Urinary Calculi

Prof. Dr. Murtadha Almusafer

Urology Consultant

University of Basrah – College of Medicine (Urology)

2022-2023

Objectives

1- Identify the main risk factors.

2- Impact of COVID-19 on patients with urinary calculi

3- Know the types of urinary calculi.

4- Diagnose by (history, physical examination, investigations, imaging) & know different methods of treatment & recognize those patients with urinary calculi who need urgent intervention due to complications.

5- Know how to prevent stone recurrence.

Definition

Urinary stone is a polycrystalline aggregate.

Aetiology & risk factors

1.Dietetic: High sodium intake and vitamin A deficiency increase the incidence of urinary calculi.

2. Altered urinary solutes and colloids: Dehydration & reduction of urinary colloids which adsorb solutes

3.Decreased urinary citrate

4.Renal infection: urea-spllitting Streptococci,Staphylococci and especially Proteus spp.

5.Inadequate urinary drainage and stasis

6.Prolonged immobilization

7.Hyperparathyroidism

8. Occupation: Patients with Sedentary works have higher incidence of urinary stones.

9. Climate: Individuals living in a hot climate are more prone to dehydration

which increase the incidence of urinary stones

10. Family history: also increase its incidence.

11. Medications: as Indinavir, and triametrene.

12. Structural and anatomical abnormalities of the urinary tract.

13. Gastrointestinal diseases (i.e., jejuno-ileal bypass, intestinal resection, Crohn's disease, malabsorptive conditions, enteric hyperoxaluria after urinary diversion, exocrine pancreatic insufficiency) and bariatric surgery

14. Increased levels of vitamin D

Impact of COVID-19 on urinary stones:

1.Homestay with physical inactivity & consequent weight gain

2.Due to fear of visiting outpatient, there will be more incidence of complications

and if the patient has DJ stents, there is high incidence of encrustation.

Stone Varieties

1- Calcium calculi: It accounts for 85% of urinary stones. it includes calcium oxalate and calcium phosphate calculi.

2-Uric Acid Stones

-It accounts for less than 5% of all urinary calculi.

-They are usually formed in male patients with gout, rapid weight loss and those

with myeloproliferative diseases.

-Those patients usually have urinary PH≤5.5

-Pure UA stones are radiolucent

3-Struvite Stones: Composed of magnesium, ammonium and phosphate (MAP). It frequently found & tends to grow in alkaline urine so it is more common in women with recurrent U.T.I. with urea splitting organisms.

4-Cystine Stones

-usually secondary to inborn error of metabolism.

-Uncommon

-Appear in acidic urine

-They are opaque because they contain sulphur

-Very hard

5-Xanthine Stones

-usually secondary to deficiency of xanthine oxidase enzyme.

-Extremely rare

6) Other rare stones: as Indinavir, Silicate and Matrix stones.

Clinical Features

Renal Stones

-Approximately 50% presents between 30-50 yrs

1. Silent calculi: uremia may be the first indication of bilateral calculi, although secondary infection usually produces symptoms first.

2. Pain: a leading symptom in 75%

3.Hematuria: Is Sometimes a leading symptom of stone disease & occasionally the only one.

4.Fever

Ureteric Stone

1. Ureteric colic

2. N&V, abdominal distention

3. Irritative voiding symptoms: as dysuria, frequency and or urgency especially in the presence of infection or stone in the uretero-vesical junction.

4. Anuria or oliguria with signs and symptoms of renal failure especially in:

a. Bilateral staghorn stones

b. Bilateral ureteral stones or

c. Stone obstructing single kidney

5. Fever & rigor

6. Radiation & referred pain

Vesical Stones:

Primary= Develops in sterile urine & often originate in kidney.

Secondary= occurs in presence of infection, outflow obstruction, impaired

bladder emptying, or F.B.

Men are affected 8 times more frequently than women.

A solitary bladder stone is the rule, but there are numerous stones in 25% of patients. Stone analysis frequently reveals ammonium urate, UA, or Ca oxalate.

Symptoms= Frequency, sensation of incomplete emptying, pain(strangury), it occurs at end of micturition and referred to tip of penis or labia majora, more rarely referred to perineum or suprapubic region.

In children screaming and pulling at penis with hand at end of micturition are indicative. Hematuria, interruption of urinary stream. Infection is a common presenting symptom.

Urethral Stone:

Poor stream, dysuria, intermittent stream, hematuria & if impacted lead to urine retention

Clinical Examination:

General Examination: Dehydration, Uremic signs, half & half nails, uremic frost, signs of gout

Local Examination:

1.Regarding renal stones:

a. Percussion over kidney produces a stab of pain & may be tenderness on deep palpation

b. Palpable loin swelling is rare due to hydronephrosis or pyonephrosis.

2.Regarding ureteric stones: During attack of ureteric colic there is rigidity of lateral abdominal muscle but not as a rule, of rectus abdominis.

3. Regarding vesical stones: May be normal, there may be suprapubic tenderness.

Vaginal exam: occasionally large calculus is palpable in female.

4.Regarding urethral stone: may be palpable distended bladder due to retention of urine, or palpable urethral stone or showing urethral stone

Lab. Investigations and Diagnosis:

After careful medical and surgical history and thorough physical examination

then lab. investigations and imaging studies are used to ensure the diagnosis. and

include:

1. Urinalysis (G.U.E.): Look for RBC, WBC, Crystals, casts and pH.

2. Blood investigations: B.urea, S.creatinine.

Imaging studies include:

1. Abdominal ultrasound (Urinary system ultrasound) should be used as the primary diagnostic imaging tool, although pain relief, or any other emergency measures, should not be delayed by imaging assessments. Ultrasound is safe (no risk of radiation), reproducible and inexpensive. It can identify stones located in the calyces, pelvis, and pyeloureteric and vesico-ureteral junctions (US with filled bladder), as well as in patients with upper urinary tract (UUT) dilatation.

2.K.U.B.: Kidney-ureter-bladder radiography should not be performed if NCCT is being considered; however, it is helpful in differentiating between radiolucent and radiopaque stones and should be used for comparison during follow-up.

X-Ray Characteristics of stones:

Radiopaque	Poor radiopacity	Radiolucent
Calcium oxalate dehydrate	Magnesium ammonium phosphate	Uric acid
Calcium oxalate monohydrate	Apatite	Ammonium urate
Calcium phosphates	Cystine	Xanthine
		2,8-Dihydroxyadenine
		Drug-stones (Section 4.11)

3. Non-contrast-enhanced computed tomography has become the standard for diagnosing acute flank pain and has replaced intravenous urography (IVU). Non-contrast-enhanced CT can determine stone diameter and density. When stones are absent, the cause of abdominal pain should be identified. In evaluating patients with suspected acute urolithiasis, NCCT is significantly more accurate than IVU or US.

Perform a contrast study if stone removal is planned and the anatomy of the renal collecting system needs to be assessed.

M.R.I. is a poor study for documentation of urinary stones.

TRT of Renal Stones:

1. Conservative TRT

a. Increase fluid.

b. Dissolution agents: oral alkalinizing agents which include Na or K bicarbonate and k citrate.

2. Extracorporeal Shock Wave Lithotripsy(ESWL):

Renal stone size (<25 mm) and those with failed conservative treatment.

*Contraindications:

a. Pregnancy.

b. Large abdominal aneurysm.

c. Uncorrectable bleeding disorders.

3. Percutaneous Nephrolithotomy(PNL):

It is indicated for:

a. Big renal stones (≥ 25 mm).

b. Distal obstruction not caused by the stone such as PUJ obstruction.

c. Stone in calyceal diverticulum.

d. Lower pole renal stones where the success of ESWL is low.

e. when there is contra indication for ESWL.

*Various types of lithotripters can be used for destruction and removal of renal stones as pneumatic, ultrasonic or laser probes lithotripters

4.RIRS (Retrograde Intrarenal Surgery):

By using Flexible ureteroscopy and laser

5. ECIRS: Endoscopic Combined Intrarenal Surgery to increase the stone free rate.

6.Laparoscopic pyelo and uretero- lithotomy.

7-Open Surgery: Pyelolithotomy, nephrolithotomy, partial Nephrectomy, & nephrectomy.

Treatment of Ureteral Calculi:

1. Spontaneous passage depends on stone size, site, shape & associated ureteral oedema.

2.Medical Expulsive Therapy:

a. NSAID: Diclofenac & Indomethacin.

b. PDE-5 Inhibitors like Tadalafil

c. Alphablockers: Tamsulosin

d. Ca channel blokers: Nifedipine.

3.ESWL

4.Endoscopic Stone Removal: Dormia basket, ureteric meatotomy, & ureteroscopy.

5.Open surgery (Ureterolithotomy) and laparoscopic ureterolithotomy.

Indications of Surgical and enoscopic Intervention of Ureteric Stone:

a. Repeated attacks of pain and stone is not moving.

b. Stone is enlarging.

c. Complete obstruction of kidney

d. Urine is infected.

e. Stone is too large to pass.

f. Stone is obstructing solitary kidney or there is bilateral obstruction.

Management of sepsis and/or anuria in obstructed kidney

Recommendations
Urgently decompress the collecting system in case of sepsis with obstructing stones, using percutaneous drainage or ureteral stenting.
Delay definitive treatment of the stone until sepsis is resolved.
Collect (again) urine for antibiogram test following decompression.
Start antibiotics immediately (+ intensive care, if necessary).
Re-evaluate antibiotic regimen following antibiogram findings.

Treatment options for bladder calculi:

1.Endoscopic vesico - litholapexy

By cystoscope with use of various types of lithotripters as mechanical, ultrasonic, electrohydrolic or laser lithotripters.

2. P/C Suprapubic Litholapexy.

3. Open vesicolithotomy

TRT Uretheral stones:

- Small stones near the external meatus can be grasped with a grasper.
- Large and posterior uretheral stones can be pushed to the bladder and removed endoscopicaly.

Prevention

In bilateral & recurrent stone formers:

1.Serum calcium

2.Serum uric acid

3.Urinary urate, Ca & Phosphate in 24 hr collection, & urine should be screened for cystine.

4. Analysis of any stone passed.

5. Dietary advice

6.Drink plenty of fluid.

7.Drug TRT: Idiopathic hypercalciuria: Bendroflumethiazide 5mg.Allopurinol & urine alkalinization.