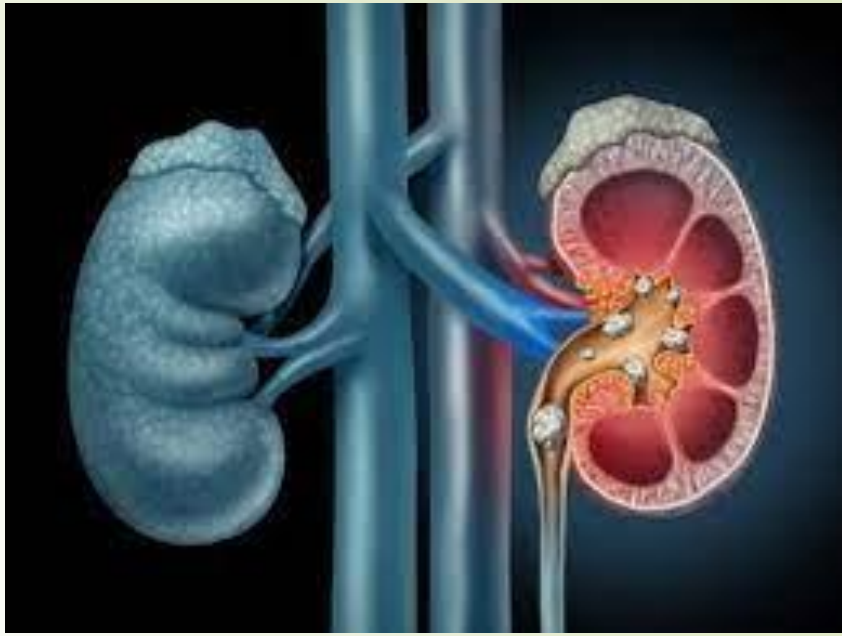

# Management of urolithiasis

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# Introduction


- Nephrolithiasis is a common disease entity around the world, with an increasing prevalence and incidence
- patients with kidney stones are more likely to experience many complications, including cardiovascular and CKD , UTI , and fractures

# Introduction


- The need for medication is determined by the results of 24-h urine analysis and the risk level of the patient
- The metabolic workup should be individualized according to the stone type and the severity of the disease

# Introduction


- High fluid intake, reduced soft drink intake, low animal protein diet, normal levels of calcium, low salt reduce numbers of stone recurrences
- The DASH-style diet that is high in fruits and vegetables, moderate in low-fat dairy products, low in animal proteins and salt is associated with a marked decrease in risk of incident stone formation

# Diagnostic evaluation

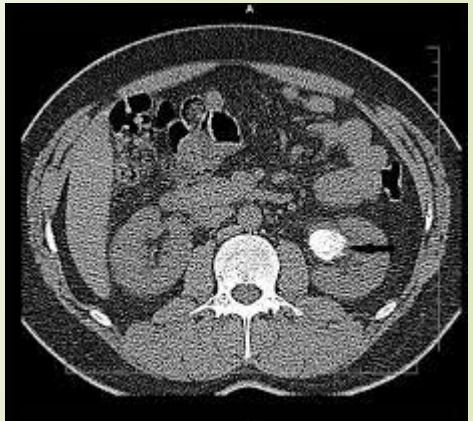

- Standard evaluation includes a detailed medical history and physical examination
- Patients with ureteral stones usually present with pain, vomiting, and sometimes fever, but may also be asymptomatic
- Immediate evaluation is indicated in patients with solitary kidney, fever

# Acute flank pain/suspected ureteral stones

- Ultrasound (US) should be used as the primary diagnostic imaging tool, although pain relief, or any other emergency measures, should not be delayed by imaging assessments
- Ultrasound is safe (no risk of radiation), reproducible and inexpensive
- It can identify stones located in the calyces, pelvis, and pyeloureteric and vesico-ureteral junctions

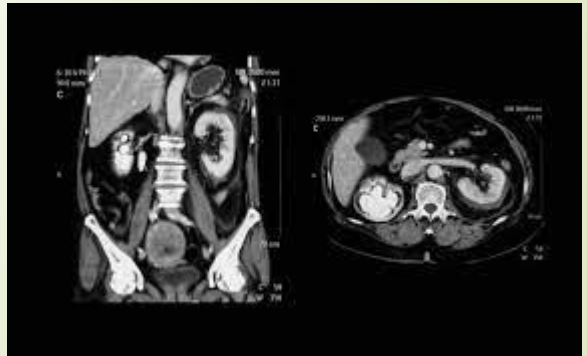
# Evaluation of patients with acute flank pain/suspected ureteral stones

- CT has become the standard for diagnosing acute flank pain and has replaced IVU
- Non-contrast-enhanced CT can detect uric acid and xanthine stones, which are radiolucent on plain films, but not indinavir stones
- NCCT can determine stone density, inner structure of the stone, skin-to-stone distance, and surrounding anatomy; all of which affect selection of treatment modality



# Diagnostic imaging during pregnancy

- In pregnant women radiation exposure may cause teratogenesis effects.
- Ultrasound become the primary radiological diagnostic tool when evaluating pregnant patients suspected of renal colic
- MRI can be used, as a second-line option , to define the level of urinary tract obstruction
- The use of gadolinium is not routinely recommended in pregnancy to avoid toxic effects to the embryo



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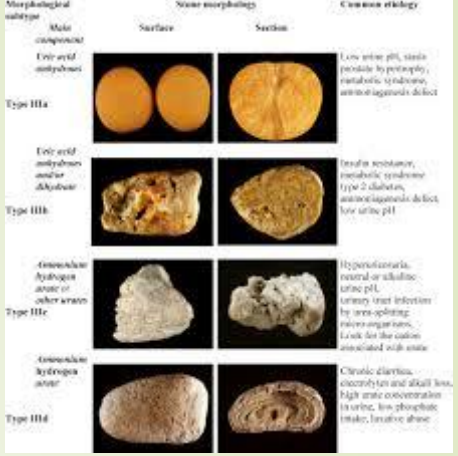
# Analysis of stone composition



- Stone analysis should be performed in all first-time stone formers.
- Repeat stone analysis is needed in the case of:
  - Recurrence under pharmacological prevention
  - Early recurrence after interventional therapy with complete stone clearance
  - Late recurrence after a prolonged stone-free period

# Disease Management

- The treatment of urolithiasis is based on many parameters and is individualised for each patient
- Parameters such as the size, number, location, and constitution of the stones are cornerstones for deciding the treatment

# Renal colic


## Pain relief

- NSAIDs and paracetamol are effective in patients with acute stone colic , and have better analgesic efficacy than opioids
  - Although diclofenac can affect renal function in patients with already reduced function, it has no functional effect in patients with normal renal function
- Opioide

# Management of sepsis and/or anuria in obstructed kidney

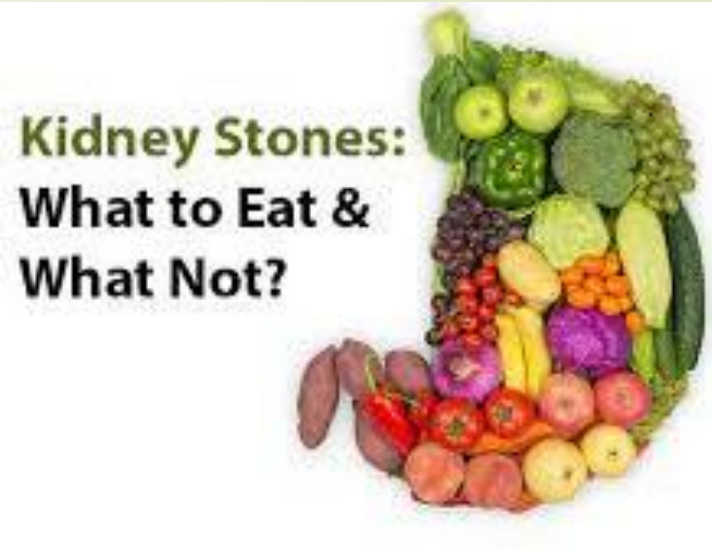
- The obstructed kidney with all signs of UTI and/or anuria is a urological emergency.
- Urgent decompression is often necessary to prevent further complications in infected hydronephrosis secondary to stone-induced, unilateral or bilateral, renal obstruction

# General considerations for recurrence prevention

**Table 4.5: General preventive measures**

| | |
|---|---|
| Fluid intake (drinking advice) | Fluid amount: 2.5-3.0 L/day |
| | Fluid amount: 2.5-3.0 L/day |
| | Water is the preferred fluid |
| | Diuresis: 2.0-2.5 L/day |
| | Specific weight of urine: < 1,010 g/day |

# General considerations for recurrence prevention




| | |
|---|---|
| Nutritional advice for a balanced diet | Balanced diet* |
| | Rich in vegetables and fibre |
| | Normal calcium content: 1-1.2 g/day |
| | Limited NaCl content: 4-5 g/day |
| | Limited animal protein content: 0.8-1.0 g/kg/day |
| Lifestyle advice to normalise general risk factors | BMI: Retain a normal BMI level |
| | Adequate physical activity |
| | Balancing of excessive fluid loss |
| | Reduce the intake of alcohol containing fluids |
| | Reduce the intake of sodas and calorie-containing fluids |

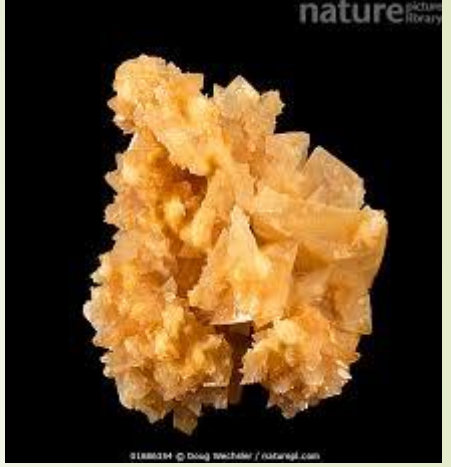
# Medical expulsive therapy

- Several drug classes including a-blockers, calcium channel inhibitors and phosphodiesterase type 5 inhibitors (PDEI-5) are used for MET
- The panel concludes that MET using a-blockers seems efficacious in the treatment of patients with distal ureteral stones > 5 mm

# Calcium oxalate stones

- Calcium oxalate (CaOx) is the most prevalent type of kidney stones.
- Calcium containing stones may exist in the form of pure calcium oxalate (50%) or calcium phosphate (5%) or a mixture of both (45%)
- Urinary risk factors for calcium stone formation include
  - hypercalciuria
  - hypocitraturia
  - hyperoxaluria
  - combination

# Hypercalciuria

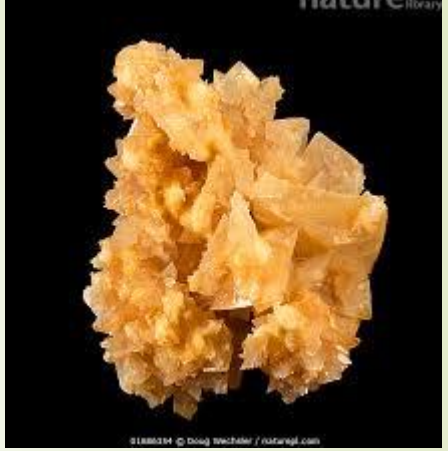


- Dietary measures such as a low-sodium, low-animal-protein diet is beneficial in reducing hypercalciuria.
- The only medical therapy directed at reducing urinary calcium is the usage of thiazide diuretics.
- Thiazide prescription is associated with decreased urinary citrate, this is caused by thiazide-induced hypokalemia, which would stimulate citrate reabsorption in the proximal tubules

# Hypercalciuria

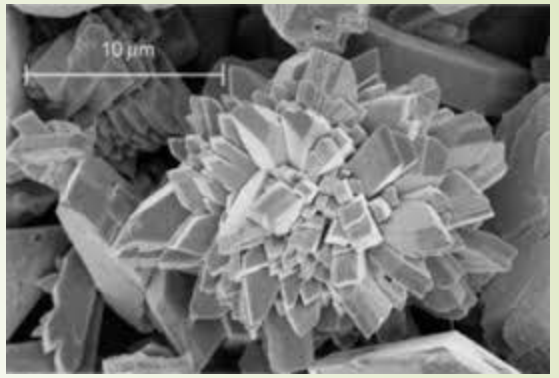

- Restriction of dietary calcium intake is recommended only when hypercalciuria is due to excessive intestinal calcium absorption, such as with uncontrolled sarcoidosis
- Dietary calcium intake should be maintained at 1,000-1,200 mg/day because restriction can exacerbate bone mineral loss and cause hyperoxaluria due to enhanced intestinal oxalate absorption

# Hypercalciuria



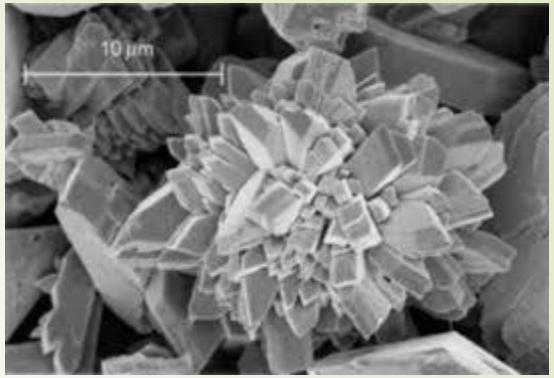
- Moderate restriction of animal-derived protein can be considered.
- Bisphosphonates have been suggested because they reduce urine calcium in some cases and treat associated osteoporosis

# Hypocitraturia



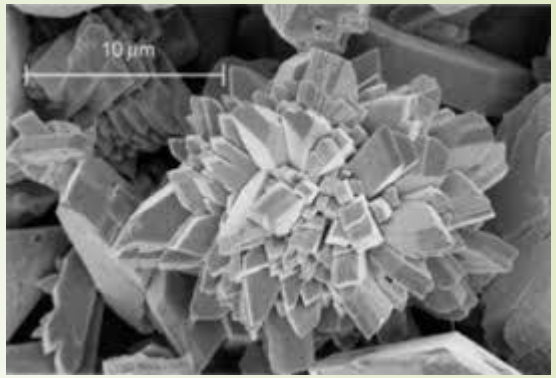

- Citrate supplements are available as sodium and potassium salts, but potassium is the preferred citrate compound because the sodium salt can increase urinary calcium excretion

# Hypocitraturia



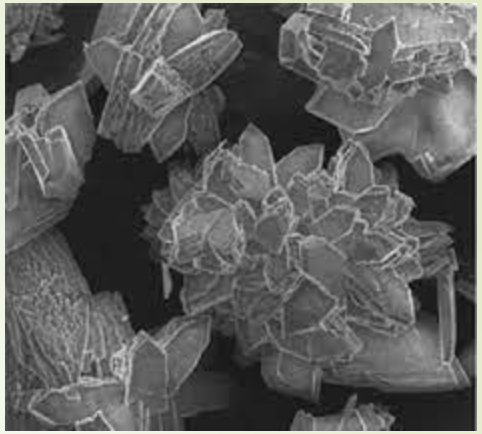

- Potassium citrate is available in 3 preparations as tablets, crystals for oral solution, and oral solution.
- Typical doses of potassium citrate for adults with idiopathic hypocitraturia and normal renal function range from 40 to 60 mEq per day
- Serum potassium needs to be monitored closely for hyperkalemia among patients with reduced kidney function

# Hypocitraturia



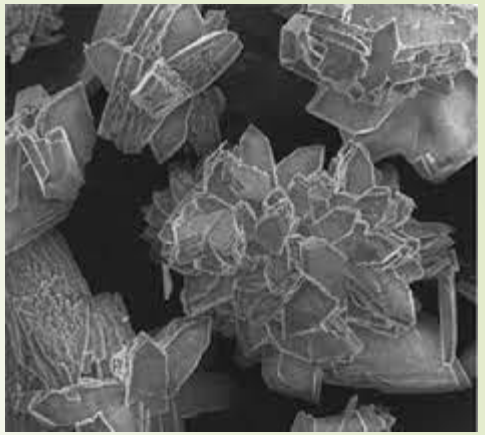

- Potassium citrate is commonly used in combination with a thiazide diuretic in the medical management of recurrent hypercalciuric nephrolithiasis
- Combining thiazide diuretics with potassium citrate or potassium chloride prevents hypokalemia and hypochloremic metabolic alkalosis

# Hyperoxaluria



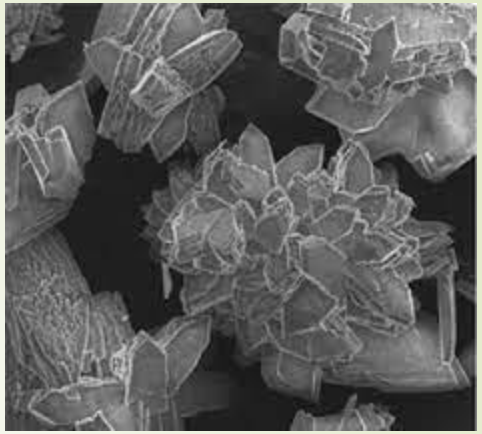
- A large daily fluid intake is important in all types of PH
- In PH1, it is recommended to have a high fluid intake of at least 3 L/m2 per 24 h.
- Vitamin B6 (pyridoxine) should be used in any patients with proven PH1, starting at a dose of 5 mg/kg per day and not exceeding 20 mg/kg per day.
- Oral potassium citrate at a dose of 0.10–0.15 g/kg per day

# Hyperoxaluria



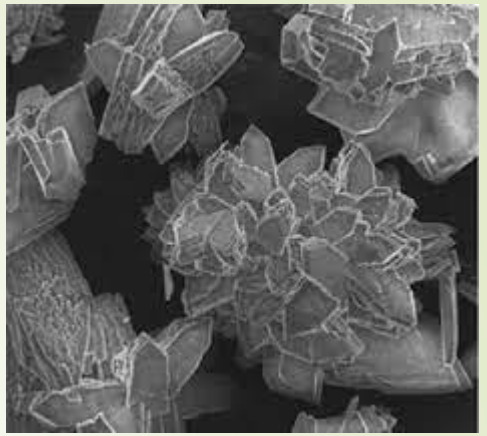
- Increasing urine volume in individuals with chronic diarrhea can be very challenging.
- Restriction of dietary oxalate to <100 mg/day
- Excessive intake of vitamin C should be avoided.
- Calcium carbonate or citrate given with meals reduces oxalate absorption.

# Hyperoxaluria



- Isolated liver transplantation can correct the metabolic defect before significant renal damage occurring
- combined hepato-renal transplantation is required once end stage renal disease has occurred

# Hyperoxaluria



- In SH, the most important strategy is increasing fluid intake in order to increase the urine output to more than 2–3 L per day.
- Orally calcium supplements with the meals to promote binding of dietary oxalate and decreased its intestinal absorption
- Cholestyramine uses a bile acid sequestrant to reduce oxalate hyperabsorption in the presence of enteric hyperoxaluria

# Calcium phosphate stones

- Discontinuation of offending medications that increase urine pH is critical
- Increasing urine volume and lowering the urine calcium excretion rate by sodium restriction and thiazides are reasonable initial interventions to decrease supersaturation to the goal of <1.

# Calcium phosphate stone

- Potassium citrate should be used cautiously because it raises urine pH, potentially worsening calcium phosphate supersaturation
- Citrate should be assessed after starting therapy; if citrate does not rise, the medication should be stopped

# Hyperuricosuria

- The results showed that febuxostat (80 mg) once daily lowered 24-hour urinary uric acid excretion significantly more than allopurinol (300 mg) in recurrent stone formers with higher urinary uric acid excretion.
- Despite the greater reduction in 24-hour urinary uric acid level when compared to allopurinol, there was no change in stone size or number at six months

# Uric acid stone

- Treat chronic diarrhea if it is present and advise a lower animal protein intake.
- Alkali therapy to maintain a 24-h urine pH between 6.0 and 6.5 is effective at reducing stone recurrence.
- Oral potassium citrate is usually administered with an adult dosage of 15–30 mEq twice daily.

# Uric acid stone

- Potassium salts are a better choice than sodium salts
- Sodium bicarbonate may substitute potassium citrate if the gastrointestinal side effects of potassium citrate are intolerable.
- The normal adult prescription of sodium bicarbonate is normally 650–1000 mg three or four times a day
- Acetazolamide is effective in increasing the urinary pH in patients with uric acid who were not responsive to potassium citrate therapy

# Uric acid stone

- Uric acid stone formers should rarely be treated with xanthine oxidase inhibitors like allopurinol unless clinical gout is present, or hyperuricosuria is severe
- They are always indicated in patients with hyperuricosuria :
  - myeloproliferative disorders
  - hemolytic anemia
  - tumor lysis syndrome

# Uric acid stone

- The usual dose range of allopurinol  for adults is 100 to 300 mg/d
- In the patient with renal insufficiency, the dose should be adjusted to creatinine clearence
- Adverse reactions include gastrointestinal upset, precipitating acute gout attacks, Stevens-Johnson syndrome, and hypersensitivity syndrome

# Cystine stone

- For cystine stone formers, cystinuria is a chronic condition, with no definitive treatment; it is diagnosed in early age and can lead to kidney failure if it is not appropriately treated.
- Initial management is through conservative means such as
  - decreased intake of methionine containing foods
  - urinary alkalinization up to pH 7.5
  - increased fluid intake.

# Cystine Stones

- Urinary pH has a crucial role in the prevention of stone formation
- The solubility of cystine is enhanced when the urine pH is maintained between 7.0 and 7.5
- Although protein restriction may assist in achieving this, potassium citrate or sodium bicarbonate therapy is typically necessary

# Cystine stone

- Hydration is the first step in the medical management by increasing fluid intake sufficiently to produce 2–3 L/day of urine.
- Patients should drink 240 mL of water every hour during the day and 480 mL before bed and at least once during the night.
- They should monitor the specific gravity of their urine using reagent strips, with a goal of achieving a value less than 1.010

# Cystine Stones

- Treatment of cystinuria is aimed at decreasing the urinary cystine concentration to < 250 mg/L by
  - increasing urine volume,
  - restricting dietary sodium,
  - reducing methionine and cystine intake through dietary restriction of animal protein

# Cystine stone

- D-penicillamine, a-mercaptopropionyl glycine (tiopronin).
- These drugs have the ability to dissociate the cystine molecule into disulfide moieties with much higher solubility
- Tiopronin dose starting at 800 mg/day divided into two or three times daily
- The dosage should be readjusted depending on the urinary cystine value to achieve a urine cystine concentration of less than 250 mg/L

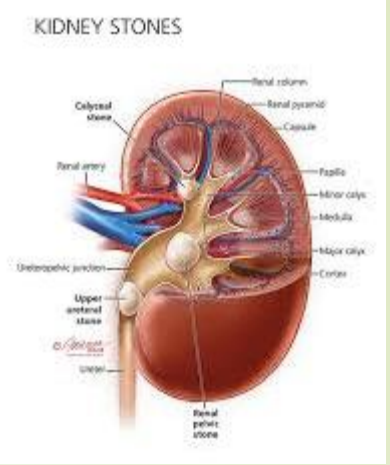
# Cystine stone

- Captopril can be used for cystinuria, it form captopril-cysteine disulfide complex which is 200 times more soluble than cystine
- long-term captopril therapy may be useful in the treatment of cystinuria with 150 mg or 75 mg dose per day

# Struvite stone

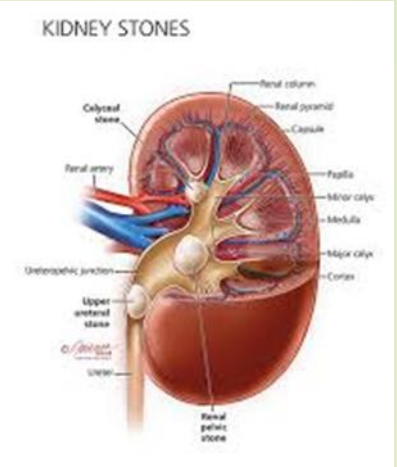
- The three key principles of treating struvite stones are
  - removal of all stone fragments,
  - the use of antibiotics to treat the infection,
  - prevention of its recurrence
- When selecting antibiotics to treat infection, it is necessary to acquire a stone culture or urine culture from the renal pelvis
- Acidification of the urine to less than pH 6.5 can greatly increase the solubility of this type of infection stone

# Take home massage




- All stone formers, independent of their risk, should follow the preventive measures such as increasing their fluid intake, eating a balanced diet rich in fruit and vegetables and reduced their salt intake.
- The fluid amount should be 2.5–3.0 L/day to obtain a diuresis of 2.0–2.5 L/day.
- Medical management of recurrent stone formers should be based on the process of correcting the specific abnormalities of the 24-hour urine collection

# Take home massage




- A follow-up 24-h urine study is important after the initiation of preventive therapy; it is recommended within 8–12 weeks of treatment.
- It is also advised to perform a repeat 24-h urine evaluation every 12 months, once therapy is stabilized.

EXPERT OPINION ON PHARMACOTHERAPY
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REVIEW



# Established and recent developments in the pharmacological management of urolithiasis: an overview of the current treatment armamentarium

Mohamed Abou Chakra[a], Athanasios E. Dellis[b], Athanasios G. Papatsoris[c] and Mohamad Moussa[a]

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# EAU Guidelines on Urolithiasis

Core Curriculum in Nephrology

AJKD

# Kidney Stone Pathophysiology, Evaluation and Management: Core Curriculum 2023

*Shani Shastri,* Jiten Patel,* Kamalanathan K. Sambandam, and Eleanor D. Lederer*

# Thank you