The septic obstructed kidney: a urological emergency

The septic obstructed kidney is a urological emergency and, as such, prompt diagnosis and management are critical in achieving good outcomes. This article highlights the presenting features, radiological investigation and surgical management of this condition, and compares the two methods of surgical decompression.

Patients with urinary tract obstruction and superimposed infection may present to a range of medical practitioners. This condition carries a significant mortality and it is important to be recognized as an emergency requiring urgent urology input. This article covers the common presenting features of the obstructed, septic kidney, causes of urinary tract obstruction, relevant radiological investigation and initial resuscitation of the patient. Subsequent surgical management is also considered, comparing retrograde and antegrade decompression.

Case scenario

The GP letter read: Thank you for seeing this 35-year-old man who has a 3-day history of mild to moderate left flank pain. His pain initially settled well with non-steroidal anti-inflammatory drugs. However, the patient now reports that he has severe flank pain, feels feverish and feels generally unwell.

On further questioning the patient described a 3-day history of left flank pain radiating to his groin. The pain came on suddenly and was colicky and spasmodic in nature. It had become progressively more severe over the preceding 24 hours. The pain was greatest over the left renal angle. He reported that he had been vomiting with the pain and over the last few hours had felt hot and feverish. Regarding his past medical history, he stated that he may have passed a kidney stone several years ago. There was no other past medical history of note.

On examination, the patient appeared unwell and uncomfortable. He was pale and sweaty. His blood pressure was 105/60 mmHg, heart rate 105 bpm, respiratory rate 28 breaths per minute and temperature 38.5°C. Palpation of the patient's left renal angle elicited severe pain. A urine sample tested positive for microscopic haematuria, leucocytes, nitrites and protein.

Presentation

Important information to ascertain on history taking includes:

- Accurate pain history including radiation and exacerbating or relieving factors – ureteric colic typically starts in the loin and radiates to the groin
- Personal and family history of renal stone disease – there is a 2.5 times greater risk of developing renal stones if a patient has a family history of stone disease (Curhan, 2007)
- Lower urinary tract symptoms including dysuria, foul-smelling urine and haematuria which may indicate a urinary tract infection.

This history suggests that this patient had ureteric colic, and urinalysis findings were in keeping with a urinary tract infection. Symptoms which may indicate an obstructed kidney include loin pain radiating into the groin, associated nausea and vomiting. More worryingly, the patient's symptoms and signs suggested sepsis. Signs of sepsis include warm dilated peripheries, pyrexia, tachycardia, hypotension, decreased urine output and raised respiratory rate.

The classical presentation of the obstructed, infected kidney is the triad of colicky flank pain, fever and hydronephrosis (dilatation of the renal pelvices and calyces).

Diagnosis

What causes urinary obstruction?

There are many causes of urinary obstruction, which can broadly be divided into upper and lower urinary tract causes. Upper urinary tract causes include kidney stones, ureteric strictures, and intraluminal or extraluminal malignancy. Lower urinary tract causes include bladder stones, benign prostatic hypertrophy, malignant disease of bladder and prostate, severe phimosis and urethral stricture.

In children, obstruction is commonly the result of a ureteropelvic junction obstruction whereas in adults, Sidney and Regalado (2006) highlight that urinary tract stones cause obstruction in more than 50% of cases.

Any obstructed kidney is susceptible to a superimposed infection and this is a urological emergency.

Radiological investigations

Radiological imaging plays a key role in the diagnosis of obstruction and investigation of the cause in these patients.

Dr M Arneill *is F1 Trainee,* **Mr DB Hennessey** *is Urology Specialty Trainee and* **Mr AJ Glackin** *is Urology Consultant in the Department of Urology, Craigavon Area Hospital, Portadown, BT63 5QQ*

Correspondence to: Dr M Arneill (marneill01@qub.ac.uk)

Traditionally, the initial radiological investigation consisted of a conventional kidney, ureter and bladder plain film radiograph (*Figure 1*), followed by intravenous urography. These modalities alone can help detect calculi and identify the point of obstruction and its severity (*Figure 2*).

In patients where radiation cannot safely be used (patients with acute renal failure, contrast allergy, pregnant patients) ultrasonography is very useful. It is good at identifying stones in the pelvicalyceal system, stones at the vesico-ureteric junction and screening for secondary signs of obstruction (i.e. hydronephrosis) (Bultitude and Rees, 2010). The National Institute for Health and Care Excellence guidelines recommend that if an obstructed, infected kidney is suspected in the setting of acute kidney injury, immediate ultrasonography of the renal tracts should be offered and performed within 6 hours of assessment (National Institute for Health and Care Excellence, 2013).

Non-contrast computed tomography has become the gold standard method for investigating acute flank pain and has largely superseded intravenous urography as the primary modality for evaluation of these patients, as reflected in the European Association of Urology guidelines on urolithiasis (Türk et al, 2012). It provides a means of rapid examination of patients suspected of having urolithiasis and has the advantages of detecting other pathology and eliminating the nephrotoxic and anaphylactic risk of intravenous contrast. Non-contrast computed tomography can help identify calculi and their location, determine their size, and guide management (*Figure 3*). However, questions remain regarding the optimal use of this technique because of concerns about radiation exposure and cost (Tamm et al, 2003).

Figure 1. Plain kidney, ureter and bladder (KUB) film demonstrating a left ureteric calculus (arrow).

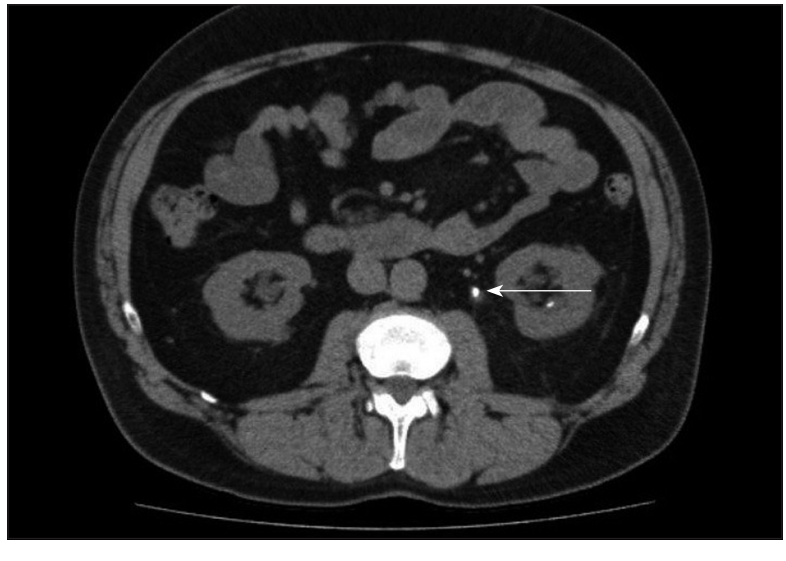
Management

Initial management of the septic obstructed kidney

This clinical situation is an emergency – Kalra and Raizada (2009) showed that the mortality rate from

Figure 2. An intravenous pyelogram allows good visualization of the collecting systems and ureters. Contrast medium is injected intravenously and subsequent X-rays show progression of the contrast as it is excreted by the kidneys and collects in the bladder. This demonstrates an obstructed right collecting system. Notice the dilated right ureter, renal pelvis and calyces.

Figure 3. Non-contrast computed tomography kidney, ureter and bladder (KUB) which demonstrates a left ureteric calculus (arrow).



urosepsis can be as high as 42%. Senior help is advised at an early stage in the management of these patients as they can rapidly deteriorate. It is important to initially resuscitate the patient, counteracting the effects of sepsis. Intravenous access must be obtained, ideally with two wide bore cannulae. Bloods may be taken at this stage and the College of Emergency Medicine (2013) advises urea and electrolytes to assess renal function, full blood picture to assess white cell count and C-reactive protein to assess the degree of inflammation. Coagulation screen should be performed if the need for a nephrostomy tube is anticipated. A fluid bolus of either crystalloid (such as 0.9% normal saline) or colloid may be required to restore the patient's effective circulating volume. It is important to administer intravenous antibiotics. Urinary cultures and blood cultures should be obtained before beginning administration of antibiotics. *Escherichia coli* is the most common pathogen that is isolated from the infected kidney so generally an antibiotic with good Gram-negative cover is considered first line – Arya et al (2010) suggest gentamicin. The patient must be kept under careful observation with regular monitoring of vital signs and urinary output.

Every effort must be made to ensure that the patient's pain is managed. The choice of analgesia used in the management of acute ureteric colic is changing, with increasing use of non-steroidal anti-inflammatory drugs (Bultitude and Rees, 2010). Most studies have shown these drugs to be as effective as opioids, with opioid analgesia used if pain is not adequately controlled. Opioids are associated with a significant burden of side effects including nausea, vomiting and dizziness. The British Association of Urological Surgeons section of endourology (2012) guidelines suggest oral or parenteral diclofenac as first-line treatment, although choice will depend on local policy. If an opioid is needed, it is recommended that pethidine is not used, owing to a high incidence of vomiting with its use.

Data on the effect of opiates on ureteric tone suggest that they cause an increase or no change in tone. Non-steroidal anti-inflammatory drugs inhibit prostaglandin-induced effects. This has the benefit of reducing local oedema and inflammation. They also inhibit the stimulation of ureteric smooth muscle, which reduces peristalsis and subsequent increased ureteric pressure. Although non-steroidal anti-inflammatory drugs reduce pain associated with ureteric colic, a consequence of prostaglandin inhibition is a reduction in the kidney's autoregulatory response to poor renal blood flow. This may act as a precipitant of acute kidney injury, particularly in those patients with pre-existing renal disease.

Subsequent management

Prompt surgical intervention is required to drain the infection from the obstructed renal pelvis. The National Institute for Health and Care Excellence (2013) guidelines recommend that when nephrostomy or stenting is used to treat upper tract urological obstruction in adults, children and young people with acute kidney injury, this should be within 12 hours of diagnosis. The affected renal pelvis may be accessed by either the bladder and lower end of the ureter (retrograde) or percutaneously (antegrade). Retrograde decompression is achieved by retrograde ureteric stent insertion – this involves visualizing the ureteric orifices using a cystoscope and passing a JJ stent into the affected ureter (*Figure 4*).

A ureteric stent makes a channel for urine to pass into the bladder, allowing the renal pelvis to drain. Ryan et al (1994) demonstrated that acute effects of ureteric stent insertion include raised renal intrapelvic pressure, and reduced pelvic and ureteric motility. This raised intrapelvic pressure resolves with time, but changes in both renal and ureteric motility are persistent. A nephrostomy does not cause these effects.

Antegrade decompression is achieved with a percutaneous nephrostomy tube placement. This involves the passage of a nephrostomy tube through the skin into the renal pelvis under ultrasound guidance.

There are a number of contraindications to surgical decompression, as highlighted by Hautmann and Leveillee (2013). Patients with untreated infections, that is those septic patients who have not been adequately resuscitated or given initial antibiotic therapy, should not have a procedure. Other contraindications include bleeding diathesis (thrombocytopenia, haemophilia), uncontrolled hypertension and concurrent use of anticoagulants such as warfarin.

Figure 4. Plain kidney, ureter and bladder (KUB) radiograph demonstrating a left ureteric stent in situ.

Patients may develop severe sepsis following surgical intervention for removal of any obstruction. Chen et al (2008) describe the catastrophic development of a systemic inflammatory response and severe sepsis using their experience of percutaneous nephrolithotomy. This potential complication should be anticipated and lead to adequate patient monitoring post procedure with supportive therapy if required.

The cause of obstruction will influence the method used to manage the obstruction. No definitive guidelines currently exist for the treatment of malignant ureteric obstruction and treatment options are decided on a case-by-case basis. The goal of treatment may be to provide symptom relief, avoid complications from deterioration in renal function or facilitate further systemic oncological therapy. Ureteric stents tend to have a higher failure rate than nephrostomy tubes as a result of external compression. When this is anticipated, such as in advanced abdominal malignancy, percutaneous nephrostomy drainage should be preferred. Allen et al (2010) point towards the potential benefit of metallic stents because they lead to better relief of obstruction with fewer side effects and increased interval between changes.

Which is superior: nephrostomy or retrograde stenting?

There is much debate regarding the optimal method of decompressing the renal collecting system. Ramsey et al (2010) showed there was no significant difference in the time to treatment between the two methods or length of patient stay. However, each method has advantages and disadvantages.

Retrograde decompression

Advantages

A urologist can perform the procedure and there is no requirement for a radiologist. There is no risk of injury to organs adjacent to the kidney, and a nephrostomy bag is not required.

Disadvantages

Retrograde decompression includes the need for general anaesthetic. The JJ stent may be associated with increased irritative urinary symptoms and a higher chance of local discomfort, as highlighted by Joshi et al (2002). This is supported by Mokhmalji et al (2001) who reported that a reduction in the patient's quality of life is more pronounced in patients with stents compared to nephrostomies.

Intraoperative backflow of infected urine into the systemic circulatory system is always a risk with retrograde manipulation. This may result in iatrogenic sepsis and the patient deteriorating.

Antegrade decompression

Advantages

This can be performed under local anaesthetic, thus removing the additional risks of a general anaesthetic.

Antegrade decompression permits antegrade treatment of obstructing stone(s) and antegrade radiographic studies often help with treatment planning once the patient is stable.

Disadvantages

There is a risk of renal trauma, and it is a difficult procedure in patients with a large body habitus or mild hydronephrosis that makes localization with ultrasonography challenging.

Patients with nephrostomies tend to require more help with the daily care of the nephrostomy tube than patients with ureteric stents (Pearle et al, 1998; Joshi et al, 2001).

Conclusions

The classical presentation of the obstructed, infected kidney is the triad of colicky flank pain, fever and hydronephrosis. Obstruction can be demonstrated by a number of radiological investigations. This is a urological emergency as urosepsis has a high mortality rate. The patient requires immediate resuscitation and subsequent drainage of the infected renal pelvis.

Decompression of the obstructed kidney is achieved by one of two methods, either retrograde ureteric stent insertion or percutanous nephrostomy placement. Further research is needed to identify the optimal method. **BJHM**

Conflict of interest: none.

Allen DJ, Longhorn SE, Philp T, Smith RD, Choong S (2010) Percutaneous urinary drainage and ureteric stenting in malignant disease. *Clin Oncol (R Coll Radiol)* **22**(9): 733–9

Arya M, Shergill, I, Kalsi J, Muneer A, Mundy A (2010*) Viva Practice for the FRCS (Urol) Examination.* Radcliffe Publishing, Oxford

British Association of Urological Surgeons section of endourology (2012) Guidelines for acute management of first presentation of renal/ureteric lithiasis. www.baus.org.uk/Resources/BAUS/

KEY POINTS

- The classical presentation of the septic, obstructed kidney comprises the triad of renal colic, fever and hydronephrosis.
- Non-contrast computed tomography is the gold standard method for investigating acute flank pain.
- Initial resuscitation of the patient is followed by prompt surgical decompression with percutaneous nephrostomy placement or retrograde ureteric stenting.

Documents/PDF%20Documents/Sections/Endourology/Revised%20Acute%20Stone%20Mgt%20Guidelines.pdf (accessed 16 January 2014)
Bultitude M, Rees J (2010) Management of renal colic. *BMJ* **345**: 30–5
Chen L, Xu Q-Q, Li J-X, Xiong L-L, Wang X-F, Huang X-B (2008) Systemic inflammatory response syndrome after percutaneous nephrolithotomy: An assessment of risk factors. *Int J Urol* **15**: 1025–8
College of Emergency Medicine (2013) Clinical standards for Emergency Departments. www.collemergencymed.ac.uk/code/document.asp?ID=4688 (accessed 16 January 2014)
Curhan GC (2007) Epidemiology of stone disease. *Urol Clin N Am* **34**: 287–93
Hautmann S, Leveillee R (2013) Nephrostomy. http://emedicine.medscape.com/article/445893-overview#a05 (accessed 13 January 2014)
Joshi HB, Adams S, Obadeyi OO, Rao PN (2001) Nephrostomy tube or 'JJ' ureteric stent in ureteric obstruction: assessment of patient perspectives using quality-of-life survey and utility analysis. *Eur Urol* **39**: 695–701
Joshi HB, Okeke A, Newns N, Keeley FX Jr, Timoney AG (2002) Characterization of urinary symptoms in patients with ureteral stents. *Urology* **59**(4): 511–16
Kalra OP, Raizada A (2009) Approach to a patient with urosepsis. *J Glob Infect Dis* **1**: 57–63
Mokhmalji H, Braun PM, Martinez Portillo FJ, Siegsmund M, Alken P, Kohrmann KU (2001) Percutaneous nephrostomy versus ureteral stents for diversion of hydronephrosis caused by stones: a prospective, randomised clinical trial. *J Urol* **165**(4): 1088–92
National Institute for Health and Care Excellence (2013) Acute kidney Injury: Prevention, detection and management of acute kidney injury up to the point of renal replacement therapy. http://guidance.nice.org.uk/CG169 (accessed 16 January 2014)
Pearle MS, Pierce HL, Miller GL et al (1998) Optimal method of urgent decompression of the collecting system for obstruction and infection due to ureteral calculi. *J Urol* **160**: 1260–4
Ramsey S, Robertson A, Ablett MJ, Meddings RN, Hollins GW, Little B (2010) Evidence-based drainage of infected hydronephrosis secondary to ureteric calculi. *J Endourol* **24**: 185–9
Ryan PC, Lennon GM, McLean PA, Fitzpatrick JM (1994) The effects of acute and chronic JJ stent placement on upper urinary tract motility and calculus transit. *Br J Urol* **74**(4): 434–9
Sidney P, Regalado MD (2006) Emergency Percutaneous Nephrostomy. *Semin Intervent Radiol* **23**(3): 287–94
Tamm EP, Silverman PM, Shuman WP (2003) Evaluation of the patient with flank pain and possible ureteral calculus. *Radiology* **228**: 319–29
Türk C, Knoll T, Petrik A, Sarica K, Straub M, Seitz C (2012) Guidelines on urolithiasis. www.uroweb.org/gls/pdf/20_Urolithiasis_LR%20March%2013%202012.pdf (accessed 16 January 2014)