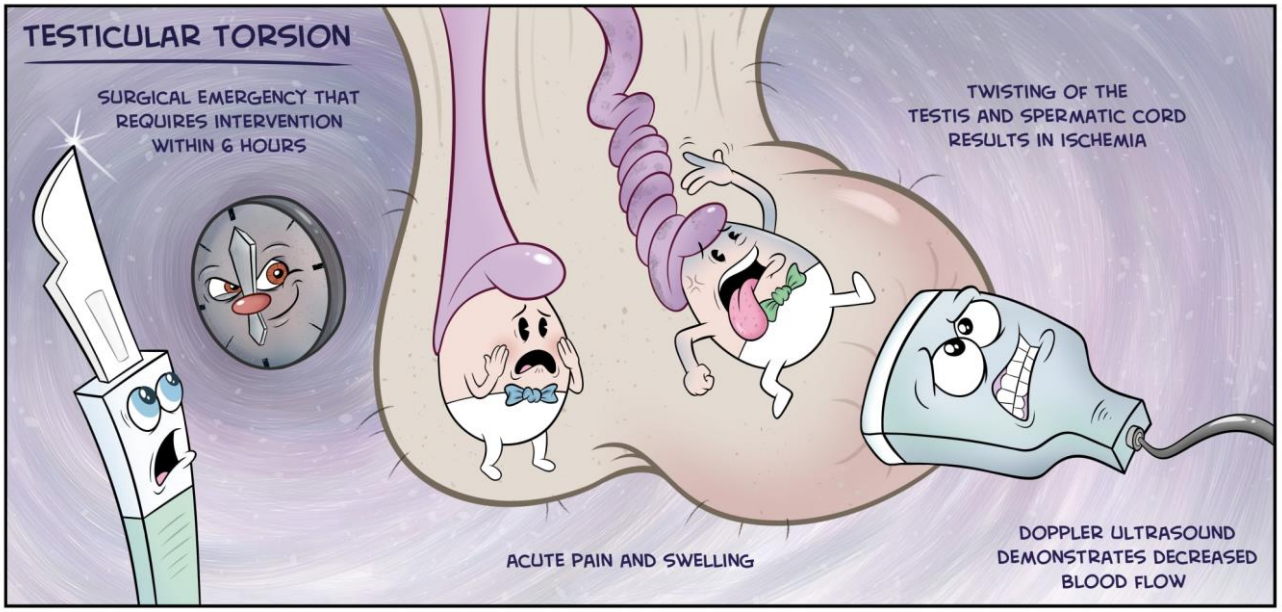
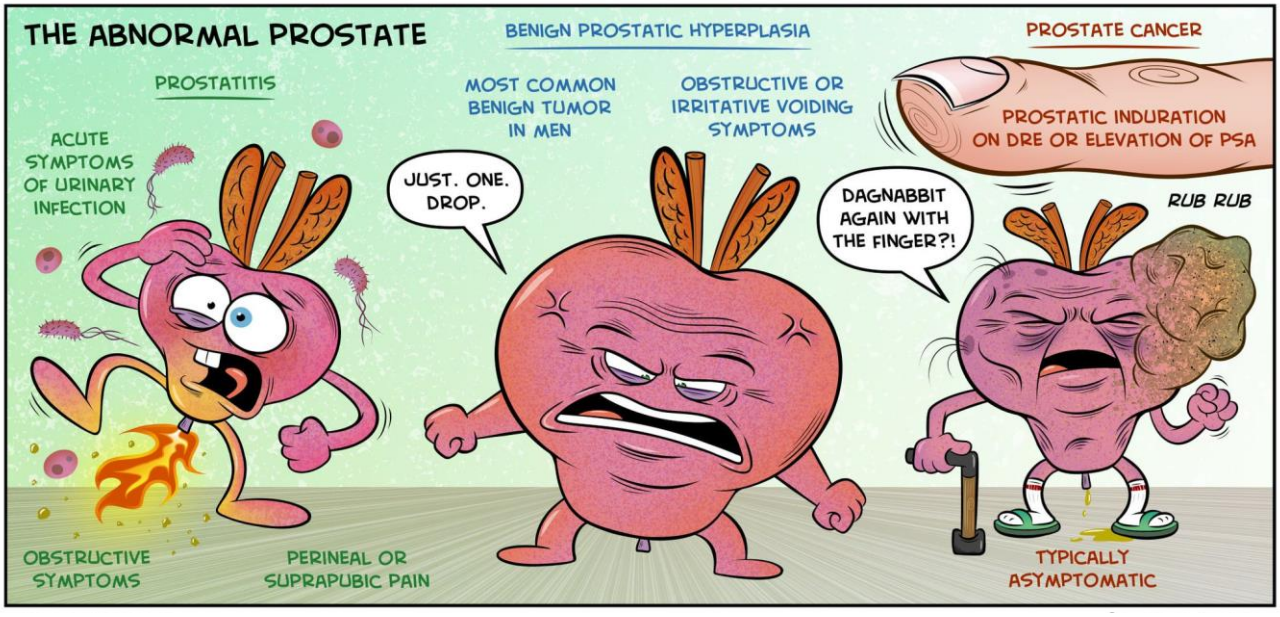
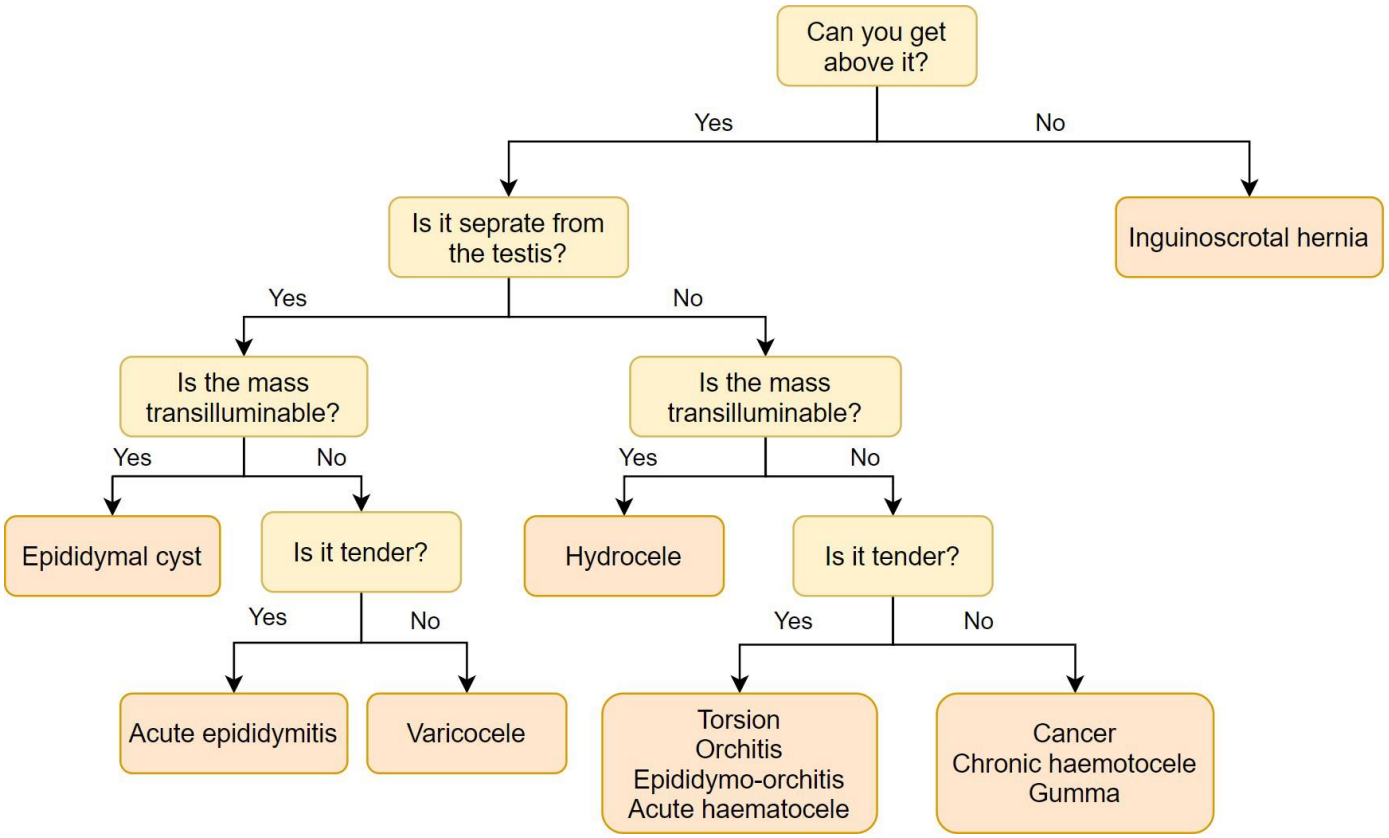


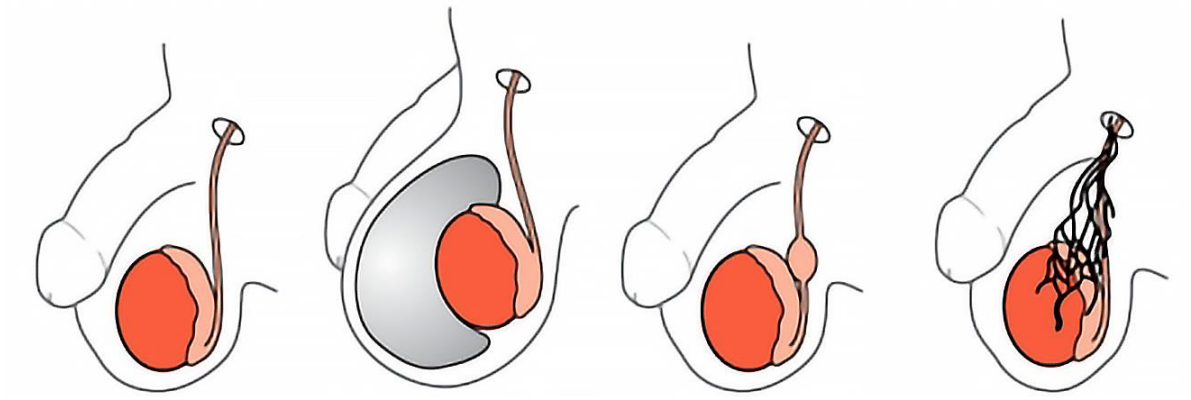


Scrotal swelling

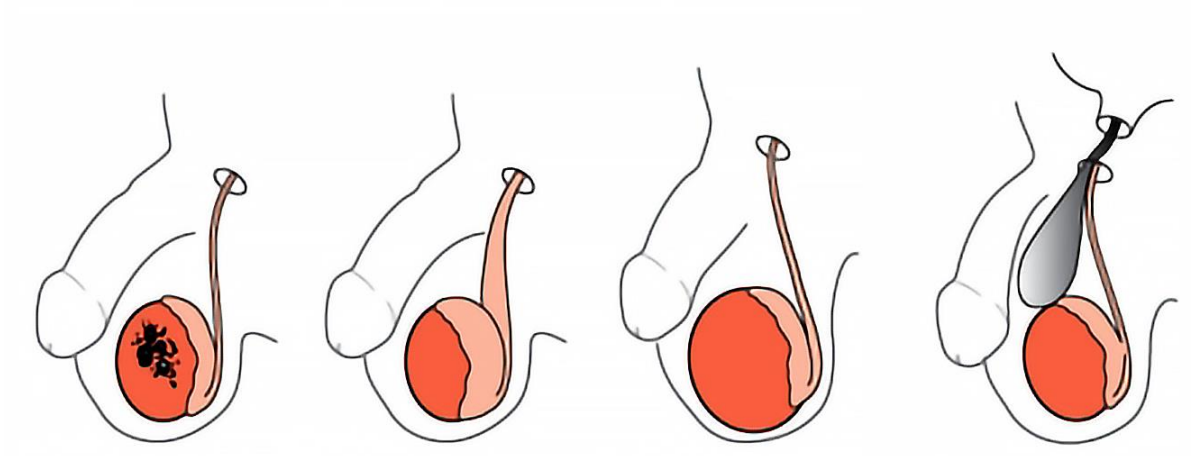
Differential diagnosis

	Features	Management
Testicular tumours	• Often discrete testicular nodule (may have associated hydrocele) • Symptoms of metastatic disease may be present USS scrotum and serum AFP and β HCG required	**Always treated with** orchidectomy via an inguinal approach**. This allows high ligation of the testicular vessels and avoids exposure of another lymphatic field to the tumour**
Acute epididymo-orchitis	• Often history of dysuria and urethral discharge • Swelling may be tender and eased by elevating testis • Most cases due to *Chlamydia* • Infections with other gram negative organisms may be associated with underlying structural abnormality	
Testicular torsion	• Severe, sudden onset testicular pain • Risk factors include abnormal testicular lie • Typically affects adolescents and young males • On examination testis is tender and pain not eased by elevation • Commonest in young teenagers and the history in older children can be difficult to elicit. Intermittent torsion is a recognised problem. • Urgent surgery is indicated, the contra lateral testis should also be fixed • Torsion of spermatic cord → absent cremasteric reflex • Torsion of testicular appendage → preserved reflex	The treatment is **prompt surgical exploration** and testicular fixation. This can be achieved using sutures or by placement of the testis in a Dartos pouch.
Epididymal cysts	• **Painless** • Single or multiple cysts • May contain clear or opalescent fluid (spermatoceles) • Usually occur over 40 years of age • Lie above and behind testis • **Testis can be felt separately** i.e palpated unlike hydrocele • It is usually possible to "get above the lump" on examination • Transilluminates	Excised using a scrotal approach
Inguinal hernia	• If inguinoscrotal swelling; **cannot "get above it"** on examination • **Cough impulse may be present** • May be **reducible**	
Hydrocele	• **Non painful**, soft fluctuant swelling • Usually contain clear fluid • Will often **transilluminate** • May be presenting feature of testicular cancer in young men • **Testis is NOT palpated** • Often possible to "get above it" on examination • Can be secondary (causes include trauma, infection and tumour)	Managed differently in children where the underlying pathology is a patent processus vaginalis and therefore an **inguinal approach is used in children so that the processus can be ligated. In adults a scrotal approach is preferred** and the hydrocele sac excised or plicated **(Jaboulay's procedure)**.
Varicocele	• Varicosities of the pampiniform plexus • Typically occur on left (because testicular vein drains into renal vein) • May be presenting feature of renal cell carcinoma • Affected testis may be smaller and bilateral varicoceles may affect fertility	Usually managed **conservatively**. If there are concerns about testicular function or infertility, then surgery or radiological management can be considered
Hematocele	• Tense, tender • Does not transilluminate • Post-traumatic	





Normal *Hydrocele* *Epididymal cyst* *Varicocele*



Testicular tumour *Epididymitis* *Orchitis* *Indirect Inguinal hernia*

Testicular cancer

Testicular cancer is the most common malignancy in men aged 20-30 years. Around 95% of cases of testicular cancer are germ-cell tumours. Germ cell tumours may essentially be divided into:

Tumour type	Key features	Tumour markers	Pathology
Seminoma	• **Commonest** subtype (50%) • Average age at diagnosis = 40 • Even advanced disease associated with 5 year survival of 73%	• AFP usually normal • HCG elevated in 10% seminomas • Lactate dehydrogenase; elevated in 10-20% seminomas (but also in many other conditions)	Sheet like lobular patterns of cells with substantial fibrous component. Fibrous septa contain lymphocytic inclusions and granulomas may be seen.
Non seminomatous germ cell tumours (42%) • Teratoma • Yolk sac tumour • Choriocarcinoma • Mixed germ cell tumours (10%)	• Younger age at presentation: 20-30 years • Advanced disease carries worse prognosis (48% at 5 years) • Retroperitoneal lymph node dissection may be needed for residual disease after chemotherapy	• AFP elevated in up to 70% of cases • HCG elevated in up to 40% of cases • Other markers rarely helpful	Heterogenous texture with occasional ectopic tissue such as hair

Leydig cell tumours are rare testicular sex cord stromal tumours (which also include sertoli cell tumours) which are associated with hormonal activity.

- Patients with Leydig cell tumours may present with **gynaecomastia** before they notice testicular enlargement.
- Majority are benign
- Histology: eosinophilic cells in columns

Summary

Tumor	Peak Patient Age	Morphology	Tumor Markers
Seminoma	40–50	Sheets of uniform polygonal cells with cleared cytoplasm; lymphocytes in the stroma	10% of patients have elevated hCG
Embryonal carcinoma	20–30	Poorly differentiated, pleomorphic cells in cords, sheets, or papillary formation; most contain some yolk sac and choriocarcinoma cells	Negative (pure embryonal carcinoma)
Spermatocytic tumor	50-60	Small, medium, and large polygonal cells; no inflammatory infiltrate	Negative
Yolk sac tumor	3	Poorly differentiated endothelium-like, cuboidal, or columnar cells	90% of patients have elevated AFP
Choriocarcinoma	20–30	Cytotrophoblast and syncytiotrophoblast without villus formation	100% of patients have elevated hCG
Teratoma	All ages	Tissues from all three germ cell layers with varying degrees of differentiation	Negative (pure teratoma)
Mixed tumor	15–30	Variable, depending on mixture; commonly teratoma and embryonal carcinoma	90% of patients have elevated hCG and AFP

Priapism

Prolonged unwanted erection, in the absence of sexual desire, lasting more than 4 hours.

Classification of priapism

Low flow priapism	Due to veno-occlusion (high intracavernosal pressures). • Most common type • Often painful • Often low cavernosal flow • If present for > 4 hours requires emergency treatment
High flow priapism	Due to unregulated arterial blood flow. • Usually presents as semi rigid painless erection
Recurrent priapism	Typically seen in sickle cell disease, most commonly of high flow type.

Causes

- Intracavernosal drug therapies (e.g. for erectile dysfunction>
- Blood disorders such as leukemia and sickle cell disease
- Neurogenic disorders such as spinal cord transection
- Trauma to penis resulting in arterio-venous malformations

Tests

- Exclude sickle cell/ leukemia
- Consider blood sampling from cavernosa to determine whether high or low flow (low flow is often hypoxic)

Management

- Ice packs/ cold showers
- If due to low flow, then blood may be aspirated from corpora or try intracavernosal alpha adrenergic agonists.
- Delayed therapy of low flow priapism may result in erectile dysfunction.

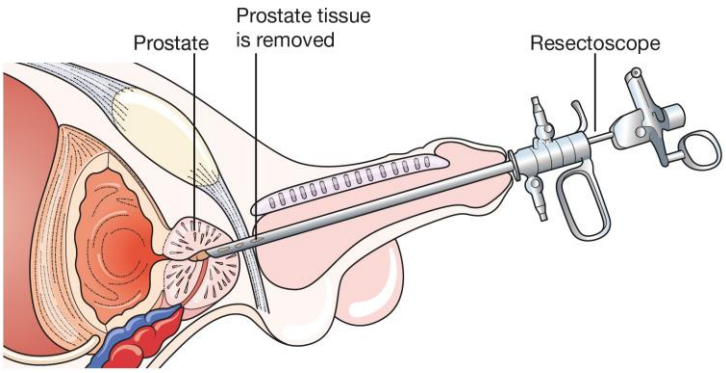
BPH (Benign Prostatic Hyperplasia)

Definition

Increase in size of the prostate gland **without malignancy.** It is so common as to be normal with advancing age

Management

- Medical
  - α blocker (tamsulosin):
    - Works by relaxing bladder and prostate muscles
    - Rapid outcome, not used in hypotensive patients
  - 5- α-reductase inhibitors (finasteride)
    - Causes prostate to shrink, prevents growth
    - Takes time



For transurethral resection of the prostate the resectoscope is inserted transurethrally. Electric current is passed through a diathermy loop at the end of the instrument. The surgeon moves this back and forth to create a cavity using diathermy to cauterise as they go. The resultant chips are washed out of the bladder intermittently throughout the procedure. A visual image of the operative field is transmitted through lenses running in the middle of the resectoscope. Around this lens, irrigating fluid is instilled and flows out, washing blood away from the operative field. The procedure is complete when an adequate channel has been created through the prostate.

- TURP

  Indications:
  - Urinary retention (intractable)
  - Renal insufficiency (caused by obstruction)
  - Failure of medical management
  - Recurrent cystitis
  - Bladder calculi
  - Persistent prostatic bleeding

- Open Prostatectomy

  Indications
  - For men whose prostates are too large for TURP for fear of incomplete resection, significant bleeding or the risk of dilutional hyponatremia (TUR syndrome)

Prostate Cancer

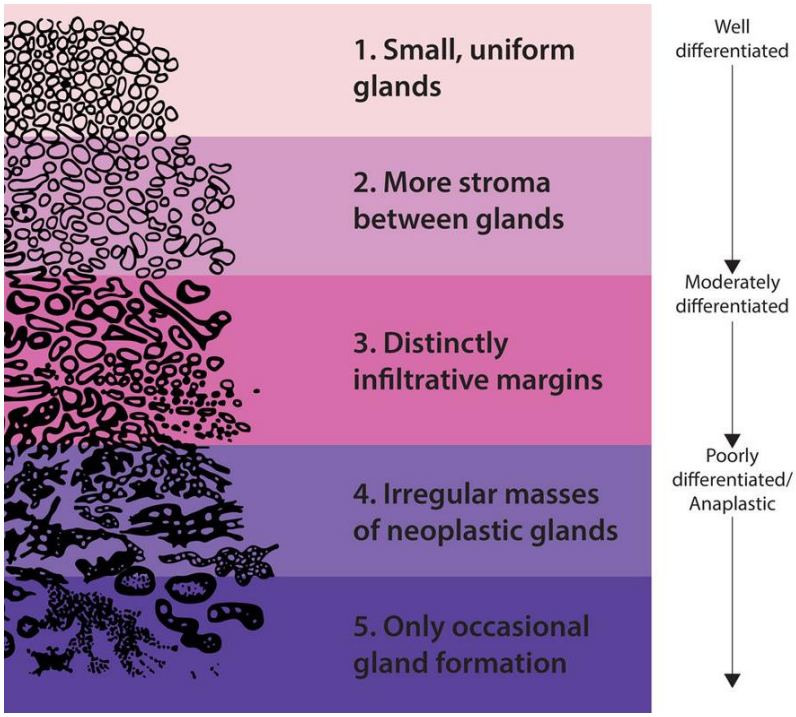
Diagnosis

- Early prostate cancers have few symptoms.
- Metastatic disease may present as bone pain.
- Locally advanced disease may present as pelvic pain or with urinary symptoms.
- Prostate specific antigen measurement
- Digital rectal examination
- Trans rectal USS (+/- biopsy)
- MRI/ CT and bone scan for staging.

PSA Test

The normal upper limit for PSA is 4ng/ml. However, in this group will lie patients with benign disease and some with localised prostate cancer. False positives may be due to prostatitis, UTI, BPH, vigorous DRE.

The percentage of free: total PSA may help to distinguish benign disease from cancer. Values of <20% are suggestive of cancer and biopsy is advised.



Gleason grading system

Pathology

- 95% adenocarcinoma
- In situ malignancy is sometimes found in areas adjacent to cancer. Multiple biopsies needed to call true in situ disease.
- Often multifocal, 70% lie in the peripheral zone.
- Graded using the **Gleason** grading system, two grades awarded 1 for most dominant grade (on scale of 1-5) and 2 for second most dominant grade (scale 1-5). The two added together give the Gleason score. Where 2 is best prognosis and 10 the worst.
- Lymphatic spread occurs first to the obturator nodes and local extra prostatic spread to the seminal vesicles is associated with distant disease.

Treatment

- **Watch and wait:** Elderly, multiple co-morbidities, low Gleason score
- **Radiotherapy** (External): Both potentially curative and palliative therapy possible. However, radiation proctitis and rectal malignancy are late problems. Brachytherapy is a modification allowing internal radiotherapy.
- **Surgery:** Radical prostatectomy. Surgical removal of the prostate is the standard treatment for localised disease. The robot is being used increasingly for this procedure. As well as the prostate the obturator nodes are also removed to complement the staging process. Erectile dysfunction is a common side effect. Survival may be better than with radiotherapy (see references).
- **Hormonal therapy:** Testosterone stimulates prostate tissue and prostatic cancers usually show some degree of testosterone dependence. 95% of testosterone is derived from the testis and **bilateral orchidectomy** may be used for this reason. Pharmacological alternatives include LHRH analogues and anti-androgens (which may be given in combination).
- In the UK the National Institute for Clinical Excellence (NICE) suggests that **active surveillance is the preferred option for low risk men**. It is particularly suitable for men with clinical stage T1c, Gleason score 3+3 and PSA density < 0.15 ng/ml/ml who have cancer in less than 50% of their biopsy cores, with < 10 mm of any core involved.

  Candidates for active surveillance should:
  - *have had at least 10 biopsy cores taken*
  - *have at least one re-biopsy.*

  If men on active surveillance show evidence of disease progression, offer radical treatment. Treatment decisions should be made with the man, taking into account co-morbidities and life expectancy.

Causes of Haematuria

Trauma	• Injury to renal tract • Renal trauma commonly due to blunt injury (others penetrating injuries) • Ureter trauma rare: iatrogenic • Bladder trauma: due to RTA or pelvic fractures
Infection	• Remember TB
Malignancy	• Renal cell carcinoma (remember paraneoplastic syndromes): painful or painless • Urothelial malignancies: 90% are transitional cell carcinoma, can occur anywhere along the urinary tract. Painless haematuria. • Rare bladder tumours (Squamous cell carcinoma and Adenocarcinoma) • Prostate cancer • Penile cancers: SCC TCC of the renal pelvis may seed down the ureter. SCC of the kidney usually arises in an area of chronic inflammation such as a staghorn calculus. Renal adenocarcinoma on the left side may invade the gonadal vein and produce varicocele. They also have paraneoplastic phenomena such as hypercalcaemia.
Renal disease	• Glomerulonephritis
Stones	• Microscopic haematuria common
Structural abnormalities	• Benign prostatic hyperplasia (BPH) causes haematuria due to hypervascularity of the prostate gland • Cystic renal lesions e.g. polycystic kidney disease • Vascular malformations • Renal vein thrombosis due to renal cell carcinoma
Coagulopathy	• Causes bleeding of underlying lesions
Drugs	• Cause tubular necrosis or interstitial nephritis: aminoglycosides, chemotherapy • Interstitial nephritis: penicillin, sulphonamides, and NSAIDs • Anticoagulants
Benign	• Exercise
Gynaecological	• Endometriosis: flank pain, dysuria, and haematuria that is cyclical
Iatrogenic	• Catheterisation • Radiotherapy; cystitis, severe haemorrhage, bladder necrosis
Pseudohaematuria	For example following consumption of beetroot, rhubarb, blackberries, and some drugs*

Schistosoma **haemat**obium causes **haemat**uria

**Rifampicin, phenytoin, levodopa, methyldopa, and quinine all cause pseudohaematuria.*

Complete urological evaluation for haematuria includes a full history and physical examination, laboratory analysis, and radiological imaging ***(see later)*** of the upper urinary tract followed by cystoscopic examination of the urinary bladder. Urinary cytology, although controversial, often constitutes part of the initial work up for hematuria

Imaging for Haematuria:

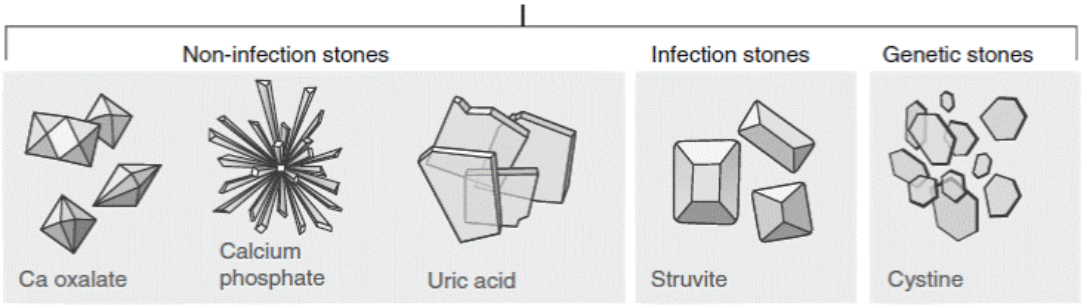
There is currently no universal agreement about the optimal imaging work up of haematuria. The choice of modality to image the urinary tract will depend on individual patient factors such as age, the presence of risk factors for malignancy, renal function, a history of calculus disease and pregnancy, and other factors, such as local policy and practice, cost effectiveness and availability of resources.

See also: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4124848/

Renal stones

Type	Features	Opacity	Percent	Urine acidity *	Urine pH
Calcium oxalate	• **Hypercalciuria** is a major risk factor (various causes) • **Hyperoxaluria** may also increase risk • **Hypocitraturia** increases risk because citrate forms complexes with calcium making it more soluble • Hyperuricosuria may cause uric acid stones to which calcium oxalate binds	Stones are radio-opaque (though less than calcium phosphate stones)	85%	Variable	6
Cystine	• **Inherited** recessive disorder of transmembrane cystine transport leading to decreased absorption of cystine from intestine and renal tubule • **Multiple** stones may form	Relatively radiodense because they contain sulphur (Semi-opaque, 'ground-glass')	1%	Normal	6.5
Uric acid	• Uric acid is a product of purine metabolism • May precipitate when urinary **pH low** • May be caused by diseases with extensive tissue breakdown e.g. **malignancy** • More common in children with **inborn errors of metabolism**	Radiolucent	5-10%	Acid	5.5
Calcium phosphate	• May occur in **renal tubular acidosis, high urinary pH** increases supersaturation of urine with calcium and phosphate • Renal tubular acidosis types 1 and 3 increase risk of stone formation (types 2 and 4 do not)	Radio-opaque stones (composition similar to bone)	10%	Normal – alkaline	>5.5
Struvite	• Stones formed from magnesium, ammonium and phosphate. • Occur as a result of urease producing bacteria (and are thus associated with chronic infections, for example Infection with *Proteus mirabilis*). • Under the alkaline conditions produced, the crystals can precipitate.	Slightly radio-opaque	2-20%	Alkaline	>7.2

** Urine pH will show individual variation (from pH 5-7). Post prandially the pH falls as purine metabolism will produce uric acid. Then the urine becomes more alkaline (alkaline tide). When the stone is not available for analysis the pH of urine may help to determine which stone was present.*



Summary for the exam

Most common	Ca oxalate
Most opaque	Ca phosphate
Most radio-lucent / Staghorn stone	Uric acid
Hereditary	Cystine
UTI	Struvite

Therapeutic selection

Disease	Option
Ureteric calculi less than 5mm	Manage expectantly
Stone burden of less than 2cm	Lithotripsy (or Ureteroscopy if pregnant female or impacted)
Complex renal calculi and staghorn calculi	Percutaneous nephrolithotomy
Stone any size + obstructed, infected system	Urgent decompression (ureteroscopy, nephrostomy)

Lower genitourinary tract trauma

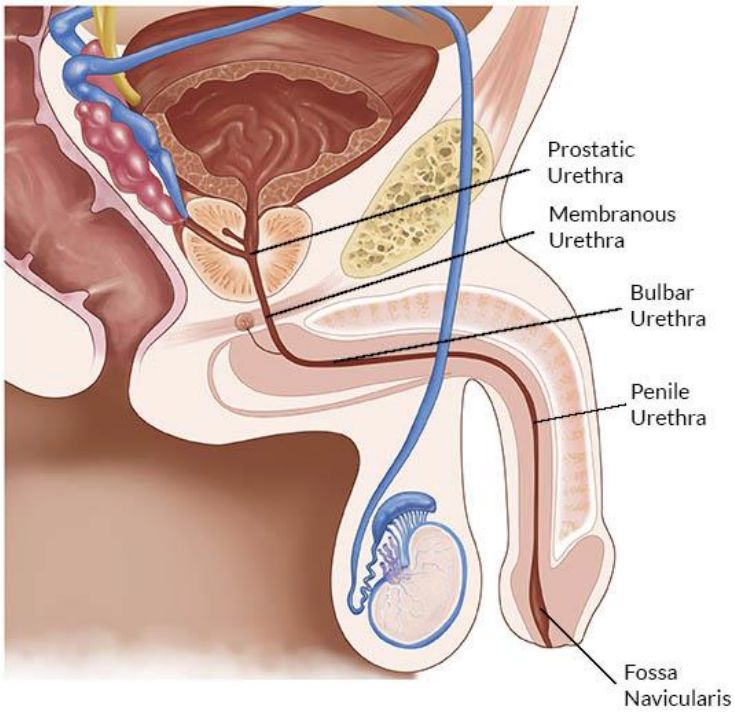
- Most bladder injuries occur due to blunt trauma
- 85% associated with pelvic fractures
- Easily overlooked during assessment in trauma
- Up to 10% of male pelvic fractures are associated with urethral or bladder injuries

Types of injury

Urethral injury	• Mainly in males • Blood at the meatus (50% cases) • There are 2 types: *1- Bulbar rupture* - Most common - Straddle type injury e.g. bicycles - Triad signs: urinary retention, perineal haematoma, blood at the meatus *2- Membranous rupture* - Can be extra or intraperitoneal - Commonly due to pelvic fracture - Penile or perineal oedema/haematoma - DRE: Prostate displaced upwards (beware co-existing retroperitoneal haematomas as they may make examination difficult) • *Investigation:* Ascending urethrogram • *Management:* Suprapubic catheter (surgical placement, not percutaneously)
External genitalia injuries (i.e., the penis and the scrotum)	• Secondary to injuries caused by penetration, blunt trauma, continence- or sexual pleasure-enhancing devices, and mutilation
Bladder injury	• Rupture is intra or extraperitoneal • Presents with haematuria or suprapubic pain • History of pelvic fracture and inability to void: always suspect bladder or urethral injury • Inability to retrieve all fluid used to irrigate the bladder through a Foley catheter indicates bladder injury • *Investigation:* IVU or cystogram • *Management:* laparotomy if intraperitoneal, conservative if extraperitoneal

Male Urethra

In males the urethra is much longer and is divided into four parts.

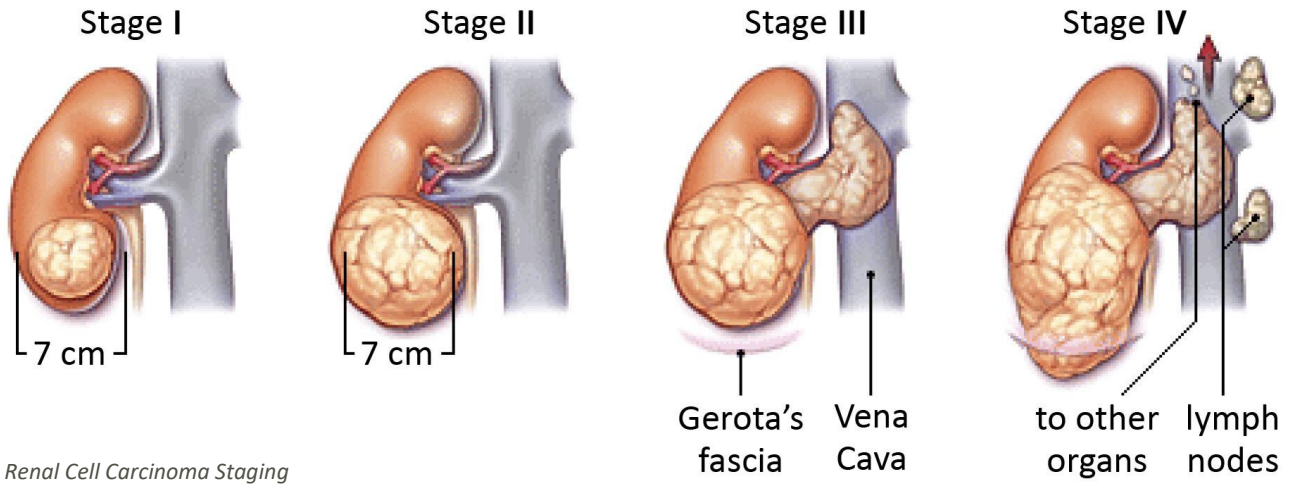


Pre-prostatic	Extremely short and lies between the bladder and prostate gland.It has a stellate lumen and is between 1 and 1.5cm long.Innervated by sympathetic noradrenergic fibres, as this region is composed of striated muscles bundles they may contract and prevent retrograde ejaculation.
Prostatic	This segment is wider than the membranous urethra and contains several openings for the transmission of semen (at the midpoint of the urethral crest).
Memb.	Narrowest part of the urethra and surrounded by external sphincter. It traverses the perineal membrane 2.5cm postero-inferior to the symphysis pubis.
Penile	Travels through the corpus spongiosum on the underside of the penis. It is the longest urethral segment.It is dilated at its origin as the infrabulbar fossa and again in the gland penis as the navicular fossa. The bulbo-urethral glands open into the spongiose section of the urethra 2.5cm below the perineal membrane.

Renal lesions

Lesion	Disease specific features	Treatment
Renal cell carcinoma (adenocarcinoma)	• Most present with haematuria (50%) • Common renal tumour (85% cases) • **Paraneoplastic** features include hypertension and **polycythaemia** • Features include: **Renal vein thrombosis**, PUO, **left varicocele** • Ix: CT (Biopsy not done if nephrectomy is planned) • Most commonly has haematogenous metastasis	Usually radical or partial nephrectomy
Nephroblastoma	• Rare **childhood** tumour • It accounts for 80% of all genitourinary malignancies in those under the age of 15 years • Up to 90% will have a mass • 50% will be hypertensive • Diagnostic work up includes ultrasound and CT scanning	Surgical resection combined with chemotherapy (usually vincristine, actinomycin D and doxorubicin)
Neuroblastoma (Wilms' tumor)	• Most common extracranial tumour of childhood • 80% occur in those under 4 years of age • Tumour of neural crest origin (up to 50% occur in the adrenal gland) • The tumour is usually calcified and may be diagnosed using MIBG scanning • Staging is with CT	Surgical resection, radiotherapy and chemotherapy
Transitional cell carcinoma	• Accounts for 90% of lower *urinary tract* tumours, but only 10% of renal tumours • Males affected 3x more than females • **Occupational exposure** to industrial dyes and rubber chemicals may increase risk • Up to 80% present with painless haematuria • Diagnosis and staging is with CT IVU	Radical nephroureterectomy
Angiomyolipoma	• 80% of these hamartoma type lesions occur sporadically, the remainder are seen in those with **tuberous sclerosis** • Tumour is composed of blood vessels, smooth muscle and fat • Massive bleeding may occur in 10% of cases	50% of patients with lesions >4cm will have symptoms and will require surgical resection
Adult Polycystic Kidney Disease (ADPKD/APKD)	• APKD is associated with **liver cysts** (70%), **berry aneurysms** (25%) and pancreatic cysts (10%). Patients may have a renal mass, hypertension, renal calculi and macroscopic haematuria.	Supportive / Symptomatic

SCC of the kidney usually arises in an area of chronic inflammation such as staghorn calculus.



Renal Cell Carcinoma Staging

Stage I: tumour <7 cm in the largest dimension, limited to the kidney
Stage II: tumour >7 cm in the largest dimension, limited to the kidney
Stage III: tumour in the major veins or adrenal gland with intact Gerota's fascia, or regional lymph nodes involved
Stage IV: tumour beyond Gerota's fascia

Bladder Cancer

Transitional (Urothelial)	Squamous Cell Carcinoma	Adenocarcinoma	Small Cell Carcinoma
90% of bladder cancers in developed countries *Risk factors* • Smokers • Dyes • Rubber and leather factories	70% in African Associated with chronic bladder irritation and infection *Risk factors:* • Schistosomiasis • Long catherization • Bladder stone	Rare Histologically identical to adenocarcinomas seen in the gastrointestinal tract	Indistinguishable from small-cell carcinomas of the lung Often in association with urothelial, squamous, or adenocarcinoma

Pathologic T (Primary Tumor) Staging of Bladder Carcinoma

Depth of Invastion	AJCC / UICC
Ta	Noninvasive, papillary
Tis	Carcinoma in situ (noninvasive, flat)
T1	Lamina propria invasion
T2	Muscularis propria invasion
T3a	Microscopic extravesicle invasion
T3b	Grossly apparent extravesicle invasion
T4	Invades adjacent structures

AJCC/UICC, American Joint Commission on Cancer/Union Internationale Contre le Cancer

See also TNM Staging

Hydronephrosis

Causes of hydronephrosis: *SUPER PACT*

Bilateral: ***SUPER***
- **S**tenosis of the urethra
- **U**rethral valve
- **P**rostatic enlargement
- **E**xtensive bladder tumour
- **R**etro-peritoneal fibrosis

Unilateral: ***PACT***
- **P**elvic-ureteric obstruction (congenital or acquired)
- **A**berrant renal vessels
- **C**alculi
- **T**umours of renal pelvis

Investigation
- USS- identifies presence of hydronephrosis and can assess the kidneys
- IVU- assess the position of the obstruction
- Antegrade or retrograde pyelography- allows treatment
- If renal colic suspected: non contrast CT scan (majority of stones are detected this way)

Management
- Remove the obstruction and drainage of urine
- Acute upper urinary tract obstruction: Nephrostomy tube
- Chronic upper urinary tract obstruction: Ureteric stent or a pyeloplasty

Retrograde ureteropyelogram showing hydronephrosis with greatly enlarged pelvis and dilated 'clubbed' calyces

Functional Renal imaging

DMSA scan (Dimercaptosuccinic acid (DMSA) scintigraphy)

- DMSA localises to the renal cortex with little accumulation in the renal papilla and medulla.
- It is useful for the identification of **cortical defects** and **ectopic or aberrant kidneys**.
- It does not provide useful information on the ureter of collecting system.

Diethylene-triamine-penta-acetic acid (DTPA)

- This is primarily a glomerular filtration agent. It is most useful for the assessment of renal function. Because it is filtered at the level of the glomerulus it provides useful **information about the GFR**.
- Image quality may be degraded in patients with chronic renal impairment and derangement of GFR.
- **Not used in renal impairment**

MAG 3 renogram

- Mercaptoacetyle triglycine is an is extensively protein bound and is primarily secreted by tubular cells rather than filtered at the glomerulus.
- This makes it the agent of choice for imaging the kidneys of patients with **existing renal impairment** (where GFR is impaired).

Micturating cystourethrogram (MCUG scan)

This scan provides information relating to bladder reflux and is obtained by filling the bladder with contrast media (via a catheter) and asking the child to void. Images are taken during this phase and the degree of reflux can be calculated

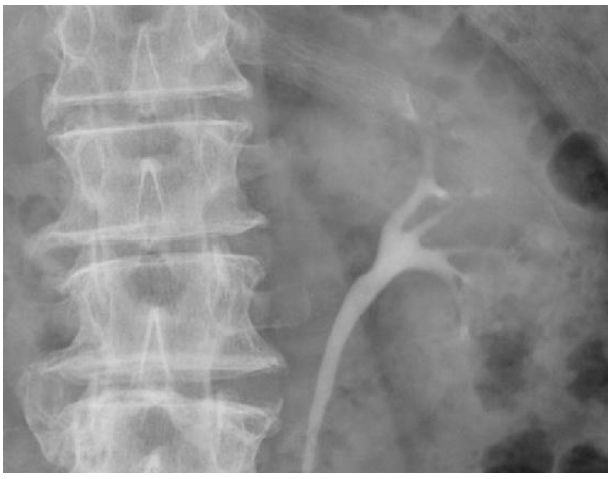
Cystoscopy

- Mandatory for macroscopic haematuria.
- Usually done under local anaesthetic in the outpatient setting as part of a Haematuria clinic.

Intra venous urography (IVU)

- This examination is conducted by the administration of intravenous iodinated contrast media. The agent is filtered by the kidneys and excreted and may provide evidence of renal stones or other structural lesions.
- Has been the traditional "gold standard" in the evaluation of the upper urinary tract, however current evidence casts doubt on the role of IVU as the "gold standard" for urothelial imaging and in recent years the dominant role of IVU has been **surpassed by MDCTU** (Multi-detector row CT Urography).
- Widely available, and is often the most cost-efficient test in many centers.
- IVU can also depict renal masses although it is not possible to distinguish a cyst from a solid mass and many lesions can go undetected. It has a limited sensitivity for detecting renal masses less than 3 cm in size and, even when a mass is identified, further imaging, usually with CT, is required to characterize the lesion
- A rough approximation of renal function may be obtained using the technique. But it is not primarily a technique to be used for this purpose. With the advent of widespread non contrast CT scan protocols for the detection of urinary tract calculi **it is now rarely used.**

Intravenous urogram (bladder image obtained 15 minutes following contrast administration). There is an infiltrative mass lesion involving the bladder wall on the right. This was confirmed to be a urothelial cell carcinoma following biopsy at cystoscopy.

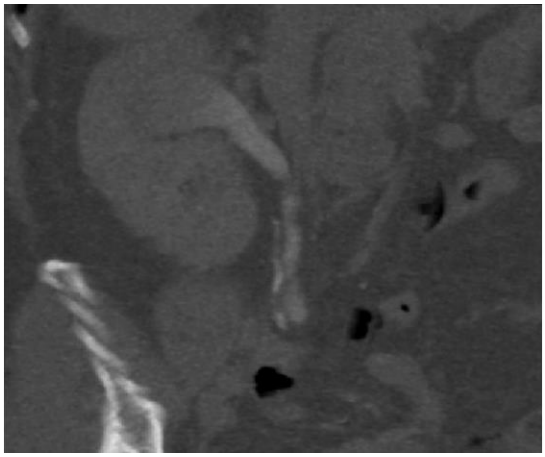


Intravenous urogram demonstrates a filling defect in the lower pole calyx of the left kidney, a histologically-proven urothelial cell carcinoma.

CT Urography (CTU)

- Firmly established as the overall **most sensitive** modality for determining the cause of haematuria.
- It is the **gold standard** in the detection **of renal parenchymal masses, calculi, upper tract urothelial tumors, and extrinsic lesions**.
- *Regarded by many as the gold standard imaging modality for haematuria in patients over 40y. In patients less than 40y a decision will be made by the consultant radiologists as to the best imaging modality and this may involve a combination of USS and IVU.*

CT urogram (coronal urographic phase image) demonstrates a large polypoid mass arising from the bladder wall. This was confirmed to be a urothelial cell carcinoma following biopsy at cystoscopy.



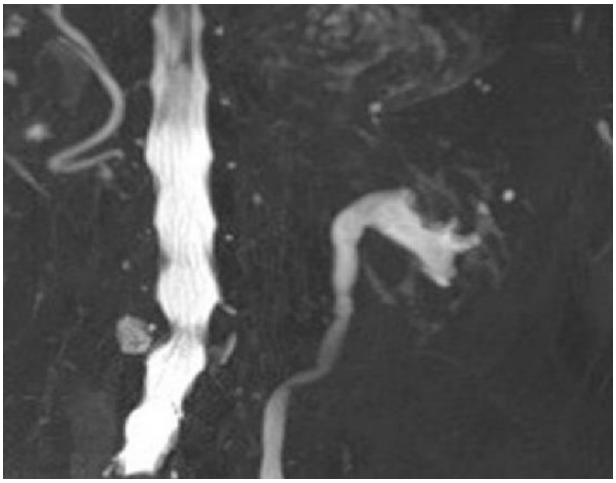
CT urogram (coronal urographic phase image) demonstrates a filling defect in the upper moiety of a duplex right kidney. This was histologically confirmed to be urothelial cell carcinoma following ureteroscopy and biopsy.

PET/CT

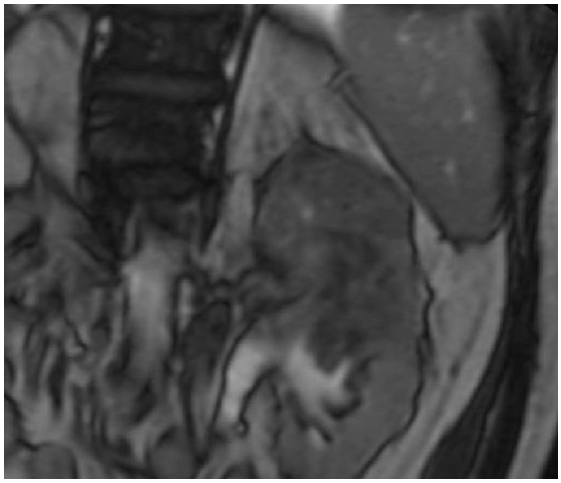
This may be used to evaluate structurally indeterminate lesions in the **staging of malignancy.**

Magnetic Resonance Urography (MRU)

- MRU is an evolving technology with the potential to provide a noninvasive "one-stop shop" comprehensive evaluation of the upper urinary tract and surrounding structures without the use of ionizing radiation.
- MRI has been shown to be comparable to CT in the detection of renal masses
- A significant short falling of MRI is its relative insensitivity for the detection of urinary tract calculi.
- MRU has a specific role in the evaluation of painful hydronephrosis in pregnancy.



T2-weighted MR urography demonstrates a mass at the upper pole of the left kidney directly invading the renal pelvis.



Coronal T2-weighted MRI of kidneys shows a large heterogeneous low T2 signal mass centered in the upper pole of the left kidney.

References:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4124848/
- https://pubmed.ncbi.nlm.nih.gov/14615555/
- *Investigation of adult haematuria in Oxfordshire – Oxford University Hospitals*

Renal Physiology

See Physiology Notes

Acute Renal Failure

See Physiology Notes

Renin-Angiotensin-Aldosterone System

See Physiology Notes

Transplant Types

See Organ Transplant Notes

Renal Transplant and Complications

See Organ Transplant Notes