General Surgery

51

Lecture Package

Subject: Renal stones

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Urinary calculi

*** Urinary Calculi (Urolithiasis):** a condition where solid concretion of calculi (crystal aggregation) are formed or located anywhere in the urinary system.

- **Nephrolithiasis**: stones in kidney (renal calculi)
- **Uretrolithiasis**: stones in ureter.
- **Vesicle calculi (Cystolithiasis)**: stones which are formed or have passed into the urinary bladder.

(Stones are mainly upper urinary tract stones so in the bladder and urethra it's mostly secondary not primary)

Risk Factors

1- Gender: Males are more prone to develop stones because females excrete more Citrate and less calcium.
2- Age: Stones are more common at the age group 20-40 years old (3^{rd}-5^{th} decades).
3- Ethnic group
4- Family History
5- Diet
6- Environmental Factors
7- Medications
8- Occupation
9- Past medical history (Hyperparathyroidism, chronic diarrheal diseases, short bowel syndrome, Gout, UTI, Cystinuria, renal tubular acidosis).

Renal calculi

Etiology:

This subject is complex, and the following represents a brief summary of current opinion.

Super saturation + Crystallization

When urine becomes very saturated with a certain solute (e.g. sodium oxalate or calcium phosphate) it will start to **precipitate and crystallize**.

When these crystals aggregate, they will join each other at a "**Nidus**"; which

is made of an organic matter usually a protein. So, when you cut a stone you will find a pattern exactly like the one you find when you cut a tree trunk with the nidus in the middle.
When the solute crystalizes, it will take a geometric structure, for example the **cysteine will take a pentagonal shape** and the **triphosphate they will form a triangle shape**. They are a very strong structure once they reach the crystallization stage, they will never go back to solution state except in certain conditions
The commonest site for forming a stone is the renal tubules. They form in the tubules and then they come down to the pelvis to start enlarging.

Dietetic

Deficiency of vitamin A causes desquamation of epithelium forming a nidus on which a stone is deposited. This mechanism is probably active in the formation of bladder calculi.

Altered urinary solutes and colloids

Dehydration concentrates urinary solutes until they precipitate.
Reduction of urinary colloids, which adsorb solutes, or mucoproteins, which chelate calcium, might tend to crystal and stone formation.

Decreased urinary citrate

The presence of citrate in urine, 300–900 mg per 24 hours (1.6–4.7 mmol per 24 hours) as citric acid, keeps relatively insoluble calcium phosphate and citrate in solution.
Remember: The most important inhibitors are **Citrate** and **Magnesium.** Low levels of citrate and magnesium in urine will make the solubility of some stone-forming-solutes decrease, and thus leading to their precipitation and stone formation.

Renal infection

Infection favors the formation of urinary calculi. Clinical and experimental stone formation are common when urine is infected with urea-splitting streptococci, staphylococci and especially *Proteus* spp.

Inadequate urinary drainage and urinary stasis

Stones are liable to form when urine is static (e.g. dehydration).

Prolonged immobilization

Immobilization is liable to result in skeletal decalcification and an increase in urinary calcium favoring the formation of calcium phosphate calculi.

Hyperparathyroidism

Hyperparathyroidism leading to hypercalcemia and hypercalciuria is found in 5 per cent or less of those who present with radio-opaque calculi. In cases of recurrent or multiple stones, this cause should be eliminated by appropriate investigations. A parathyroid adenoma should be removed before definitive treatment for the urinary calculi.

Types of renal calculus

Oxalate calculus (calcium oxalate)

Oxalate stones are irregular with sharp projections. A calcium oxalate monohydrate stone is hard and **radiodense**.

Phosphate calculus

A phosphate calculus (calcium phosphate often with ammonium magnesium phosphate (struvite)) is smooth and dirty white.
It grows in alkaline urine, especially when urea-splitting *Proteus* organisms are present. The calculus may enlarge to fill most of the collecting system, forming a **stag-horn calculus.** Even a large stag-horn calculus may be asymptomatic for years until it presents with hematuria, urinary infection or renal failure.

Uric acid and urate calculi

These are hard, smooth and often multiple and multifaceted.
Pure uric acid stones are **radiolucent**. CT will distinguish them from other causes of filling defects including tumors of the ureter.
Most uric acid stones contain some calcium, so they cast a faint radiological shadow.

Cystine calculus

An uncommon congenital error of metabolism leads to cystinuria.
Cystine stones are often multiple and may grow to form a cast of the collecting system. Cystine stones are **radio-opaque** and very hard. They are very common in our region due to the autosomal recessive disease cystinuria.

Oxalate calculi.

Stag-horn calculus.

Cystine stones

remember

Radio-opaque stones · stones that appear white on X-ray · 80-90% of stones are radio-opaque
- **Radio-lucent stones** · stones that do not appear on X-ray · 10-20% of stones are radio-lucent (e.g. Uric acid stones)

Types of Stones According to Etiology:

Metabolic Causes:

• **Hypercalcemia** -> Hyperparathyroidism -> Bone metastasis -> Immobilization -> vitamin D intoxication -> multiple myeloma -> hyperthyroidism
• **Hypercalciuria** -> Idiopathic -> hypercalcemia
• **Cystinuria** -> autosomal recessive disease-> the amino acid cystine is lost in urine due to enzyme deficiency.
• **Hyperuricemia** -> GOUT-> chemotherapy due to tumor lysis syndrome
• **Hyperoxaluria** -> Short bowel syndrome -> diet
• **Hypocitraturia /Hypomagnesemia** -> they are inhibitory agents for stone formation

Non-Metabolic Causes

- **Anatomical causes** -> Strictures and stenosis in urinary tract -> congenital anomalies such as: Horse shoe kidney, ectopic kidney and duplicated pelvis.
- **Environmental causes** -> Hot climates
- **Infections** -> UTI
- **Drugs** -> diuretics (thiazides)-> Allopurinol
- **Renal tubular acidosis**.

Clinical features

- Renal calculi are common.
- Approximately 50 per cent of patients present between the ages of 30 and 50 years.
- The male–female ratio is 4:3

Silent calculus

Renal failure may be the first indication of bilateral silent calculi, although secondary infection usually produces symptoms first.

Pain

Pain occurs in 75 per cent of people with urinary stones. Fixed renal pain occurs in the renal angle, the hypochondrium, or in both. It may be worse on movement. sudden onset, severe pain originating in the flank region, very severe (described by the patient as the worst pain ever), patient keeps moving like a worm hoping to find a comfortable position to reduce pain.

Ureteric colic is an agonizing pain passing from the loin to the groin. Pain resulting from renal stones rarely lasts more than 8 hours in the absence of infection. There is no pyrexia, although the pulse rate rises because of the severe pain.

Ureteric colic is often caused by a stone entering the ureter, but it may also occur when a stone becomes lodged in the pelviureteric junction. The severity of the colic is not related to the size of the stone.

Hematuria

Hematuria, usually small in amount, is common and sometimes is the only symptom of stone disease.

Pyuria

Infection is particularly dangerous when the kidney is obstructed.
Pressure builds in the system, organisms are forced into the circulation and a septicemia can quickly develop.

remember

Renal stones
_ Are common
_ May be clinically silent even when large
_ Are usually visible on a plain abdominal radiograph
_ May be radiolucent when composed of uric acid

Abdominal examination

Percussion over the kidney produces a stab of pain and there may be tenderness on gentle deep palpation.
Hydronephrosis or pyonephrosis leading to a palpable loin swelling is rare.

Always when you have a patient with flank pain you MUST do a genital and digital rectal exam because some genital cases can present as flank pain such as Testicular torsion.

Investigations

X-ray
The 'KUB' film shows the kidney, ureters and bladder. A branched stone is unmistakable. An opacity maintaining its position relative to the urinary tract during respiration is likely to be a calculus.
Calcified mesenteric nodes and opacities within the gut will be anterior to the vertebral bodies on a lateral x-ray and thus outside the urinary tract

remember

Opacities on a plain abdominal radiograph that may be confused with renal calculus

_ Calcified mesenteric lymph node
_ Gallstones or concretion in the appendix
_ Tablets or foreign bodies in the alimentary canal (e.g. cyclopenthiazide (Navidrex-K))
_ Phleboliths – calcification in the walls of veins, especially in the pelvis
_ Ossified tip of the 12th rib
_ Calcified tuberculous lesion in the kidney
_ Calcified adrenal gland

Contrast-enhanced CT

CT, preferably spiral, has become the mainstay of investigation of acute ureteric colic.

Excretion urography

IVU will establish the presence and position of a calculus and the function of the other kidney.

Ultrasound scanning

Ultrasound scanning is of most value in locating stones for treatment by extracorporeal shock wave lithotripsy (ESWL).

treatment of urinary calculi:

Conservative management

Calculi smaller than 0.5 cm pass spontaneously unless they are impacted. Surgical intervention should be avoided. Small renal calculi may cause symptoms by obstructing a calyx or acting as a focus for secondary infection. Most can be safely observed until they pass.

Management of small stones

_ Most small urinary calculi will pass
_ Infection in an upper urinary tract obstructed by stone is dangerous and needs urgent surgical intervention

Preoperative treatment

Antibiotic treatment starts before surgery and continues afterwards.

Operation for stone

Most stones should be treated by minimal access and minimally invasive techniques. Open operations are still needed when appropriate expertise is not available or newer techniques have failed.

* Most urinary calculi can be treated by minimal access Techniques.

Modern methods of stone removal

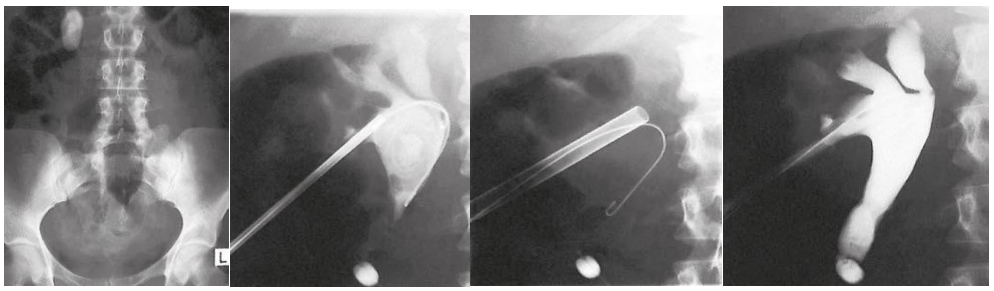
Percutaneous nephrolithotomy

Endoscopic instruments are passed into the kidney by a percutaneous technique. Small stones may be grasped under vision and extracted whole. Larger stones are fragmented by an ultrasound, laser or electrohydraulic probe and removed in pieces.

The aim is to remove all fragments. A nephrostomy drain is left in the system when the procedure is complete.

This decompresses the kidney and allows repeated access if necessary. Percutaneous nephrolithotomy is sometimes combined with ESWL in the treatment of complex (stag-horn) calculi.

Complications of percutaneous nephrolithotomy include: (1) hemorrhage from the punctured renal parenchyma; (2) perforation of the collecting system with extravasation of saline irrigant; (3) perforation of the colon or pleural cavity during placement of the percutaneous track.



Percutaneous renal stone removal.
(a) The stone is in the right renal pelvis. (b) Placement of a cannula under radiological control into the renal pelvis and through it a balloon catheter to stop fragments migrating into the upper ureter. (c) The stone is disrupted by contact lithotripsy and the fragments have been successfully removed by irrigation.
(d) A nephrostogram confirms that the renal pelvis is intact.

Extracorporeal shock wave lithotripsy

Crystalline stones disintegrate under the impact of shock waves produced by the ESWL machine. The shocks may be aimed by ultrasound or x-ray imaging . The devices also differ in the disruptive force that they can develop. Less powerful machines break stones less effectively and several treatments may be necessary. Weaker shocks hurt less, and treatment can be given without general anesthesia.

Ureteric colic is common after ESWL, and the patient needs analgesia, usually in the form of a non-steroidal anti-inflammatory drug. Bulky stone fragments may impact in the ureter, causing obstruction. To avoid this, a stent should be placed in the ureter to drain the kidney while stone fragments pass. Occasionally, impacted fragments must be removed ureteroscopically . The principal **complication** of ESWL is infection. Many calculi contain bacteria, which are released from the broken stone.

It is wise to give prophylactic antibiotics before ESWL, and an obstructed system should be decompressed by a ureteric stent or percutaneous nephrostomy before treatment.

The clearance of stone from the kidney will depend upon the consistency of the stone and its site. Most oxalate and phosphate stones fragment well and, if lying in the renal pelvis, will clear within days. The results with harder stones, especially cystine stones, are less satisfactory. When treating calyceal stones, the patients should be warned that the clearance may take months.

Extracorporeal shock wave lithotripsy.
(a) The patient being placed on the ultrasound lithotripter.
(b) Positioning of the patient being checked by ultrasound.

Open surgery for renal calculi

Operations for kidney stone are usually performed via a loin or lumbar approach. All the procedures are difficult unless the kidney is fully mobilized, and its vascular pedicle controlled. A sling should be placed around the upper ureter to stop stones migrating downwards.

Pyelolithotomy

Pyelolithotomy is indicated for stones in the renal pelvis. When the wall of the renal pelvis has been dissected from its surrounding fat, an incision is made in its long axis directly on to the stone. The stone is removed with gallstone

forceps. Stone fragments in peripheral calyces may be detected by direct palpation or by intraoperative x-ray or nephroscopy. If there is sepsis, a nephrostomy is essential to drain the system.

Extended pyelolithotomy

The plane between the renal sinus and the wall of the collecting system is developed on the posterior surface of the kidney. This avoids major vessels and allows incisions into the calyces so that even large stag-horn stones can be removed intact.

Nephrolithotomy

If there is a complex calculus branching into the most peripheral calyces, it may be necessary to make incisions into the renal parenchyma to clear the kidney. Nephrolithotomy may also be necessary when the adhesions from previous surgery complicate access to the renal pelvis. The renal pedicle is temporarily cross-clamped to reduce bleeding from the vascular
renal tissue. Incisions are made posterior and parallel to the most prominent part of the convex renal border, where the territories of the anterior and posterior branches of the renal artery meet (Brödel's line). Cooling the kidney extends the ischemia.
Nephrolithotomy incisions must be closed with hemostatic sutures and the patient observed for signs of reactionary hemorrhage.
Partial nephrectomy is sometimes preferable for a stone in the lower most calyx with infective damage to the adjacent parenchyma.
A functionless kidney destroyed by stone disease should be removed, particularly when there is xanthogranulomatous pyelonephritis. This stone-related inflammatory mass must be removed with care because it is liable to be attached to adjacent structures such as the colon.

Treatment of bilateral renal stones

Usually the kidney with better function is treated first, unless the other kidney is more painful or there is pyonephrosis which needs urgent decompression.

Prevention of recurrence

Ideally, stone formers should be investigated to exclude metabolic factors, although the diagnostic yield is low in patients with a single small stone. The urine should be screened for infection. The following investigations are appropriate in bilateral and recurrent stone formers:

- serum calcium, measured fasting on three occasions to exclude hyperparathyroidism;
- serum uric acid;
- urinary urate, calcium and phosphate in a 24-hour collection; the urine should also be screened for cystine;
- analysis of any stone passed.

Dietary advice is not usually helpful in avoiding stone recurrence in people who have a balanced diet. Those who consume excessive amounts of milk products (calcium stones), rhubarb, strawberries, plums, spinach and asparagus (calcium oxalate stones) should be advised to be more moderate. Patients with hyperuricemia should avoid red meats, offal and fish, which are rich in purines, and should be treated with allopurinol. Eggs, meat and fish are high in Sulphur-containing proteins and should be restricted in cystinuria.

Stone sufferers should drink plenty to keep their urine dilute. Drug treatment is largely ineffective except in those few patients who are shown to have idiopathic hypercalciuria.
Bendroflumethiazide (5 mg) and a calcium-restricted diet reduce urinary calcium.
So **remember:**
_ Stones are more common in those who have had a previous stone.
_ Unless there is a specific biochemical abnormality, high fluid intake is the best prophylactic measure.

* Complications:

1- **Calculous hydronephrosis**: Aseptic dilatation due to back pressure.

2- **Calculous pyonephrosis:** Septic dilatation – kidney turns into bag of pus

3- **Renal failure**: Bilateral staghorn stones may be asymptomatic till presentation with features of renal failure.

URETERIC CALCULUS

A stone in the ureter usually comes from the kidney. Most pass spontaneously.

Clinical features

A stone passing down the ureter often causes intermittent attacks of ureteric colic.
Ureteric colic
The waves of agonizing loin pain are typically referred to the groin, external genitalia and the anterior surface of the thigh.
As the stone enters the bladder, the pain can be referred to the tip of the penis.
Impaction
There are five sites of narrowing where the stone may be arrested. An impacted stone causes a more consistent dull pain, often in the iliac fossa and

increased by exercise and lessened by rest. Distension of the renal pelvis due to obstruction may cause loin pain.
The stone may become embedded as the adjacent ureteric wall becomes eroded and edematous as a result of pressure ischemia. Perforation of the ureter and extravasation of urine is a rare complication.
Severe renal pain subsiding after a day or so suggests complete ureteric obstruction. If obstruction persists after 1–2 weeks, the calculus should be removed to avoid pressure atrophy of the renal parenchyma.

Hematuria
Almost all ureteric colic is associated with transient microscopic hematuria. Serious bleeding is uncommon and should suggest clot colic.

Abdominal examination

There is tenderness and some rigidity over some part of the course of the ureter. The presence of hematuria does not rule out appendicitis because an inflamed appendix can give rise to a local ureteritis leaking some red cells into the urine. The patient with acute ureteric colic is usually in greater pain and less ill than one with appendicitis or acute cholecystitis.

Imaging

Most urinary calculi are radio-opaque. Stones are difficult to see if small or obscured by bowel contents or nearby bones.
IVU while the patient has pain can confirm the diagnosis, although spiral CT is preferable. In ureteric colic, there will probably be little or no excretion on the affected side. Occasionally, there is an extravasation of contrast from the dilated system. Late x-rays, taken up to 36 hours after the injection of contrast, may show dilatation of the ureter down to an obstructing calculus.
A radiolucent uric acid stone may be demonstrated as a filling defect in the contrast-filled system.
Analgesic abusers occasionally fake symptoms to obtain drugs, and emergency imaging is useful in excluding renal colic.
If the CT or urogram is normal during an attack, the patient does not have renal colic. The absence of blood in the urine makes colic less likely but its presence can be simulated.
Cystoscopy is not indicated routinely but may reveal edema around the ureteric orifice when the stone is nearby.
Retrograde ureterography is performed as an immediate preliminary to an endoscopic operation to remove a calculus.

Treatment

For Pain:

Non-steroidal anti-inflammatory drugs, such as diclofenac and indomethacin, have replaced opiates as the first line of treatment for renal colic. The value of smooth muscle relaxants, such as propantheline (Pro-Banthine), is debatable.

Removal of the stone

Expectant treatment is appropriate for small stones likely to pass naturally. If the patient is not disabled by recurrent attacks of colic, progress can be followed by x-rays every 6–8 weeks.

Indications for surgical removal of a ureteric calculus

_ Repeated attacks of pain and the stone is not moving
_ Stone is enlarging
_ Complete obstruction of the kidney
_ Urine is infected
_ Stone is too large to pass
_ Stone is obstructing solitary kidney or there is bilateral obstruction

Endoscopic stone removal

Dormia basket

The use of wire baskets under image intensifier control has been replaced by ureteroscopic techniques but they may be useful when the instruments and expertise are not available. There is a danger of ureteric injury even with small stones.

Ureteric meatotomy

Endoscopic incision with a diathermy knife will enlarge the opening and free a stone lodged in the intramural ureter. The consequent urinary reflux rarely causes problems.

Ureteroscopic stone removal

A ureteroscope is introduced transurethrally across the bladder into the ureter to remove stones impacted in the ureter. Stones that cannot be caught in baskets or endoscopic forceps under direct vision are fragmented using an electrohydraulic, percussive or laser lithotripter.

Push bang

A stone in the middle or upper part of the ureter can often be flushed back into the kidney using a ureteric catheter. A J-stent secures the calculus in the kidney for subsequent treatment with ESWL.
A flexible fiberoptic ureteroscope can be used for laser destruction of calculi in the renal collecting system or ureter and to retrieve small stones from the kidney.

Lithotripsy *in situ*

A stone in a part of the ureter that can be identified by the imaging system of the lithotripter can be fragmented *in situ*. This form of treatment is not appropriate if there is complete obstruction or if the stone has been impacted for a long time.

Open surgery

Ureterolithotomy

An x-ray confirms the position of the stone immediately before surgery.

The skin incision must be appropriate for the position of the stone. Calculi in the upper third of the ureter are approached through a loin or upper quadrant transverse incision as used for a stone in the renal pelvis. Access to midureteric stones is through a muscle-cutting iliac fossa incision; lower ureteric stones are best reached through a Pfannenstiel incision.

For stones close to the bladder, exposure is improved by ligating and dividing the superior vesical vascular pedicle. The ureter is exposed in the retroperitoneum and slings are applied above and below the calculus to stop it from escaping. The ureter is incised longitudinally, directly on to the stone, which is freed by blunt dissection and removed with stone forceps. Soft catheters are passed upwards and downwards to ensure that the ureter is clear.

The ureterotomy is closed with interrupted absorbable sutures and a drain left to drain urine leakage. The operation can be performed laparoscopically, but alternative minimal access techniques described above are usually preferable.

Bladder stones

Definition

A primary bladder stone is one that develops in sterile urine; it often originates in the kidney.

A secondary stone occurs in the presence of infection, outflow obstruction, impaired bladder emptying or a foreign body.

Incidence

Until the twentieth century, bladder stone was a prevalent disorder among poor children and adolescents. Because of improved diet, especially an increased protein–carbohydrate ratio, primary vesical calculus is rare.

Composition and cystoscopic appearance

Most vesical calculi are mixed. An oxalate calculus is a primary calculus that grows slowly; usually, it is of moderate size and solitary, and its surface is uneven. Although calcium oxalate is white, the stone is usually dark brown or black because of the incorporation of blood pigment. Uric acid calculi

are round or oval, smooth and vary in color from yellow to brown. They occur in patients with gout but are also found in patients with ileostomies or with bladder outflow obstruction. A cystine calculus occurs only in the presence of cystinuria and is radio-opaque because of its high Sulphur content.
A triple phosphate calculus is composed of ammonium, magnesium and calcium phosphates and occurs in urine infected with urea-splitting organisms. It tends to grow rapidly. In some instances, it occurs on a nucleus of one of the other types of calculus; more rarely it occurs on a foreign body. It is dirty white in color and of chalky consistency.
A bladder stone is usually free to move in the bladder and it gravitates to the lowest part of the bladder. Less commonly, the stone is wholly or partially in a diverticulum, where it may be hidden from view.

Clinical features

Men are affected eight times more frequently than women.
Stones may be asymptomatic and found incidentally.

Symptoms:

Frequency is the earliest symptom and there may be a sensation of **incomplete bladder emptying**.

Pain (strangury) is most often found in patients with a spiculated oxalate calculus. It occurs at the end of micturition and is referred to the tip of the penis or to the labia majora; more rarely, it is referred to the perineum or suprapubic region. The pain is worsened by movement. In young boys, screaming and pulling at the penis with the hand at the end of micturition are indicative of bladder stone.

Hematuria is characterized by the passage of a few drops of bright-red blood at the end of micturition, and is due to the stone abrading the vascular trigone.

Interruption of the urinary stream is due to the stone blocking the internal meatus. Urinary infection is a common presenting symptom.

Examination

Rectal or vaginal examination is normal; occasionally, a large calculus is palpable in the female. Examination of the urine reveals microscopic hematuria, pus or crystals that are typical of the calculus, for example envelope-like in the case of an oxalate stone or hexagonal plates in the case of cystine calculi.
In most patients, the stone is visible on ultrasound or on a plain x-ray. Imaging of the whole of the urinary tract should be undertaken to exclude an upper tract stone. Nearly all stones can be dealt with endoscopically. In men with bladder outflow obstruction, endoscopic resection of the prostate should be performed at the same time as the stone is dealt with.

Treatment

The cause of the stone should be sought and treated; this may include bladder outflow obstruction or incomplete bladder emptying in patients with neurogenic bladder dysfunction.

Litholapaxy

The blind lithotrite was an early type of minimally invasive technique. Standard management now includes the optical lithotrite, electrohydraulic lithotrite, Holmium laser or ultrasound probe. Other devices include the stone punch, which is useful to crush small fragments further so that they can be evacuated with an Ellik evacuator.

Contraindications to perurethral litholapaxy are extremely rare:

- urethral: a urethral stricture that cannot be dilated sufficiently; when a patient is aged below ten years;
- bladder: a contracted bladder;
- stone characteristics: a very large stone.

Ultrasound lithotripsy is extremely safe but appropriate only for small stones. Laser lithotripsy with the holmium laser can deal with most large stones. Once small fragments are produced, the optical lithotrite can be used to finish the job. For evacuation of the fragments, fluid (200 mL) is introduced into the bladder.

The evacuator, filled with solution, is fitted on to the sheath.

The bulb is compressed slowly and then permitted to expand; the returning solution carries with it fragments of stone.

Percutaneous suprapubic litholapaxy

It is possible to insert a needle into the bladder and then pass a guidewire. As in percutaneous nephrolithotomy, Alken metal dilators can be passed over the guidewire to dilate the track and an Amplatz sheath inserted followed by a large-bore nephroscope.

This is the best method to use if it is not possible to carry out litholapaxy per urethram because of a narrow urethra.

Removal of a retained Foley catheter

A retained Foley catheter is usually caused by the channel that connects the balloon to the side arm becoming blocked, usually at the end near the balloon. The best way of dealing with this problem is to further inflate the balloon with 20 mL of water and then burst the balloon percutaneously using a needle under ultrasound screening. If the balloon bursts, it is important to subsequently cystoscope the patient to ensure that any fragments are removed before they can form a foreign body calculus.

Cutting off the side arm and attempting to clear the channel with a wire is only occasionally successful.

The end …

Edited by: Doa'a H. AL-Qudah

Q1. resolution therapy is best instituted in

a. triple phosphate stone

b. calcium oxalate stone

c. matrix stone

d. **uric acid stone**

e. cystine stone

Uric acid stones can be dissolved by **alkalization** of urine using the drug: Acetazolamide.

Q2 Urinary tract infection with urea splitting bacteria may result in the formation of:

a. + magnesium-ammonium-phosphate stones

b. uric acid stones

c.cystine stones
d. xanthine stones
e. calcium oxalate stones

Q3. Which of the following is radiolucent stone?

a. + Uric acid stone

Radiolucent stones: Stones that do not appear on X-ray, 10-20% of stones.
Radio-opaque stones: Stones that appears white on X-ra

Q4. The most common complication of ESWL:

- gram –ve infection
- **+stone impaction**
- stone nucleation

Extracorporeal shock wave lithotripsy (**ESWL**) is a non-invasive that uses shock waves to break kidney stones into small pieces that can easily travel through the urinary tract and pass from the body.
ESWL works best with stones between (0.4 cm and 2.0 cm) in diameter. The most common complication is stone impaction (Steinstrasse: German for "*street of stone*

Q5 Which microorganism is associated with urinary stones?

a. + Proteus vulgaris and pseudomonas aeruginosa

Struvite stones (MAP): consist of magnesium + ammonium +phosphate, seen in people with urinary tract infection and formed by urea splitting bacteria like: Proteus vulgaris, and staphylococci.

New Slides
Dr. Mohammad Kammash

Epidemiological Aspects

A- Intrinsic factors:

1- Hereditary:

RTA: frequent episodes of urinary lithiasis.

Cystinuria: Homozygous recessive disease.

Which is ↑Excretion of **COLA**: cystine, ornithine, Lysine, and arginine.

2- Age & sex:

-Peak age: 3rd - 5th decade

-Female: male 1:3

B- Extrinsic Factors

- Diet.
- Geography.
- Climate & seasonal factors.
- Water intake.
- Occupation.

Inhibitors of Crystallization

1- Organic inhibitors: Nephrocalcin, Urea and Citrate.

2- Inorganic: Phosphates and Magnesium.

Urolithiasis…

A- Stones forming in Acid urine: Cystine and Uric Acid stones.

B- Stones forming in alkaline urine: Calcium phosphate and Struvite stones.

Note: Calcium oxalate stones precipitate throughout the pH range.

Pathology Changes

Obstruction by calculus→

- Hydronephrosis.
- Destruction of renal parenchyma.
- Atrophy and loss of renal parenchyma.
- Infection sometimes superimposed: Calculus pyelonephritis and Calculus pyohydronephrosis.

Types of Stones
Pure calcium oxalate: 39.4%.
Mixed calcium oxalate & phosphate:20.2%.
Pure Ca. phosphate: 13.2%.
Magnesium Ammonium phosphate (**struvite**): 15.4%
Uric acid: 8%.
Cystine: 2.8%.

Calcium Urinary Lithiasis
Etiology:
1. Idiopathic Hypercalciuria: Absorptive Hypercalciuria or Renal leak Hypercalciuria.
Other causes of Hypercalcemia& Hypercalciuria:
Vit. D Intoxication, Sarcoidosis, Immobilization syndrome, Multiple myeloma, Hyper PTH and Milk-alkali syndrome.
2. Hyperuricosuria
3. Hypocitraturia
4. Hyperoxaluria

Stones of Urinary Infection
Struvite stones: (Magnesium Ammonium Phosphate stones)
- Alkaline urine.
- Always associated with urea-splitting bacteria.
- Urea-splitting bacteria: Proteus, Providentia and others like: Pseudomonas, Klebsiella, Staph and Mycoplasma.

Cystine Urinary Lithiasis
- Cystinuria: Inherited defect in renal tubular reabsorption of COLA.
- Less soluble in acidic urine.
- Family history of stone disease.

Uric acid stones are:
-Radiolucent stones
- Gout, myeloproliferative diseases, chemotherapy
-Formed in acidic urine
-Treatment: Fluid, alklinazation, Allopurinol

Diagnosis of Urolithiasis

History:

Renal colic
GI symptoms
Hematuria
Dysuria
UTI.

Signs of Urolithiasis:

- Fever: UTI.
- Renal angle tenderness.

Laboratory

***Urinalysis**

Hematuria or normal (10%)
Crystals: Cystine, Uric Acid.

***Kidney function tests (KFT)**

***CBC**: Hb, WBC

Radiographic Examination

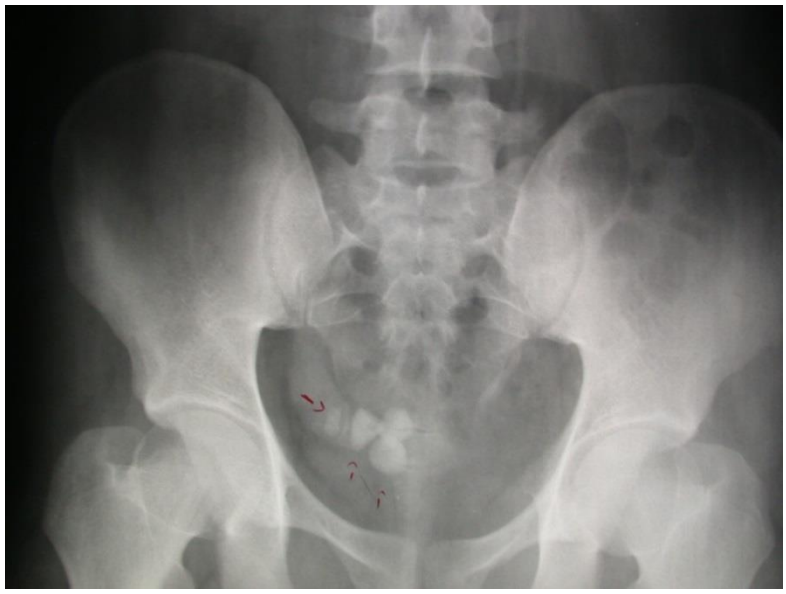
KUB: Ca^{+2} phosphate: most radiopaque.
Uric acid stones: radiolucent.
Ultrasonography: Acoustic shadow.
Non- Enhanced Computed tomography (NECT).

Role of helical non-enhanced computerized tomography (NECT) in the evaluation of acute flank pain

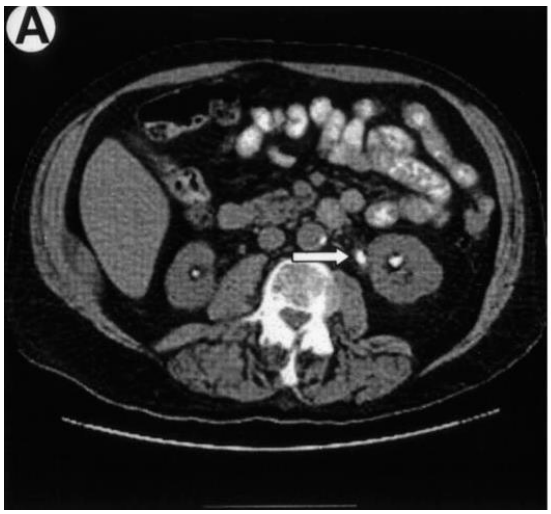
	Sensitivity (%)	Specificity (%)
KUB	57	71
Uls	87	94
IVU	87	97
NECT	96	100

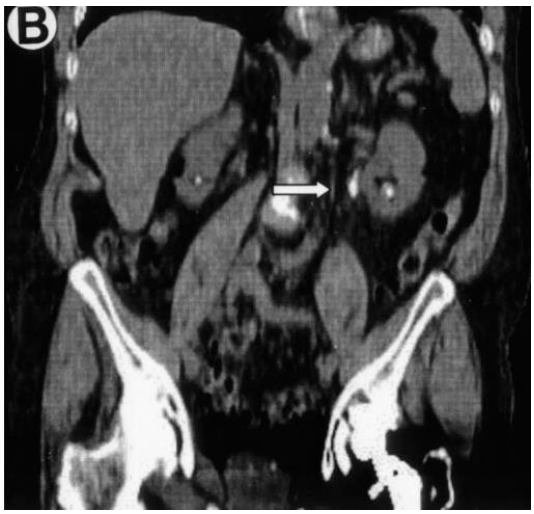
Average sensitivities and specificities of various stone imaging methods

KUB:



Coronal NECT:





Factors that Influence Choice of Rx

1. Economic status of the pt.
2. Duration of symptoms.
3. Size
4. Status of the opposite kidney.
5. Age & general condition.
6. Presence of obstruction & infection.

Urgent procedural Rx

- Unremitting pain
- Significant obstruction (degree & duration)
- Deteriorating renal function
- Oliguria or anuria (in bilateral obstruction or in solitary system or Tx Kidney)
- Associated infection (fever)

Management
-Conservative management
-Dissolution agents like alkalization agent (K citrate)
-Relieve of obstruction: nephrostomy vs DJ stent
-ESWL: (Extracorporeal shock wave lithotripsy): For kidneys are ureteric stones.
-Ureteroscopy
-PCNL
-Open stone surgery

Conservative management

- Narcotics:
  - meperidine → 1mg/kg
  - morphine → 0.1mg/kg
- NSAID, Cox2 inhibitors
- No empirical antibiotics
- Alpha blocker

Metabolic Indications
-Stone analysis
-Metabolic workup: recurrent, paediatric, bilateral stones
*Serum: KFT, Ca, P, uric acid
*Urine 24h collection: Ca, uric acid, oxalate, citrate, sodium, and pH.

Vesical Calculi
M > F
Presentation: LUTS, pain, hematuria
Cause: BOO, neurogenic bladder, FB
Treatment: cystolithotripsy vs cystolithotomy
And treat the underlying cause.