



Review Article

A BRIEF REVIEW ON: KIDNEY STONE**Ashiya Ansari*, S.P. Singh, M.P. Khinchi, Shama Parveen, Megha Mahaver**

Department of Pharmacology, Kota College of Pharmacy, Kota, Rajasthan, India.

ABSTRACT

The kidneys are two bean-shaped organs that are roughly four inches in length. They are located towards the back of the abdomen (stomach) on either side of the spine. The kidneys remove waste products from the blood and transfer them into the ureter, along with excess fluids. The ureter is the tube that attaches each kidney to the bladder. From there, the waste products and excess fluid are disposed of as urine. There are four types of kidney stone. Calcium Stone, Uric Acid Stone, Struvite Stone, Cystine Stone, Kidney stone. Kidney stones typically form in the kidney and leave the body in the urine stream. A small stone may pass without causing symptoms. A stone may also result in blood in the urine, vomiting, or painful urination. Pathophysiology are complete in three steps:

Hypocitraturia, Supersaturation of urine, Inhibitors of stone formation. In these article mention the symptoms of kidney stone: Severe pain in the side and back, below the ribs, Pain on urination, Pink, red or brown urine. Way of the passes of kidney stone such as: Drinking more fluids, Lemon juice, olive oil & Avoiding alcohol. Diagnosis of kidney stones is made on the basis of information obtained from the history, physical examination, urinalysis, and radiographic studies. Clinical diagnosis is usually made on the basis of the location and severity of the pain, which is typically colicky in nature (comes and goes in spasmodic waves). measures depend on the type of stones. In those with calcium stones, drinking lots of fluids, thiazide diuretics and citrate are effective as is allopurinol in those with high uric acid levels in the blood or urine.

Keywords: Struvite Stone, Cystine Stone, Hypocitraturia, Supersaturation, Allopurinol.

INTRODUCTION

Kidney stones are stone-like lumps that can develop in one or both of the kidneys. The medical name for stones in the kidneys is nephrolithiasis. If the stones cause severe pain, this is known as renal colic. The kidneys are two bean-shaped organs that are roughly four inches in length. They are located towards the back of the abdomen (stomach) on either side of the spine. The kidneys remove waste products from the blood and transfer them into the ureter, along with excess fluids. The ureter is the tube that attaches each kidney to the bladder. From there, the waste products and excess fluid are disposed of as urine. The clean blood is then transferred back into the body.

Kidney stones typically form in the kidney and leave the body in the urine stream. A small stone may pass without causing symptoms. If a stone grows to more than 5 millimeters (0.2 in) it can cause blockage of the ureter resulting in severe pain in the lower back or abdomen. Risk factors include high urine calcium levels, obesity, certain foods, some medications, hyperparathyroidism, gout and not drinking enough fluids.⁽¹⁾

Stones form in the kidney when minerals in urine are at high concentration. The diagnosis is usually based on symptoms, urine testing, and medical imaging. Blood tests may also be useful. Between 1% and 15% of people globally are affected by kidney stones at some point in their life. In 2013, 49 million cases occurred, resulting in about 15,000 deaths. Kidney stones have affected humans throughout history with descriptions of surgery to remove them dating from as early as 600 BC.

*Corresponding author:

Ashiya Ansari

Department of Pharmacology, Kota College of Pharmacy, Kota

Mob. 7728844986

E mail- ashियाansari07@gmail.com

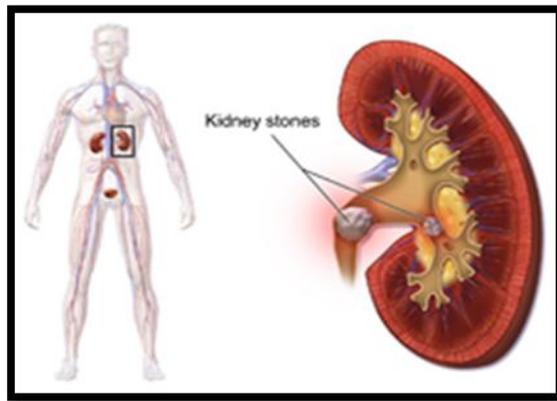


Figure: 1 Kidney stone

DEFINITION

A stone in the kidney or a stone that originates in the kidney but has passed lower down in the urinary tract. Kidney stones are a common cause of blood in the urine and pain in the abdomen, flank, or groin.

Pathophysiology^(2,3,4)

Hypocitraturia:

Hypocitraturia or low urinary citrate excretion (defined as lower than 320 mg/day) can cause kidney stones in up to 2/3 of cases. The protective role of citrate is linked to several mechanisms; in fact, citrate reduces urinary supersaturation of calcium salts by forming soluble complexes with calcium ions and by inhibiting crystal growth and aggregation.

Supersaturation of urine:

When the urine becomes supersaturated (when the urine solvent contains more solutes than it can hold in solution) with one or more calculogenic (crystal-forming) substances, a seed crystal may form through the process of nucleation. Heterogeneous nucleation (where there is a solid surface present on which a crystal can grow) proceeds more rapidly than homogeneous nucleation (where a crystal must grow in a liquid medium with no such surface), because it requires less energy. Supersaturation of the urine with respect to a calculogenic compound is pH-dependent. For example, at a pH of 7.0, the solubility of uric acid in urine is 158 mg/100 ml. Reducing the

pH to 5.0 decreases the solubility of uric acid to less than 8 mg/100 ml.

Inhibitors of stone formation:

Normal urine contains chelating agents, such as citrate, that inhibit the nucleation, growth, and aggregation of calcium-containing crystals. The biochemical mechanisms of action of these substances have not yet been thoroughly elucidated. However, when these substances fall below their normal proportions, stones can form from an aggregation of crystals.

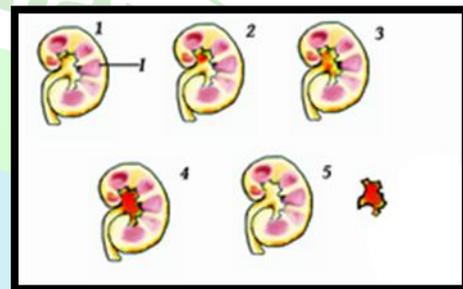


Figure: 2 Stone formations

Small crystals formed in the kidney. The most common crystals are made of calcium oxalate and they are generally 4–5 mm.

- Calcium and oxalate come together to make the crystal nucleus. Supersaturation promotes their combination (as does inhibition.)
- Continued deposition at the renal papillae leads to the growth of the kidney stones.
- Kidney stones grow and collect debris. In the case where the kidney stones block all routes to the renal papillae, this can cause severe discomfort.
- The complete staghorn stone forms and retention occurs.
- Displaced stones travel through the ureter. If they cannot be broken down, they must be physically removed by a surgeon.

HOW TO PASS KIDNEY STONE?

Kidney stones may be removed from the body using different ways and this could be according to the stone's size and composition. Natural ways to remove kidney stones are ways that do not use chemicals,

drugs and surgical procedures to pass stones from the body.

Drinking more fluids:

Increasing our water or fluid intake in a day could help dilute the kidneys and the urinary bladder. It could also prevent the formation of small stones and may also help dissolve smaller stones so these may be passed safely out of the body via the urine.

Avoiding alcohol:

Since we need to drink a lot fluids, this not necessary mean we need drink alcohol to help Alcohol is debilitating to our kidneys and drinking alcoholic beverages when we have been diagnosed with kidney stones will only make symptoms worse. Alcohol will also overwork your kidneys and your liver which will also affect the already weak kidneys.



Figure: 3 Avoiding alcohol

Diet:

What we eat may also help you naturally pass out kidney stones. Foods like asparagus, Brussels sprouts, tomatoes, lettuce and blueberries are just some of the foods that are known to be natural diuretics or foods that will stimulate the kidneys from producing more urine. The most common characteristics of all these foods is that all have high potassium and manganese content which naturally helps the body remove fluids through urination. We may eat these foods on their own or you may include them in recipes and salads.



Figure: 4 Diet

Using natural remedies:

There are countless natural remedies and traditional techniques that are known to be effective in the removal of smaller kidney stones.

Lemon juice and olive oil:

2 ounces of freshly-squeezed lemon juice together with 2 ounces of olive oil are known to reduce the symptoms of kidney stones. This mixture is added to 12 ounces of water and must be taken every hour until pain is reduced.



Figure: 5 Fresh Lemon Juice

Urvaursi

Is a traditional remedy for kidney stones and not only will it help reduce pain but will also treat kidney and bladder infections caused by kidney stones. It also promotes urinary system health and as a tonic for the kidneys, liver and the pancreas. Urvaursi is available in capsule form, teas and extracts.

Pomegranate juice

Natural pomegranate juice have so many health benefits. The seeds as well as the juice of the lowly pomegranate contain natural chemicals that will help stimulate the kidneys to produce more urine. The best way to take

advantage of the pomegranate's amazing therapeutic properties is to drink freshly squeezed pomegranate juice using a juicer.

Using magnesium supplements

Magnesium supplements are known to reduce the symptoms of kidney stones in people who are diagnosed with the illness. You can help prevent smaller stones from developing into large stones and to reduce pain and inflammation caused by stones as well.

Sound waves

Possibly one of the most successful ways to remove kidney stones is the use of sound waves. Lithotripsy is a method wherein a person is immersed in a tub full of water, sound waves are applied on the water and this in turn vibrate the stones in an effort to crush or to disintegrate stones into smaller bits. This treatment may be recommended by a doctor according to the size and the location of the stones.

SYMPTOMS^(5,6)

A kidney stone may not cause symptoms until it moves around within our kidney or passes into our ureter the tube connecting the kidney and bladder. At that point, you may experience these signs and symptoms:

- Severe pain in the side and back, below the ribs
- Pain that spreads to the lower abdomen and groin
- Pain that comes in waves and fluctuates in intensity
- Pain on urination
- Pink, red or brown urine
- Cloudy or foul-smelling urine
- Persistent need to urinate
- Urinating more often than usual
- Fever and chills if an infection is present
- Urinating small amounts of urine



Figure: 5 symptoms

Area of the body. We have to target the root cause of your pain to effectively take it away.

Pain that spreads to the lower abdomen and groin:



Figure: 6 Groin area

The groin is an area of your hip between your stomach and thigh. It is located where our abdomen ends. These are called:

- Adductor Brevis
- Adductor Longus
- Adductor Magnus
- Gracilis
- Pectineus

Groin pain is any discomfort in this area. The pain typically results from an injury caused by physical activity, such as sports.

Pain on urination:

Painful urination is a broad term that describes discomfort during urination. This pain may originate in the bladder, urethra, or perineum. The urethra is the tube that carries urine outside of your body.

Pink, red or brown urine:

Cloudy or milky urine is a sign of a urinary tract infection, which may also cause a bad smell. Milky urine may also be caused by bacteria, crystals, fat, white or red blood cells, or mucus in the urine.

Nausea and vomiting:

Nausea is an uneasiness of the stomach that often comes before vomiting. Vomiting is the forcible voluntary or involuntary emptying ("throwing up") of stomach contents through the mouth.

Fever and chills if an infection is present:

Fever- Fever is an abnormally high body temperature. Usually defined by 3 oral temperatures greater than 38°C or 100.4°F in a 24-hour period, or one temperature greater than 38.5°C or 101.3°F. Fever is the body's response to infection.

CAUSES

Kidney stones often have no definite, single cause, although several factors may increase our risk. Kidney stones form when our urine contains more crystal-forming substances—such as calcium, oxalate and uric acid—than the fluid in your urine can dilute. At the same time, our urine may lack substances that prevent crystals from sticking together, creating an ideal environment for kidney stones to form. “Medical conditions”. Many medical conditions can affect the normal balance and cause stones to form. Examples include gout and inflammatory bowel disease, such as Crohn's disease.

DIAGNOSIS

Diagnosis of kidney stones is made on the basis of information obtained from the history, physical examination, urinalysis, and radiographic studies. Physical examination may reveal fever and tenderness at the cost over tebral angle on the affected side.

Imaging studies:

In people with a history of stones, those who are less than 50 years of age and are presenting with the symptoms of stones without any concerning signs do not require helical CT scan imaging. Otherwise a non contrast helical CT scan with 5 millimeters (0.2 in) sections is the diagnostic modality of choice in the radiographic evaluation of suspected nephrolithiasis. All stones are detectable on CT scans except very rare stones composed of certain drug residues in the urine, such as from indinavir.

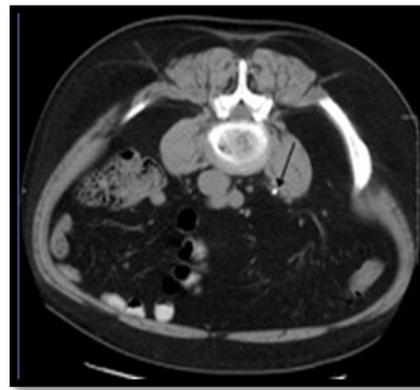


Figure:7(a)



Figure: 7 (b)

Laboratory examination:

Struvite crystals found on microscopic examination of the urine

Laboratory investigations typically carried out include:

- microscopic examination of the urine, which may show red blood cells, bacteria, leukocytes, urinary casts and crystals;
- urine culture to identify any infecting organisms present in the urinary tract and sensitivity to determine the susceptibility of these organisms to specific antibiotics;

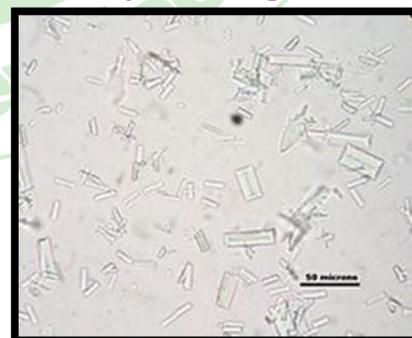


Figure: 8 Struvite crystals found on microscopic examination of the urine

PREVENTION^(7,8)

Preventative measures depend on the type of stones. In those with calcium stones, drinking lots of fluids, thiazide diuretics and citrate are

effective as is allopurinol in those with high uric acid levels in the blood or urine.

Dietary measures:

Specific therapy should be tailored to the type of stones involved. Diet can have a profound influence on the development of kidney stones. Current dietary recommendations to minimize the formation of kidney stones include:

- Increasing total fluid intake to more than two liters per day of urine output.
- Increasing citric acid intake; lemon/lime juice is the richest natural source.
- Moderate calcium intake
- Limiting sodium intake
- Avoidance of large doses of supplemental vitamin C

Urine alkalinization:

The mainstay for medical management of uric acid stones is alkalinization (increasing the pH) of the urine. Uric acid stones are among the few types amenable to dissolution therapy, referred to as chemolysis. Chemolysis is usually achieved through the use of oral medications, although in some cases, intravenous agents or even instillation of certain irrigating agents directly onto the stone can be performed, using antegradenephrostomy or retrograde ureteral catheters. Acetazolamide (Diamox) is a medication that alkalinizes the urine. In addition to acetazolamide or as an alternative, certain dietary supplements are available that produce a similar alkalinization of the urine. Increasing the urine pH to around 6.5 provides optimal conditions for dissolution of uric acid stones. Increasing the urine pH to a value higher than 7.0 increases the risk of calcium phosphate stone formation.

Diuretics:

One of the recognized medical therapies for prevention of stones is the thiazide and thiazide-like diuretics, such as chlorthalidone or indapamide. These drugs inhibit the formation of calcium-containing stones by reducing urinary calcium excretion. Sodium restriction is necessary for clinical effect of

thiazides, as sodium excess promotes calcium excretion. Thiazides work best for renal leak hypercalciuria (high urine calcium levels), a condition in which high urinary calcium levels are caused by a primary kidney defect. Thiazides are useful for treating absorptive hypercalciuria, a condition in which high urinary calcium is a result of excess absorption from the gastrointestinal tract.

Allopurinol:

For people with hyperuricosuria and calcium stones, allopurinol is one of the few treatments that have been shown to reduce kidney stone recurrences. Allopurinol interferes with the production of uric acid in the liver. The drug is also used in people with gout or hyperuricemia (high serum uric acid levels). Dosage is adjusted to maintain a reduced urinary excretion of uric acid. Serum uric acid level at or below 6 mg/100 ml is often a therapeutic goal. Hyperuricemia is not necessary for the formation of uric acid stones; hyperuricosuria can occur in the presence of normal or even low serum uric acid.

MANAGEMENT^(9,10)

Stone size influences the rate of spontaneous stone passage. For example, up to 98% of small stones (less than 5 mm (0.2 in) in diameter) may pass spontaneously through urination within four weeks of the onset of symptoms, but for larger stones (5 to 10 mm (0.2 to 0.4 in) in diameter), the rate of spontaneous passage decreases to less than 53%.

Pain management:

Management of pain often requires intravenous administration of NSAIDs or opioids. Orally administered medications are often effective for less severe discomfort. The uses of antispasmodics do not have further benefit.

Expulsion therapy:

The use of medications to speed the spontaneous passage of stones in the ureter is referred to as medical expulsive therapy. Several agents, including alpha adrenergic blocker and calcium channel blockers, have been found to be effective. Alpha blockers

appear to lead to both higher and faster stone clearance rates. Alpha blockers; however, only appear to be effective for stones over 4 mm but less than 10 mm in size. These treatments also appear to be a useful in addition to lithotripsy.

Lithotripsy:



Figure: 9 A Schematic diagram of Lithotripsy

A lithotripter machine is seen in an operating room; other equipment is seen in the background, including an anesthesia machine and a mobile fluoroscopic system. Extracorporeal shock wave lithotripsy (ESWL) is a noninvasive technique for the removal of kidney stones. Most ESWL is carried out when the stone is present near the renal pelvis. ESWL involves the use of a lithotripter machine to deliver externally applied, focused, high-intensity pulses of ultrasonic energy to cause fragmentation of a stone over a period of around 30–60 minutes. Following its introduction in the United States in February 1984, ESWL was rapidly and widely accepted as a treatment alternative for renal and ureteral stones. Recent increase the degree of stone fragmentation.

Surgery:

Most stones under 5 mm (0.2 in) pass spontaneously. Prompt surgery may, nonetheless, be required in persons with only one working kidney, bilateral obstructing stones, a urinary tract infection and thus, it is presumed, an infected kidney, or intractable pain. Beginning in the mid-1980s, less invasive treatments such as extracorporeal shock wave lithotripsy, ureteroscopy, and percutaneous nephrolithotomy began to

replace open surgery as the modalities of choice for the surgical management of urolithiasis. More recently, flexible ureteroscopy has been adapted to facilitate retrograde nephrostomy creation for percutaneous nephrolithotomy. This approach is still under investigation, though early results are favorable.

Ureteroscopic surgery:

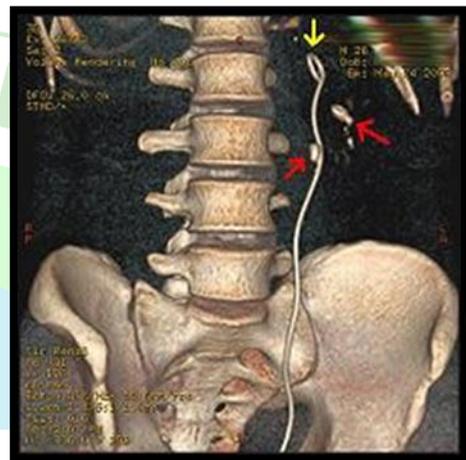


Figure: 10 Ureteroscopic surgery

Three-dimensional reconstructed CT scan image of a ureteral stent in the left kidney (indicated by yellow arrow), with a kidney stone in the inferior renal pelvis (highest red arrow) and one in the ureter beside the stent (lower red arrow)

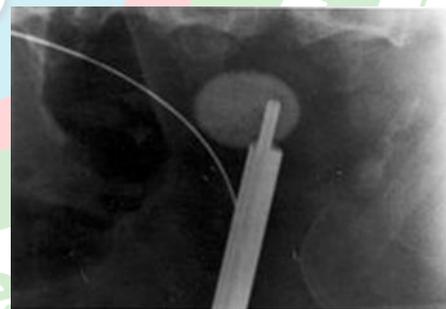


Figure: 11 Three-dimensional reconstructed CT scan image

One ureteroscopic technique involves the placement of a ureteral stent (a small tube extending from the bladder, up the ureter and into the kidney) to provide immediate relief of an obstructed kidney. Stent placement can be useful for saving a kidney at risk for postrenal acute renal failure due to the increased hydrostatic pressure, swelling and infection (pyelonephritis and pyonephrosis) caused by an obstructing stone. Ureteral

stents vary in length from 24 to 30 cm (9.4 to 11.8 in) and most have a shape commonly referred to as a "double-J" or "double pigtail", because of the curl at both ends. They are designed to allow urine to flow past an obstruction in the ureter. They may be retained in the ureter for days to weeks as infections resolve and as stones are dissolved or fragmented by ESWL or by some other treatment.



Figure: 12 Medications

MEDICATIONS⁽¹¹⁾

Medications can control the amount of minerals and acid in your urine and may be helpful in people who form certain kinds of stones. The type of medication your doctor prescribes will depend on the kind of kidney stones we have. There are some examples:

Calcium stones:- To help prevent calcium stones from forming, your doctor may prescribe a thiazide diuretic or a phosphate-containing preparation.

Uric acid stones:- Our doctor may prescribe allopurinol (Zyloprim, Alopriam) to reduce uric acid levels in your blood and urine and a medicine to keep your urine alkaline. In some cases, allopurinol and an alkalinizing agent may dissolve the uric acid stones.

Struvite stones:- To prevent struvite stones, your doctor may recommend strategies to keep your urine free of bacteria that cause infection. Long-term use of antibiotics in small doses may help achieve this goal. For instance, your doctor may recommend an antibiotic before and for a while after surgery to treat your kidney stones.

Cystine stones: - Cystine stones can be difficult to treat. Our doctor may recommend that we drink more fluids so that you produce a lot more urine. If that alone doesn't help, your doctor may also prescribe a medication that decreases the amount of cystine in your urine

CONCLUSION

Lifetime prevalence of kidney stones approaches 10% of all adults worldwide, and has been constantly increasing in the last decades. The increase in kidney stone prevalence is associated with other chronic diseases such as obesity, diabetes and hypertension. Changes in diet and lifestyle can partly explain this phenomenon. Urolithiasis is a multifactorial disease; many factors can increase the risk of stone formation. Chronic dehydration is a major risk factor for kidney stones. Chronic dehydration results in a low urine volume and increases urine supersaturation. A high fluid intake increases urine volume, promotes urine dilution and reduces urine supersaturation. Increased fluid intake is an effective preventive measure for the prevention of kidney stones recurrence and may help reduce the risk of first episodes. Adequate water intake is cost-effective and can help reduce the economic burden of kidney stones. Water is essential and should be at the core of everyone's daily intake. To prevent recurrence, official guidelines include a fluid intake sufficient to achieve a urine volume of at least 2.0L per day.

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