Finlay Macneil
Simon Bariol

Urinary stone disease

Assessment and management

Background
Urinary stones affect one in 10 Australians. The majority of stones pass spontaneously, but some conditions, particularly ongoing pain, renal impairment and infection, mandate intervention.

Objective
This article explores the role of the general practitioner in the assessment and management of urinary stones.

Discussion
The assessment of acute stone disease should determine the location, number and size of the stone(s), which influence its likelihood of spontaneous passage. Conservative management, with the addition of alpha blockers to facilitate passage of lower ureteric stones, should be attempted in cases of uncomplicated renal colic. Septic patients require urgent drainage and antibiotics. Other indications for referral and intervention include ongoing pain, renal impairment and stone size unlikely to pass spontaneously. There are many ways to eliminate stones, but laser lithotripsy is being used with increasing frequency. Up to 50% of people with a first presentation of stone disease will have a recurrence within 5 years. General advice for stone prevention consists of increasing fluid intake, especially water (sufficient to maintain dilute urine output), avoiding added salt and maintaining a well balanced low oxalate diet. Some patients may require a more detailed metabolic assessment and specific dietary advice.

Keywords: renal stones; ureteric stones; pyonephrosis; lithotripsy

CPD

Data from the Australian Institute of Health and Welfare showed an annual incidence of 131 cases of upper urinary tract stone disease per 100 000 population in 2006–2007.[1] An upper urinary tract stone is the usual cause of what is commonly called 'renal colic', although it is more technically correct to call the condition 'ureteric colic'.

Importantly, the site of the pain is notoriously inaccurate in predicting the site of the stone, except in the setting of new onset lower urinary tract symptoms, which may indicate distal migration of a stone. The majority of stones only become clinically apparent when they migrate to the ureter, although many are also found on imaging performed for other reasons.[2,3] The best treatment of a ureteric stone is frequently conservative (nonoperative), because all interventions (even the more modern ones) carry risks. However, intervention may be indicated in certain situations.

Investigation

For the patient presenting with ureteric colic, the investigation of choice is noncontrast computerised tomography of the kidneys, ureters and bladder (CT KUB).[4] This offers near absolute sensitivity and specificity in the diagnosis of ureteric and renal stones, irrespective of stone type, with the potential to diagnose alternate pathology if a stone is not identified. Concerns regarding radiation dose are well founded however, and so a plain KUB X-ray should be performed in addition to a CT scan at the time of presentation. If the stone is visible on plain KUB, then this can be utilised for follow up imaging, with a lower radiation dose.[5] Only calcium containing stones are visible on plain KUB X-ray, and this information also has implications for stone management.

Intravenous pyelogram is used rarely in the diagnosis of ureteric colic due to the sensitivity and specificity of noncontrast CT KUB. However, a contrast study (CT urogram) may sometimes be helpful for treatment planning purposes. Ultrasound is generally reserved for the assessment of loin pain in pregnant women or for following patients with uric acid stones, which cannot be seen on a plain KUB X-ray due to their radiolucency. Ultrasound may also be used in follow up to ensure that signs of obstruction (such as hydronephrosis) have resolved after conservative management of ureteric colic, or to monitor stone size in asymptomatic patients. There is no role for magnetic resonance imaging (MRI) in the assessment or management of urolithiasis.

Simple investigations can be used to assess renal function: urea, electrolytes and creatinine; and diagnose and manage sepsis: full blood examination (FBE) and midstream urine microscopy culture and sensitivity (MSU MC&S). However, the white cell count and creatinine are often mildly elevated in uncomplicated ureteric colic. Similarly, a negative urine culture does not exclude upper tract infection in association with high grade upper tract obstruction.[6]

Management

Conservative management

The majority of urinary stones that migrate to the ureter will pass spontaneously. The size of the stone and its location within the ureter are the major factors affecting the probability of stone passage. Up to 70% of stones less than or equal to 6 mm in transverse diameter will pass spontaneously. Recent randomised studies have shown that this increases to 90% with the addition of tamsulosin 400 µg/day to the usual regimen of analgesia for lower ureteric stones.[7] This is a worthwhile addition to conservative treatment regimens for lower ureteric stones, although it is not available on the Australian Pharmaceutical Benefits Scheme (www.pbs.gov.au).

The best analgesia for out-of-hospital care is nonsteroidal anti-inflammatory drugs (NSAIDs) suppositories. Importantly, the limitations of peptic ulcer disease and avoiding patients with chronic renal insufficiency should be kept in mind when considering NSAIDs, even if given rectally. There is no published evidence to support the practice of increasing oral fluids to help spontaneous passage of stones. This only has a place in prevention of further stones.

When following patients with stones to allow spontaneous passage, the issue of silent (asymptomatic) obstruction should be considered, as this can result in permanent loss of renal function. Patients should have repeat imaging after 6 weeks to confirm that their stone has passed.

Interventional management

There are relative and absolute indications for intervention in the setting of renal or ureteric stones. Absolute indications are:

- infection (pyonephrosis)
- renal failure.

Relative indications are:

- ongoing or recurrent pain
- stone larger than 6 mm, unlikely to pass
- occupational/social.

Infection

Fever, or history suggesting fever, raises the possibility of pyonephrosis (infection above an obstructing stone). The obstructed kidney drains by means of calyceal rupture, pyelovenous and pyelolymphatic backflow. Therefore infection in an obstructed system can result in life threatening Gram negative sepsis. Antibiotics alone cannot reliably treat pyonephrosis, and urgent hospital admission for drainage of the upper tract above the stone is required. Previously, percutaneous nephrostomy under local anaesthetic was considered to be the ideal treatment, but this has recently been challenged by a randomised study demonstrating equivalent outcomes from retrograde stenting and percutaneous nephrostomy.8 Patients often find stents uncomfortable and complain of lower urinary tract symptoms. Despite this, stents still play an important role in the management of pyonephrosis. Following drainage and a 1–2 week course of antibiotics, these patients then need to return for definitive management of their stone and removal of the stent. There has been a reluctance of urologists to undertake 'hot' ureteroscopic laser lithotripsy in these patients for fear of worsening endotoxaemia, although the evidence for this is only Level III.[9]

Renal failure

Deteriorating renal function is mainly an issue for patients with a solitary kidney or pre-existing chronic renal impairment. Intervention tends to be offered early in this group of patients, unless they present with a very small distal ureteric stone (ie. one that is likely to rapidly pass spontaneously).

Ongoing or recurrent pain

Patients may choose to have surgery after a trial of conservative management rather than face the prospect of continued pain associated with the passage of a stone.

Large stone

Stones larger than 6 mm in transverse diameter are less likely to pass or will take longer to pass. Patients with large stones may choose early referral for intervention.

Occupational/social

There are a number of occupations (eg. airline pilots) that mandate complete removal of stones from the upper tract before the patient can return to work. Patients who have upcoming important social events or planned overseas holidays, particularly to remote locations, may also elect for early intervention, even for smaller stones.

Definitive treatment of ureteric stones

Currently, most patients with ureteric stones that require intervention will have ureteroscopic laser lithotripsy.[10] The use of pulsed lasers to break up stones has been advocated for 15 years,[11] but such lasers have only become commonly available in Australia in the past 10 years in the private health system, and even more recently in the public health system. New South Wales public hospitals began acquiring lasers in order to expedite the treatment of upper tract stones following the publication of a study on the management of upper tract stones in New South Wales teaching hospitals in 2008.[12] This study showed that most patients who were stented for renal colic waited more than 13 weeks for definitive management.[12] Importantly, beyond 13 weeks there is an increased risk of encrustation of the stent.

Ureteroscopic laser lithotripsy is an effective treatment for ureteric stones and according to a Cochrane review, has a stone-free rate that

is superior to shock wave lithotripsy (SWL).[13] We favour the use of ureteroscopic laser lithotripsy for definitive management of ureteric stones at any level. Transient pain and storage ('irritative') lower urinary tract symptoms may occur after this procedure, especially if a ureteric stent is required. Major complications are rare but include urinary sepsis and ureteric injury. Untreated urinary tract infection is a contraindication to ureteroscopy, as with all forms of stone treatment.

Treatment of stones in the kidney

The presentation of stones in the kidney is usually less dramatic and may include dull loin or back ache, haematuria, urinary tract infections, renal impairment or an incidental discovery on imaging. Treatment is determined by the size, position and composition of the stone(s), in the context of the patient's symptoms and comorbidities. Importantly, the appropriate treatment for asymptomatic renal stones remains unclear,[14] despite investigation into their natural history. It is thought that the large increase in use of retrograde ureterorenoscopy and laser is at least partly attributed to a lowering of the intervention threshold.[10] Certainly removal of stones from the kidney at the time of removal of ureteric stones when patients present with ureteric colic is justified. However pre-emptive treatment of asymptomatic stones should be limited to those likely to become impacted and cause symptoms if they pass (>5 mm). The following sections note the methods most commonly used to treat renal stones and the efficacy, contraindications and complications of each.

Shock wave lithotripsy

Shock wave lithotripsy is the least invasive method of eliminating stones, but also the least effective. The efficacy of SWL depends on:

- stone size – less effective once stone is >1 cm, almost never used for stones >2 cm
- stone position – stone clearance rates from the lower pole are poor, particularly for stones >1 cm (20%).[15] This improves to 75% for stones in the middle and upper calyces.[15]

Complications

- Significant pain with the passage of stone fragments is seen in 15% of patients
- Haematuria is almost universal, but is problematic for less than 1% of patients
- Perinephric haematoma is rare.

Contraindications

- Pregnancy
- Urinary tract infection
- Antiplatelet or anticoagulant drugs
- Abdominal aortic aneurysm
- Abnormalities of drainage from the kidney.

For these reasons, SWL is generally reserved for stones that are not causing any or much trouble at the time of presentation, or for patients with stones inaccessible to retrograde or percutaneous access.

Retrograde uretero pyeloscopic laser lithotripsy

Retrograde uretero pyeloscopic laser lithotripsy has gained increased popularity with the miniaturisation of flexible uretero renoscopes and the wider availability of lasers. Latest generation instruments enable surgeons to explore the entire collecting system and achieve stone clearance rates of around 95% with a single operation for stones up to 1 cm, and 88% for stones 1–2 cm in the lower pole.[16] The technique has a higher complication rate than SWL.

Complications

- Haematuria – very common but problematic in <1% of patients
- Infection in at least 5% of patients
- Postoperative pain
- Ureteric injury – rare but significant.

Contraindications

The only contraindication is urinary sepsis or general contraindications to anaesthesia. Patients on antiplatelet/anticoagulant drugs can continue taking the drugs with little increased risk.

Percutaneous nephrolithotripsy

Percutaneous nephrolithotripsy is now generally reserved for stones larger than 2 cm, and most commonly for staghorn calculi. It has considerably more risks than retrograde lithotripsy, particularly bleeding and sepsis. Patients may have delayed retrograde laser lithotripsy or SWL to 'tidy up' small remaining fragments in calyces not accessible to the percutaneous approach. Patients need an average of three nights in hospital and a week or more off work.

Open nephro- or pyelo-lithotomy

Although open surgery is performed rarely for stone disease nowadays, it remains an effective treatment for staghorn calculi with stone clearance rates of >80%.[17] However, it comes at the cost of a week in hospital, considerable postoperative pain from a loin incision and a 6 week recovery before return to work for most occupations.

Stone prevention

Unfortunately recurrence rates are high following a first presentation with stone disease; up to 50% within 5 years.[18] Medical evaluation often leads to an examination of lifestyle and dietary changes or drug treatments which can prevent recurrence, although the utility and cost effectiveness of the changes is somewhat controversial.

At first presentation with renal colic it is reasonable to perform the following investigations:

- urinalysis
- serum calcium, uric acid and electrolytes
- stone analysis (if available).

However, stone type can also be inferred from the radiological findings. Stone recovery can be aided by instructing the patient to catch all urine in a white ice-cream container and examine for the stone, then

strain the stone out when passed to allow analysis. This improves compliance over straining all urine, which makes a mess and results in poor compliance.

General advice for stone prevention consists of:

- increasing fluid intake, especially water, sufficient to maintain dilute urine output
- avoiding added salt
- maintaining a well balanced diet.

Patients with calcium oxalate stones, which are the most common,[1] should be further advised to keep a low oxalate diet. The majority of published evidence now favours dietary salt and oxalate reduction rather than calcium reduction in these patients.[19,20] The evidence in favour of salt reduction is strongest for patients with hypercalciuria.[21]

Common oxalate rich foods include: tea, chocolate, spinach, beetroot, rhubarb, peanuts, cola, and vitamin C (most supplementary vitamin C is converted to oxalate).

Further investigation

A more detailed metabolic assessment is indicated for the following patients: recurrent stone formers, those with a family history of stones, children <16 years of age, and those with associated gastrointestinal pathology (bypass or ileal resection) resulting in fat malabsorption. This excess fat binds to calcium (saponification) in the gut so the calcium is not available to bind oxalate (which normally prevents absorption of oxalate), thereby allowing increased colonic absorption of oxalate. The assessment includes measurement of serum calcium, uric acid, parathyroid hormone, electrolytes and at least one 24 hour urine study examining volume, calcium, oxalate, uric acid, cystine, citrate and magnesium[22] and enables more specific dietary advice to be targeted to the stone and any underlying metabolic issue. This type of assessment generally occurs in the specialist setting and is beyond the scope of this article.

Summary of important points

- The assessment of acute stone disease should determine the location, number and size of the stone(s).
- Conservative management, with the addition of alpha blockers to facilitate passage of lower ureteric stones, should be attempted in cases of uncomplicated renal colic.
- Septic patients require urgent drainage and antibiotics.
- Indications for referral and intervention include ongoing pain, renal impairment and stone size unlikely to pass spontaneously.
- General advice for stone prevention consists of increasing fluid intake, especially water, sufficient to maintain dilute urine output, avoiding added salt and keeping a well balanced diet. Low dietary oxalate is recommended in patients with calcium oxalate stones. Some patients may require a more detailed metabolic assessment and specific dietary advice.

Authors

Finlay Macneil MBBS(Hons), FRCSEd, FRACS(Urol), is Conjoint Senior Lecturer in Surgery, University of Newcastle and visiting medical officer, Department of Urology, Gosford Hospital, New South Wales. findoc@bigpond.com

Simon Bariol MBBS, BSc(Med), FRACS(Urol), is visiting medical officer, Department of Urology, Westmead Hospital, Sydney, New South Wales.

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correspondence **afp@racgp.org.au**