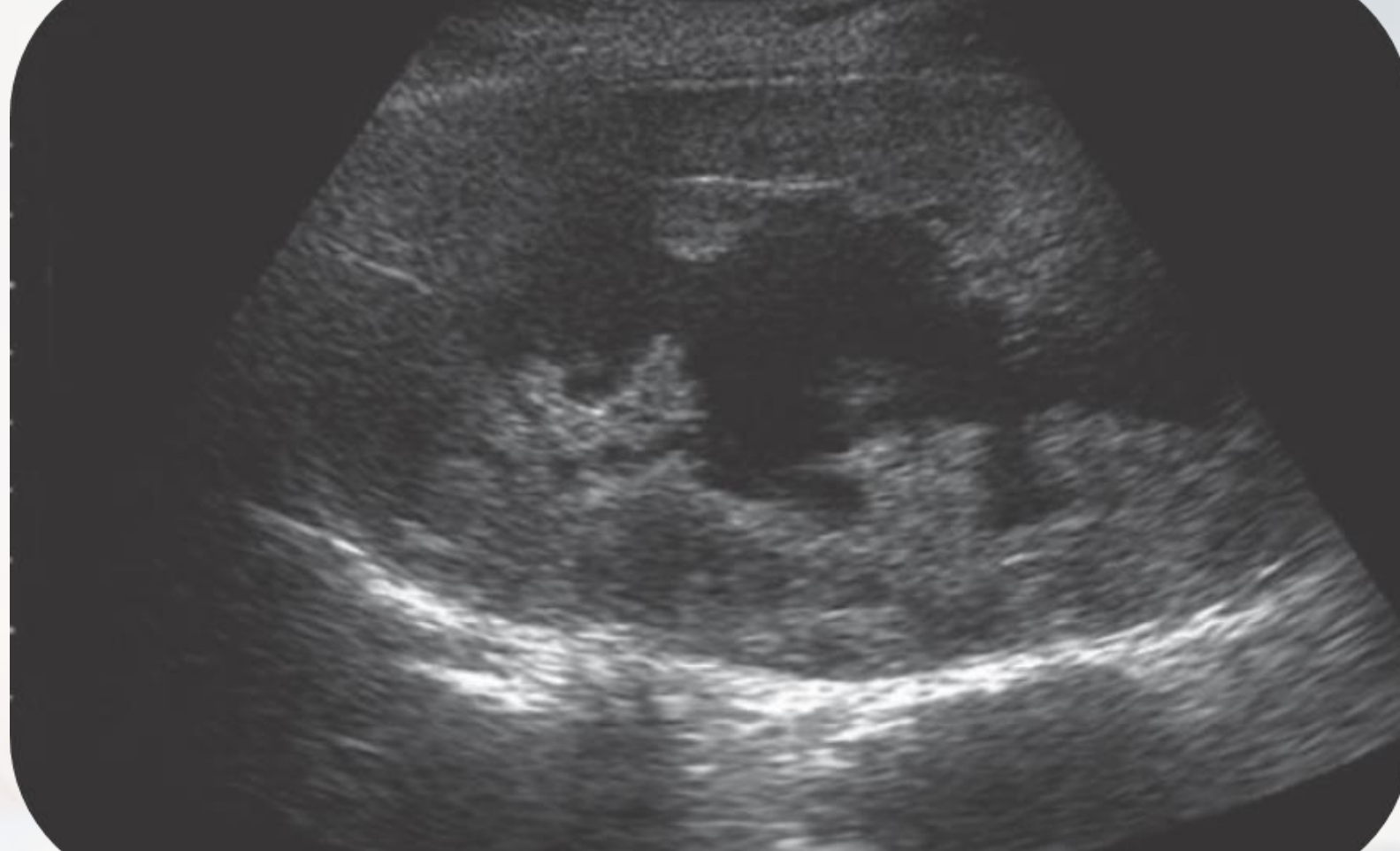
**Polycystic kidney disease**

# Abnormal images

A close-up, slightly blurred photograph of a person's hand operating the control panel of an ultrasound machine. The hand is positioned over a large, circular trackball. The control panel is white and features numerous buttons, knobs, and a trackball. The background is out of focus, showing a white surface and a vertical probe or handle. The overall lighting is bright and clinical.



Renal disease  
A 52-year-old female on dialysis with  
the brightly echogenic kidney

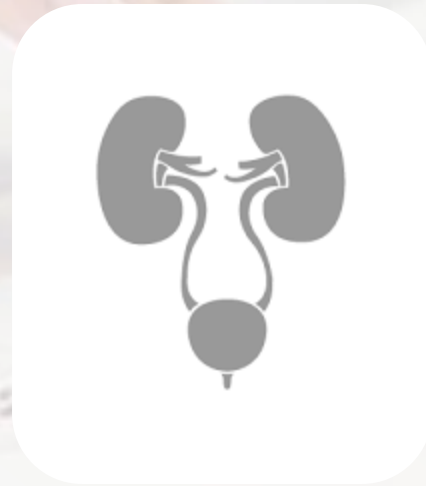


### Renal carcinoma

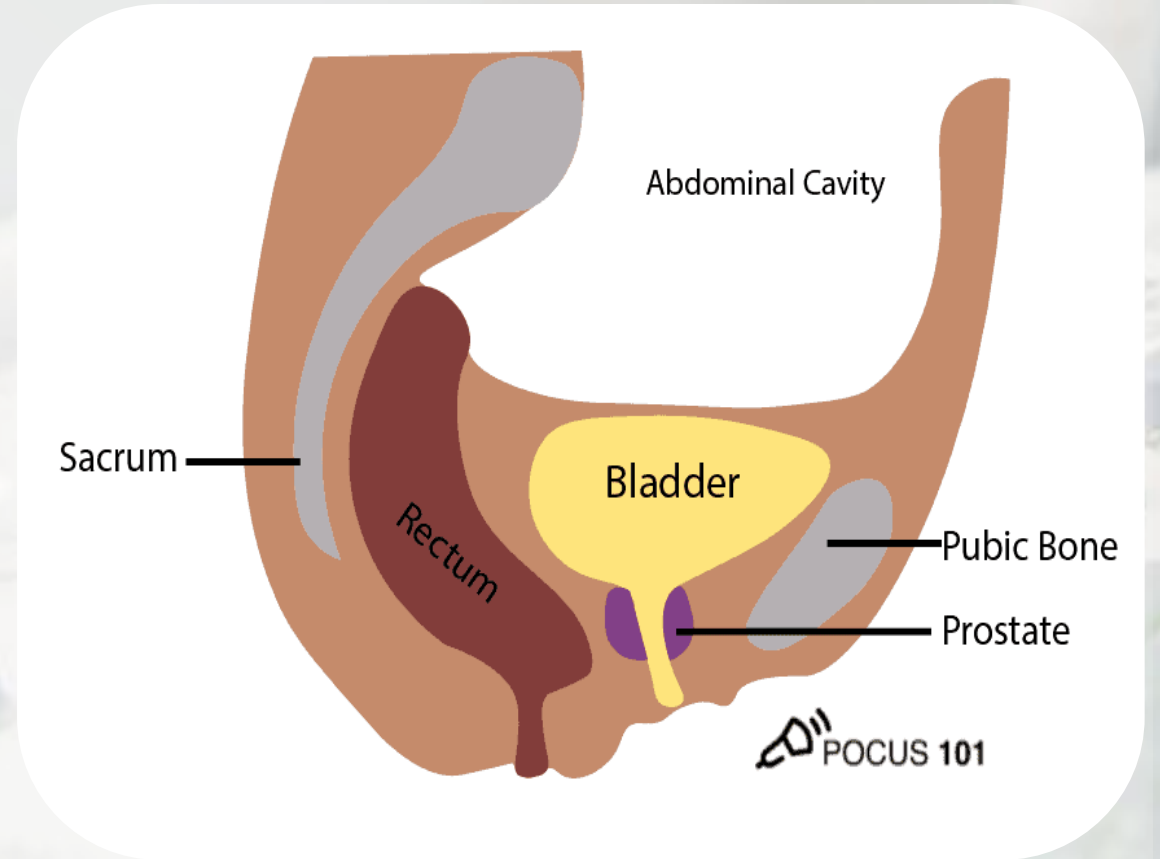
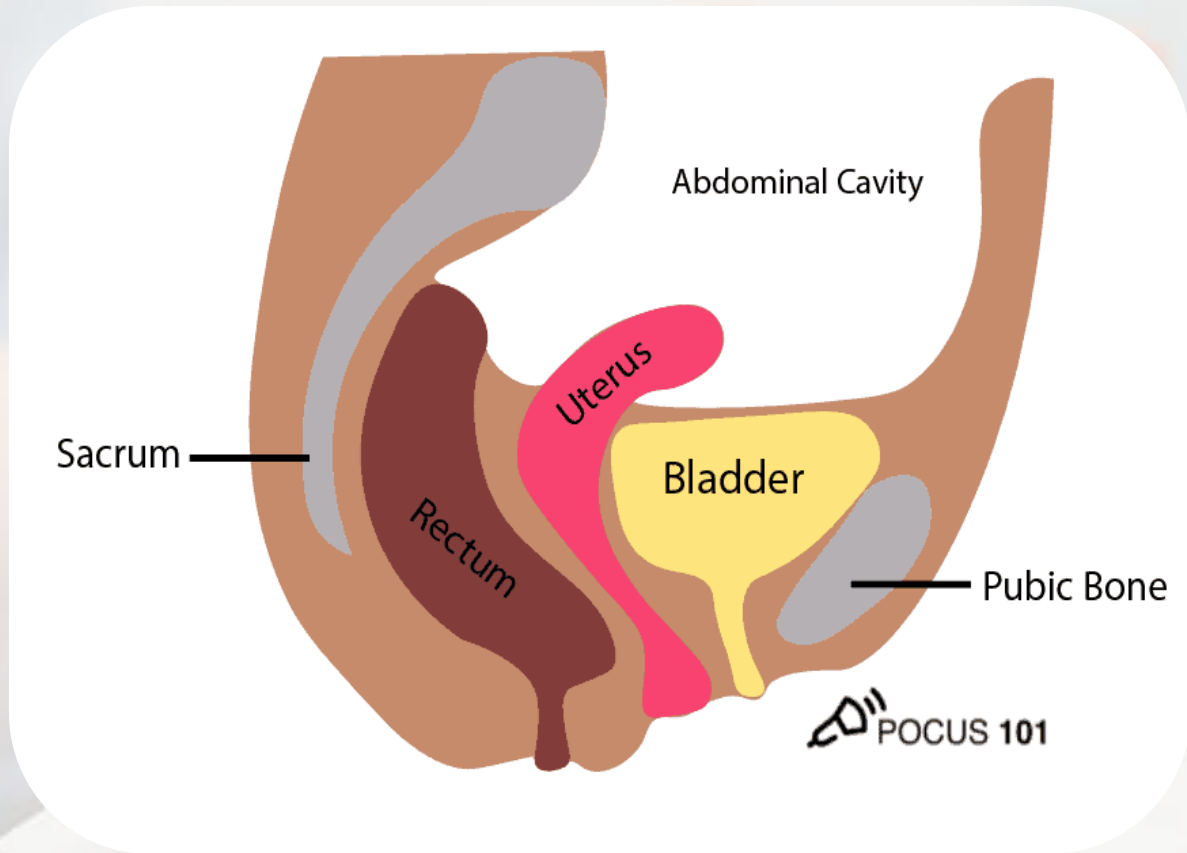
An 83-year-old female presents with mild back pain and hematuria. An ultrasound reveals a massively enlarged left kidney with a large irregular cystic mass



# Bladder on POCUS



# Anatomy



# Technique

- **Probe selection**

Curvilinear/Phased array

- **Views**

longitudinal

Transverse planes



# Patient Position

The patient will lie supine. You may have the patient bend their knees to soften their abdominal wall

Make sure to place a towel or sheet to cover the patient's pelvic area



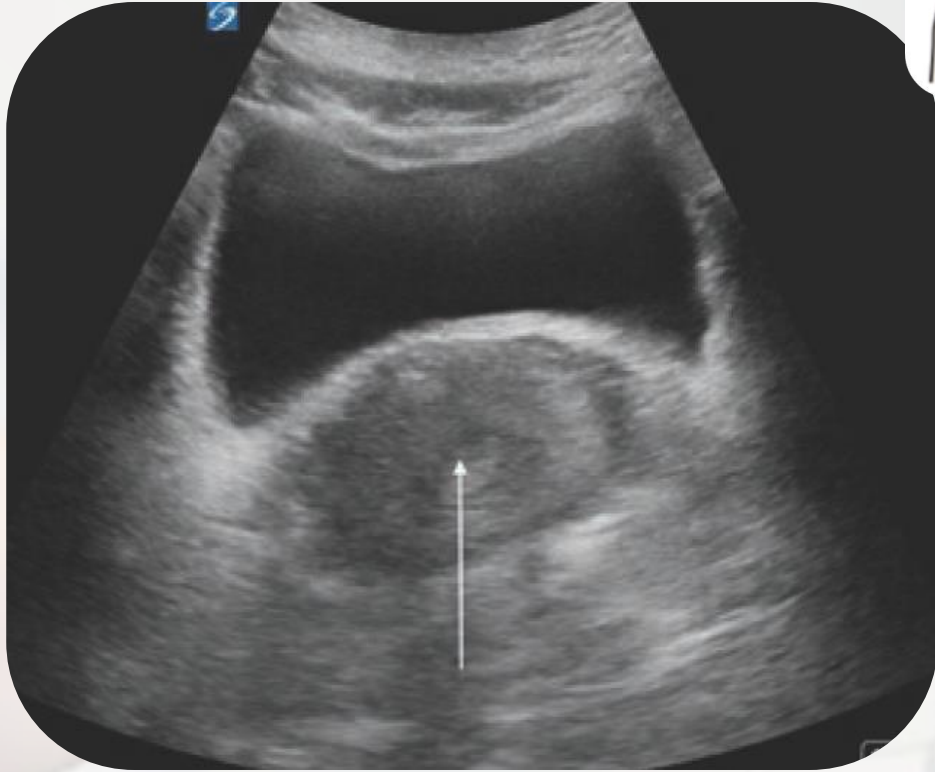
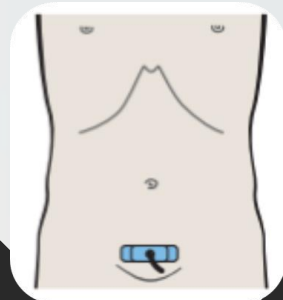




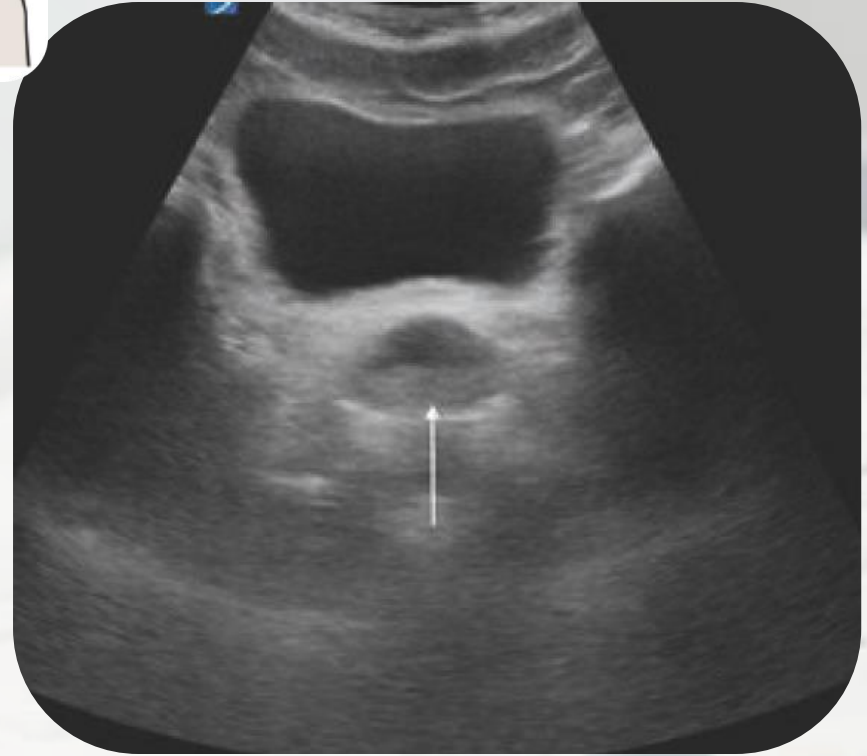
**Longitudinal view of bladder**



**Transverse view of bladder**



**In females, the uterus is located directly posterior to the bladder**



**In males, the prostate is located posterior to the bladder**

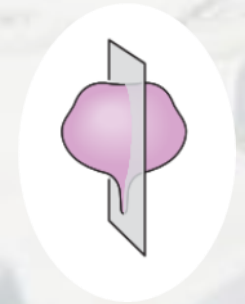
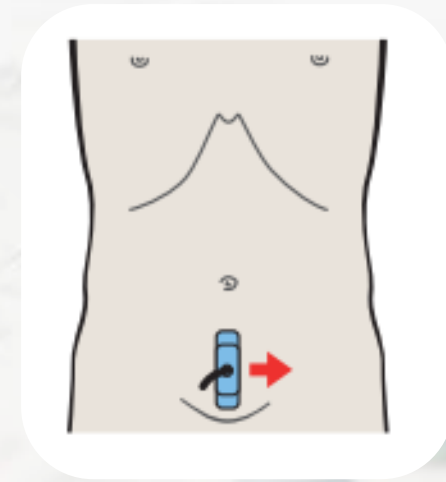
# Longitudinal View

Place the transducer with the **indicator pointing towards the patient's head** in the patient's midline, right **above the pubic symphysis**

Rock the probe so that it **points down towards the pelvic cavity**

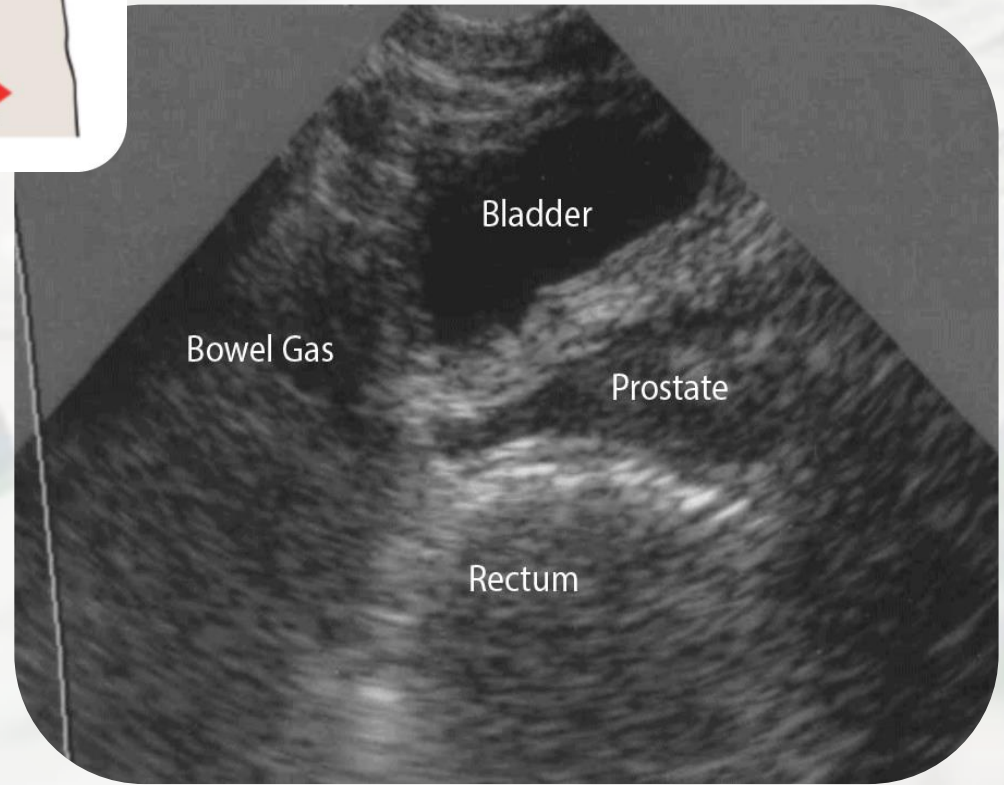
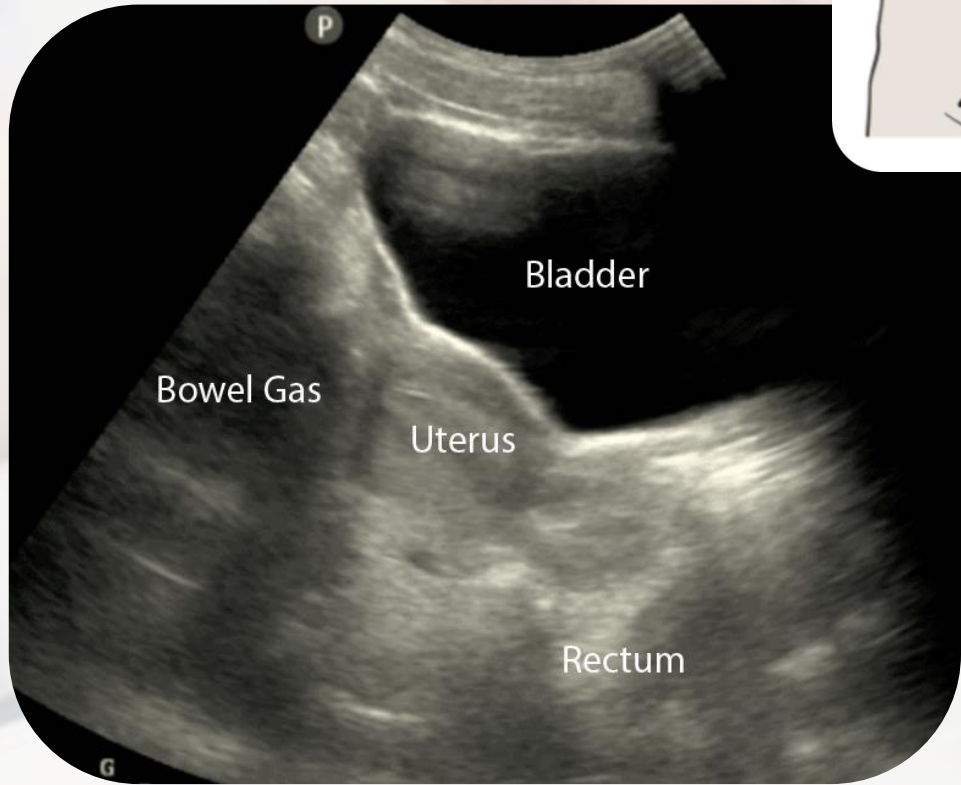
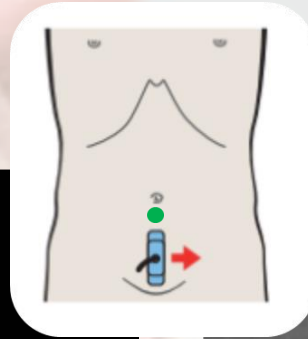


**The full bladder appears in longitudinal section as a triangular structure devoid of internal echoes. The shape varies depending on bladder fullness**





In the **longitudinal view**, identify the **Bladder**, **Bowel Gas**, **Uterus**, **Prostate**, and **Rectum**



# Transverse View

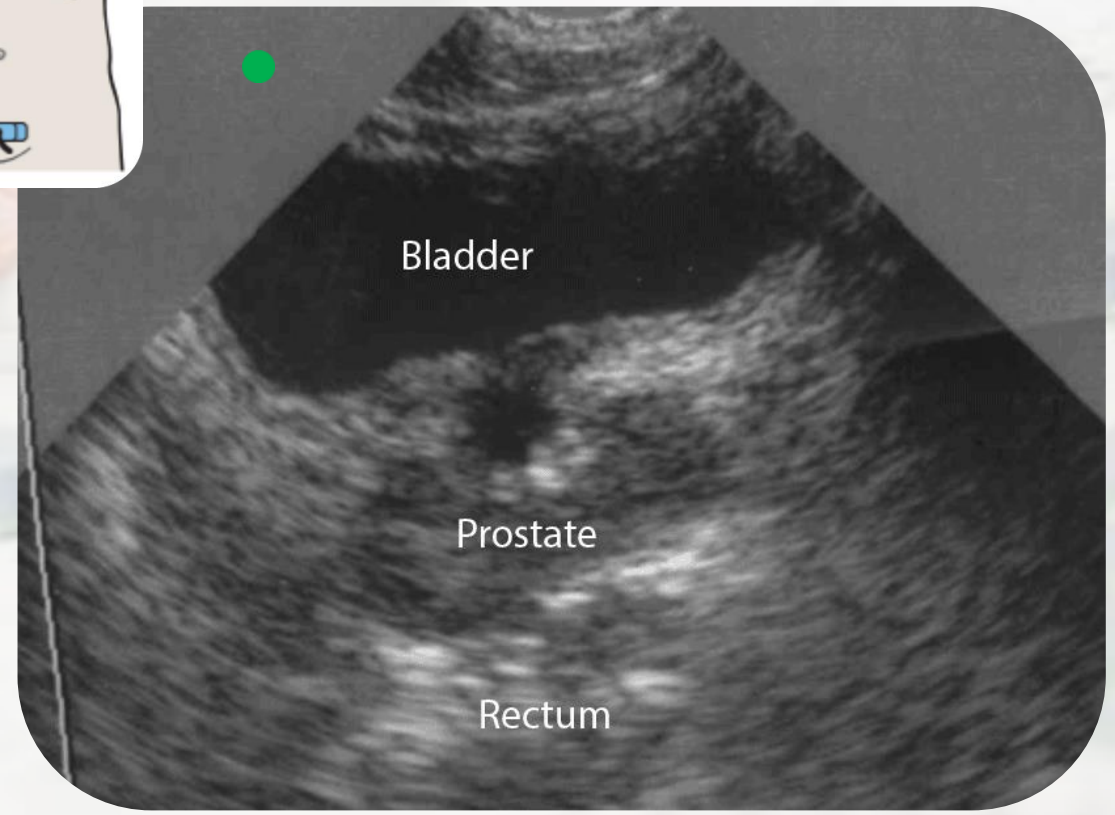
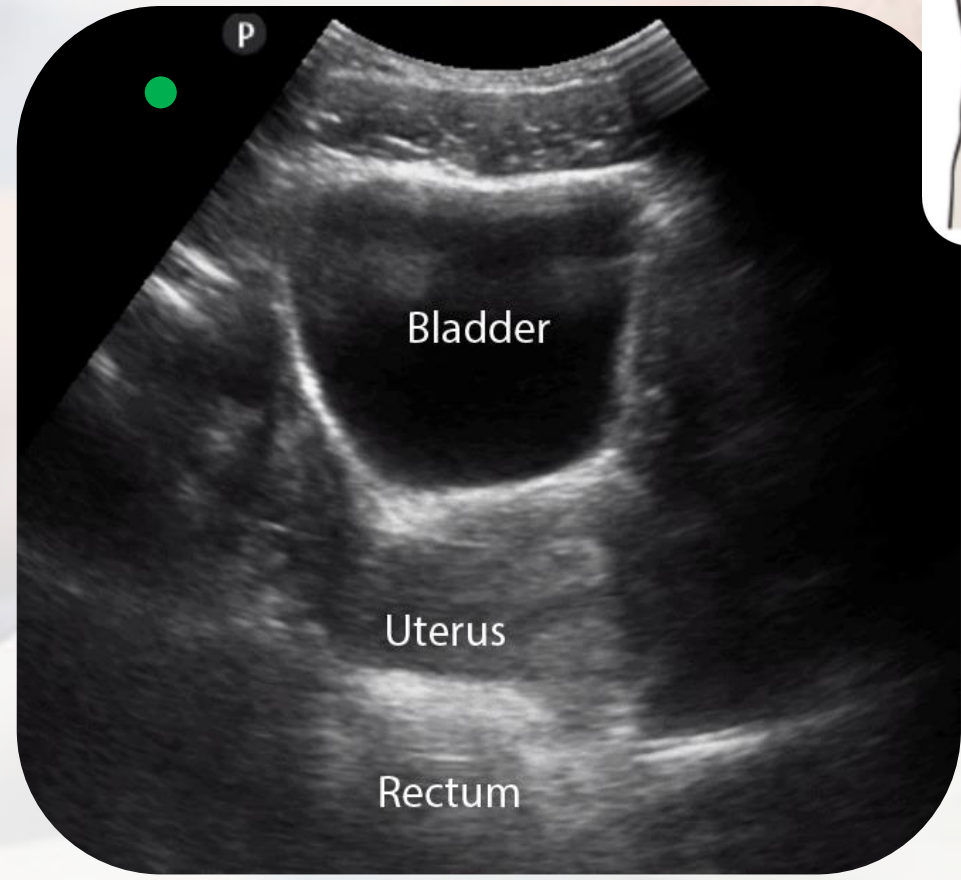
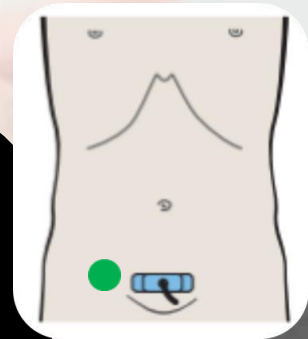
Next, center the bladder and then **rotate the transducer 90 degrees counterclockwise**

The indicator should now point to the patient's Right side

Make sure to tilt the ultrasound probe so it scans into the pelvic cavity

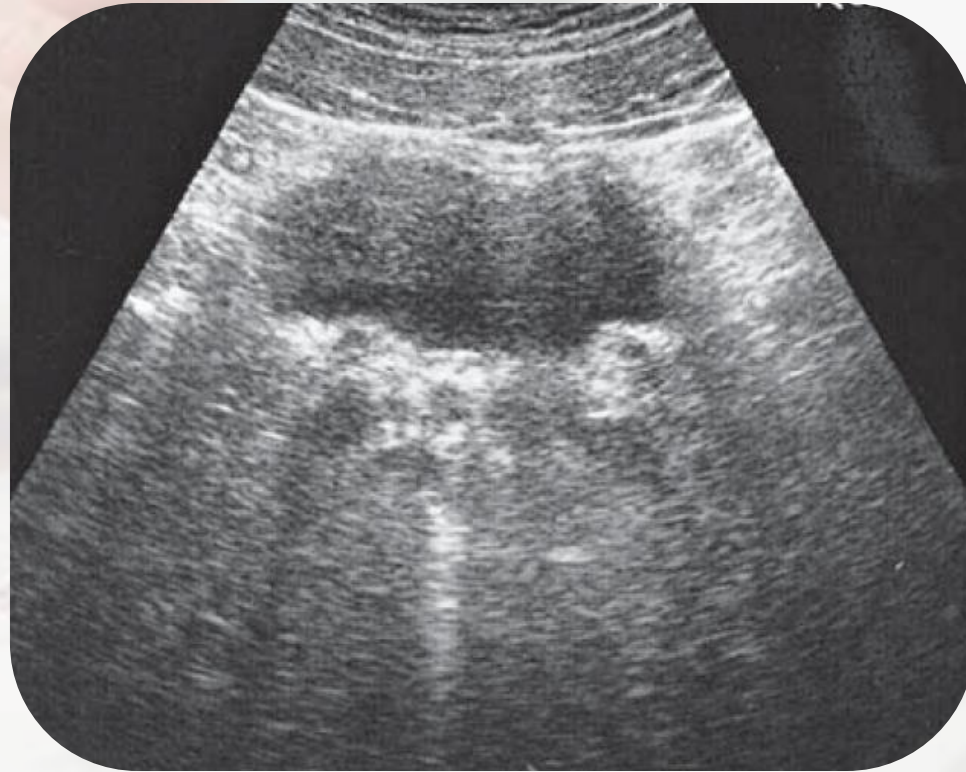
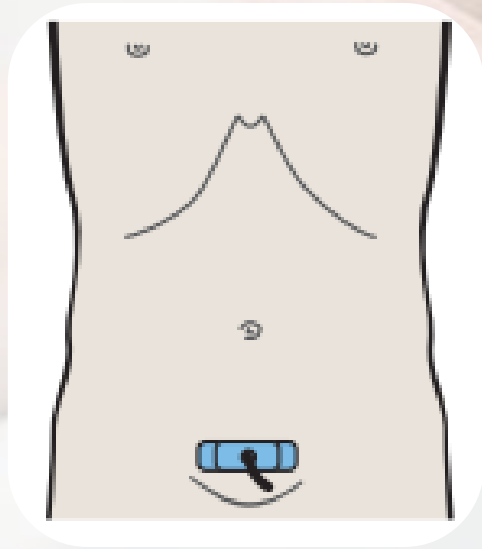


In the **transverse** view, identify the **Bladder**, **Uterus**, **Prostate**, and **Rectum**





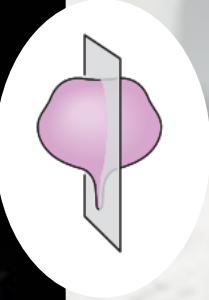
# Transverse view of bladder





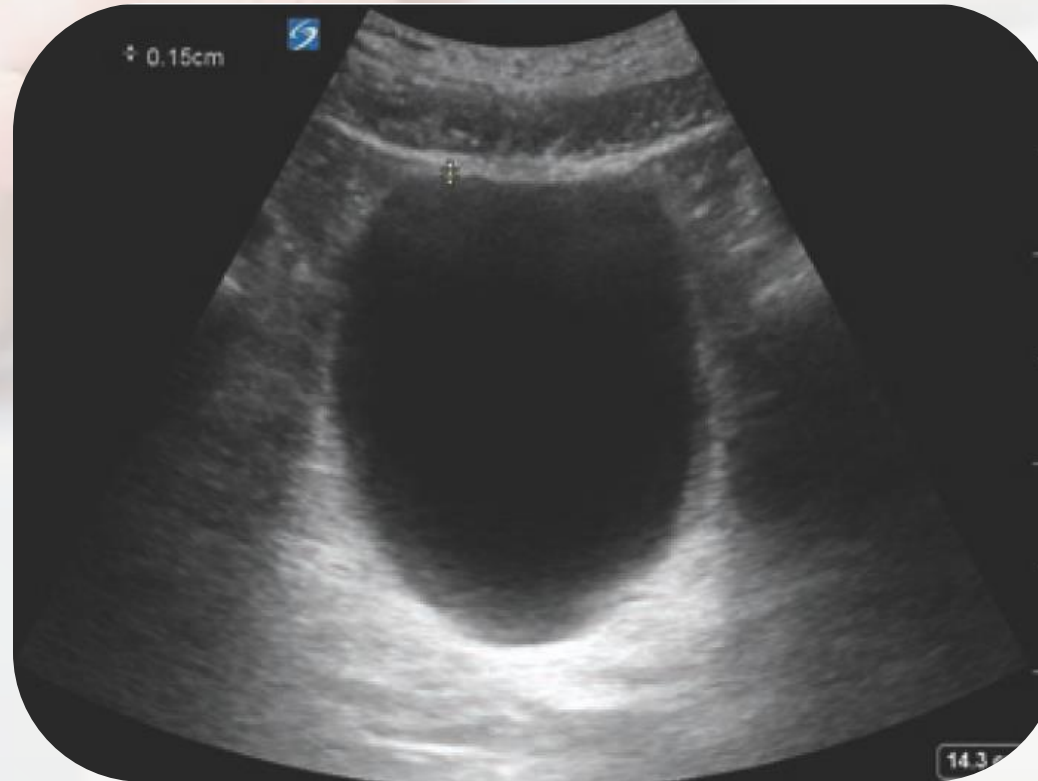


**Transverse view of bladder**



**Longitudinal view of bladder**

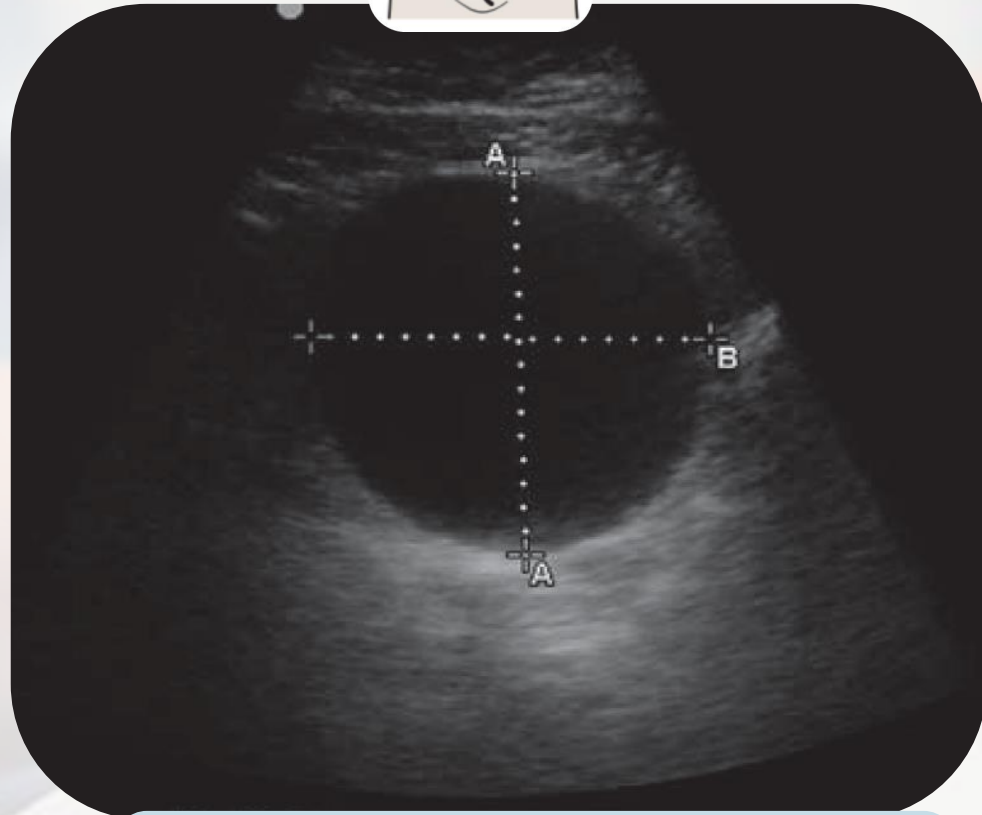
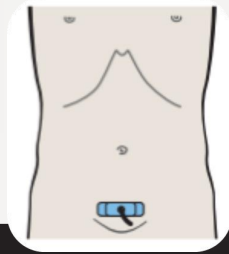
Normal bladder wall thickness is less than **5 mm when empty** and less than **3 mm when full**



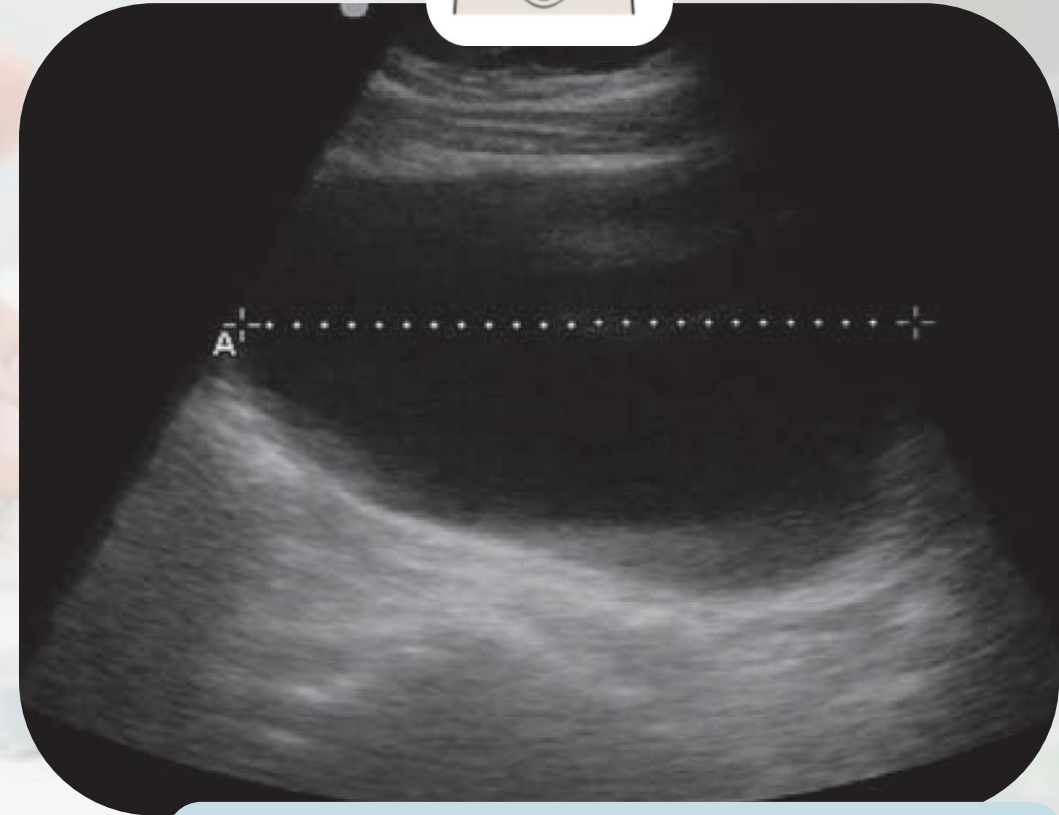
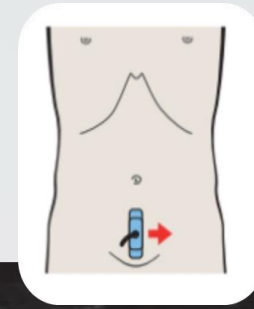
## Bladder volume estimation

$0.75 \times \text{width} \times \text{length} \times \text{height}$

Normal: less than **300-400 mL** in healthy adults



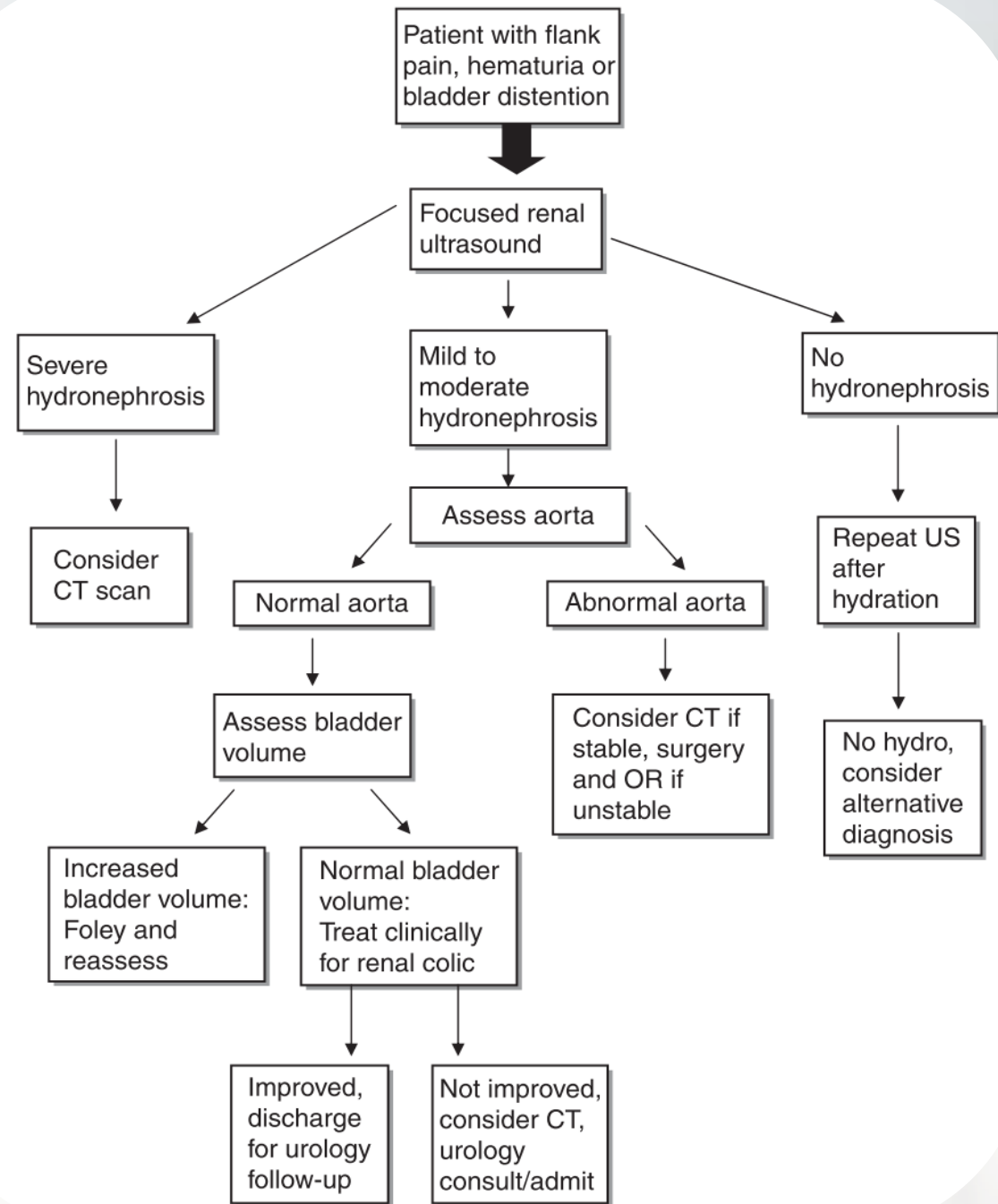
**Measured width and height on transverse view**



**Measured depth on longitudinal view**

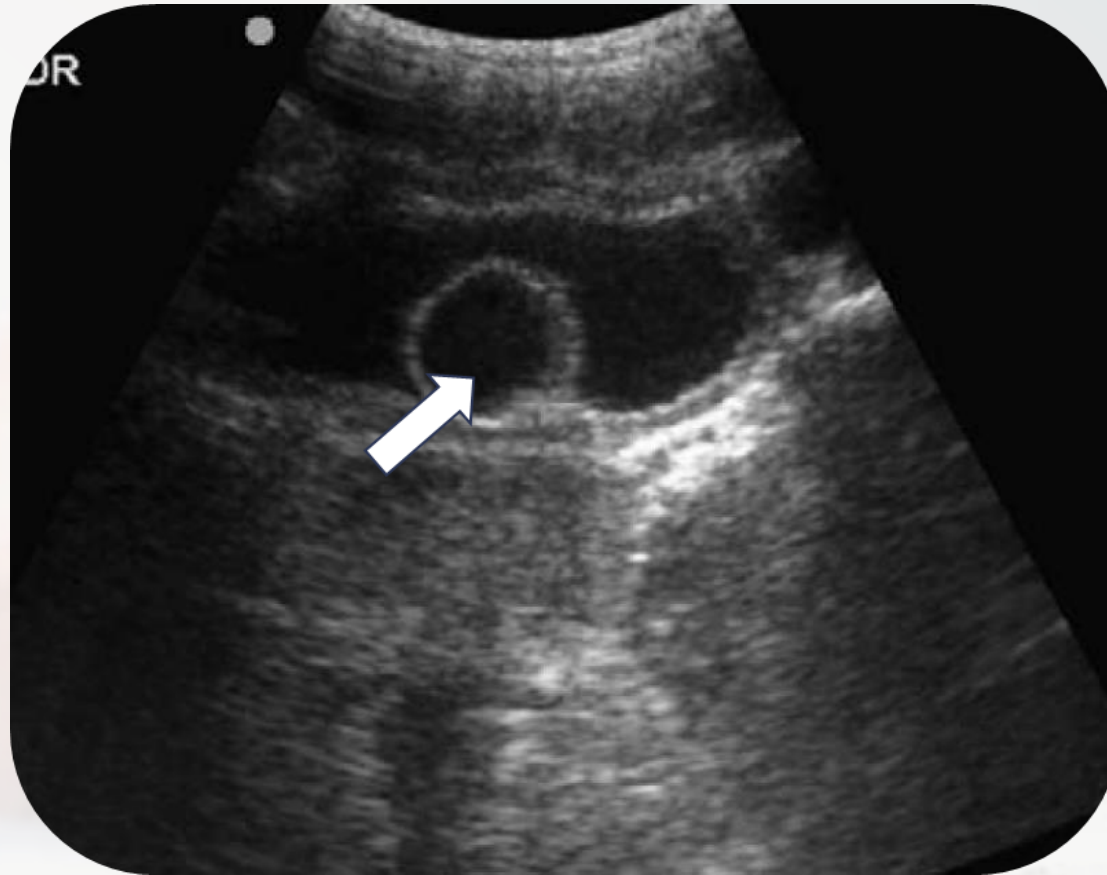


## Clinical protocol for the use of renal and bladder ultrasound

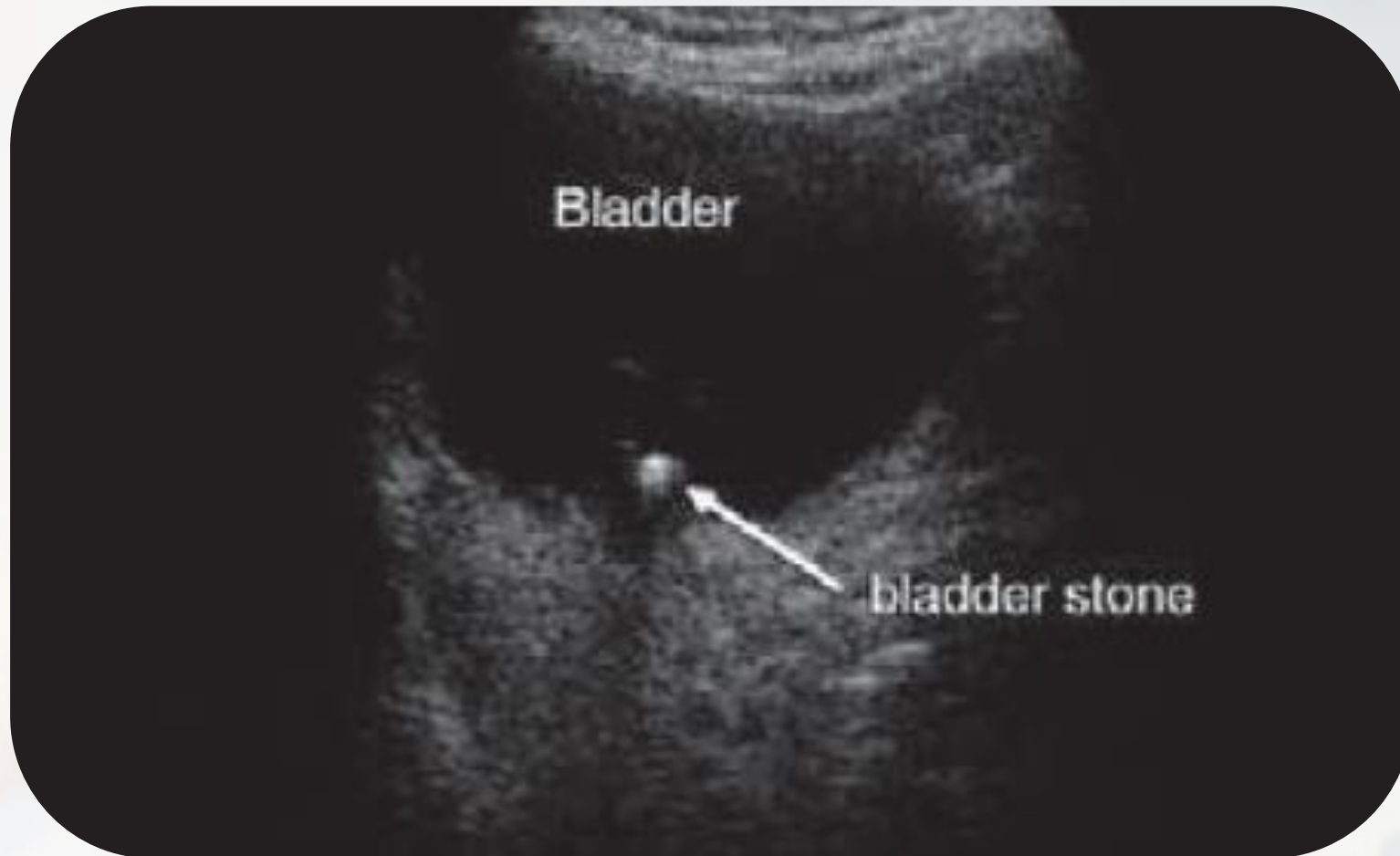


# Abnormal images

A close-up, slightly blurred photograph of a person's hand operating the control panel of an ultrasound machine. The hand is positioned over a large, circular trackball. The control panel is white and features numerous buttons, some with small icons, and several blue, dome-shaped knobs. The background is out of focus, showing a white surface and a vertical white object, possibly a probe or a container. The overall lighting is bright and clinical.



**The bulb of the Foley catheter is visualized on ultrasound with a Partially decompressed bladder**



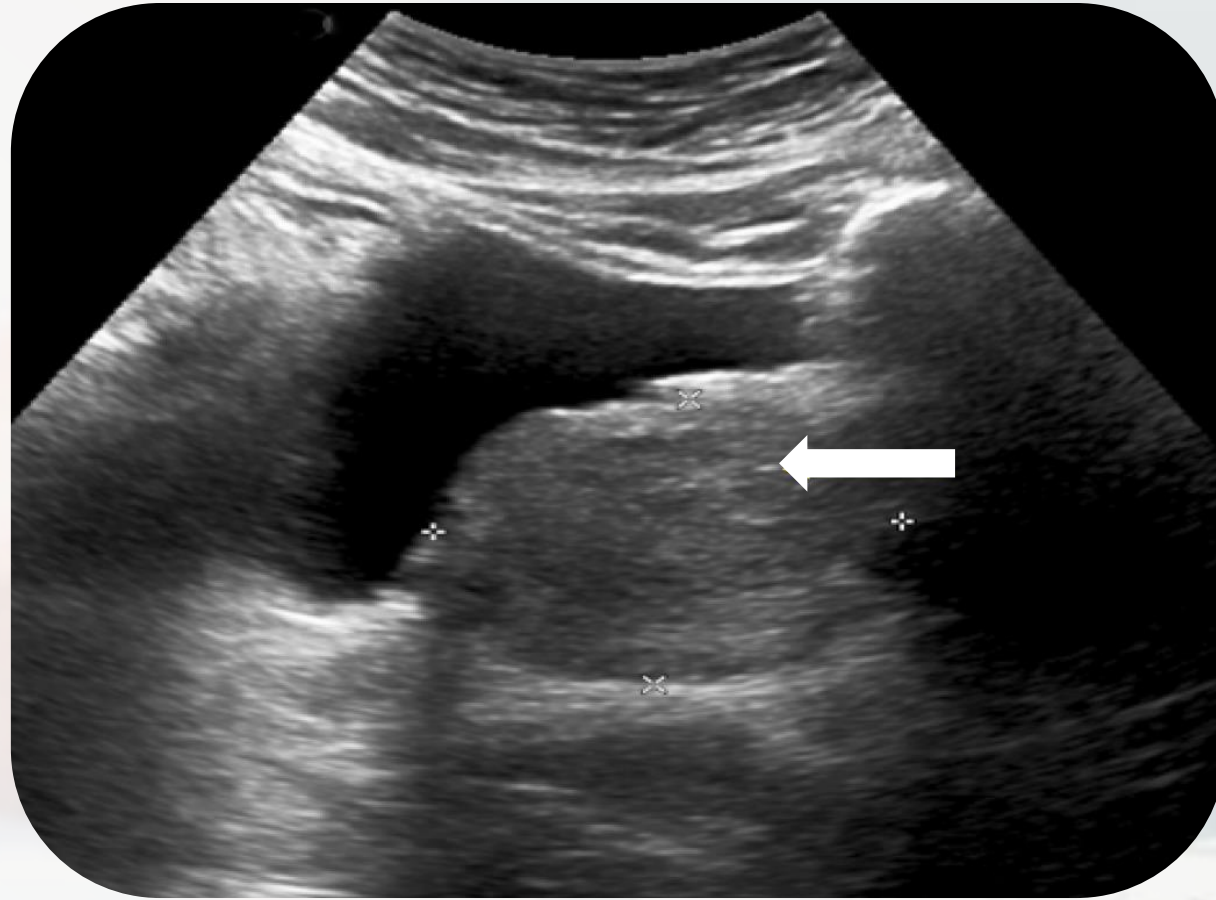
**A stone in the bladder with shadowing behind**



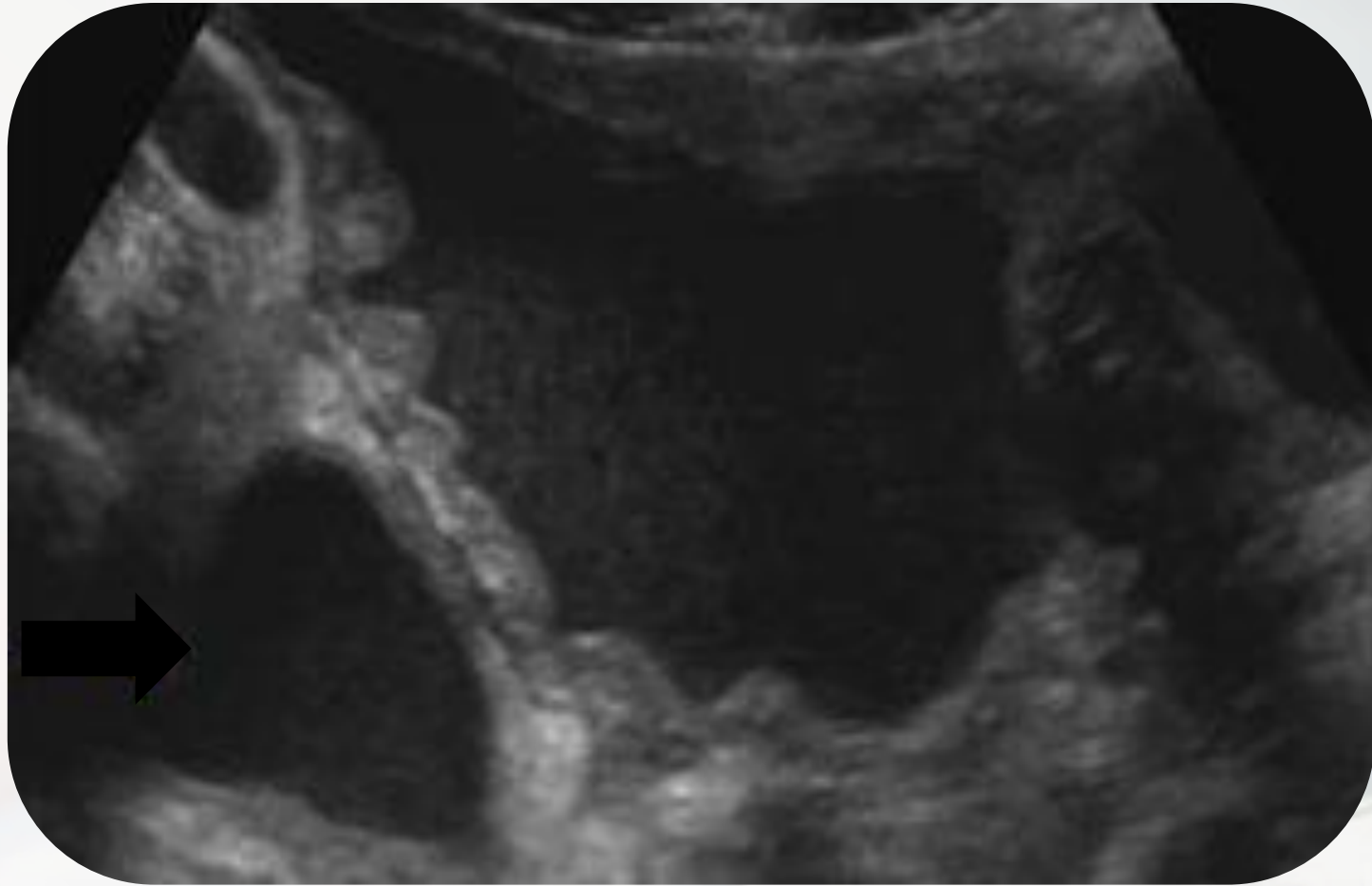


**Distended bladder filled with urine despite the presence of Foley catheter indicating catheter malfunction**

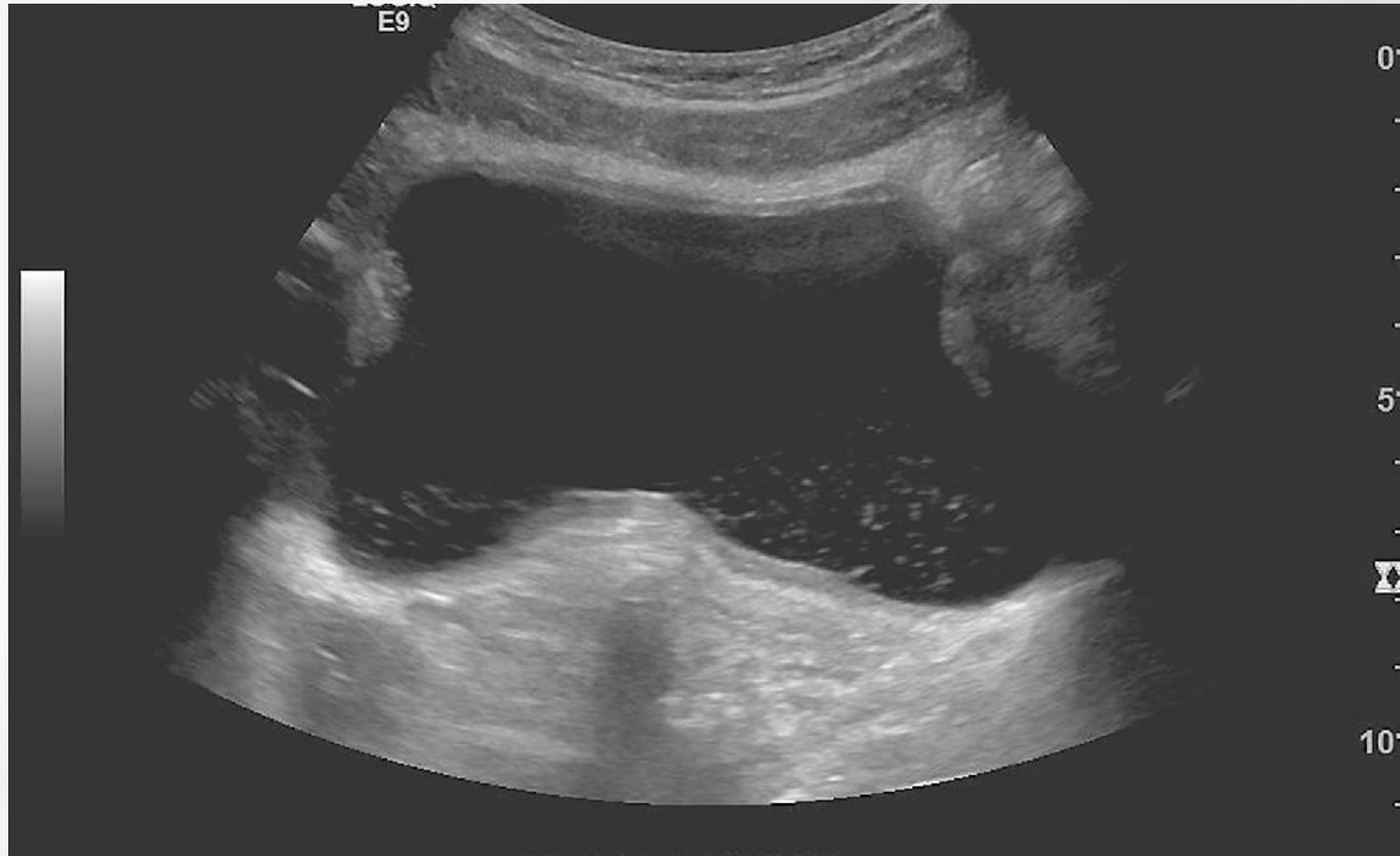
Koratala A, Bhattacharya D, Kazory A. Point of care renal ultrasonography for the busy nephrologist: A pictorial review. *World J Nephrol* 2019; 8(3): 44-58 [PMID: [31363461](#) DOI: [10.5527/wjn.v8.i3.44](#)]



Enlarged prostate (arrow) compressing the urinary bladder



**Multiple bladder diverticula with sedimentation of infected urine and a thickened wall of the urinary bladder in a patient with chronic urinary tract infection**



**A 31-year-old female presenting with right flank pain and underwent an ultrasound. Grayscale image of the bladder demonstrates echogenic dependent foci within the bladder consistent with bladder debris.**



# References

1. Noble VE, Nelson BP. *Manual of emergency and critical care ultrasound*. Cambridge University Press; 2011 Jun 16.
2. J. Christian Fox - *Clinical emergency radiology*, 2017, Cambridge University Press
3. <https://www.pocus101.com>
4. Koratala A, Bhattacharya D, Kazory A. Point of care renal ultrasonography for the busy nephrologist: A pictorial review. *World J Nephrol* 2019; 8(3): 44-58 [PMID: 31363461 DOI: 10.5527/wjn.v8.i3.44]
5. M. Kalyanaraman, D. McQueen, J. Sykes, T. Phatak, , F.Malik, Preethi S.Raghava. *Urosepsis and postrenal acute renal failure in a neonate following circumcision with Plastibell device*. 2013