

Urolithiasis: Adult & Pediatric

Genitourinary

Clinical Decision Tools for RNs with Additional Authorized Practice [RN(AAP)s]

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Background

Urolithiasis are urinary stones (calculi) located in the urinary tract (kidneys, bladder, or urethra) (Huether, 2019). The stones are masses of crystals, protein, or other substances and are often the cause of urinary obstruction (Huether, 2019). Urinary calculi are classified according to the primary minerals in their composition, size, and location (Huether, 2019). The most common stone types are calcium oxalate or phosphate (70% to 85% of stones), magnesium, ammonium, and phosphate (struvite stones; one percent to five percent), or uric acid (five percent to 10%). Less commonly, stones can be formed as a result of medications (e.g., indinavir, acyclovir, sulfADIAZINE), enhanced oxalate absorption (e.g., gastric bypass surgery), or other genetic disorders (e.g., cystine stones, an inborn error of amino acid metabolism) (Huether, 2019). Stones classified according to their size and location are referred to as staghorn calculi or non-staghorn calculi.

Staghorn calculi are large and fill the minor and major calyces of the renal pelvis. Non-staghorn calculi are variable in size, located in the calyces, renal pelvis, or ureter (Huether, 2019).

Immediate Consultation Requirements

The RN(AAP) should seek immediate consultation from a physician/NP when any of the following circumstances exist:

- pediatric clients;
- client with severe pain, nausea, and vomiting, as they may require hydration, parenteral pain management, and antiemetic medications;
- solitary kidney;
- known non-functioning kidney;
- hydronephrosis;
- inability to take adequate fluids due to nausea and vomiting;
- pain does not respond to administration of non-steroidal anti-inflammatory drugs (NSAIDs);
- anuria;

- pregnancy;
- pulsatile mass in abdomen; or
- diagnostic uncertainty (e.g., leaking aortic aneurysm may present with similar symptoms (Interprofessional Advisory Group [IPAG], personal communication, October 3, 2019).

Predisposing and Risk Factors

Predisposing and risk factors for urolithiasis include:

- age (first episode most common before age 50),
- sex (more common in males),
- race (Caucasian, more common),
- geographic/seasonal factors (influences fluid intake [e.g., hot and humid vs. cold climates] and dietary patterns),
- anatomical anomalies in the kidneys and/or urinary tract (e.g., horseshoe kidney, ureteral stricture),
- occupation (exposure to high environmental temperatures),
- genetic predisposition (e.g., cystinuria, xanthinuria),
- hypertension (doubles risk of stone formation),
- atherosclerosis,
- immobilization or sedentary lifestyle,
- metabolic disorders which increase excretion of solutes (e.g., chronic metabolic acidosis, hypercalciuria, hyperuricosuria),
- primary hyperparathyroidism,
- personal history of urolithiasis,
- hypercalciuria is the main risk factor (hereditary condition in 50% of men and 75% of women with calcium stones),
- deficiency of citrate in the urine (calcium stones),
- medications (e.g., calcium/vitamin D supplements, calcium stones),
- low fluid intake (calcium stones),
- hyperoxaluria (calcium stones),
- hyperparathyroidism (calcium stones),
- increased bone resorption (calcium stones),
- dietary factors (e.g., excessive purine intake [e.g., from beer and meat], uric acid stones),
- metabolic syndrome (uric acid stones),
- obesity (uric acid stones),
- high serum uric acid or gout (uric acid stones),
- type 2 diabetes (uric acid stones),
- recurrent urinary tract infections (UTIs) or upper UTI due to *Proteus* or *Klebsiella* (struvite stones), and
- alkaline urine (struvite and calcium stones) (Conner, Thomas, & Porter, 2019; Huether, 2019).

Health History and Physical Exam

Subjective Findings

The circumstances of the presenting complaint should be determined. These include:

- sudden onset of mild ache to severe, colicky pain in one flank that often increases and decreases in severity;
- nausea and vomiting when stones pass into the ureter, cause obstruction, or both;
- pain radiating to lower abdomen, flank, groin, labia, or testicle;
- movement of pain depending on location of stone and level of obstruction (may be vague or acute, abdominal or flank, may change location as the stone moves);
- alterations in voiding patterns;
- dysuria, urgency, and/or frequency may develop; or
- stone or "gravel" in urine may be noted (Conner et al., 2019; Huether, 2019).

Objective Findings

The signs and symptoms of urolithiasis may include:

- restlessness, and obvious signs of distress;
- abdominal distention;
- guarding of abdomen on palpation;
- flank tenderness on percussion (e.g., costovertebral angle tenderness);
- decreased or absent bowel sounds;
- fever (if concurrent acute infection);
- hematuria present;
- may have hypertension, tachypnea, and/or tachycardia due to pain; and/or
- client may be pale, cool, and diaphoretic (Conner et al., 2019).

Differential Diagnosis

The following should be considered as part of the differential diagnosis:

- abdominal aortic aneurysm (the most important differential diagnosis to rule out, often mimics urinary colic),
- appendicitis,
- diverticulitis,
- mesenteric adenitis,
- pancreatitis,
- ileus,
- peptic ulcer disease,
- salpingitis or tubo-ovarian abscess,
- ovarian cysts/masses and ruptured ovarian cysts,

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- ectopic pregnancy (important to rule out in any female client of childbearing age with abdominal pain),
- gallbladder disease,
- acute pyelonephritis, or
- attention or drug-seeking client (Conner et al., 2019).

Making the Diagnosis

The diagnosis of urolithiasis is usually made clinically based on presenting symptoms and history combined with a focused physical assessment and diagnostic study results (Huether, 2019).

Clients often have the characteristic cramping and intermittent abdominal and flank pain that occur as the kidney stone(s) travel within the urinary tract. The pain is often accompanied by hematuria, nausea or vomiting, and malaise.

Fever and chills may also be present (Conner et al., 2019).

If symptoms are mild, the client is afebrile, and able to tolerate oral fluids and medications, and the diagnosis is clear, the client can be treated on an outpatient basis. If symptoms are uncontrollable or severe, client is unable to tolerate oral fluids, or the diagnosis is questionable, consultation with a physician/NP and possible inpatient treatment will be needed.

Investigations and Diagnostic Tests

Diagnostic tests for the initial assessment of urolithiasis include a urinalysis (routine and microscopic). The presence of red cells, as hematuria, is suggestive of urolithiasis.

White cells and nitrites suggest infection. A pH greater than seven suggests urea-splitting organisms, such as *Proteus*. A pH less than five suggests uric acid stones, crystals; and/or mineral casts. A pregnancy test to rule out pregnancy, if female client is of childbearing age. A complete blood count may show infection or septicemia. A renal panel may reveal an elevated blood urea nitrogen secondary to urinary tract obstruction and serum creatinine may be elevated secondary to kidney damage (Conner et al., 2019; Huether, 2019).

Management and Interventions

Goals of Treatment

The primary goals of immediate treatment are to manage pain, promote stone passage, prevent complications arising from existing stones, and prevent subsequent recurrence of stones (Conner et al., 2019; Huether, 2019).

Non-Pharmacological Interventions

The RN(AAP) should recommend, as appropriate, the following non-pharmacological options:

- Application of heat (e.g., heating pad) to abdomen or lower back.
- Drink six to eight 8 ounce glasses of water a day (unless contraindicated by underlying health conditions), which must continue indefinitely.
- Monitor intake and output and strain urine for passed stones.
- Any stones retrieved from the urine should be sent for analysis and dietary restrictions made based on stone analysis. Other dietary modifications include caffeine, beer, and wine avoidance.
- Physical activity reduces the risk of stone formation related to calcium shifts and urinary stasis in sedentary individuals.
- Depending on the mineral composition of the stone, over-the-counter drugs containing phosphorus or calcium (such as antacids), and most vitamin supplements should be avoided (Conner et al., 2019; Huether, 2019).

Pharmacological Interventions

The pharmacological interventions recommended for the treatment of urolithiasis are in accordance with the *RxFiles: Drug Comparison Charts* (RxFiles Academic Detailing Program, 2021) and *Urinary Tract Disorders* (Conner et al., 2019).

Analgesics

Initial pharmacological interventions are aimed at reducing pain. Oral NSAIDs are first line for the relief of pain related to renal colic. They are more effective than opioids and have fewer tendencies to cause nausea. Oral NSAIDs also have been shown to relax ureteral smooth muscle which may facilitate stone passage.

	Drug	Dose	Route	Frequency	Duration
Adult					
	Naproxen	500 mg	p.o.	b.i.d. prn	14 days
OR	Ibuprofen	600-800 mg (maximum dose of 3200 mg/day)	p.o.	q6-8 prn	14 days
OR	Ketorolac	10-30 mg (maximum dose of 120 mg/day)	IM	q4-6h	2 days

Client and Caregiver Education

The RN(AAP) provides client and caregiver education as follows:

- Counsel about appropriate use of medications (dose, frequency, compliance, etc.).
- Encourage to try to retrieve the stone for analysis. This may mean urinating through a tea strainer, filter paper such as a coffee filter, or gauze.
- Advise that the majority of stones will pass spontaneously if less than 5 millimetres in diameter but may take one to three weeks. Clients who have not passed a stone or who have continuing symptoms should have the progress of the stone monitored at a minimum on a weekly basis to assess progression.
- Conservative management may be continued for up to three weeks unless the client is unable to manage the pain, or if he or she develops signs of infection, or obstruction.
- Recurrence of renal stones is common, therefore clients who have had a renal stone should be advised to adopt several lifestyle measures which may help prevent or delay recurrence:
 - increase fluid intake to 2 to 3 litres per day to maintain urine output;
 - reduce salt intake;
 - reduce the amount of meat and animal protein in the diet;
 - reduce oxalate intake (e.g., foods rich in oxalate include chocolate, rhubarb, nuts) and urate-rich foods (e.g., offal and certain fish);
 - drink cranberry juice on a regular basis, as it increases citrate excretion and reduces oxalate and phosphate excretion; and
 - maintain calcium intake at normal levels (lowering intake increases excretion of calcium oxalate) (Conner et al., 2019; Huether, 2019).

Monitoring and Follow-Up

The RN(AAP) should instruct the client to collect and strain all urine for stones and save any stones that are passed and then bring them to the clinic so they can be sent for analysis. The client should be seen for follow-up in 24-48 hours or sooner if pain is uncontrollable or a fever develops.

Complications

The following complications may be associated with urolithiasis:

- urinary retention;
- accumulation of uremic wastes;
- electrolyte imbalance;
- UTI, pyelonephritis, or sepsis;
- hematuria;
- chronic kidney disease; or
- myocardial infarction (Conner et al., 2019; Huether, 2019).

Referral

Refer to a physician/NP if client presentation is consistent with those identified in the *Immediate Consultation Requirements* section or the stone has not passed in three weeks, or who require medical or surgical expulsive therapy to facilitate the passage, or who may benefit from preventative therapy (IPAG, personal communication, October 2, 2019).

References

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