



430 Radiology team

Lecture

Radiology of urinary tract diseases

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Resources:

- Lecture by Dr. Sultan Alharbi
- Diagnostic Imaging (Armstrong, Diagnostic Imaging) by Peter Armstrong, Martin Wastie and Andrea G. Rockall (May 12, 2009)

Urinary tract pathologies:

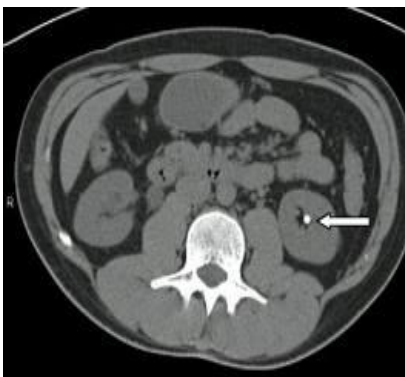
- ▶ Urinary tract stones.
- ▶ Urinary tract trauma.
- ▶ Urinary tract infections.
- ▶ Urinary tract tumors.
- ▶ Urinary tract congenital anomalies.
- ▶ Renal impairment.

Case One

29 year old female patient presented to the emergency department complaining of acute sudden severe right flank pain radiated to the groin for 1 hour associated with hematuria.

- ▶ What is the likely diagnosis?
Renal stone.
- ▶ What investigation you will request?
Non-contrast CT (gold standard)

- We can use x-ray or ultrasound but the best is non-contrast CT.
- MRI has no role in this case.



Non-contrast CT
(gold standard)



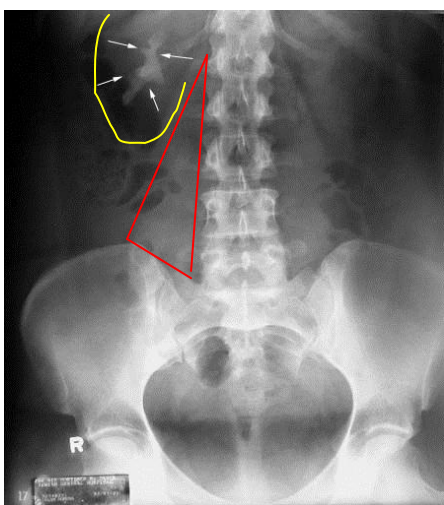
contrast CT
coronal section.



Non-contrast CT
oblique sagittal reformate shows
proximal ureteric stone with
dilatation of the renal pelvis.

- ▶ What are the findings you expect to see?
Dense radiopaque structure.

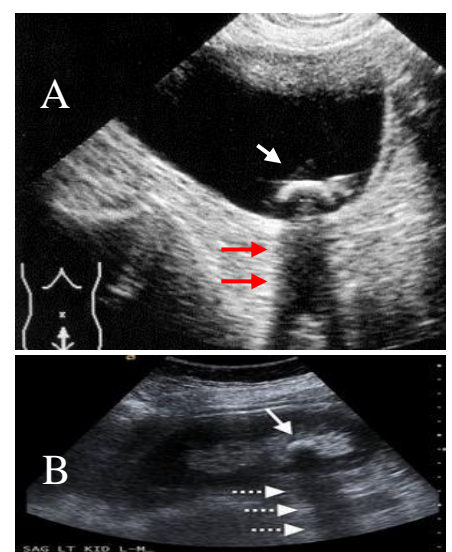
Renal stone findings in other imaging modalities:



x- ray → staghorn calculi.
(large radiopaque stones
filling the pelvicaliceal
system).
Red: psoas muscle.
yellow: kidney.



IVU → dilated renal pelvis +
stone will appear as filling
defect.

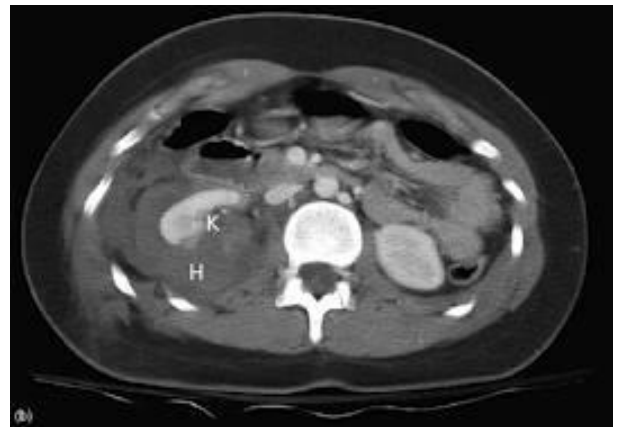


US → hyperechoic structure
(oblique arrow) + posterior
acoustic shadowing
(horizontal arrows).
(A) Stone in the urinary
bladder.
(B) Stone in the kidney.

Case Two

36 year old male patient involved in road traffic accident. On examination patient is conscious oriented and in pain. Abdominal examination revealed diffuse guarding and tenderness.

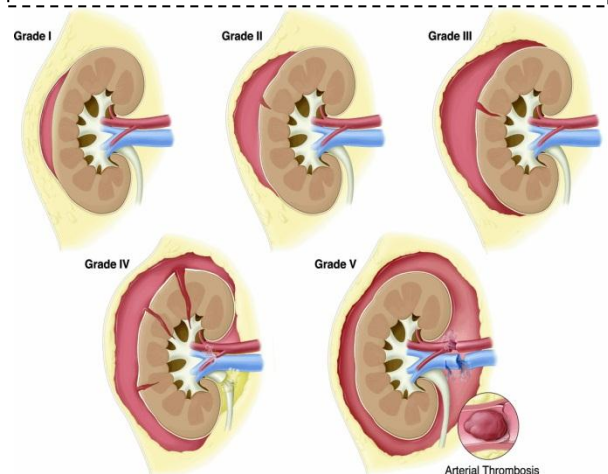
- ▶ What is the likely diagnosis?
Traumatic injury to abdominal viscera.
- ▶ What investigation you will request?
CT with IV contrast.
- ▶ What are the findings you expect to see?
 - **No perinephric fat.**
 - **Displaced kidney**
 - **Hematoma (H)**



CT scan with IV contrast of the abdomen at the level of the kidneys showing evidence of right kidney injury(k).

Grades of renal injury:

- Grade 1 → contusion and subcapsular hematoma.
- Grade 2 → parenchymal laceration <1cm.
- Grade 3 → parenchymal laceration >1cm.
- Grade 4 → parenchymal laceration extending to cortico-medullary junction into the collecting system.
- Grade 5 → major laceration resulting in shattered kidney and devascularisation of kidney (therefore the kidney will not be enhanced by contrast). Tx: remove kidney.



Case Three

34 year old male patient involved in road traffic accident presented to emergency department with multiple pelvic fractures. After stabilization of the patient and orthopedic fixation of the fractures . The patient give history difficulty in urination.

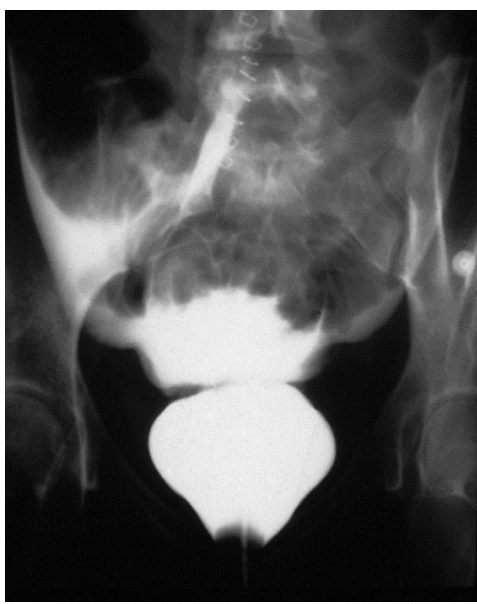
- ▶ What is the likely diagnosis?
Urinary bladder rupture and urethral injury.
- ▶ What investigation you will request?
Contrast studies : micturating cystourethrogram & ascending urethrogram.
- ▶ What are the findings you expect to see?
 - MCUG→Leakage of contrast into peritoneum.**
 - AU→Leakage of contrast outside the urethra.**

Urinary bladder rupture classification:

Lower part (base) rupture→ extraperitoneal leakage.

Upper part (dome) rupture → intraperitoneal leakage. (usually there is blunt trauma to fully distended bladder).

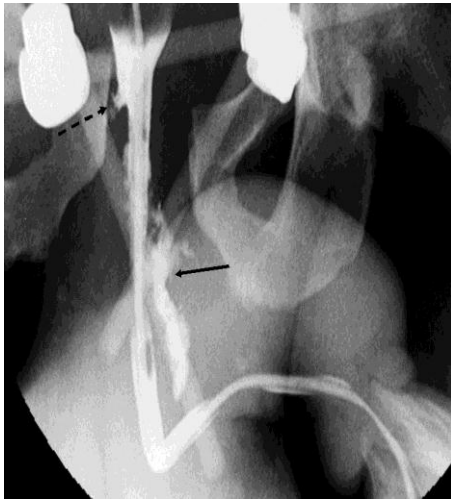
Urinary bladder rupture is usually accompanied with pelvic bone fractures.



Micturating Cystourethrogram showing intraperitoneal leakage.



CT showing leakage of contrast into abdomen indicating urinary bladder rupture.



Ascending urethrograph showing Leakage of contrast outside the urethra.

Case Four

49 years old male patient smoker for 30 years. Presented to primary health care with complaint of hematuria and weight loss. Patient denied history of flank or pelvic pain.

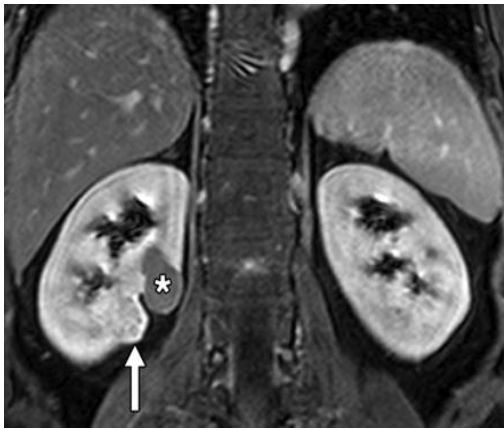
- ▶ What is the likely diagnosis?
Tumour
- ▶ What investigation you will request?
CT with contrast & MRI
- ▶ What are the findings you expect to see?
 - **Heterogeneous mass in the kidney**
 - **Less enhancement in the centre of the mass.**

MRI is the second choice.
indications:
-Contrast allergy.
-Renal impairment.

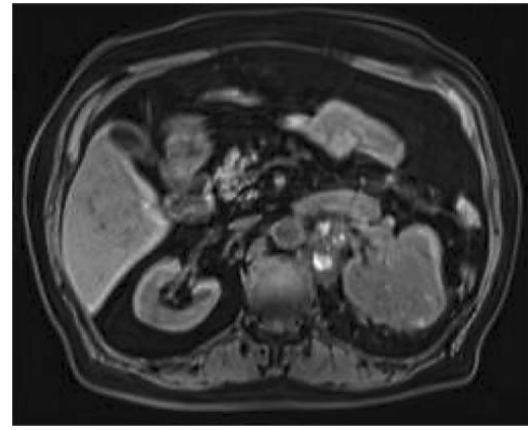


CT with contrast

Tumours usually has necrotic center → less vascular supply → less enhancement resulting in heterogeneous appearance of the mass.
The periphery of the tumour is enhanced and looks like the kidney tissue.



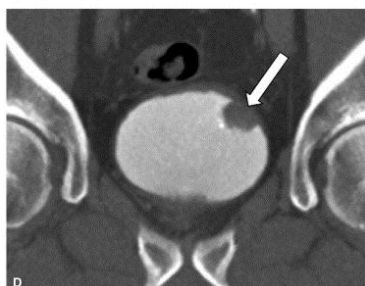
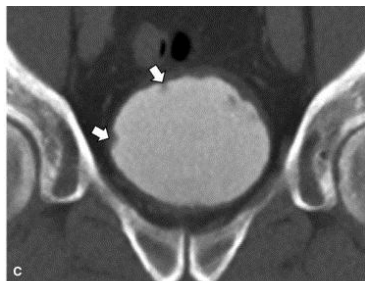
MRI with contrast – coronal section.
-The star shows right extra renal pelvis which is normal.
-The arrow points at the tumour.



MRI without contrast showing large mass filling the left renal pelvis.

Other urinary tract tumours:

1) Transitional cell carcinoma



Transitional cell carcinoma: tumour arising from the transitional epithelium extending from renal pelvis to urinary bladder.

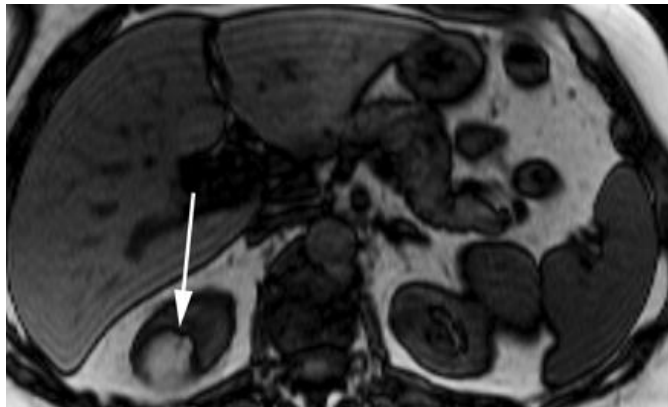
(A) IVU- filling defect in the urinary bladder wall.(arrows)

(B-C-D) CT urography – coronal reformat image showing filling defects in the urinary bladder wall.

- 2) **Angiomyolipoma:** Benign tumour which has fat density appearance.(similar appearance to subcutaneous and perinephric fat)



Black mass on CT.

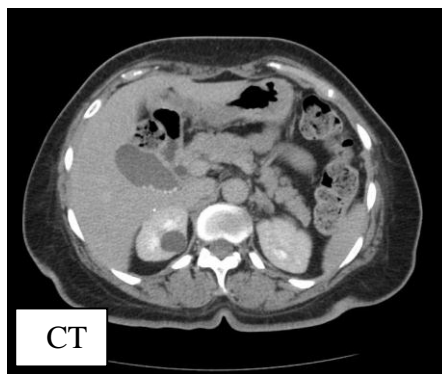
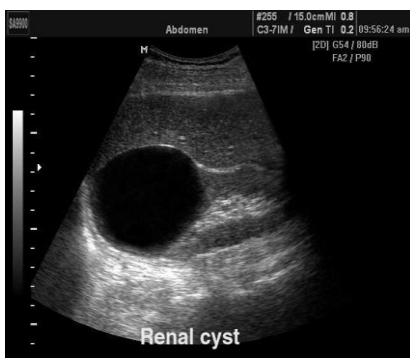


white mass on MRI.

Renal cysts:

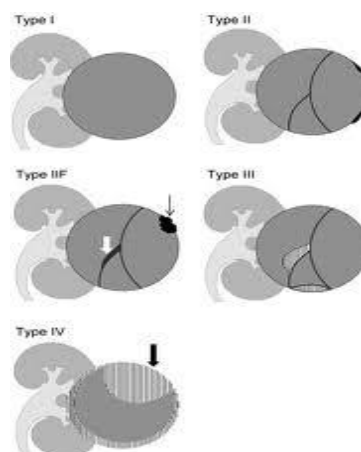
1) **Simple renal cyst:**

cyst showing a well-defined edge, thin wall, uniform water density.

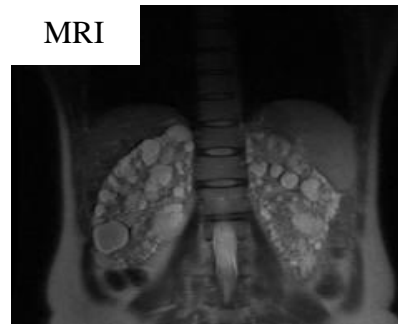
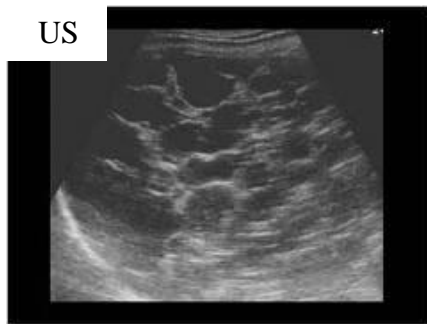


Renal cyst classification:

Type 1 → simple cyst, just fluid collection.
 Type 2 → with very thin calcified septa.
 Type 2f → thicker calcification.
 Type 3 & 4 → with solid enhancing components → need to be removed because it is highly suspicious for malignancy (renal cell carcinoma).



- 2) **Polycystic kidney disease:**
multiple variable sized cyst.



Case Five

9 years old girl presented to the pediatric clinic with complaints of burning micturition and urgency and frequency of micturition. Urine exam: WBC+++.

- ▶ What is the likely diagnosis?
Urinary tract infection.
- ▶ What investigation you will request?
No need for radiological investigation in this case.

Case six

7 years old boy presented with recurrent attacks of flank pain and burning micturition. Urine exam: WBC+++

- ▶ What is the likely diagnosis?
Pyelonephritis (recurrent attacks are most likely due to underlying congenital anomalies. Eg: vesicouretral reflux.)
- ▶ What investigation you will request?
Micturating Cystourethrography (MCUG).
- ▶ What are the findings you expect to see?
Contrast leaking into ureter (tortious ureter + dilated urinary collecting system).



Nuclear scan test :

- **Decreased uptake of contrast by renal tissue due to renal scarring because of recurrent attacks of UTI. (mainly in children with vesico-ureteric reflux and pyelonephritis)**
- **Decrease renal function test.**

Evidence of cortical scarring in the left kidney. Only 35% of total renal function.
Note: it is a posterior view.

1) Duplicating collecting system

A- Partial duplicating: the two ureters may join at any level between the renal hilum and the bladder and continue as one ureter.

B- Complete duplicating: the two ureters may insert separately into the bladder.

Upper ureter is usually abnormally inserted (outside bladder) → obstruction → dilatation of upper moiety.

Lower ureter is normally inserted but usually accompanied with VUR.



2) Ectopic kidney



3) Horseshoe kidney

- The patient's kidneys fuse together to form a horseshoe-shape during development in the uterus.
- Almost it is the lower poles that remain fused.
- Prone to obstruction, trauma, infections, stone formation.

the central portion of the kidney may be found just inferior to the inferior mesenteric artery because the normal embryologic ascent of the kidneys is arrested by its presence.

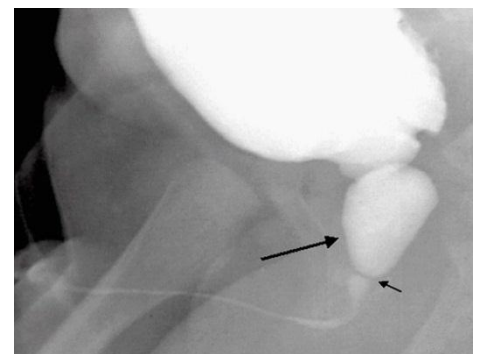


CT with contrast showing fusion of the lower poles of the kidneys.



4) Posterior urethral valves

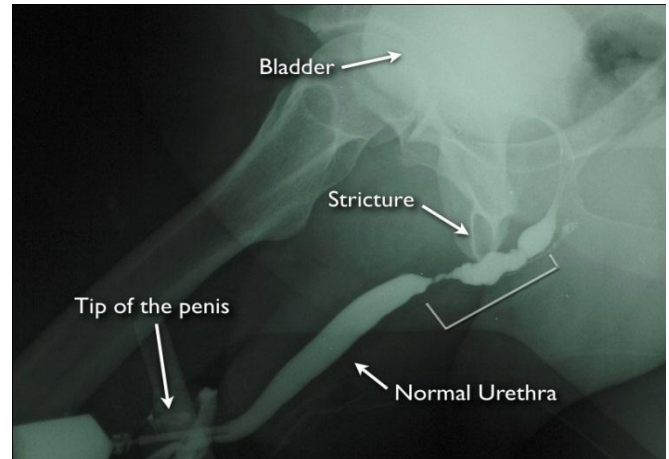
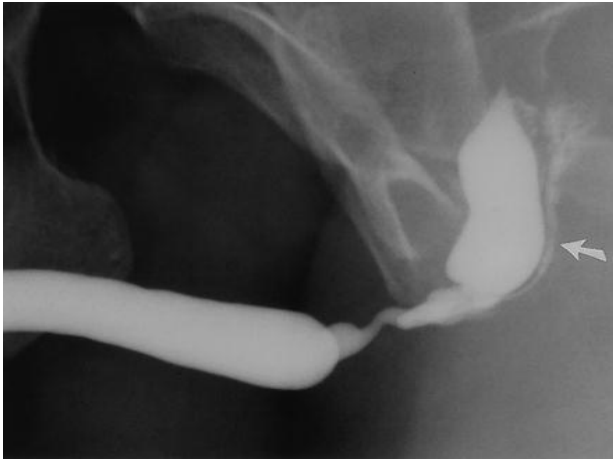
- small arrow → site of valve.
- big arrow → dilatation of the posterior urethra.
- Note the irregular outline of the thick-walled bladder due to chronic obstruction.
- MCUG → dilatation proximal to the valve when voiding.
- Urgent situation to save kidneys. (the patient may have VUR as a consequence of prolonged obstruction)



Case Seven

37 years old male patient presented to the urology clinic with a complaint of difficulty in urination and urethral discharge.

- ▶ What is the likely diagnosis?
STD
- ▶ What investigation you will request?
Ascending urethrogram.
- ▶ What are the findings you expect to see?
Stricture in penile urethra. (reduced caliber and irregular narrowing)



Case Eight

54 years old female patient known case of diabetes and hypertension found to have high creatinine level.

- ▶ What is the likely diagnosis?
Renal impairment.
- ▶ What investigation you will request?
CT and US
- ▶ What are the findings you expect to see?
chronic renal failure due to DM and HTN → the kidney is small and hyper-echoic → can't differentiate between cortex and medulla.

Causes of renal failure:

- Pre- renal → decreased perfusion
- Renal → DM , HTN.
- Post renal → urinary tract obstruction.
Which we can investigate by radiology
because we can see structural changes.



Renal failure due to urinary tract obstruction :

- The cardinal sign of obstructive uropathy is dilatation of the pelvicaliceal system.
- A- US (good to diagnose hydronephrosis) → thin cortex + dilated renal pelvis.
- B- CT → dilated renal pelvis
- C- IVU → PUJ obstruction (ballooning obstruction)
- D- Nuclear scan showing urinary tract obstruction.

