Bladder and renal stones: management and treatment

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The prevalence of renal tract calculi in the population is such that patients may present acutely not only to urologists, but in the setting of any medical specialty. This article aims to enable all practitioners to be able to recognize the condition and instigate early investigation and management before referring to the urologist for definitive treatment.

Much of the early history of surgery has to do with stone disease, often with disastrous consequences, and hence the exhortation of Hippocrates in his famous oath 'I will not cut for stone even for patients in whom the disease is manifest; I will leave this operation to be performed by practitioners (specialists in this art)'. Until the last 20 years most stones still required open surgery with its attendant morbidity but with the advent of fine fibreoptic instruments, percutaneous renal surgery and external lithotripsy open stone surgery has become rare. Only 1% of stone operations performed by the stone unit at the Institute of Urology (a major referral centre) in 2000 were open cases, the remainder being managed endoscopically or with lithotripsy.

Kidney stones are common. The chance of a white male developing a kidney stone by the age of 70 years is almost 10% and the overall prevalence rate in the Caucasian population is 2–3% (Anderson, 1973; Ljunghall, 1987). The recurrence rate for calcium oxalate stones at 10 years is about 50% (Johnson et al, 1979). This obviously represents a huge social and economic burden and stones will be seen by most doctors in their careers, no matter in which branch of medicine they specialize.

WHY DO STONES FORM?

If the concentration of two ions is gradually increased in a solution, saturation point will eventually be reached, the ions will precipitate and crystallization will occur. The concentration at which this occurs is called the solubility product and is dependent on both temperature and pH. Many ions in urine exist in concentrations above their solubility product and yet crystallization does not occur. This is because urine is composed of a complex solution of both salts and proteins and some of the proteins inhibit crystal formation. In fact it has been found that urine from normal patients can inhibit the setting of cement, whereas that from stone formers does not (Gutman and Yu, 1968). Inhibitors may be organic or inorganic and include citrate, glycosaminoglycans, RNA fragments and magnesium.

The interaction of urinary salt concentration, pH and inhibitor concentration results in the formation of crystals which then aggregate to form small stones. Most stones produced in this manner are still microscopic and are usually flushed out of the urinary tract by the flow of urine. If there are abnormalities in the urinary tract predisposing to urinary stasis or mucosal adherence of these tiny stones, they act as a nidus for further growth and thus lead to clinically evident stones.

STONE TYPES

Below are the five main stone types. In fact many stones are of mixed composition, for example a calcium oxalate stone forming on a nidus of sodium urate.

Calcium oxalate

Around 60–70% of stones are composed of calcium oxalate (Trinchieri, 1996). Only about 50% of patients have hypercalciuria, the rest are normocalciuric and the aetiology of these stones is either an increase in urinary oxalate or a decrease in inhibitor concentrations.

Struvite

Struvite stones make up 15–20% of stones suffered by patients. These stones are made of magnesium ammonium phosphate (sometimes called triple phosphate) and arise as a result of chronic infection with urease-producing organisms.

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Calcium phosphate

Pure calcium phosphate stones are quite rare, accounting for about 10% of stones, and occur in alkaline urine. Renal tubular acidosis should be suspected in these patients. This is a condition in which there is a problem with the ability of the kidney to excrete acid.

Uric acid

Hyperuricaemia may occur idiopathically or in association with gout, and occurs in 5–10% of patients with stones. About 20% of patients with gout have uric acid stones (Howard et al, 1967), which are associated with acid urine.

Cystine

Cystinuria is an autosomal recessive disorder in which there is a problem with the renal tubular handling of cystine. Stones only occur in homozygotes. Cystinuria is responsible for stones in 1% of patients.

PRESENTATION, INVESTIGATION AND EARLY MANAGEMENT OF RENAL STONES

Urinary tract stones may be asymptomatic but they classically present with ipsilateral loin to groin pain, which is colicky in nature and severe. Females will, classically, report the pain to be ‘worse than having a baby’. There is often, but not invariably, associated microscopic or rarely macroscopic haematuria. It is important to rule out conditions which may present in a similar way but have disastrous consequences if they remain undiagnosed. The most important of these are a ruptured abdominal aortic aneurysm or a ruptured ectopic pregnancy. All women of childbearing age should therefore have a urinary β-human chorionic gonadotropin estimation (this is also important from the point of view of imaging, as ionizing radiation should be avoided in pregnant patients).

The investigation of choice for a patient presenting with the symptoms of acute renal colic is a non-enhanced spiral computed tomography (CT) scan (Katz et al, 1996) (*Figure 1*). This has a sensitivity of up to 98% for renal and ureteric stones and allows the detection of other pathologies. Reconstruction films allow an accurate assessment to be made of the size of the stone and an estimate can be made on the degree of obstruction. Unfortunately this facility is still not available in many hospitals in Britain and the next best investigation remains an intravenous urogram (IVU).

The IVU (*Figure 2*) gives information about the size and position of the stone and about the degree of obstruction. It also gives information about stone composition (uric acid stones are radiolucent). In contrast to a CT scan it provides no information about other possible pathologies if no stone is seen and a significant number of patients are allergic to the contrast agent. It also takes longer than a CT scan.

Figure 1. Spiral computed tomography reconstruction showing a urate stone in the mid right ureter. This technique is particularly useful for imaging radiolucent stones.

Figure 2. Intravenous urogram showing a dense right-sided nephrogram and absent ureteric contrast. This indicates complete ureteric obstruction.

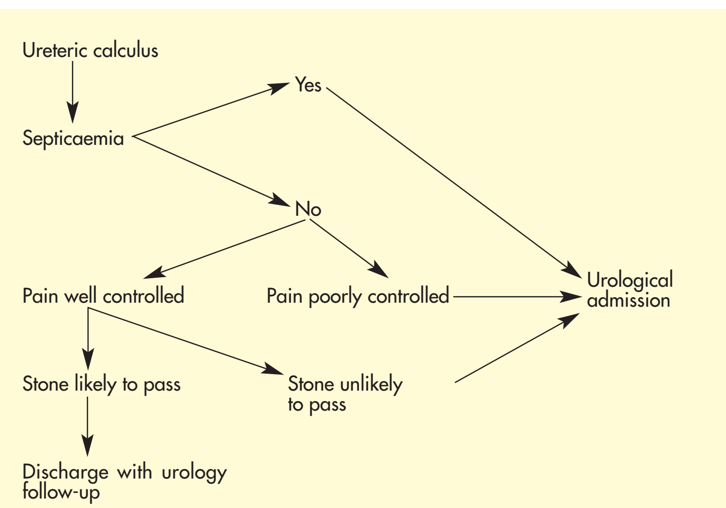
Ultrasound scanning, which is very operator dependent, can usually detect stones in the renal pelvis. Ureteric stones are often not seen but their presence can be inferred by ipsilateral hydronephrosis. Not all stones cause obstruction or hydronephrosis and not all dilated renal pelves are caused by obstruction. An ultrasound is usually accompanied by a plain abdominal film covering the areas occupied by the kidneys, ureters and bladder (KUB film).

The first goal in the immediate management of the patient is pain relief. Non-steroidal anti-inflammatory drugs are very useful (Sandu et al, 1994) (for example, diclofenac suppository 100 mg 16-hourly) but often opiate analgesia is required. If the patient has adequate analgesia and if there is no evidence of infection then he/she may be discharged home with oral analgesia and arrangements made for early follow up. The patient should be advised to sieve the urine so any stones recovered can be sent for analysis. If oral analgesia is not sufficient then the patient will need to be admitted for parenteral analgesia. If the patient has evidence of sepsis (elderly and debilitated patients may not have a high temperature), then it is extremely important to rule out an infected, obstructed kidney. If the patient does have pyonephrosis then urgent drainage is mandatory (usually with a percutaneous nephrostomy).

The degree of obstruction does not necessarily impact on the management of the patient. Many patients have high grade obstruction secondary to small, distal ureteric stones, which have a high chance of passing spontaneously. If these patients get adequate analgesia from oral agents they too can be discharged to be followed up in outpatients. If the stone has not moved after 2 weeks then the patient should either have a renogram, to determine if there is still obstruction present, or early intervention may be considered. This intervention may be external shock wave lithotripsy (ESWL) (although it can sometimes be tricky in the distal ureter), ureteroscopic removal or the placement of a stent or percutaneous nephrostomy tube. High grade obstruction associated with a large stone which is unlikely to pass spontaneously should be managed actively, usually with the placement of a stent or a percutaneous nephrostomy tube in the first instance before more definitive therapy is considered. A simple algorithm for the early management of ureteric stones is given in *Figure 3*.

Further management depends on the size and position and to some degree the type of the stone. This will be discussed in a later section.

Figure 3. Simple algorithm for early management of stones.



FURTHER INVESTIGATIONS IN STONE FORMERS

Additional mandatory investigations in all stone formers are shown in *Table 1*. Further investigation (such as measurement of 24-hour urinary constituents) is rarely helpful in the ongoing management of the stone-forming patient, but is useful in detecting reversible abnormalities which when treated will lead to a decreased rate of further stone formation. Although abnormalities can be detected in most patients with stones, only a few lend themselves to specific treatment and these will, invariably, be detected by the following investigation schedule.

1. Serum calcium: Hyperparathyroidism is a rare but important and surgically curable cause of stone disease which should be looked for in all stone formers.
2. Serum urate: A high serum uric acid level can lead to uric acid stones. It can be treated with allopurinol.
3. Urine culture: Urease-producing organisms can lead to infection stones (struvite). They include *Proteus* and *Klebsiella* among others. Infection stones need to be dealt with surgically and with organism-specific antibiotics. Conversely any patient presenting with a *Proteus* or *Klebsiella*

TABLE 1. Mandatory investigations in stone-formers

Serum calcium
Serum urate
Urine culture
Urine pH
Stone analysis

urinary tract infection (UTI) should have an ultrasound scan and plain film to ensure that they do not have stones.

4. Urine pH: Alkaline urine predisposes to calcium phosphate stones and acidic urine to uric acid stones. It can be difficult to acidify the urine but ammonium phosphate has been used. Alkalization is important in both uric acid and cystine urolithiasis.
5. Stone analysis: This is of course the definitive way to find out exactly what kind of stone is involved and management decisions can be made accordingly.

Patients with large staghorn calculi should have a renogram performed in order to determine the remaining function in that kidney (it will often be normal). If the kidney has less than 10% function then nephrectomy should be considered (see below).

MEDICAL MANAGEMENT OF STONE DISEASE

With few exceptions medical management is preventative. Only uric acid stones (Drach, 1976) and to a lesser degree cystine stones (Pak et al, 1986) can be dissolved with medical therapies. By far the most important non-surgical stone intervention is to increase the patient's fluid intake (Burtis et al, 1994).

General measures

Increased fluid intake: This serves to decrease the concentration of stone-forming salts in the urine and thus reduce the rate of stone formation. In general, enough should be drunk to give a urine output of more than 2000 ml per day. In cystinurics a urine output of 3500 ml per day is recommended and this requires having to wake at night to drink. It is worth taking a proportion of the daily fluid intake as lemonade which contains citrate, an inhibitor of stone formation. Tea contains high levels of oxalate and should be taken in moderation.

Dietary salt reduction: A high sodium load in the renal tubules results in an increased excretion of calcium into the tubular fluid thus increasing the risk of crystallization and stone formation (Burtis et al, 1994).

Moderation of calcium intake: Paradoxically decreasing the calcium intake can actually lead to an increased chance of stone formation. This is because calcium binds to oxalate in the gut and thus prevents the absorption and subsequent urinary excretion of oxalate. High urinary oxalate is an extremely powerful promoter of calcium oxalate urolithiasis. Patients should maintain a moderate calcium intake.

Specific measures

Calcium oxalate stones: Thiazide diuretics reduce the concentration of calcium in the tubular fluid and have been shown to be effective in reducing stone recurrence rates.

Potassium citrate has been shown to be an important inhibitor of calcium oxalate precipitation (Costanzo and Weiner, 1974).

Calcium phosphate stones: These occur in alkaline urine and acidifying the urine may be helpful. Ammonium chloride is usually used. The development of calcium phosphate stones is a risk of alkalinization therapy for cystine and uric acid stones.

Cystine stones: Medical therapies are important in cystinurics. The mainstay of treatment is to encourage the patient to have a high urine output (3500 ml per day). Urinary alkalinization is also important as the solubility of cystine increases markedly at higher pH. Sodium bicarbonate may be used to keep the urine pH above 7.5. In resistant cases inhibitors of cystine binding are used, for example D-penicillamine (Bartter et al, 1965).

Uric acid stones: These occur in acid urine. The solubility of uric acid increases 100-fold as the pH moves from 5.5 to 6.5. Uric acid stones can be dramatically debulked with alkalinization with sodium bicarbonate. Occasionally these stones may be completely dissolved. A high serum uric acid level such as that seen in patients with gout may be treated with allopurinol (Rundles et al, 1969). Allopurinol is not useful in the treatment of uric acid stones unless the patient has a demonstrably high serum uric acid.

Struvite stones: These stones occur because of chronic infection with urease producing organisms. Surgical treatment is the mainstay, and organism specific antibiotics are essential perioperatively. Urease inhibitors may sometimes be useful (Dixon et al, 1975; Griffith et al, 1991).

SURGICAL MANAGEMENT OF STONE DISEASE

There are three major considerations in planning any operative intervention for stone disease.

1. Is the stone amenable to ESWL?
2. If not, what is the best way to get to the stone?
3. What is the best way to deal with the stone once it has been accessed?

External shock wave lithotripsy

This technique, invented in the 1980s, has revolutionized the treatment of stones (Chaussy et al, 1982). It involves the generation of shock waves, which are then focused upon the stone under either ultrasonic or fluoroscopic guidance (*Figure 4*). It can often be carried out without the need for general or regional anaesthesia.

Often two or more treatments are required to effect complete stone clearance.

ESWL is not suitable for all stones. The two most important considerations are the size and position of the stone. Stone composition is of secondary importance. As the size of the stone increases the chance of complete stone clearance decreases. Stones greater than 2 cm are generally considered unsuitable for ESWL. Also as the size of the stone increases there is an increased chance of the large number of stone fragments liberated becoming stuck in the distal ureter and causing renal obstruction (stein strasse) (Coptcoat et al, 1988).

Stone position is also important. Clearance rates are dramatically increased when there is dependent drainage for the fragments. Upper calyceal stones, therefore, are much easier to clear than lower calyceal stones. The intrarenal anatomy must also be considered when considering ESWL. A stone in a calyceal diverticulum or one in a calyx with a long, narrow infundibulum is unlikely to be successfully treated with ESWL. Ureteric stones can generally be treated successfully with high clearance rates in the upper and lower thirds of the ureter. Midureteric stones have a lower success rate because stone visualization can be difficult when the stone overlies the sacrum.

Cystine and calcium phosphate stones can be difficult to fragment with ESWL and uric acid stones are usually radiolucent and therefore not able to be seen fluoroscopically. ESWL is contraindicated in pregnant women.

Figure 4. External shock wave lithotripsy in action.

Stone access

Minimally invasive techniques have now become so sophisticated that open stone surgery is rare. Stones can be accessed either retrogradely using a ureteroscope or anterogradely via a percutaneous tract directly into the kidney.

A ureteroscope is a long thin instrument that can be passed up the urethra and into the ureter to the level of the stone, which can then be dealt with as outlined below. The main risk of ureteroscopy is ureteric perforation and rarely ureteric avulsion. A fine, manoeuvrable flexible ureterorenoscope (*Figure 5*) has recently been developed which allows retrograde access to the renal calyces.

Percutaneous nephrolithotomy (PCNL) involves creation of one or more direct punctures into the collecting system through the patient's back (*Figure 6*). These punctures are then dilated to allow passage of a 24–30F working channel down which a nephroscope can be passed. Different instruments can be passed down the inside the nephroscope to deal with the stone. The main risk of PCNL is bleeding, this is usually venous and stops with tamponade. Occasionally arterial bleeding occurs and embolization is required.

The choice of technique depends on the size and position of the stone. Large upper tract stones including staghorn calculi are best treated percutaneously. Smaller, ureteric stones are usually easily dealt with ureteroscopically.

Figure 5. The flexible ureterorenoscope.

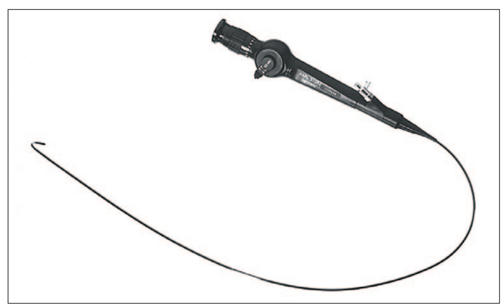


Figure 6. Percutaneous nephrolithotomy used to access a large calyceal stone in a child.

Endoscopic lithotripsy

Once the stone has been accessed there are a number of options available for stone clearance.

Basket retrieval: Wire baskets have been developed which can be passed up the ureteroscope. The stone is snared and is removed as the instrument is withdrawn. Baskets are mostly used in the ureter but special 'zero tip' baskets have recently been developed which can also be used in the kidney itself to retrieve calyceal stones.

Electrohydraulic lithotripsy: This is a non-contact lithotriptor that utilizes electrical energy for stone fragmentation. Its advantage is that it is a fine, flexible wire that can be passed up both the rigid and flexible ureteroscope. Its major disadvantages are that it tends to hit the stone away and that it is relatively easy to perforate the ureter. It has now been superseded by the holmium laser (Watson et al, 1993).

Holmium-yttrium-aluminium-garnet (YAG) laser lithotripsy: These fine laser fibres (200 microns) can be passed up both the rigid and flexible ureteroscope and can accurately deliver an adjustable dose of energy to cause stone fragmentation. Ureteric injury is rare as this is a contact lithotriptor that can be accurately applied to the stone before the pulse of energy is released.

Ultrasonic lithotripsy: Ultrasound is particularly useful in dealing with soft struvite stones. The ultrasonic waves fragment the stone and a built-in suction channel removes the small fragments. It is a rigid and relatively large instrument that cannot be passed up a ureteroscope. Its main role is in treating large, soft infection stones via the nephroscope. It is very safe but tends to generate a significant amount of heat, therefore cold irrigation should be maintained during use. It is excruciatingly slow at fragmenting harder stones.

Lithoclast pneumatic lithotripsy: This device uses a pneumatically powered piston to punch a fine metal rod, which is passed up the rigid ureteroscope or the nephroscope to the stone. The rod is placed against the stone which fragments as it is hit. This is a versatile lithotriptor which can be used for most stone types. Its main disadvantage is that in the ureter it is easy to shoot the stone proximally and thus out of range of the ureteroscope.

Open stone surgery

Rarely a stone will not be amenable to minimally invasive techniques and open surgery is required. The operative approach depends on the position and size of the stone. A ureteric stone is relatively easily treated by making a longitudinal ureterotomy directly over the stone which is then removed with graspers, the ureter being repaired over a temporary indwelling stent.

Renal stones can be more technically demanding. Often an attempt has already been made with one of the less invasive technologies resulting in fibrosis around the kidney. Procedures range from a fairly straightforward pyelolithotomy, where the renal pelvis is opened and the stone removed, to the demanding anatrophic nephrolithotomy in which the kidney is split longitudinally to allow the removal of a large staghorn calculus.

The risks of open stone surgery vary with the procedure. Ureterotomy can result in ureteric stricture formation and there is always the risk of bleeding when operating in the renal hilum (which rarely can lead to nephrectomy). Anatrophic nephrolithotomy can result in the loss of a significant number of functioning nephrons.

Nephrectomy

Large staghorn stones may be associated with minimally or non-functioning kidneys. In this situation it is easier to perform a nephrectomy. Staghorn stones in non-functioning kidneys left untreated are associated with a high mortality rate as a result of infection.

STONE MANAGEMENT STRATEGIES

Infected system

If there is a stone causing obstruction in an infected system then that system needs to be unobstructed as an emergency (no matter what the size or position of the stone). The patient should be given intravenous saline and an intravenous antibiotic which has a strong gram-negative spectrum. The obstruction can be relieved with either a percutaneous nephrostomy tube or by a retrogradely placed stent. The stone does not need to be dealt with until the patient is no longer septic.

Small stone in ureter

Approximately 95% of distal ureteric stones of a size less than 5 mm in diameter will pass of their own accord. The only indication for more active intervention in these patients is the presence of continuing severe pain, despite simple analgesics. As the stone gets larger and more proximal, the likelihood of it passing decreases, and ESWL or ureteroscopic removal may be required.

Calyceal and renal pelvic stones

ESWL has high success rates for stones <15 mm in diameter and in the renal pelvis or upper and midpolar calyces. The success rate for stones in the lower pole calyces is lower and depends on the intrarenal anatomy. For large renal pelvic and lower pole stones PCNL is usually the best option.

Staghorn calculi

Staghorn calculi are large stones which form a cast of the calyceal collecting system and bear a resemblance to the horns of a stag (*Figure 7*). Struvite, uric acid and cystine commonly form staghorn stones. These stones are usually best managed with PCNL and often multiple punctures in the kidney are required. ESWL is sometimes used as an adjunct to clear up small remaining fragments. With struvite stones in particular it is important to obtain full clearance as bacteria are embedded in the stone matrix and the stone will quickly reform if all the fragments are not removed. Very rarely open stone surgery, such as anatrophic nephrolithotomy, is required.

Stones in pregnancy

There is no increased incidence of stones during pregnancy compared to an age-matched population. The problem with stones in pregnancy is related to diagnosis. Obviously the radiation dose must be limited because of the teratogenic potential for the fetus and so the first investigation for a pregnant patient presenting with renal colic is an ultrasound. Ultrasound is, unfortunately, relatively insensitive for ureteric stones and physiological dilatation of the ureters as a result of pregnancy can easily be interpreted as hydronephrosis. Sometimes a nephrostomy or retrograde stent is placed under ultrasound control to see if the patient's pain is resolved even though a definite stone has not been seen. This may be the only form of treatment required while the pregnancy continues to term. Severe pain or intolerance of a stent will precipitate a definitive procedure such as ureteroscopic removal. As previously stated, ESWL is contraindicated in pregnancy.

BLADDER STONES: EPIDEMIOLOGY AND PATHOGENESIS

Bladder stones occur in three broad groups of patients. The first group is third world children where the incidence is thought to be related to malnutrition (Teotia and Teotia, 1972). Indeed paediatric bladder stones used to be common in Britain before the beginning of the 19th century and subsequent dietary improvements. The stones seen in this group of patients are usually composed of ammonium acid urate or calcium oxalate.

The second group of patients is men older than 50 years, who have bladder outlet obstruction, most commonly as a result of benign prostatic hyperplasia, urethral stricture disease or neurogenic problems. Stones occur in this situation because of urinary stasis and this, in association with high urinary salt concentrations, leads to crystal precipitation and aggregation (*Figure 8*). Stasis may also lead to chronic infection with urease-producing organisms and the development of infection stones. Less commonly a stone passed from the kidney into the bladder may act as a nidus for further crystal deposition.

The advent of reconstructive urology and the increasing use of bowel segments in the urinary tract have lead to a third group of patients at risk of bladder stones. The bowel used in reconstruction continues to produce mucus that can act as a nidus for stone formation. These stones tend to be infection stones.

PRESENTATION AND INVESTIGATION

The most common patient seen in Britain with a bladder stone is the adult male with bladder outlet obstruction and the discussion will limit itself to this group of patients. Symptoms may include feelings of urgency and frequency with or without frank haematuria. There may be associated suprapubic pain. There is often sharp penile tip pain because the stone is sitting on the trigone of the bladder. Occasionally the patient may experience a sudden interruption during voiding as the stone obstructs the bladder neck. Stones in the bladder may be asymptomatic.

Diagnosis of a bladder stone may be made with ultrasound scanning, plain abdominal X-ray (this will not pick up pure bladder stones), intravenous urogram (stones will appear as a negative shadow in the bladder film), or cystoscopy.

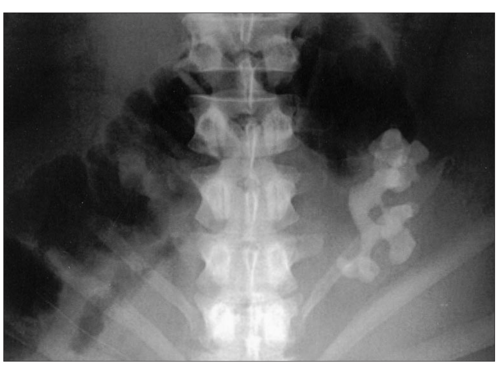


Figure 7. Staghorn calculus.

Figure 8. A large bladder stone.

Further investigation should be directed towards the cause of bladder outlet obstruction. An urine culture should be requested.

TREATMENT OPTIONS AND MANAGEMENT

The choice of treatment of the bladder stone depends on its size. Small stones can easily be removed endoscopically via the urethra. They may either be flushed out or they may require fragmentation which can be accomplished with crushing forceps or a lithoclast. The ultrasonic lithotriptor can be useful for soft infection stones. An advantage of the endoscopic approach is that it allows the cause of the bladder outlet obstruction to be addressed at the same time.

Larger stones can be removed endoscopically. This is sometimes best managed via a percutaneous tract placed suprapubically, but big stones can take a frustratingly long time to deal with in this way and it is often better to make a small suprapubic cystotomy and remove the stone whole. This is also a good option if the patient has a very large prostate and an open prostatectomy can be carried out at the same time.

ESWL has been used to treat bladder stones but does not remove the underlying cause. Multiple treatments are required with painful passage of stone fragments and ESWL for bladder stones is not recommended other than in very selected cases.

CONCLUSIONS

Renal tract calculi are common and may present acutely in any specialty. Rapid diagnosis and early treatment is important in the acute presentation of renal tract calculi so as not to miss obstructing stones which may lead to irreversible loss of kidney function. Initial investigation should include an IVU or ultrasound with KUB film. Spiral CT is the gold standard, but its availability is limited in this country. The decision to admit will depend upon the presence of obstruction, adequacy of pain control and the degree of sepsis. Urine culture and stone analysis should be performed to identify stone type and in recurrent stone formers a full metabolic work-up is essential.

Bladder calculi occur in specific groups of patients and are secondary to an underlying pathology (usually bladder outlet obstruction), which must be treated to prevent recurrence. Management of renal tract stones has both surgical and medical aspects, the former being used to clear the stone and the latter essential to reduce recurrence rates. **HM**

Conflict of interest: none.

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KEY POINTS

- Infected obstructed kidneys need emergency drainage.
- Stones less than 5 mm in diameter will almost always pass spontaneously.
- All stone patients should have a urine culture and urinary pH measured as well as serum calcium and urate. Stones should be sent for analysis.
- Increased oral fluid intake is the single most effective measure to reduce stone formation. Some of this should contain citric acid (e.g. 'real' lemonade).
- Struvite stones need to be managed surgically. If they are not completely removed they will recur.
- Almost all stones can be managed by minimally invasive techniques.
- Non-functioning kidneys with struvite stones need to be removed. There is a high mortality rate associated with leaving these stones in situ.
- External shock wave lithotripsy is contraindicated in pregnancy.
- When treating bladder stones the cause should be identified and also treated.
- If possible, sepsis should be treated before tackling the stone.