

RADY 401 Case Presentation

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Focused patient history and workup

A 17 y/o female with no pertinent PMH presented to the ED shortly after being awakened with sudden onset of sharp/severe right flank pain radiating from her back to the RLQ. She appeared distressed and was doubled over in pain. She reported having experienced nausea prior to arrival and she vomited while in the ED. She denied constipation, diarrhea, dysuria, and fever and was feeling fine the day before. Patient had no recent trauma, alcohol use, surgeries, or sexual activity but reported an increase in her intake of soft drinks over the past couple of weeks. She rated her pain as 10/10 and unchanging.

Focused patient history and workup

Physical Exam/Labs

- Vitals were within normal range.
- Tenderness** to palpation of the **RLQ**. No CVA tenderness.
- Bloodwork: Unremarkable with **normal WBC**
- Urine : 2+ blood. No overt signs of infection

Differential Dx

- Nephrolithiasis
- Appendicitis
- Ovarian Torsion
- Constipation

List of imaging studies

- Renal Ultrasound
- X-Ray abdomen and Pelvis (KUB)
- Transabdominal Pelvic Ultrasound

*** *KUB + Ultrasound vs NCCT were chosen to reduce radiation exposure in this pediatric patient.*

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Acute Onset Flank Pain—Suspicion of Stone Disease (Urolithiasis)

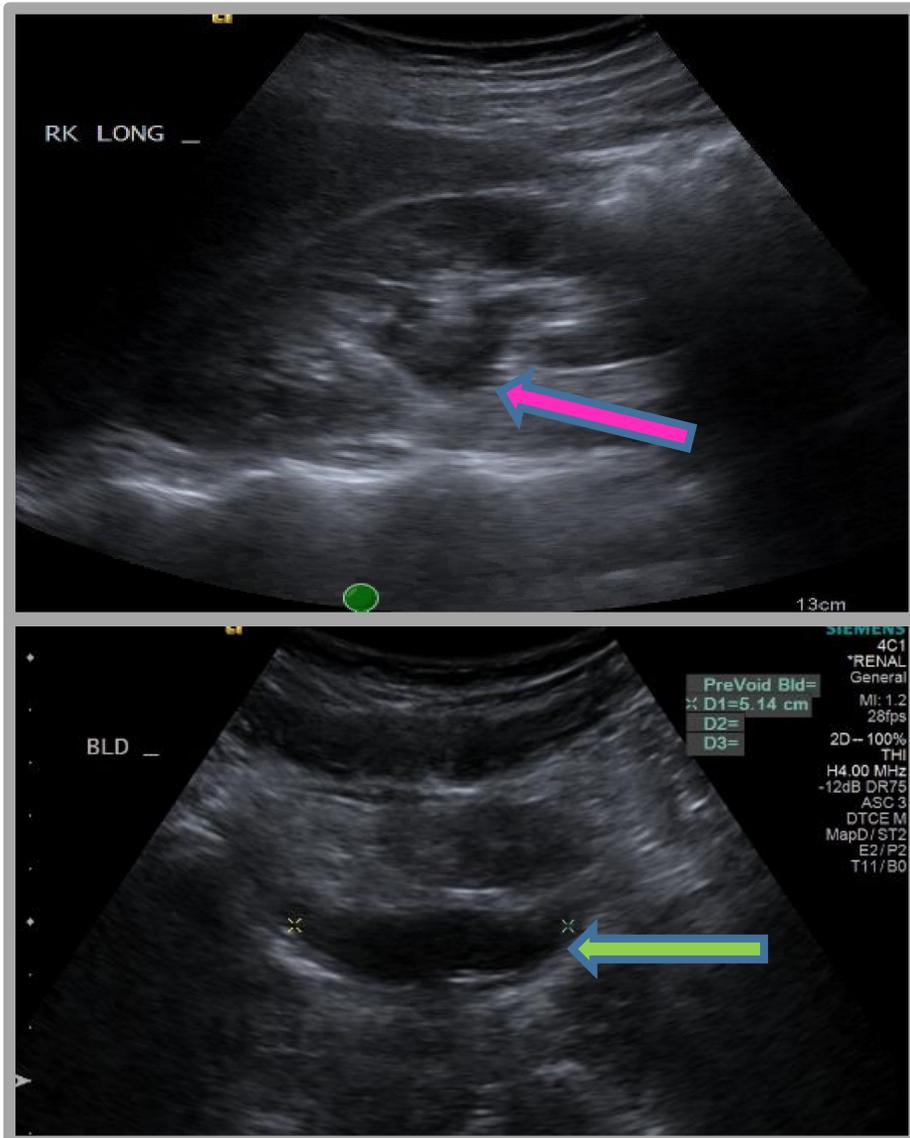
Variant 1: Suspicion of stone disease.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis without IV contrast	8	Reduced-dose techniques are preferred.	⊕⊕⊕
CT abdomen and pelvis without and with IV contrast	6	This procedure is indicated if CT without contrast does not explain pain or reveals an abnormality that should be further assessed with contrast (eg, stone versus phleboliths).	⊕⊕⊕⊕
US color Doppler kidneys and bladder retroperitoneal	6		0
Radiography intravenous urography	4		⊕⊕⊕
MRI abdomen and pelvis without IV contrast	4	MR urography.	0
MRI abdomen and pelvis without and with IV contrast	4	MR urography.	0
X-ray abdomen and pelvis (KUB)	3	This procedure can be performed with US as an alternative to NCCT.	⊕⊕
CT abdomen and pelvis with IV contrast	2		⊕⊕⊕

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

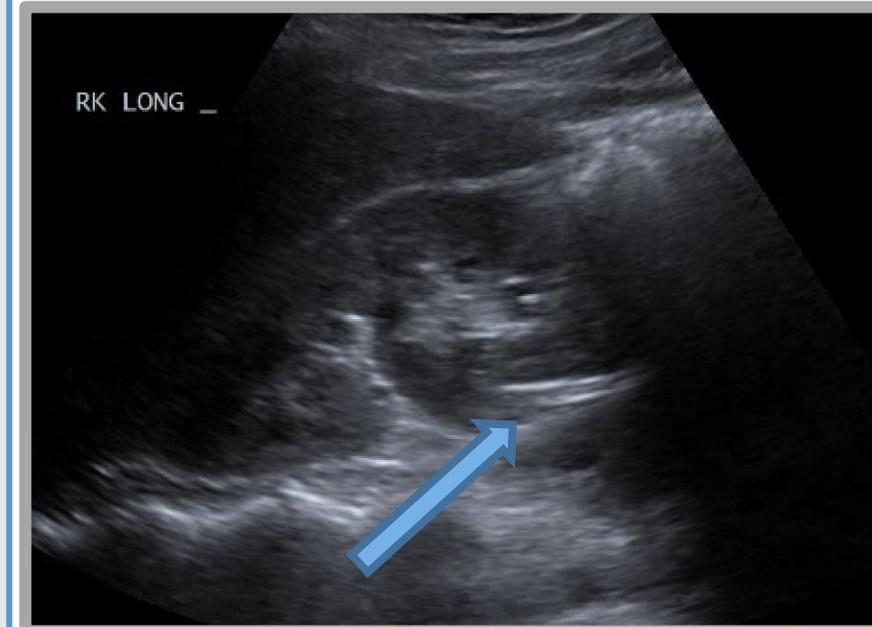
Renal Ultrasound



Renal ultrasound demonstrated **mild right sided hydronephrosis** with **mild dilatation of the renal pelvis/proximal ureter**. Kidneys were normal in shape, size, and echogenicity. Bladder appeared normal in size. No bladder wall thickening. **Bladder was not fully distended** (vol. 18mL), making it difficult to assess the distal ureters and pelvic/gynecological organs for abnormalities.

*** No renal or ureteral calculi were visualized. ***

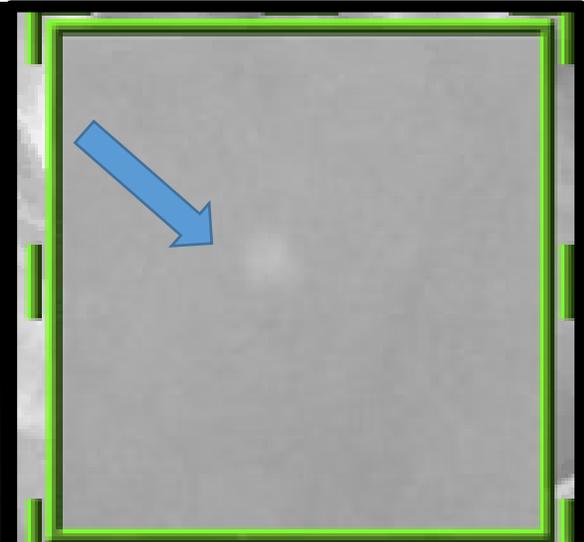
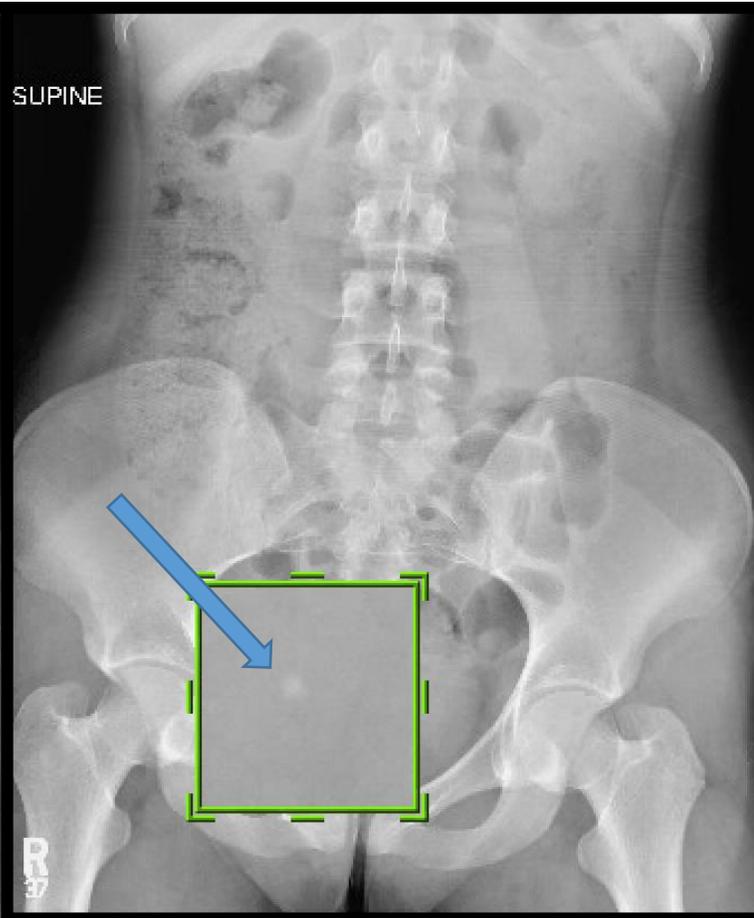
Left kidney and proximal ureter appeared normal.



X-ray Abdomen and Pelvis (KUB)



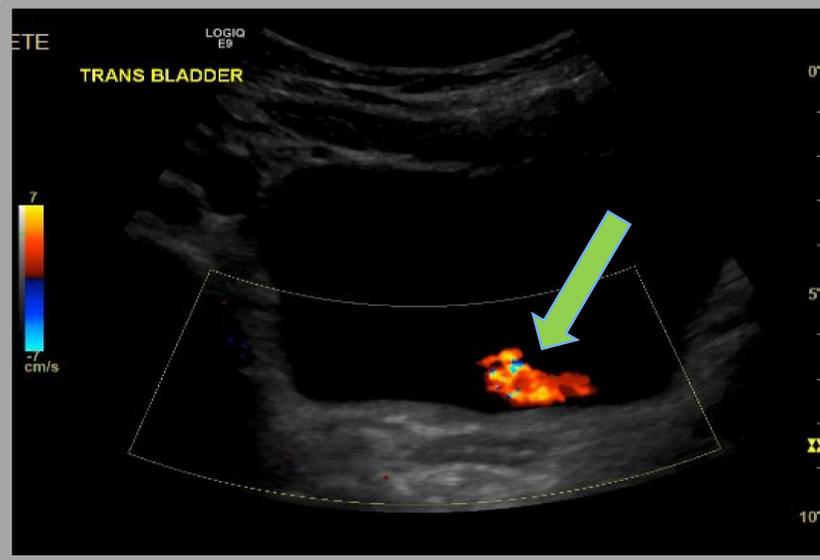
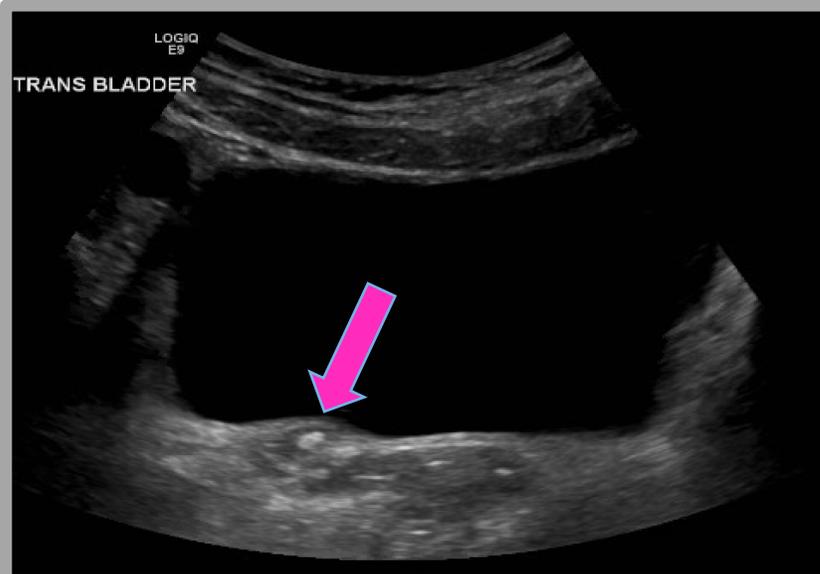
AP Supine View



KUB demonstrated a small calcific density in the right pelvis that was overlying the bladder. Moderate stool burden was noted. No calcifications noted over the kidney regions or the remaining ureters.

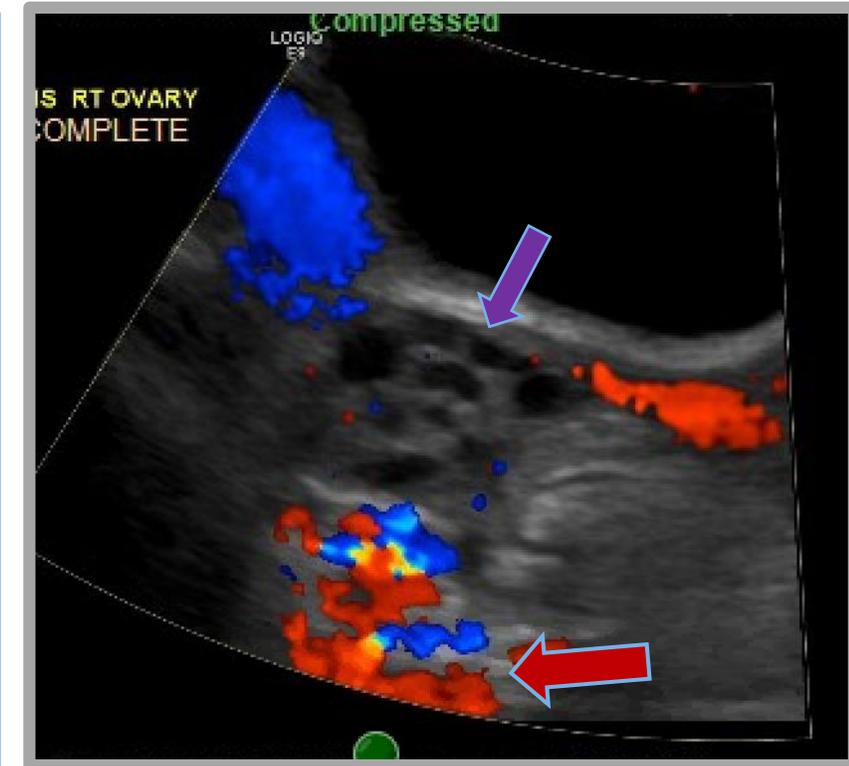
Calcific density in this location could represent distal Ureterovesical Junction (UVJ) stone, bladder stone, or phlebolith.

Transabdominal Pelvic Ultrasound w/ doppler



Transabdominal pelvic ultrasound demonstrated a well distended bladder. **Echogenic focus**, measuring 6mm in diameter, was noted within the right UVJ suggesting right UVJ calculus. **Normal physiologic ureteral jet** was present on the left; however, right ureteral jet was **not** visualized suggesting ureteral obstruction.

Ovaries contained small anechoic structures, likely **follicles**. Doppler revealed **adequate blood flow** to the ovaries ruling out ovarian torsion.



*** Appendix was not visualized. No signs of appendicitis were noted.

Patient Treatment/Outcome

The patient was diagnosed with a 6mm obstructing right ureteral stone present at the UVJ with associated hydronephrosis. The patient was treated with IV medications in attempts to control pain and was admitted for monitoring. The hope was that, with hydration and pain control, the patient would pass the stone without need for surgical intervention. However, right flank and RLQ pain (10/10) did not subside and the patient continued to have nausea and vomiting. Urology made plans to surgically intervene.

Patient Treatment and Outcome

Surgical Intervention for right ureteral stone

- Cystourethroscopy
- Right ureteral stone removal and stent placement (4.8 French x 26cm)

The patient tolerated surgery well. Pain was managed with Tylenol post-operatively and she was drinking and voiding adequately. She was discharged with prescription pain medication and will follow up with pediatric surgery clinic. Will plan for eventual stent removal.

Discussion: Stones

- ❑ There are multiple types and causes of kidney stones. Stones can result from lack of adequate hydration, infection, gout, and various medications.
- ❑ The most common type of stone is a calcium oxalate stone which can be seen on the commonly indicated imaging studies for stones. Certain stones caused by medication (e.g. Indinivir) are not visible on noncontrast CT and extra measures (delayed phase contrast CT) must be taken to visualize them.

Discussion: Correct Imaging?

❑ Non-Contrast CT with reduced dose techniques is commonly the first line imaging study for acute flank pain/suspicion of stone. It has high accuracy in identifying stones as well as other causes of flank pain. CT **without oral or IV contrast** is indicated because contrast can obscure the stones.

❑ In cases where symptoms are classic for stones and there is a desire to **reduce radiation dosage**, KUB (X-ray of the the abdomen and pelvis) + Renal US can be used as an alternative.

Non Contrast CT (NCCT)
Axial View

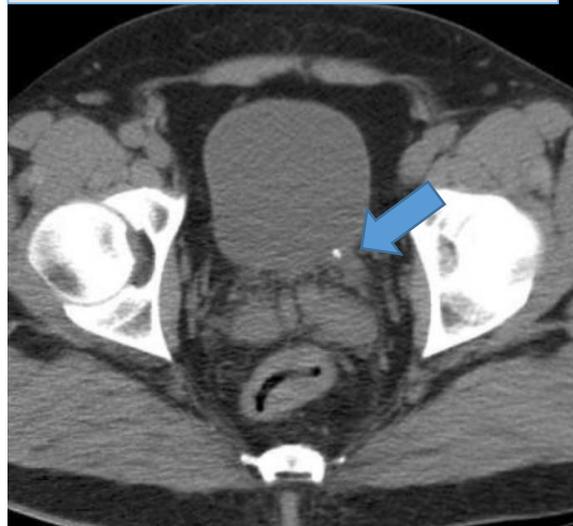


Image from:
<https://emedicine.medscape.com/article/381993-overview>

❑ In the pediatric patient specifically, such as in this case, concern about radiation dosages may be increased.

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Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

*** Transabdominal Pelvic US was added for this patient due to initial inability to visualize pelvic and gynecological structures.

Discussion: Classic Findings and Artifacts on Imaging

Twinkle Artifact



Twinkle artifact is a multicolored signal that is specific for reflective objects such as calculi.

When identifying small stones, the twinkling artifact is more sensitive than acoustic shadowing.

Image from this case.

Image from: <https://www.semanticscholar.org/paper/Unilateral-leg-swelling-and-hydronephrosis.-Alraies-Kabach/53e8907ca474a0d40f1fd48828eaa8f7cef531>

Acoustic shadowing is a "signal void" that is found most often behind solid objects that absorb or reflect the US waves.

Posterior Acoustic Shadowing

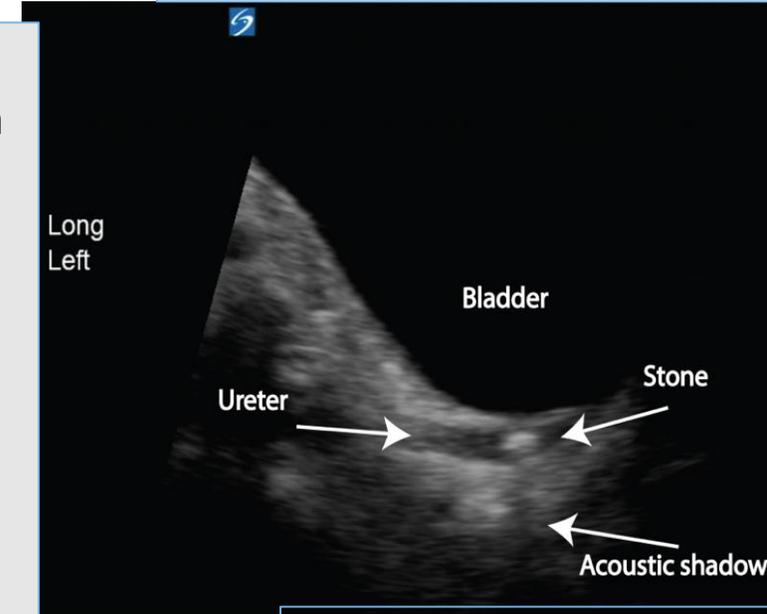
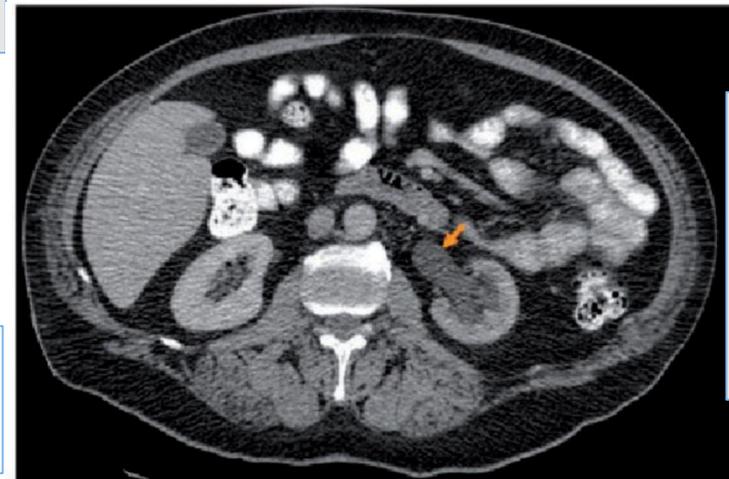


Image from: <https://www.criticalcare-sonography.com/2017/04/07/renal-colic/>



Unilateral hydronephrosis on NCTT. Dilated renal calyces and proximal ureter.

Discussion: Imaging Sensitivity and Specificity

❑ NCCT (Abdomen and Pelvis)

- Sensitivity of 97%; decreases with smaller stone size
 - Sensitivity can also be further decreased if radiation dose is decreased by more than 50%
- Specificity of 95%

❑ Ultrasound

- Sensitivity of 61%-90% in detecting any stone when patient presents with acute flank pain. Operator dependent.
 - In comparison to NCCT, sensitivity for detecting a stone is around 24%-57%. Poor sensitivity for small stones (<3mm).
 - With acute flank pain, can be 100% sensitive and 90 % specific for diagnosing some sort of ureteral obstruction. US detects hydronephrosis, perinephric fluid, or ureterectasis.

❑ KUB (Abdominal/Pelvic Radiography)

- Sensitivity of about 59%
 - Varies significantly depending on the location and size of the stone as well as the body habitus of the patient.
 - Some calcifications may actually represent phleboliths
- Specificity of around 76%

Sensitivity/specificity of combined KUB/US is increased. 73% sensitivity compared to 93-97% with NCCT.

Discussion: Costs and Radiation Dosages

- ❑ Non Contrast CT (Abdomen and Pelvis)
 - Cost: \$298- 3,602 with “fair price” of \$1,038
 - Radiation Dose
 - 3-4 mSv with low dose protocol vs 10-12 mSv for conventional protocol
- ❑ Renal/Transabdominal Ultrasound
 - Cost: \$104-\$641 with “fair price” of \$233
 - Radiation dose
 - Zero Radiation Exposure
- ❑ KUB (Abdominal/Pelvic Radiography)
 - ❑ Cost: \$23 - \$450 with “fair price” of \$58-\$69
 - ❑ Radiation Dose
 - ❑ 0.8 mSv if single radiograph. Increases (2.4-2.7 mSv) with multiple views

Costs and “fair prices” according to [healthcarebluebook.com](https://www.healthcarebluebook.com).

Wrap Up

- ❑ Non Contrast CT is often the go to imaging study for suspicion of renal stones; however, KUB + US can be used when there is high suspicion of an obstructing stone and a strong desire to decrease radiation exposure. (such as in children or patients with recurrent stones)
- ❑ The most common three locations to look for ureteral stones are at the ureteropelvic junction, where the ureter crosses the iliac vessels, and at the **ureterovesical junction**. Ureteral narrowing occurs at each of these anatomic locations.
- ❑ Twinkle artifact, posterior acoustic shadowing, and hydroureteronephrosis are all suggestive of renal/ureter stones.
- ❑ If large stones (>5 mm) do not pass on their own with increased hydration, surgical intervention is necessary.

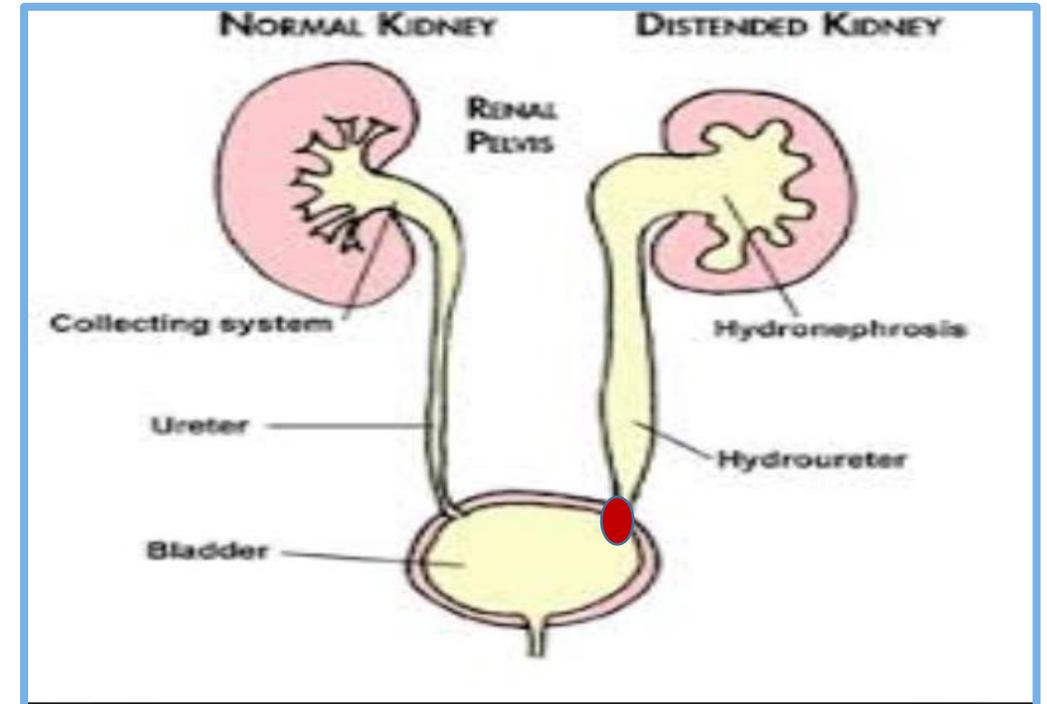


Image from:
<https://www.oumedicine.com/docs/ad-urology-workfiles/bladder-news-10-hydro.pdf?sfvrsn=2>

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