

Urology

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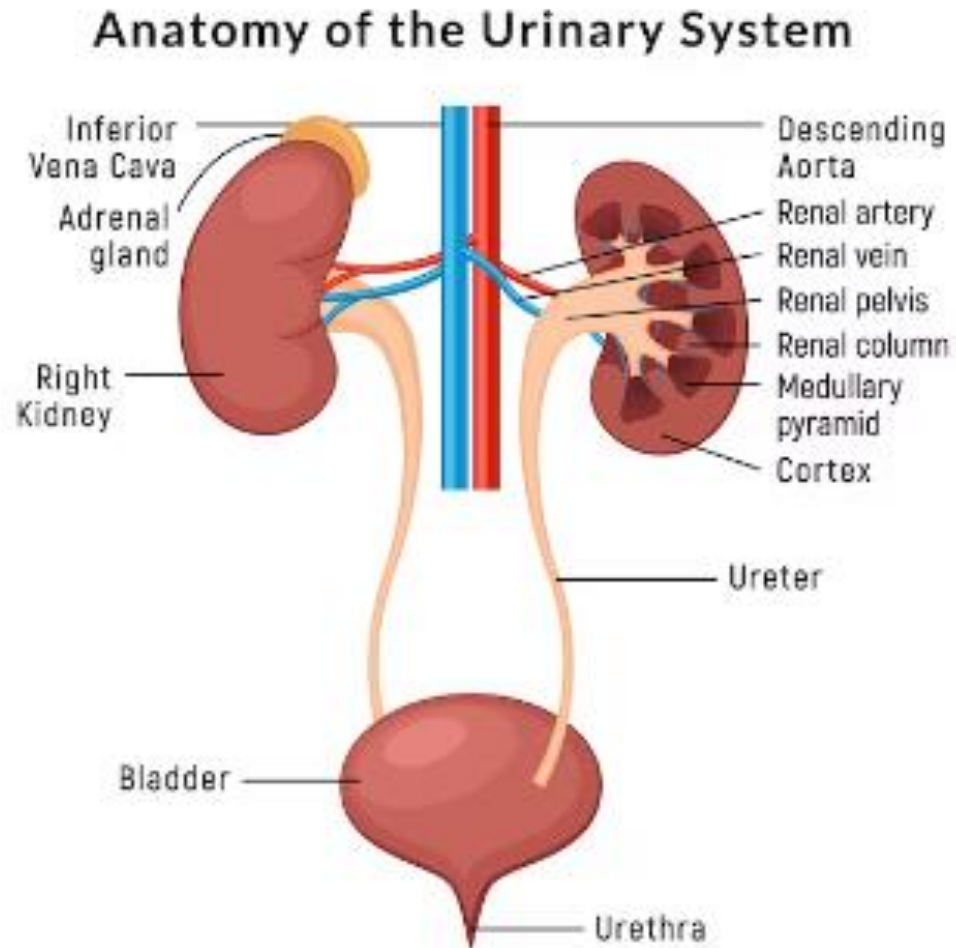
Anatomy Of the Urinary system

Kidney

Ureter

Bladder

Urethra




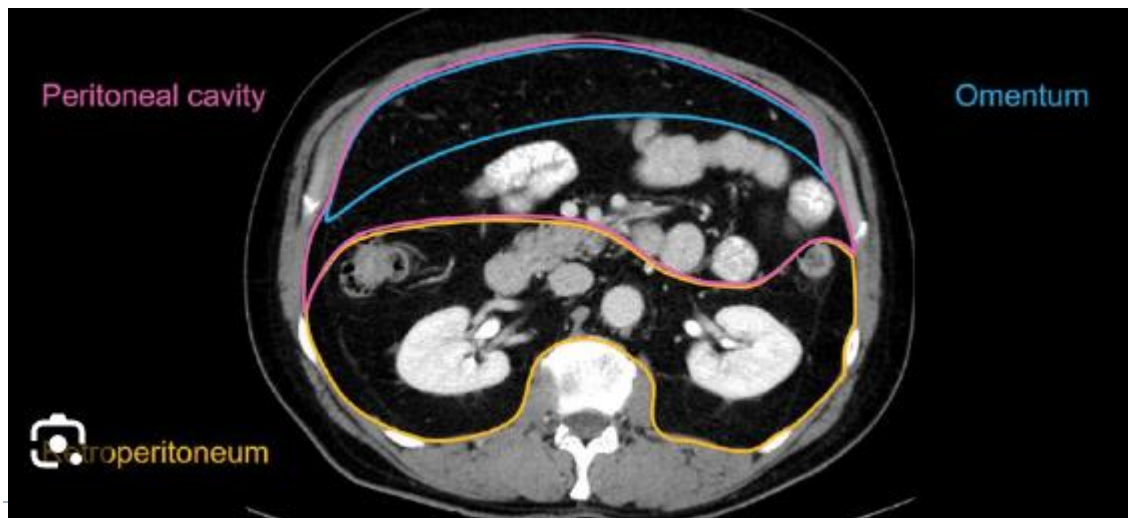
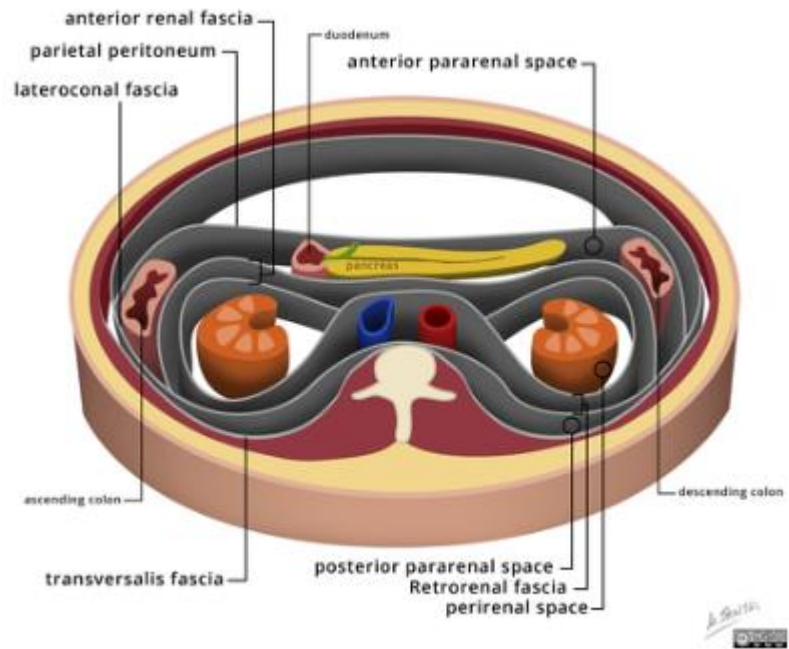
Kidney

The kidneys play a central role in **excretion** of many metabolic breakdown products, including **ammonia** and **urea** from protein, **creatinine** from muscle, **uric acid** from nucleic acids, drugs and toxins.

Each kidney is approximately 11–14 cm in length in healthy adults; they are located **retroperitoneally** on either side of the aorta and inferior vena cava between the **12th thoracic and 3rd lumbar vertebrae** .

The right kidney is usually a few centimetres lower because the liver lies above it. Both kidneys rise and descend several centimetres with respiration





The ureters and bladder

The ureters drain urine from the renal pelvis and deliver it to the bladder, a muscular organ that lies anteriorly in the lower part of the pelvis, just behind the pubic bone.

The **function of the bladder** is to store and then release urine during micturition

Radiographic features: The bladder is usually easier to evaluate when full, and it is sometimes difficult to identify when empty.



Radiographic features

The bladder is usually easier to evaluate when full, and it is sometimes difficult to identify when empty.

Plain radiographs: The bladder may be seen as a rounded soft tissue mass .

Fluoroscopy: Cystography can be performed where the bladder is filled with contrast either via an antegrade or retrograde technique.

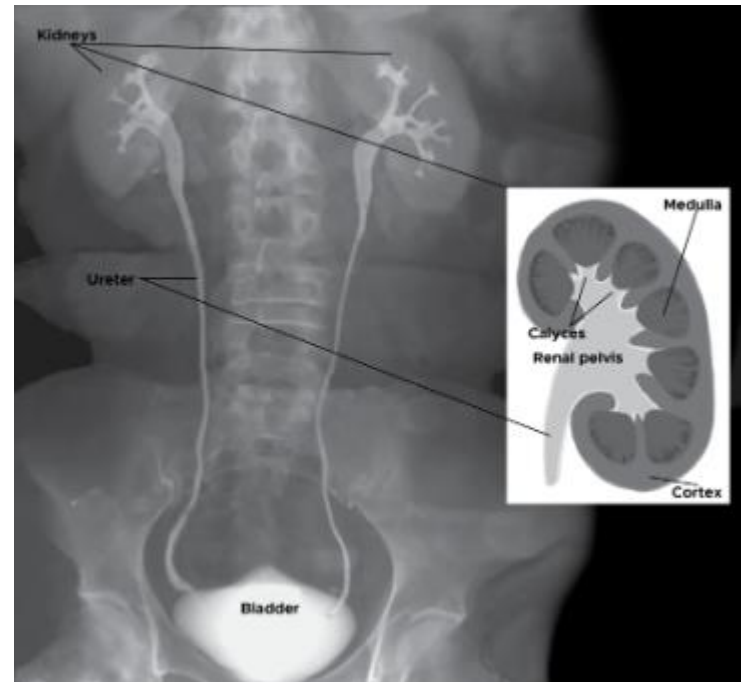
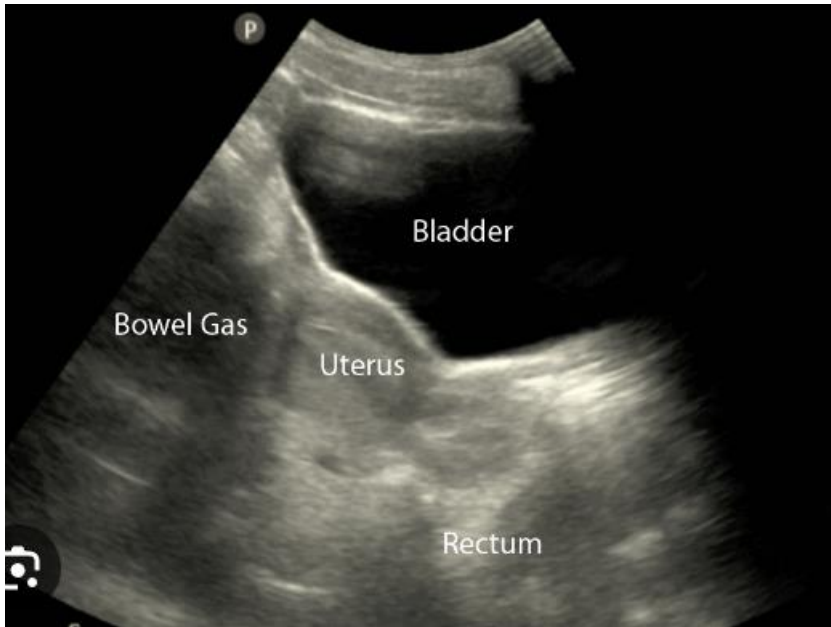
Ultrasound: The bladder wall is best assessed with this modality

MRI

T1: bladder wall and contents are homogeneous low signal

T2: bladder wall is of low signal and urine of high signal.



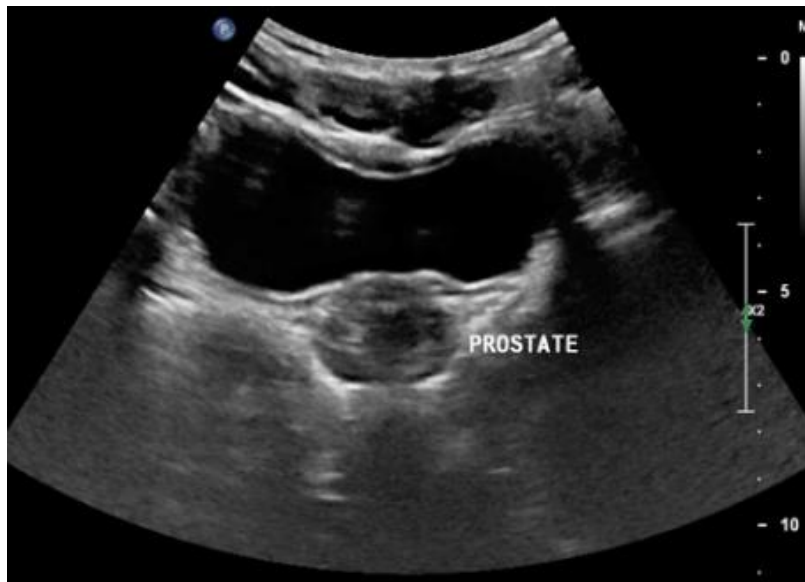
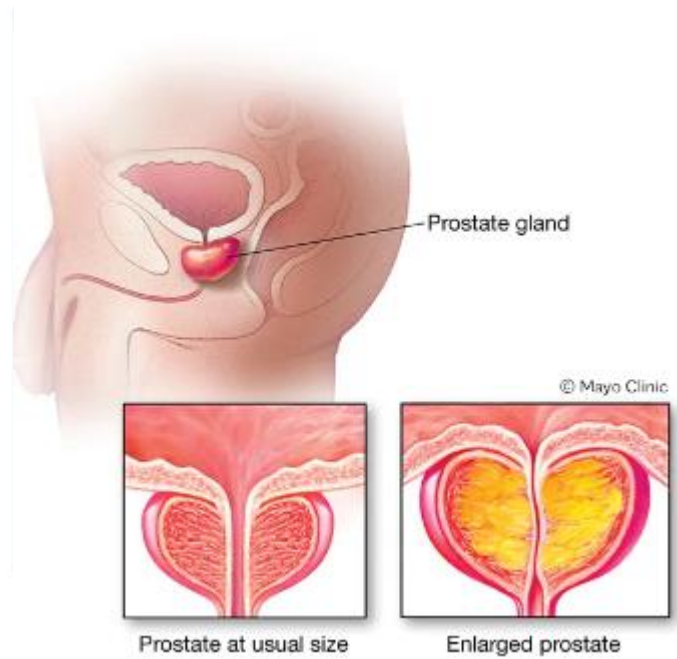
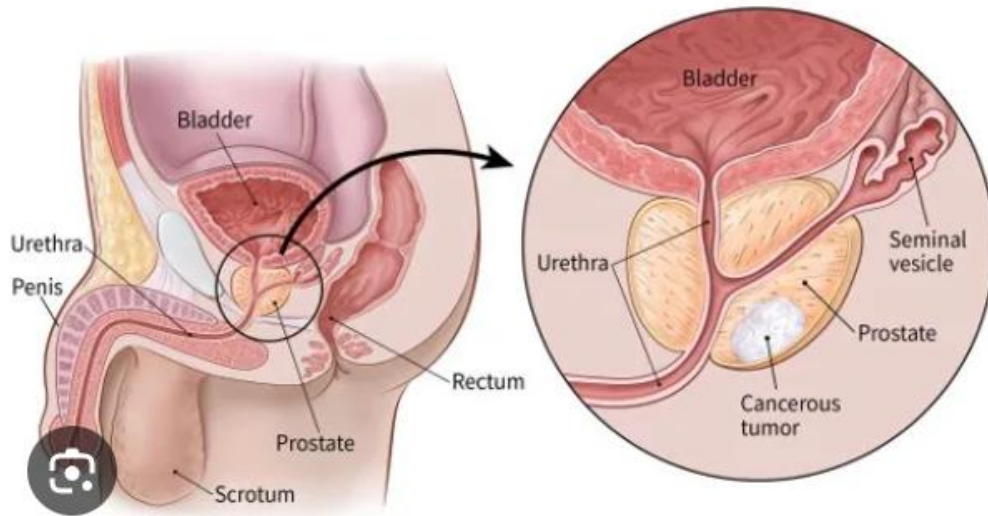


The prostate gland

The prostate gland is situated at the base of the bladder, surrounding the proximal urethra

Exocrine glands within the prostate produce fluid, which comprises about 20% of the volume of ejaculated seminal fluid and is rich in zinc and proteolytic enzymes.





Imaging for Urinary system

Ultrasound

Computed tomography

Magnetic resonance imaging

Renal arteriography

Pyelography

Radionuclide studies



Ultrasound

Renal ultrasound is a valuable non-invasive technique that may be performed to assess

Renal size and to investigate patient who are suspected of having obstruction of the urinary tract, renal tumours, cysts or stones.

Ultrasound can also be used to provide images of the **prostate gland and bladder**, and to estimate the completeness of emptying in patients with suspected bladder outflow obstruction.

In addition, it can reveal other abdominal, pelvic and retroperitoneal pathology



Computed tomography urography (CTU)

Computed tomography urography (CTU) is used to evaluate cysts and mass lesions in the kidney or filling defects within the collecting systems.

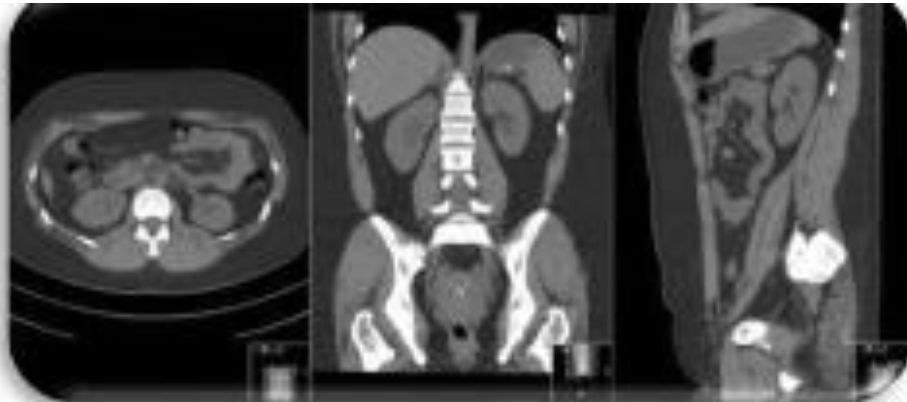
It usually entails an initial scan without contrast medium, and subsequent scans following injection of contrast to **obtain a nephrogram image** and images during the excretory phases.

CTU has largely replaced the previous gold-standard investigation of intravenous urography (IVU) for investigation of the upper urinary tract, having the advantage of providing complete staging information and details of surrounding organs.

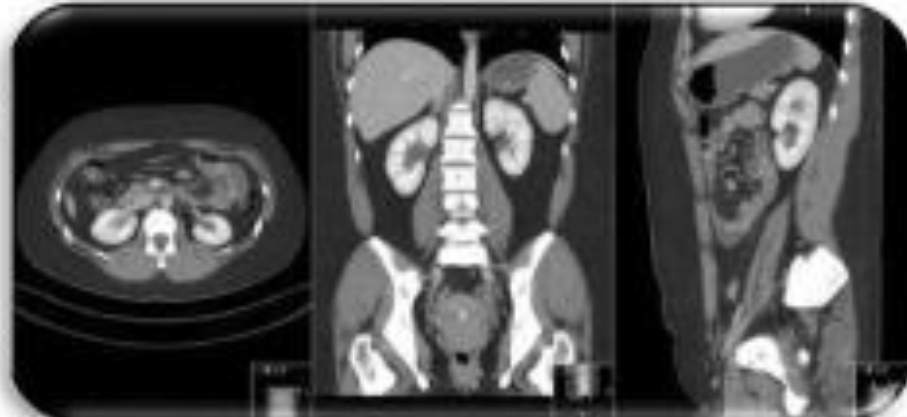
Contrast enhancement is particularly **useful for characterising mass lesion** within the kidney and differentiating benign from malignant lesions



Native
Phase



Nephrogram
Phase



Excretory
Phase



Magnetic resonance imaging (MRI)

Magnetic resonance imaging (MRI) offers excellent resolution and gives good distinction between different tissue types.

It is very useful for local staging of prostate, bladder and penile cancers.

Magnetic resonance angiography (MRA) provides an alternative to CT for imaging renal vessels but involves administration of gadolinium-based contrast media, which may carry risks for patients with impaired renal function. Whilst MRA gives good images of the main renal vessels, stenosis of small branch arteries may be missed



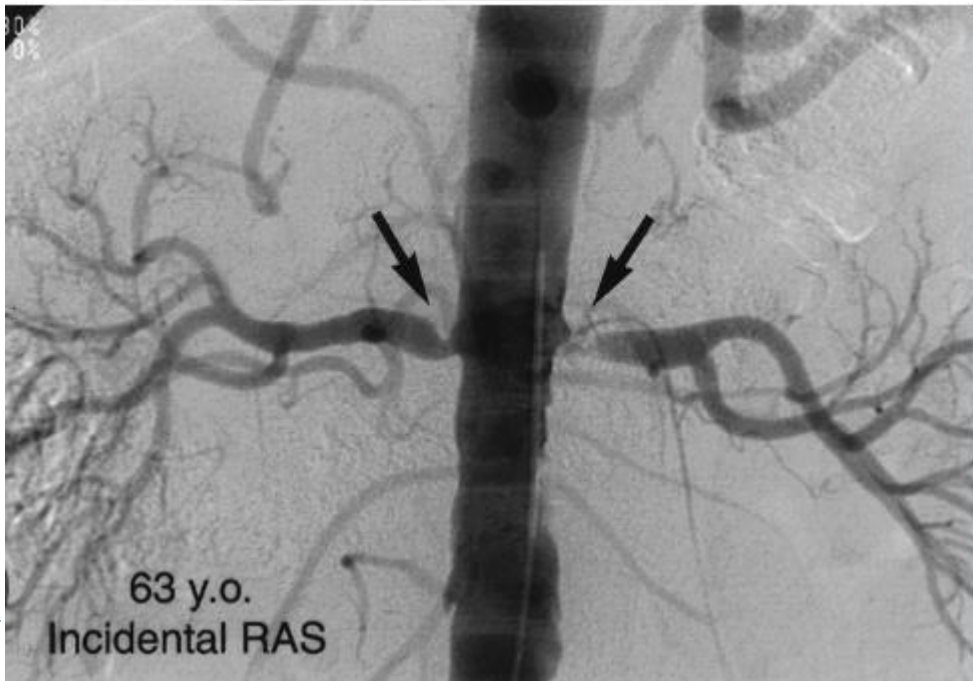
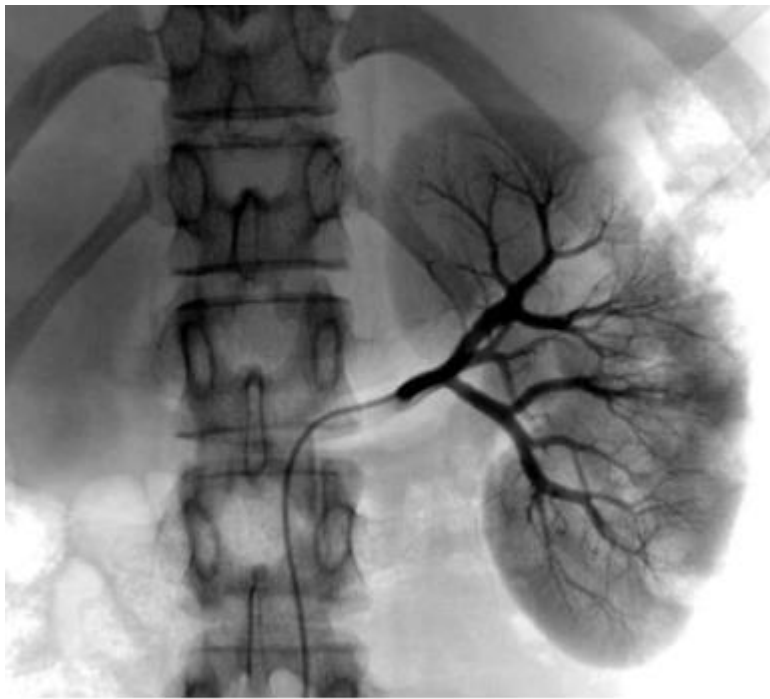
Renal arteriography

Renal arteriography involves taking X-rays following an injection of contrast medium directly into the renal artery.

The main indication is to investigate renal artery stenosis or haemorrhage following renal trauma.

Renal angiography can often be combined with therapeutic balloon dilatation or stenting of the renal artery involves taking X-rays following an injection of contrast medium directly into the renal artery.



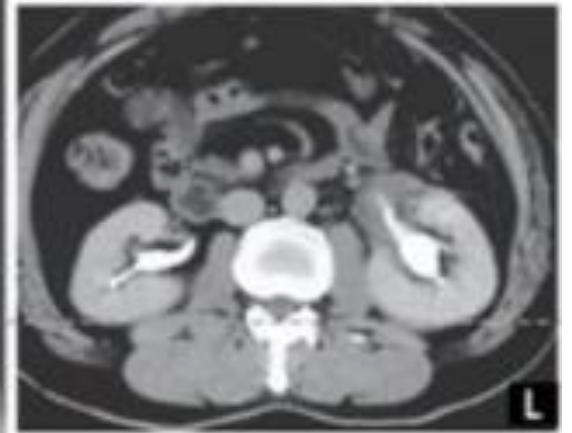


Pyelography

Pyelography involves direct injection of contrast medium into the collecting system from above (antegrade) or below (retrograde).

It offers the best views of the collecting system and upper tract, and is often used to identify the cause of **urinary tract obstruction**





The left side collecting system could not be demonstrated by IVU image

Oblique reconstructed imaging of CTU images showed left side hydronephrosis and stenosis of the left ureter



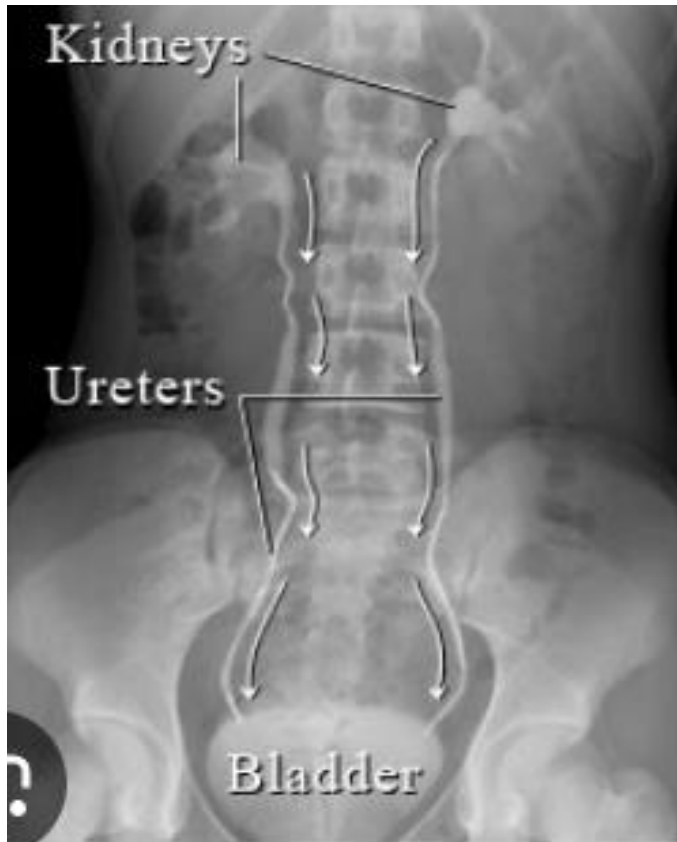


Figure 1



Figure 2



Radionuclide studies

Radionuclide studies: These are functional studies requiring the injection of gamma ray-emitting radiopharmaceuticals that are taken up and excreted by the kidney, a process that can be monitored by an external gamma camera.



An obstructive uropathy

Any cause of complete or partial, congenital or acquired, and permanent or intermittent obstruction of the urinary tract.

Depending on the severity of obstruction and extent, **it may result in permanent change** in both the collecting system proximal to the obstruction and to the renal parenchyma which normally drains into the affected collecting system.



Etiology

Ureter

transitional cell carcinoma of the ureter
retrocaval ureter
urolithiasis
ureterocele

Bladder: **transitional cell carcinoma (TCC) of the bladder**

Urethra

posterior urethral valves (PUV)
urethral atresia
urethral stenosis
urethral carcinoma
benign prostatic hypertrophy (BPH)



Transitional cell carcinoma (urinary tract)

Transitional cell carcinoma (TCC), also called urothelial cell carcinoma (UCC), is the most common primary malignancy of the urinary tract and may be found along its entire length, from the renal pelvis to the bladder.

97% is bladder TCC (The most common)



Clinical presentation

Clinical presentation is variable and usually non-specific.

Hematuria: most common presenting symptom for upper tract tumors

Symptomatic hydronephrosis

Palpable pelvic mass

occasionally patients only present once systemic symptoms of metastatic disease are present



Radiographic features

Ultrasound

Ultrasound has a limited role to play in either diagnosis or staging transitional cell carcinomas of the urinary tract in general.



CT

Bladder transitional cell carcinomas appear as either focal regions of thickening of the bladder wall, **or**

As masses protruding into the bladder lumen, **or**

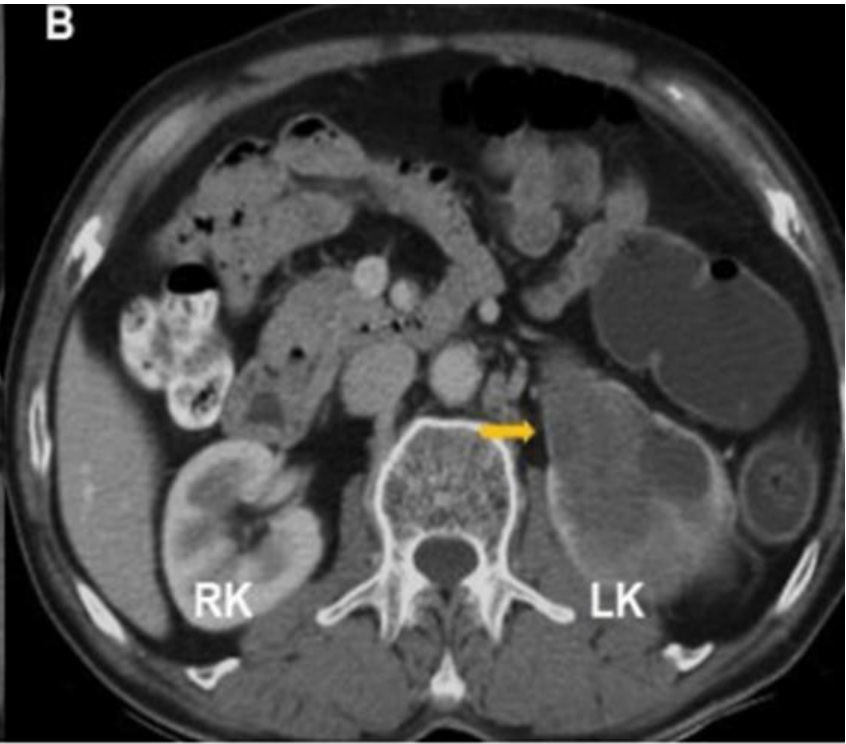
Extending into adjacent tissues in advanced cases.



CT or conventional urography

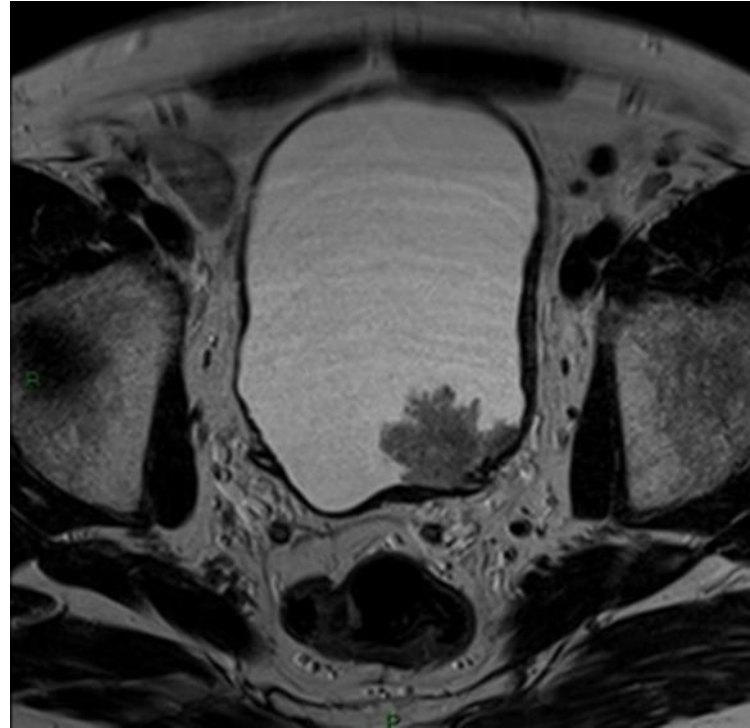
Urography's primary role is in assessing the remainder of the urinary tract for transitional cell carcinomas of the renal pelvis or ureter.





MRI

MRI is superior to other modalities in locally staging the tumor and is in some instances able to distinguish T1 from T2 tumors on T2 weighted images



Urolithiasis

Urolithiasis refers to the presence of calculi anywhere along the course of the urinary tracts. The terms urolithiasis, nephrolithiasis, and renal/kidney stones are used interchangeably.

Most patients tend to present between 30-60 years of age

Types

calcium oxalate +/- calcium phosphate: ~75%

struvite (triple phosphate): 15%

pure calcium phosphate: 5-7%

uric acid: 5-8%



Clinical presentation

1. Although some renal stones remain **asymptomatic**, most will result in pain.
 2. Small stones that arise in the kidney are more likely to pass into the ureter where they may result in **renal colic**.
 3. **Hematuria**, although common, may be absent in approximately 15% of patients .
 4. Some patients may also present with the complication of **obstructive pyelonephritis**, and may, therefore, have a septic clinical presentation.
 5. In children, **vague abdominal pain** is more typical than the classic colicky pain described by adults
-



Radiographic features

Plain radiograph:

Calcium-containing stones are **radiopaque**: Ca.Oxalate

Lucent stones include: uric acid

Intravenous urography (IVU): It involves the administration of intravenous contrast. This exam has been replaced mainly by non-contrast CT

Ultrasound

Ultrasound is frequently the first investigation of the urinary tract, and although by no means as sensitive as CT, it can often identify calculi

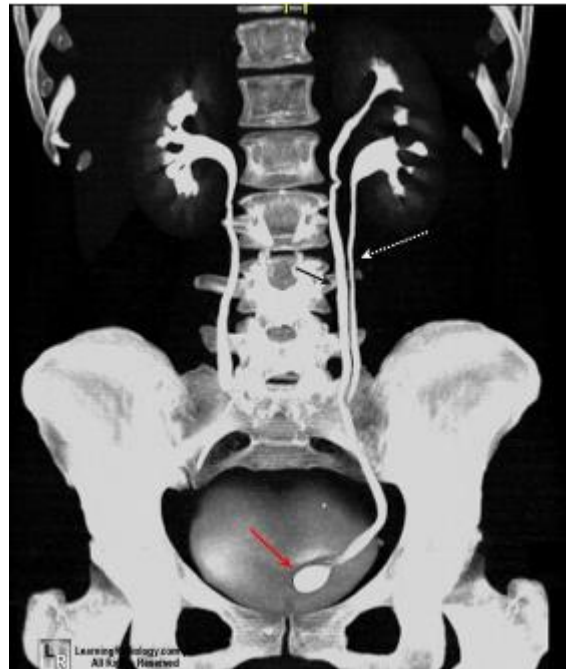
CT

On CT almost all stones are opaque but vary considerably in density.



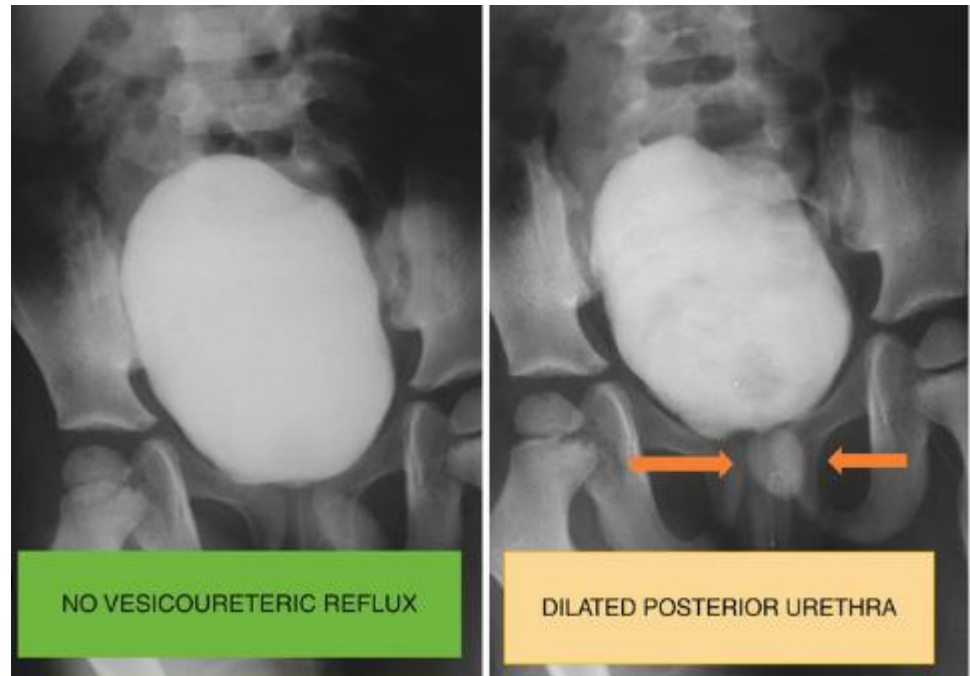
Ureterocele

Ureteroceles represent abnormal congenital dilatation of the distal-most portion of the ureter.



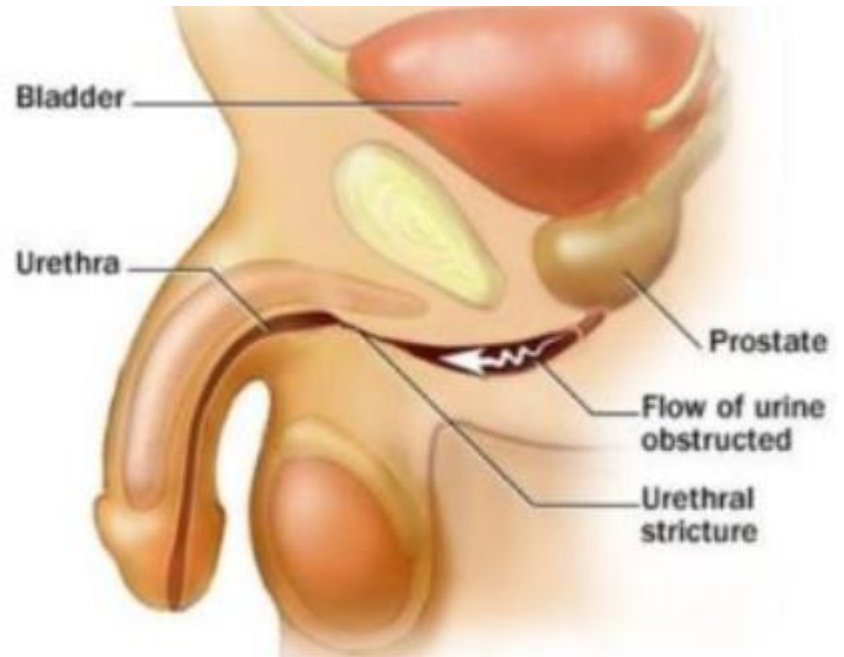
Posterior urethral valves

Posterior urethral valves (PUV), also referred to as congenital obstructing posterior urethral membranes (COPUM), are the most common congenital obstructive lesion of the urethra and a common cause of obstructive uropathy in infancy.



Urethral strictures

are relatively common and typically occur either in the setting of trauma or infection.



Benign prostatic hyperplasia

Benign prostatic hyperplasia (BPH), is an extremely common condition in elderly men and is a major cause of bladder outflow obstruction.

By the age of 60, 50% of men have benign prostatic hyperplasia, and by 90 years of age, the prevalence has increased to 90%



Clinical presentation

1. Asymptomatic
2. Lower urinary tract symptoms
3. Poor stream despite straining
4. Hesitancy, frequency, and incomplete emptying of the bladder
5. Nocturia

DDx Prostate CA



Ultrasound for BPH

Ultrasound has become the standard first-line investigation after the urologist's finger.

There is an increase in the volume of the prostate.

The central gland is enlarged and is hypoechoic or of mixed echogenicity

Calcification may be seen both within the enlarged gland

Post-micturition residual volume is typically elevated

Associated bladder wall hypertrophy and trabeculation due to chronically elevated filling pressures



