

Management and Treatment of Kidney and Ureteral Stone

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Kidney and ureteral stone are common trouble worldwide with substantial morbidities and economic costs. This review describes focusing on management and treatments of stones. Most ureteral stones can be observed with a reasonable expectation of uneventful stone passage. When an active ureteral stone treatment is warranted, the best procedure to choose is dependent on several factors like stone size and location, patient's preference, available equipment and related costs. Current trends in extracorporeal shockwave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and ureterorenoscopy (URS). ESWL was recommended as the first-line treatment for small and intermediate-sized stones in the lower pole, URS and PCNL is recommended in large size stone treatment. Alpha-blockers are commonly used to improve stone passage through so-called medical expulsive therapy (MET). Immunosuppressive medications and calcium channel blocker use in medical therapy for distal ureteral lithiasis. In the management of kidney stones 2-3 lit/day fluid intake ensures the avoidance of kidney stones formation. Dietary modifications, lifestyle changes, and medical management are essential. This review focuses on management and treatment of kidney and ureteral stones.

Keywords: *Kidney stone; urolithiasis; nephrolithiasis; renal calculi.*

ABBREVIATIONS

ESWL : *Extracorporeal Shockwave Lithotripsy*
URS : *Ureteroscopy*
PCNL : *Percutaneous Nephrolithotomy*
MET : *Medical expulsive therapy*

1. INTRODUCTION

Kidney stone disease is one of the oldest and most common problems of the urinary system. Race, gender and ethnicity play a part in who may get kidney stones [1]. The yearly relative incidence of urolithiasis is about 10-15% in the western world but can be as prominent in Middle East 20-25%. The recurrence rate without preventive treatment is approximately 10% at 1 year, 33% at 5 years, and 50% at 10 years. In India, more or less 5-7 million patients suffer from stone disease and leastwise 1/1000 of Indian universe necessarily hospitalization due to kidney stone disease [2]. Nephrolithiasis has a higher prevalence in hot, arid, or dry climates, such as the mountains, desert, or tropical areas. Worldwide, regions of high stone prevalence include the US, British Isles, Scandinavian and Mediterranean countries, northern India and Pakistan, northern Australia, central Europe, portions of the Malay peninsula, and China [3]. Stones stuck in the ureter, which is the tube that transports urine from the kidney to the bladder, often cause pain and make people see a doctor. Depending on which part of the ureter the stone is stuck in and the size of the stone, it will open pass into the bladder on its own over weeks. If the stone does not come out by itself, people often need to have procedures done to remove the stone [4,5]. Stone incidence depends on geographical, climatic, ethnic, dietary and genetic factors. The recurrence risk is basically determined by the disease or disorder causing the stone formation. Accordingly, the prevalence rates for urinary stones vary from 1% to 20% [6]. Nephrolithiasis is currently more prevalent in men than in women (13% Vs 7%, respectively), and it is three to four times more likely to present in white than nonwhite patients [7]. Medical evaluation for and treatment of kidney stones places a significant economic burden on society. The Urologic Diseases in America project estimated an annual cost of more than \$2 billion in the United States alone [8]. The first step in the treatment for acute renal colic caused by obstructing ureteral stones is medical relief of symptoms. It is very important to insert information about parsley in diet section. Parsley may prevent kidney stones. It was found that

parsley helped increase urine volume, decrease urinary calcium excretion, and raise the acidity of urine [9]; it also act as a natural diuretic, and prevent kidney stone formation [10,11,12].

When a drug therapy does not resolve the symptoms, the placement of a ureteral catheter or a nephrostomy tube has routinely represented the next step. These easy manoeuvres can offer a prompt relief from pain for the patient and they are usually followed by ureteroscopy (URS) or extracorporeal shockwave lithotripsy (ESWL), which currently represents the mainstay of treatment for symptomatic ureteral stones [13]. There are numerous ways to treat renal tract calculi, depending on their size, location, volume, anatomical factors and patient comorbidities. Historically, it was open surgical techniques; shock wave lithotripsy (SWL) was introduced in 1980, followed by percutaneous nephrolithotomy (PCNL) and subsequently endourological techniques with the popularisation of ureteroscopy (URS) [14]. Shock wave lithotripsy (SWL) and ureteroscopy (URS) have become the most common treatment modalities. In this paper, indications, results, complications, and innovations of these and other treatments of ureteral stones are reviewed.

2. MANAGEMENT OF STONE

Several guidelines are available to provide a clinical framework for diagnosis, follow-up, and prevention of kidney stone disease [15]. In 2007 the joint EAU and AUA Nephrolithiasis Guideline Panel joined efforts in developing internationally endorsed guidelines focusing on the changes in ureteral stone management [16]. The guidelines state that observation, with or without medical expulsive therapy, should be offered to patients with uncomplicated distal ureteral stones that are ≤ 10 mm in diameter. The guidelines also state that active surveillance can be offered for asymptomatic, non-obstructing calyceal stones [17]. Acute medical treatment for renal or ureteric colic includes conservative therapy, such as hydration, analgesia (intravenous pain relief with morphine or the NSAID ketorolac), and antiemetics [3]. Patients who present with acute nephrolithiasis most often require fluid administration, aggressive pain management, and treatment for nausea or vomiting. Most ureteral stones measuring 5.0 mm or less will typically pass spontaneously within a few weeks, but larger stones usually require intervention—in some cases, surgery [7]. Ureteral stones with a diameter less than 5 mm will pass in up to 68% of cases; however, for

stones with a greater diameter the overall chances of spontaneous passage are lower [13]. Incidences of nephrocalcinosis increase with age, whereas nephrolithiasis is mostly a disease of the third to fifth decades of life [18]. Complete management means not only proper evaluation and treatment, but also prophylaxis to prevent recurrence, which is impossible without the knowledge of the composition of the offending stone [19,12]. The modern western lifestyle provides a host of factors that impair urine composition and thereby increase the risk of stone formation. In our everyday life, we do not drink enough water and only twice or thrice a day, we eat food that is too rich in calories and table salt, but have deficiencies in fiber and alkali. Last but not least, we do not exercise enough. Recent work showed that being overweight is a crucial risk factor with significant impact on stone formation [20]. Management of a kidney stone depends on its size, location, and composition and the presence of anatomical malformation and complications. The presence of a complication (complicated stone)—infection or obstruction—may necessitate immediate intervention, whereas uncomplicated stones can be managed conservatively with adequate fluid intake and analgesia. If a stone does not pass spontaneously then definitive treatment is needed to remove it [21].

All patients with stones should be offered conservative treatment, whether or not additional treatments with drugs are to be offered. Conservative treatment for hypercalciuric individuals with normal bone density includes a high fluid intake to ensure a minimum urine

volume of 2 L/day, dietary sodium restriction (about 100 meq/day), oxalate restriction (avoidance of dark roughage, tea, nuts, soya bean, sweet potato), increased citrus-fruit intake, avoidance of a meat-rich diet, and a moderate intake of dietary calcium (up to an equivalent of one glass of milk per day). A high intake of fluids has been shown to be effective when used as the only method to prevent stone recurrence [22,23]. Stone disease has been increasingly linked to systemic conditions, although it is not clear if stone disease is a cause of these disorders or if it is a consequence of the same conditions that lead to these disorders. Overweight/obesity, hypertension and diabetes have all been shown to be associated with an increased risk of stone disease [24]. Management of stone disease needs individualization. Clinical presentation, proper history, and laboratory tests help to identify whether one needs urgent surgical or medical treatment [23]. Management of urolithiasis in transplanted patients is similar to that in the general population and includes factors such as transplant function, coagulative status, and anatomical obstacles due to the iliac position of the organ, directly influence the surgical strategy [4,6]. Therapeutic nutrition recommendations for the secondary prevention of urolithiasis are widely used. General nutrition guidelines are useful in promoting public health and for developing nutrition plans that reduce the risk for or attenuate the effects of diseases that are affected by nutrition. Nutrition therapy is the application of nutritional assessment, diagnosis, intervention, and counseling to prevent or manage disease [25].

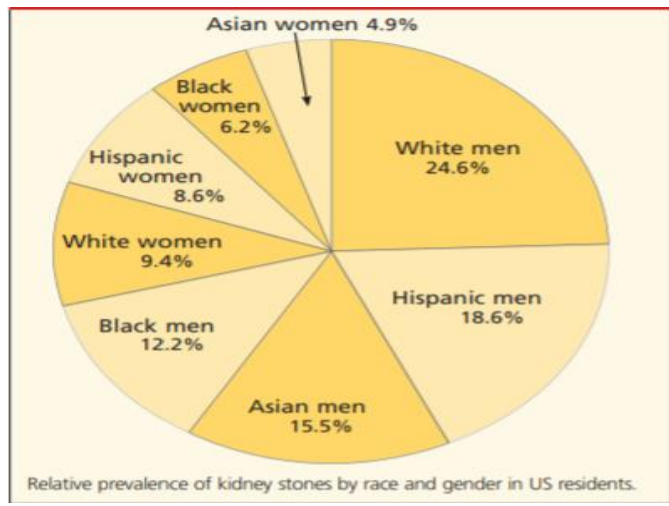


Fig. 1. Ethnic diversity in the prevalence of kidney stones [7]

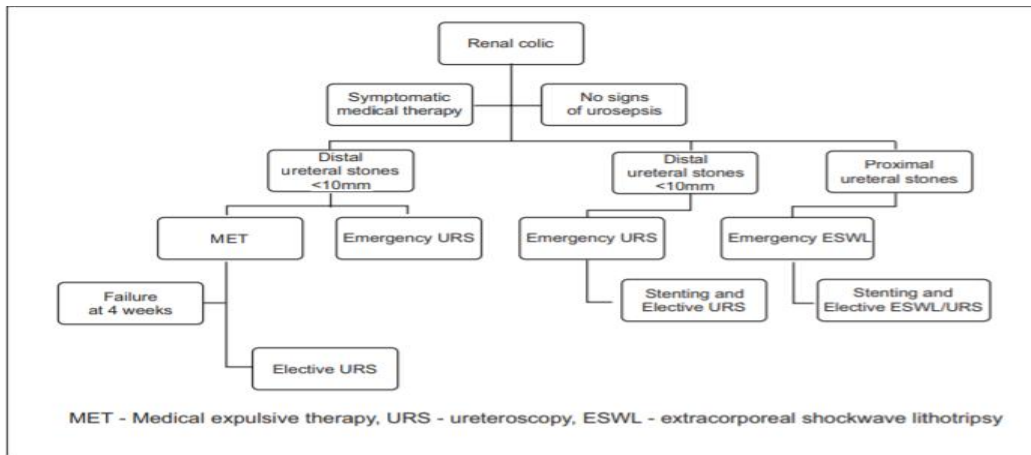


Fig. 2. Emergency management of ureteral stones [13]

3. TREATMENT OF STONE

Development in surgical equipment and technologies, starting in the 1980s, has provided numerous tools for the intra- and extra-corporeal fragmentation of urinary calculi for treatment [26]. Treatment depends on the type of stone, stone composition, how bad it is and the length of time you have had symptoms. There are different treatments to choose from. It is important to talk to your health care provider about what is best for you [1,6]. Until the 1980s, treatment of the upper urinary tract often involved extensive open surgical procedures. In the last 20 years the treatment of stone disease has undergone tremendous changes, especially with the introduction of the extracorporeal shock-wave lithotripsy (ESWL) and refinements in endourological procedures such as percutaneous nephrolithotomy (PCNL) and ureterorenoscopy (URS) techniques, which exclusively depend upon the use of various kind of energies to fragment the stone [27,19]. You can simply wait for the stone to pass. Smaller stones are more likely than larger stones to pass on their own. Waiting four to six weeks for the stone to pass is safe as long as the pain is bearable [1].

3.1 Medication

- Certain medications have been shown to improve the chance that a stone will pass. The most common medication prescribed for this reason is tamsulosin. Tamsulosin (Flomax) relaxes the ureter, making it easier for the stone to pass. You may also need pain and anti-nausea medicine as you wait to pass the stone [1,23]. tamsulosin 0.4 mg taken daily for one month. However, in several trials terazosin

5-10 mg daily or doxazosin 4 mg daily were used with similar efficacy [13].

- If the patient has a stone present without signs and symptoms of infection, he or she can be managed conservatively with opioids and nonsteroidal anti-inflammatory drugs (NSAIDs). NSAIDs have been shown to offer effective pain relief from acute kidney stone related pain with fewer side effects than opioids and acetaminophen [3,6].
- Medical expulsive therapy (MET) has recently emerged as an appealing option for the initial management of ureteral stones [13]. There is evidence to support that medical expulsive therapy, namely alpha-blockers, may increase ureteral stone passage rate and decrease the time to stone passage, particularly in distal ureteral stones < 10mm in size. However, if a 4- to 6-week trial of MET has been attempted without successful stone passage, the patient should undergo definitive surgical management [3,5]. The addition of steroids to either calcium channel blockers or α -adrenergic antagonists added only a small incremental benefit [16,23].
- Immunosuppressive medications, particularly cyclosporine, increase urine concentration and serum and urine uric acid levels, which may promote stone formation. The treatment of these patients is challenging, due to immunosuppressive drugs used [4].
- Many patients require narcotic medications to control pain adequately. Antiemetic agents (such as the H₁-receptor blocker dimenhydrinate 42) should be

- administered to control nausea and vomiting [7].
- Nifedipine: This is a calcium channel blocker commonly used in the treatment of hypertension and angina. It acts as a suppressing mechanism of the fast component of ureteral contraction leaving the peristaltic rhythm unchanged. Its use in medical therapy for distal ureteral lithiasis has been tested in various studies [13].
 - It has been seen that the combination of restricted intake of animal protein (52 g/day), restricted salt intake (50 mmol, or 2,900 mg/day of sodium chloride), and normal calcium intake (30 mmol/day, or 1,200 mg/day) was associated with a lower incidence of stone recurrence in men with hypercalciuria, compared with traditional low-calcium intake (10 mmol, or 400 mg/day). Patients should therefore be advised to avoid excessive intake of animal protein [17,21].
 - Insulin resistance is the most important factor of metabolic syndrome and kidney stone formation, since insulin resistance decreases the production and transport of ammonia, resulting in a low urine pH [15].
 - addition to conventional treatment of a calcium channel blocker (nifedipine) to relax ureteral muscles, short term prednisone (for five days) to reduce local oedema through its anti-inflammatory action, antibiotics to prevent and treat urinary tract infection, and paracetamol to raise the pain threshold and reduce the need for narcotics boosted the rate of passage of stones and led to fewer lost work days, emergency room visits, and surgical interventions, with a similar side effect profile [21].
 - Thiazides (trichlormethiazide 2 or 4 mg four times a day, or hydrochlorothiazide 50 mg twice or four times a day) correct the “renal leak” of calcium, and restore normal parathyroid function, intestinal calcium absorption, and urinary calcium. Potassium citrate or bicarbonate (20 meq twice a day) given with thiazide prevents hypokalaemia and improves citrate excretion [22]. Thiazides should be considered appropriate for both calcium oxalate and calcium phosphate stone formers [24]. Significant side effects are thus associated with thiazide therapy in at least 5% of the cases [27]. Potential side-effects hypokalemia, glucose intolerance, dyslipidemia, and hyperuricemia [28].

3.2 Specific Recommendations for Different Types of Stones

3.2.1 Calcium oxalate stones

In patients with the common form of nephrolithiasis, avoiding high-dose vitamin C supplements is the only known strategy that reduces endogenous oxalate production. Firstly, foods that contain high amounts of oxalate should be avoided e.g. spinach, rhubarb, and potatoes [17]. Increased citrus fruit intake is recommended to prevent stone recurrence [3]. For calcium oxalate and calcium phosphate stones thiazide diuretics (with sodium restriction) may be used to reduce urine calcium [29]. Thiazide diuretics—decrease urinary calcium excretion by augmenting tubular reabsorption of calcium, but do not decrease intestinal absorption in absorptive hypercalciuria; the effect may be attenuated or lost after two or more years of treatment [21]. High fluid intake may be beneficial not only to prevent CaOx overgrowth, but also to reduce plaque formation itself. Thiazide diuretics, which lower urine calcium, may reduce plaque as well as urine CaOx SS [30]. Thiazide diuretics have shown to reduce the recurrence rates by up to 70% [23]. Magnesium and citrate are inhibitors of crystallization since they can reduce the saturation of calcium oxalate by complexing oxalate and calcium, respectively [18].

3.2.2 Calcium phosphate stones

Calcium phosphate stones share the same risk factors as with calcium oxalate stones like higher concentrations of urine calcium and lower concentrations of urine citrate [17]. Potassium phosphate—may suppress calcitriol synthesis and thereby decrease calcium absorption [21]. CaP SFs are usually treated with fluids and thiazide diuretics to lower urine calcium excretion. Urine citrate excretion can be reduced, as in idiopathic CaOx SFs, but because potassium citrate salts can increase urine pH and CaP SS, careful follow-up is needed. No clinical trials have documented treatment outcomes for CaP SFs [30]. In patients who also have hypocitraturia) or the use of a combination thiazide/potassium-sparing diuretic, such as amiloride/hydrochlorothiazide in patients who do not require citrate repletion. Monitoring of urine pH is also critical because elevation of the urine pH greater than 6.5 can lead to supersaturation of calcium phosphate and possible change in stone recurrence composition [28].

3.2.3 Uric acid stones

The mainstay of prevention of uric acid stone formation entails increasing urine pH. While acidifying the urine can be challenging, alkalinising the urine can be readily achieved by increasing the intake of foods rich in alkali (e.g. fruits and vegetables). Supplementation with bicarbonate or citrate salts (preferably potassium citrate) can be used to reach the recommended pH goal of 6–7 throughout the day and night [17]. For uric acid nephrolithiasis and other disorders of the metabolic syndrome, a common pathophysiological cause is on the horizon – insulin resistance. Patients with recurrent uric acid stones were found to be severely insulin resistant compared to healthy controls [20]. Allopurinol to inhibit uric acid synthesis and decrease urinary uric acid excretion [21,23]. Allopurinol also has serious side effects. One study reported a 3.5% incidence of side effects in 1835 hospitalized patients who received allopurinol; 1.7% developed skin rash and 1.8% developed a variety of other complications of which the most serious was liver necrosis [27]. Prevention and even dissolution of UA stones depends upon the ability to increase urine pH above 6.0, which is accomplished by administration of 20–30 mEq potassium alkali, 2 or 3 times daily [30]. If urine pH is not increased, xanthine oxidase inhibition of uricosuria may be ineffective; at high urine pH, xanthine oxidase inhibition is redundant in addressing recurrent uric acid stones [28].

3.2.4 Struvite stones

These stones require complete removal by a urologist. New stone formation can be avoided by the prevention of UTIs [17]. Acetohydroxamic acid, a urease inhibitor, has been shown to reduce the urinary saturation of struvite but is associated with high frequency of side effects (deep vein thrombosis, haemolytic anaemia), which limits its use [21,23]. Patients treated for struvite stones may still be at risk for recurrent UTI after stone removal, and in some patients surgical stone removal is not feasible. The use of a urease inhibitor, AHA, may be beneficial in these patients, although the extensive side effect profile may limit its use [24]. For patients with struvite calculi undergoing endourologic procedures, preoperative antibiotics are commonly used [28].

3.2.5 Cystine stones

Treatment must include increasing urine output to about 3.5–5 liters /day and adequate

alkalinisation (urine pH > 7.0) with potassium citrate. In addition, specific agents such as, α - mercaptopropionylglycine or d-penicillamine that form soluble complexes with cystine are used [21,30,23]. Although often well-tolerated, infrequent side effects include the following: bone marrow suppression, proteinuria with nephropathy, hepatotoxicity, aplastic anemia, drug-induced lupus, abdominal pain, diarrhea, nausea and vomiting, and anorexia [28]. Potassium citrate therapy provides an alkali load that leads to increased urine pH for cystine stone formers, a urine pH of 7.0 should be achieved [24]. Captopril, a commonly used antihypertensive that contains a thiol-group, is another theoretical pharmacologic target for cystinuria. However, it does not appear in the urine in sufficient quantities to affect cysteine solubility and several small studies have yielded equivocal data on its ability to decrease urinary cystine level [28].

3.3 Surgery

Surgery may be needed to remove a stone from the ureter or kidney if:

- The stone fails to pass.
- The pain is too great to wait for the stone to pass.
- The stone is affecting kidney function. Small stones in the kidney may be left alone if they are not causing pain or infection. Some people choose to have their small stones removed. They do this because they are afraid the stone will unexpectedly start to pass and cause pain [1].

About 10-20% of all kidney stones need radiological or surgical intervention to remove the stone [21]. If there is spontaneous passage of stones, most pass within 4 to 6 weeks. Surgical intervention is indicated in the presence of persistent obstruction, failure of stone progression, sepsis, or persistent or increasing colic [3]. Surgical intervention may be required if stones are too large to pass spontaneously (typically ≥ 8 mm); if they cause acute renal obstruction; or if they are located at a site with a potential for complications or can lead to persistent symptoms without evidence that they are passing [7]. The type of surgery chosen depends on the size and location of the stone, as well as the operators experience, patient preference, available equipment and related costs. Presence or absence of obstruction [13].

Surgeries to remove stones in the kidneys or ureters are:

1. Shock wave lithotripsy (SWL)
2. Ureteroscopy (URS)
3. Percutaneous Nephrolithotomy (PCNL)

3.3.1 Shock wave lithotripsy (SWL)

The first successful ESWL treatment was accomplished in 1980 in Germany by Dr Christian Chaussy using a Dornier HM1 lithotripter. Owing to its effectiveness and its rare side effects, ESWL was quickly approved by the US Food and Drug Administration (FDA) for clinical use [16,14,31]. Shockwave lithotripsy as first-line therapeutic option, applied rapidly after the onset of renal colic, has deserved very limited attention so far [13]. Shock Wave Lithotripsy is used to treat stones in the kidney and ureter. Shock waves are focused on the stone using X-rays or ultrasound to pinpoint the stone. Repeated firing of shock waves on the stone usually causes the stone to break into small pieces. These smaller pieces pass out in the urine over a few weeks [1,26,30]. However, intervention success rates depend on stone composition, size, properties and location of the stone as well as the orchestration type and frequency of shock. This procedure has been optimized, and new instruments have been developed to increase utility to urologists and to improve tolerability for the patient [2,13]. Calculi between 10 mm and 20 mm are in general treated with extracorporeal shock wave lithotripsy (ESWL) or ureteroscopy as first-line therapy. However for ESWL, the results for lower pole stones are inferior (55%) to upper and mid pole stones (71.8% and 76.5%, respectively) [3,7]. ESWL is a valuable, noninvasive method for stone management, but some limitations exist in transplanted patients. Usually, ESWL is a reasonable treatment for calculi smaller than 1.5 cm [4]. Success depends on the efficacy of the lithotripter and the size, location and composition (hardness) of the stones, patient's habitus performance of SWL [6]. Lowering shock wave frequency from 120 to 60-90 shock waves/min improves SFR. Tissue damage increases with shock wave frequency [32]. Reducing the shock-wave rate to 60/min improves stone disintegration and reduces tissue damage [33]. The major advantages of SWL are that it is the least invasive technique to treat renal and ureteral stones and potentially can be performed with only sedation and analgesics in most patients [16]. ESWL is usually an outpatient procedure performed with analgesia or sedation. The use of ESWL has increased but still PCNL has many advantages over ESWL and in some cases, URS [17]. Medical treatment could lower

the recurrence rate after ESWL, endo-urological procedures, and open surgery [19]. Shock wave lithotripsy is less efficacious if the stone is dense (attenuation value of more than 1000 Hounsfield units) on helical computed tomography and might adversely affect ovarian function when used for distal ureteric stones in women [21]. It can have side effects. In human and animal models it can cause acute renal injury [34]. Although the application of ESWL in children was first reported in 1986. When considering ESWL for kidney stones in children, it appears to be a different condition from that in adults [35]. ESWL can become more efficient and safer. In addition, new concepts, novel ideas, and future research are leading the way toward a brighter future for ESWL [31]. The advantages of ESWL are that it is minimally invasive, usually well tolerated, and a stent is not usually required. The risks of ESWL include bruising, pain or urinary obstruction from fragments of stone, haematuria and, rarely, perinephric haematoma, the disadvantages of ESWL are that effectiveness decreases with increasing body mass index, it is not suitable in pregnancy [36].

3.3.2 Ureteroscopy (URS)

Rigid URS was first applied therapeutically for the treatment of mid distal ureteral calculi in the 1980s. Although large (>10F) diameter ureteroscopes were used, success rates of 90% were achieved [16,17]. Ureteroscopy represents a safe and minimally invasive procedure in the management of ureteral stones [13]. Ureteroscopy is used to treat stones in the kidney and ureter. URS involves passing a very small telescope, called an ureteroscope*, into the bladder, up the ureter and into the kidney. Rigid telescopes are used for stones in the lower part of the ureter near the bladder. Flexible telescopes are used to treat stones in the upper ureter and kidney. The ureteroscope lets the urologist see the stone without making an incision (cut). Once the urologist* sees the stone with the ureteroscope, it can be fragmented using a laser and a small, basket-like device grabs smaller stones and removes them. The procedure is more invasive than ESWL [1,3,37]. Ureteroscopy using the holmium:yttrium-aluminum-garnet (YAG) laser (photothermal lithotripsy) is effective for stones of all compositions and sizes, with a success rate of 97-100%. 29 [21]. Flexible ureteroscopy is recommended for adequate access and desintegration of calculi and can be done by electrohydraulic lithotripsy, ultrasonic lithotripsy

or holmium laser in the ureter and kidney, with a success rate of 67–100% [4]. Technical improvements including endoscope miniaturization, improved deflection mechanism, enhanced optical quality and tools, and introduction of disposables have led to an increased use of URS for both, renal and ureteral stones [6]. ureteroscopy is more efficacious, less expensive than shock wave lithotripsy for distal ureteral stones but is more time consuming and technically demanding [8,21]. ureteroscopy is useful when complex or lower pole renal calculi

are present or when patient factors such as pregnancy, coagulopathy, or morbid obesity preclude lithotripsy [34]. The high success rate and low morbidity of UL for stones of >2 cm render it preferable to other methods, including ESWL and PCNL. It should be considered as a standard approach to treat large renal calculi [32]. One disadvantage of ureteroscopy is that a ureteral stent, which causes considerable discomfort in some patients, is often necessary to prevent obstruction from ureteral oedema or stone fragments [33].

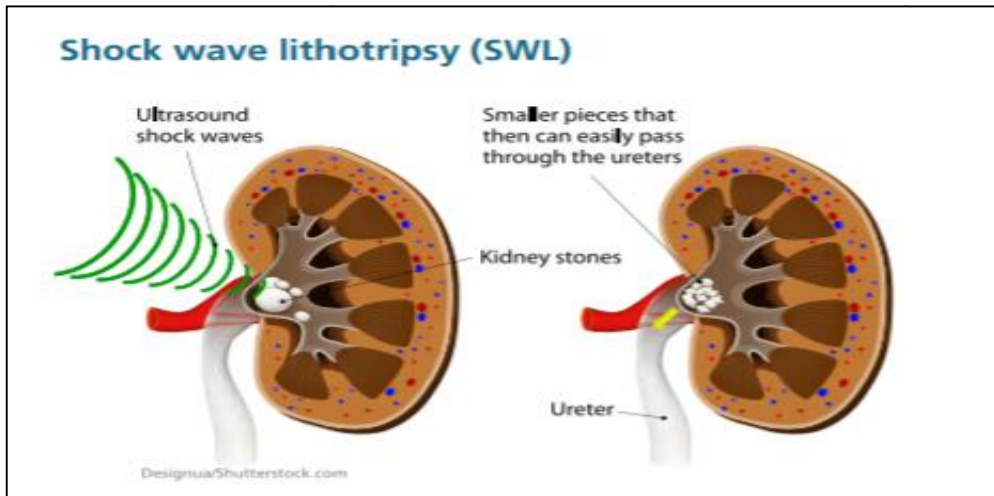


Fig. 3. Shock wave lithotripsy (SWL) [1]

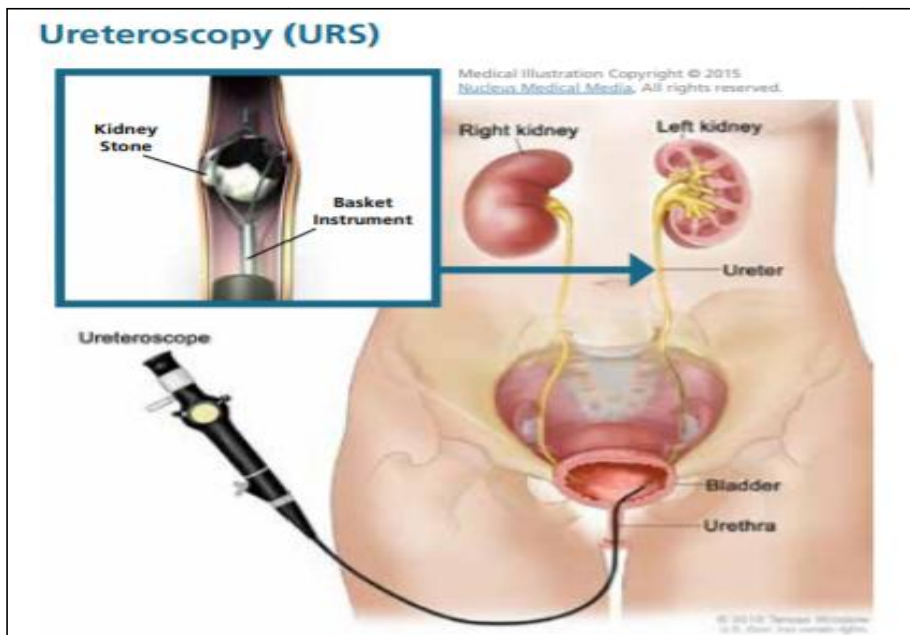


Fig. 4. Ureteroscopy (URS) [1]

3.3.3 Percutaneous nephrolithotomy (PCNL)

PCNL was established as a minimally invasive treatment option for kidney stone removal in the 1970s [33]. The first report of percutaneous stone surgery for upper-tract stones in adults in 1976. experience has dramatically increased with the increasing application of PCNL in subsequent years. Nine years later, in 1985, the first paediatric series of PCNL was reported [35]. Patients with larger or more complex stones may require percutaneous nephrolithotomy [7]. Percutaneous Nephrolithotomy is the best treatment for large stones in the kidney. General anesthesia is needed to do a PCNL. PCNL involves making a half-inch incision (cut) in the back or side, just large enough to allow a rigid telescope (nephroscope) to be passed into the hollow center part of the kidney where the stone is located. An instrument passed through the nephroscope breaks up the stone and suctions out the pieces, graspers, or basket extraction. This procedure usually requires two days in hospital [1,34,36]. Patients with stones >20 mm should primarily be treated with PCNL unless specific indications for an alternate procedure are present. While PCNL is the first-line therapy for

large stones [2]. PCNL was developed to reduce the morbidity and mortality associated with open renal surgery. However, it represents the most morbid of the minimally invasive endoscopic surgeries for renal stones [17]. 1,000 consecutive patients who underwent percutaneous removal of renal and ureteral stones. Removal was successful for 98.3 per cent of the targeted renal stones and 88.2 per cent of the ureteral stones. Percutaneous techniques are an effective way to handle the majority of renal calculi [29]. Traditionally, PCNL has been considered advantageous for treating large lower-pole stones, but recent series showed that UL achieves comparable outcomes [32]. PCNL as the first-line treatment in children with staghorn calculi, open surgery is recommended among the secondary options, with ESWL [35]. PCNL is still a challenging procedure and can be associated with significant complications. increase morbidity associated with larger instruments like blood loss, postoperative pain and potential renal damage, infection, other organ damage and problems due to residual stones [4,6,16,32]. The advantages of PCNL are that it provides excellent access to large stones and has a high rate of stone clearance [36].

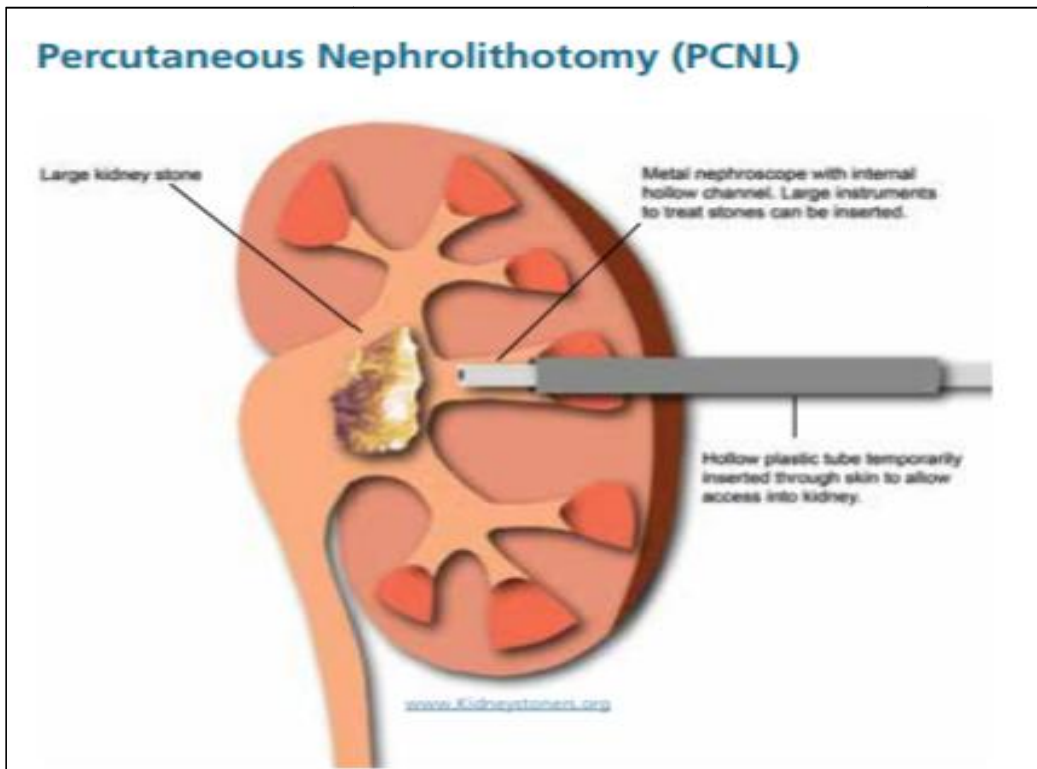


Fig. 5. Percutaneous nephrolithotomy (PCNL) [1]

❖ Diet

Drink enough fluids each day have shown that increasing urine volume to at least 2 L/day OR 2 lit/day can reduce the recurrence of stone disease by up to 40–50%, Reduce the amount of salt in your diet, Eat plenty of fruits and vegetables, Eat foods with low oxalate levels, Eat less meat, Eat the recommended amount of calcium [1,23,37]. Modern lifestyle, dietary habits and obesity emerge to be the promoters of idiopathic stone disease. Modern diets containing a lot of animal protein, refined carbohydrates and salts act on the metabolism like an acid concentration [2,38]. high fluid intake ensures optimal specific weight levels of urine < 1.010. A purine-reduced diet decreases the risk of spontaneous crystallization in urine [6]. A diet high in calcium ($\geq 1,200$ mg/d) reduces the risk for calcium oxalate stone recurrence. oxalate-rich foods like cucumber, green peppers, beetroot, spinach, soya bean, chocolate, rhubarb, popcorn, and sweet potato should be avoided [7,23]. Fish-oil supplementation showed advantageous effects on the lithogenic serum and urine parameters [20]. Oral potassium citrate (Kcit) has been shown to be useful in increasing urinary citrate and reducing the stone recurrence. Surprisingly, fresh tomato juice was found to have the highest citrate and low oxalate content [23]. Nutrition therapy, widely used for secondary prevention of urolithiasis, is the application of nutritional assessment, diagnosis, intervention, and counseling to prevent or manage disease [25]. Patients with urolithiasis should be well hydrated, and have a diet low in salt, oxalate and protein [36].

4. CONCLUSION

The incidence of urolithiasis is increasing worldwide. Kidney stone disease remains a major public health burden. Many aspects of renal stone formation remain unclear. The increasing incidence of renal stones is adding to the morbidity and huge economic losses worldwide of this pathology. The technological advances have helped with early diagnosis and treatment. High fluid intake and adopting healthy lifestyle measures are some of the cost-effective measures of preventing renal stones. Treatment is successful if attended in early stage itself. Surgical treatment is more effective. URS is associated with a significantly greater stone free rate and fewer required re-treatment. Medical therapy, when used judiciously in conjunction with dietary measures, can help in preventing

recurrence and in expulsion of small size stones. Removal of stones from the kidney and ureter is an important and extensive part of the care of patients with urinary tract stone disease. For smaller ureteral stones in a reasonable asymptomatic patient, MET is an excellent initial form of treatment. Regarding their expulsive efficacy, alleviation of pain, and safety profile, both calcium channel blockers and α -adrenergic antagonists can be suggested. In terms of active stone removal, SWL, PCNL and URS have been shown to be useful alternatives and are effective in treating the overwhelming majority of stones. This techniques have advantages and disadvantages as well as different patterns of complications. All such factors need to be considered when choosing the most appropriate method. Patient satisfaction becomes increasingly important when choosing between competing modalities of similar efficacy, and so it is difficult to give priority to either of these procedures. Operator's experience, access to adequate equipment and specific circumstances are probably the most important determinants of which method will be most appropriate for each particular case.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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