

Recurrent Kidney Stones

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Family physicians are critical in the diagnosis and management of patients presenting with urinary tract calculi. This common disorder afflicts approximately 10% of the general population. After their initial stone episode, more than 50% of patients will have at least one recurrence in their lifetime, with a recurrence rate of about 7% per year.

Diagnostic considerations

History and physical examination

Although recurrent urolithiasis may be asymptomatic, patients often present with symptoms similar to their first stone episode. Approximately 25% of patients with recurrent urinary calculi have a family history of urinary tract calculi.

Common symptoms of renal or ureteral calculi include:

- dull flank ache,
- acute renal colic with or without nausea and/or vomiting,
- microscopic or gross hematuria or
- symptoms indicative of a urinary tract infection.

Infectious symptoms can often be localized to the lower urinary tract (suprapubic pain, irritative voiding symptoms) or upper urinary tract (flank pain with fever, chills, rigors).

In severe and potentially life-threatening cases of an obstructing stone, patients can present with systemic infectious symptoms, including hemodynamic instability (hypotension, tachycardia, tachypnea), mental status changes and oliguria or anuria. This symptom constellation requires urgent intervention with appropriate urinary tract drainage and

Simon's case

- Simon, 56, presents with mild, intermittent, left renal, colicky-type pain.
- He has a past history of urolithiasis and passed a stone four years ago.
- His pain is adequately controlled and a kidneys/ureters/bladder X-ray demonstrates a 9 mm x 5 mm calcification suspected of residing in the proximal left ureter.
- A computed tomography scan confirms a 9 mm proximal left ureteral stone with mild hydronephrosis.
- A urology referral is made; extracorporeal shock wave lithotripsy and ureteroscopic laser lithotripsy, etc. options are discussed.
- He chooses ureteroscopy; his stone is fragmented using laser lithotripsy and is retrieved for analysis.
- Post-operatively, Simon is pain-free and follow-up imaging demonstrates that he is also stone-free.
- His stone analysis reveals a calcium oxalate monohydrate stone.
- He undergoes a metabolic stone workup three months later, which is normal other than a low 24-hour urinary volume (1,200 mL).
- Simon is advised to increase his oral fluid intake to at least 2,500 mL per day.



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Table 1

History for patient with recurrent urolithiasis

Domain	Important historic points
Current signs and symptoms	Pain (back, flank, abdominal, inguinal, genital); lower urinary tract symptoms (frequency, urgency, nocturia); signs of generalized infection (fever, chills, rigors, malaise); gross hematuria; nausea and vomiting; oliguria or anuria
Past history of urinary tract calculi	Number of episodes; age of onset; symptoms; previous investigations; bloodwork, urine tests, stone analysis, radiologic; previous treatment (observation, dietary, pharmacologic, surgical); time of last followup for urolithiasis
Past urologic history	Renal insufficiency/failure; solitary kidney; transplant kidney; hydronephrosis; urologic surgery; urinary tract infections; recurrent, chronic, pyelonephritis; voiding dysfunction/neurogenic bladder
Past medical history	Metabolic disease; gout; inflammatory bowel disease; chronic diarrhea; granulomatous disease; sarcoidosis, tuberculosis; prolonged immobilization
Past surgical history	Bowel resection; pelvic surgery
Diet	Daily fluid intake; calcium and vitamin D intake (milk, vitamins); meat/protein intake; oxalate intake
Medications	Vitamin supplements; diuretics; antihypertensives; steroids; lithium
Family history	Urinary calculi; urologic disease; nephrologic disease; metabolic disease (hyperparathyroidism, gout, hyperthyroidism)

referral to an acute care centre. Table 1 outlines the important history points to cover.

Physical examination in patients with recurrent stones in the elective, outpatient setting is usually non-contributory.

Although most recurrent urinary tract calculi form in the kidney, they may also form in the bladder when there is an obstruction of the bladder outlet or urethra, which may lead to intravesical urinary stasis. Bladder calculi may cause or exacerbate lower urinary tract symptoms and, in some cases, may even cause urinary retention.

Pediatric patients with recurrent urinary tract calculi must be investigated, as they often have an underlying metabolic or anatomic abnormality that predisposes them to urolithiasis. Tables 2 and 3 outline other indications for urologic referral and metabolic stone testing, respectively.

Investigations

Patients with recurrent urolithiasis require urine studies and bloodwork in order to determine any underlying metabolic abnormality that predisposes them to form recurrent stones.

Stone analysis is performed to determine the stone composition. Diagnostic imaging establishes the size and location of the stone(s), which impacts stone treatment. Diagnostic imaging tests include plain kidney/ureters/bladder (KUB) X-ray, intravenous pyelogram (IVP), ultrasound and computed tomography (CT) scan.

KUB is a reasonable starting point, as it is the least expensive and is readily available. CT scan-

FAQ

What blood work is included in a metabolic stone workup?

Complete blood cell count, electrolytes, bicarbonate, blood urea nitrogen, creatinine, calcium (total and ionized), uric acid, total protein, albumin, magnesium, phosphate, parathyroid hormone

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Table 2

Indications for urologic consultation

Urgency of consultation

Urgent (i.e., hospital admission required)

Conditions

Clinically unstable patient:

- Signs and symptoms of infection
- Uncontrollable pain
- Uncontrollable nausea and vomiting

Bilateral calculi with potentially obstructing ureteral calculus

Solitary (anatomic or functional or transplant) kidney with potentially obstructing ureteral calculus

Known renal insufficiency or failure with potentially obstructing ureteral calculus

Elective (i.e., outpatient assessment)

Recurrent urinary calculi

Multiple calculi

Large calculus unlikely to pass:

- ≥ 6 mm in maximum dimension
- Staghorn calculus

Symptomatic calculus any size that has failed a trial of spontaneous passage after one month

Any non-calcium oxalate calculus

- Uric acid
- Struvite
- Cystine

Patient age < 16 years

Pregnancy

Nephrocalcinosis

History of genitourinary tract surgery

Occupational requirement to be 100% stone-free (i.e., pilot, astronaut)

Table 3

Indications for metabolic stone testing

Stone factors

- Recurrent urinary calculi
- Multiple calculi
- Bilateral calculi
- Staghorn calculus
- Non-calcium oxalate stone composition
- Patient age < 16 years
- Solitary kidney, including renal transplant
- Family history of stone disease

Patient factors

- Nephrocalcinosis
- Inflammatory bowel disease
- Occupation requires 100% stone-free status

FAQ

What urine studies are included in a metabolic stone workup?

- Urinalysis, urine microscopy for crystals, urine culture and sensitivity
- A 48-hour urine collection for urine volume, pH, creatinine, sodium, potassium, chloride, bicarbonate, calcium, magnesium, phosphate, oxalate, uric acid, citrate, protein, cystine, urine cyanide-nitroprusside test (for cystinuria), if indicated.

Table 4

Metabolic abnormalities and treatment/prevention strategies for patients with recurrent urolithiasis

Stone type	Metabolic abnormality	Treatment and prevention strategies
Any	Low urine volume Urinary tract abnormalities (congenital or acquired)	<ul style="list-style-type: none"> Increased fluid intake Surgical intervention
Calcium oxalate +/- Calcium phosphate	Hypercalcemia and/or Hypercalciuria	<ul style="list-style-type: none"> Potassium citrate Treat underlying condition Thiazide diuretic
Calcium oxalate	Hyperoxaluria	<ul style="list-style-type: none"> Pyridoxine if gastrointestinal related Decrease dietary oxalate intake
Calcium phosphate (pure)	Hypocitraturia	<ul style="list-style-type: none"> Potassium citrate
Uric acid	Hyperuricemia and/or Hyperuricosuria	<ul style="list-style-type: none"> Decrease dietary purine intake Allopurinol Potassium citrate Sodium bicarbonate
Cystine	Cystinuria	<ul style="list-style-type: none"> Low methionine diet Restrict dietary sodium (< 3 gm/day) Potassium citrate Sodium bicarbonate Penicillamine Captopril
Struvite	Urinary tract infection with urease-producing organism	<ul style="list-style-type: none"> Antibiotics Ensure complete bladder emptying

FAQ

When is the optimal time to order a metabolic stone workup?

- At least two or three months after the most recent period of stone activity (symptoms or surgery) to allow the patient to resume normal baseline activity, diet and fluid intake.

ning has largely replaced IVP. Ultrasonography is also widely available and identifies the presence of hydronephrosis, which may be indicative of obstruction. However, it is not particularly sensitive in detecting mid and distal ureteral stones. Currently, a non-contrast helical CT scan is the most sensitive and specific, making it the “gold standard” imaging modality used in the diagnosis of urinary tract calculi.

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Treatment

The first step in the prevention and treatment of recurrent urolithiasis is to increase the daily fluid intake to at least 2.5 L to 3 L per day. It has been shown that a urine output greater than 2 L per day will significantly decrease the risk of recurrent urinary calculi.

When possible, dietary modifications are also helpful. Restricting foods that are high in dietary oxalate (spinach, tea, chocolate, peanuts, rhubarb, cranberries, beetroots), purines (anchovies, brains, gravies, kidneys, liver, sardines, sweetbreads, beef, fish, turkey) or methionine (potatoes, tofu, broccoli, spinach, green peas, mushrooms, nuts) may be useful for calcium



Take-home message

1. Kidney stones have a very high recurrence rate
2. A metabolic stone work-up and specialist referral is recommended for all recurrent stone formers
3. Increasing daily fluid intake is the mainstay of long-term prevention of future stone episodes


oxalate, uric acid and cystine stones, respectively. Pharmacologic manipulation is useful when a metabolic abnormality that predisposes the patient to forming stones exists. Table 4 outlines medical treatments and prevention strategies for each major stone type.

Surgery is performed as indicated. Today, virtually all stones may be treated by a minimally invasive approach.

Our summary...

Urinary tract calculi are very common and many patients develop recurrent stones. Patients with

recurrent urolithiasis should undergo metabolic testing and should be referred to a nephrologist or urologist. Investigation and treatment will depend on the presentation (*i.e.*, acute versus chronic).

Regardless of the stone type, increasing fluid intake is critical in preventing future episodes and is the foundation of long-term management in most patients with recurrent kidney stones. 

References available—contact *The Canadian Journal of Diagnosis* at diagnosis@sta.ca.