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Review Article

Initial Management for Renal Colic: Expel, Decompress or Shocks

Matthew E Sterling, Justin B Ziemba and Phillip Mucksavage*

Division of Urology, Hospital of the University of Pennsylvania, USA

***Corresponding author:** Phillip Mucksavage, Division of Urology, Hospital of the University of Pennsylvania, Penn Medicine Washington Square, 800 Walnut Street Philadelphia, PA 19107, USA

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Introduction

Over half a million patients present to emergency departments (ED) and nearly 3 million patients visit healthcare providers annually due to problems associated with urolithiasis [1]. Initial management includes analgesia and antiemetics. Additionally, a urinalysis and creatinine are required laboratory evaluations. Acute imaging with a non-contrast CT (NCCT) scan is the diagnostic imaging modality of choice. Low-dose non-contrast CT (LD-NCCT) scans are now standard of care for the initial diagnosis of renal colic in patients with a BMI ≤ 30. Medical expulsive therapy (MET) is recommended for patients with a ureteral calculus <10mm and no signs of infection. Emergent urinary decompression is mandatory for a specific subset of patients, especially those with infection. Although limited data exists, emergent ureteroscopy or even shock wave lithotripsy may also be therapeutic options.

Presentation

Patients with nephrolithiasis typically present with acute flank pain with or without radiation to the groin, referred to as renal colic. The pain is described as colicky in nature because it is intermittent and associated with restlessness, differing from peritonitis pain where patients often remain still. The pain is thought to arise due to obstruction of the ureter with continued peristalsis or spasms of the ureter around the stone. Additionally, obstruction can lead to hydronephrosis and/or hydroureter with pain arising due to distention of the collecting system and renal capsule [2]. In addition to renal colic, patients often present with nausea and vomiting. Furthermore, microscopic or gross hematuria can be a presenting sign of nephrolithiasis due to irritation of the mucosa by the stone or a coexisting urinary tract infection (UTI). Close attention needs to be paid to patients presenting with suspected nephrolithiasis and signs and symptoms of a UTI or sepsis.

Initial Diagnostic Imaging

A thorough history and physical examination is the first step in the evaluation of suspected renal colic. This is particularly important given the often non-specific flank or groin pain associated with nephrolithiasis. Once renal colic is suspected, diagnostic imaging should be performed with the choice of modality selected based on patient type. In the non-obese adult, non-pregnant patient, the preferred initial imaging modality of choice is a low dose non-contrast computed tomography (NCCT) due to its high sensitivity (Median 98%) and high specificity (Median 97%) for identifying urinary calculi [3]. Low dose NCCT scans not only accurately report the presence of stones, but also the size, location, density via Hounsfield units, evidence of obstruction, and skin to stone distance, which all help to determine the need for surgical intervention [4]. A renal ultrasound (RUS) is an attractive alternative given no risk of ionizing radiation and should be first line in pregnant and pediatric patients. However, RUS only has a sensitivity of 61% in detecting nephrolithiasis [3], much worse than a NCCT, and should not be first line for adults during their initial presentation of renal colic.

Follow-up Diagnostic Imaging

A recent review of the National Hospital Ambulatory Medical Care Survey estimated that approximately 5-10% of visits to the ED for nephrolithiasis were return visits [5]. While LD-NCCT is the imaging modality of choice during the initial presentation, repeat CT imaging in those with known nephrolithiasis changed the diagnosis in only a small percentage of patients [6]. Therefore, the AUA recommends that initial imaging should include a RUS and KUB in patients presenting with a known radio-opaque ureteral/kidney stone and persistent symptoms [3]. If no hydronephrosis or stone is identified on KUB or RUS and the patient is still symptomatic, then a LD-NCCT scan is recommended [3]. In those with radiolucent stones and persistent symptoms, RUS can be used to assess for hydronephrosis with a clinical decision made whether to repeat a NCCT based on the RUS results [3].

Initial Management

The initial management for renal colic is supportive care with analgesia and anti-emetics. The mainstay of pain control for renal colic includes non-steroidal anti-inflammation drugs (NSAIDs) and narcotic medications. NSAIDs have been shown to provide improved pain relief versus narcotics without the added side effects of nausea or vomiting [2]. Therefore, an oral or intravenous (IV) NSAID is first line therapy [2]. Narcotic medications can be added for additional relief. Furthermore, antiemetic medication can be utilized as needed for nausea and/or vomiting often associated with renal colic. Increased fluid intake or IV hydration is often used during acute renal colic episode, but there is no evidence supporting increased fluid aids with spontaneous passage [2]. Patients with dehydration, often due to nausea and vomiting should be adequately replaced.

Initial Laboratory and Urine Evaluation

According to the EAU guidelines, all patients presenting with acute symptomatic nephrolithiasis should have a urine dipstick to

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assess for blood in the urine, leukocytes for signs of inflammation, and nitrite to assess for specific bacteria and thus infected urine [7]. If the urine dipstick is suspicious for infection, a urine culture should be sent [7]. Additionally, all patients should have a creatinine level to assess for acute kidney injury and the possibility of an obstructive process [7]. In patients with a fever, evaluation should also include a complete blood count (for analysis of a patient's white blood cell (WBC) count for evidence of inflammation or infection) and C-reactive protein (CRP) [7]. Additional studies can include a basic metabolic panel (BMP) for analysis of sodium and potassium levels in those with nausea and vomiting [7].

Indications for Consultation

Many patients with an acute episode of nephrolithiasis initially present to their primary care physician or the ED. A consultation with urology is recommended if pain is intractable, the patient is unable to tolerate an oral diet due to persistent nausea or vomiting, there is evidence of obstructive uropathy, concurrent UTI is suspected, or in any patient with a solitary or transplant kidney. If the patient is to be discharged from a primary care physician or ED, it is recommended to follow up with an outpatient urology visit in 1-2 weeks in all cases of nephrolithiasis.

Emergent Decompression

While most patients will eventually pass small ureteral stones, clear indications for decompression in the acute management of ureteral stones includes the presence of infection, intractable pain or vomiting, obstruction in a solitary or transplant kidney, bilateral obstructing stones, or relief of ureteral calculi obstruction in pregnant females pending definitive management post-partum [7]. Randomized controlled trials (RCTs) have shown ureteral stenting and percutaneous nephrostomy (PCN) tubes are equally effective for emergency decompression of the urinary system [8]. A small RCT of 42 patients by Pearle et al. investigated ureteral stent vs. PCN tube for obstructive ureteral stones and signs of infection, reporting equal times to normalization of fever and WBC count with a trend towards longer hospital stays in those following PCN placement [8]. Another small trial assessed 40 patients with a ureteral stone and hydronephrosis, with or without signs of infection, and did not demonstrate a difference in outcomes between ureteral stent and PCN tube placement [9]. A recent retrospective study by Goldsmith et al. investigated patients with obstructive stones identified on CT scan and systemic inflammatory response syndrome (SIRS) at the time of diagnosis to determine differences in outcomes between ureteral stent and PCN tube placement [10]. A total of 130 patients met inclusion criteria. Patients selected for PCN tube placement had larger stones (10mm vs. 7mm), were more ill based on their APACHE score, and had a higher proportion of surgically altered urinary tract anatomy [10]. After resolution of the patient's sepsis, those undergoing ureteral stent were more likely to be treated with ureteroscopy (65 vs. 40%, p=0.004) and those undergoing PCN tube placement were more likely to be treated with percutaneous nephrolithotomy (38 vs. 6%, p=0.001) [10]. Time from initial septic event to definitive treatment and rate of spontaneous stone passage was similar between the PCN tube and ureteral stent group [10]. Intensive care unit admission rates were higher for the PCN tube group (42 vs. 20%, p=0.006), likely due to more ill patients being selected for PCN tube placement [10].

In summary, indications for emergent urinary tract decompression include intractable pain, nausea/vomiting, evidence of obstructive uropathy, symptoms or signs of infection, and calculi in a solitary or transplant kidney. The preferred method of decompression (ureteral stent or PCN) is likely equivalent, and should therefore be based on stone size, stability of the patient, available hospital resources, and anticipated future method of definitive treatment.

Urgent Ureteroscopy

In the acute management of stones, patients are typically discharged without the need for a procedure. If, however, a procedure is indicated, then palliation with a ureteral stent or PCN is often performed. Despite this common practice, recent investigations have assessed urgent ureteroscopy. Proponents of this practice cite that immediate stone removal can relieve pain, and prevent multiple trips to the operating or emergency room. Sarica et al. published a prospective study on 145 patients presenting to the ED with obstructing ureteral stones [11]. Stones were located in the distal ureter in 67.6% and proximal ureter in 32% [11]. Patients were split into either ureteroscopy within 24 hours of first colic attack or medical expulsive therapy (MET) for >7 days followed by ureteroscopy within 7-21 days [11]. There was no difference in intra operative complications or stone location [11]. Ureteral stents were placed in 24.6% of those on MET vs. 0% in those undergoing immediately ureteroscopy (p=0.001) [11]. There was no difference in the need for additional procedures [11]. Stone free rate was 87.9% in the MET first group and 90.8% in the emergency ureteroscopy group [11]. Readmission rates were higher in the MET first group, with 3.03 mean read missions to the ED [11].

Al-Ghazo et al. examined 244 patients treated with emergent ureteroscopy (within 24 hours of admission) for acutely symptomatic ureteral stones [12]. Overall success rate, defined as complete absence of stone fragments at 4 weeks post-operatively, was 90.6% [12]. Proximal ureter, mid ureter, and distal ureter stones had 69.4%, 94.8%, and 96.6% success rates, respectively (p<0.001) [12]. Overall complication rate was 13.1%, decreasing to 2.5% when excluding stones 10mm or greater, consistent with prior studies [13-16]. Although limited data exists on this topic, ureteroscopy within 24 hours of initial presentation may be a viable option, especially for patients with a symptomatic, obstructing mid to distal ureteral stone without evidence of infection. However, further investigation is necessary prior to widespread adoption.

Urgent Extracorporeal Shockwave Lithotripsy (ESWL)

Since its introduction in the 1980s, ESWL is a minimally invasive method to treat both kidney and ureteral stones. According to the EAU guidelines, ESWL and ureteroscopy are both first line treatments for proximal ureteral stones [7]. A recent meta-analysis by Picozzi et al. assessed 7 studies with a total of 570 patients who underwent urgent ESWL for the treatment of a symptomatic stone [17]. Stone free rates and complication rates did not differ statistically from those reported in the most recent AUA or EAU guidelines for elective ESWL; however, subsequent surgery was required in 15.8% of patients to completely remove the stone [17]. ESWL is thus an option to emergently treat stones, although further investigation is needed.

Medical Expulsive Therapy (MET)

The majority of patients (83%) presenting with nephrolithiasis will pass their stone without any need for intervention [18]. Furthermore, 95% of these patients will pass their stone within 6 weeks [18]. Therefore, the EAU guidelines recommend for ureteral stones <10mm with minimal to moderate hydronephrosis, no evidence of renal damage and otherwise medically stable, observation with or without medical expulsive therapy (MET) is standard of care [7]. MET has been shown to improve the rate of stone passage [7]. Calcium channel blockers, steroids, and alpha-blockers have all demonstrated improved stone passage rates [7]. Steroids are usually avoided because of the numerous systemic effects. While alpha blockers are most often prescribed because they are commonly used in urology for lower urinary tract symptoms, in a meta-analysis of available RCTs comparing MET to placebo, calcium channel blockers showed an absolute increase in stone passage of 9% and alpha-blockers shown an absolute increase in stone passage of 29% [7]. Therefore, alpha-blockers are the preferred agent for MET.

Tamsulosin is the most widely studied alpha-blocker used for MET. Fan et al. performed a meta-analysis of 20 RCTs across 10 countries including 799 patients in the tamsulosin arm and 794 patients in the control arm [19]. Expulsion rates for lower and upper ureteral stones were significantly higher in the tamsulosin arm (lower ureteral stones: RR 1.55, p<0.00001; upper ureteral stones: RR 1.28; p=0.02) [19]. Additionally, expulsion time was improved in the tamsulosin group by an average of 2.63 days [19]. These patients also had fewer colic episodes and underwent fewer auxiliary procedures. In a RCT, Al Ansari et al. studied 100 patients with lower ureteral stones and compared placebo to tamsulosin and found spontaneous passage rate to be 82% in the tamsulosin group vs. 61% in the placebo group [20]. Expulsion time was also shorter [20]. Yencilek et al. showed improved passage rates in those receiving tamsulosin vs. placebo for ureteral stones < 5mm (passage rate 71.4% vs 50%) [21].

In summary, for ureteral calculi < 10mm without signs of infection or acute renal failure, a trial of MET should be initiated. Alpha-blockers are considered first line for MET due to the familiarity with the drugs, improved rates of spontaneous passage, decreased time to stone passage, and fewer colic episodes. While tamsulosin is the most studied medication for MET, other alpha-blockers should have similar outcomes. For those with documented spontaneous passage of their stone, repeat imaging is not necessary. If the patient is persistently symptomatic after passage, Fulgham et al. recommend a follow up RUS with a NCCT if the patient has hydronephrosis [3]. While the optimal length of time of MET before intervention is controversial, common practice is for 4-6 weeks [22].

Pregnant Patients

Nephrolithiasis affects about 1 in 500 pregnancies [23-25] and often becomes symptomatic in the second or third trimester [26-28]. Fortunately 70-80% of these patients will pass their stone spontaneously with conservative management [28]. A RUS is universally accepted as the first line study in pregnant patients presenting with suspected nephrolithiasis with a sensitivity of 34% and specificity of 86% [29]. If a RUS fails to identify nephrolithiasis or alternative diagnoses, the EAU recommends either a Trans vaginal ultrasound to assess for UVJ or bladder stones or an MR Urography (MRU), which avoids ionizing radiation [7]. MRU has limited capacity to identify small calculi, is costly, and is often unavailable; however, it avoids ionizing radiation, which may increase the risk of secondary malignancies [30-32]. Additionally, MRU should not be used in the first trimester due to unknown risks to the developing fetus [30,33]. Some have advocated the use of LD-NCCT scans in complicated cases where no other diagnosis has been identified, but this requires ionizing radiation and patients must be counseled extensively about the risks and benefits to the mother and fetus. Most notably, a single pelvic CT may increase the risk of childhood cancer in the exposed fetus by 2 times; however, due to the low absolute risk of childhood cancer (1 in 2000), the increase in absolute risk is extremely low [34]. The American Congress of Obstetricians and Gynecologists (ACOG) guidelines for diagnostic imaging during pregnancy report that exposure to less than 5 rad (which is the case for a NCCT of the abdomen and pelvis) has not been associated with an increase in fetal anomalies or pregnancy loss and that a single diagnostic x-ray procedure does not result in harmful fetal effects [35].

Pregnant patients should be treated similarly to non-pregnant patients with fluids and analgesia [7]. The medications (alpha blockers, calcium channel blockers and steroids) used for medical expulsive therapy, however, should be avoided in pregnancy. Additionally, urinary diversion with a ureteral stent or PCN may be required in the emergent setting when meeting the same criteria as the non-pregnant patient. These should be placed using ultrasound guidance or with limited fluoroscopic radiation as possible. Ureteral stents or PCN tubes need to be exchanged every 4-8 weeks during pregnancy versus every 3 months in non-pregnant patients due to an increased risk of encrustation [7]. Ureteroscopy, using laser lithotripsy, is increasing being employed in this population as experience has increased [7].

Conclusion

Acute renal colic is a common problem seen in the emergency room. The primary goal is to accurately make the diagnosis and proceed with treatment based on the stability of the patient. Most stones will pass spontaneously, with the aid of an alpha blocker; however, urgent ureteroscopy or shock wave lithotripsy can also be effective in managing an acute episode.

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