

urolithiasis

2013 DR RIYADH TOMA

Aetiology



1)Diet:

- ❖ **deficiency of vitamin A causes desquamation of epithelium. The cells form a nidus around which stone is deposited.**
- ❖ **Ingestion of excessive amounts of purines, oxalates , calcium, phosphate, and other elements often results in excessive excretion of these components in urine**
- ❖ **Increased water intake and increased urinary output decrease the incidence of urinary calculi in those patients who are predisposed to the disease**



2)Altered urinary solutes and colloids:



dehydration leads to an increased concentration of urinary solutes and tends to cause them to precipitate.



3)Decreased urinary citrate:



citrate in urine tends to keep relatively insoluble calcium phosphate and citrate in solution



4) infection:



Infection favours the formation of urinary calculi.



The predominant bacteria found in the nuclei of urinary stones are *staphylococci* and *Escherichia coli*.

❖ *Some bacteria can change the PH of urine like urea splitting microorganisms specially proteus*

❖ ***5) Inadequate urinary drainage and urinary stasis:***

❖ Stones are liable when urine does not pass freely like in BPH ,neurogenic bladder and boo .

❖ ***6) Prolonged immobilisation from any cause:***

❖ result in skeletal decalcification (hypercalcaemia) and an increase in urinary calcium (hypercalciuria) favouring the formation of calcium calculi .

❖ ***7) Hyperparathyroidism:***

❖ leading to hypercalcaemia and hypercalciuria is found in 5 per cent or less of those who present with radio-opaque calculi

❖ ***Randall's plaque and microliths:***

❖ **Randall** suggested that the initial lesion in some cases of kidney stone was an erosion at the tip of a renal papilla. Deposition of calcium on this erosion produced a lesion which has been called **Randall's plaque**. It has further been shown that minute concretions (microliths) regularly occur in the renal parenchyma postulated that these particles are carried by lymphatics to the sub endothelial region where they may accumulate causing Ulceration of the epithelium

❖ **Genetics:**

❖ About 25% of patients with kidney stones have a family history of kidney stones

❖ Several disorders that cause renal stones are hereditary like renal tubular acidosis (RTA), cystinuria , xanthinuria and dihydroxyadeninuria

- ❖ Age and Sex:
- ❖ The peak incidence of urinary calculi is from the twenties to the forties
- ❖ increased serum testosterone levels resulted in increased endogenous oxalate production by the liver
- ❖ lower serum testosterone levels may protect women and children against oxalate stone .
- ❖ estrogens decrease urinary oxalate excretion, plasma oxalate concentration, and kidney calcium oxalate crystal deposition

Types of renal calculus

- ❖ Oxalate stone (calcium oxalate):
- ❖ irregular in shape and covered with sharp projections. The surface of the calculus is discoloured by the pigments of altered blood.
- ❖ it is easy to be seen radiologically.
- ❖ Phosphate calculus [usually calcium phosphate, although sometimes combined with ammonium ,magnesium ,phosphate (**struvite**)]
- ❖ is smooth and dirty white tends to grow in alkaline urine
- ❖ phosphate calculi are usually easy to see on X-ray films
- ❖ Uric acid and urate calculi:
- ❖ are hard, smooth and often multiple. Their colour varies from yellow to brown and they sometimes have an attractive multifaceted appearance
- ❖ Pure uric acid stones are radio lucent and appear on an excretory urogram as a filling defect

- ❖ Cystine calculi:
- ❖ are uncommon.
- ❖ often multiple and may grow to form a cast of the renal pelvis and calyces. They are pink or yellow when first removed but they change colour to a greenish when exposed to air
- ❖ are radio-opaque because of the sulphur that they contain, and they are very hard.

- ❖ Xanthine calculi:
- ❖ are extremely rare. They are smooth and round, brick red in colour and show lamellation on cross section.

presentation

- ❖ *1) Silent calculus:*
- ❖ Some stones cause no symptoms
- ❖ *2) Pain:*
- ❖ Pain is the leading symptom in 75 % of people with urinary stone disease. Fixed renal pain is located posteriorly in the renal angle .

- ❖ *3) Haematuria:*
- ❖ Haematuria is sometimes a leading symptom of stone disease and occasionally the only one. As a rule the amount of bleeding is small.

- ❖ *4) Pyuria:*

- ❖ is particularly dangerous when the kidney is obstructed
- ❖ the mechanical effect of stones irritating the urothelium may cause pyuria even in the absence of infection
- ❖ If infection pressure builds in the dilated collecting system, organisms are injected into the circulation and a life-threatening septicaemia can quickly develop.

- ❖ **Renal dysfunction may be the presenting sign**
Investigation of suspected urinary stone disease

Urinalysis

- ❖ *presence of microscopic or gross hematuria
- ❖ *moderate pyuria may occur even in patients with uninfected urinary lithiasis
- ❖ *urine crystals of the same type that are creating the calculus.

Radiography

- ❖ 1) ***'KUB' film:***
- ❖ An opacity that keeps a constant position relative to the urinary tract during respiration is likely to be a calculus within it

❖❖ 2) *Excretion urography E U, IVU, IVP:*

❖❖ It shows where the stone is , and gives important information about the function of the kidneys.

❖❖ limitations included:

- 1-inability to obtain proper bowel preparation to aid in imaging in acute cases,
- 2-risk of allergy to contrast agents,
- 3-potential nephrotoxicity,
- 4-need to assess renal function before contrast injection,
- 6-and the time-consuming nature of the study.

❖❖ 3) *Ultrasound scanning:*

❖❖ is of most value in locating stones and the consequent hydronephrosis and other complications.

❖❖ the study is operator dependent. furthermore, the study is unable to locate ureteral stones in many instances

❖❖ 4) *Retrograde Pyelography:*

❖❖ perhaps in cases of relatively radiolucent calculi that are difficult to locate by other techniques.

❖❖ 5) *CT(computed tomography):*

❖❖ nonenhanced studies are rapidly becoming the standard means of evaluating patients presenting to emergency departments with acute flank pain and it is the method of choice in uretral stone .

❖❖ 6) *Magnetic Resonance Imaging:*

❖❖ specifically used to visualize the urinary tract has been termed magnetic

resonance (MRU) urography and has been reported to be effective in detecting urinary tract dilation

❖ **MRI unable to visualize most stones**

Treatment Decision

❖ **Medical therapy** for

- ❖ 1) treatment of the acute episode and
- ❖ 2) prevention of stone recurrences or new stone formations
- ❖ 3) and some times even dissolving large stones.

❖ 1) After diagnosis a stone , the first is to assess the degree of seriousness of the disease process

❖ 1) The majority of patients with renal colic require prompt therapy for pain relief

❖ Most patients who present with a stone are encouraged to drink more fluid and advise patients to drink sufficient water to keep the urine volume above 3 L/day

❖ Patients are instructed to limit their daily meat intake

❖ to substitute whole wheat bread for white bread, and to eat natural fiber cereals

❖ limit added salt at the table .

❖ **Thiazides**

❖ directly stimulate calcium resorption in the distal nephron while promoting excretion of sodium

❖ **Sodium Cellulose Phosphate**

❖ that binds calcium and inhibits intestinal calcium absorption

- ❖ poorly tolerated by some individuals, giving rise to nausea and diarrhea
- ❖ binds magnesium, resulting in hypomagnesuria
- ❖ it may increase urinary oxalate excretion
- ❖ Use only in documented cases of absorptive hypercalciuria

❖ **Allopurinol**

- ❖ Allopurinol inhibits xanthine oxidase and decreases the production of uric acid

❖ **Citrates**

- ❖ citrate therapy is a new and promising method for prevention of recurrent calcium oxalate stone disease

❖ **Magnesium**

- ❖ reduced urinary excretion of oxalate
- ❖ produce a more favorable magnesium-to-calcium ratio in the urine, a condition that offers relative protection against stone formation
- ❖ increases urinary citrate excretion

- ❖ Hospitalization for renal stones is mandatory under three clinical circumstances:

- ❖ 1-in patients with symptoms not controlled with oral medications;
- ❖ 2-in the presence of obstructive anuria
- ❖ 3-in patients with an obstructing stone and superadded infection .

Surgical treatment of renal calculi

❖ **1*Percutaneous nephrolithotomy PNL :**

- ❖ the placement of a hollow needle into the renal collecting system through the soft tissue of the loin and the renal parenchyma
- ❖ the nephroscope used to look for the stone
- ❖ Small stones may be grasped under vision and extracted whole. Larger stones must be fragmented by an ultrasound or electrohydraulic probe and removed in piecemeal.

- ❖ When the operation is finished a nephrostomy tube is left to drain the system
- ❖ This decompresses the kidney and allows repeated access to the system if stone particles remain
- ❖ Complications
 - ❖ (1) haemorrhage
 - ❖ (2) perforation of the collecting system with extravasation of irrigant fluid.
 - ❖ (3) perforation of the colon or pleural cavity during placement of the percutaneous track.

❖ ***2*Extracorporeal shock-wave lithotripsy:***

- ❖ A urinary calculus is a crystalline structure. If it is bombarded with shock waves of sufficient energy it will disintegrate into fragments
- ❖ shock waves are poorly transmitted through air, both the patient and the shock-wave generators were immersed in a bath of water.
- ❖ Modern ESWL machines do not have a water bath; the fluid is confined to the path that the shock waves must follow to reach the kidney

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Complications

- 1.. Pain during procedure or ureteric colic due to passage of a stone. Ureteric colic is common after ESWL and the patient must be given appropriate analgesia

If the stone is large the bulky fragments may become impacted in the ureter, causing obstruction so a self-retaining stent should be placed in the ureter so that the kidney can drain while the pieces of stone pass.

- 2 .. Haematuria
- 3 .. Sepsis
- 4 .. obstruction

Contraindications:

Absolute c. i.

- pregnancy.
- uncontrolled bleeding tendency .
- abdominal aortic aneurism.

Relative c.i.

- distal obstruction .
- febrile UTI.
- lower ureteric stone in fertile female .

Energy source, coupling mechanism, localization of
stone(us,fluoroscope or both)

3*Open Surgery for renal calculi:

usually performed via a loin or lumbar approach

A sling should be placed around the upper ureter to prevent stones migrating downwards.

Pyelolithotomy is indicated for stones in the renal pelvis

If there is gross sepsis, it is wise to place a nephrostomy or ureteric stent (double j stent)to drain the system.

If there is no infection, the pelvic incision is closed by absorbable sutures

Extended pyelolithotomy:

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 to be made into the calyces so that even large stag-horn stones can be removed intact.

- ❖ **Nephrolithotomy:** If there is a complicated calculus branching into the most peripheral calyces

- ❖ also necessary when the adhesions resulting from previous surgery make access to the renal pelvis difficult
- ❖ **Partial nephrectomy:** is sometimes preferable when the stone is present in the lowermost calyx and there is associated infective damage to the adjacent parenchyma.
- ❖ **Nephrectomy:** is indicated when the kidney has been destroyed by obstruction and infection associated with stone disease

Treatment of bilateral renal stones

- ❖ In patient with renal dysfunction Usually the kidney with better function is treated first, the operation on the contralateral side being deferred for 2—3 months later .
- ❖ but in patient with normal renal function we should operate on the less functioning kidney first .
- ❖ In cases of silent bilateral stag-horn calculi in the elderly patient , it may be better not to operate. The patient should be encouraged to maintain a high fluid intake.

Ureteric calculus

- ❖ A stone in the ureter nearly always has its origin in the kidney
 - ❖ Most are single small stones which pass spontaneously
- Clinical features

❖ **1)Ureteric colic:**

- ❖ waves of agonising pain are typically referred more to the groin, external genitalia and the inner surface of the thigh.

Ureteric colic is an agonising pain passing from the loin to the groin. Typically it starts suddenly causing the patient to move around.

the painful passage of a few drops of urine, may occur if the stone is in the intramural ureter

During an attack of ureteric colic there is rigidity of the lateral abdominal muscles
The severity of the colic is not related to the size of the stone.

❖ 2) Impaction:

- ❖ There are three locations where stones can be impacted in the urinary tract.
- ❖ The first area in which a calculus may become impacted is the **ureteropelvic junction**.(PUJ)
- ❖ A second area of impaction is at or near the **pelvic brim**, where the ureter begins to arch over the common iliac vessels posteriorly into the true pelvis.
- ❖ Finally, the most constricted area through which the urinary calculus must pass is the **ureterovesical junction**, which is the most common site of impaction.
- ❖ When the stone becomes impacted the attacks of colic give way to a more consistent dull pain, often felt in the iliac fossa
- ❖ The pain is increased by exercise and lessened by rest
- ❖ Perforation of the ureter and extravasation of urine is a rare complication
- ❖ If obstruction persists after 1-2 weeks, the calculus should be removed because prolonged distension of the kidney will lead eventually to atrophy of the renal parenchyma.

Indication of intervention in ureteric stone:

- Intractable pain not responding to analgesia like opiod
- Sepsis
- Renal dysfunction
- Impaction
- Bilateral ureteric stone
- Patient with Single kidney

Work up for ureteic stone :

- ... Urine exam can show hematuria or pyurea and some times it is normal
- ... Renal function test specially in bilateral cases
- ... X ray (KUB) most urinry stones are radiopaque . An intravenous urogram performed while the patient has pain can confirm the diagnosis.
- ... Ultrasound can show dilitation in p.c.s .

... CT scan is the method of choice in the diagnosis of ureteric stone .

❖ **Cystoscopy:**

- ❖ is not indicated routinely but may reveal oedema and petechiae of the urothelium around the ureteric orifice when the stone is in the lower ureter. The stone may be visible in the orifice as it makes its passage into the bladder.

❖ **Retrograde ureterography:**

- ❖ is usually performed as an immediate preliminary to an endoscopic operation to remove a calculus but it may be of use if doubt remains after the intravenous urogram.

Treatment

❖ **Pain**

- ❖ Nonsteroidal anti-inflammatory drugs to relief pain and decrease the edema around the stone .
- ❖ There is no rule of antispasmodic drug now .

❖ **Fluid:**

- ❖ It is very important step to replace water and electrolyte due to vomiting .
- ❖ An increase in diuresis, however, may reduce the rate of ureteral peristalsis. If so, forced water drinking may inhibit the ability to pass stones spontaneously

❖ **Removal of the stone :**

- ❖ Expectant treatment is appropriate for small stones that are likely to pass naturally
- ❖ *1*Endoscopic stone removal:* Dormia basket should only be used for small stones that are within 5 or 6 cm of the ureteric orifice. There is a significant danger of ureteric injury

❖ ***2*Ureteric meatotomy:***

- ❖ Careful endoscopic incision using a diathermy knife can enlarge the opening and free the stone.
 - it may lead to urinary reflux

❖ *3*Ureteroscopy :*

- ❖ Stones that cannot be caught in baskets or endoscopic forceps under direct vision are fragmented using an electrohydraulic, or ultrasonic or laser lithotripter.

❖ *4*Push bang:*

- ❖ A stone that is lying in the middle or upper part of the ureter can often be flushed back into the kidney using a ureteric catheter. The repositioned calculus is 'secured' in the kidney by a J-stent. The patient can then be referred for ESWL

❖ *5*intracorporeal Lithotripsy by endoscopy :*

- ❖ it can be fragmented in situ by laser or electrohydraulic or pneumatic lithotripters
- ,
- ❖ this form of treatment is not appropriate if there is complete obstruction or if the stone has been impacted for a long time.

❖ *6*Open surgery:*

❖ **Ureterolithotomy:**

- ❖ the upper third of the ureter is 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.

Bladder stones

- ❖ **A primary** bladder stone is one that develops in sterile urine; it often originates in a kidney and passes down the ureter to the bladder, where it enlarges.
- ❖ **A secondary** bladder stone occurs in the presence of infection, bladder outflow obstruction, impaired bladder emptying or a foreign body such as nonabsorbable sutures, metal staples or catheter fragments

Clinical features

- ❖ *asymptomatic: found incidentally during U/S examination or cystoscopy
- ❖ **Frequency and urgency : is the earliest symptom
- ❖ ***Pain: in the suprapubic area and radiates to the tip of the urinary meatus . usually occurs at the end of micturition, is worsened by movement
- ❖ ****Haematuria: is characterised by the passage of a few drops of bright red blood at the end of micturition
- ❖ *****Interruption of the urinary stream: which may develop into acute retention of urine
- ❖ *****Symptoms of urinary infection

Investigations

- ❖ Examination of the urine usually reveals microscopic haematuria, pus or crystaluria .
- ❖ Radiography — in most patients, the stone is visible on a plain X-ray...If the stone is radiolucent, a filling defect may be visualised on IVU. Radiographs of the whole of the urinary tract should be taken to exclude upper tract stone.
- ❖ Ultrasound can show the size and associated anomalies
- ❖ Cystoscopy .is essential

Treatment

- ❖ the cause of the underlying stone should be treated like infection, bladder dysfunction. In most patients, treatment can be delivered endoscopically.

❖ *Litholopaxy*

- ❖ Crushing the stone into a small pieces and evacuate them by endoscopy

❖ *Suprapubic vesicolithotomy:*

- ❖ It is indicated in very large stone, very hard stone, and in urethral stricture that cannot be dilated.
- ❖ It is done by removal of the stone through a suprapubic incision, after which the bladder is closed and drained by a urethral catheter.

❖ *Percutaneous suprapubic litholopaxy*

- ❖ It is possible to insert a needle into the bladder and then pass a guide wire
- ❖ a large-bore nephroscope can be inserted
- ❖ This is the best method to use if it is not possible to carry out litholopaxy per urethra because of a narrow urethra

❖ *Extracorporeal shock wave lithotripsy (ESWL)*

- ❖ These devices can be used in the treatment of bladder calculi, but if the stone is large endoscopic litholopaxy is preferable.

Urethral calculi

- ❖ A calculus that obstructs the urethra is infrequent, since the calculi that spontaneously migrate down the ureter are usually small enough to be passed through the urethra



Symptoms:



The symptoms of urethral obstruction secondary to a calculus are classic: the patient complains of the sudden onset of a midstream obstruction to the flow of urine.



The outflow obstruction may be complete, or a decreased or split stream may be described



Diagnosis:



Palpation of the penile, scrotal, or perineal urethra will usually reveal the calculus.



An abdominal radiograph that includes the genitalia will usually show the stone.



Before endoscopic examination, the diagnosis may be confirmed by a retrograde urethrogram.

Treatment



Urgent relief of obstruction may be attempted by passage of a urethral catheter, manipulate the calculus to the bladder where it may be crushed at a later date.



If the catheter fails to dislodge the calculus and the patient is unable to void, relief of obstruction must be obtained by means of suprapubic drainage.



The patient's urethral stone may then be treated by endoscopic methods.



A cystoscope with biopsy forceps or stone-crushing forceps is placed in the urethra under regional or general anesthesia.



A calculus that cannot be dislodged, manipulated, crushed or fragmented is rare.



However, if this occurs, the urethra is incised longitudinally at the site of the palpable calculus, which then can be popped out.

Pediatric Urolithiasis



is relatively uncommon



seldom present with typical ureteric colic. In most series, about 70% of patients

are diagnosed during work-up of urinary tract infection. Hematuria and abdominal pain are other presenting symptoms, with typical ureteric colic occurring in less than 15% of individuals

- ❖ Treatment
- ❖ Percutaneous nephrolithotomy
- ❖ Ureteroscopy tends to be more difficult
- ❖ Electrohydraulic lithotripsy and other forms of stone fragmentation have been effective in the management of children with urolithiasis

Stones in Pregnant Women

- ❖ Although pregnancy by itself does not predispose to calculi, physiologic dilation of the ureters and back pressure changes because of the gravid uterus allow preformed calculi more room for movement, resulting in renal colic and hematuria.
 - ❖ patients may present with vague abdominal pain, unexplained fever, unresolved bacteriuria, and microscopic hematuria so diagnosis is difficult
 - ❖ *Investigations:* ultrasound has become the cornerstone of evaluation of suspected renal colic in pregnancy
 - ❖ *Treatment:* Approximately 65% to 85% of pregnant women with ureteric colic spontaneously pass the calculi when treated conservatively with hydration, analgesics, and, if infected, antibiotics
 - ❖ do the least required to keep the kidney functioning, the patient free from symptoms, and the urine uninfected. Stents should be placed cystoscopically with minimal radiographic or sonographic monitoring
 - ❖ If the symptoms do not resolve with appropriate treatment, alternative therapy such as percutaneous nephrostomy should be considered
 - ❖ . Definitive procedures such as ultrasonic/electrohydraulic lithotripsy should be avoided until after delivery
 - ❖ In exceptional circumstances in which persistent pain, sepsis, or recurrent obstruction demands an intervention, percutaneous stone removal under carefully monitored anesthesia and suitable radiation shielding has been advocated by some
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