Contemporary management of renal stones

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The lifetime risk of developing calculi in the urinary tract is around 10–15% and appears to be increasing. The chance of a subsequent stone after the initial episode in a 10-year period is 50%. The authors describe how contemporary non-invasive and minimally invasive treatments have dramatically changed stone management, making open surgery almost obsolete.

It is common for renal stones to be asymptomatic and found incidentally during investigations for other symptoms. Patients complaining of loin pain may be investigated for stones, but small stones in the kidneys found during these investigations will be difficult to assign as the cause of the symptoms until they are treated. Patients may also present with recurrent urinary tract infections (UTI), haematuria or renal failure.

INVESTIGATIONS

All patients should have a detailed urological history. Risk factors include poor oral fluid intake, low calcium, high salt diets, obesity and low levels of activity. A focused clinical examination with subsequent serum biochemistry, including calcium, urate and urinalysis, is necessary in all patients. Parathyroid hormone (PTH) should be added if primary hypoparathyroidism is suspected.

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Additional metabolic assessment should be considered in high-risk patients, and where there is significant family history or repeated stone formation. Where the stone is available, either after retrieval from urine or during surgical intervention, it should be analysed for composition.

Imaging is central to the diagnosis, treatment and follow-up of renal stone patients. The available modalities in mainstream practice are ultrasound scan (USS), plain X-ray, intravenous urogram (IVU) and non-contrast computerised tomography (CT) scan. Each has its own merits and disadvantages.

USS is a good primary imaging modality that can identify renal stones located in the calyces, renal pelvis and pelvi-ureteric junction. It can also provide information on degree of obstruction. It is the imaging of choice in children and pregnant women. However, although USS avoids radiation exposure, it may not be available at all times of day, is operator dependent and may not identify small calculi.

Plain X-ray is limited by bowel gas pattern and bony structures. It may be more useful for the follow-up of radio-opaque calculi to minimise cumulative radiation exposure from CT.

IVU was previously the gold standard for renal colic, but has now been superseded by unenhanced CT. CT scanning has the advantage of assessing size, location and allowing some prediction of the composition of calculi. Additionally, it provides information on the degree of obstruction and can identify alternative pathologies in case of diagnostic uncertainty.

MANAGEMENT

Kidney stones may often be asymptomatic. Factors considered in treatment decision-making are: stone growth; stones in patients at high risk of further stone formation; presence of obstruction; recurrent UTI; symptoms; patient preference; comorbidities; stones in a solitary kidney; poor renal function; and stone burden >15mm size.

SURVEILLANCE

Surveillance can be appropriate for asymptomatic non-obstructing stones. In a study of 160 stones, Droupin et al found that upper or mid pole stones were more likely to become symptomatic and require intervention. They also found that a small number developed silent obstruction, providing a good argument for follow-up imaging.

Following a retrospective analysis of 177 patients with a staghorn calculus with mean follow-up of 7.7 years, Teichman et al found that renal deterioration occurred in 100% of patients who were not treated in comparison with 28% of those who were treated. This reiterates the message of the key paper by Blandy et al in 1976 that staghorn calculi are not appropriate for conservative management. Both papers were published before percutaneous nephrolithotomy (PCNL) became mainstream treatment.

CASE STUDY

A 73-year-old woman with type 2 diabetes and hypertension presented with left loin pain, haematuria and recurrent UTI. Ultrasound demonstrated a large left renal calculus in the collecting system. A CT scan confirmed a 3.4cm calculus in the left kidney (Figure 1). Additionally, there was a 6mm calculus in the mid pole and a 12 x 7cm cyst in the lower pole. She underwent an uneventful left sPCNL. Complete stone clearance was achieved apart from the mid pole stone. This was subsequently successfully treated with ESWL.

EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY

Introduced in the 1980s, extracorporeal shock wave lithotripsy (ESWL) revolutionised the treatment of stone disease and can be used for 85–90% of adult stones. ESWL is achieved by the generation of shock waves, which are targeted onto calculi, resulting in fragmentation. Shock wave generation may be achieved from an electrode, piezoelectric or electromagnetic sources. Stone clearance is dependent on the lithotripter used, patient body habitus and stone factors (ie size, location and composition). Efficacy is up to 90% for stones less than 2cm but as low as 20% in stones >2cm located in the lower pole calyx. In such cases, other treatment options may therefore be more suitable. Stones located in the lower pole calyx are the most common, but fragments can also collect in the lower poles following treatment of upper and mid pole stones. Both situations are likely a result of gravity, but also the effect of an acute infundibulopelvic angle, and a long and/or narrow infundibulum.
Contraindications to ESWL include pregnancy, abdominal aortic aneurysm and uncorrected coagulopathy or urinary tract infection. Stenting is not a prerequisite, although it may prevent subsequent renal colic or obstruction. Antibiotics are also not mandatory, but should be used in patients with recurrent UTI. Analgesia is essential to minimise patient movement during the treatment and reduce respiratory excursion.

The main disadvantage of ESWL is the need for repeated treatment sessions. The European Association of Urology guidelines recommend that the number of sessions does not exceed five and that the interval between these sessions should be two weeks to allow for recovery of renal contusions. Conversely, there is no consensus opinion on the shock rate or number of shocks delivered; however, it is known that stone disintegration is more efficacious with lower frequency and renal damage is also reduced.

**SURGICAL OPTIONS**

Retrograde intrarenal surgery (RIRS) can be suitable for all patients, provided that they are fit for an anaesthetic. The procedure has advanced with improvements in optical definition and other technical advances. After a safety guidewire is passed to the kidney under fluoroscopic guidance, a preliminary rigid ureteroscopy may be performed. A flexible ureteroscope is then passed either over a working wire or through an access sheath. The use of an access sheath facilitates low intrarenal pressure being maintained throughout the procedure, allows multiple passes and protects the delicate instrument. Laser fragmentation is most commonly used. Follow-up imaging is required as an outpatient.

Percutaneous nephrolithotomy (PCNL) involves achieving percutaneous renal access using a combination of ultrasound and intraoperative fluoroscopic guidance, subsequent dilatation of the tract and access to the kidney via a sheath. A nephroscope is then passed into the renal collecting system and stone fragmentation achieved using ultrasonic, ballistic or laser energy. Pre-operative imaging is essential to plan access and the access itself is paramount to the procedure, in order to allow the most direct approach to the stone but without causing excessive trauma and/or bleeding. Puncture of the centre of the calyx is the safest site. PCNL is most frequently performed in the prone position, which has anaesthetic implications, particularly in patients with cardiopulmonary comorbidities, obesity or difficult airways.

A nephrostomy tube is normally placed at the end of the procedure, but not invariably. Tubeless PCNL describes patients left without a nephrostomy at the end of the procedure, and totally tubeless PCNL refers to patients without either a nephrostomy or ureteric stent. The decision regarding nephrostomy or stent placement is based on several factors, including solitary kidneys, planned repeat procedure, residual stone burden and excessive bleeding. Tubeless procedures in selected patients reduce hospital stay and do not increase the rate of complication or re-admission.

The Clinical Research Office of the Endourological Society (CROES) PCNL global study found that patients with renal anomalies have similar outcomes to the normal situation. The elderly, patients with solitary kidneys and patients with BMI >40, however, are more likely to have lower stone-free rates and encounter more complications.

Since the introduction of PCNL in the late 1970s, considerable effort has been devoted to reducing tract size in order to reduce the invasiveness of the procedure and, consequently, its complications, hence the development of mini PCNL, ultra-mini PCNL and micro PCNL. The latter involves direct vision with a 16G needle, referred to as the ‘all-seeing needle’. The ever decreasing tract size is associated with lower transfusion rates.

PCNL is contraindicated in untreated infection, suspicion of renal cell carcinoma or upper tract transitional cell carcinoma and pregnancy.

**LEARNING POINTS**

- Extracorporeal shock wave lithotripsy (ESWL) is a non-invasive treatment suitable for 85–90% of stones
- Flexible ureterorenoscopy (FURS) may be suitable for patients with stones <2cm who have failed or who have contraindications for ESWL
- FURS and percutaneous nephrolithotomy (PCNL) may also be more appropriate for patients who need a single procedure instead of multiple treatments with ESWL
- PCNL is indicated for stones >2cm, or >1.5 cm if in the lower pole. Reducing tract size has made PCNL more appealing by conferring greater safety whilst offering high stone-free rates
supine procedures. The use of supine PCNL is currently based on an individual patient’s characteristics as well as surgeon experience and preference.

OTHER OPTIONS
In complicated cases it is not unusual to adopt a multimodal approach, either because ESWL as first line has failed or because of complicated anatomy or complicated stone burden. Such management may include ureteroscopy plus PCNL or multi-tract PCNL.

Dissolution treatment, originally used as an alternative to open surgery, is an option for uric acid stones with either oral or direct (via nephrostomy) treatment.

Where considerable morbidity is caused by the presence of renal stone burden and the function provided by the kidney involved is minimal, nephrectomy may be considered appropriate.

Declaration of interests: none declared.

REFERENCES