Review

# Kidney Stones:
## Options for the GP

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Urinary stone prevalence is estimated to be at 3%, affecting up to 12% of the population during their lifetime and recurrence rates approach 50%. Caucasian males have the highest incidence of urinary stones. Stone pain has been described as being equal to or more severe than pain experienced during childbirth.

The most common stone compositions are calcium oxalate, uric acid, struvite and cystine. In this article, the diagnosis and management are reviewed for renal and ureteral stones.

### *Presentation*

The classic history and exam of a renal stone patient is:

- Acute, colicky flank pain radiating to the ipsilateral groin or gonad (patient is often writhing in unsuccessful attempts to find a comfortable position)
- Ureteral colic may localize to the abdomen overlying the stone
- Nausea and vomiting due to shared splanchnic innervation
- Gross or microscopic hematuria in approximately 90% of those affected
- Costovertebral angle or lower quadrant tenderness
- Relatively non-tender abdomen

### Parker's case

Parker, 42, presents with acute right flank pain radiating to the right lower quadrant, with nausea, right costovertebral angle tenderness and microhematuria.

A CT scan shows a 4 mm proximal right ureteral stone with mild hydronephrosis. He is given diclofenac and a urology referral with instructions to strain his urine.

Parker presents 3 days later to urology with more severe right lower quadrant pain and a fever of 39°C. He appears septic and a repeat CT scan shows a 4 mm distal right ureteral stone with moderate hydroureteronephrosis. Consequently, a stent is placed and Parker is given antibiotics.

With medication, Parker defervesces, but does not pass his stone and so opts for shock wave lithotripsy (SWL). His stone does not fragment with SWL. He subsequently undergoes ureteroscopy and his stone is basketed and removed.

**Turn to page 79 for another case.**

Table 1 shows the differential diagnosis of kidney stones.

### *Diagnosis*

Diagnostic tests to confirm a kidney or ureteral stone include:

- Unenhanced, helical CT scans are the "gold standard"

- IV urogram, though rarely performed
- Kidney ureter bladder plain film
- Ultrasound (first test to order for suspected stones in pregnancy)
- Magnetic resonance urogram (second test to order for suspected stones in pregnancy)

Additional tests that may be helpful include:

- Urinalysis
- Urine culture (if fever, urosepsis, or pyuria is present)
- Serum creatinine (to estimate renal function)

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## Management

The most pressing issue is the patient requiring urgent intervention (Table 2 and Parker's case). Since most stone patients present with pain, analgesia must be addressed. In randomized, double blind trials for colic, NSAIDs have shown to provide equal or greater efficacy, shorter duration to pain relief, with equal or fewer side-effects than narcotics. Typical options for pain management include:

- NSAIDs (*e.g.*, 50 mg of diclofenac t.i.d., taken either rectally or orally, as needed)

### Camilla's case

Camilla, 49, has a history of kidney stones. She presents to the ED with severe, colicky right flank pain and nausea.

An exam shows costovertebral angle tenderness and a soft non-tender abdomen. A CT scan shows a 1.5 cm right lower pole stone and lower pole hydronephrosis.

She undergoes an uneventful right percutaneous nephrolithotomy and is rendered stone-free.

**Look to page 80 for another case.**

**Table 1**

**Differential diagnosis of acute renal colic in adults**

- Renal or ureteral stone
- Hydronephrosis (ureteropelvic junction obstruction, sloughed papilla)
- Bacterial cystitis or pyelonephritis
- Acute abdomen (bowel, biliary, pancreas or aortic abdominal aneurysm sources)
- Gynecologic (ectopic pregnancy, ovarian cyst torsion or rupture)
- Radicular pain (L1 herpes zoster, sciatica)
- Referred pain (orchitis)

**Table 2**

**Indications for urgent intervention of a urinary stone**

- Obstructed upper tract with infection (obstruction reduces glomerular filtration rate and antibiotics penetrate poorly into obstructed system)
- Impending renal deterioration (*e.g.*, preexisting renal insufficiency or solitary kidney with hydronephrosis)
- Pain refractory to analgesics
- Intractable nausea/vomiting
- Patient preference (*e.g.*, aviation pilots)

## George's case

George, 39, is a morbidly obese male who presents with severe right flank pain and nausea and right costovertebral angle tenderness.

A CT scan shows an 8 mm stone at the right ureteropelvic junction with moderate hydronephrosis. Due to his morbid obesity, he is too large for the SWL table. He follows through with retrograde ureteronephroscopy and has successful laser lithotripsy of the stone. Fragments are removed and George is rendered stone-free.

- Narcotics (*e.g.*, 0.1 mg/kg of morphine sulfate q.4.h., intramuscularly or by IV, as needed)
- 40 µg of desmopressin intranasally every half hour as needed
- Decompression (ureteral stent or nephrostomy)

*Most stones < 5 mm in diameter pass spontaneously and two-thirds of these small ureteral stones pass spontaneously within four weeks of symptom onset.*

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### *Spontaneous stone passage*

The next clinical decision is whether the patients may be followed expectantly in anticipation of passing their stone spontaneously vs. elective intervention. Stone size is a key determinant to predict spontaneous stone passage. Most stones < 5 mm in diameter pass spontaneously and two-thirds of these small ureteral stones pass spontaneously within four weeks of symptom onset. The likelihood of spontaneous stone passage decreases as the stone size increases (Table 3).

Spontaneous stone passage is facilitated by the use of drugs that relax the distal ureter and enhance expulsion. Effective agents for medical expulsion therapy include:

- α-blockers (*e.g.*, 0.4 mg of tamsulosin p.o. q.d.),
- calcium channel blockers (*e.g.*, 10 mg of nifedipine p.o. q.d.) and
- corticosteroids (*e.g.*, 10 mg of prednisone p.o. q.d.), though rarely used.

### *Risk of renal deterioration*

A concern is whether there is a risk of renal deterioration by allowing the patient to pass the stone spontaneously. In complete unilateral ureteral obstruction in dogs, irreversible loss of renal function begins at two weeks. Patients rarely have complete obstruction and thus the risk of renal deterioration from observation is low. However, a ureteral stone that has not passed within one to two months is unlikely to pass spontaneously with further observation. An observation period of several weeks is reasonable in most circumstances.

Table 3
**Spontaneous stone passage**

| Stone size (mm) | Mean number of days to pass stone | Likelihood of eventual need for intervention |
|---|---|---|
| ≤ 2 | 8 | 3% |
| 3 | 12 | 14% |
| 4-6 | 22 | 50% |
| > 6 | - | 99% |

*Renal calculi < 2 cm in maximal diameter are generally best treated by SWL. Success varies based on SWL machine, stone size, composition and location.*

### *Intervention*

For patients in whom intervention is warranted, treatment is based on stone composition, stone location and size, upper tract anatomy and patient preference (Table 4). Uric acid calculi, which comprise < 10% of stones, may be managed medically in some cases. On plain radiography, pure uric acid calculi are radiolucent, but are visible on ultrasound or CT scan. Pure uric acid stones may also be suspected on CT scans with an attenuation of approximately 350 Hounsfield units (HU) (most calcium and struvite stones have an attenuation of > 600 HU). Uric acid is poorly soluble at a pH of < 5.5 and solubility increases at a pH of > 6.0. Urine alkalinization with potassium citrate, or alternatively sodium citrate or sodium bicarbonate, will dissolve uric acid stones. Non-uric acid stones (> 90% of stones) cannot be dissolved medically.

## *Treating renal and ureteral calculi*

Renal calculi < 2 cm in maximal diameter are generally best treated by shockwave lithotripsy (SWL). Success varies based on SWL machine, stone size, composition and location. SWL is less successful for renal calculi located in the lower pole compared to other renal locations. A randomized, prospective trial for patients with lower pole stones showed patients are more likely to be stone-free if treated by percutaneous nephrolithotomy (PCNL) than by SWL. Large renal calculi > 2 cm (or > 1 cm in the lower pole) are treated most efficaciously by PCNL, with or without adjunctive SWL (Camilla's case).

**Table 4**
**Options for stone intervention**

- Oral stone dissolution (only for pure uric acid)
- SWL
- Ureteroscopy
- Percutaneous nephrolithotomy
- Open or laparoscopic lithotomy

Retrograde ureteronephroscopy is also an option for renal calculi < 1 cm with stone-free outcomes for renal calculi of 60% to 84% from a single outpatient procedure, but larger stones often require multiple ureteronephroscopy procedures.

*Ureteroscopy is the preferred management option for patients with kidney or ureteral stones in the setting of pregnancy, morbid obesity, or uncorrected coagulopathy.*

The treatment of ureteral calculi is SWL or ureteroscopy. Ureteral stones > 1 cm are generally more effectively treated by ureteroscopy than SWL. For smaller ureteral calculi, proximal ureteral calculi are generally treated by SWL. Ureteral calculi located over the bony pelvis may be problematic for SWL. These stones may be difficult to image and target with shock waves. Ureteroscopy is often required. For distal ureteral calculi, the preferred treatment is controversial. Ureteroscopy is generally more effective than most SWL machines (Parker's case).

Ureteroscopy is the preferred management option for patients with kidney or ureteral stones in the setting of pregnancy, morbid obesity, or uncorrected coagulopathy (George's case).

## Conclusion

Urinary calculi typically present with renal colic and hematuria. The unenhanced CT scan is the best initial diagnostic test. Clinicians should assess the need for urgent intervention and the likelihood for spontaneous stone passage. Urologic intervention must be individualized. Dx

Resources
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