Kidney Stones

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KEYWORDS

• Kidney stones • Renal stones • Bladder stones • Nephrolithiasis
• Medical management • Surgical management

KEY POINTS

- Prevalence of kidney stones is increasing as more stones are found incidentally on CT and risk factors for stone disease (eg, obesity and type 2 diabetes mellitus) become more prevalent.
- Etiology of nephrolithiasis varies with stone type and depends on genetic, dietary, medication, lifestyle, and metabolic factors.
- Diagnostic evaluation of stone formers includes thorough history and physical, imaging, blood work, urinalysis, imaging, and analysis of stone fragments when possible.
- Medical and surgical management of stone disease includes increased hydration, dietary changes, pharmacological therapy for specific metabolic derangements, as well as, shock wave lithotripsy, ureteroscopy, percutaneous nephrolithotomy, and laparoscopic/robotic-assisted surgery.
- Nephrolithiasis during pregnancy requires special consideration in diagnosis, imaging, and treatment.

EPIDEMIOLOGY

Approximately 1 in 11 people in the United States is affected by kidney stones in their lifetime. The most recent data show prevalence in the United States of 8.8% for the period of 2007 to 2010, according to the National Health and Nutrition Examination Survey database. This represents an increase from 5.2% in 1988 to 1994 and 3.8% prevalence in 1976 to 1980.[1] A trend of increasing stone disease prevalence has been noted worldwide, although it is possible that this is partially attributable to incidental finding of asymptomatic calculi on high-quality CT scans.[2,3] Rates of stone disease vary with gender, race, age, comorbidities, and geography.

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Demographics

The prevalence of kidney stones peaks between ages 40 and 70 for men and between ages 50 and 60 for women.[2] Stone disease is more prevalent among non-Hispanic white men and women than other races and ethnicities. Urinary calculi are less than half as prevalent among black men as white men, and prevalence among Asian women is 45% lower than among white women.[4] Historically, white men have been more frequently treated for stone disease than white women (male-to-female ratio of 1.7:1), but recent data show that the gap between men and women is narrowing and is now closer to 1.3:1.[5] The same pattern is not seen among blacks and Hispanics, where women comprise 68% and 60% of stone formers, respectively.[6,7]

Environment

Because warm climates are more conducive to stone disease, calculi prevalence increases in the United States from north to south and from west to east, with the greatest prevalence in the southeastern United States.[8] Accordingly, the warm summer months have the highest incidence of stone disease and workers who are regularly exposed to extreme heat (such as steel workers) have higher rates of stone disease than those who work at room temperature.[9,10]

Comorbidities

Comorbid health conditions influence the likelihood that a person will form urinary calculi. Risk of stone disease rises with increasing body mass index, particularly in women.[11] For each element of metabolic syndrome (centripetal obesity, hypertension, elevated blood sugar, high serum triglycerides, and low high-density lipoprotein level) a patient has, the risk of stone disease increases.[12] The mechanism for the increased risk is not yet completely understood. It is possible that the low urine pH and increased excretion of urinary oxalate, uric acid, sodium, and phosphorus associated with obesity and insulin resistance could predispose stone formation.[13]

PATHOPHYSIOLOGY

The development of stones in the urinary tract has many etiologies. Diet, medication, lifestyle, genetic and metabolic variations all influence stone formation. The underlying pathophysiologic basis of stone formation is unique to each stone type and can be an indicator of an underlying disease. The metabolism of minerals, such as calcium, phosphorus, magnesium, and oxalate, all play a role in the progression or inhibition of kidney stone formation (**Table 1**).

Calcium-based stones are the most common, accounting for approximately 80% of all stones. Calcium oxalate is the most common stone type, making up approximately 60% of all stones. Calcium phosphate (brushite and apatite) stones account for 20% of stones. The remaining stones are uric acid, struvite, cystine, ammonium acid urate, and medication related (eg, triamterene and indinavir).

Calcium Stones

The formation of calcium stones is mediated through several factors. Supersaturation of calcium and oxalate in the urine promotes stone formation, as do several metabolic derangements, including low urine volume, low or high urine pH, high urinary excretion of calcium, oxalate, and uric acid, and low urinary excretion of citrate.[14]