

432 Radiology Team



(9): Radiology of Urinary System Disease

* Many thanks to 431 team for their helpful notes *

Thank you Dana Aldubaib for sharing your notes



Done By:
Hessah Binjadeed

Reviewed By:
Othman.T.AIMutairi

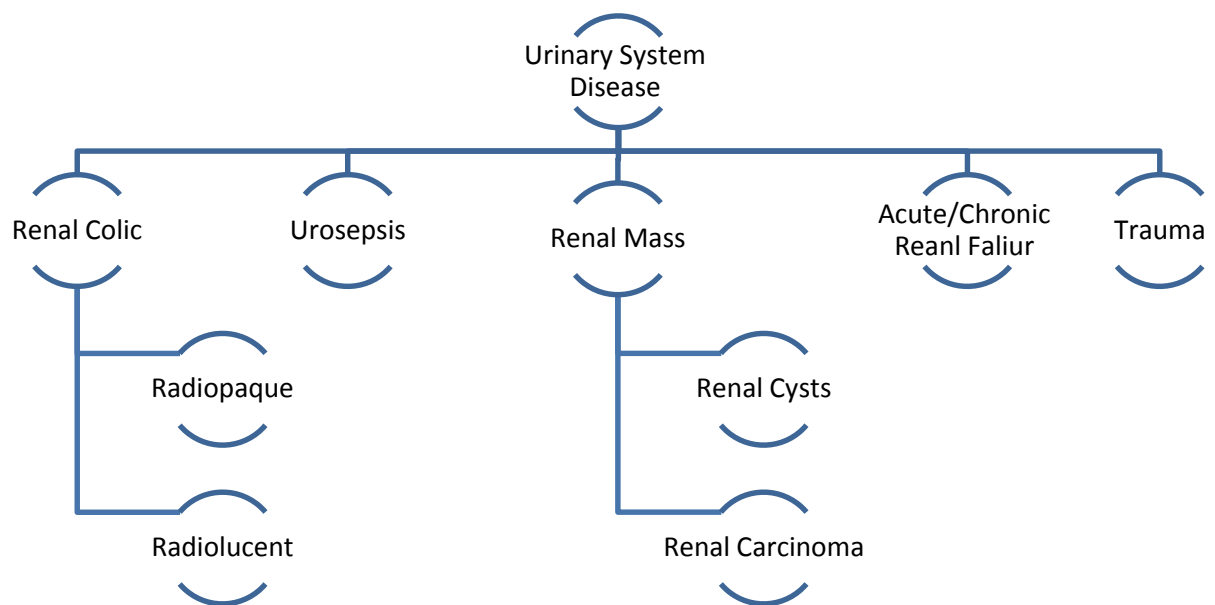
جامعة
الملك سعود
King Saud University



COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional • 431 team

Objectives

Not given



Renal Colic:

If a patient present with renal colic, you should answers the following questions:

1. Are urinary stones present? If so, what is **the level, size and location**
2. Is obstruction present? If so, what is the level, severity **and is partial or complete obstruction?**
3. Is urgent intervention required? Factors include: urosepsis, solitary kidney, sever pain. **By intervention, we mean** treating the patient with percutaneous nephrostomy or ureteric stent.

1) X-RAY:

A) Radiopaque Stones:



Multiple opaque shadows are seen in the left side of the abdomen, and this area is projecting over the left kidney. This means, it is most likely a renal stones



We can see a large opaque shadow taking the shape of the pelvicalyceal system. (staghorn stones)

Note(s):

~~~~~  
**How to differentiate between a gallbladder stone and a renal stone?**

*A gallbladder stone: is multiple but uniform in size + Hypodense in the center + hyperdense (bright) in the periphery. Very spherical*

*A renal stone: in not rounded, not uniform even if they are multiple + they don't have the hypodensity in the center.*

~~~~~



Multiple opaque shadows are seen close to the hilum of the right kidney. These are gallbladder stones. Gallbladder stones can mimic renal stones.



Radiopaque shadow in the pelvis.



A whole sac filled with fluid. This is the bladder. Fluid is dark in US and stones are bright. The **acoustic shadowing***, which is the dark shadow, tell us this is a stone.

**It is better NOT to specify the exact location of the shadow in a plain film because we really don't know where it's exactly. Say a shadow in the pelvis NOT in the bladder NOT in the ureter. After you do the US, CT, IVU ... then you can say the stone is where exactly.*

**An acoustic shadow is an area through which sound waves fail to propagate. It's dark and seen behind the stone.*



Tiny shadow in the right pelvis



A magnified focus spot film showing a **Tiny shadowing** in the right pelvis.

These two radiographic images are IVP preliminary film (control film) in a patient with right renal colic.

A preliminary radiographic: Imaging made before the administration of contrast material. Also called scout image.



An IVU film with a contrast

**You can see the left pelviclyceal system and part of ureter is filled with contrast, which means the left kidney is functioning well and excreting the contrast in the 10 minutes film. Also, there is no dilatation in the pelviclyceal system, nor in the ureter.*

whereas in the right side of 10 minutes film shows no contrast, which means it is not functioning well. Why? Because of the **obstruction in the distal ureter. "seen in the previous film".*

**the right ureter is dilated compare to the left ureter.*

**the normal diameter is 3 mm.*



The three areas of normal narrowing:

- 1) Uretropelvis junction.
- 2) Bifurcation of the iliac vessels.
- 3) Uretrovesical junction.

The stone in distal ureter. Most likely at the vesicoureteral junction (ureterovesical junction), on of the three narrowest areas of the ureter.

The dilated ureter

B) Radiolucent Stones :

Radiolucent stones can't be seen by x-ray, however, they can be seen by US and CT.



KUB imaging (kidney, ureters and bladder)

A filling defect be seen (not filled by the contrast), which indicates obstruction. Could be a mass, a stone.. etc.

Radiolucent uric acid stones



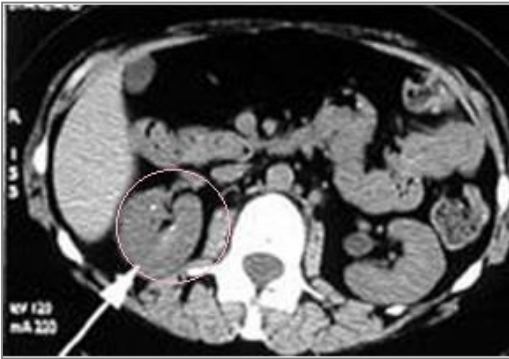
Acoustic shadowing

You can see the cortex, medulla, hyper echoic shadow, and acoustic shadowing, indicating stones.

Bladder filled with urine "fluid always black in US". Hyper echoic shadow floating, indicating stones. *you can't see the acoustic shadow because the urine is dark and the shadow is dark.

2) CT:

In CT all the stones will appear



You can see small dots in the right kidney which are **small stones**. CT scan is very **sensitive**. It can detect **less than 1mm**.

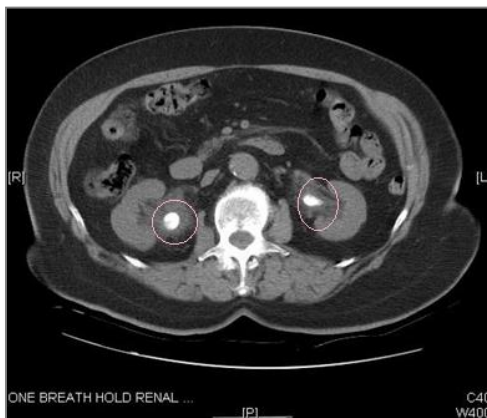


A **stone** in the left kidney. It is located in the **calyx**.

**Peripheral stones: in Calyx
→ not causing obstruction*

**central stones: in Pelvic area → cause obstruction.
stones must be removed if they are causing pain or obstruction.

** Although CT is the most sensitive test for detecting stones, we don't always start with it because of ionized radiation.*



Stones at uretero-pelvic junction. Fluid is surrounding the stones. They are causing obstruction.



*You can see dilated pelvis of the right kidney, indicating **hydronephrosis**.
*Urine is seen as well, meaning obstruction, which could be due to stones or other cause.

Hydronephrosis – water inside the kidney – refers to distention and **dilatation of renal pelvis and calyces, usually caused by obstruction of the free flow of urine. Untreated, it leads to progressive atrophy of the kidney. In case of **hydroureteronephrosis**, there is distention of the ureter, renal pelvis and calices.*

3) Management of Renal Stones:

Depend on location, and size of the stone. It can be managed by Extracorporeal Shock Waves Lithotripsy (ESWL), ureteroscopy, percutaneous debulking and ESWL. Surgery is rarely done.

Upper and >5mm :ESWL , lower and <5mm: goes spontaneously

Urosepsis:

- Urosepsis is a secondary infection that occurs when a urinary tract infection spreads to the bloodstream.
- It is clinically diagnosed generally.
- The primary infection can be: Pyelonephritis, Cystitis, and prostatitis.
- Urosepsis and an obstructed ureter is a Urologic Emergency. Why? Because the patient can get into a **septic shock**.
- If the doctor suspect a urosepsis, a renal US should be performed to rule out renal obstruction , and renal or perirenal abscess.



*Left **pyonephrosis**, the cortex is thin and we can't see the medulla.
 *The calyx is dilated.
 *The fluid is infected (**pus**) "NOT clear fluid" NOT totally black". If it's totally black, the urine could be clear, or there's not much pus.



Right UPJ stone causing **hydronephrosis**

**Could be complicated by abscess in the kidney.*

** Normal diameter of the cortex 2.5 cms. (It's not fixed, for example 1.2 cms is not considered normal, 0.8 is considered thin.*

** The cortex is thin because of obstruction, hydronephrosis and loss of renal tissue.*



Percutaneous nephrostomy for decompression



2 weeks post ESWL

We said urosepsis is an emergency. So what to do in such cases?

*We insert a tube (**catheter**) Through the skin to the calyx to renal pelvis. This is called **nephrostomy tube**. This is done to relieve the pressure over the kidney. Later on you go for ESWL.*



Right **pyonephrosis** and obstructing **UPJ stones**.

Renal Mass:

- A mass can be solid, simple cystic or atypical (complicated) cystic.
- The US is one of the most sensitive modality for differentiating a solid from a cystic mass. **US is better than CT to tell if there is a solid or a cystic mass.**
- Simple cysts are usually present in many people after the age of 50.

Simple Kidney cysts: abnormal, fluid-filled sacs that form in the kidneys. They are usually unilateral and solitary lesion with well-defined features. They do not enlarge the kidneys, replace their normal structure, or cause reduced kidney function.

Approach to renal masses:

- **Most renal masses are simple cysts.**
- Use US to characterize the mass:
 - 1) If you find a simple cyst, then STOP. "Nothing further to do"
 - 2) If you find either a solid mass or atypical cyst, then you should do CT. **CT should be with IV contrast or it will not help us.**



An US showing a **large simple cyst**



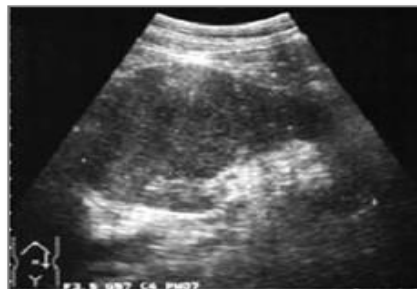
Left renal mass on IVP
*A stretching of the upper pole, indicating a cystic lesion, which was confirmed by US.



Simple cyst on US



left pelvicalyceal Distortion
*This indicates a problem you have to do US or CT.

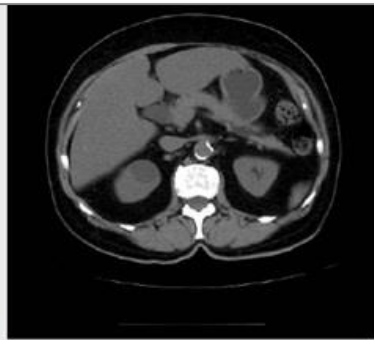


Solid left renal mass in a patient with **micro hematuria**
*CT: you can see the difference between the 2 kidneys. The size, appearance and enhancement. There is a mass in the left kidney.

1) Renal Cysts:

- US will determine if the lesion is cystic or solid

- 2 Types of Renal Cysts:
 1) Simple: spherical, echo-free fluid collection within a thin surrounding wall and will show good sound wave transmission
 2) Complicated: will show the presence of echos within the cyst, will have a thick wall, and/or show calcification in the wall



On US :

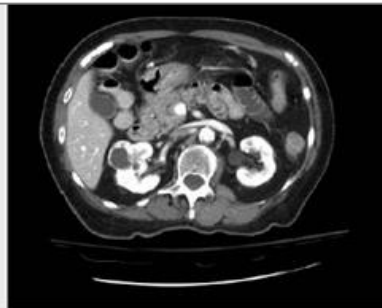
Renal stone: *acoustic shadow*
"shadow is black"

Cyst: *acoustic enhancement*
"shadow is white"

Renal mass: *without shadow*

2) Renal Carcinoma:

- if US indicates that the mass is solid, CT with IV contrast can characterize the tumour in greater detail – delineate extent, show the degree of vascularity, presence/absence of necrotic centre, presence/absence of local invasion of adjacent structures



- 90% of all renal malignancies " The most common " are due to renal adenocarcinoma.
- 15--13% are metastatic at diagnosis.
- Hematogenous and lymphatic spread.
- 10% have venous invasion. (Renal vein or IVC)
- Treatment: Radical or partial nephrectomy.

Appropriate imaging workup:

- Chest x--ray: Pulmonary metastases.
- CT abdomen: Local invasion, lymphadenopathy, and venous extension.
- MRI abdomen: if there is contraindication to IV contrast. "Renal failure or contrast allergy"

Renal Angiomyolipoma:

- A benign hamartomatous tumour comprised of vessels, smooth muscle, and fat.
- Usually asymptomatic. Occasionally present with hemorrhage when large or multiple.
- Fat detected in 96% by CT.

Transitional cell carcinoma (TCC):

- Most common malignancy of pelvicalyceal system, ureter and bladder.
 - “Not kidneys”
 - <10% of renal malignancies.
 - Typically present with gross hematuria.
 - CT for staging and surgical planning.
- Treatment: Radical nephrectomy

A filling defect could be due to:

- 1) tumor.
- 2) clot.
- 3) stone.



IVP and retrograde pyelogram TCC proximal left ureter.
*proximal left ureter shows irregularity with a filling defect.

Small TCC of bladder in patient with hematuria
Filling defect in the left side of the bladder



IVP and pelvic CT – large TCC of bladder obstructing right ureter.

Dilation of pelvicalyceal due to distal obstruction.

Compare the normal wall of the bladder on the right to the thickened irregular wall in the left. You can see a fluid-fluid level, contrast and urine are not mixed together.
There's a mass in the right side of the bladder.



Bladder TCC in two patients

Acute and Chronic Renal Failure:

- ◆ Clinical categories
 - Prerenal (dehydration, shock, cardiac failure)
 - Renal (parenchyma, diabetes, GN, drugs, renovascular)
 - Postrenal (obstruction)
- ◆ IV contrast contraindicated if creatinine > 200 mmol/d
- ◆ Use ultrasound to assess:
 - Renal size
 - Parenchymal thickness
- ◆ Ultrasound guided renal biopsy to establish diagnosis



Hydronephrosis *post-renal



Atopic, echogenic kidney
*Medical renal disease

Acute: The kidney is **enlarged** in size. It is edematous. Sometimes there is obstruction.

Chronic:

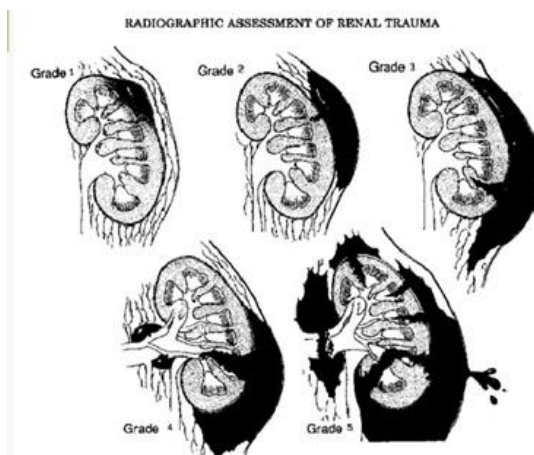
- Small in size, Bright echo pattern.
- The normal darkness of the cortex is NOT seen.
- We CAN'T differentiate between cortex and medulla, because they have the same echo pattern.
- Some cysts can also be seen.

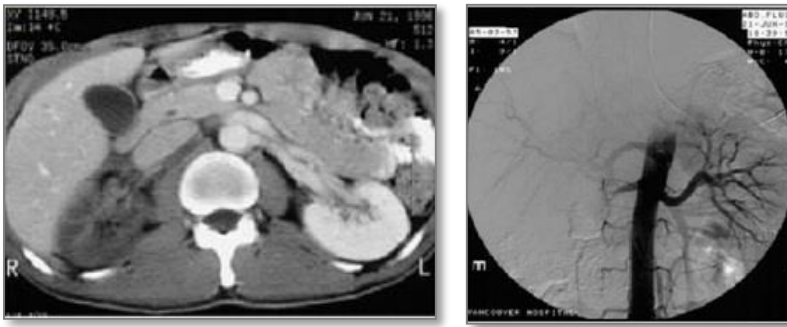
GU trauma:

- Penetrating trauma. (Gunshot, stab)
- If patient is Unstable → go for surgery or angiogram “to stop bleeding (Therapeutic effect)”
- If stable → you can go for CT, and other modalities

Renal trauma grading: Often done using the American Association for the Surgery of Trauma (AAST) according to depth of damage and involvement of the urinary collecting system and renal vessels.

<http://radiopaedia.org/articles/renal--trauma--grading>





Grade 5 injury: **Thrombosed renal artery**

The CT scan and angiogram of traumatic patient:

- Low visualization of right kidney.
- Only part of the renal artery can be seen.
- You can also see that the kidney is not perfused at all.
- No blood supply due to thrombosis of renal artery.



Grade 4 injury : **deep laceration with perirenal hemorrhage**



Extraperitoneal bladder rupture



Intraperitoneal bladder rupture

For a urinary bladder injury: do a **cystogram**.

- Extra peritoneal leak → the **contrast doesn't extend** to the abdomen.
- Intraperitoneal leak → the **contrast extends** to the abdomen.



Normal retrograde urethrogram



Traumatic rupture of bulbous urethra

- For urethral injury: perform voiding cysto--urethro--gram "inject contrast and let patient urinate while scanning".
- You can see irregularity and leak in bulbous urethra, which is due to trauma

SUMMARY

1. A gallbladder stone: is multiple but uniform in size + Hypodense in the center + hyperdense (bright) in the periphery. Very spherical
2. A renal stone: is not rounded, not uniform even if they are multiple + they don't have the hypodensity in the center.
3. Radiolucent stones can't be seen by x-ray, however, they can be seen by US and CT. Uric acid stones are radiolucent stone.
4. US is better than CT to tell if there is a solid or a cystic mass.
5. Most renal masses are simple cysts.
6. The most common renal malignancy is adenocarcinoma.
7. On US Renal stones: acoustic shadow "black shadow", Cysts: acoustic enhancement "white shadow", Tumor: no shadow.
8. CT scan can detect tiny stones down to 1mm sized stones.
9. Stones > 5mm require ESWL, Stones < 5mm pass spontaneously.
10. Nephrostomy tube is used to decompress the kidneys in a case of urosepsis.
11. Renal Adenocarcinoma is the most common type of renal malignancies.

Questions

- 1) The selected CT imaging is showing:
- Urinary bladder mass.
 - Stones in distal left ureter.
 - Mass in the rectum.
 - Destruction in the lumbar vertebra.



- 2) A renal US was performed. Which of the following is the finding seen?
- Stones at urinary bladder.
 - Mass at urinary bladder.
 - Stones at renal pelvis.
 - Mass at the lower pole.



Answers:

1st Questions: a

2nd Questions:a

432 Radiology Team Leaders

Eman AlBedaie
Emansaleh202@gmail.com

