The management of renal colic

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Abstract

Renal colic can be a challenging cause of abdominal pain in the military population. This review highlights the management of renal colic in the Royal Navy’s operational setting. It provides an overview of the diagnosis, treatment options and occupational health issues in the deployed (Role 1) and hospital environments (Role 2 and 3).

Introduction

Renal colic is the pain experienced when a ureter becomes obstructed. The most common cause of renal colic is ureteric stones; other causes include external compression by a mass and internal obstruction by blood clots or sloughed renal cells. Around 80% of renal stones are made up of either calcium oxalate or calcium phosphate and, as calcium is radio-opaque, are visible on plain radiography. The remainder are usually made up of uric acid or magnesium ammonium phosphate; these stones, if pure, are radio-lucent. If these stones have some calcium content they may appear faintly opaque on plain imaging (1).

Most stones form within the calyces or renal pelvis. Renal colic occurs if the stones dislodge, migrate along the ureter and impact at a ureteric narrowing. Most commonly this occurs at one of three points along the ureter: the pelvi-ureteric junction (PUJ), the mid-ureter where it crosses the iliac vessels, or the vesico-ureteric junction (VUJ). The resultant obstruction and irritation may result in pain and proximal hydroureteronephrosis (distension and dilatation of the ureter, renal pelvis and calyces).

The UK life-time risk of renal colic is around 10%, with an annual incidence of renal colic of 1 to 2 per 1000 and a 3:1 male to female ratio (2). Both individual and environmental factors can pre-dispose to renal stone formation and are listed in Table 1 (1). The epidemiology of renal stones in Royal Navy (RN) personnel has been previously reported. Blacklock reported the incidence of renal colic in the RN from 1958 to 1964 as 0.45 per 1000 with an increased risk seen in Engine Room Artificers, Officers and those based in warmer climates of the Middle East and Far East stations (3). Raffaelli recorded an incidence of 0.7 per 1000 in the RN from 1979 to 1985 and identified no increased risk between those based in the submarine flotilla compared to those in the surface fleet (4). More recent data from the United States military from 2001 to 2010 reported an incidence of 5 per 1000 with a 1:1 male to female ratio (5). Both the British and American military data report that those aged over 40 years had a four to five-fold increased incidence of renal colic compared to those below the age of 25 years. Possible causes of the observed increase in the incidence of renal colic over the last 50 years (which has also been observed in the civilian population) include the increased sensitivity of investigations, allowing the identification of smaller stones, and increased rates of obesity (5).

<table>
<thead>
<tr>
<th>Patient</th>
<th>Male : Female (3:1)</th>
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<tbody>
<tr>
<td></td>
<td>Previous history of renal stones</td>
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<tr>
<td></td>
<td>Family history of renal stones</td>
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<tr>
<td></td>
<td>Other urological disease (urinary tract infections, anatomical abnormalities of the renal tract)</td>
</tr>
<tr>
<td></td>
<td>Diseases associated with stone formation, such as hyperparathyroidism, renal tubular acidosis, cystinuria, Crohn's disease, primary hyperoxaluria, gout</td>
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<tr>
<td></td>
<td>Medications associated with stone formation, such as calcium or vitamin D supplements and quinolones</td>
</tr>
<tr>
<td></td>
<td>Obesity</td>
</tr>
<tr>
<td>Environment</td>
<td>High ambient temperatures</td>
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<td></td>
<td>Decreased fluid intake</td>
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Table 1: Risk factors for developing renal colic
Clinical Picture
The classical presentation of renal colic is sudden onset pain, often centred on the loin (on the side of the abdomen, just below the twelfth rib), radiating towards the groin (6). Whilst the pain is described as very severe (sufficient to incapacitate the patient), the patient is restless, continuously moving in an attempt to find a comfortable position. This is in contrast to peritonitis where the patient typically remains still in order to avoid further irritation of the inflamed peritoneum. Other clinical features characteristic of renal colic and potential differential diagnoses are listed in Tables 2 and 3 respectively.

| Pain | Sudden-onset loin pain radiating towards the groin or genitals |
|      | Feeling of being unable to get comfortable               |
|      | Intermittent episodic pain which may include intervals of being pain-free |

| Urinary | Urinary symptoms (urgency feeling of needing to urinate, passing small volumes of urine, increased frequency of urination) |
|         | Haematuria. Around 85% of patients will have microscopic haematuria, detectable with a urine dipstick. Occasionally, macroscopic haematuria is present (visible blood in the urine) |

| Other | Nausea and vomiting |

Table 2: Signs and symptoms of renal colic

<table>
<thead>
<tr>
<th>Differential Diagnosis</th>
<th>Differentiating features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other acute inflammatory abdominal conditions</td>
<td>Appendicitis, biliary colic/cholecystitis, pancreatitis, inflammatory bowel disease</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Pyelonephritis</td>
</tr>
<tr>
<td>Testicular pain</td>
<td>Testicular torsion or epididymitis</td>
</tr>
<tr>
<td>Gynaecological</td>
<td>Ectopic pregnancy, ovarian pathology</td>
</tr>
<tr>
<td>Vascular pathology</td>
<td>Leaking abdominal aortic aneurysm, ischaemic bowel</td>
</tr>
<tr>
<td>Others</td>
<td>Musculoskeletal, Herpes Zoster (shingles)</td>
</tr>
</tbody>
</table>

Diagnosis
In the primary care setting, investigations are limited to basic observations and urine dipstick testing. These are important to identify concurrent infection which warrants urgent antibiotic therapy and medical evacuation (MEDEVAC) for further investigations and treatment. A mid-stream urine (MSU) sample should also be collected and sent for microscopy, culture and sensitivities (MC&S).

In the hospital setting, the gold standard investigation is non-contrast computed tomography (CT), which has sensitivity and specificity of greater than 90%, having replaced the intra-venous urogram (IVU) as the imaging modality of choice. However in the Role 2 (Light Maneouvre / Afloat) setting, CT is currently unavailable. Instead, plain Kidney Ureter Bladder (KUB) radiograph is used as an alternative and, if the appropriate equipment and personnel are available, this can be combined with ultrasound (US). Within the NHS setting, these are the imaging modalities of choice in pregnant women and children, to minimise radiation exposure associated with CT. Plain radiographic imaging has a sensitivity of around 50% and specificity of 80-85% but can only detect radiopaque stones with significant calcium content. Moreover,
it is often difficult to differentiate between renal stones, faecoliths and phleboliths. The plain KUB film is also used to confirm the passage of stones during follow-up for patients treated conservatively. US can identify stones in the kidney and occasionally the upper ureters, but is less useful for more distal stones. It can also identify associated hydronephrosis as well as the presence or absence of ureteric jets from the VUJ (Doppler US visualisation of urine entering the bladder as evidence that there is urine flow in the ureter). Experienced sonographers can achieve a sensitivity of 96% and specificity of nearly 100% for proximal stones greater than 5mm in diameter (1).

Initial laboratory investigations should include full blood count, amylase, urea and electrolytes and MSU to determine the renal function as well as any other pathology or associated inflammatory response or infection. The presence of infection or underlying renal disease (e.g. single functioning kidney) may precipitate a surgical emergency with rapid deterioration in the patient’s condition. Patients with confirmed renal stones should also have baseline biochemical screening with serum calcium and uric acid levels. Those with multiple stones should have full metabolic biochemical screening undertaken by the urology team in accordance with national and international guidelines (1).

Clinical Management

Primary Care Afloat or Deployed Ashore (Role 1)
The focus at sea or in the field should be effective analgesia along with the identification and treatment of associated infection. Simple measures such as local warming to the loin with a hot water bottle can help to ease symptoms. The first line analgesic drugs are non-steroidal anti-inflammatory drugs (NSAIDs), for instance Diclofenac (75-150mg daily in two or three divided doses) or Ibuprofen (400mg, three or four times a day, maximum of 2.4g daily). If the patient is actively vomiting, Diclofenac via the rectal route is indicated. If the pain remains un-controlled, opiate analgesia with a concurrent anti-emetic is appropriate (Morphine IM or IV titrated to the pain with Cyclizine or Ondansetron). If systemic symptoms such as fever, rigors or sweats are present, prompt antibiotic treatment is indicated in accordance with local antimicrobial prescribing guidelines (usually Co-Amoxiclav). Clinical advice should then be sought to determine the urgency for MEDEVAC.

Primary Care Ashore
Patients presenting to the ashore Medical Centre with symptoms suggestive of renal colic for the first time may be appropriate for community management, especially if the episode of renal colic has settled (7). Indications for immediate admission to hospital are listed in Table 4. Patients managed in the community should have access to analgesia in case a further episode of colic develops and appropriate imaging arranged with urological out-patient review within 1 to 2 weeks. The patient should be advised to sieve their urine until their imaging study using a simple kitchen sieve or one fabricated from an engineering filter mesh, in case they pass the stone beforehand. A similar strategy could be used if the patient is at a location more than a few hours away from appropriate hospital facilities (1).

On some occasions, Naval patients may have presented to an NHS Emergency Department and subsequently been discharged with conservative management. The patient should then present to their Service Medical Centre to ensure that they have adequate analgesia in the event of further episodes of renal colic and to allow assessment for military occupational health purposes (see below). Stones that fail to pass will require urological follow-up for surgical removal. All stones should be clinically or radiologically confirmed to have passed, and if any doubt exists specialist opinion should be sought (1).

Hospital management (Role 3)
Protocol for management of renal colic in current Role 3 operations
The presentation of patients with renal colic during recent operations in Afghanistan identified a need for a guideline applicable to the Role 3 setting (Figure 1). It is currently in draft form and will be incorporated into Clinical Guidelines for Operations in the near future (8).
Urgent surgical intervention is indicated if there are signs of sepsis or if the patient has only one functioning kidney with evidence of obstruction or infection. Following resuscitation and commencement of antibiotic therapy, surgical treatment involves decompression of the obstructed ureter by percutaneous nephrostomy (where the renal pelvis is drained under radiological guidance) or retrograde stenting (where a stent is inserted from the bladder to the renal pelvis through a cystoscope). This relieves the underlying obstruction and drains any pus, but the definitive treatment of the stone is left for a later date (1).

Figure 1: Draft treatment guidelines for patients presenting with renal colic on deployment
Conservative & Medical Expulsive Therapy (MET)

Around 90% of stones less than 4mm in diameter will pass spontaneously, falling to 60% in those 4-6mm and 40% of those 6-10mm in size (1). Conservative management is appropriate with stones smaller than 10mm in pain-free patients with no evidence of infection, renal dysfunction or structural renal disease. The addition of medical expulsive therapy (MET) using alpha-1-antagonists (e.g. Tamsulosin) has been reported to increase the proportion of small stones that pass spontaneously, shorten the time before they are passed and decrease the amount of analgesia required. This is based upon a number of small scale randomised control trials (RCT) although more recent trials have suggested the scale of the effect may be smaller than previously reported (1). Currently a multi-centre randomised control trial of 1200 patients, coordinated by a group at the University of Aberdeen, is comparing several drugs against placebo in the SUSPEND trial; it is expected to report in 2015. If started on MET, the patient should be made aware of the potential side effects of this medication and that its use for this indication is “off-licence” (9). Patients should have imaging repeated every two weeks to monitor changes in position of the stone and for ongoing hydroureteronephrosis. Conservative treatment carries the risk of permanent renal damage if there is obstruction of the kidney for greater than four weeks. If a stone has not passed after six weeks, it is unlikely to do so spontaneously and surgical treatment should be considered.

Surgical Treatment

A number of surgical approaches may be used (1, 6) depending on the size and location of the stone as well as patient factors and service availability. Stones in the renal pelvis or calyces up to 20mm in diameter may be treated with Extracorporeal Shock Wave Lithotripsy (ESWL) or ureteroscopy. EWSL is usually carried out as a day case procedure with analgesia or minimal sedation and uses a shock wave source, which is focused onto the stone by a parabolic reflector pressed against the patient’s loin. The stone is targeted using US or X-ray imaging. A number of different shock wave sources are available including electromagnetic, piezoelectric and electrohydraulic, each having various advantages and disadvantages. Several treatment sessions may be required and contraindications include pregnancy, infection and anticoagulation (1).

Ureteroscopy is an alternative to ESWL for upper tract stones up to 20mm. Smaller stones can be removed using basket extraction, whilst larger stones can be fragmented using a laser. Ureteroscopy can be undertaken as a day case procedure, albeit under general anaesthesia. Patients may require a ureteric stent to be placed at the end of the procedure. This stent lies between the bladder and the renal pelvis and is placed to prevent post-operative obstruction secondary to oedema or small stone fragments, usually being removed a week later using a flexible cystoscope without the need for general anaesthetic. Ureteroscopy is the treatment of choice for ureteric stones which fail to pass spontaneously. ESWL is not generally used for ureteric stones due to difficulty in stone targeting. However, ESWL can be used for VUJ stones in some centres with a dedicated lithotripter service and experienced staff (1).

For stones larger than 20mm, percutaneous nephrolithotomy (PCNL) is indicated. This involves making a tract directly into the renal collecting system via a loin approach through the renal cortex. A nephroscope is passed into the kidney through which various stone breaking and extraction instruments can be used. This represents major renal surgery and requires detailed anaesthetic work-up and patient preparation. Risks include bleeding, infection and incomplete stone removal. Patients undergoing this type of surgery often have multiple, complex renal stones associated with other co-morbidities or underlying anatomical abnormalities requiring sub-specialist renal stone surgeons utilising the full gamut of surgical options. Laparoscopic or open surgery is reserved for around 1% of patients with the largest or most complex stones, or where other procedures have failed. Laparoscopic surgery has replaced open surgery in most cases due to the lower risk of complications and open surgery is generally reserved as a last resort (1).

Deployment and Occupational Health Considerations

The diagnosis of renal colic may have significant occupational health consequences for RN personnel (10). During an episode of renal colic, a temporary medical downgrade is appropriate for the period until the stone has passed, to ensure appropriate out-patient follow-up. Renal colic may also recur without warning, potentially incapacitating the patient during a critical or safety-related task; or the side-effects of analgesics or MET may impair the patient’s work.

Whilst deployed, there is currently no facility to surgically treat renal stones in the Role 2 or 3 settings. Figure 1 provides guidance on either conservative treatment with or without MET in theatre, or MEDEVAC to the UK. An American Combat Support Hospital in a six month period in Iraq conservatively treated 60% of their patients with renal colic with 28% of stones documented as spontaneously passing and no serious complications, although the data are limited due to patients lost to follow-up (11). The lifetime recurrence rate of renal colic is 60-80% with a 14% risk within one year and 35% within five years. All patients should be provided with advice that will help to reduce the risk of further stone formation (Table 5) (2).

Any stone that is collected after being passed spontaneously or after treatment should be sent for further analysis to determine chemical composition. Although a single
A clinical episode of renal colic is not an indication for a permanent downgrade of medical category, in recurrent renal colic or those with multiple or bilateral calculi, patients require full metabolic screening at a specialist centre and an occupational health referral. Certain branches of the RN, such as air-crew and submariners, pose higher occupational risk and therefore advice from appropriate specialists is suggested and referral to the Naval Service Medical Board of Survey (NSMBOS) must be considered.

Before entry into the Armed Forces, an individual with a history of a single episode of renal colic which has been investigated without demonstration of underlying pathology may be graded Medically Fully Deployable (MFD) P2, and allowed to join the Armed Forces. However, any candidate who has a confirmed history of stone formation or a history of more than one episode of renal colic is graded Medically Non-Deployable (MND) and considered permanently unfit for service in the UK Armed Forces (P8). Medical Officers should be aware of patients under their care who have concurrent medical co-morbidities or underlying structural kidney disease (especially among those who are subject to less stringent medical standards such as civilian or Royal Fleet Auxiliary personnel). In addition, military personnel can maintain a medical category of MFD P2 even after being a donor for kidney transplant (10). These personnel would be at greater risk if complications arise in their remaining kidney and should have a lower threshold for MEDEVAC and referral.

Conclusions
Renal colic is an important differential diagnosis of abdominal pain in the military population. The diagnosis of renal colic may be made clinically at sea and managed with analgesia until appropriate facilities for imaging studies are available. However, concurrent sepsis is an emergency and warrants immediate antibiotic treatment and urgent MEDEVAC. Otherwise, it has a low risk of complications and mortality but can have a significant impact on the ability of patients to carry out their duties and their fitness to remain in an operational setting. The management of renal stone disease is dependent on the size and position of the stone. Solitary ureteric stones up to 10mm may be managed conservatively with MET, but the risks associated with infection and obstruction should be appreciated. Confirmation of stone passage should always be achieved and specialist advice should be sought if any doubt exists.

References
10. The relevant military occupational health advice is available in JSP950 Leaflet 6-7-5 Annex F and Leaflet 6-7-4 Annex F, BR1750A or AP1269A.
Footnotes
Surgeon Captain Professor Sir Norman Blacklock KCVO OBE FRCS read medicine at Glasgow University and first joined the RN in 1951 during his National Service. He was later Surgeon to the Queen and Professor of Urology at Manchester University. He died in 2006 and his obituary is published in the JRNMS. 2006;92(3):164.

Surgeon Vice-Admiral Philip Iain Raffaelli, CB QHP FRCP read medicine at Edinburgh University and joined the RN in 1976. He was Medical Director General (Naval) from 2007 to 2009 and Surgeon General from 2009 to 2012.

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