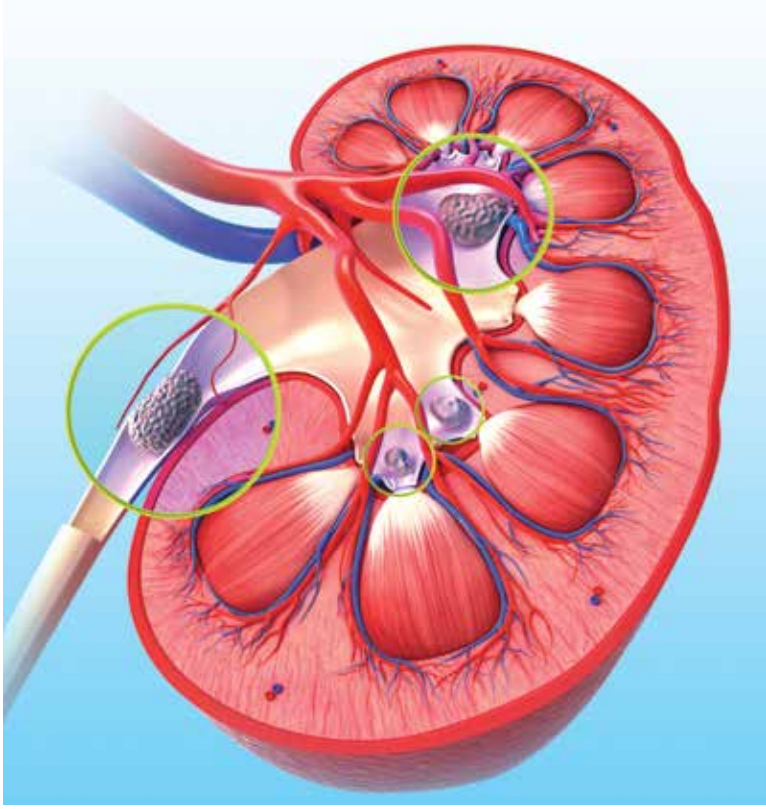
Adult urinary stone disease

A practical approach and management guide



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Urinary stone disease is a common medical condition. Patients with acute stone disease may need admission to hospital for analgesia, intravenous hydration and, in some cases, decompression of the obstructed kidney. Those with nonacute disease should be followed up with serial imaging studies.

Urinary stone disease (nephrolithiasis) is a common medical condition affecting between 4 and 8% of the Australian population at any one time. The reported lifetime risk of developing urinary stones is one in 10 for Australian men and one in 35 for Australian women.[1] Several factors increase the likelihood of developing urinary stones, such as increasing age, a family history of stone formation or certain genetic disorders, and a history of systemic medical conditions such as diabetes.[2,3] After a history of urinary stone, the risk of developing a second stone is approximately 5 to 10% each year. Up to 50% of people with a first urinary stone will develop a second one within five years.[1,3]

With the prevalence of stone disease increasing, it is likely that the healthcare costs associated with diagnosis, treatment and follow up of patients with stones will rise.[4,5]

Most urinary stones are calcium-based stones such as calcium oxalate, calcium phosphate (hydroxyapatite) or mixed stones; other stone compositions include struvite or 'infective' (magnesium ammonium phosphate), uric acid and cysteine. Calcium and uric acid stones are more frequent in men, whereas infectious stones are more common in women. The proposed pathophysiological mechanism of renal stone formation includes supersaturation of urinary solutes, disequilibrium of urinary organic and inorganic inhibitors, overgrowth of urinary crystal (epitaxy) and crystal retention (Randall's plaque).[6]

Clinical presentation

Unlike other acute abdominal conditions for which the diagnosis is readily apparent, stone disease can often be asymptomatic and presents sporadically and intermittently. Asymptomatic urinary stone disease may be discovered during a course of radiographic studies undertaken for unrelated reasons. A patient may not need treatment but can be followed up with serial imaging. Most stones only become clinically apparent when they migrate into the ureter causing urinary obstruction and renal colic.

The most common presentation of urinary stones is renal colic and the typical pain characteristics are paroxysmal severe pain which is often accompanied by nausea, vomiting and occasional blood in the urine. The site of urinary tract obstruction determines the location of pain: an upper ureteral or renal pelvic obstruction leads to flank pain, whereas a lower ureteral obstruction causes pain that radiates to the groin (hence 'loin to groin' pain). In some cases, acute renal failure (obstructed uropathy) and urosepsis (in the setting of urinary tract infection) can occur. A stone in the distal ureter or bladder may result in lower urinary tract symptoms such as urgency, intermittency and dysuria.

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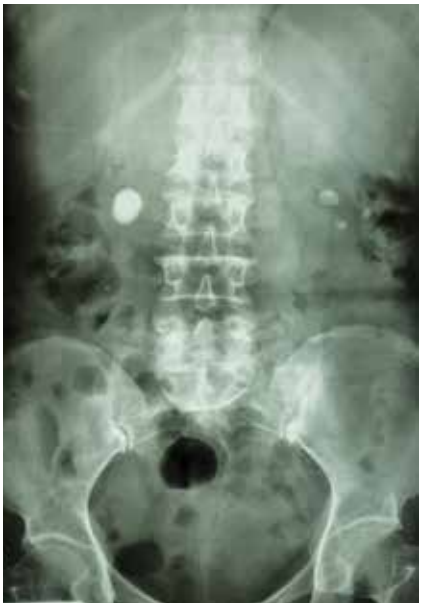

Figure. Bilateral urinary stones (x-ray).

Clinical approach to stone disease

The clinical approach to urinary stone disease depends on whether it is an acute (acute renal colic with or without obstructed uropathy/urosepsis) or a non-acute presentation. For patients presenting with acute renal colic, the imaging modality of choice is low dose noncontrast CT of the kidneys, ureters and bladder to confirm the diagnosis of stone disease and exclude alternative diagnoses such as abdominal aneurysm.[7] Renal tract ultrasound should be offered to pregnant women and obese patients, but it is often difficult to confirm the location of the ureteric stone in these patients. A plain x-ray of the kidneys, ureters and bladder is an inexpensive and easily obtainable imaging test because most stones are partially radio-opaque with the exception of pure uric acid, cysteine and xanthine stones. Intravenous pyelogram or CT with contrast are not routinely performed for the investigation of urinary stones unless there is a need to define anatomical abnormality or no stone is seen on other (non-contrast) imaging tests in the setting of renal colic.[8]

In emergency settings when possible renal failure and/or urosepsis are a concern, the focus of treatment should be on correcting hydration, treating infection and preventing acute renal failure and subsequent renal scarring. Aggressive intravenous fluid hydration is usually not necessary unless the patient is dehydrated and unable to consume fluid orally. Aggressive fluid uptake may exacerbate the degree of ureteric obstruction and result in increased patient discomfort. Analgesics (e.g. NSAIDs or opiates) and antiemetics should be prescribed routinely, with the use of NSAIDs to be avoided in elderly patients, patients with renal failure and pregnant women. Testing for serum electrolytes, creatinine, calcium and uric acid levels as well as urinalysis should be performed routinely.

The location, number and size of stones will influence the likelihood of spontaneous stone passage. Most stones that migrate to the ureter will pass spontaneously provided that they are small (less than 5 mm) and located distally in the ureter. Alpha-blockers such as oral tamsulosin therapy (400 µg/day) have been used off label as medical expulsive therapy and can relax the musculature of the ureter and lower urinary tract, thereby markedly facilitating the passage of ureteral stones.[9] The findings of a systematic review support the use of combination analgesia and alpha-blockers for improving the chance of spontaneous stone passage (in lower ureteric stones) in addition to treating pain and reducing the need for surgical intervention.[10]

Urological intervention with a ureteric stent is indicated in patients with persistent pain, a stone larger than 6 mm, failure of conservative measures to induce stone passage, the presence of urinary tract infection and deteriorating renal function. Patients with a solitary kidney or a coexisting systemic condition with renal impairment or who are immunosuppressed or pregnant should also undergo emergency intervention. Patients in certain occupations, such as airline pilots, or certain circumstances, such as being overseas or in a remote location, will need early intervention. Nephrostomy placement is indicated in the setting of urosepsis or if retrograde stent insertion is not possible.

Definitive stone treatment

Medical dissolution therapy for uric acid and cysteine stones can be considered once the stone obstruction is removed. Potassium citrate is usually preferred over sodium bicarbonate for urinary alkalisation because it is available as a slow-release tablet, it avoids high sodium load and a high urinary citrate level increases the solubility of calcium in urine. The dosage of alkalising agent should be adjusted accordingly to maintain a urinary pH of between 6.5 and 7.0, as higher urinary pH may increase the potential for deposition of calcium phosphate. Cysteine-binding thiol drugs (e.g. captopril or D-pencillamine) can be offered to patients with cysteine stones who are unresponsive to dietary modifications and urinary alkalisation, or who have a large recurrent stone burden.[11] Patients with a cysteine stone should be referred for specialist review and ongoing management.

Therapeutic modalities for urinary stone clearance include extracorporeal shock wave lithotripsy (ESWL), retrograde rigid or flexible ureteropyeloscopy, percutaneous nephrolithotripsy, open or laparoscopic nephro/pyelolithotomy and/or a combination of various therapeutic modalities.[12-14]

Although ESWL is the least invasive treatment option and has low morbidity, stones greater than 1.5 cm or stones located in the lower pole or mid-ureterally are difficult to treat with ESWL and are associated with a lower success rate, based on a recent Cochrane review.[15] Contraindications to ESWL therapy include pregnancy, bleeding diathesis, obstructed stone, significant calcified arteries and/or aneurysms of vessels and presence of cardiac pacemakers. Complications

associated with ESWL include significant pain with the passage of stone fragments ('steinstrasse' occurs in 15% of patients), haematuria, urosepsis and perinephric haematoma (rare).

Retrograde ureteroscopy/pyeloscopy and stone laser lithotripsy have gained increased popularity due to advances in technology such as miniaturisation of instruments with greater deflection capabilities, and wide availability of lasers to treat stones. The efficacy of ureteropyeloscopy in stone clearance is around 90 to 95%.[16] On the other hand, percutaneous nephrolithotripsy is now generally reserved for stones larger than 2 cm (especially staghorn stones) and is usually avoided in obese patients or in patients in whom access is often difficult due to splenomegaly or interposition of the colon.[17] Open or laparoscopic surgery is rarely performed nowadays.

Follow-up care

Dietary and lifestyle factors can impact urinary stone formation because nephrolithiasis results from increased urinary concentration of stone-forming salts and urine volume is a major determinant of the concentration of lithogenic factors.[11,18] Because of insensible losses and varying intake of fluid contained in food, a universal recommendation for total fluid intake is not appropriate. Instead it is recommended that all patients who have had a urinary stone have sufficient fluid intake to achieve a urine volume of at least 2.5 L daily.[11,18]

Follow up for patients with a first incidence of stones will be guided by stone analysis and an abbreviated metabolic evaluation to rule out hyperparathyroidism, renal tubular acidosis and chronic infection with urea-splitting bacteria.[6,11] Patients with recurrent nephrolithiasis and patients at high risk of stone formation (e.g. those with a family history, younger age or medical condition predisposing to stones such as malabsorptive intestinal disorders) should undergo a formal metabolic evaluation.[19,20] Metabolic evaluation consists of one or two 24-hour urine collections (obtained from patients on a random diet) and analysis of total urine volume, pH, and calcium, oxalate, uric acid, citrate, sodium, potassium and creatinine levels.[11]

Patients with calcium stones should limit their sodium intake to no more than 2300 mg, not exceed 1000 to 1200 mg/day of dietary calcium, and increase their intake of fruits and vegetables while limiting nondairy animal protein.[11,21] Depending on the results of stone analysis and metabolic testing, patients with recurrent nephrolithiasis or who are at high risk should be counselled to limit certain minerals in their diet such as oxalate and uric acid. Patients with recurrent calcium stones should be offered medical therapy with, for example, thiazide diuretics and/or potassium citrate; and patients with uric acid and cysteine stones should be offered therapy with potassium citrate and/or cysteine-binding thiol drugs.[2,11,21]

For patients over 40 years of age with a history of a single stone that passed spontaneously or a stone that was easily treated, follow-up care to monitor for recurrent stones may be unnecessary because the chance of further stone formation is low provided that adequate fluid intake is maintained. All other patients, regardless of whether they receive medical therapy, should have periodic follow-up imaging studies with either plain x-rays of the kidneys, ureters and bladder or renal tract ultrasound every six to 12 months to monitor for stone growth and/or new stone formation based on underlying stone activity.[11] If medical therapy is instituted, it is important to monitor patient compliance and adequacy of the metabolic response with urine metabolic testing.

Summary points on the management of adult urinary stone disease are listed in the Box.

SUMMARY POINTS

- Urinary stone disease affects 4 to 8% of the Australian population, and reported lifetime risk ranges from 1 in 10 in men to 1 in 35 in women.
- The classic triad of acute urinary stone presentation is renal colic ('loin to groin' pain), nausea and microscopic haematuria.
- Imaging of choice for patients presenting with acute renal colic is noncontrast CT of the kidneys, ureters and bladder.
- Treatment principles in the acute setting include pain control, intravenous hydration, use of antiemetics and medical expulsive therapy and decompression of the obstructed kidney.
- Definitive stone surgery needs to take into account stone characteristics (size, number and location) and patient's general health and urinary anatomy.
- A follow-up plan should include advice on stone prevention, metabolic screening and six to 12 monthly surveillance imaging.

Conclusion

Urinary stone disease is a common medical condition. Treatment principles for acute stone disease include analgesia control, intravenous hydration, use of antiemetics and medical expulsive therapy and decompression of the obstructed kidney. Definitive stone surgery needs to take into account stone size, number and location and the patient's general health and urinary anatomy. A follow-up plan should include providing advice on stone prevention, metabolic screening in patients who are at high risk of stone formation or who experience recurrent stone formation, and six to 12 monthly surveillance imaging. MT

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A list of references is included in the website version of this article (www.medicinetoday.com.au).

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