The management of acute renal colic

Patients frequently present to emergency departments in the UK with acute renal colic. The condition affects 5–15% of the population at some point, with a yearly incidence of 0.3% in the UK, causing significant morbidity and potentially requiring emergency intervention. Awareness of the latest advice and guidelines concerning the presentation, investigations, medical and surgical management of renal colic will allow an optimal quality of care. Knowledge of the red flag symptoms and consideration of other significant differential diagnoses allows rapid and early intervention to prevent further complications. It is therefore essential for junior doctors to be aware of the latest guidelines and advice in managing patients with renal colic in the acute setting.

Introduction

The term renal colic is generally used to describe acute and severe loin pain caused by renal stones obstructing urinary flow (Stewart and Joyce, 2008). The term renal colic is somewhat of a misnomer. Although commonly used, it is only when stones pass into and obstruct the ureter that they cause colic, and consequently ureteric colic is probably the correct term. This also fits with the definition of colic, which is spasmodic pain from a tubular hollow viscus. However, in this article the term renal colic will be used as it is the more commonly recognized terminology.

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Renal colic is a common cause of morbidity, with an annual incidence of 3 cases per 1000 people. It has been estimated that 12% of men and 6% of women will have one episode of renal colic at some stage in their life (Curhan, 2007).

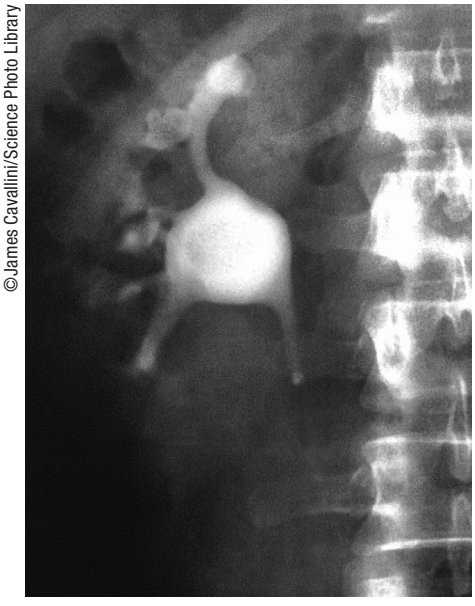
Causes of renal colic

While the most common cause of renal colic is stones (*Figure 1*), blood clots (from upper tract bleeding) or sloughed renal papillae (which can occur in patients with diabetes, sickle cell disease or long-term analgesia use) must also be considered (Bultitude and Rees, 2012).

The basis of stone formation is the aggregation of crystals in supersaturated urine which then adhere to the urothelium. Eighty per cent of all stones contain calcium, most commonly as calcium oxalate (60%) and calcium phosphate (20%). Uric acid stones make up 7% of all cases of renal colic, with a higher proportion in patients with metabolic syndrome (Bultitude and Rees, 2012). Other types include cysteine and struvite stones (a mixture of magnesium, ammonium and phosphate – the 'triple-phosphate' stone). *Table 1* summarizes the most common types of renal stone.

There is a higher incidence of stone formation in warmer climates, which is likely to be the result of dehydration and sunlight exposure (*Figure 2*). Obesity and a genetic predisposition to stone formation have also been implicated. Stones usually obstruct at one of three sites: the vesicoureteric junction, in the mid-ureter where the ureter crosses the iliac vessels and the pelvi-ureteric junction (Bultitude and Rees, 2012). Complications of renal stones include ureteric strictures, irreversible kidney damage and potentially life-threatening sepsis. Therefore, it is essential to be aware of the most up to date recommendations for managing renal colic in the acute setting.

Figure 1. Abdominal X-ray in a patient with renal colic with very severe pain from the lumbar region to the genitals. This pain is from an obstruction of the upper urinary tract, most often from kidney stones (urolithiasis) between the kidney and bladder.



How does renal colic present?

The classical presentation of renal colic is acute, intermittent flank pain radiating to

Table 1. The most common composition of renal stones

Stone composition	% of all stones
Calcium oxalate, phosphate or both	70–80
Uric acid	5–10
Struvite (magnesium ammonium phosphate)	5–15
Cystine	1
Other (e.g. xanthine, guaifenesin)	1

Figure 2. The stone belt – characterized by a urinary stone prevalence of 10–15%.

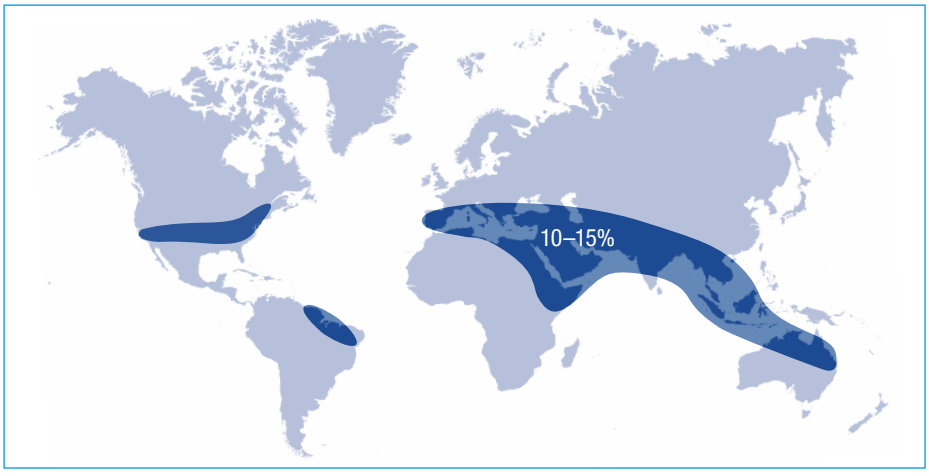
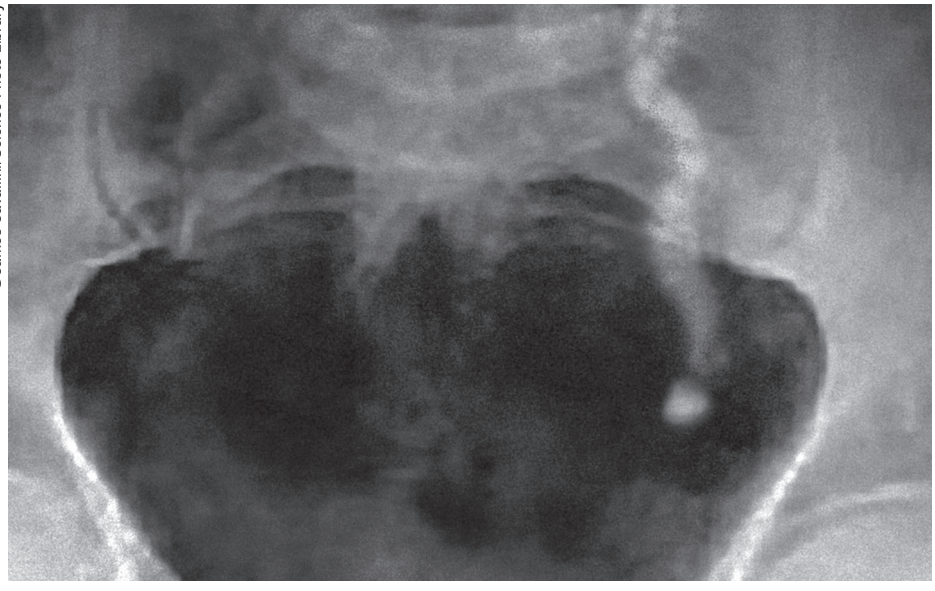


Figure 3. X-ray of the pelvis, showing renal colic caused by urolithiasis in the left ureter.



the groin or scrotum (Badalato et al, 2016). Intermittent pain occurs as a result of renal capsular distension and ureteric smooth muscle contraction lasting minutes to hours, interspersed with pain-free intervals (Pickard et al, 2015). The severity of pain does not relate to the size of the stone and is often accompanied by nausea, vomiting and haematuria (Bultitude and Rees, 2012). As the stone descends the ureter, pain may localize to the abdomen overlying the stone (*Figure 3*). Patients are usually restless and cannot get comfortable, unlike in peritonitic conditions where patients tend to remain completely still. Signs of sepsis, including fever, tachycardia and hypotension, may indicate an obstructing stone with infection, necessitating urgent urology referral. Lower urinary tract symptoms such as dysuria, urgency and frequency may occur once the stone reaches the vesicoureteric junction, as a result of detrusor muscle irritation (Bultitude and Rees, 2012).

Physical examination often reveals costovertebral angle or lower abdominal tenderness. The latter may represent referred testicular pain, so the scrotum must also be examined. Assessment should include measurement of vital signs, as altered observations of temperature, heart rate or respiratory rate may indicate the necessity for acute intervention (Turk et al, 2018).

Bedside investigations

The British Association of Urological Surgeons and European Association of Urology recommend that all patients undergoing investigation for renal colic should have urine dipstick testing (Tsiotras et al, 2017; Turk et al, 2018). The presence of nitrites, with or without leukocytes, may indicate a urinary tract infection. Thus a midstream sample should be sent for microscopy culture and sensitivity. The presence of haematuria helps to support the diagnosis, but a negative result does not exclude the diagnosis (Eisner et al, 2009). Microscopic urinalysis may reveal crystals, which may be representative of cystinuria, oxaluria or uricosuria.

The British Association of Urological Surgeons and European Association of Urology recommend that measurement of the full blood count, serum electrolytes, creatinine, C-reactive protein, uric acid and calcium levels should be undertaken (Tsiotras et al, 2017; Turk et al, 2018). A coagulation screen should be performed if intervention is required. *Table 2* summarizes the investigations that should be performed in all patients with suspected renal colic.

Radiological investigations

The gold standard radiological investigation for diagnosing urolithiasis is non-contrast enhanced computed tomography (computed tomography of the kidneys ureters and bladder), because of its high

Table 2. Investigations for suspected renal colic

Urine	■ Dipstick ■ Midstream urine for microscopy, culture and sensitivity (if urine dipstick is leucocytes and nitrites +ve)
Blood	■ Full blood count ■ Urea and electrolytes (sodium, potassium, creatinine) ■ C-reactive protein ■ Calcium ■ Uric acid
Computed tomography of the kidneys ureters and bladder	

TOP TIPS

- Start the patient on non-steroidal anti-inflammatory agents with paracetamol – ensure that there are no contraindications.
- Advise the patient to increase his/her water intake to 2–3 litres/day. If compliance is difficult, advise increasing oral fluids to maintain colourless urine.
- Arrange an urgent non-contrast computed tomography scan of the abdomen.
- Should the patient develop a fever (>38°C) or other signs of sepsis, promptly arrange admission to hospital and start intravenous antibiotics as per hospital guidelines.
- Check electrolytes, creatinine and estimated glomerular filtration rate at admission.

sensitivity (97%) and specificity (95%) (Tsiotras et al, 2017; Rodger et al, 2018). This study has surpassed the intravenous pyelogram, which had been the standard imaging of choice.

A plain abdominal radiograph (of the kidneys ureters and bladder) is a useful adjunct to a positive computed tomography scan, as it allows the establishment of radio-opacity, allows disease activity monitoring in the future and determines whether extracorporeal shockwave lithotripsy can be considered. Renal ultrasound can be used to diagnose renal stones, particularly in pregnancy or other situations where avoiding radiation exposure is advised, but is not routinely recommended because of its low sensitivity. However, it has been shown to be useful in diagnosing intramural and bladder calculi.

Differential diagnosis and red flags

The underlying cause of acute flank pain is not always ureteric calculi, with many other conditions mimicking this. A thorough history and examination are required to determine further management, with an emphasis on signs and symptoms that may warrant acute hospital admission – namely infection and obstruction. Pyelonephritis must be considered in those with a fever and a tender kidney. In men over 50 years of age with the first presentation of suspected renal colic, a ruptured aortic aneurysm must be excluded. The testes must also be examined as, rarely, scrotal pathology may present solely with abdominal pain. Diverticulitis (left-sided pain) and appendicitis (right-sided pain) must also be considered in the initial management. In young women, ovarian pathology (rupture or torsion) and ruptured ectopic pregnancy may present similarly.

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Management

The management of acute renal colic must involve symptom management, consideration of the need for immediate hospital admission, medical expulsion therapy and active intervention.

Symptom management

European Association of Urology guidelines recommend non-steroidal anti-inflammatory drugs as the preferred analgesia in acute renal colic (Turk et al, 2018). Several large systematic reviews and meta-analyses have shown that non-steroidal anti-inflammatory drugs have a longer duration of efficacy, reduced need for further analgesia and fewer side effects compared to opioids and paracetamol (Afshar et al, 2015; Pathan et al, 2018). Non-steroidal anti-inflammatory drugs should be used as the first line in all except those with a specific contraindication (known or suspected renal impairment, history of peptic ulceration or asthma) (Afshar et al, 2015). They work by inhibiting prostaglandin-mediated pain pathways and decreasing ureteral contractility or peristalsis (Holdgate and Pollock, 2004). The National Institute for Health and Care Excellence (2015) recommends the use of diclofenac (oral, per rectal or intramuscular preparations), and suggests that a parenteral anti-emetic such as ondansetron or metoclopramide can be given for relief of nausea or vomiting.

The guidance regarding the use of alpha-blockers as part of medical expulsion therapy for conservative stone management remains controversial and debatable (Tsiotras et al, 2017). Meta-analyses of randomized controlled trials have traditionally advocated for the use of an alpha-blocker (typically tamsulosin 400 µg) to reduce pain, result in a quicker stone passage and a higher rate of stone passage overall (Pickard et al, 2015). This evidence is supported by European Association of Urology guidelines which recommend the use of tamsulosin as medical expulsion therapy for distal ureteral stones >5 mm in size (Turk et al, 2018). However, a large, multicentre, randomized, placebo-controlled trial with 1136 participants found that neither tamsulosin 400 µg nor nifedipine 30 mg is effective at decreasing the need for further treatment to achieve stone clearance in patients with renal colic (Pickard et al, 2015). Should tamsulosin be considered, it is essential to consider and discuss the side effects of alpha-blockers, which include postural hypotension and headache, with patients.

Conservative or immediate intervention?

Emergency surgical intervention is indicated in four situations:

1. The presence of an obstructed infected kidney
2. Obstruction of a solitary kidney
3. Bilateral obstruction
4. Uncontrolled pain (Bultitude and Rees, 2012).

Patients with urinary calculi along with fever and other signs or symptoms suggesting infection in an obstructed system need immediate urological consultation to re-establish urinary drainage and for intravenous antibiotics (Antonelli and Maalouf, 2018). Failure to do so may perpetuate urosepsis and result in mortality. The European Association of Urology suggests that drainage can be accomplished in two equally efficacious ways: either an indwelling ureteric double J stent can be inserted by a urologist to bypass the obstruction (in relatively stable patients), or a percutaneous nephrostomy tube can be inserted by interventional radiology under local anaesthetic (Turk et al, 2018). European Association of Urology and British Association of Urological Surgeons suggest that definitive management can be delayed until the sepsis is resolved, with subsequent ureteroscopy being undertaken within 4 weeks to minimize patient morbidity and mortality (Tsiotras et al, 2017; Turk et al, 2018).

KEY POINTS

- Urolithiasis is the most common cause of renal colic.
- The classic presentation is acute colicky flank pain radiating to the groin with associated nausea and vomiting. These symptoms may mimic other significant causes of pain such as an abdominal aneurysm, or testicular or other abdominal pathology.
- Urine dipstick and a blood sample for full blood count, and levels of urea and electrolytes, calcium, uric acid, C-reactive protein and markers of sepsis should be taken.
- The gold-standard imaging is non-contrast enhanced computed tomography.
- The best initial analgesia is non-steroidal anti-inflammatories with paracetamol, with opioids as the second-line treatment.
- Stones <5 mm are likely to pass spontaneously, with evidence for medical expulsion therapy having divided opinions.
- Patients with obstruction or sepsis should undergo immediate intervention with either percutaneous nephrostomy or retrograde stent insertion.

The National Institute for Health and Care Excellence (2015) guidelines state that small stones (of <5 mm) are likely to pass spontaneously within 1–2 months of the onset of symptoms. Thus, for most patients (approximately 75%) without reasons for prompt intervention to drain the affected kidney, management can be conservative. Conservative management consists of pain relief, antiemetics, dietary modification and increased fluid intake to prevent future episodes. Once the pain is controlled, care can continue at home with oral analgesics with a planned reassessment at approximately 4 weeks (usually at a stone clinic) to assess whether spontaneous stone expulsion has occurred (Pickard et al, 2015). Reasons for changing to active management include poor pain control, the onset of systemic infection or concerns regarding deterioration of kidney function (Pickard et al, 2015).

Active stone management

The decision to actively treat a stone depends on its size, location, pain intensity, treatment availability and patient preference. Definitive removal of a stone can be achieved in three ways: extracorporeal shockwave lithotripsy, fragmentation with ureterorenoscopy or percutaneous nephrolithotomy.

Extracorporeal shockwave lithotripsy is a non-invasive ambulatory treatment which uses shockwaves focussed on the stone from outside the body. These shockwaves break the stone without damaging surrounding tissues, with the stone particles then passing spontaneously (Bultitude and Rees, 2012).

Ureterorenoscopy allows direct visualization of stones by passing a small calibre endoscope (ureteroscope) up the ureter from the bladder. The stone can then be extracted whole or fragmented in situ with a variety of energy sources (often laser) and removed in pieces with a range of baskets (Miller and Lingeman, 2007). Ureterorenoscopy allows a greater certainty of stone removal but does involve a hospital admission and general anaesthetic (Pickard et al, 2015).

Percutaneous nephrolithotomy is usually considered when extracorporeal shockwave lithotripsy or ureterorenoscopy is unsuitable. Percutaneous nephrolithotomy is usually indicated for stones larger than 20 mm, staghorn and partial staghorn calculi (Preminger et al, 2005). The contraindications for percutaneous nephrolithotomy include pregnancy, bleeding disorders and uncontrolled urinary tract infections. A nephroscope is passed through a percutaneous puncture into the renal collecting system, and the stone is fragmented and extracted through the nephroscope (National Institute for Health and Care Excellence, 2015).

Conclusions

Acute renal colic is a frequent presentation to the emergency department in the UK causing significant morbidity and may require emergency surgery. It is paramount that diagnoses other than urolithiasis are considered in a patient presenting with loin to groin pain. Usually, computed tomography of the kidneys ureters and bladder is helpful in elucidating the cause of the pain. Awareness of red flags such as sepsis and renal functional impairment require rapid and early intervention to prevent further complications. It is therefore essential for junior doctors to be aware of the latest guidelines in managing such patients. **BJHM**

Conflict of interest: none.

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