Urolithias is

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- **Urolithiasis** refers to the presence of calculi anywhere along the course of the urinary tract (**kidneys, ureters, a bladder,and a urethra).**

- Urinary calculi are the **third most common** affliction of the urinary tract, exceeded only by urinary tract infections and pathologic conditions of the prostate.

- **Nephrolithiasis** have been linked to systemic conditions such as obesity, diabetes, and metabolic syndrome.

- high worldwide prevalence with rates which range from 7 to 13% in North America, 5 to 9% in Europe, and 1 to 5% in Asia according to recent reports nephrolithiasis has been considered to be a male-predominant disease.

- No difference in stone prevalence between men and women under 50 years of age.

Stone formation theory

- formation of urinary tract stones is a result of increases in urinary ***supersaturation***
- Supersaturation depends on;

1 **urinary pH**
2 **ionic strength**
3 **solute concentration**
4 **complexation.**

(As ion concentrations increase, their activity product reaches a specific point termed the **solubility product (*K*sp)**. Concentrations above this point are capable of **initiating crystal growth and heterogeneous nucleation.)**

Also the formation of **crystalline particles** in the urine is based on the *thermodynamic state* of the urine chemistry.

- So, Stone development = urine **saturation**, urine **supersaturation**, **crystal nucleation**, and **aggregation**.

Stone Types

- Stones may be classified according to composition ,
- X-ray appearance, size, and shape.
- Stone classification is traditionally divided into two groups: **calcium based** and **non-calcium based** stones

Stone type		Frequency (%)
Calcium (80%)	Calcium oxalate monohydrate	35–55
	Calcium oxalate dihydrate	20–30
	Calcium phosphate	10–15
Non-calcium (20%)	Struvite	5–10
	Uric acid	5–10
	Cystine	1–2
	Urate (Ammonium acid, Sodium)	<1
	Xanthine	<1
	Drug-induced	<1

Radiodensity on X-ray

Three broad categories of stones are described, based on their X-ray appearance and determining their composition.

1 Radio-opaque Opacity

Calcium phosphate stones are the most radio-dense stones, being almost as dense as bone.

Calcium oxalate stones are slightly less radio-dense.

2 Relatively radiolucent on plain X-ray

Cystine stones are relatively radio-dense because they contain Sulphur.

Magnesium ammonium phosphate (struvite) stones are less radio-dense than calcium-containing stones.

3 Completely radiolucent on plain X-ray

Uric acid, triamterene, xanthine, indinavir.

Infectious Urolithiasis (struvite)

Infectious stones are composed of ***magnesium ammonium phosphate***, which may be present purely or in mixed composition with other stone types, often carbonate apatite and hydroxyapatite.

These calculi occur *secondary to urinary tract infection* by urease–splitting bacteria. (Bacterial urease splits urea and promotes the formation of ammonia and carbon dioxide leading to **urine alkalinization** and formation of phosphate salts = stones)

Proteus, Klebsiella, Providencia, Morganella, Corynebacterium, and Ureaplasma species.

Cystine Urolithiasis

Cystinuria is a hereditary condition, usually with an autosomal recessive inheritance pattern, which is characterized by defective resorption of the dibasic amino acids cystine, ornithine, lysine, and arginine within the proximal renal tubule.

Xanthine stones

Xanthine stones are secondary to a congenital deficiency of *xanthine dehydrogenase*. This enzyme normally catalyzes the oxidation of hypoxanthine to xanthine and of xanthine to uric acid.

It is of interest that **allopurinol**, used to treat hyperuricosuric calcium nephrolithiasis and uric acid lithiasis, produces ***iatrogenic xanthinuria***. Blood and urine levels of uric acid are lowered, and hypoxanthine and xanthine levels are *increased*; however, there are *no* case reports of xanthine stone formation resulting from allopurinol treatment.

EVALUATION

1-History

Pain:

Upper tract urinary stones frequently cause pain when passing down the ureter. The character of the pain depends on the location.

Calculi small enough to venture down the ureter usually have difficulty passing through the ureteropelvic junction, or entering the bladder at the ureterovesical junction.

- Renal colic and noncolicky renal pain are the two types of pain originating from the kidney.

~ Renal colic usually is caused by stretching of the collecting system or ureter.

~ Non-colicky renal pain is caused by distention of the renal capsule. Local mechanisms such as inflammation, edema, hyperperistalsis, and mucosal irritation may contribute to the perception of pain in patients with renal calculi

Ureteropelvic stone: Severe costovertebral angle pain from capsular and pelvic distention.

Midureteral stone: more pain in the lower abdomin quadrant.

Low uereteral stone: pain radiating into bladder, vulva and scrotum

When the stone approaches the bladder, urgency and frequency with burning on urination develop as a result of inflammation of the bladder wall around the ureteral orifice

the pain is acute and abrupt in onset that may awake patient from sleep, and they try to move to relieve the pain, differs from acute abdomen that prevents patient's movement.

1-
Hematouria:

We can detect it by complete urinalysis, or by gross hematuria or tea coloured urine (Old blood).

2-Infection:

Magnesium ammonium phosphate is most common stone that causes infection, followed by Calcium phosphate stones.

They are commonly associated with Proteus, Pseudomonas, Providencia, Klebsiella, and Staphylococcus infections.

Stasis and obstruction is a factor for infections thus we should do cultures and start antibiotics accordingly.

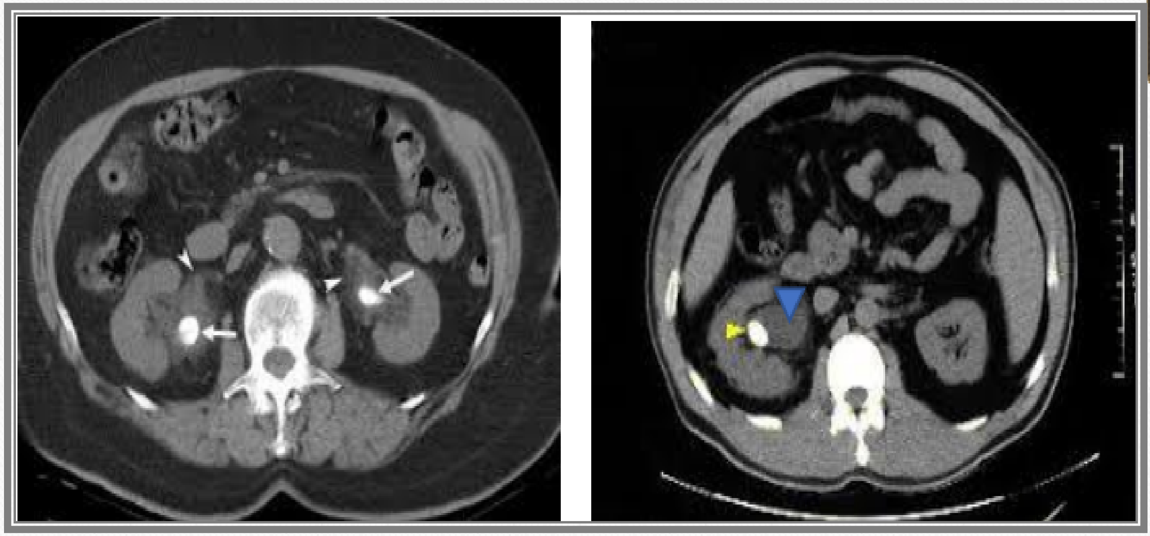
3-Fever:

As a result from infection, and it is a relative medical emergency

4-Nausea and Vomiting

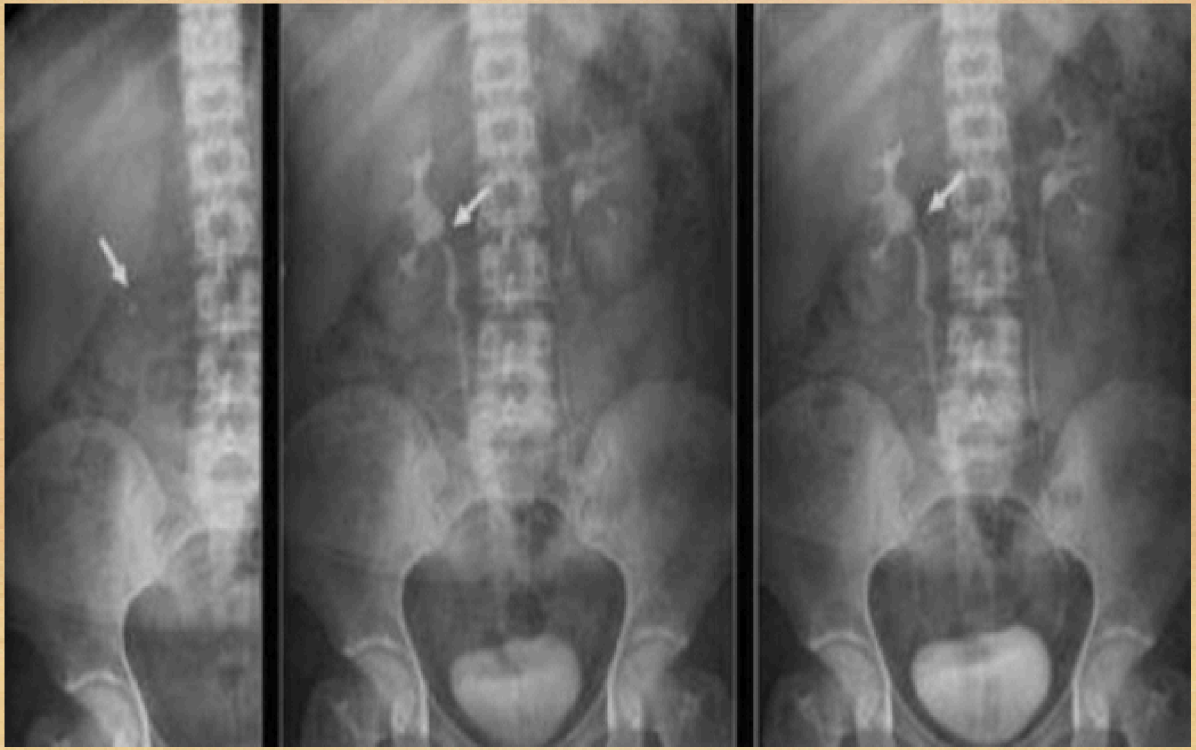
Evaluation: Radiologic Investigations

- 1. Computed tomography—Noncontrast spiral CT scans are now the imaging modality of choice in patients presenting with acute renal colic. It is rapid and is operator independent.

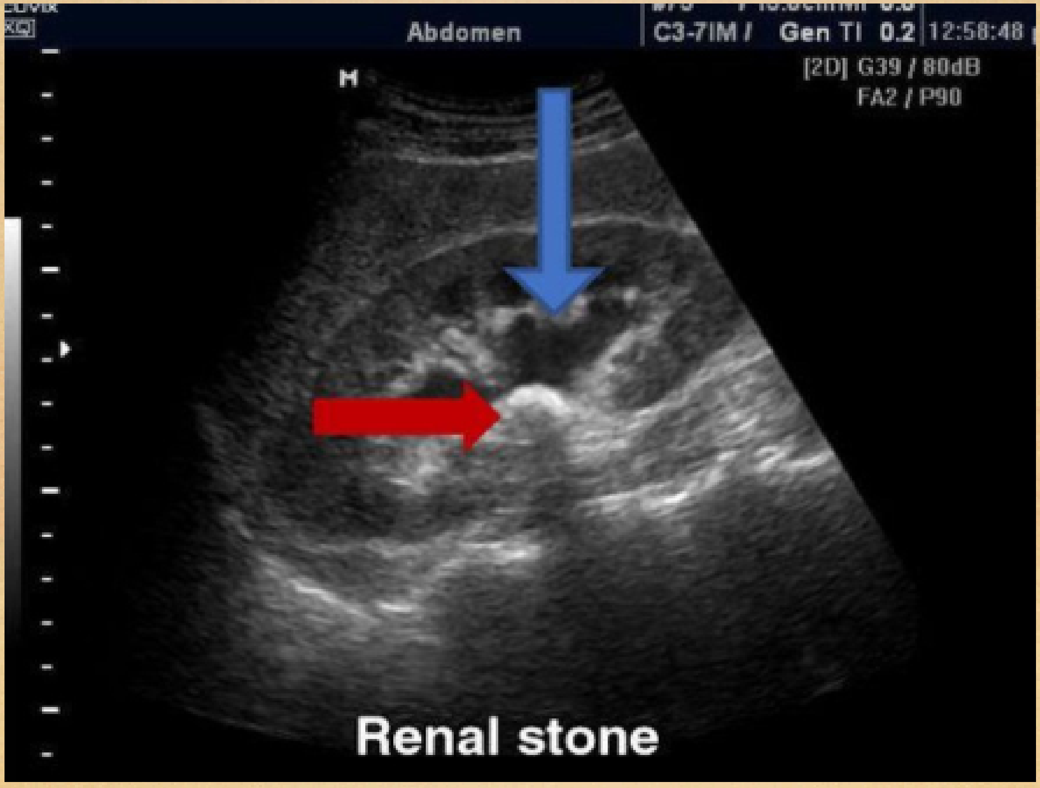


2. Intravenous pyelography

An IVP can simultaneously document nephrolithiasis and upper tract anatomy. It is rarely used today with the widespread availability of CT scanners and ultrasound machines. Extraosseous calcifications on radiographs may be erroneously assumed to be urinary tract calculi.



3. The ultrasound examination should be directed by notation of suspicious areas seen on a KUB film; it is, however, operator-dependent. The distal ureter is easily visualized through the acoustic window of a full bladder. Ultrasound imaging by a trained emergency physician, or by a radiologist appears just as useful when compared to CT imaging for the acute diagnosis of urinary stones.



4. KUB films

A KUB film and renal ultrasound may be as effective as a CT scan in establishing a diagnosis.

3- Risk Factors

1. **Crystalluria**

Crystalluria is a risk factor for stones. "***Stone formers***", especially those with calcium oxalate stones.

2. **Socioeconomic factors**

Renal stones are more common in affluent, industrialized countries. Immigrants from less industrialized nations gradually increase their stone incidence and eventually match that of the indigenous population. Use of soft water does not decrease the incidence of urinary stones.

3. Diet

Vegetarians may have a decreased incidence of urinary stones. *High sodium intake* is associated with increased urinary sodium, calcium, and pH. *Fluid intake and urine output* may affect urinary stone disease. The average daily urinary output in stone formers is 1.6 L.

4. Occupation

Occupation can have an impact on the incidence of urinary stones. *Physicians* and other white-collar workers have an increased incidence of stones compared with manual laborers. This finding may be related to differences in diet but also

5. Climate

Individuals living in *hot climates* are prone to dehydration, which results in an increased incidence of urinary stones, especially uric acid calculi.

Although heat may cause a higher fluid intake, sweat loss results in lowered voided volumes. Hot climates usually expose people to more ultraviolet light, increasing vitamin D3 production. Increased calcium and oxalate excretion have been correlated with increased exposure time to sunlight.

6. **Family history**

A family history of urinary stones is associated with an increased incidence of renal calculi. A patient with stones is twice as likely as a stone-free cohort to have at least one first-degree relative with renal stones (30% vs 15%). Those with a family history of stones have an increased incidence of multiple and early recurrences. Large studies of identical twins have found that >50% of stones have a significant genetic component.

7. **Medications**

A thorough history of medications taken may provide valuable insight into the cause of urinary calculi. The **antihypertensive medication** triamterene is found as a component of several medications, including Dyazide, and has been associated with urinary calculi with increasing frequency. Long-term use of **antacids** containing silica has been associated with the development of silicate stones. **Carbonic anhydrase inhibitors** may be associated with urinary stone disease (10–20% incidence). **Protease inhibitors** in immunocompromised patients are associated with radiolucent calculi.

Stone-inducing medications		
Medications	Direct stone promotion	Indinivir (and other antiretroviral protease inhibitors)
		Ciprofloxacin
		Triamterene Silicates
		GuaifenesinfEphedrine
		Sulfa Medications
	Indirect stone promotion	Carbonic anhydrase inhibitors (Acetazolamide. Topiramaie. Zonisamide)
		Long term loop
		diuretics Chronic corticosteroid use
		Vitamin D and Calcium Supplements
		Vitamin C Supplements
		Chemotherapy

Intervention

1. **Conservative Observation**

Most ureteralcalculi pass and do not require intervention.

Spontaneous passage depends on stone size, shape, location, and associated ureteraledema (which is likely to depend on the length of time that a stone has not progressed). Ureteralcalculi 4–5 mm in size have a 40–50% chance of spontaneous passage.

Medical expulsive therapy (MET) helps facilitate spontaneous passage of ureteralstones. An -α-blocker, nonsteroidalanti-inflammatory medications with or without low-dose steroids has been studied to optimize spontaneous ureteralstone passage.

2. **Dissolution Agents**Oral alkalinizing agents used for uric acid dissolution include sodium or potassium bicarbonate and potassium citrate. Struvitestone dissolution requires acidification and may be achieved successfully with Suby'sG solution and hemiacidrin (Renacidin).

Urgent intervention is indicated in patients with:

1-obstructed upper urinary tract

2-infected upper urinary tract

3-impending renal deterioration

4-intractable pain

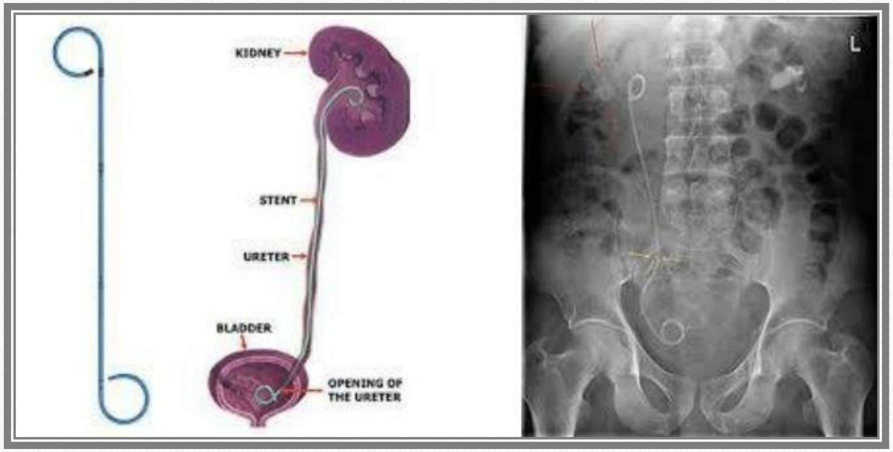
5-Vomiting

6-Anuria

7-solitary or transplanted kidney.

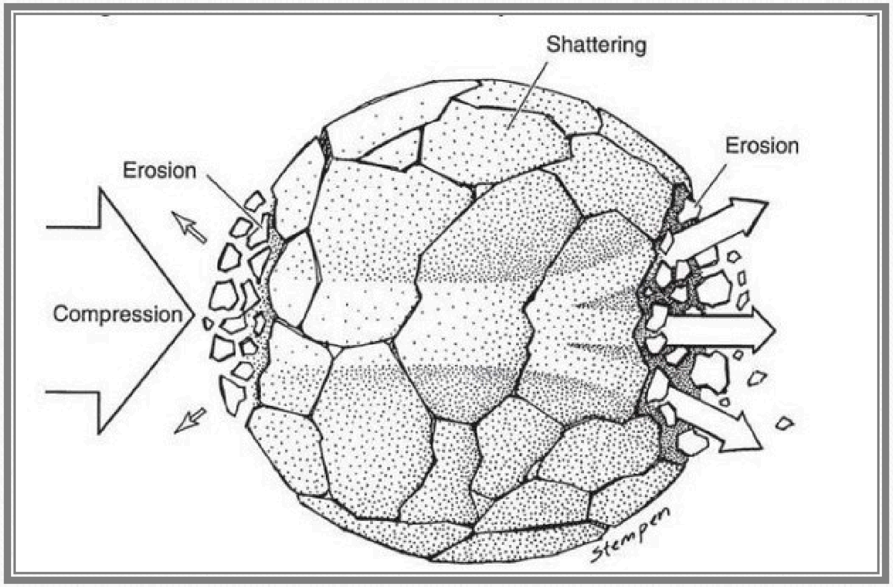
3. Relief from Obstruction

- A patient with obstructive urinary calculi with fever and
  - infected urine requires emergent drainage. Retrograde pyelographyto define upper tract anatomy is logically followed by retrograde placement of a *double-J*ureteral stent. On occasion, such catheters are unable to bypass the offending calculus or may perforate the ureter. In such situations, one must be prepared to place a percutaneous nephrostomytube.



4. Extracorporeal Shockwave Lithotripsy

- Extracorporeal SWL has revolutionized the treatment of urinary stones. All shockwaves, despite their source, are capable of fragmenting stones when focused.
- Fragmentation is achieved by erosion and shattering.



Patients with large renal pelvic calculi (1.5 cm) have a stone-free rate at 3 months approximating 75%, in comparison with those with a similar stone in a lower calyx, which approximates only 35%.

Patients with small renal pelvic stones (<1.5 cm) have approximately a 90% stone-free rate in comparison with those with similar stones in a middle calyx (approximately 75%) or lower calyx (approximately 50%).

75% of patients with renal calculi treated with SWL become stone-free in 3 months. As stones increase in size, stone-free rates decrease, more so in the lower and middle calyces than in superior calycealand renal pelvic locations.

5. UreteroscopicStone Extraction

Ureteroscopic stone extraction is highly efficacious for lower ureteral calculi. The use of small-caliber ureteroscopes and the advent of balloon dilation or ureteral access sheaths have increased stone-free rates dramatically. Even relatively large-caliber endoscopes without balloon dilation are effective in lower ureteral stone retrieval

It is likely that disposable ureteroscopes will become more common to ensure a functional, clean, and available instrument. Stone-free rates approach 95–100% and are dependent on stone burden and location, length of time that the stone has been impacted, history of retroperitoneal surgery, and the experience of the operator.

A variety of lithotrites can be placed through an ureteroscope, including electrohydraulic, solid and hollow-core ultrasonic probes, a variety of laser systems, and pneumatic systems.

6. Percutaneous Nephrolithotomy

Percutaneous removal of renal and proximal ureteral calculi is the treatment of choice for large (>2.0 cm) calculi; those resistant to SWL; select lower pole calyceal stones with a narrow, long infundibulum and an acute infundibulopelvic angle; and instances with evidence of obstruction;

Percutaneous extraction of calculi requires patience and perseverance. Residual calculi can be retrieved with the aid of flexible endoscopes, additional percutaneous puncture access, follow-up irrigations, SWL, or additional percutaneous sessions.

7. Open-Stone Surgery

Open-stone surgery is the historic way to remove calculi, yet it is rarely used today.

Prevention

In general, 50% of patients experience recurrent urinary stones within 5 years without prophylactic intervention.

-Appropriate education and preventive measures Risk factors should be identified and modified Fluid intake should result in about 1.5–2.0 L of urine/24 hours. Fluids should be encouraged during mealtime. In addition, liquids should be increased approximately 2 hours after meals.

1. Metabolic Evaluation

A systematic metabolic evaluation should be instituted after a patient has recovered from urinary stone intervention or spontaneous stone passage. Stone analysis should be obtained to help direct the workup. An outpatient urine collection during typical activities and fluid intake helps unmask significant abnormalities. An initial 24-hour urine collection for calcium stone formers should include tests for calcium, uric acid, oxalate, citrate, phosphate, sulfate, sodium, volume, and pH.

Baseline serum levels for blood urea nitrogen, creatinine, calcium (with or without parathyroid hormone), phosphorous, and uric acid

2. Oral Medications
1.Alkalinizing pH agents (Potassium citrate):

- It is indicated in those with calcium oxalate calculi secondary to hypocitraturia(<450 mg/day), including those with renal tubular acidosis.
- Potassium citrate also may be used effectively to treat uric acid lithiasisand milder forms of hyperuricosuriccalcium nephrolithiasis.

- 2. Gastrointestinal absorption inhibitor
  - Cellulose phosphate binds calcium in the gut and thereby inhibits calcium absorption and urinary excretion and is appropriate for patients with type 1 absorptive hypercalciuria.

3. Phosphate supplementation

Renal phosphate leak is best treated by replacing phosphate.

4. Diuretics

*Thiazides*can correct the renal calcium leak associated with renal hypercalciuria.

5. Calcium supplementation

Enteric hyperoxaluriccalcium nephrolithiasisis effectively treated with calcium supplements.

6. Uric acid

lowering medications—Allopurinolis used to treat hyperuricosuriccalcium nephrolithiasis with or without hyperuricemia.

7. Urease inhibitor Acetohydroxamicacid is an effective

adjunctive treatment in those with chronic urea-splitting urinary tract infections associated with struvitestones.

. Prevention of cystinecalculi

Conservative measures, including massive

fluid intake and urinary alkalinization, are frequently inadequate to control cystine stone formation. Penicillamine, Mercaptopropionylglycine (Thiola).

THANK YOU