

Imaging of renal system (2nd lecture)

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Objectives

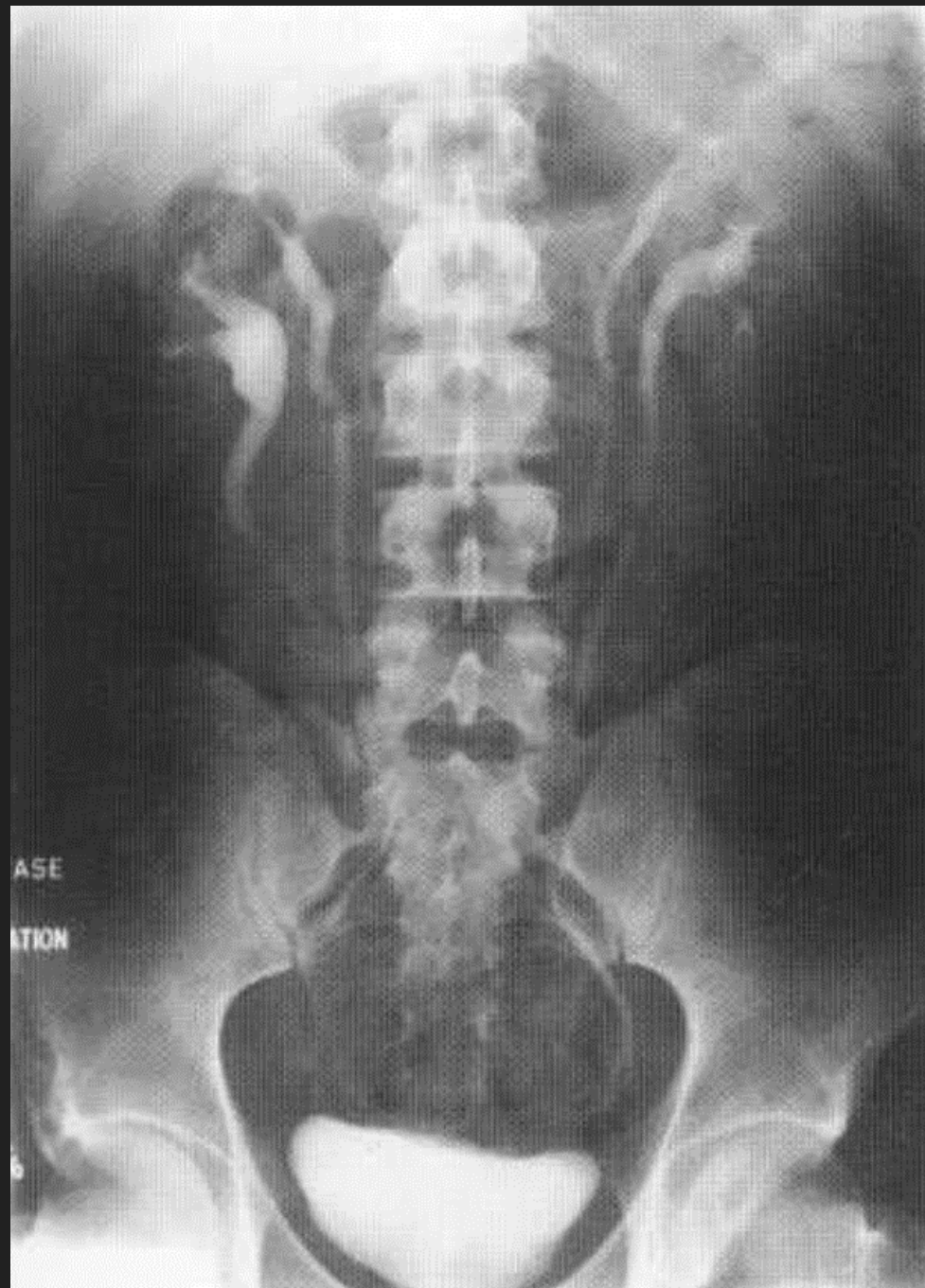
- Radiological findings of common congenital anomalies of renal system.
- Urinary tract disorders: Urinary calculi
 - Urinary tract obstruction
 - Imaging of renal masses

Congenital anomalies of renal tract

Bifid collecting system (Duplication abnormalities)

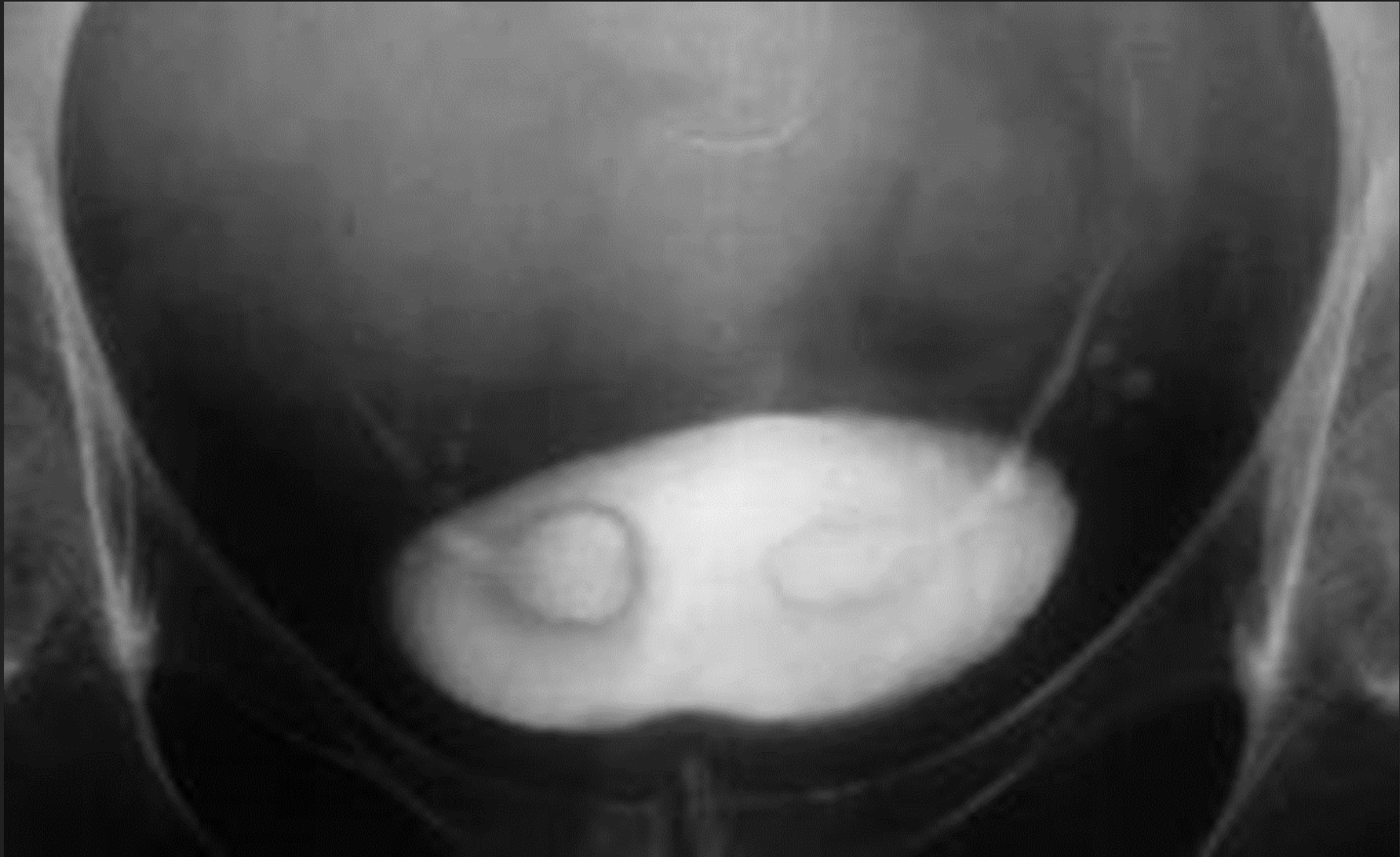
- Are the most frequent congenital variations.
- May be unilateral or bilateral.
- Sometimes just the pelvis is bifid, an anomaly of no importance.
- Duplex kidneys are characterized by two ureters and renal pelvis
- The two ureters may join at any level between the renal hilum and the bladder or may insert separately into the bladder.

- The ureter of upper moiety usually inserted inferior and medial to ureter of lower moiety and usually associated with ureterocele, lower moiety ureter have orthotopic insertion but usually associated with reflux .
- The ureter of the upper moiety may drain outside the bladder, e.g. into the vagina or urethra, producing incontinence if the opening is beyond the urethral sphincter. Such ureters, known as *ectopic ureters*, are frequently obstructed and lead to dilatation of the entire moiety; the dilated lower ureter may prolapse into the bladder, forming a *ureterocele*.



Ureterocele

- Ureterocele: is a submucosal dilatation of intramural segment of the ureter, can be divided into simple or ectopic (associated with complete ureteric duplication)
- On IVU it appears as contrast filled structure surrounded by thin lucent wall within contrast filled urinary bladder give an appearance of copra head
- On US it appears as cyst within urinary bladder
- Complications: obstruction lead to hydroureter and hydronephrosis, stasis lead to infection and stone formation.



Ectopic kidney

- During fetal development the kidneys ascend within the abdomen. An ectopic kidney results if this ascent is halted.
- They are usually in the lower abdomen and rotated so that the pelvis of the kidney points forward. The ureter is short and travels directly to the bladder
- Complications of ectopic kidney: Chronic pyelonephritis, hydronephrosis, calculi, increase risk of trauma, hypertension (is more frequently encountered in cases with more than one renal artery), and reflux
- However ectopic kidneys are often incidental findings of no consequence to the patient



Ectopic left
kidney

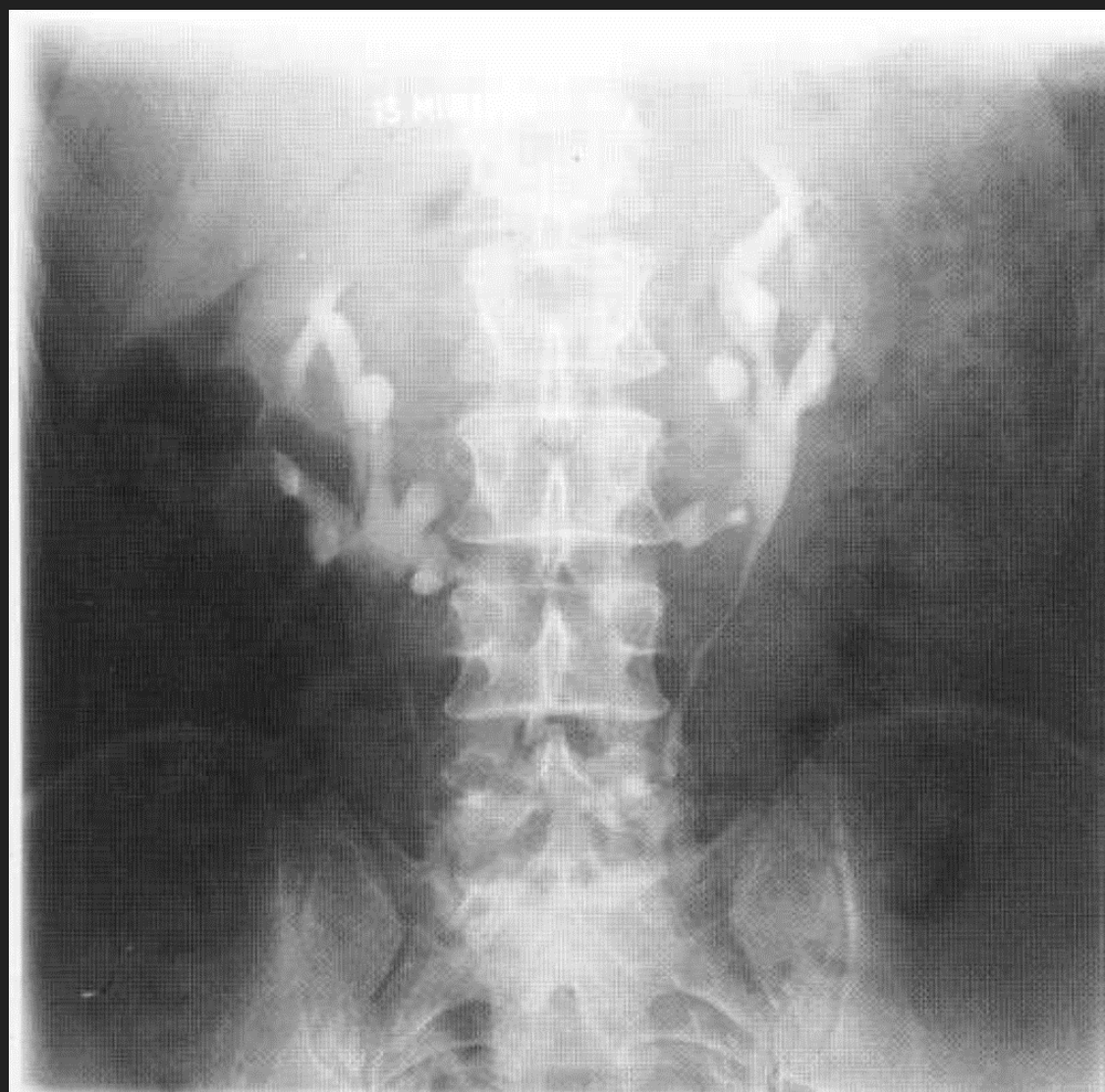
Crossed fused ectopia

- refers to an anomaly where the kidneys are fused and located on the same side of the midline
- The anomaly is readily detected on conventional urography. In 90% of crossed ectopy, there is at least partial fusion of the kidneys (the remainder demonstrate two discrete kidneys on the same side, crossed-unfused ectopy).
- Usually the upper pole of lower kidney fused with lower pole of upper kidney
- The ureter of crossed kidney usually have normal insertion into the trigon



Horse –shoe kidney

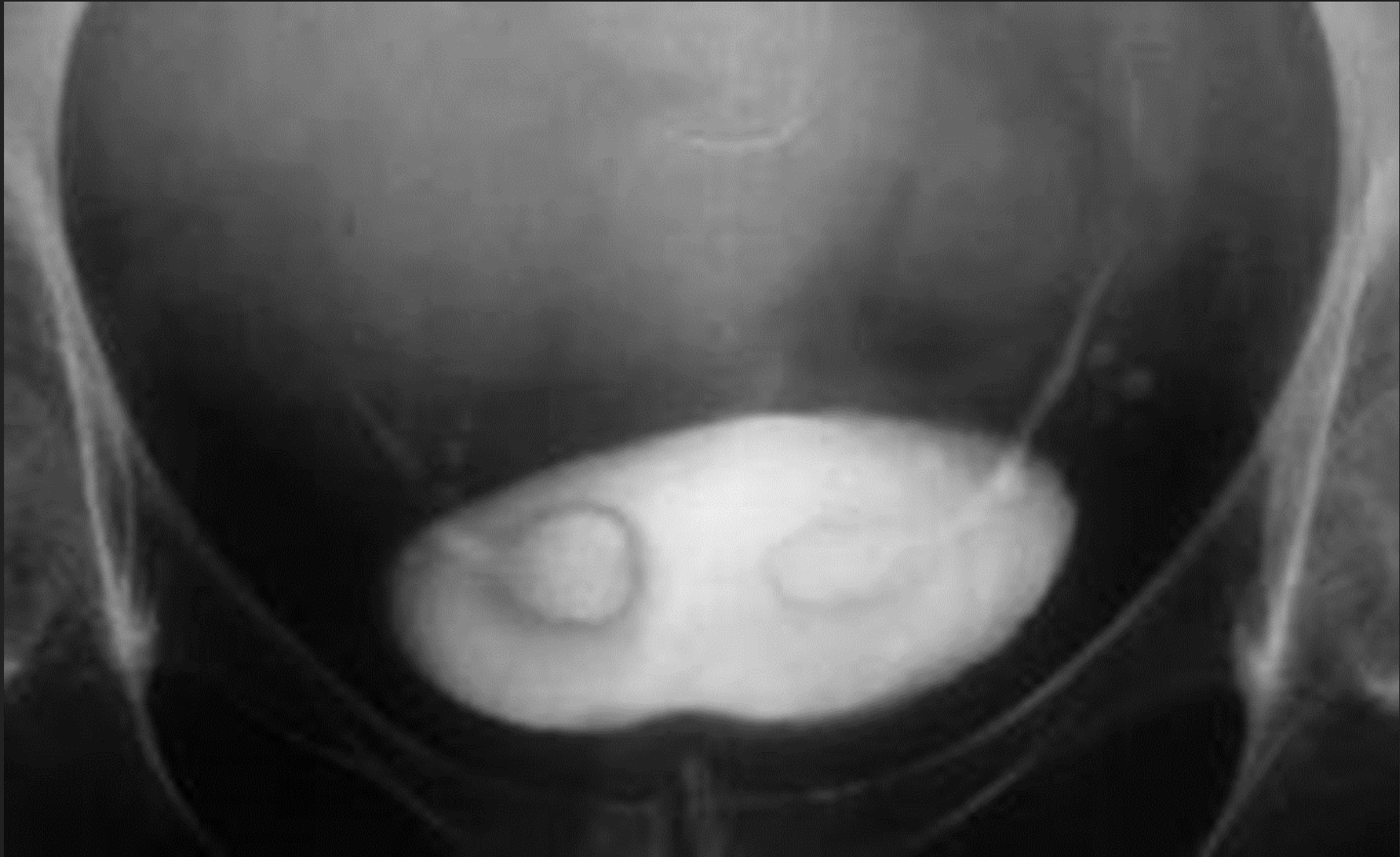
- The kidneys may fail to separate, giving rise to a horseshoe kidney. Almost invariably it is the lower poles that remain fused
- The anomaly may be an incidental finding and of no significance, but pelviureteric junction obstruction to the collecting systems and calculi formation are both fairly common, in addition they render the kidneys susceptible to trauma and are an independent risk factor for the development of transitional cell carcinoma of the renal pelvis.
- Radiographic appearance: the kidneys are oriented with their lower pole pointed medially rather than laterally (unlike normal renal axis), they are lower than normal position and usually mal-rotated (the pelvicalyceal systems point anteriorly and show fullness or some degree of stasis)
- Best modality to identify connection: CT scan



Pelvi-ureteric junction obstruction

- Peristalsis is not transmitted across the PUJ
→ functional obstruction
- The disease may present at any age but it is usually discovered in children or young adults
- Radiological appearance: dilatation of all calices and the pelvis, with an abrupt change in caliber at the PUJ, Often, the ureter cannot be identified at all. If it is seen, it will be either narrow or normal in size





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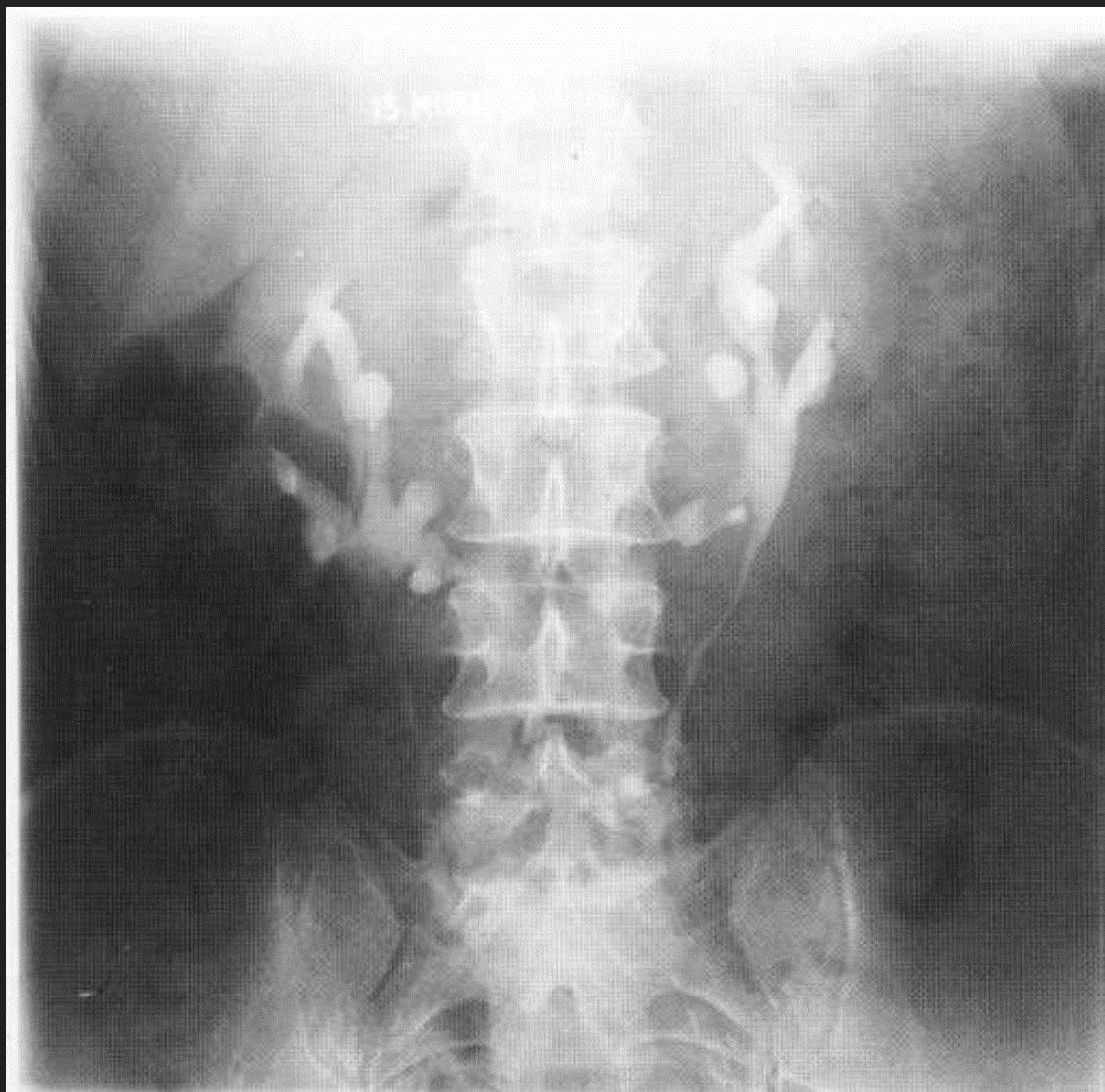
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Urinary tract disorders

Urinary calculi

- 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
- Pure uric acid and xanthine stones are radiolucent on plain radiograph.
- Small calculi are often round or oval, the larger ones frequently assume the shape of PCS and known as staghorn stones.

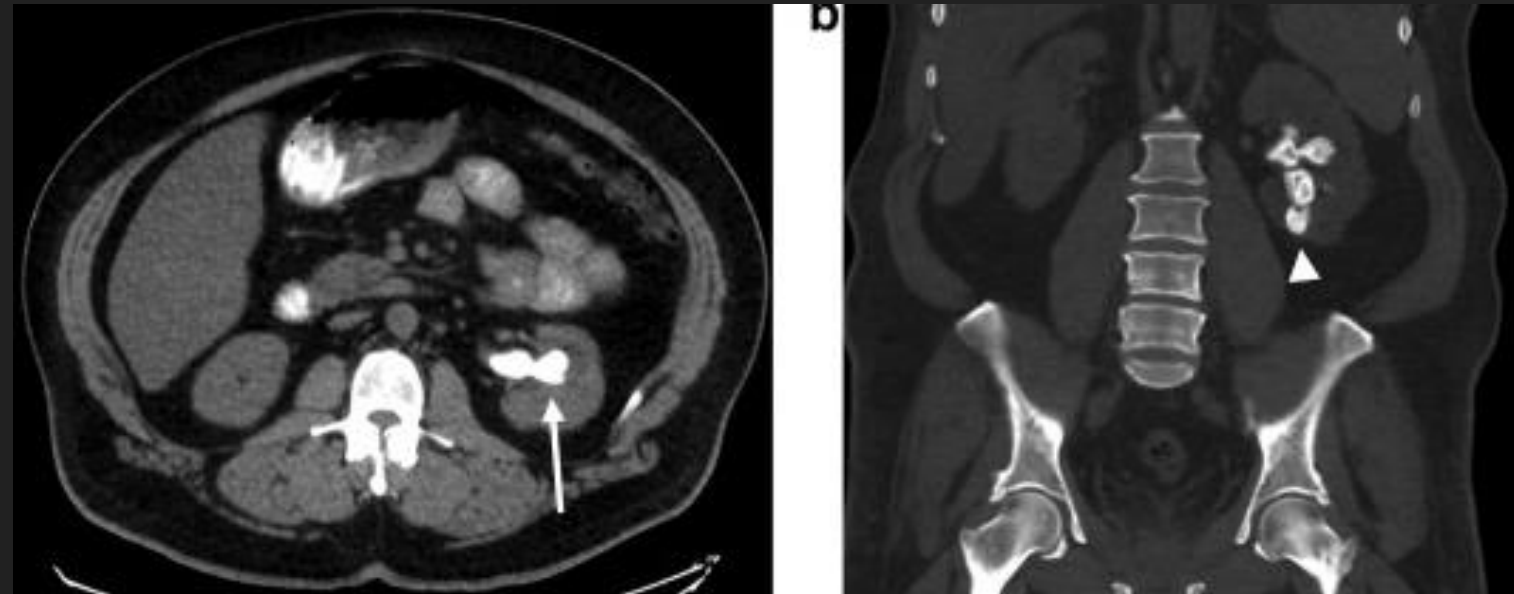
Imaging of urinary calculi

- **Plain film (KUB)**: detecting opaque renal and ureteric calculi.
- **IVU**: appear as filling defect or they may be totally hidden within the opacified collecting system.
- **Ultrasound**: *most renal calculi > 5mm are readily seen as intense echoes and cast acoustic shadows, hydronephrosis can also be seen if associated with stone.
 - *Stones in the ureter can not be excluded on ultrasound, although stone at VUJ may be demonstrated
 - *Stones in the bladder are well demonstrated



Imaging of urinary calculi

- **Ct scan:** is exquisitely sensitive for detection of calculi, if a stone is obstructing a ureter a dilated ureter can usually be followed down to level of the stone, below which the ureter undistended





a.

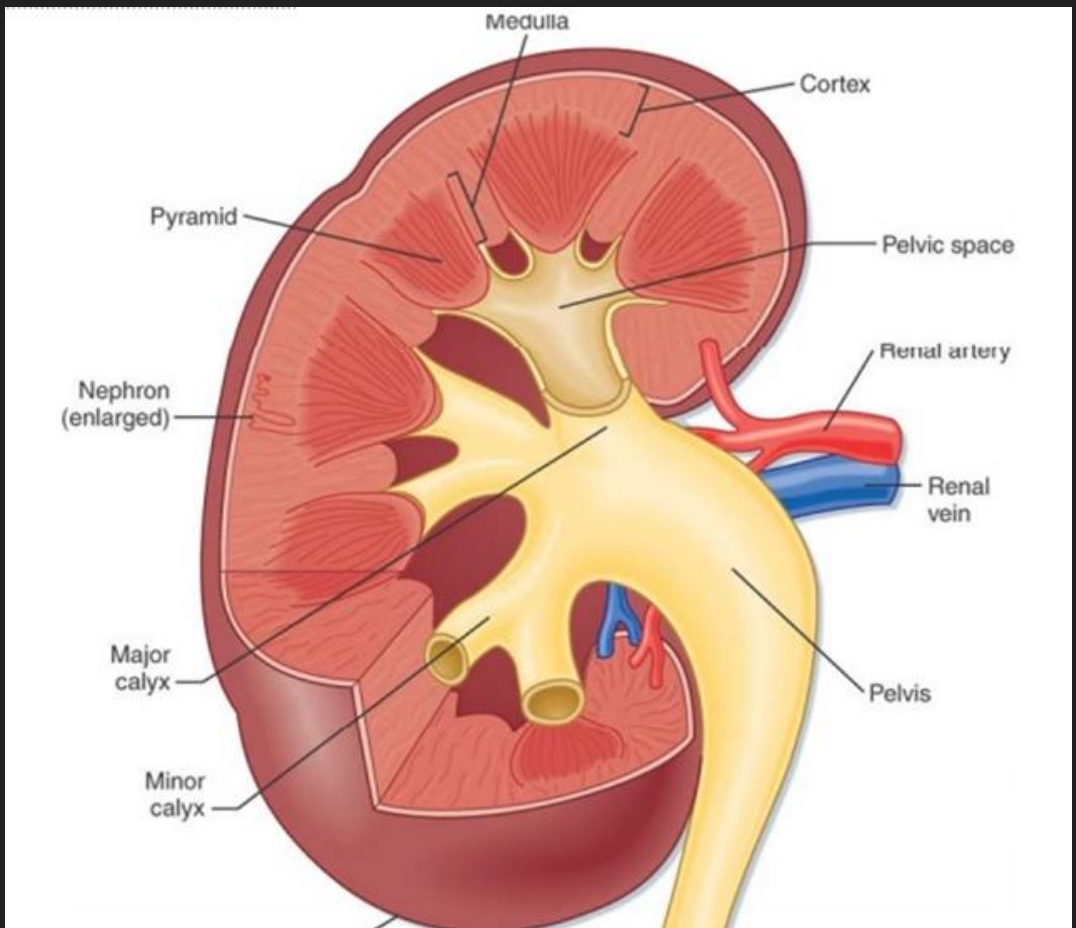


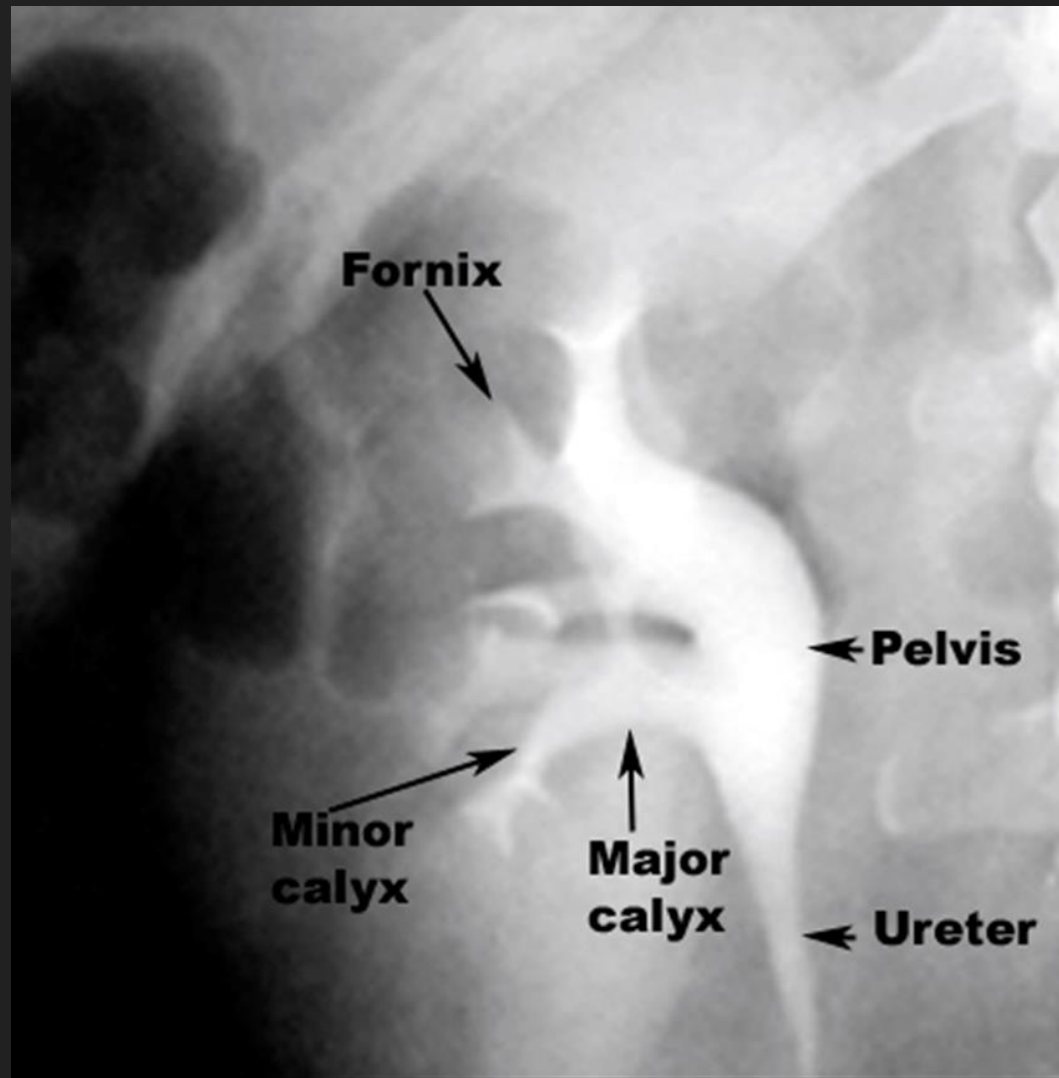
b.

Urinary tract obstruction

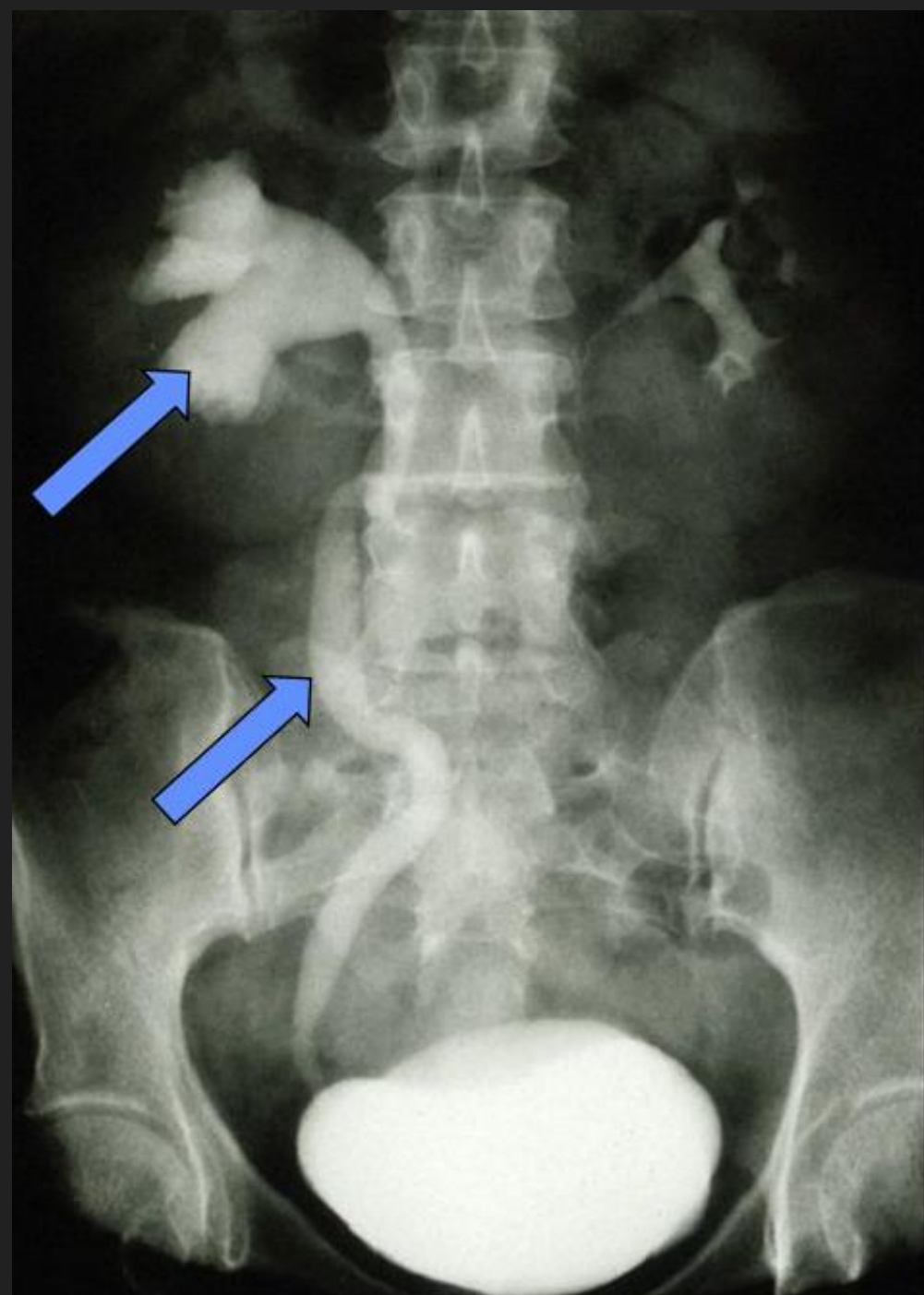
- The principle features of obstruction is dilatation of PCS and ureter
- All the affected calices are dilated to approximately the same degree, the degree depend on chronicity.
- The obstructing collecting system is dilated down to level of the obstructing pathology and demonstrating this level is the prime objective of imaging.
- Ultrasound and urographic examination play a major role in evaluation of obstruction
- CT urography has overtaken IVU.

- The calices should be evenly distributed and reasonably symmetrical
- The shape of normal calix is cupped
- When it is dilated it is described as clubbed





Pappilae positioned in the apex of pyramids drain into the fornix of the minor calyces. They join to form 3 or 4 major calyces, which join to form the renal pelvis. The renal pelvis drains into a muscular tube called the ureter.



Causes of dilated calices

Due to obstruction, with dilatation down to a specific point of hold-up

- Within the lumen
 - calculus
 - blood clot
 - sloughed papilla
- Within the wall of the collecting system
 - intrinsic pelviureteric junction obstruction
 - transitional cell tumour
 - infective stricture (e.g. tuberculosis or schistosomiasis)
- Extrinsic compression
 - retroperitoneal fibrosis
 - pelvic tumour, e.g. cervical, ovarian or rectal carcinoma
 - aberrant renal artery or retrocaval ureter

Due to papillary atrophy or destruction

- Reflux nephropathy
- Papillary necrosis
- Tuberculosis

Renal masses

Goals of imaging a suspected renal mass include:

- Confirmation of presence and site of mass
- Classification into simple cyst, complicated cyst or solid mass
- Assessment of contents, such as the presence of fat
- Differentiation of benign from malignant
- Diagnosis of complications such as local invasion, venous invasion, lymphadenopathy and metastases.

Classification of renal masses

Simple cyst

Very common in adult
Usually asymptomatic
Have thin walls and
clear fluid contents.

Complex cyst

include a simple cyst
complicated by
hemorrhage or infection,
benign cyst containing
septations or calcifications
or a cystic tumor

Solid mass

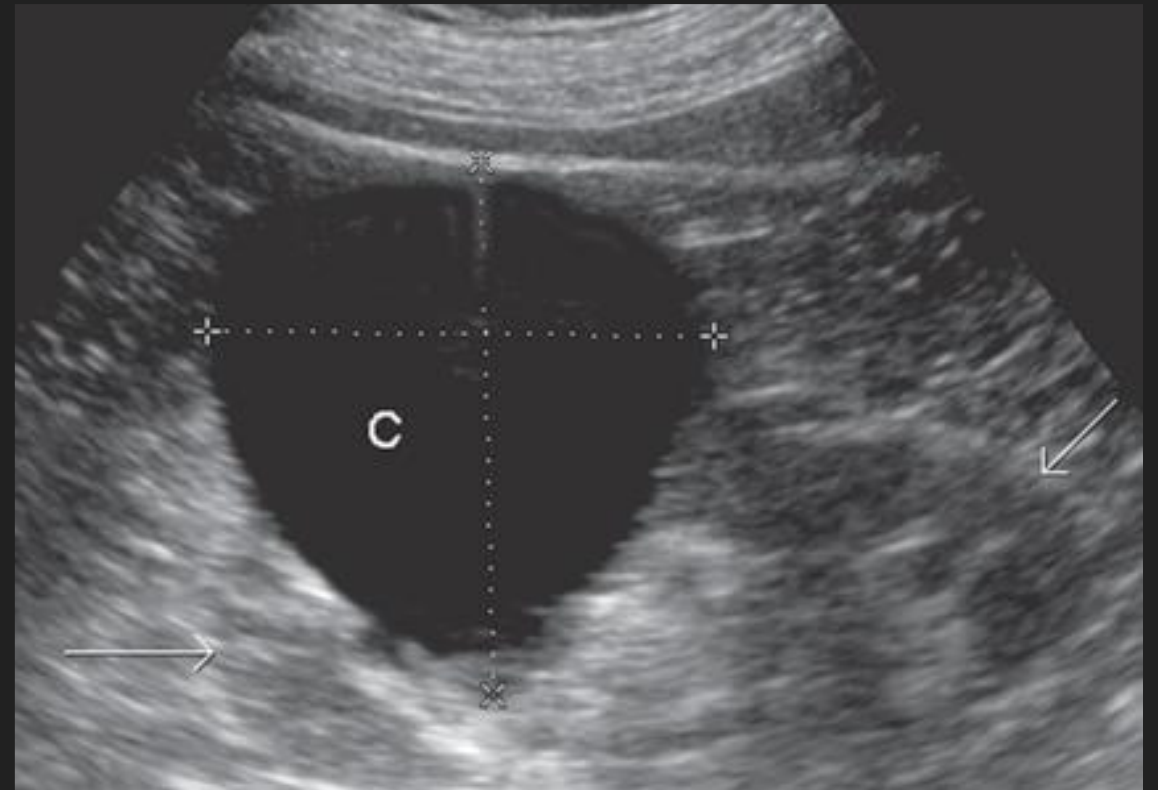
Most solid renal masses are
malignant; renal cell
carcinoma RCC (most
common)
others: lymphoma, metastases
Benign: angiomyolipoma
(characteristically containing
fat)

Main imaging modalities: US, CT scan, MRI

Imaging of simple cyst

Appears on ultrasound as :

- a round anechoic (black) structure with a thin or invisible wall and distal acoustic enhancement.
- No further imaging required for simple cyst diagnosed by ultrasound



Imaging of simple cyst (conti)

Appear on CT scan as:

- Well-defined, **thin** walled lesion of water density that **does not enhance**



Imaging of complex cyst

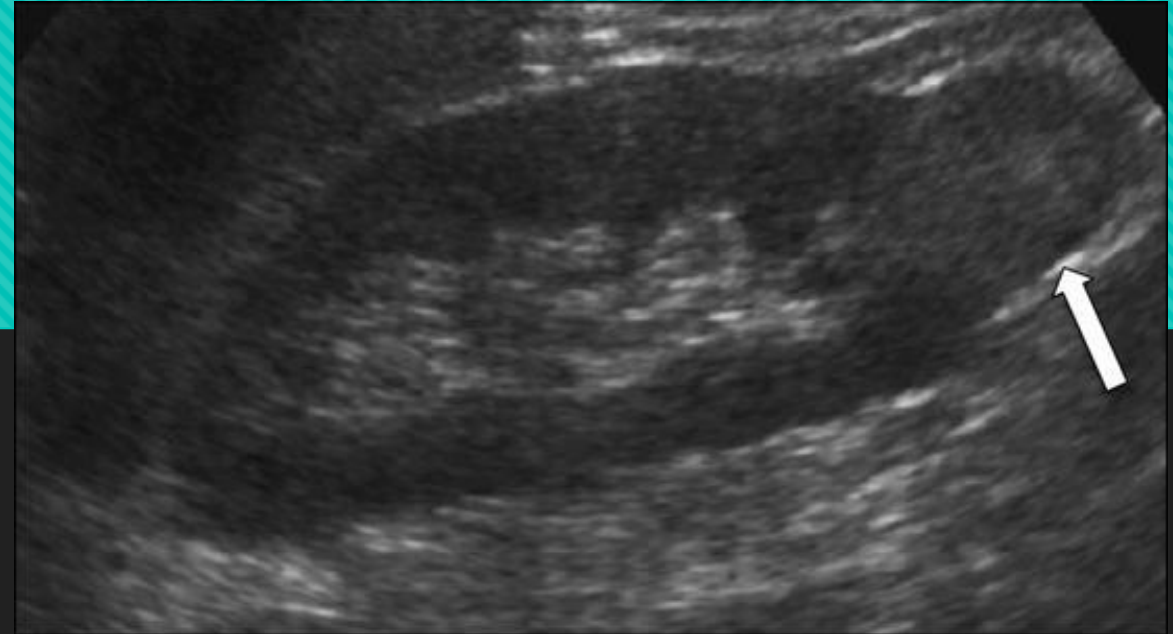
Ultrasound: it may show

- internal echoes that may be due to hemorrhage or infection, soft tissue septations, calcifications, or an associated soft tissue mass

CT scan:

- is more accurate than US for characterization of internal contents, help to classify complex cyst into benign (no follow up), probably benign (need Follow-up CT), Indeterminate; 50% malignant (need biopsy or surgery) or frank malignant cystic lesion.

Imaging of solid mass



Ultrasound:

- A solid mass on US may show areas of increased echogenicity due to calcification or fat, or areas of decreased echogenicity due to necrosis.
- Where RCC is suspected, US is also used to look for specific findings such as invasion of renal vein and inferior vena cava (IVC), lymphadenopathy and metastases in the liver and contralateral kidney.

Imaging of solid mass (cont.)

Ct scan

- is more accurate in showing areas of fat confirming the diagnosis of AML (angiomyolipoma)
- RCC usually appear as a heterogeneous soft tissue mass that enhances with intravenous contrast material
- Used for staging: local invasion, lymphadenopathy and distant metastases



Thank you