

Radiology Team 429

RADIOLOGY OF URINARY SYSTEM DISEASES



Radiology Team 429

In this team we used the outlines from
the:
Doctor's slides
Lecture notes
427 Radiology team
Diagnostic Imaging –PETER ARMSTRONG
– 6Th Edition

Sorry we don't hold responsibility for any
missing information or perhaps –
perhaps -wrong material.

We tried our best to present this lecture in
the best way, and we hope what we
wrote is enough to cover the subjects.

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Best Wishes :)

Pathological Conditions of The Urinary Systems

- A. Renal colic: Could be due to renal stone
- B. Urosepsis: Due to obstruction which lead to inflammatory process
- C. Renal mass
- D. Acute/ chronic renal failure
- E. Trauma

The 2 most common complaint of GU is :

1- renal colic 2-hematouria

Terminology X-ray

Radiopaque

- doesn't allow x-ray to pass
- White color e.g. bone



Radiolucent

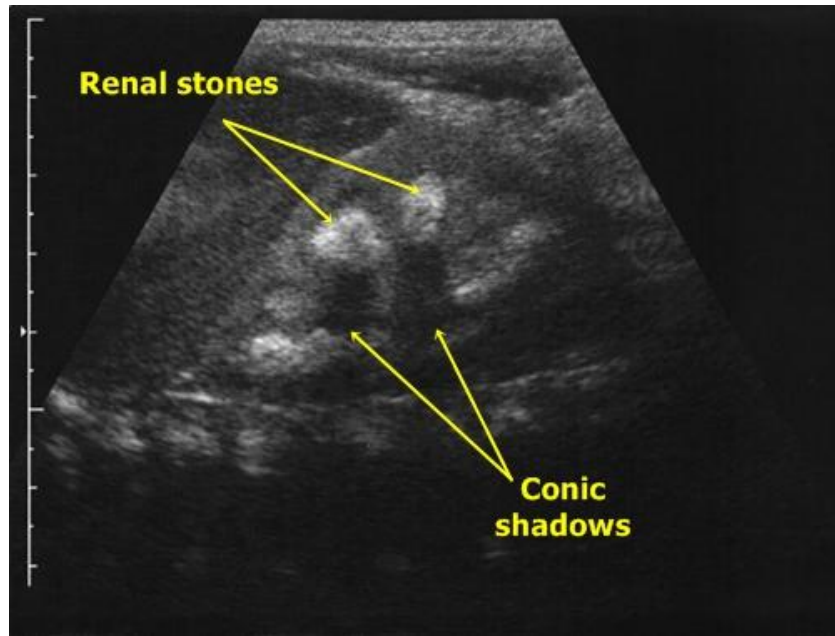
- allows x-ray to pass, appears dark
- e.g. air , cartilage, soft tissue



Terminology Ultrasound:

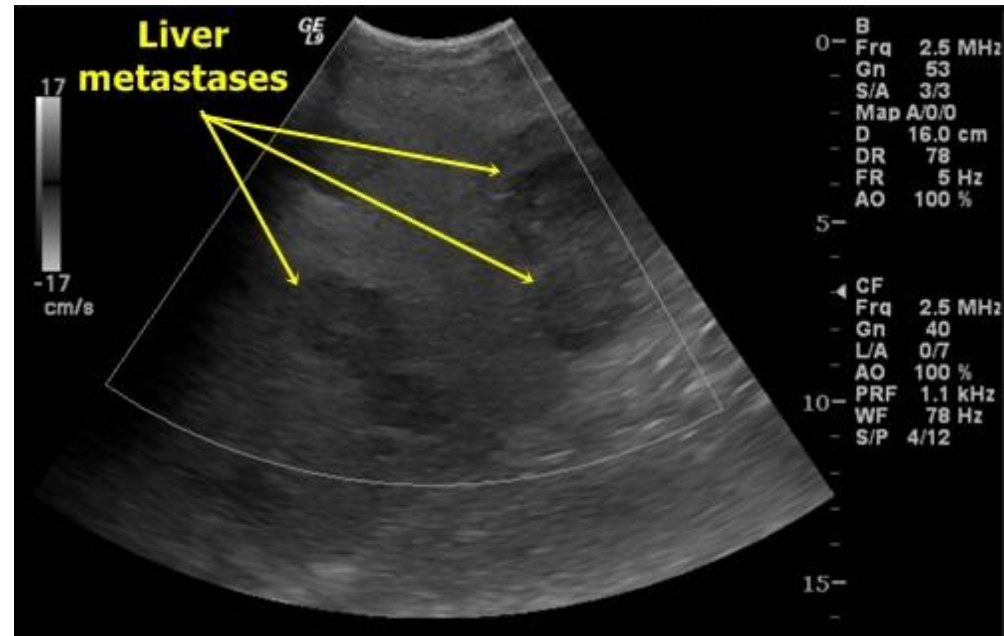
Hyper-echogenic

- There are many internal echoes
- Hyperechoic tissues appear bright and white e.g. fat ,



Hypo-echogenic

- Few internal echoes
- Hypoechoic structures appear dark and black e.g. fluid (echolucent)



A. Renal Colic

- A type of abdominal pain, often colicky (comes in waves) due to ureteric peristalsis
- To know what is causing the pain, ask these questions:
 - Are urinary stones present?
 - If so, what is the level and size? (depends on location and size)
 - Are obstructions present? (severity)
 - If so what is the level and severity?
 - Is urgent intervention required?
- Factors include: urosepsis, solitary kidney, severe pain
- **Treatment:** percutaneous nephrostomy or ureteric stent

1. Renal Stones

Also called **renal calculi**

Management dictated by size and location of stones:

- ESWL monotherapy: if the stones are in the kidney
- Ureteroscopy: stones in the ureter
- Percutaneousdebulkingand ESWL: if ESWL alone didn't work
- Surgery is rarely necessary

Renal Stones

Imaging :

X-ray: calcifications appear as radio-opaque shadow

- So if the stone does not appear in x-ray try the US
- In the plain film we can only look at the organ's shadow not the organs themselves



Plain film (KUB):

There is an opaque shadow projecting the right kidney or the right side of the abdomen .

Renal Stones Imaging

X-ray



- Top: Staghorn calculus: a large renal calculus with multiple irregular branches.
- Bottom: The site of the radiopaque object has to be confirmed. i.e. in this picture, it looks like a renal colic, but when it was confirmed it turned out to be gallstones

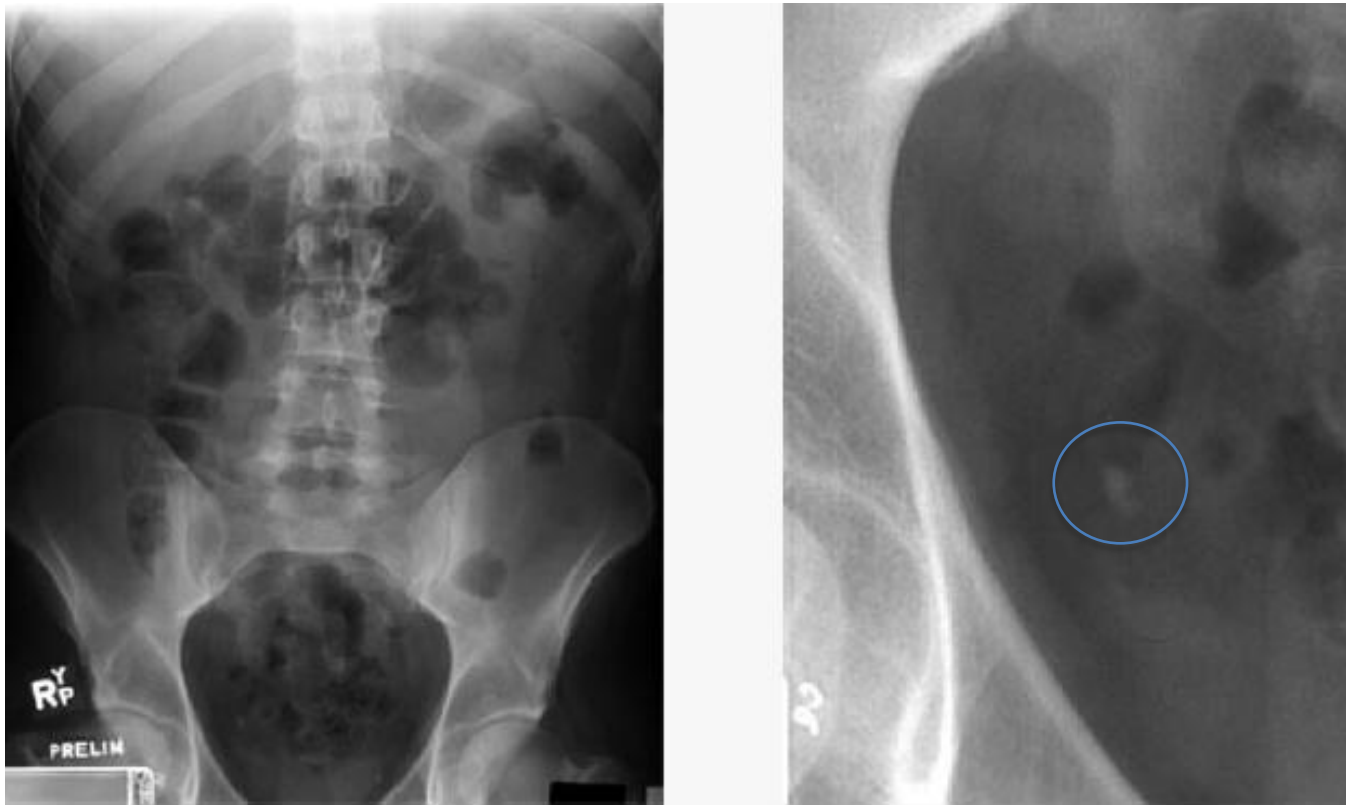


- Most urinary calculi are calcified and show varying density on plain x-ray examinations.
- Many are uniformly calcified but some, particularly bladder stones, may be laminated.
- Only pure uric acid and xanthine stones are radio lucent on plain radiography, but they can be identified at CT or ultrasound.
- Small renal calculi are often round or oval; the larger ones
- frequently assume the shape of the pelvicaliceal system and
- are known as staghorn calculi

Renal Stones Imaging

X-ray

- An opaque shadow could be a stone in the ureter, bladder or classified vessels
- Stone in the ureter barely seen so we magnified it

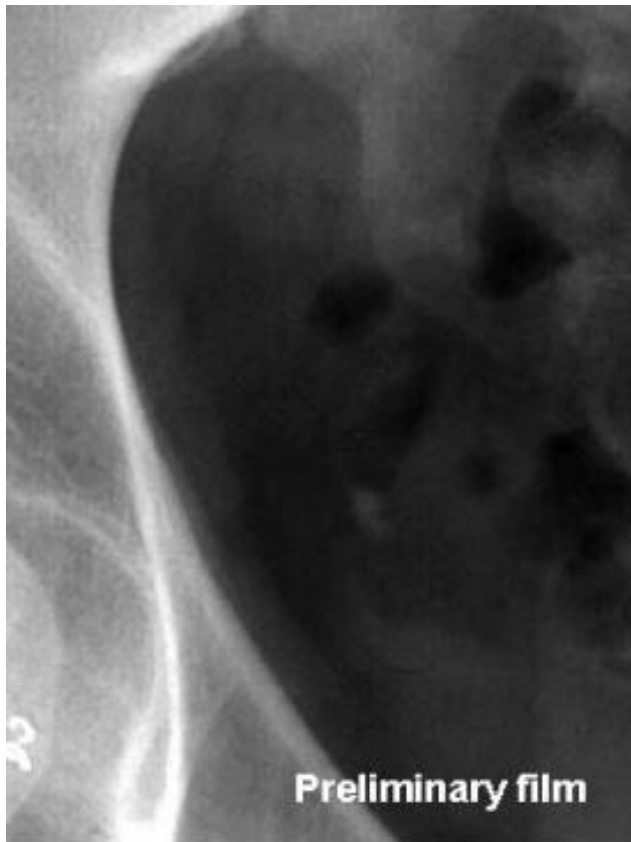


Preliminary film in patient with right renal colic

Renal Stones Imaging

X-ray

Dilated Ureter b/c
of an obstruction



Radiopaque stone distal ureter

Renal Stones Imaging

IVP



10 minutes

Delayed function
on right side



25 hours

Persistent nephrogram



29 hours

Dilated ureter to stone

It Demonstrates both function and structure of the renal system .

Function → filtration

Structure → Contrast filled filtration system

Renal Stones Imaging

IVP



Radiolucent uric acid stones

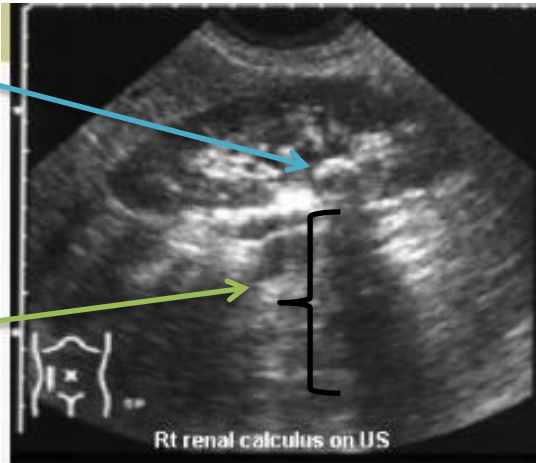
Left: Black shadow: gas (negligible)

Right: Uric acid stone in the pelvis of the left kidney

Renal Stones Imaging Ultrasound

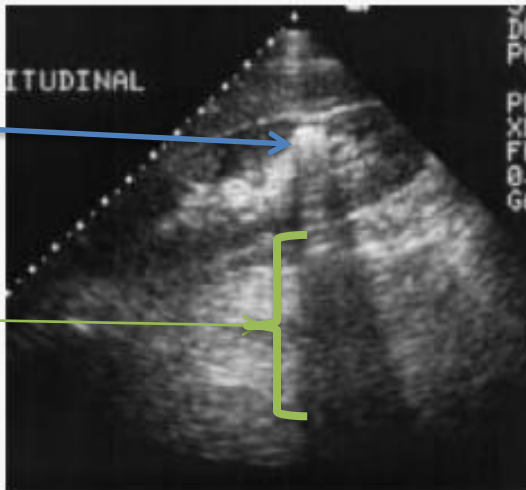
1-In the kidney :
Hyperechoic
shadow
(stone)

Acoustic
shadow
posterior
to the
stone



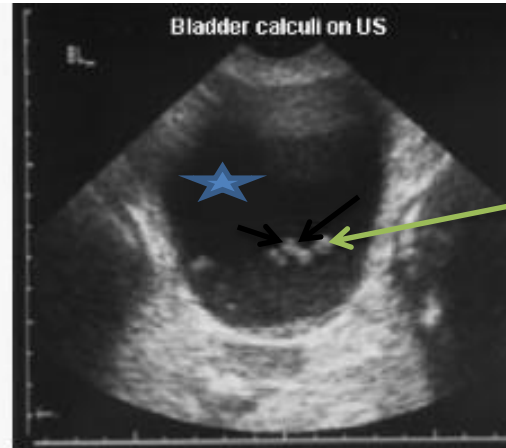
Stone(hyperechoic shadow)

Acoustic shadow



★ 3-In urinary
the bladder the
all black inside
it is the
urine(because
fluids are black
in ultrasound)

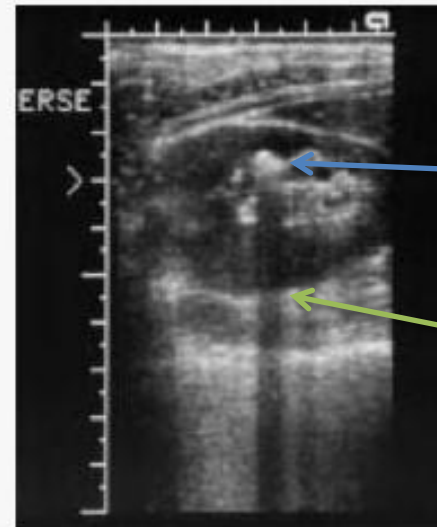
Hyperechoic
shadow(mult
iple stones)



Kidney
stones

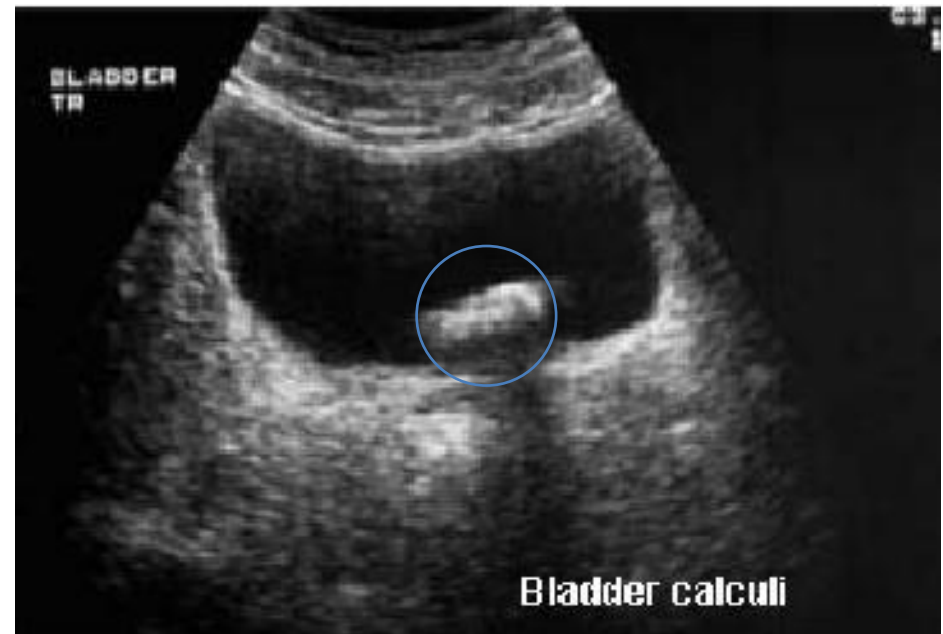
Hyperechoic
shadow

Acoustic
shadow



Renal Stones Imaging

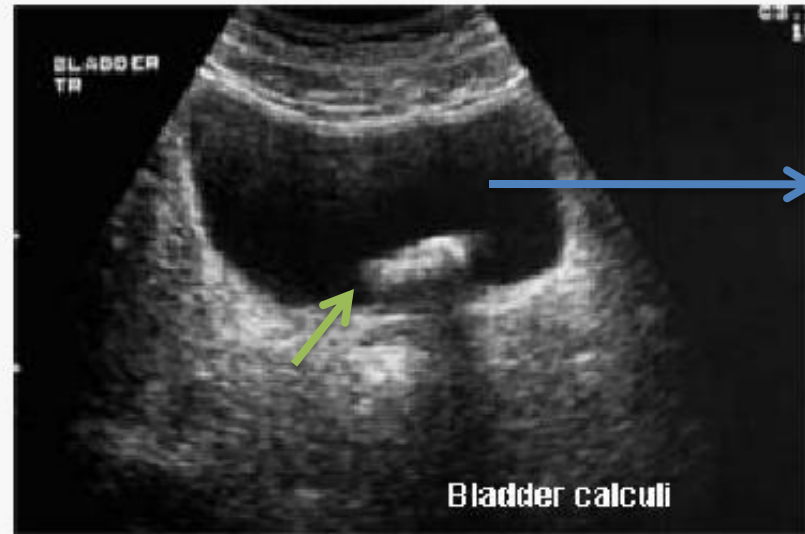
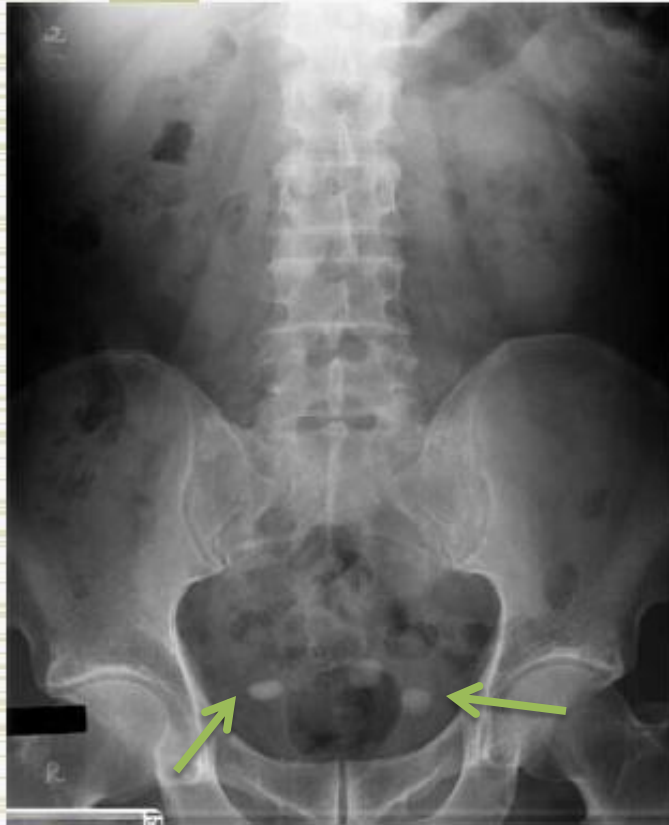
Ultrasound



In US, the term hyperechoic is synonymous with radiopaque in X-Ray. In this picture, there is a hyper echoic object with a longitudinal shadow underneath, called acoustic shadow. Acoustic shadow is formed by the impact of US on a calcified object.

Microscopic Hematuria Bladder Calculi

Ultrasound : hyperechoic
The *hyperechogenicity*
(bright in color) is the stone



The
dark
color is
urine

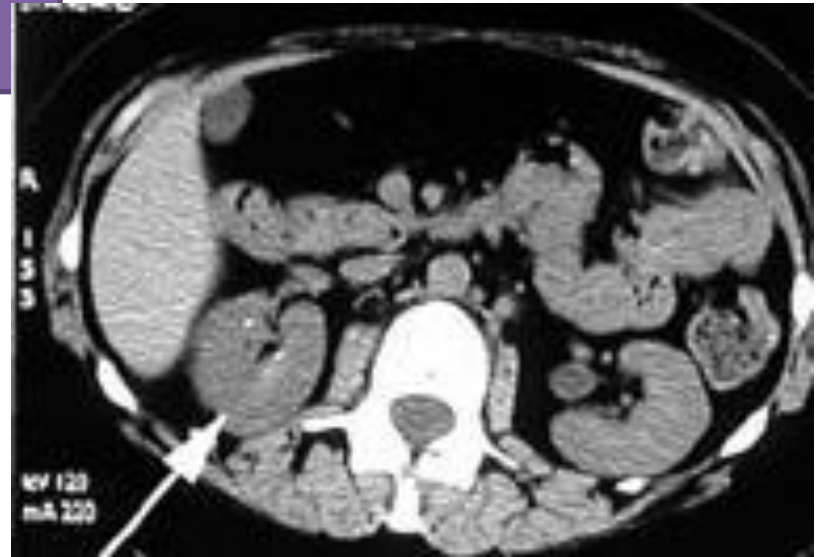
KUB : (radiopaque stone)

U can see an opaque shadow (bright in color) in the pelvic region & these shadow could be a stone in the bladder or distal ureters

Renal Stones Imaging

CT

- The stones in CT are called either : hyperdense or hypodense.
- In CT, Hyper dense is also synonymous with radiopaque in X-Ray.
- There are some hyperdense shadows which are stones in the renal pelvis
- Stones in pelvi-ureteric junction are hyper dense
- Top picture: Small hyperdense shadows (stones in the calyx)
- Bottom: Bilateral hyper dense objects in the renal pelvis, and to some extent in PUJ



Complication of Renal Stones

Hydronephrosis:

- Hydro → water, Nephrosis → dilatation of the pelvicalical system
- Picture: hydronephrosis in the kidney by CT as a grey shadow in the right kidney
- There Is fluid in the pelvicalicalsystem(it is dilated) → there is obstruction in the ureter (stone,tumor)
- Hydroureter → fluid in the ureters



B. Urosepsis

- Inflammatory changes in the urinary tract Can caused by: obstruction(bystone)→urin stay for long time in the kidney→causeinfalammtion→pus produced
- Establish a clinical diagnosis: pyelonephritis, cystitis, prostatitis
- Urosepsis and an obstructed ureter is a urologic emergency
- Renal US performed to rule out :
 - 1- Renal obstruction
 - 2- Renal or perirenal abscess

Imaging Ultrasound

- Pyonephrosis: Pyo → pus
Nephrosis → dilatation
- Severe hydronephrosis: renal parenchyma is too thin and almost lost
- Appearing as not complete hyperechoic shadow (means it is thick fluid=pus)

- Here there is no pus because the obstruction is partial not complete and some urine can be excreted .



Left pyonephrosis



Right UPJ stone causing
hydronephrosis

Ultrasound showing a right pyonephrosis and obstructing UPJ stone

Imaging X-ray



Percutaneous nephrostomy
for decompression



2 weeks post ESWL

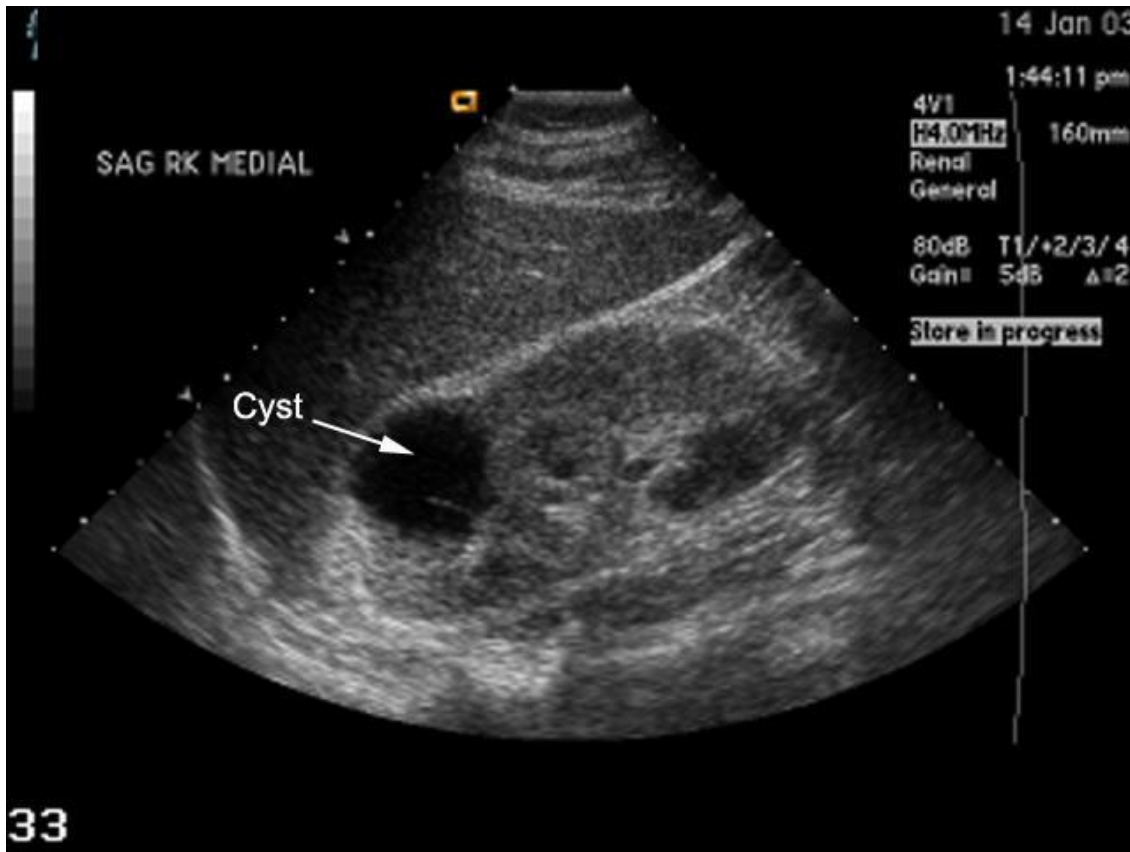
Because there is stone obstructing and to prevent the urosepsis

C. Renal Mass

Approach to renal mass:

- Most renal masses are simple cysts
- Could be cyst or tumor (benign or malignant)
- Use US to characterize the mass
 - Simple cyst : STOP
 - Solid mass or atypical cyst : CT
- US and CT characterize > 90% of masses > 1.5 cm
- Biopsy is rarely warranted

Renal Mass Imaging Ultrasound



- US is the ideal investigation for masses
- Cysts are more hypoechoic than masses
- Hypoechoic lesion “dark → fluid “ which means a renal cyst “

Renal Mass Imaging

This is an IVP study and it's difficult to determine the mass ..
But you can see that there is some mass on the upper pole of the Lt. kidney. “ well defined, rounded → cyst “ .. And if it's Taking the plevis shape →hydronephrosis”



Left renal mass on IVP

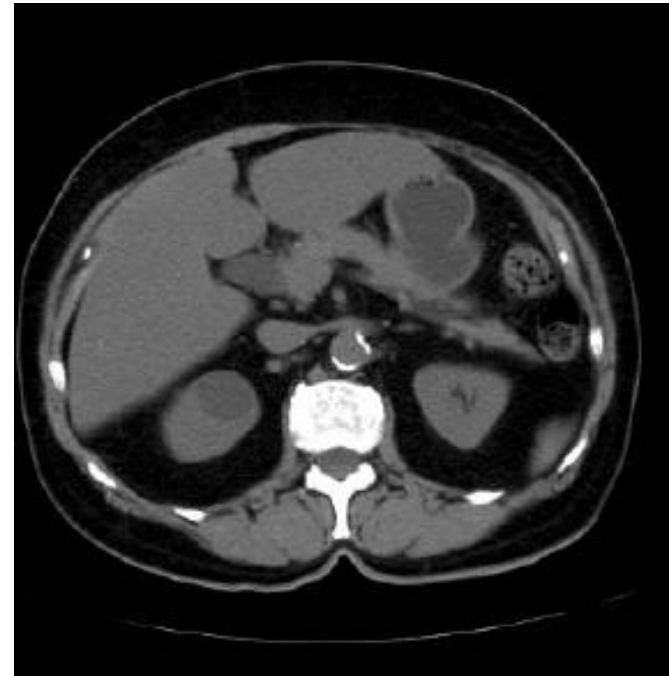


Simple cyst on ultrasound

Renal Mass

1. Renal Cyst

- US will determine if the lesion is cystic or solid
- 2 types of renal cysts:
 1. Simple: no soft tissue, well circumscribed, 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 or soft tissue in the wall. Needs further investigation



Right kidney mass → cyst
You can compare densities with the stomach
..
Why it's not hydronephrosis ?
Because it's not taking the shape of the renal pelvis.

Renal Mass

2. Renal Carcinoma

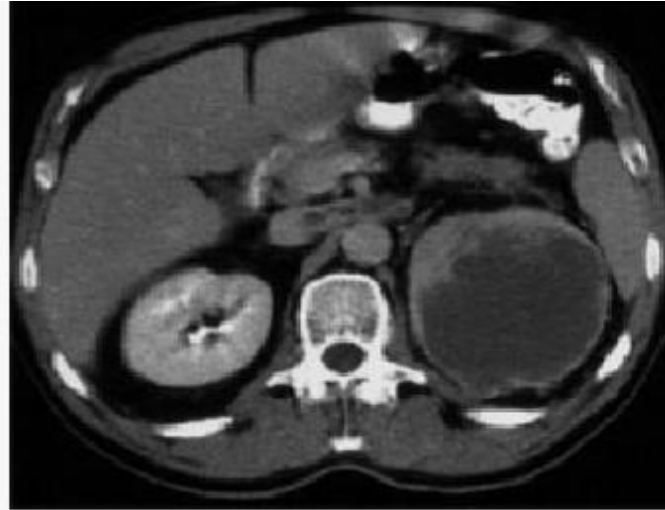
- If US indicates that the mass is solid
- CT with IV contrast can characterize the tumour in greater detail:
 - delineate extent
 - show the degree of vascularity
 - presence/absence of local invasion of adjacent structures
- Originates in the lining of proximal convoluted tubule



RT. Kidney cyst .. And why is it not taking the contrast ?

Because the necrotic core can't absorb the contrast hence the dark color

Renal Mass Imaging



Masses are less hypoechoic in US
The whole kidney is invaded by a solid mass.

Solid left renal mass in a patient with micro hematuria



Distortion of left pelvicalyceal system in IVP

Renal Mass

3. Adenocarcinoma

- 90% of all renal malignancies
- 15-30% metastatic at diagnosis
- Hematogenous and lymphatic spread
- 10% have venous invasion (renal vein or IVC)
- **Treatment:**
 - Radical nephrectomy
 - Partial nephrectomy
- **Appropriate imaging workup:**
 - Chest X-ray: pulmonary metastases
 - CT abdomen: local invasion, lymphadenopathy, venous extension
 - MRI abdomen: renal failure, contrast allergy

Renal Mass

4. Angiolipoma

- Benign hamartomatous tumor comprised of fat, smooth muscle and vessels.
- Usually asymptomatic
- **Most common** benign kidney tumor
- Occasionally present with hemorrhage when large or multiple
- Fat detected in 96% by CT

Renal Mass

5. Transitional Cell Carcinoma

- **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

Renal Mass Imaging

Transitional Cell Carcinoma



IVP and retrograde pyelogram TCC proximal left ureter

Dilated Lt. pelvis due to obstruction in the proximal left ureter.

Renal Mass Imaging

Transitional Cell Carcinoma



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

IVP: Hydronephrosis + half full bladder due an obstructive mas
In CT the bladder looks like it is divided into 3 parts .. Shining part is the contrast what's aboveitis urine .. On the sideis the mass TCC

Renal Mass Imaging

Transitional Cell Carcinoma

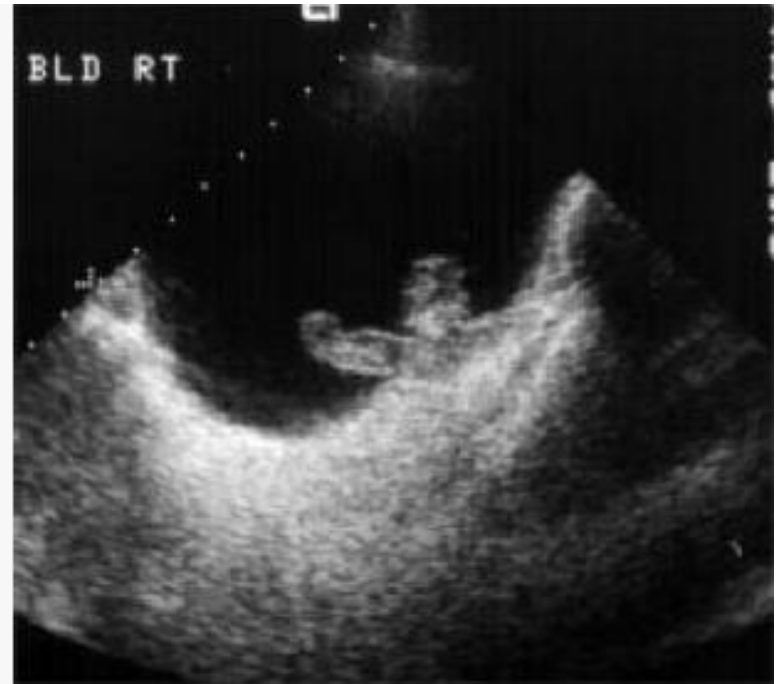


Small TCC of bladder in patient with hematuria

Filling defect

Renal Mass Imaging

Transitional Cell Carcinoma



Bladder TCC in two patients

Less hyperechoic than stones

Masses don't have any acoustic shadows

And they are less hyperechoic than stones .. But they are still considered hyperechoic.

D. 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

Acute and Chronic Renal Failure Imaging



Hydronephrosis post-renal



Atrophic, echogenic kidney
Medical renal disease

Left: hydronephrosis + renal failure

Hydronephrosis caused the renal failure, hence the term “post”

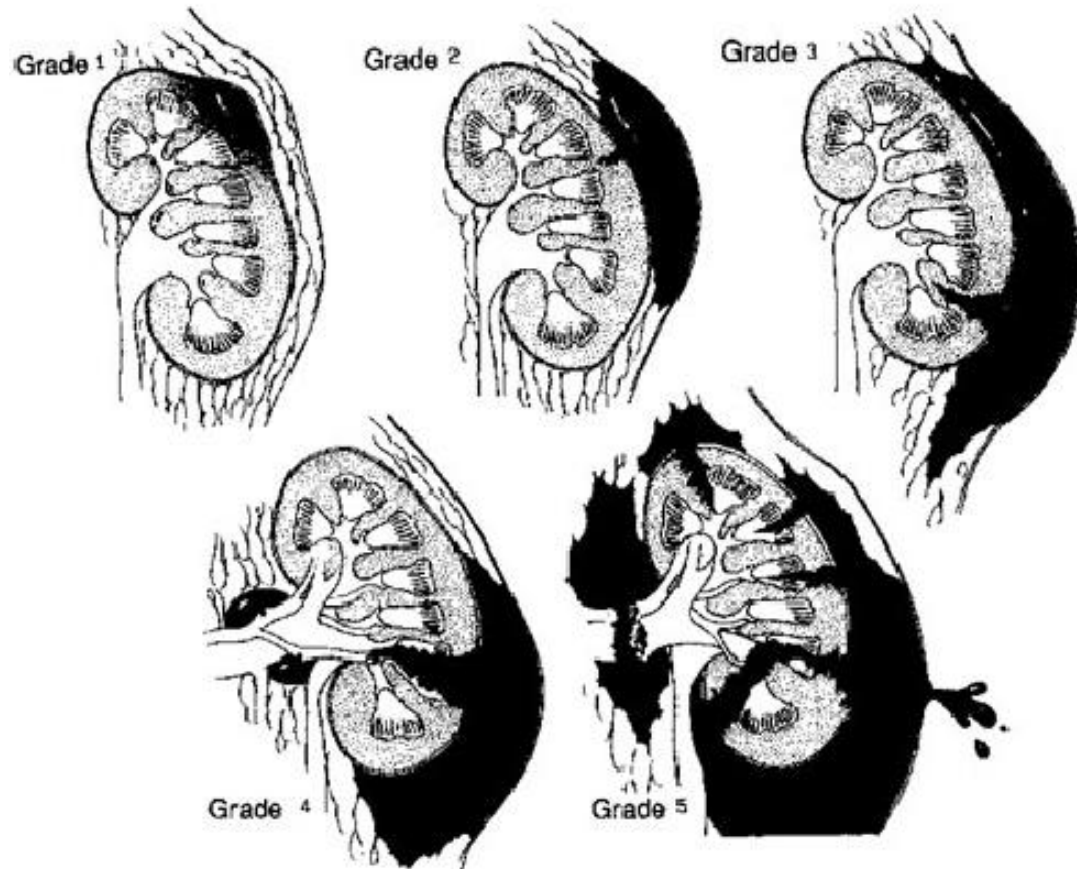
E. GU Trauma

Penetrating trauma

(gunshot, stab)

- **Unstable:** Surgery or angiography
- **Stable:** CT
- 5 grades of renal trauma :
 - 1: contusion
 - 2: laceration with some hematoma
 - 3: laceration more than 1 cm inside
 - 4: laceration reaching pelvis + ureter
 - 5: involving blood vessels also.

RADIOGRAPHIC ASSESSMENT OF RENAL TRAUMA



GU Trauma Imaging



Grade 4 injury: deep lacerations with perirenal hemorrhage

GU Trauma Imaging



Grade 5 injury: thrombosed renal artery

GU Trauma Imaging



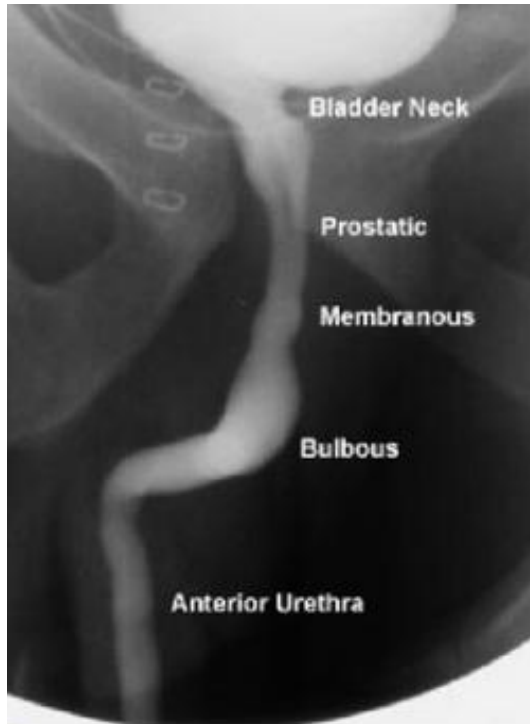
Extraperitoneal bladder rupture



Intraperitoneal bladder rupture

Cystogram to see the bladder which is injured and you can see that by looking at the contrast that it's reaching outside of bladder → **Extravasation**

GU Trauma Imaging



Normal retrograde
urethrogram



Traumatic rupture of bulbous urethra