Imaging of renal system (Lec1)

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Objectives

- To know the imaging methods of investigation in disorders of renal system

Imaging methods of investigation

- Ultrasound
- KUB
- Intravenous urography
- Ct scan
- MRI
- Radionuclide examination

Imaging methods of investigation

Additional investigations:

- Voiding cystourethrography
- Urethrography
- Retrograde and antegrade pyelography
- Nephrostogram
- Vascular procedure: conventional Angiography, CT angiography, MR angiography

Ultrasound

Is the first-line investigation in most patients, providing **anatomical** information without requiring ionizing radiation or the use of intravenous contrast medium, also it is non invasive and affordable

The main uses of ultrasound are to:

1- Investigate patients with symptoms thought to arise from the urinary tract.

2- Demonstrate the size of kidneys and exclude hydronephrosis in patients with renal failure.

Ultrasound (continue)

3- Diagnose hydronephrosis, renal tumors, abscesses and cysts including polycystic disease.

4- Assess and follow-up renal size and scarring in children with urinary tract infections.

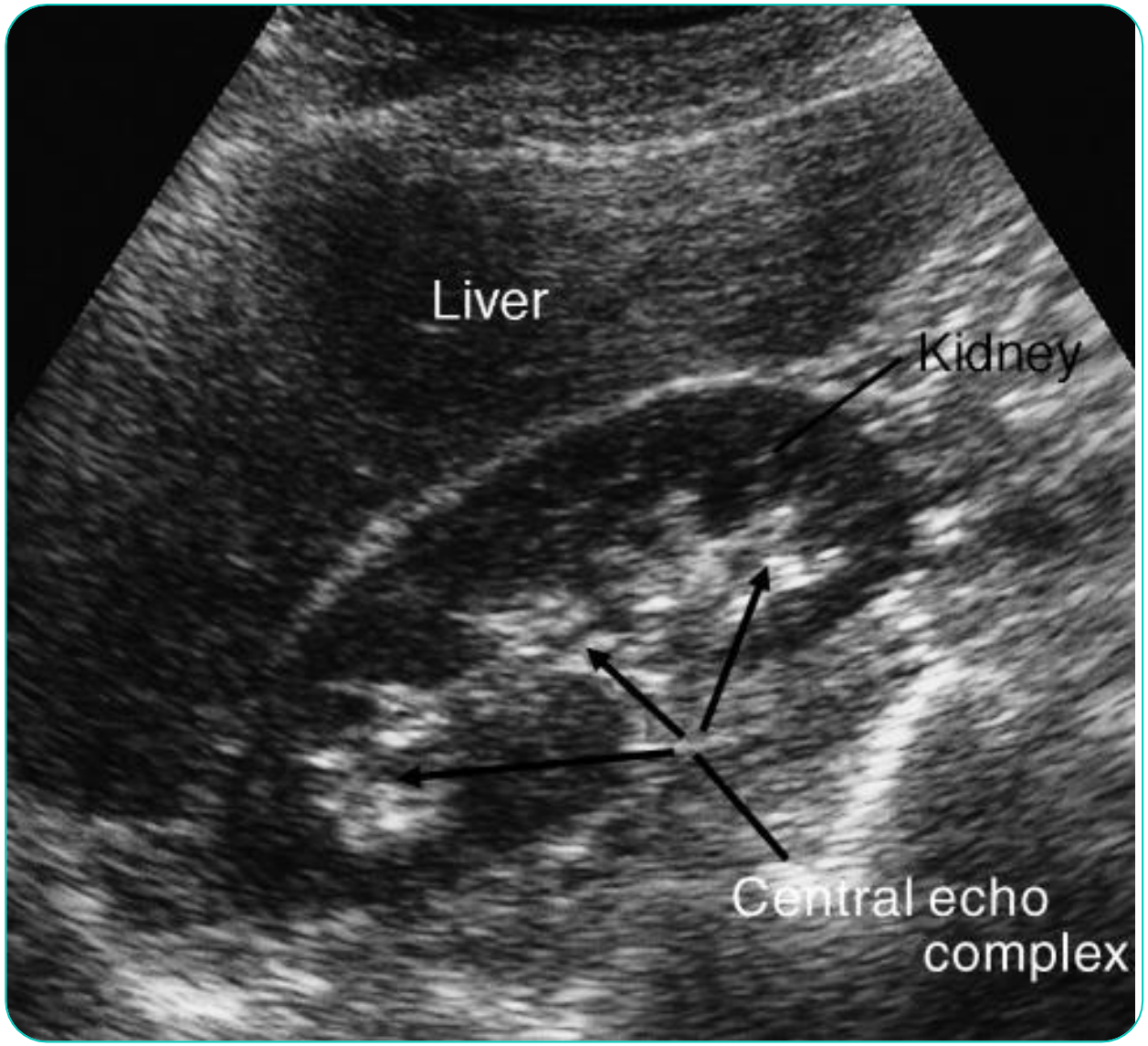
5- Assess the bladder and prostate, asses residual urine volume post voiding to give idea about bladder function and any outlet obstruction

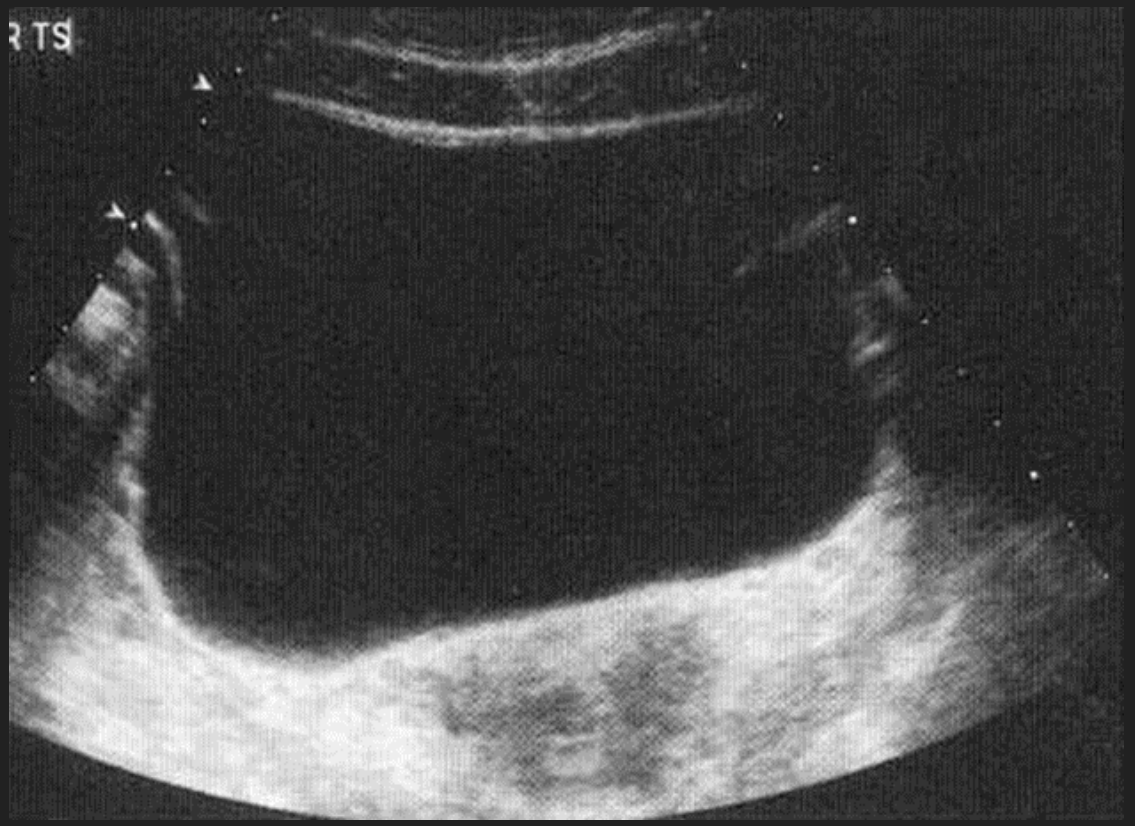
6- Assessment of testis (e.g. torsion, infection, mass, hydrocele, initial investigation for ectopic testis)

7- Guide diagnostic or therapeutic procedures

Normal renal ultrasound

- Smooth outline
- Highly reflective central echo-complex (sinus fat, blood vessels, PCS)
- Homogenous parenchyma (equal or less than the liver)

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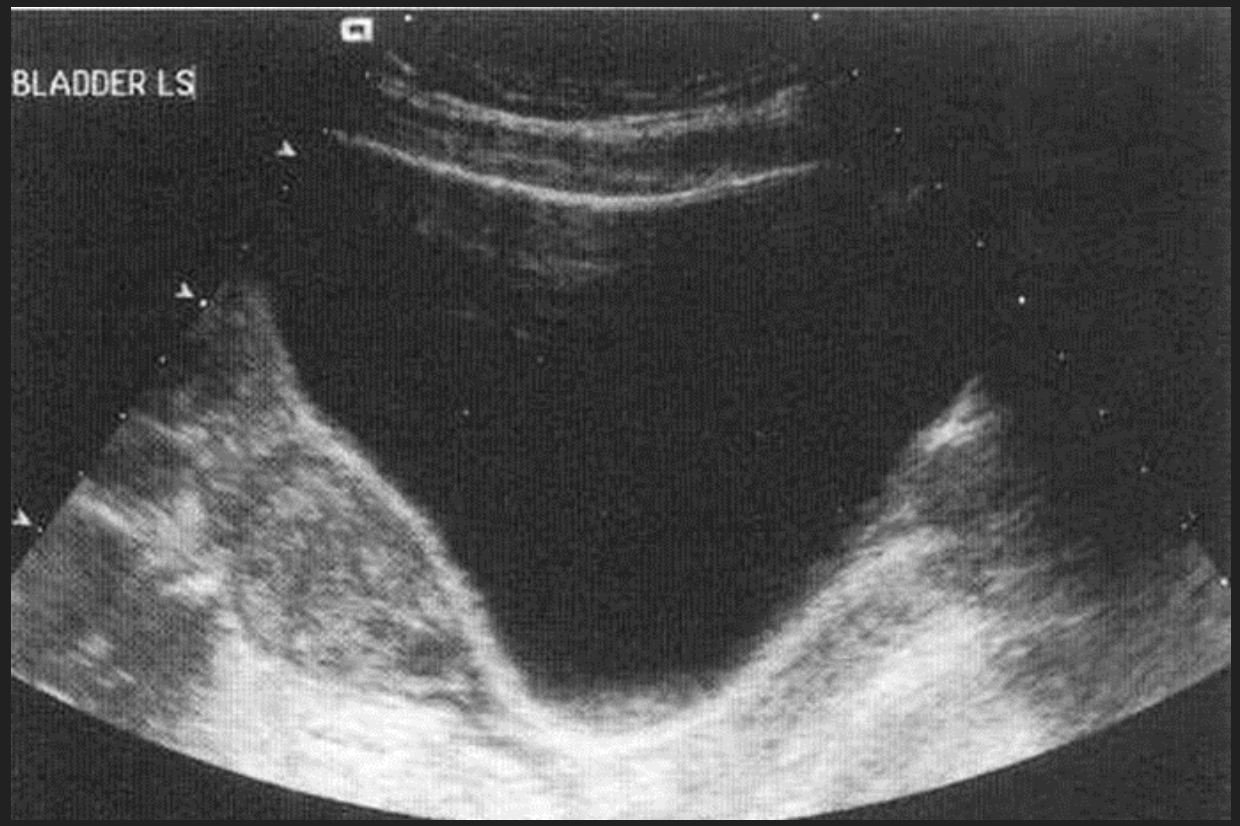

BLADDER LS

KUB (kidney, ureter, bladder)

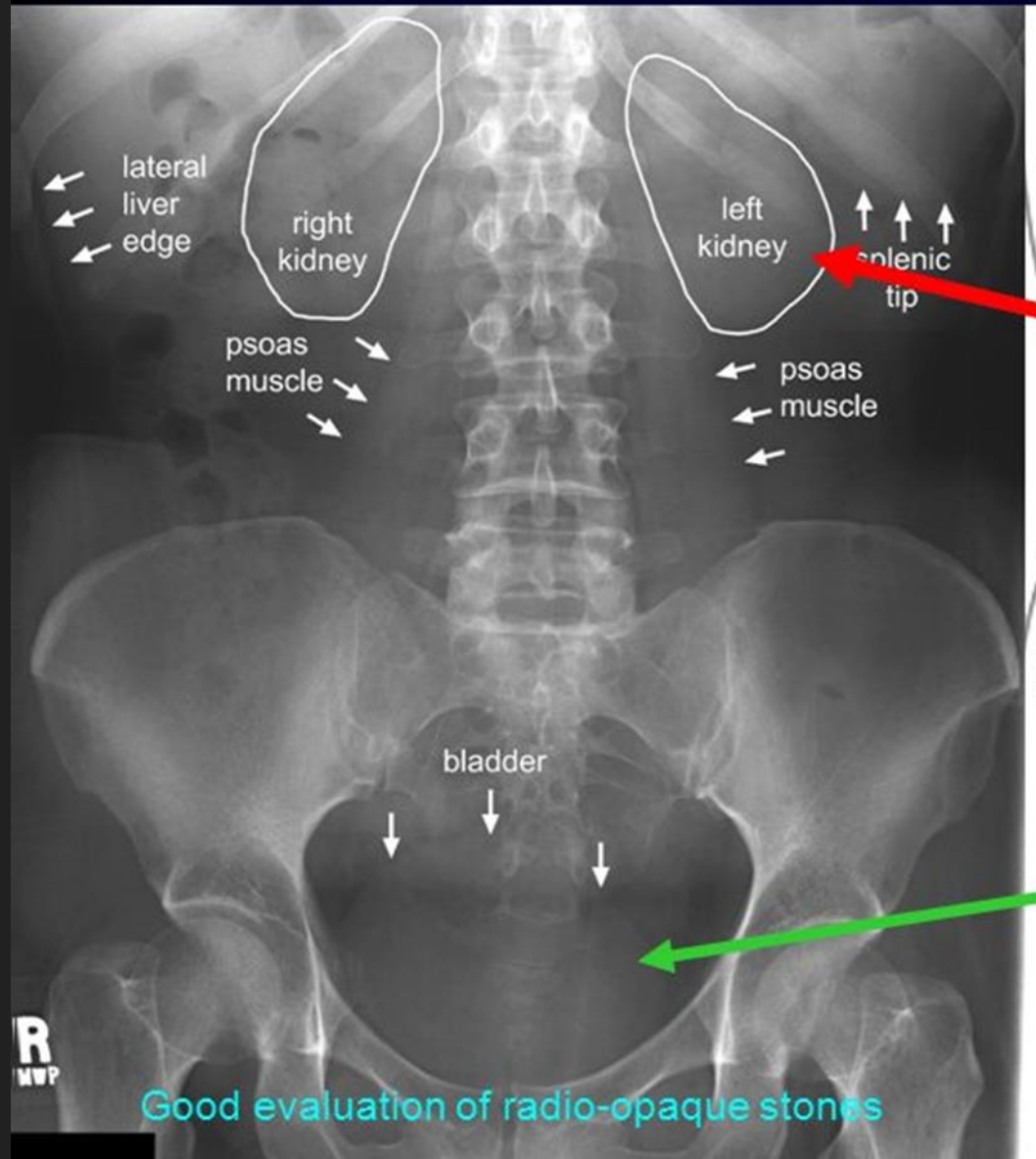
- Plain abdominal X RAY , AP view
- included the lower border of symphysis pubis to ensure visualization of area of urethra .
- It shows the outlines of several anatomical structures including renal, psoas and bladder outlines, much of axial skeletons, bowel gas pattern and the lung bases

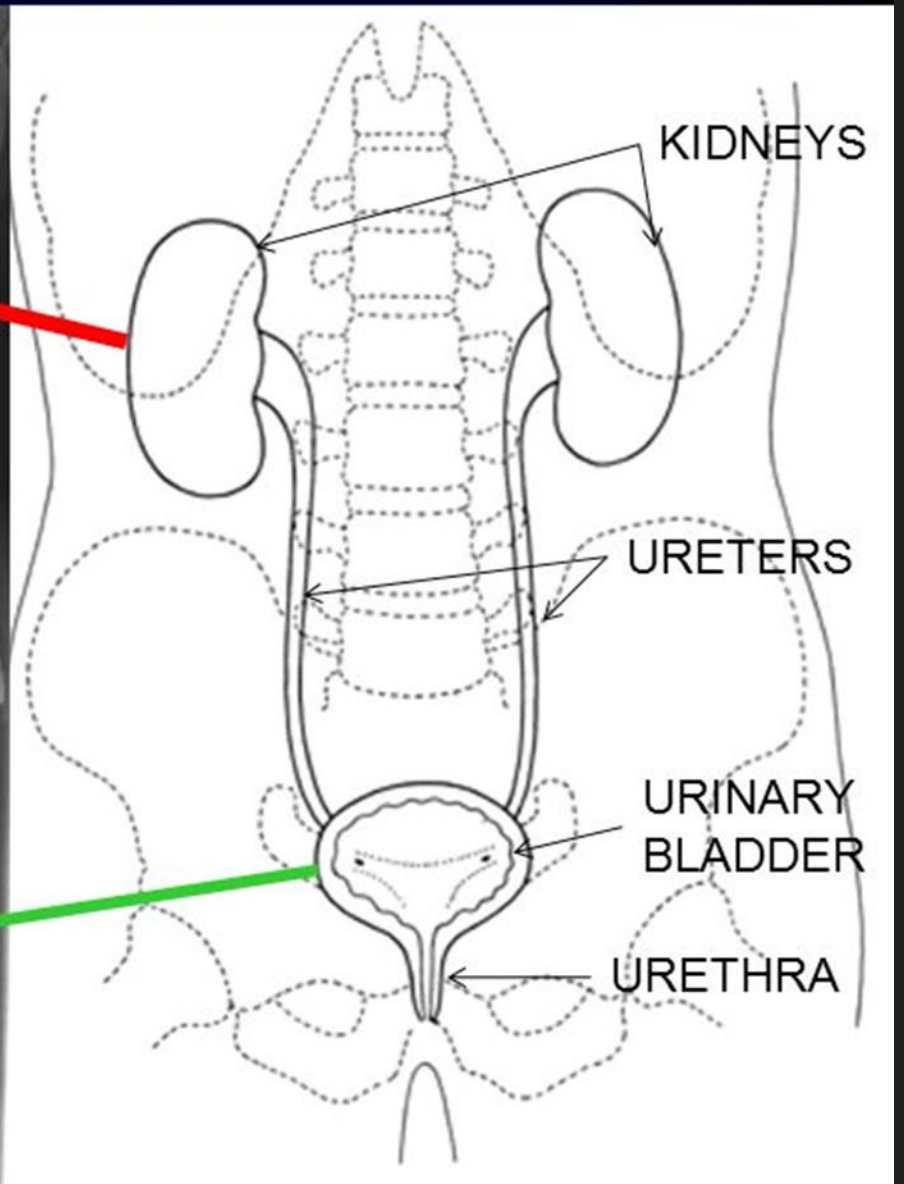
KUB (continue)

- Its principle use is in the assessment of radiopaque urinary tract calculi however it's unreliable investigation because there are numerous causes of calcification visible on plain radiograph with considerable overlap in their appearances
- **So it's most usefully employed as part of IVU or to follow up a previously proven calculus.**

KUB

Conventional plain film of the abdomen is called a KUB
(Kidneys, Ureters, Bladder)

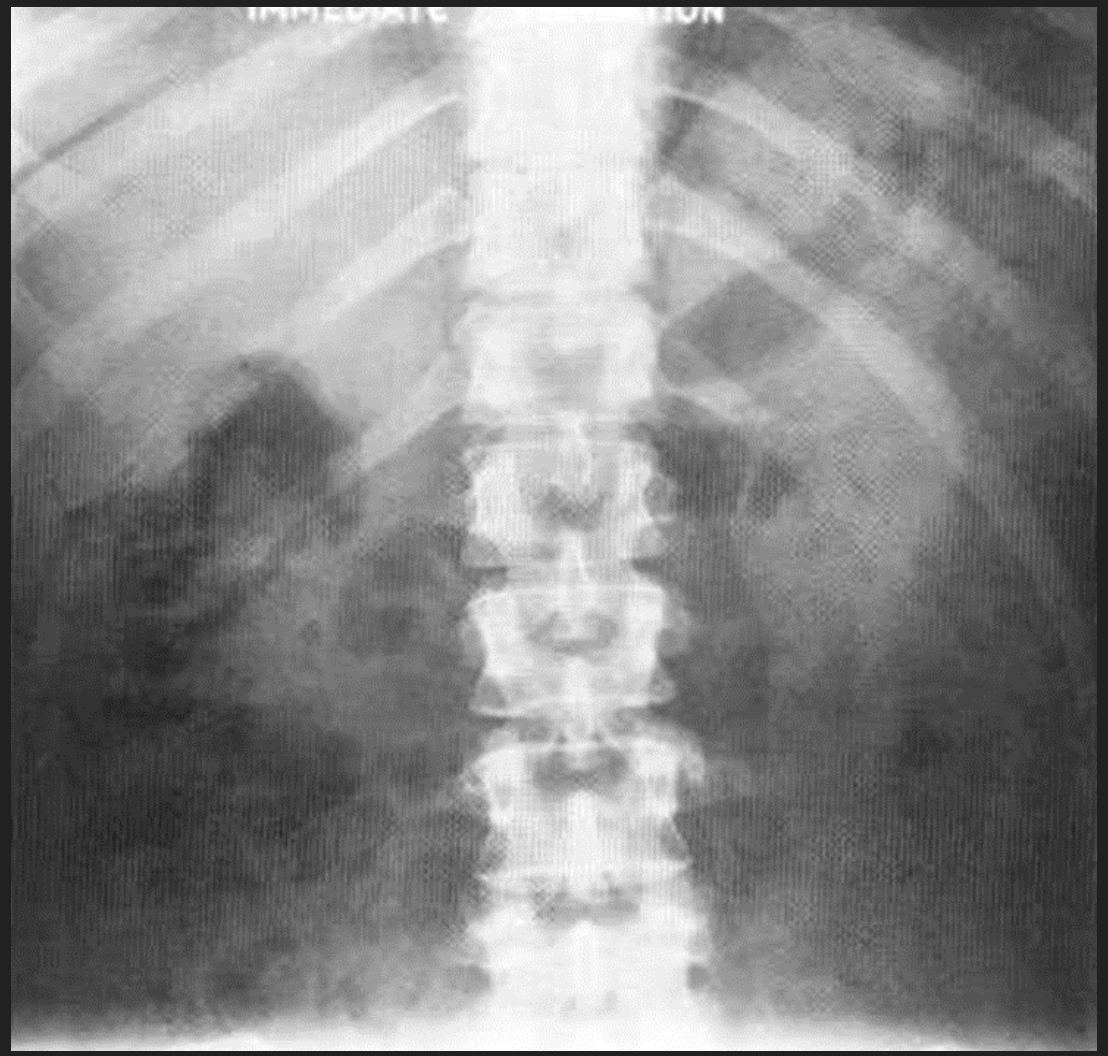


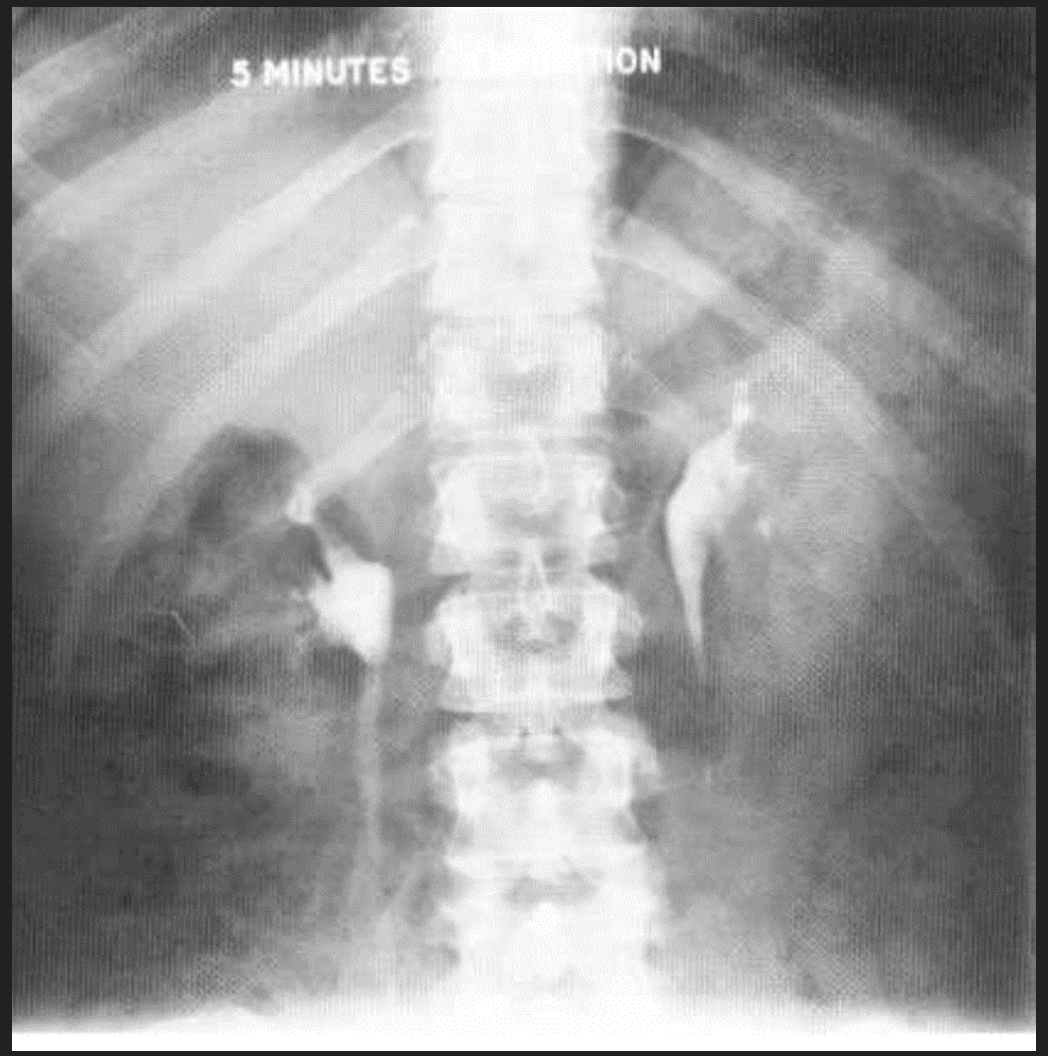


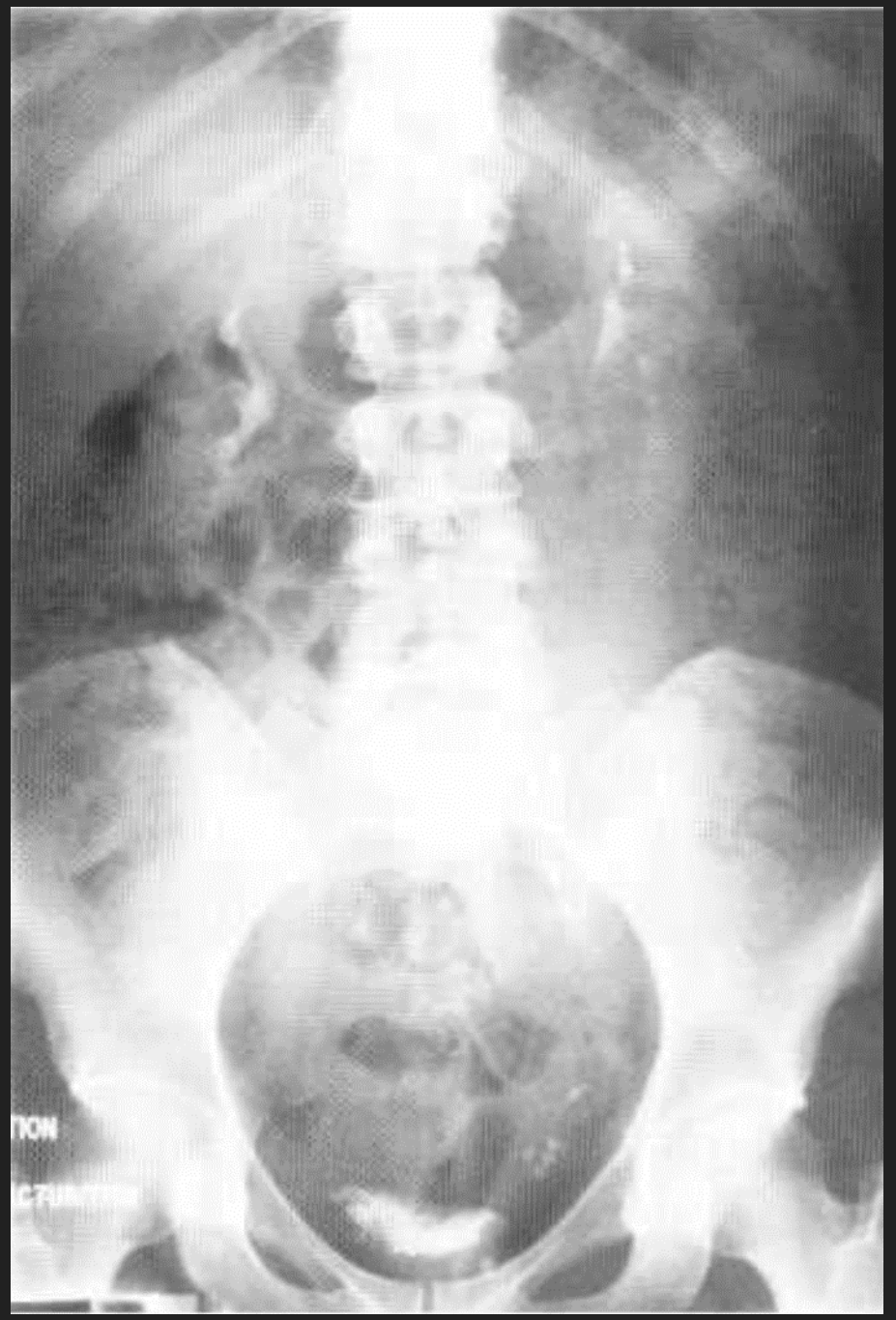

RT

Intravenous urography

- Involve series of plain films taken after injection of IV contrast media (water soluble iodine containing contrast media).
- **Functional** and **anatomical** imaging.
- Classic series: plain film(KUB), immediate (nephrogram), 5 minute (pyelogram), 15 minute(full length film), post void film.
- Additional films that may be required: cystogram, delayed films




5 MINUTES



Indications of IVU:

- When detailed demonstration of the pelvicaliceal system and ureters are required e.g. persistent or frank hematuria
- Suspected ureteric injury (e.g. following pelvic surgery or trauma), ureteric fistula or stricture
- Assessment of acute ureteric colic
- congenital anomalies of urinary system

Ct scan

Computed tomography scanning of the urinary tract , involve both unenhanced image (Ct KUB) and CT urography (image taken after administration of IV iodinated contrast media)

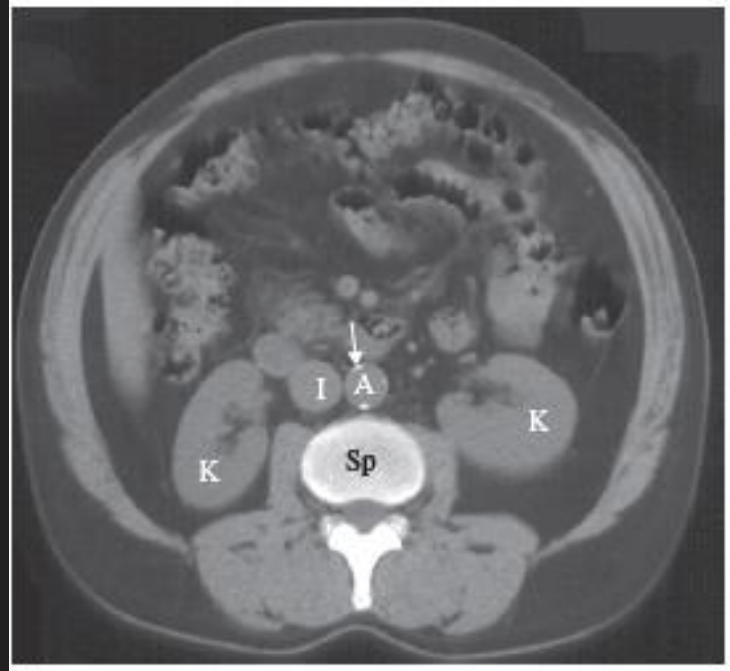
CT Advantages:

- Detection of radio-opaque and radio-lucent calculi.
- Diagnosis of urinary obstruction and its level.
- Characterization of congenital anomalies.
- Investigation of haematuria
- Detection and staging of urinary system neoplasm.

- Differentiation between cystic and solid urinary neoplasm.
- To diagnose or exclude renal trauma.
- Direct biopsies and the positioning of percutaneous drains.

CT Angiography:

- in renal a. stenosis
- Vascular anomalies
- To delineate renal vascular anatomy (e.g. prior to live related kidney donation)



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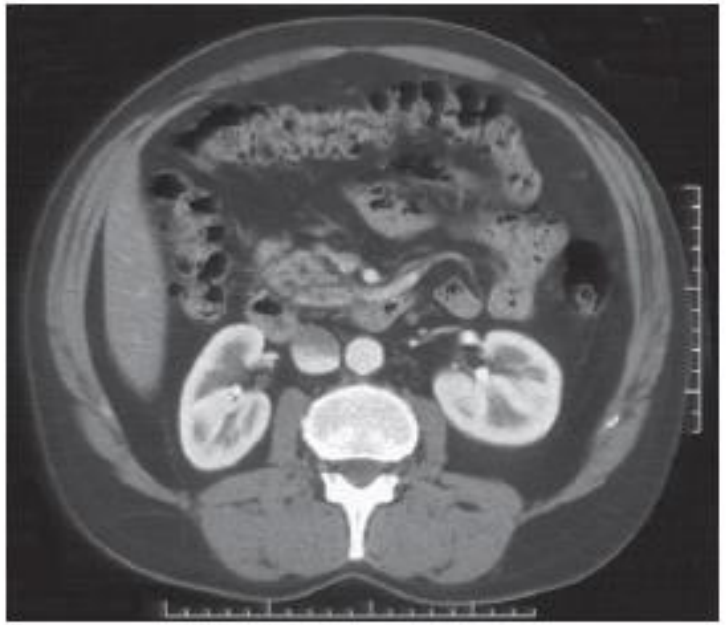

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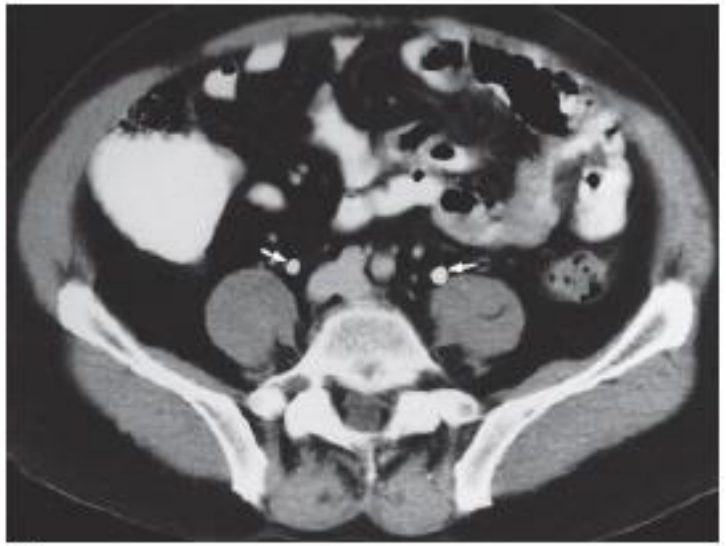


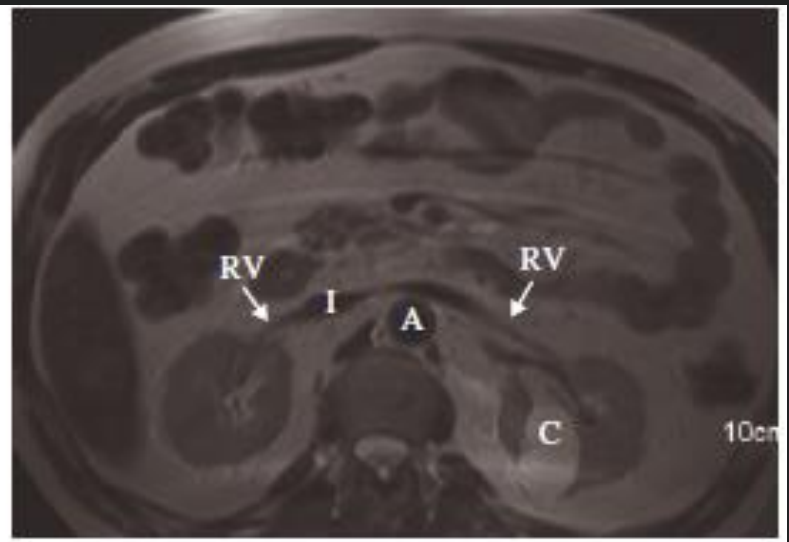
(d)

- The traditional IVU has largely been replaced by a combination of ultrasound and CT urography, CT has the advantage of being highly sensitive for the detection of stones including those which may be radiolucent on plain film, allows the characterization of renal lesions, the detection of ureteric lesions and demonstrates the surrounding retroperitoneal and abdominal tissues. In addition, CT overcomes the overlap of superimposed tissues which can cause difficulty when interpreting the traditional IVU.

MRI

- Magnetic resonance imaging gives similar anatomical information to CT, images are obtained directly in the coronal, sagittal and oblique planes, in addition to the axial plane.
- It is generally used in selected circumstances, e.g. to demonstrate renal artery stenosis or inferior vena cava extension of renal tumors or to clarify problems not solved by ultrasound or CT. It is also used to assess the extent of bladder or prostate cancer prior to consideration for surgery.
- Limitation: Calcification is not visible on MRI, which is one of the main disadvantages of the technique for renal tract imaging.

(a)



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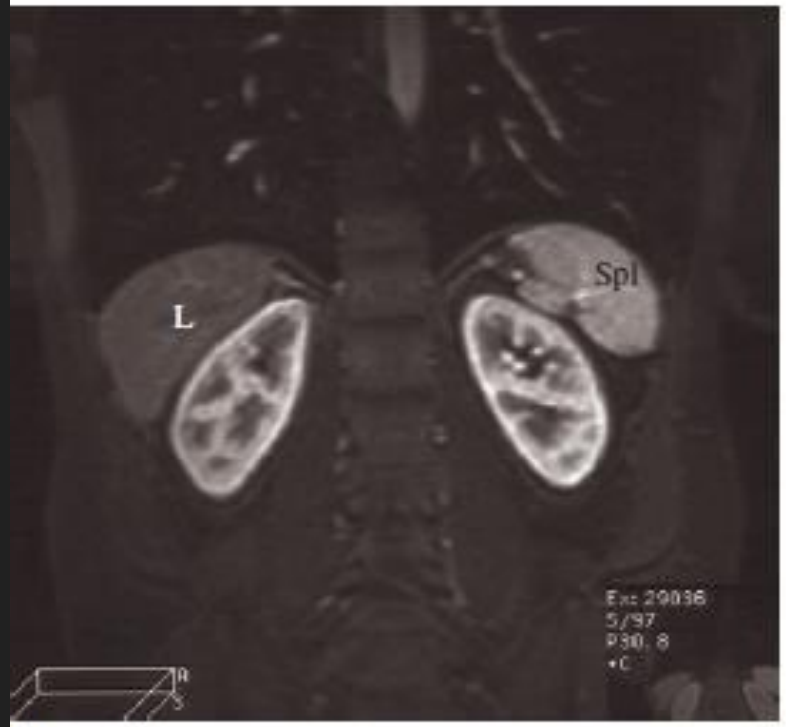

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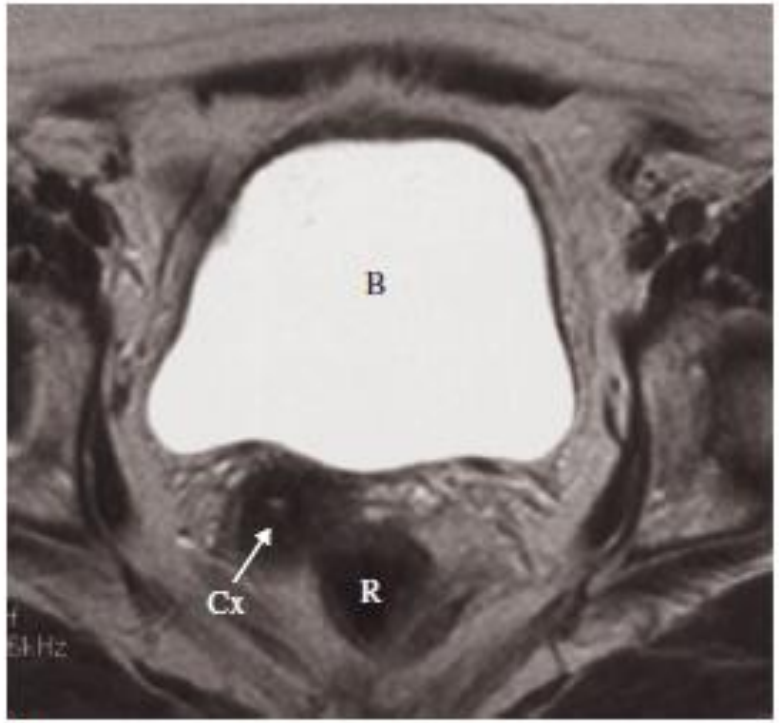

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Radionuclide examination

Radionuclide techniques for studying the kidneys include:

1- The renogram which measures renal function.

Main indications:

- Measurement of relative renal function in each kidney (this may help the surgeon decide between nephrectomy or more conservative surgery).
- Investigation of urinary tract obstruction, particularly pelviureteric junction obstruction.
- Investigation of renal transplants.

2- Scans of renal morphology (DMSA scan): They are now used mainly for evaluating renal scarring

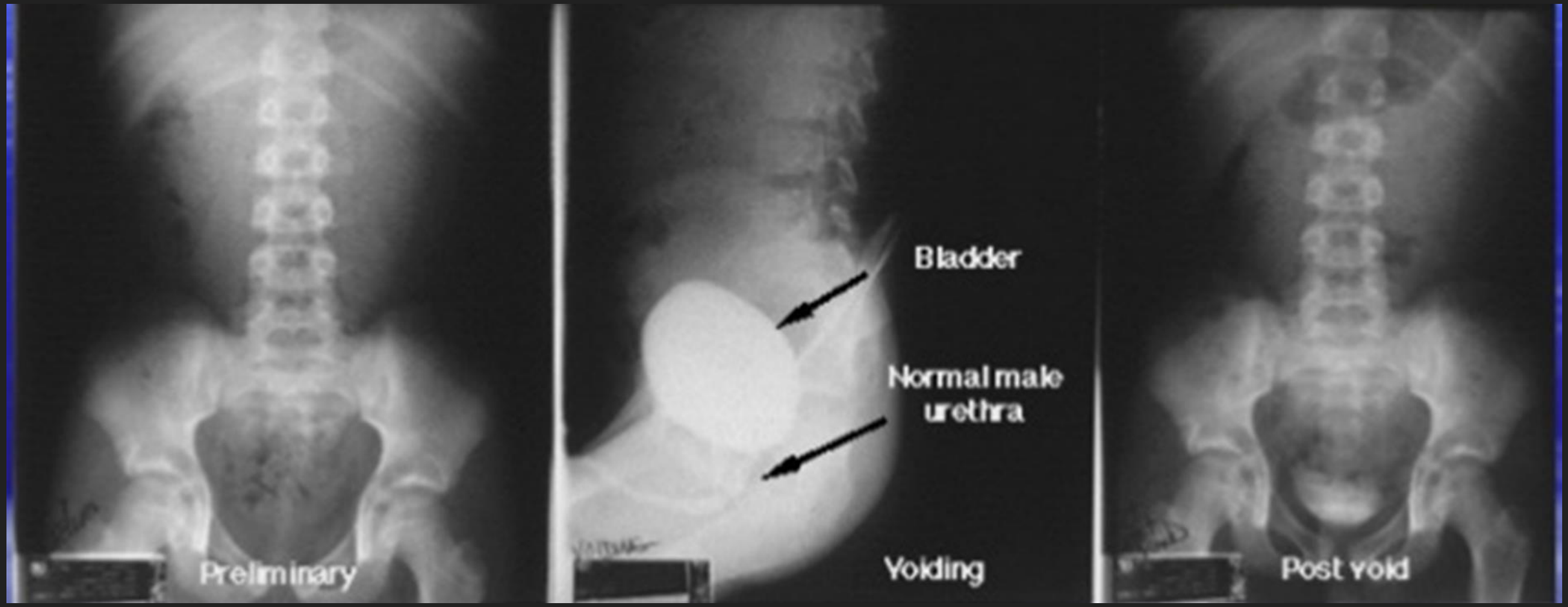
3- The presence of reflux in children may be diagnosed using the technique of nuclear cystography (a radionuclide tracer is infused into the bladder via a catheter, the child then voids whilst being imaged by the gamma camera. The presence of reflux can be detected if tracer activity is seen to rise up into one or both of the ureters at the time of micturition

Antegrade and retrograde pyelography

- The technique involve direct injection of contrast material into the pelvicaliceal system or ureters through catheters placed via cystoscopy (retrograde pyelography) or percutaneously into the kidney via the loin (antegrade pyelography).
- The indications are limited to those situations where the information cannot be achieved by less invasive means, e.g. IVU, CT or MRI to confirm a possible transitional cell carcinoma in the renal pelvis or ureter.

Voiding cystourethrogram

- In voiding cystourethrography, the bladder is filled with iodinated contrast medium through a catheter and films are taken during voiding. The entire process is observed fluoroscopically to identify vesicoureteric reflux. The bladder and urethra can be assessed during voiding to demonstrate strictures or urethral valves. (Assess posterior urethral problems in male)


Preliminary
Bladder
Normal male urethra
Voiding
Post void

- Simple cystography: frequently performed in adult used to assess the integrity of the bladder following trauma or surgery or to investigate suspected fistula involving the bladder.

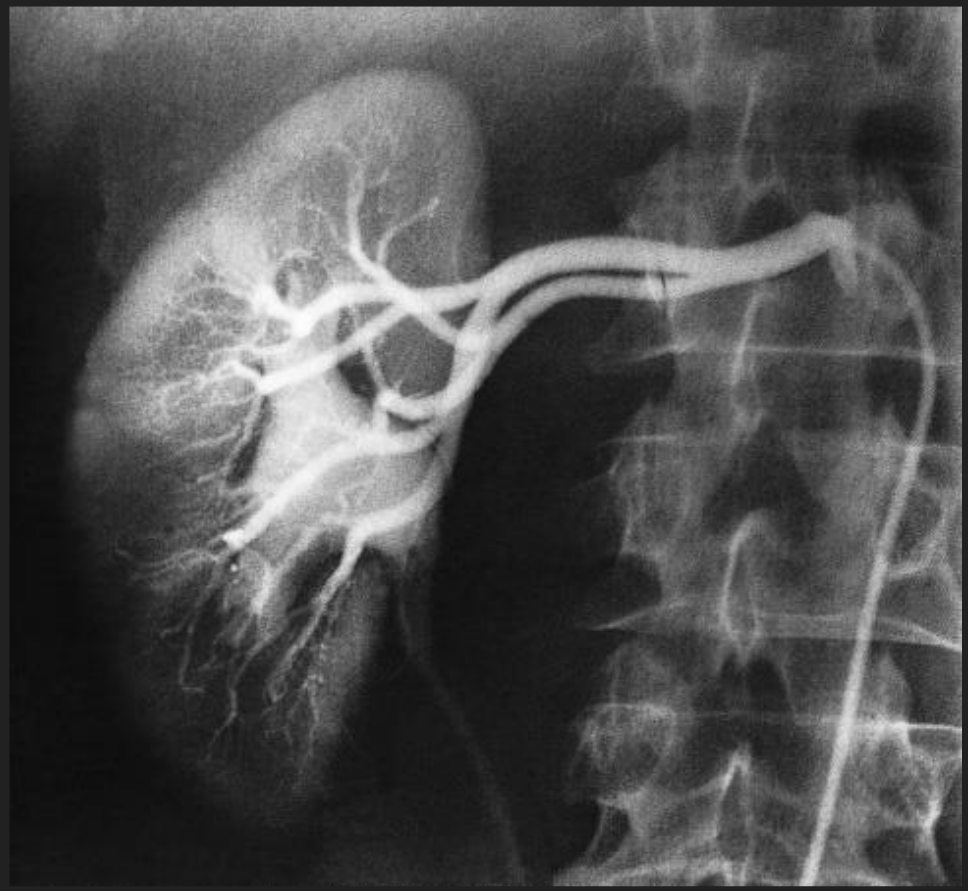
Urethrography

Can be performed via a descending or ascending approach

- In descending approach the urethra is visualized during voiding cystourethrography.
- Ascending urethrography used for full visualization of the male urethra with contrast medium injection via the external urethral meatus
- The usual indications for the examination are the identification of urethral strictures and to demonstrate extravasation from the urethra or bladder neck following trauma (prior to urethral catheterization in a male patient with an anterior pelvic fracture or dislocation, or with blood at the urethral meatus following trauma)

Renal angiography

- Renal arteriography is performed via a catheter introduced into the femoral artery by the Seldinger technique, Selective injections are made into one or both renal arteries
- It is mainly used to confirm the CT or MRI findings of vascular anatomy prior to renal surgery and to confirm renal artery stenosis prior to percutaneous balloon angioplasty.



Thank you