Urinary Stone Disease

Diagnosis, Medical Therapy, and Surgical Management

Wesley W. Ludwig, MD*, Brian R. Matlaga, MD, MPH

KEYWORDS

- Urolithiasis • Dietary therapy • Medical therapy
- Extracorporeal shockwave lithotripsy • Ureteroscopy
- Percutaneous nephrolithotomy

KEY POINTS

- Low-dose computed tomography (CT) scan is the first-line imaging modality for diagnosis of urolithiasis in nonpregnant, adult patients.
- Patients with calcium stones should reduce dietary sodium and maintain normal dietary calcium. If dietary modification fails, thiazide and citrate therapy may be beneficial.
- Uric acid and cystine stones benefit from urinary alkalinization.
- Ureteroscopy (URS) and extracorporeal shockwave lithotripsy (SWL) can be used for ureteral stones. URS is associated with a better stone-free rate.
- Lower-pole renal stones less than 10 mm can be treated with URS or SWL, whereas those greater than 10 mm should be treated with URS or percutaneous nephrolithotomy (PCNL). Non–lower-pole stones less than 2 cm are best treated with URS or SWL, whereas those greater than 2 cm are best treated with PCNL.

INTRODUCTION

Urolithiasis is highly prevalent in the United States and is commonly encountered by both primary care physicians and specialists. Based on the latest National Health and Nutrition Examination Survey, the prevalence of kidney stones in the United States is 8.8%, or nearly 1 in 11 Americans.[1] The increasing prevalence of urolithiasis is thought to be driven in part by the skyrocketing rates of obesity and diabetes, which continues to be a difficult public health crisis to manage.[2] In addition, the frequent use of cross-sectional imaging has led to the common incidental diagnosis of urolithiasis.[3]

Disclosure Statement: The authors have no conflicts of interest to disclose.
Department of Urology, The James Buchanan Brady Urological Institute, Johns Hopkins Hospital, The Johns Hopkins University School of Medicine, 600 North Wolfe Street, Marburg 134, Baltimore, MD 21287, USA
* Corresponding author.
E-mail address: wludwig1@jhmi.edu

Med Clin N Am ■ (2017) ■–■
https://doi.org/10.1016/j.mcna.2017.10.004 **medical.theclinics.com**

There have been several recent advancements in the imaging, medical, and surgical management of urolithiasis, which are reviewed in this article.

DIAGNOSIS

Presentation

Patients with stone disease typically seek medical attention due to pain. Colicky flank pain is typically due to ureteral obstruction and can be associated with a variety of symptoms, including abdominal, flank, or pelvic pain, dysuria, hematuria, fever, nausea, or vomiting.[4] This array of symptoms has a broad differential diagnosis, including urinary tract infection, interstitial cystitis, vaginitis, prostatitis, benign prostatic hyperplasia/lower urinary tract symptoms, glomerular disease, urothelial cancer, gastrointestinal disease, and musculoskeletal pain, among many others.[5]

Clinical Evaluation

A patient suspected of urolithiasis should have a complete medical history performed; this may reveal predisposing conditions, such as diabetes, primary hyperparathyroidism, gout, renal tubular acidosis type I, obesity, and diagnoses related to gastrointestinal malabsorption.[6] A thorough dietary history should be obtained, including intake of calcium, sodium, fluid, fruits, vegetables, animal protein, oxalate-rich foods, over-the-counter dietary supplements, vitamin C, and vitamin D.[6] A careful medication review should be performed because a variety of medications can predispose to urolithiasis. Some medications induce metabolic changes that predispose to stone development, such as loop diuretics, carbonic anhydrase inhibitors, and laxatives. Other medications lead to stone formation due to urinary supersaturation of the drug or metabolite, including ciprofloxacin, magnesium trisilicate, sulfa medications, triamterene, indinavir, guaifenesin, and ephedrine.[7]

Imaging

Computed tomography

When there is clinical suspicion for urinary stone disease, low-dose noncontrast computed tomography (CT) is the preferred diagnostic method for most nonobese individuals.[8] Obese individuals typically require standard-dose noncontrast CT. CT is frequently used because it has an estimated sensitivity and specificity for stone detection of nearly 100%.[9] The only stone type that cannot be visualized using CT is one formed from protease-inhibitor medications.[10] In addition, CT provides an attenuation measurement in the form of Hounsfield units, which aid in determination of stone composition.[11] Uric acid calculi are typically less than 400 HU, whereas calcium oxalate calculi are 600 to 1200 HU.[12] Because of the diagnostic accuracy and ability to aid in management planning, both the American College of Radiology and the American Urological Association recommend CT as the first-line imaging modality for patients presenting with renal colic.[13,14] The drawbacks of CT imaging are radiation exposure and higher cost compared with ultrasound (US) and MRI. There are some clinical scenarios in which CT is not an appropriate first-line imaging choice.

Ultrasound

To avoid unnecessary radiation exposure, US is the preferred first-line diagnostic test for pediatric and pregnant patients with suspected stone disease.[15,16] An additional benefit is US's significantly lower cost compared with CT, which has become an important factor as high-value care is increasingly stressed.[17] A wide range of sensitivities and specificities has been reported for the ability of US to detect urinary stones, likely because of variations in technique. A meta-analysis of studies examining stone