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KIDNEY STONE EMERGENCIES

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CLINICAL RECOGNITION

The acute passage of a kidney stone is the 9th most common cause of emergency room visits. Approximately 7-8% of women and 11-16% of men will have stone disease by age 70. The acute syndrome complex called renal colic implies obstruction of the collecting system or ureter, and the most common cause of obstruction is a kidney stone. Kidney stone colic is relatively constant in contrast to intestinal or biliary colic, which waxes and wanes or comes in waves. The onset of pain heralds the entrance of a stone into the collecting system and the ensuing obstruction. The intensity and location of the pain may vary with stone size, stone location, degree of luminal obstruction, and the suddenness of the obstruction but flank pain is very common. Referred genital pain is common with distal ureteral stones. Symptoms typically begin at night or the early morning hours with abrupt onset and awakening the patient from sleep. During the day, the onset of symptoms may follow heavy exercise and may be more gradual with an occasional prodrome of unilateral discomfort in the flank, testis or vulva on the side of the obstruction. The pain then becomes continuous, steady; and progressively more severe as it approaches a peak. For some, there are acute paroxysms of increasingly intense pain. Anorexia, nausea and vomiting commonly appear with the pain, and gross hematuria may be present. Overall, one-third of patients have a relatively rapid onset and reach peak pain in 30 minutes or less. Untreated, the pain may last for 4 to 12 hours, but most patients have presented to the emergency room by the time the pain becomes continuous, usually by two hours into the colic. Upon presentation, the pain is described as a 9 or 10 out of a scale of 1 to 10. Chills and fever may be present as well and should raise concern for infection as these symptoms are usually not present in uncomplicated urolithiasis. Similarly, hypotension also raises the likelihood of infection as the pain associated with renal colic typically induces hypertension and tachycardia.

PATHOPHYSIOLOGY

Stone-induced renal colic refers to an intraluminal cause, but non-stone related external compression of the ureter can induce the same symptom complex and be confused with the intraluminal presence of a stone. Renal colic can arise from three mechanisms: urinary

obstruction, the most common cause, is due to a direct increase in intraluminal pressure and stretch of the nerve endings in the mucosa; local ureteral mucosal or collecting system irritation from direct contact of the stone; and interstitial edema and stretch of the renal capsule, particularly when there is a concomitant pyelonephritis. Stones are more likely to hang up and obstruct at naturally narrow regions of the upper urinary tract including the ureteropelvic junction, crossing of the iliac artery and vein, pelvic brim, and the ureterovesical junction.

DIAGNOSIS and DIFFERENTIAL

Diagnosis

The diagnosis is strongly suspected by the symptom complex. The examination reveals costovertebral angle tenderness with dysesthesia of the skin overlying the area along the flank, lower abdomen, groin, or genitalia. Gross or microscopic hematuria is present in 60% to 90% of patients with renal colic but is not required for the diagnosis.

Children with renal stones may present with more vague abdominal symptoms compared to the symptom complex in adults. Therefore, abdominal pain in children and adolescents should call for a urologic evaluation if no diagnosis has been reached.

Differential Diagnosis

Acute renal colic may be caused by non-kidney stone events listed in Table 1.

Table 1. Causes of Acute Renal Colic
Intrinsic to the Collecting System
Kidney stones
Gross hematuria with clot formation
Tumor emboli
Renal papillary necrosis
Extrinsic to the Collecting System
Calyceal obstruction
Calyceal diverticula
Congenital ureteropelvic obstruction
Retroperitoneal fibrosis
Endometriosis
Dilation of the ovarian veins (pregnancy)
Mass lesions of the uterus

Acute onset of continuous, aching or dull pain that is non-colicky or flank pain without radiation to or toward the groin suggests a non-stone etiology. Common causes of acute non-colicky pain are listed in Table 2.

Table 2. Differential Diagnosis of Acute Non-colicky Renal Pain

Renal vein thrombosis
Pyelonephritis
Renal cortical abscess
Poststreptococcal glomerulonephritis
Rapidly progressive glomerulonephritis
Polycystic kidney disease
Medullary sponge kidney

DIAGNOSTIC TESTING

Imaging

The definitive diagnosis of acute renal colic relies upon radiographic imaging of the kidney and urinary tract to demonstrate the location, number, and size of the stones as well as the degree of obstruction. Non-contrast CT (NCCT) has become the imaging study of choice when evaluating patients with acute flank pain and suspected ureterolithiasis. It has both a high sensitivity and specificity for demonstrating the presence of stones and the ability to detect other abnormalities that maybe accounting for the symptoms. In addition, it has the advantage of providing information regarding stone number, location, size, and in some instances stone composition. It can also reveal signs of obstruction. The majority of patients evaluated by NCCT require no further imaging to determine the need for urological intervention. Many now advocate the use of low dose NCCT for the diagnosis of renal stones to reduce radiation exposure, particularly if the BMI is less than 30kg/m^2.

Ultrasound is also a sensitive method for detecting ureteral stones in patients with renal colic and can be used as the initial imaging method in investigating these patients. However, the quality of ultrasound information is operator dependent and ultrasound has decreased diagnostic sensitivity. Kidney stones are common during pregnancy. Because fetal radiation exposure should be avoided, ultrasound is the primary radiologic procedure followed by MRI if necessary in pregnant women. NCCT should be used only in rare instances in pregnancy. In children ultrasound is the initial imaging procedure followed by low dose NCCT if needed.

A radiographic study done while the patient is in the emergency room will establish a definitive diagnosis, especially if it can exclude other causes of acute abdominal pain; will avoid a prolongation of the painful episode; avoid delay in treatment; and reduce the risk of loss of renal function when complete obstruction is present.

Laboratory Studies

The laboratory studies that should be obtained are shown in Table 3.

Table 3. Laboratory Studies	
Complete Blood Count (CBC)	Increased neutrophils may be due to a stress response or infection

Electrolytes	
Creatinine	Usually not markedly increased. A marked increase suggests solitary kidney, baseline kidney disease, or pre-renal injury due to dehydration
Calcium	Hypercalcemia suggests the mechanism of stone formation and requires further evaluation
Uric acid	Elevated uric acid levels suggest the mechanism for stone formation and requires further evaluation
Pregnancy testing in females of reproductive age	
U/A	Hematuria very common. WBCs if > 5/high powered field suggest infection
Urine culture and sensitivity if U/A abnormal or other signs of infection	

Patients should be instructed to filter their urine in the hopes of retrieving a stone for analysis. Knowing the stone composition will help guide future preventive therapy.

TREATMENT

The goals of management during the acute phase of stone obstruction and renal colic includes: pain control and diagnostic procedures to determine the presence of a kidney stone in the collecting system and the extent of obstruction.

Pain management should be started soon after the patient arrives in the emergency room and should be continued until the episode has resolved. Nonsteroidal anti-inflammatory drugs (NSAIDS) (for example diclofenac, indomethacin or ibuprofen) are effective first line agents for acute pain treatment. If the pain persists or NSAIDS are contraindicated, narcotics, such as morphine sulfate 0.1 mg per kg body weight IM every four hours or meperidine (Demerol) 1.0 mg per kg body weight IM every three to four hours, may be used. Intravenous lidocaine (1.5mg/kg) is another option that has been shown to be effective in reducing renal colic. Anti-emetic agents may be given along with the narcotics as nausea and emesis may occur with stone passage and commonly complicate narcotic use. If medical treatment is not sufficient consultation with urology and consideration of drainage or stone removal is indicated.

Alpha blockers, such as tamsulosin, may be used to facilitate the clearance of kidney stones. In a Cochrane review of 67 studies with 10,509 participants it was concluded that “alpha-blockers likely increase stone clearance but probably also slightly increase the risk of major adverse events (hypotension, syncope, palpitations, tachycardia). Subgroup analyses suggest that alpha-blockers may be less effective for smaller (5 mm or smaller) than for larger stones (greater than 5 mm)”. Smaller stones are more likely to spontaneously pass and therefore the

advantages of alpha blockers are minimized but they may induce more rapid clearance. Additionally, alpha blockers also reduce renal colic.

The size of the stone is a major determinant of the need for surgical management vs. conservative management. Stones vary from less than 2 mm to greater than 2 cm in diameter. The majority of stones are less than 4 mm in width, small enough to pass spontaneously in most patients. A stone's size is an important factor together with symptom severity, degree of obstruction, presence or absence of infection, and level of renal function in deciding whether to manage the stone initially by observation, awaiting spontaneous passage, or to intervene with a surgical procedure. Stones with a width of 5 mm or less have a 50% chance of spontaneous passage if in the proximal ureter and a better chance if in the distal ureter. Overall, for stones ≤5 mm, approximately 68% will pass spontaneously. For stones >5 mm and ≤10 mm, an estimated 47% will pass spontaneously. One study found that stones > 9mm had only a 25% chance of spontaneous passage. Distal stones are more likely to clear than proximal stones (proximal ureter 48%, mid-ureter 60%, distal ureter 75% passage rate). Thus, in many patients with renal colic symptomatic treatment and close follow-up with the anticipation of stone passage is reasonable. The presence of infection, obstruction, refractory or difficult to treat pain, or deterioration of renal function indicates the need to urological consultation and the consideration of surgical intervention.

Urologic consultation should be obtained for possible surgical intervention for a number of reasons including stones with a low likelihood of spontaneous passage (large stones, proximal location), infection, obstruction, renal insufficiency or worsening renal function, and comorbidities that increase the risk of adverse outcomes (for example pregnancy). Depending upon the circumstances a number of procedures are available including ureteroscopic stone lithotripsy and extracorporeal shock wave lithotripsy for stone removal and percutaneous nephrostomy tube and JJ-stent for urinary drainage.

The presence of urinary tract infection increases the risk for development of pyelonephritis and/or pyonephrosis. Urgent intervention is therefore indicated, again regardless of stone size. Near-total or total ureteral obstruction predicts deterioration of renal function that may start within two weeks of presenting with stone disease and therefore indicates the need intervention.

FOLLOW-UP

Follow-up evaluation should be within one to two weeks of the acute event depending on the extent of intervention and whether there is risk for new obstruction from residual stones. Metabolic evaluation using blood and urine tests may be performed after six weeks of recovery to guide specific preventative therapy. Stone analysis, and the results of urine and blood tests can guide decisions on preventive therapy. It should be recognized that after a first stone episode 30-50% of individuals have a recurrent stone within 10 years.

GUIDELINES

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