

# A review on nephrolithiasis, it's diagnosis, treatment and recent advancements

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## ABSTARCT

Kidney stones are one of the significant reasons for grimness in around the world. Clinical treatment reduces recurrence of kidney stone. The pathogenetic systems of stone arrangement are complicated and imply both metabolic and natural danger factors. This survey talks about the presentation of kidney stones and its sort and pharmacotherapy in the avoidance of stones and future headings in the treatment. Unique and audit articles were found for Kidney stones, determination, and the board of kidney stones. Notwithstanding the epidemiological improvement, there exists clear origination how to analyze the metabolic issues behind and how to treat them effectively. It is simply acceptable strategy to treat the reason for illness rather than to eliminating its indication or symptoms. fluid or water intake to increase urine volume up to 2.5L every day is fundamental. Dietary proposals ought to be changed dependent on individual metabolic irregularities. Calcium-based urinary calculi are arising as another idea in stone examination that keeps on giving significant bits of knowledge to improved agreement and counteraction of urinary stone illness. Mostly kidney stone affect the parts of body like kidney ureters and urethra. More important, kidney stone is a recurrent disorder with life time recurrence risk reported to be as high as 50% by calcium oxalate crystals. Calcium oxalate occurred kidney stones is the most common stone reported in India. Therefore, due to disease of kidney stones there is a higher chance of developing heart diseases which are now detected in India and the rest World. Kidney stones forms lower the minerals in the body as well as reduced the essential element for bone formation. The patients have advice to take low fat diet and fibers of natural occurring plants and its herbal medicines. The combination of herbal medicines with allopathic treatment have a great idea to get rid all the complications related to kidney stones.

**KEY WORDS:** kidney stones, calcium stones, uric acid, uretroscopy.

## INTRODUCTION

The urinary system is consists of two major bean shaped kidneys, ureters, bladder and urethra. These bean shaped kidneys located just middle of the back and below the pairs of ribs. Kidneys transport water and body wastes from the circulating blood and then converts it to form urine. <sup>[1]</sup>

The term 'Urolithiasis' is a global problem affecting human beings for ancient times and also called 'Nephrolithiasis' or kidney stones. Urolithiasis is a condition in which the crystals of uroliths/stones present in the urinary tract. In the western world, annual incidence of Urolithiasis is about 0.5% with lifetime risk of developing is about 10-15% but it increasing with 20-25% in the Middle East. Urolithiasis is the formation of uneven calculi, or the condition which belongs to urinary calculi. <sup>[2]</sup>

The condition of calculi is synonymous with the term uroliths, stones, or crystals. These calculi/ stones are made by deposition of polycrystalline aggregates composed of different amounts of crystalloid and organic matrix. These calculi can different in size and shape which found anywhere in the urinary tract from kidney to the bladder. <sup>[3]</sup>

## **KIDNEY STONES DEFINITION**

Kidney stones are Mineral depositions and acid salts in the pelvis and renal calyces that are found attached or free to the renal papillae are called stones. When the urine becomes supersaturated or concentrated with respect to a mineral the stone contain crystalline and organic components. The main constituent of most stones is calcium oxalate, many of which form on a foundation of calcium phosphate called Randall's plaques. <sup>[4]</sup>

The pathogenic mechanisms of kidney stone formation are intricate and involve both metabolic and environmental risk factors. <sup>[5]</sup>

## **COMPOSITION OF KIDNEY STONE**

A kidney stone is a cluster of crystals when they formed together to create a hard lump in one or both kidneys. They can vary in size from a few millimeters to several centimeters. The majority of stones will pass out of the body in the urine without any help, but some will require intervention to remove them. <sup>[6]</sup>

The Urinary stone have been created with the stones of phosphate, uric acid, magnesium ammonium phosphate with apatite and struvite. <sup>[7]</sup>

Among the urinary stones, calcium-containing stones have been found to about 75% of every urinary analytics, which might be available as stones of unadulterated calcium oxalate (half), calcium phosphate (5%) and a combination of the two mixtures (45%). The eating regimen can influence the convergence of certain substances in the pee and can influence the causticity of urine.

The 24 hour urine assortment of urine may discovered any of the given properties have increased risk of forming stone:

- I. Undeniable degrees of calcium (hypercalciuria)
- II. Undeniable degrees of oxalate (hyperoxaluria)
- III. Undeniable degrees of uric acid (hyperuricaemia)
- IV. Low degrees of citrate (hypocitraturia)

Calcium oxalate stones can be found in any pH of urine. The formation of uric acid stones is more in acidic urine while calcium phosphate stones form in more alkaline urine . <sup>[8]</sup>

## **TYPES OF KIDNEY STONES**

There are four major types of stone are deposit in kidneys which are- calcium (75 to 85%), struvite (2 to 15%), uric acid (6 to10%) and stones of cystine (1 to 2%). The distribution and frequency of these stones is depending upon the geographical location of living being and population studied. Rarely, the long term used of drugs causes the kidneys stones which are about 1%. <sup>[9]</sup>

## CALCIUM STONES

The stones of calcium oxalate, calcium urate and calcium phosphate are associated with hypercalciuria which caused by hyperparathyroidism. People associated with disease, increased calcium absorption from the gut causes renal calcium or phosphate leak, hyperuricosuria, hyperoxaluria, hypocitraturia and hypomagnesuria developed.<sup>[10]</sup>

## URIC ACID STONES

The formation of uric acid stones depend upon high purine intake drugs or high cell turnover (e.g. malignancy ) which are mostly found in patients with gout. Uric acid stones mostly form in slightly acidic urine (pH 5.5). They are visible in nature and usually radiolucent on X-ray film.<sup>[11]</sup>

## CYSTINE STONES

Cystine stones become due to having hereditary intrinsic metabolic disorder called cystinuria in which the re-absorption of cystine in the renal tubule is impaired. These stones could difficult to find on X-rays because of high sulphur content. In drug-induced stones, several drugs can participate in the formation of renal stones.<sup>[12]</sup>

## STRUVITE STONES

Struvite is composed of magnesium ammonium phosphate stones which grow to fill the collecting system (partial or complete staghorn calculi). This stage is developed due to chronic urinary tract infections which caused by Gram-negative urea-splitting bacteria including Proteus, Pseudomonas and Klebsiella species.<sup>[13]</sup>

## DRUG-INDUCED STONES

Some drugs are also participating in the formation of renal stones which can be used for another disease. They are indinavir, atazanavir, guaifenesin, triamterene, silicate (antacids) and sulfa drugs. These stones are rare and are always seen on X-Rays (radiolucent).<sup>[14]</sup>

## CAUSES OF KIDNEY STONES

Various factors play a part in increasing the risk of stone formation for some people. According to Kidney Health Australia<sup>[15]</sup> the range of factors includes:

1. Excess calcium, phosphate, oxalate and uric acid in the urine
2. lack of stone inhibitors in the urine
3. Inadequate hydration
4. Some medications
5. Ongoing urine infection
6. Family history of stone formation

## RISK OF FACTORS

Dietary factors are major key points to promote or inhibit kidney stone formation. The stone can be formed by other factors which include environment, body weight, genes and how much of fluid intake. The following of the factors which can increase the risk of promoting kidney stones.<sup>[16]</sup>

- Dehydration of the body
- Kidney stones may be come by genetically. Cystinuria is a genetic disorder increased the risk of developing cystine stones
- Taking more amounts of proteins, fats, sodium and sugar in the diet may increase the risk of kidney stones.
- People having kidney infections (especially women) and urinary tract infections (UTIs) can develop more easily struvite stones compare to other diseases
- Obesity may increase risk of kidney stones.<sup>[17]</sup>
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## SIGN & SYMPTOMS

The subject did not identify weather he is suffering from kidney stones, it do not cause any symptoms to be observed without identification. After leaving the stone through kidney, it passed to the bladder through the help of ureters. At the same time some of the stones remain in the ureters, they block the urine flow out of the kidneys and make it to swell; this condition is called as hydronephrosis. This caused a lot of pain in the kidneys. Common symptoms of kidney stones are verified by.<sup>[18]</sup>

## DIAGNOSIS

Blood testing: Blood tests measure too much of calcium or uric acid in the blood. Blood test results help monitor the health of the kidneys.<sup>[19]</sup>

Urine testing: The 24-hour urine collection test may show that the kidneys excreting too many stone-forming minerals or too few stone preventing substances.<sup>[20]</sup>

Imaging: Imaging tests may show the availability of kidney stones in urinary tract. Options range from simple abdominal X-rays, which can miss small kidney stones, to high-speed or dual energy computerized tomography (CT) that capture even tiny stones.<sup>[21]</sup> Other imaging options include an ultrasound, a noninvasive test, and intravenous urography, which involves injecting dye into an arm vein and taking X-rays (intravenous pyelogram) or obtaining CT images (CT urogram) as the dye travels through the kidneys and bladder.<sup>[22]</sup>

## TREATMENT

Treatment of kidney stones depends of their size, location and types of stones . Stones measured less than 4mm have a 90% chance of passing without any medical procedures or surgery. Stones measured bigger than 6mm only pass on their own 20%. Stones usually get stuck at the narrow points of the ureter. primarily at the junction of the ureter with kidney. The next spot is midway toward the bladder where the blood vessels to the legs cross the ureter. The narrowest spot is at the junction of the bladder with the ureter. When stones get stuck the symptoms of urinary frequency and burning are often experienced.

## MEDICAL THERAPY FOR KIDNEY STONES:

Usually doctors prescribe with alpha blockers; they relax the muscles in the ureters, which help to pass the kidney stone more quickly. Diuretics are also useful for increasing the urine flow to pull out the stone. [23]

Small stones:

The small stones do not require much treatment; they get off the body by drinking precised amount of water. Drinking plenty of water to about 4-5 lit/day helps to get rid of stones throughout the body through urine. The movement of stones creates pain; the moving pain can be treated with certain pain relievers. [24]

## SURGICAL TREATMENT

Surgical treatments are required when the stones are of larger size or for large stones or crystals

### EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY (ESWL)

Is the first line treatment for renal stones, proximal stones, and midureteral stones because of its noninvasive nature, low costs, and high efficiency of stone disintegration with fewer complications. [25,26]

### OPEN SURGERY

Recent advances in endourological field, in the form of Open surgery have resulted in a rapid decrease in the use of higher aggressive treatment approaches. [27,28]

### PERCUTANEOUS NEPHROLITHOTOMY

PCNL It is minimally invasive procedures have become widely accepted and have almost entirely replaced open surgery for the treatment of all stones greater than or equal to 2 cm. [29]

### URETEROSCOPY

Ureteroscopy is surgical procedure for removing stones which gets stuck in the ureters or bladder. Ureteroscopy can be examined the upper urinary tract stones. This is painful procedure and contains a small wire which connects with a camera at the end. The wire is inserted into the urethra and passed into the bladder for removal of stones with a cage connected with it. [30]

## PREVENTIVE THERAPY- MEDICAL AND DIETARY TREATMENT

The treatment of stone should undergo an evaluation for a treatable metabolic cause. Stone is monitored by the results of the 24-hour urine collection. Intake of fluid is an essential component of treatment and should be adjusted so that urine output is greater than 2.5 L/day.

Potassium citrate is utilized to make urine less acidic and valuable for patients experiencing uric acid stones, calcium and cystine stones with low urinary citrate. Potassium citrate makes the urine more antacid fundamental. This property assists with forestalling arrangement of cystine and uric acid stones. The citrate level likewise expanded in the urine, which prevents formation of calcium stones. <sup>[31]</sup>

### CALCIUM STONES TREATMENT

Dietary sodium restriction is important and associated with a reduction in urine calcium excretion. As both sodium and calcium share the same transporter for movement in cells, Thiazide diuretics used in therapy for patients with hypercalciuria because they increased serum calcium levels and reduced urine calcium levels. It is important in therapy because restricting dietary calcium results in less calcium being available in the intestinal lumen to bind oxalate. This leads to increased oxalate absorption and therefore increased urinary oxalate excretion. <sup>[32]</sup>

### TREATING URIC ACID STONES

Urine alkalinization is an important part of the treatment of uric acid stones. Intake of animal proteins should be decrease which helps in decrease uric acid generation. Xanthine oxidase inhibitor, is used to decrease the formation of uric acid. Low purine diet is recommended if patient has elevated blood uric acid level. <sup>[33,34]</sup> Allopurinol is used in the treatment of gout, increases the amount of uric acid in the blood that deposits in the cavity of joints. Allopurinol lowers the raised amount of uric acid in the blood and urine. It also prescribed to prevent the calcium and uric acid stones in the kidneys. <sup>[35]</sup>

### TREATING CYSTINE STONES

Increasing fluid intake is the only diet recommendations for cysteine stones. Cystine solubility can be increased by alkalinization of the urine. Thiol containing drugs may be given to patients who are unable to comply with increased fluid intake and urinary alkalinization. These drugs increase the solubility of cystine. Low animal protein diet can lower risk by lowering methionine which is precursor of cystine. <sup>[36]</sup>

### TREATING STRUVITE STONES

The preferred treatment of struvite stones is surgical removal because they are large. Antibiotic therapy is important and may slow stone growth. Culture stone material can be helpful in direct antibiotic therapy. Low sodium diet intake can help in the prevention of struvite stone. <sup>[36]</sup>

### MEDICAL EXPULSIVE TREATMENT

MET is an important methodology for treating urethral calculi. <sup>[37,38]</sup> Alpha adrenoreceptor antagonist (alpha-blockers), calcium channel blockers, and phosphodiesterase-5 (PDE5) inhibitors are accepted to act by loosening up the ureteral smooth muscle to decrease ureteral compressions, repressing peristalsis and supporting in the end of stones. <sup>[39,40]</sup>

## RECENT ADVANCEMENT

### Isoproterenol and ureteroscopy

The use of endoluminal isoproterenol to reduce pelvic pressure compared with saline irrigation because it is not affecting heart rate or mean arterial blood pressure. The reduction of intra-pelvic pressure, without associated cardiovascular side effects, therefore offers a potentially useful safety step in ureteroscopy [41]

## ROBOTICS

Researcher has recently found the use of a modified robotic catheter system for ureterorenoscopy. The method was 'stable, easily maneuverable, and ergonomically superior' to conventional ureterorenoscopy and including the complete fragmentation of small stones. [42]

Researchers found evidence on a natural fruit extract is capable of dissolving calcium oxalate crystals kidney stones. This finding could lead to the first advance in the treatment of calcium oxalate stones in 30 years. [43]

## CONCLUSION

Kidneys stone is one of most regular issues in creating nations and rest of the World which influences urinary framework. A few of the ailment increment the danger of kidney stones issues like high fat eating routine, deficient sustenance, expansion of food that contains oxalate, high protein diet and post a medical procedure effects. Kidney Stone development relies on different factors, for example, as metabolic, ecological, also, wholesome elements. Improvement of indicative modalities has prompted a superior comprehension of the sickness. Some procedure for the treatment of kidney stone like allopathic and natural medicine or then again expulsion of stones through a medical procedure is presently in patterns. But most of the people preferred herbal therapy for removal of kidney stones. Herbal treatment is the safest and inexpensive treatment ever but the treatment needs time for their effect

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