



RADIOLOGY

TEAM 435

Radiology of urinary system diseases

[Color index: **Important** | **Notes** | Extra]

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● Objectives:

1. To know the principal diseases entities of the urinary system organs and how they look in imaging.
2. To correlate the clinical manifestation with radiological images.

● Resources:

- 435 Slides
- 434 Team
- 435 Notes

● Done by:

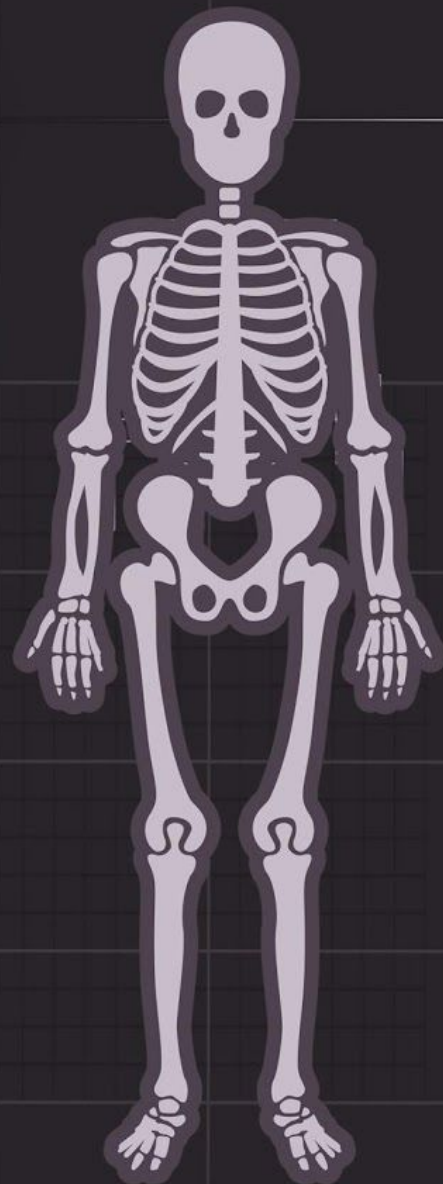
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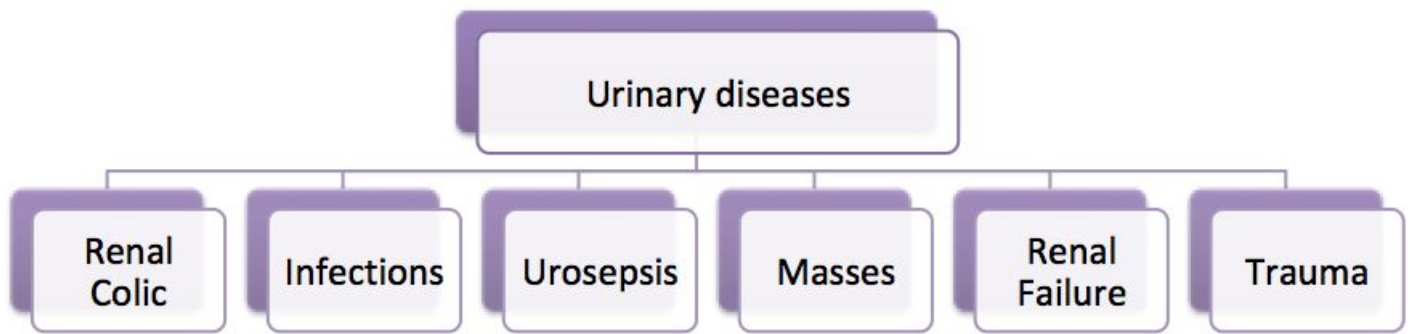
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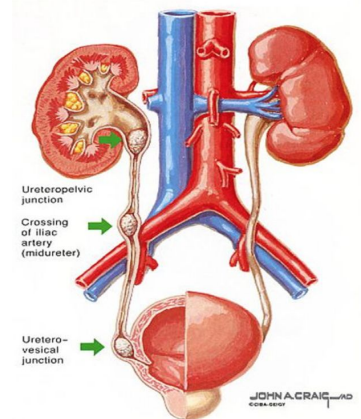
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1) Renal Colic

- It's type of pain caused by renal calculi.
- **Classic presentation: (sudden onset of severe flank pain radiating inferiorly and anteriorly to groin area +/- nausea and vomiting)**
This pain has been described by the patient as the most excruciating pain ever felt. The experienced ER physician could diagnose it just from the first moment after seeing the patient.
- Small, non obstructing or staghorn calculi may be asymptomatic or cause mild to moderate symptoms which are tolerable
- **Diagnosis often made clinically**
- **Imaging: to confirm and evaluate calculi**
- Recall from the previous lecture, The common sites for stone obstruction:
 - a) ureteropelvic junction
 - b) Cross of iliac artery,
 - c) vesicoureteral junction



❖ Questions to ask:

- Are urinary stones present? If so, what is the level and size?
Depending on the size the management will be different either conservative medically or interventional surgery.
- Is obstructions present? If so, what is the level and severity?
Severity: is it completely occluding the ureter and causing severe hydronephrosis? And it can cause severe sepsis which is fatal if it's ignored.
- Is urgent intervention required? (think about intervention if the patient have these symptoms.)
Factors include: **urosepsis (increased creatinine - hyperkalemia), solitary kidney***, **severe pain not respond to analgesics**
*solitary kidney should be treated fast and taken seriously.

❖ Treatment:

percutaneous nephrostomy* or Ureteric stent.

*insertion of a catheter through the skin and into the renal pelvis

Renal Calculi



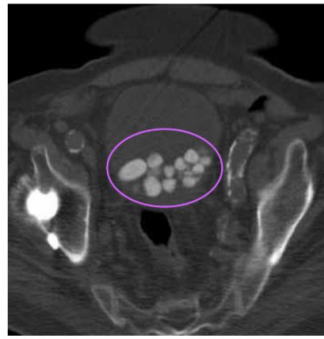
KUB: to assess total stone burden, size, shape, location
Often: US or CT is required in conjunction.

Bladder calculi (microscopic hematuria)

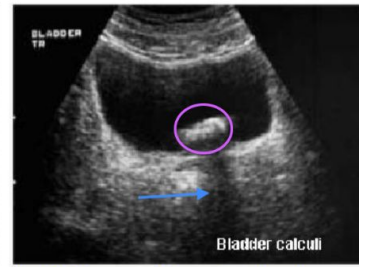
hematuria in urinalysis



Example of bladder calculi (stone) in KUB

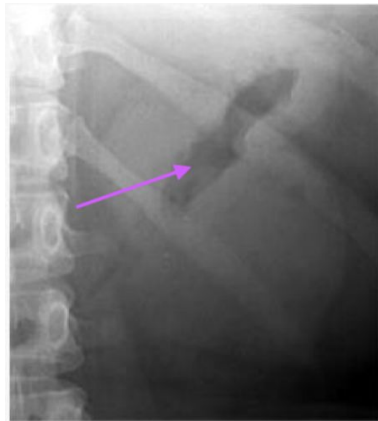


In CT "axial section": Multiple bladder stone.

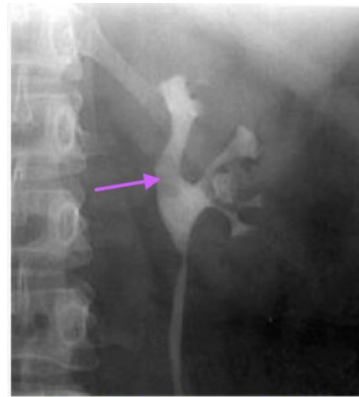


In US: hyperechogenic structure (stone) with shadow

Radiolucent uric acid stones

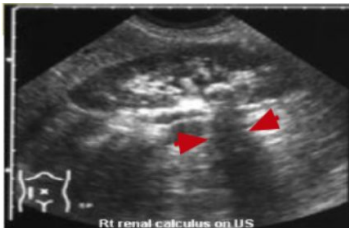


Radiolucent renal stones are not seen in case of uric acid stones, you see is bowel gas= air= black.



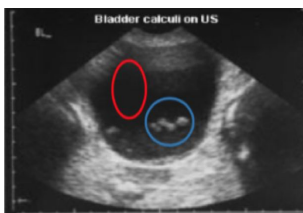
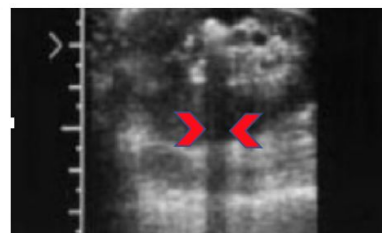
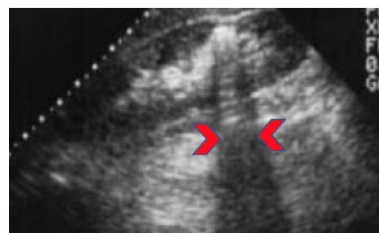
Here in the IVP we see filling defect and dilation of the superior calyces (Pink arrow) but middle and inferior calyces are normal.

Renal Calculus- Ultrasound



for all three pics :

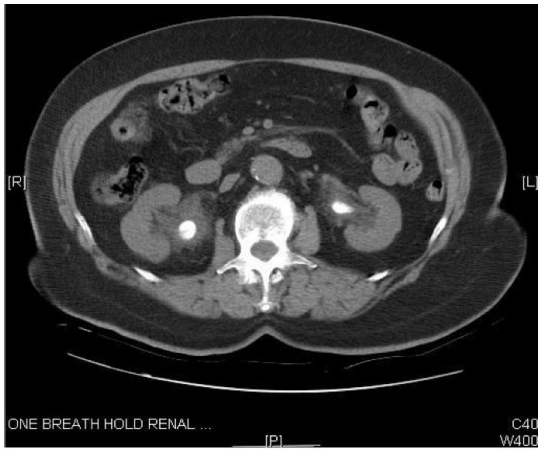
Renal stones in US "hyperechogenic structure" with shadow behind.
Shadow is important because we can't say it's stone without the shadow.
No obstruction = No dilatation



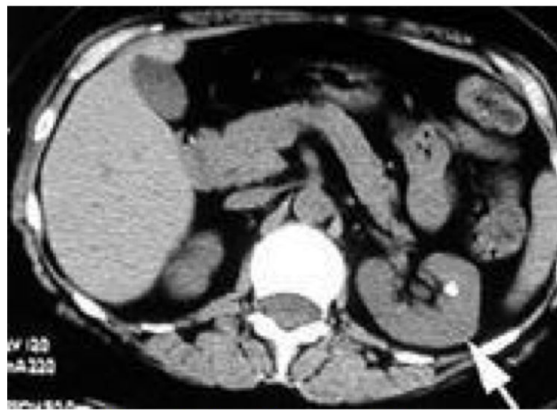
> This note only for the image on the left :

- Bladder stone with some **turbulent urine** that could be infected.
- **Fluid (urine)** will appear black, **Stones** will appear white
- The reason of the absence of shadow is (the urine in the bladder is dark and the shadow is dark)

Renal Calculus– CT Scan:



Bilateral stone with some dilatation that mean there is obstruction.



Non obstructive renal stone with no dilatation of renal urocalyceal system "pelvicalyceal".

2) Infections

1. Acute Pyelonephritis:

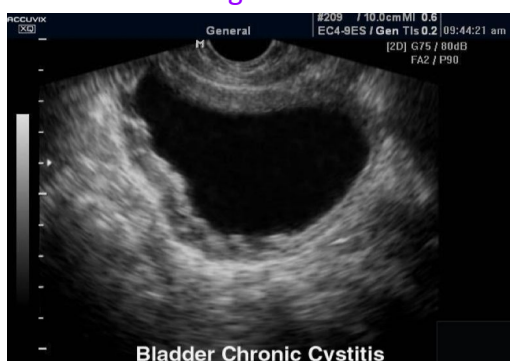
- Life threatening infection & medical emergency it can cause urosepsis and septic shock
- Bacteria can be sent Through lower urinary tract (ascending upper urinary tract infection)
- Early diagnosis and management has significant impact on patient outcome.
- Presentation: (Fever, loin pain, nausea/vomiting)
- Pregnant women are more prone to acute pyelonephritis
- The diagnosis of pyelonephritis is based on clinical diagnosis but we do CT just to confirm the diagnosis and to exclude other diseases
- In case of Acute Pyelonephritis, functions of the kidney is decreased; that's why it doesn't take the contrast and we can confirm that the patient has pyelonephritis. The correlation always with clinical picture we must rule out other infections



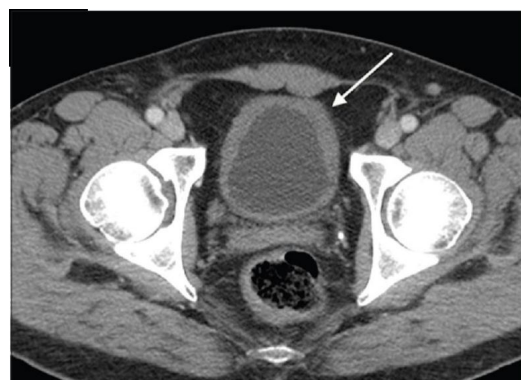
CT : Pyelonephritis
Wedge shaped hypoperfused lesion .

2. cystitis:

- Presentation: (Fever, suprapubic pain, frequent urination , sometimes hematuria)
- As upper UTI, more common in females Because of short urethra. -
- E-coli is the most common organism.



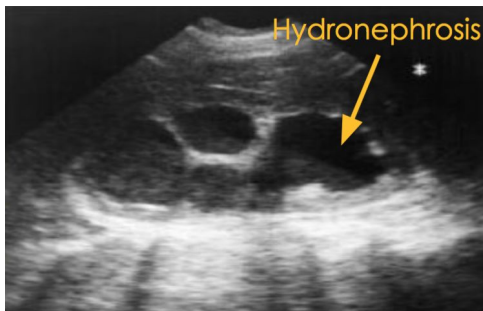
Bladder Chronic Cystitis
we see thick, irregular urinary bladder wall it should be 3mm here it's 6-7mm



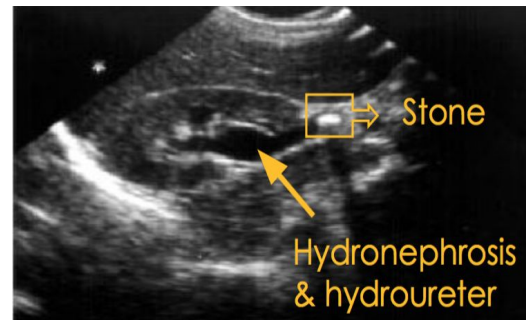
Thick bladder wall

3) urosepsis:

- sepsis from obstruction of infected urine.
- Establish a clinical diagnosis: Pyelonephritis, cystitis, prostatitis
- Urosepsis and obstructed ureter is **urologic emergency!** (If the obstruction is causing persistent dilatation ,it can lead to urosepsis which is an emergency case)
- Renal US is performed to rule out :
 - 1) Renal obstruction Obstruction in US “we see dilatation”
How to rule out renal obstruction? by checking for hydronephrosis which appears as dilatation on ultrasound
 - 2) Renal or perirenal abscess. >> need to drain



left pyonephrosis: Pyon=pus, nephrons=kidney.
So it's infection of kidneys' collecting system.
we see severe dilated pelvic calyces with echogenic content which should be black. But here the echogenicity means there is pus “calciuric sepsis”

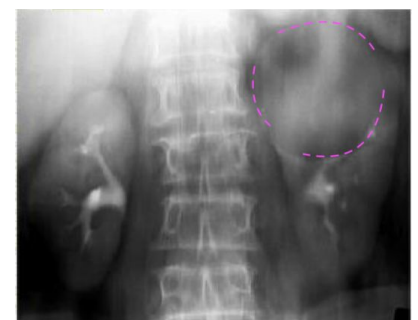


right UPJ stone causing hydronephrosis
UPJ = ureteropelvic junction.

4) Renal Masses:

❖ Approach to renal mass:

- Most renal masses are simple cysts .and we find them by coincidence when we do the US for other reasons
- Use the US to characterize the mass
 - 1) Simple cyst: STOP don't do anything it's completely benign,unless it causes compression symptoms ->we do drainage
 - 2) Solid mass or atypical cyst: CT We should do CT with contrast
- US and CT characterize > 90% of masses > 1.5 cm
- In CT if there is renal or liver mass < 1.5 cm it's difficult to characterize
- Biopsy is rarely warranted. We can diagnose it with CT



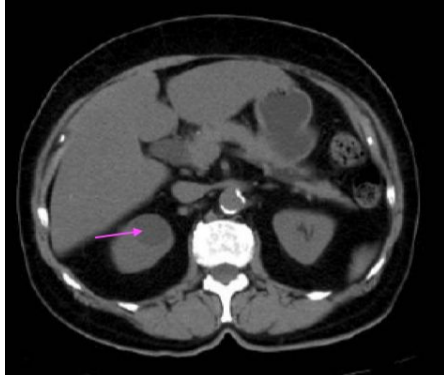
Left Renal mass on IVP
IVP showing mass on the LT kidney, we don't know is it cystic or solid

❖ **Renal Cysts:** "u have to know the simple cyst & mass, nothing other than that "

- US will determine if the lesion is cystic or solid, There are **two types** of cysts.

1- Simple cyst > (imp.)

- Spherical, **regular**
- echo-free in US= **anechoic structure inside. = black**
- fluid collection within a thin surrounding wall. **no thickening, no calcification, no septation**
- will show good sound wave transmission



2- complicated cyst

- will show the presence of echoes within the cyst. **it's not only a simple fluid**
- Will have thick wall
- And /or calcification in the wall

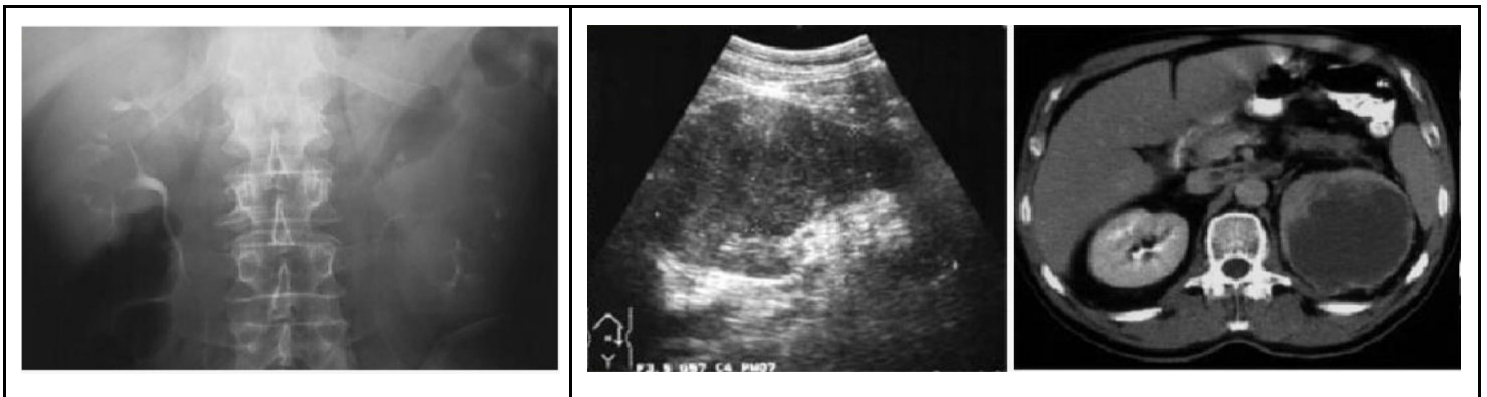
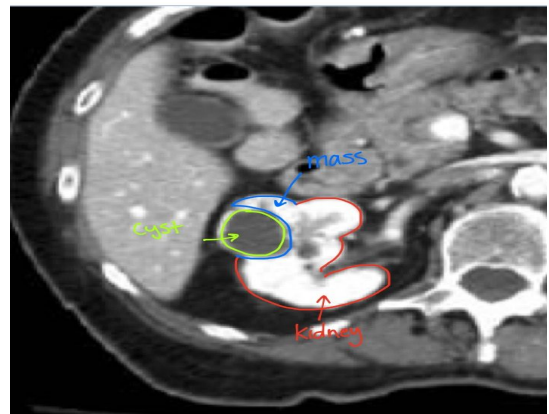
❖ **Renal Carcinoma:**

If US indicates that the mass is solid, **we must do CT with contrast*** that can characterize the tumor in greater details: delineate extent, show;

- 1) Degree of the vascularity,
- 2) Presence/absence of the necrotic center,
- 3) Presence/absence of local invasion of adjacent structures " **renal vein or IVC**"

*If the patient with renal failure we should hydrate the patient and he must undergo dialysis after the procedure. IV contrast is to characterize the lesion better.

PIC: exophytic renal mass with cystic content



● Distortion of left Pelvicalyceal System in IVP. bc **we don't see the contrast** The right kidney is normal.

● Solid left renal mass in a patient with micro hematuria.
 ● US shows **echogenic structure in the kidney** this is not cystic,
 ● CT shows in left kidney a mass with cystic content , and thick irregular wall enhanced with contrast. This is "malignant" renal cell carcinoma, patient presents with microhematuria.

❖ **Renal adenocarcinoma:**

- 90% of all renal malignancies .
- 15-30% metastatic at diagnosis . * It has good prognosis if discovered in stage 1, 5 years survival rate is more than 80%
- Hematogenous and lymphatic spread
- 10% have venous invasion (renal vein or IVC)

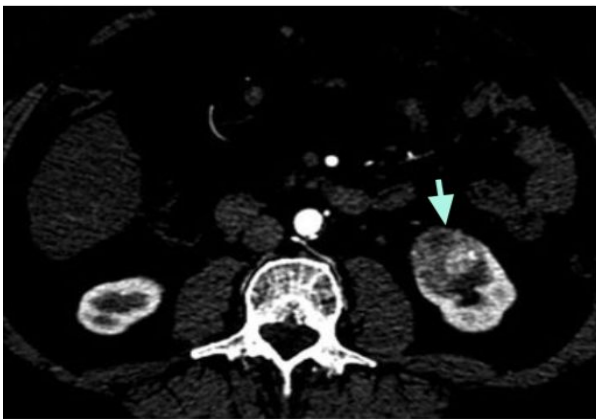
→ **Treatment :**

- 1) Radical Nephrectomy . *mostly it's the treatment of choice
- 2) Partial Nephrectomy .

Appropriate imaging workup: After we discover renal cell carcinoma we should do work up to see if there is metastasis.

- chest X-ray : pulmonary metastases OR "Pulmonary CT is more accurate"
- CT abdomen : local invasion , lymphadenopathy , venous extension .
- MRI abdomen : renal failure, Contrast allergy. MRI is used if the patient is allergic to the contrast or have renal failure.

70 y/o female presented with painless hematuria:



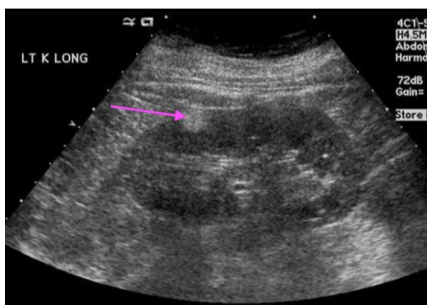
Upper pole malignant mass lesion of the Left Kidney with heterogeneous enhancement



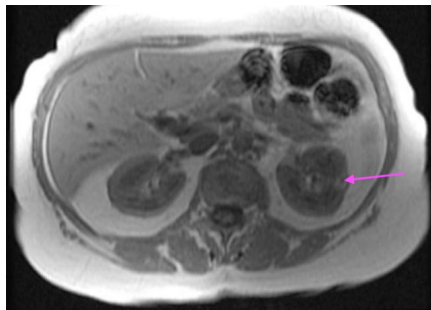
heterogeneous with enhanced part in lower pole so this is: * renal cell carcinoma.
* No invasion
* Some effective mass on the left psoas

❖ **Renal Angiomyolipoma:**

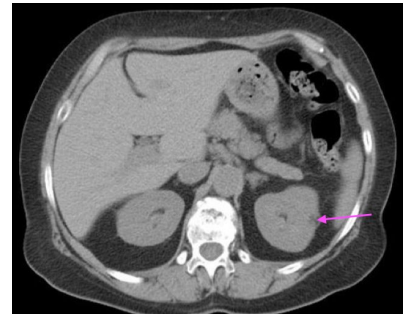
- Benign hamartomatous tumor comprised of fat , smooth muscle and vessels. Angio= vessels, myo= muscle, lipo= fat & oma= benign tumor.
- Usually asymptomatic .
- Occasionally present with hemorrhage when large or multiple . we can see it only if there is hemorrhage with this mass when it's large or multiple and we have to embolize¹ it to control this hemorrhage.
- Fat detected in 96% by CT . (usually do not need surgical intervention).



example of angiomyolipoma in US hyperechogenic Cortical rounded regular structure which is fatty



MRI: hypersignal lesion



CT: Hypodense lesion (so contains fat) of the left kidney

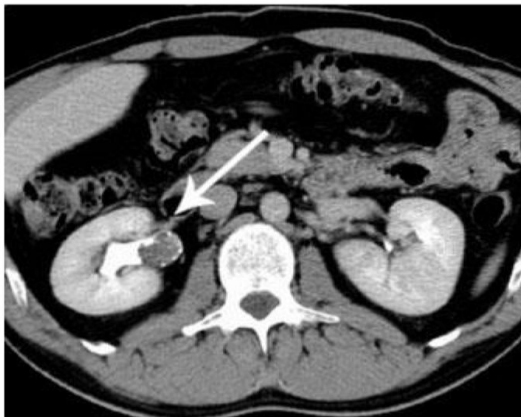
¹ **Embolization** is a minimally invasive treatment that occludes, or blocks, one or more blood vessels or vascular channels of malformations (abnormalities).

❖ **Transitional Cells Carcinoma "TCC":**

- most common malignancy of ureter and bladder
- <10%of renal malignancies .
- Typically present with **gross hematuria** .
- CT for staging and surgical planning
- Treatment : radical nephrectomy.



IVP and retrograde pyelogram TCC proximal left ureter .IVP show distortion of part of the ureter with ureteropelvic junction obstruction and dilatation. TCC was discovered here in left proximal ureter as filling defect.



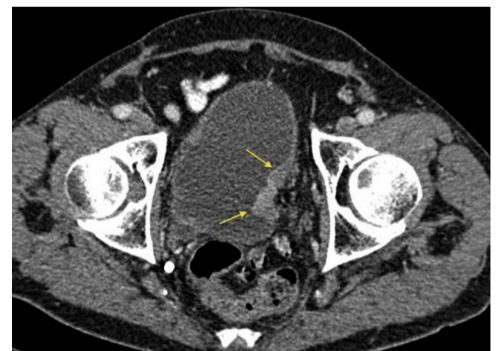
CT + contrast in the pyelograms phase
Large TCC o the right renal pelvis
Seen as filling defect. of proximal ureter



irregular TCC at the ureteropelvic junction



- Small TCC of bladder in patient with hematuria.
- Small bladder mass with dilatation of the ureter.



irregular thickening (malignant)

5) Renal failure

❖ Acute and Chronic Renal Failure:

- Clinical categories :

- prerenal (dehydration , shock , cardiac failure)
- Renal (parenchyma , diabetes , GN , drugs , renovascular)
- Postrenal (obstruction, **by chronic mass or chronic stone or malignancy**)

- IV contrast **contraindicated** if creatinine >200 mmol/dl **or the clearance**

is less than 30 ml/min. Sometimes if patient is 90 years old they should be careful when they give the contrast because may develop renal failure so we should hydrate very well and give HCO₃ to protect the kidney

- Use US to assess :

- Renal size **“with chronic renal failure the kidney is atrophic & thinning in the cortex”.**
- Parenchymal thickness

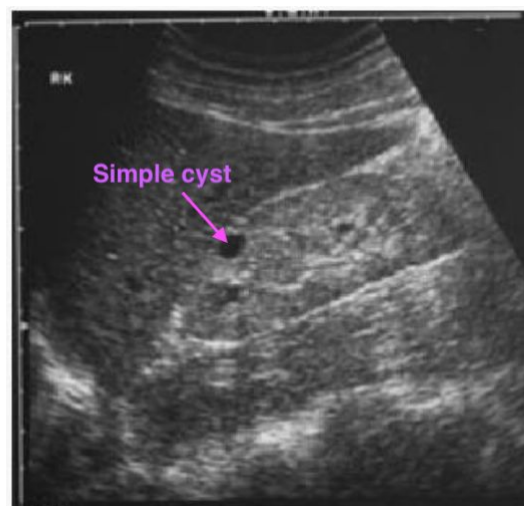
- US guided renal biopsy to establish diagnosis.

Acute	Chronic
Kidney is enlarged in size	Kidney is small in size
Oedematous	No darkness in the cortex
Obstruction	Bright echo pattern
	cysts can be seen.



Hydronephrosis post-renal

- Acute, surgically treated
- Post-renal obstruction will lead to renal failure



“Atrophic , echogenic kidney” Medical renal disease

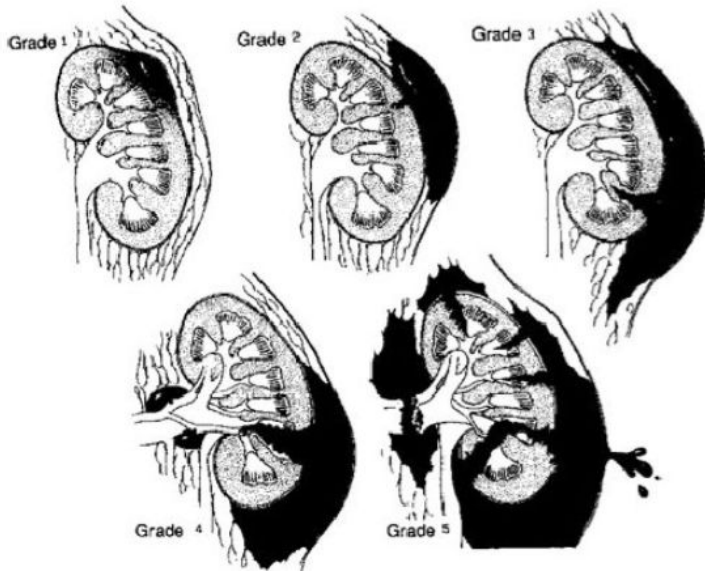
- No differentiation between the cortex and medulla,
- Undifferentiated kidney = nonfunctioning kidney.
- Medical renal disease (not surgical, treat underlying disease e.g. DM, HTN, glomerulonephritis, congenital disease...)

6) GU Trauma

❖ Penetrating Trauma (gunshot, stab):

- Unstable -> surgery or angiography (if there is extravasation of contrast we should embolize)
- stable -> CT (used to grade the injury)

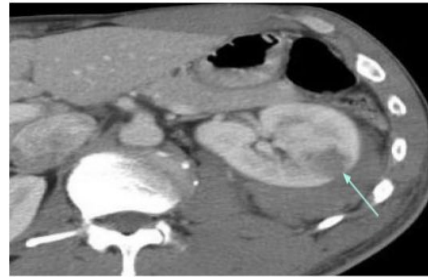
RADIOGRAPHIC ASSESSMENT OF RENAL TRAUMA



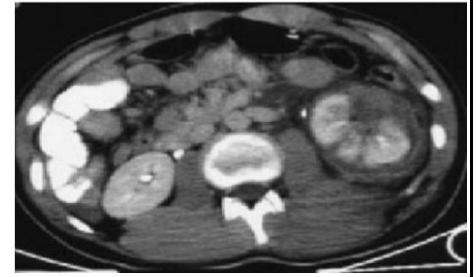
Grade 1	Hematoma, only contusion of kidney
Grade 2	Hematoma enter cortex, laceration in the cortex <1cm
Grade 3	>1 cm but not extending into collecting system
Grade 4	Extend to renal pelvis extending to the collecting system
Grade 5	Shattered kidney completely around the kidney



Grade 1-2 injury. filling defect means laceration



Grade 3 injury. Not extending to the collecting system, hypodense non enhanced area in patient with trauma history.



Grade 4 injury: deep laceration with perirenal hemorrhage, injury extending to the collecting system and there is perirenal hemorrhage and hematoma.

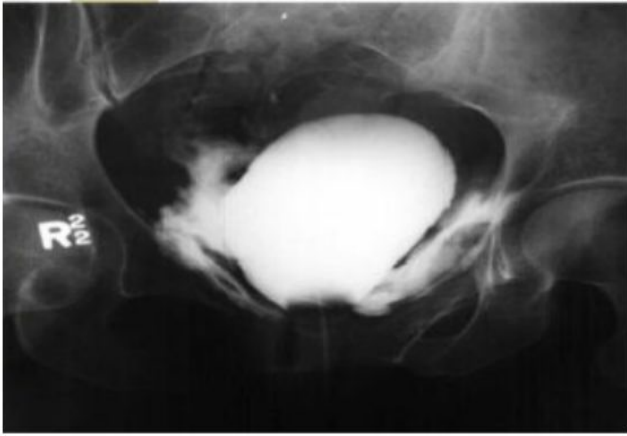


Grade 5 injury: thrombosed renal artery

Kidney non enhanced at all there is thrombosis of right renal artery which completely cut down in angiography we don't see the right kidney at all. " arrow"



bladder injury either extraperitoneal or intraperitoneal. In trauma patient we see blood at urethral meatus we should do retrograde cystography "Inject contrast by retrograde catheter" will see the contrast either extra or intra peritoneal.



Extraperitoneal bladder rupture:

- Just apply catheter to drain, until the body heal the injury.



intraperitoneal bladder rupture

- Surgical management
- intraperitoneal we see the contrast over the peritoneum and intraperitoneal bladder rupture usually in pediatric age group when bladder still in the abdomen.



CT showing bladder injury with contrast all over around the bladder and this is extraperitoneal.



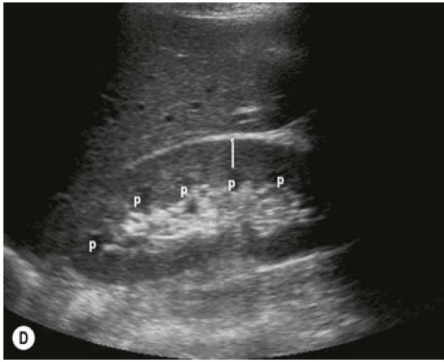
Normal retrograde urethrogram, we see all parts of urethra



Traumatic rupture of bulbous urethra. The contrast drained out of the urethra.

SPOT DIAGNOSIS

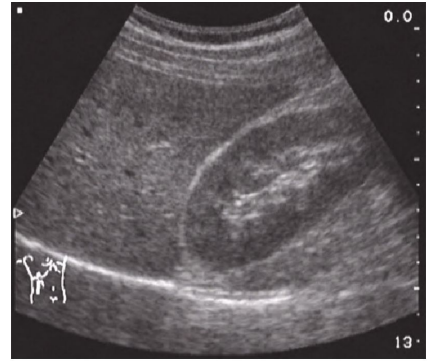
Ultrasound



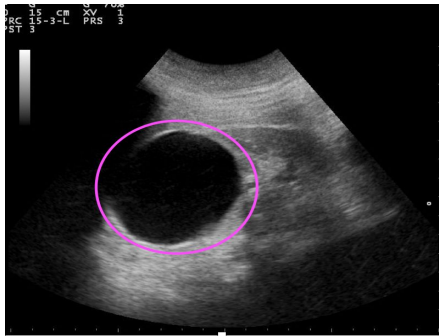
normal



Normal



normal



simple cyst thin wall



STONE with shadow



normal



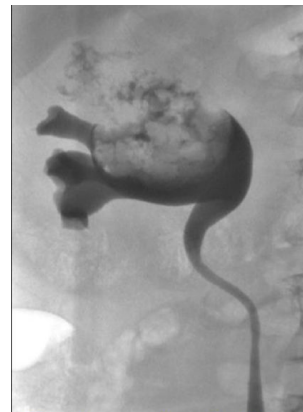
normal filled bladder

KUB



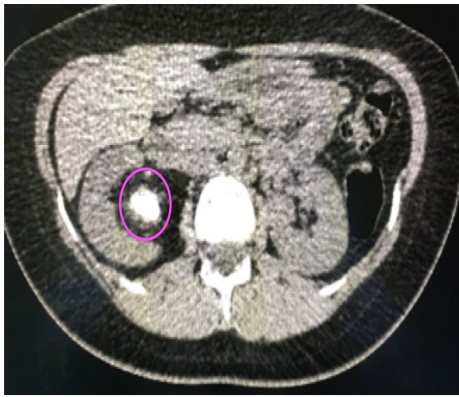
Stone

IVP (contrast is black bc image's been manipulated):P

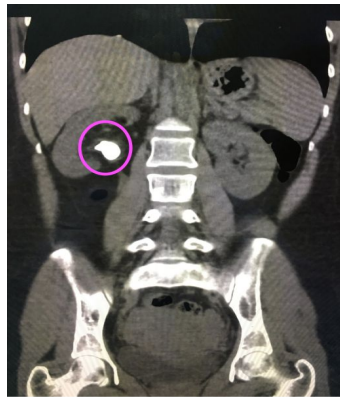


- Mass in upper the collecting system with filling defect & dilatation
- It's **Transitional cell carcinoma**

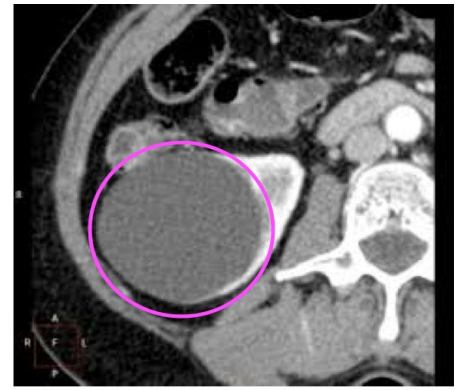
CT



Stone



stone



simple cyst



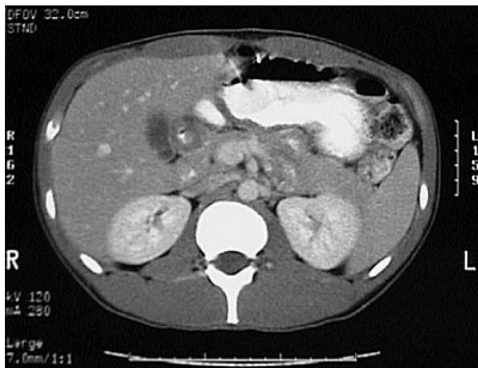
polycystic renal disease



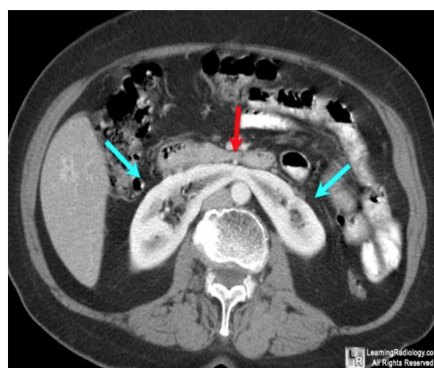
normal



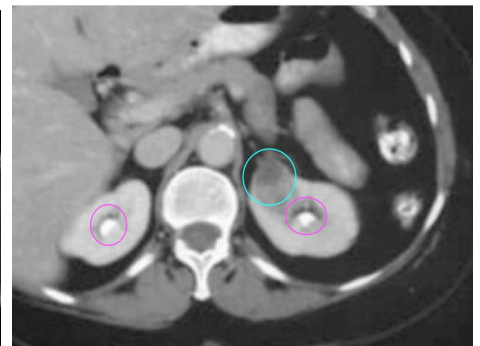
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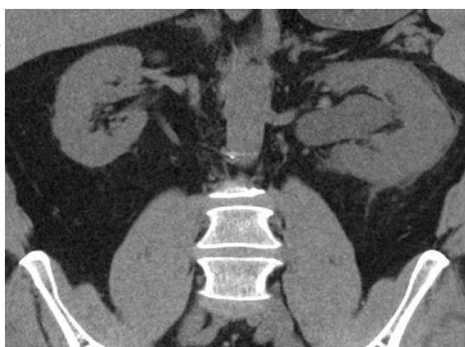
normal



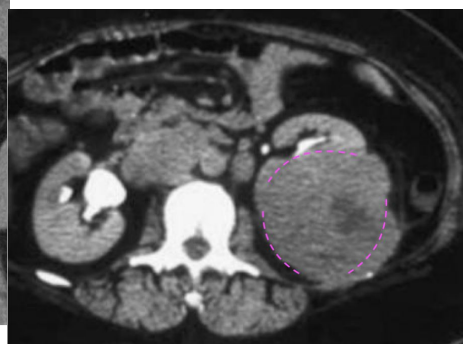
horseshoe kidney



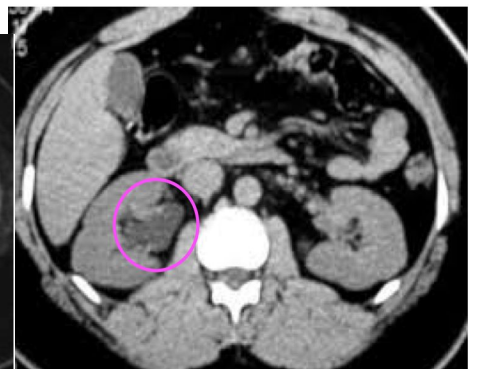
stone mass



hydronephrosis



mass

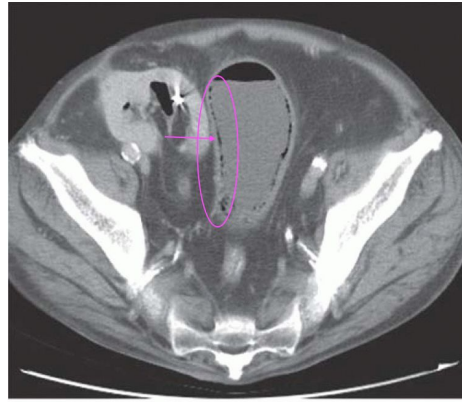


dilated calyces
hydronephrosis

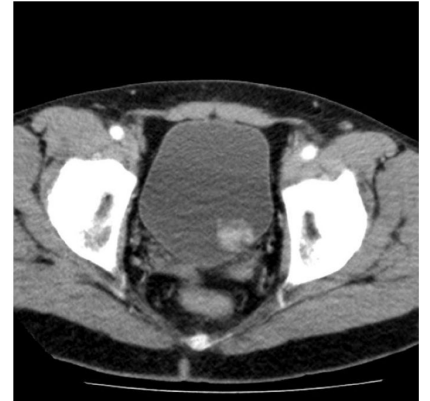
cont. CT



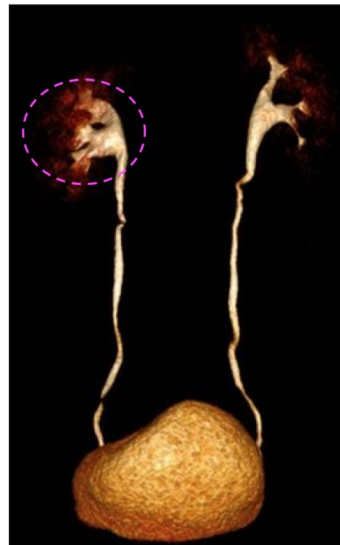
Normal



-Thickening wall
- emphysematous cystitis (the black area between fluid and the wall)



mass lesion in the bladder



3D reconstruction CT
mild dilation of pelvicalyceal system