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## A review on renal stone and its management

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### Abstract

Renal stone is a common global disease occurs in patients and is economic burden. The prevalence of kidney stones in the developed nations ranges from 4–20%. Renal stones are of 4 types such as calcium stones, Cystine stones, Struvite stones, uric acid stones, Various dietary, non-dietary and urinary risk factors contribute to their formation, Their frequent association with systemic diseases like hypertension, diabetes and obesity, highlights the role of dietary and lifestyle changes in their occurrence, recurrence, and possible prevention. Non-contrast computed tomography (CT) identifies almost every stone and is the preferred investigation for identification. Treatment includes Lithotripsy, Extracorporeal shock wave lithotripsy (ESWL), Shockwave lithotripsy (SWL), Laser lithotripsy. Herbal drugs such as basil, parsley, guava, apple cider vinegar etc are used for treating the kidney stones. This review discusses the formation, and covers risk factors and management of renal stones

**Keywords:** Renal stone, water, computed tomography CT, Shockwave lithotripsy SWL

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### Introduction

The formation of kidney stone is also known as renal calculi or crystal. It is a serious though not life-threatening disorder prevalent throughout the world. On an average 6% woman and 12% men are affected with renal stone. Recurrence rate of nephrolithiasis is 70-80% in males and 47-60% in females, with majority 80% of calcium oxalate stone in medical terminology condition of having urinary calculi is termed as nephrolithiasis and urolithiasis. Renal calculi are crystalline structures composed most commonly of calcium oxalate salts. They form when the concentrations of these ions, as well as solutes such as hydrogen ions, sodium ions and uric acid are present in the filtrate are higher than normal amounts. This condition is known as supersaturation and supersaturated ions are more likely to come out of solution and crystallize. Risk factors for supersaturation include dehydration, high fat diet, animal protein, high salt intake and obesity. The stones may remain in the collecting system or may break off and lodge in the calyces, renal pelvis and ureter. Symptoms include hematuria (blood in the urine), sweating, nausea and vomiting<sup>[1]</sup>.

### Epidemiology

Urolithiasis occurs in one out of 20 people at some time in their lives. Calcium stones are mostly found in the patients and the average age of onset is third to fourth decade (30-40years). 5% of populations is effected from kidney stone, with a lifetime risk of passing a kidney stone about 8-10%. In India, approximately 5-7 million people suffer from this disease and at 1/1000 of population of our country needs hospitalization due to urolithiasis and the prevalence increasing throughout the industrialized world<sup>[2]</sup>.

### Causes/Etiology of renal Calculi

The leading cause of kidney stones is a lack of water in the body. Stones are more commonly found in individuals who drink less than the recommended eight to ten glasses of water a day. When there is not enough water to dilute the uric acid, a component of urine, the urine becomes more acidic. An excessively acidic environment in urine can lead to the formation of kidney stones. Medical conditions such as Crohn's disease, urinary tract infections, renal tubular acidosis, hyperparathyroidism, medullary sponge kidney, and Dent's disease increase the risk of kidney stones<sup>[3]</sup>.

### The Urinary System

- The two kidneys, parts of the urinary tract system, regulate the mineral composition, water content and acidity of the body.
- The human urinary system is also involved in the excretion of metabolic waste products and chemicals, and responsible for the production of certain hormones and vitamins, and also have a key role in blood pressure regulation.
- Removal of wastes occurs in tiny units inside the kidney known as nephrons; inside each nephron is a glomerulus which acts as a sieve-like filtering unit
- A critical function of the urinary system is the maintenance of normal composition and volume of body fluid, this is accomplished by glomerular filtration, tubular reabsorption, and tubular secretion of soluble and filterable plasma components, By such means, urine contains water, electrolytes, minerals, and hydrogen ions, end products of protein metabolism such as urea, uric acid, and creatinine<sup>[4]</sup>.

### Different functions of urinary system

- Excretion of metabolic waste product, Regulates the fluid volume, Regulates different electrolytes, Maintain the pH of blood Homeostasis, Eliminates toxins Separates urea and mineral salts Mineral and salt balance [5]

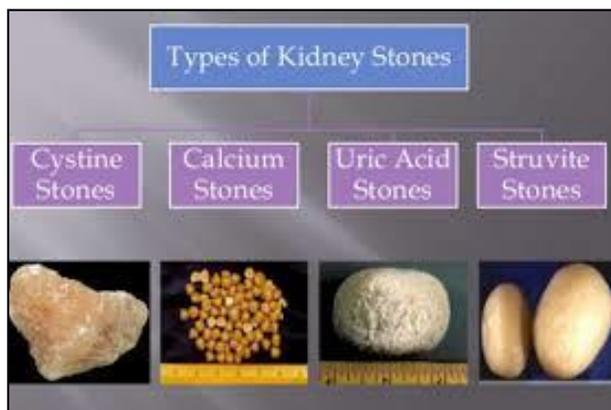
### Renal calculi

- A renal calculus is a solid crystalline mineral material that accumulates in the urinary system when one more crystal forming material separates from the supersaturated urine. Renal calculi results from the growth of crystal to form in to large lumps or aggregate of crystals or in to stone. Primary component of renal calculi is salt, mineral and other constituents found in urine.
- Renal calculi grow slowly over several days to month. Renal calculi are found in different sizes, some are as small as like grain of sand or large as pearls and big as golf ball [5].

### Symptoms of renal calculi

- Discomfort in the side and back and below the ribs. Discomfort, pain and on urination, Nausea and vomiting, Persistent urge to urinate, Discomfort waves radiating from the side and back to the lower abdomen and groin, Bloody, cloudy or foul-smelling urine, Fever and chills if an infection is present [5]

### Types of kidney stones



#### 1. Calcium stones

Calcium stones are the most common type of kidney stone and form if there's too much calcium in the urine, which can be due to. An inherited condition called hypercalciuria, which leads to large amounts of calcium in urine. Calcium stones are usually either large and smooth or spiky and rough. Approximately 80% of all kidney stones are classified as calcium stones.

#### 2. Uric Acid Stones

These types of kidney stones only account for about 5% of all kidney stones. Uric acid is a waste product resulting from normal body functioning. However when there is too much present in urine it can cause uric acid stones. People who eat a high-protein diet may be at risk of forming uric acid stones.

#### 3. Struvite Stones

Struvite stones (also referred to as staghorn kidney stones) accounts for approximately 10% of all kidney stones. They are

usually associated with urinary tract infections, which change the urinary environment to permit rapid stone growth.

#### 4. Cystine Stones

Less common (about 1%) are kidney stones made of a chemical called cystine. Cystine stones result from a genetic disorder called Cystinuria. This occurs when the kidneys do not reabsorb cystine from the urine. When a high amount of cystine is detected in the urine, it causes these stones to form. Cystine stones also have the tendency to grow rapidly and recur, and may even lead to kidney failure if not treated quickly [6].

### Pathogenesis of renal stone formation

The physical process of stone formation is a complex cascade of events, result from the growth of crystals leads to stones formation

#### ▪ Nucleation

Nucleation is the formation of a solid crystal phase in a solution. The stone formation starts from the nuclei, which means the process of new crystal formation. It is an essential step in renal stone formation the term super saturation refers to a solution that contains more of the dissolved material than could be dissolved by the solvent under normal circumstances. Crystal nucleation is the first step in the formation of stone which can either be homogeneous nucleation of a salt occurs in unstable zone of super saturation

#### Crystal growth

- After the nucleation process, the micro crystals can mature by epitaxially mediated crystal growth.
- Epitaxy is oriented overgrowth of one crystalline material on to a substrate crystalline lattice. Monoepitaxial growth refers to the adsorption of the molecules or ions one by one on the crystal surface from supersaturated urine and
- heteroepitaxial growth refers to direct growth of one crystal on a surface of different composition and the surfaces of crystal and substrate
- Several atoms or molecules in a supersaturated liquid start forming clusters.
- The total free energy of the cluster is increased by the surface energy; however, this is significant only when the cluster is small.
- Crystal growth is determined by the molecular size and shape of the molecule, the physical properties of the material, pH, and defects that may form in the crystal structure.

#### Aggregation

- Aggregation is a process in which crystal nuclei bind to each other to form larger particles.
- The initial nuclei can grow by further addition of desired salts. A small inter-particle distance increases the attractive force and privileges particle aggregation. Aggregation of particle in solution is determined by a balance of forces, between aggregating effects and disaggregation effects and also a small inter particle distance that privileges particle aggregation

## Retention

- Crystal retention can be caused by the association of crystals with the epithelial cells lining. Urolithiasis requires formation of crystals followed by their retention and accumulation in the kidney.
- Another process that may lead to stone formation is crystal retention. i.e., crystal precipitation, growth, and aggregation, which results in urinary stone formation, if the nucleated crystals were flushed out by urinary flow <sup>[7]</sup>.

## Drugs used in renal calculi

### 1. Allopurinol

- Allopurinol is in a class of medications called xanthine oxidase inhibitors. Allopurinol is used to treat high levels of uric acid in the body caused by certain cancer medications, and kidney stones. High levels of uric acid may cause gout attacks or kidney stones. Allopurinol blocks uric acid production, reducing heterogeneous nucleation of calcium oxalate by both uric acid and monosodium urate. However, Allopurinol (100 to 300 mg/day) is indicated only when hyperuricosuria is the only metabolic abnormality. On the other hand, alkali therapy with potassium citrate may also be beneficial, since raising urinary pH will help solubilizing uric acid converting it into potassium urate <sup>[8]</sup>

### 2. Coli-Urinal granules

- Coli-Urinal granules contain Hexamine, Khellin and Piperazine as active ingredients. Coli-Urinal granules works by stopping the growth of unwanted bacteria; producing vasodilator and bronchodilator action; producing a neuromuscular block. The antiseptic action of Coli-urinal depends mainly upon the presence of hexamine, which is in acid urine slowly hydrolysed to formaldehyde and ammonia. The peak concentration of formaldehyde is attained in 2 hours which acts as potent antiseptic that may be effective in some cases where other antibacterials fail (especially chronic cases). Khellin by its direct relaxant action on the smooth muscles relieves the colic which usually associates urinary disorders. Piperazine adds to the benefit of Coli-urinal by increasing uric acid excretion and dissolving urate crystals <sup>[9]</sup>.

### 3. Uralyt-U

It contains active ingredient like potassium sodium hydrogen citrate (6:6:3:5) Uralyt-U action is based on the fact that it can stabilize the pH of urine within the correct pH range of 6.2 to 6.8. Thus Uralyt-U improves the solubility of uric acid and prevents the formation of uric acid crystals (stones) and also re-dissolves any crystals (stones) that are already present. Uralyt-U is free from carbohydrates and can therefore safely be taken by diabetics <sup>[10]</sup>.

## Types of treatment

- Lithotripsy:** Lithotripsy is a 30 - 90-minute non-invasive kidney stone treatment procedure which breaks the stones in the body into small fragments. Lithotripsy can be performed to break stones in the various organs of the body such as kidney, gallbladder, liver, etc. There are several types of lithotripsy procedures for kidney stones removal:

- Extracorporeal shock wave lithotripsy (ESWL):** Shock waves are used to break the kidney stones into smaller pieces that can now easily pass through the urinary tract. This procedure is generally used to remove stones which are 4 mm to 20 mm in diameter.
- Shockwave lithotripsy (SWL):** High-energy shock waves are targeted directly at the kidney stones, causing each stone to fragment and become small enough to pass through the urinary tract. The results of SWL are generally satisfactory if the size of the stone is less than 20 mm in diameter.
- Laser lithotripsy:** In this procedure, a laser is directly targeted onto the kidney stones to break them into smaller pieces, which then pass through the urinary tract. Laser lithotripsy works best with stones less than 20 mm in diameter <sup>[11]</sup>.

## Conclusion

Nephrolithiasis remains life threatening disorder and cover almost all regions of the world. Exhaustive understanding of this disorder is necessary as lot of factors can induced this disease. Understanding the pathophysiology of this disorder is also necessary for the development of new therapeutic options or treatment. In India though nephrolithiasis is a commonly prevalence disease but pharmacotherapy is neglected emphasizing the need to develop highly effective drugs for treatment of nephrolithiasis. A number of herbal medicines and remedies have been reported for its significant nephroprotective activity, In order to understand why stones occur, and how to better treat and prevent them, it is necessary to grasp the chemical principles behind their appearance. (I.e. solubility and acidity)

## References

- Atul Sohgaura, Papiya Bigoniya. A Review on Epidemiology and Etiology of Renal Stone. American Journal of Drug Discovery and Development, 2017; 7:54-62.
- Pooja Tiwari. *et al.* Int. Res. J Pharm. 2017, 8(5):14
- <https://www.medicalnewstoday.com/articles/154193.php>
- Uthaya Chandirika Jayaraman, Annadurai Gurusamy. Review on Uro-Lithiasis Pathophysiology and Aesculapian Discussion, IOSR Journal of Pharmacy, Version. 1. 2018; 8(2):30-42.
- Atul Sohgaura, Papiya Bigoniya. A Review on Epidemiology and Etiology of Renal Stone. American Journal of Drug Discovery and Development, 2017; 7:54-62.
- Dr. David Samadi-Urologic Oncology Expert and Robotic Surgeon at Lenox Hill Hospital. <https://prostatecancer911.com/the-different-types-of-kidney-stones/>
- Uthaya Chandirika Jayaraman, Annadurai Gurusamy. Review on Uro-Lithiasis Pathophysiology and Aesculapian Discussion, IOSR Journal Of Pharmacy, Volume 8, Issue 2 Version. 1. 2018; 8(2):30-42.
- <https://medlineplus.gov/druginfo/meds/a682673.html>
- <https://www.tabletwisdom.com/egypt/coli-urinal-granules>
- [https://www.old.health.gov.il/units/pharmacy/trufot/alonim/Uralyt-U\\_dr\\_1416904401345.pdf](https://www.old.health.gov.il/units/pharmacy/trufot/alonim/Uralyt-U_dr_1416904401345.pdf)
- <https://www.practo.com/health-wiki/lithotripsy-meaning-procedure-and-cost/1340/>