Management of Ureteral Stones

Ureteral stone disease is among the most painful and prevalent of urologic disorders. As many as 5 percent of Americans will be affected by urinary stones at some point in their lives.

Fortunately, most stones pass out of the body without any intervention. If you are not so lucky, the following information should help you and your doctor address the causes, symptoms and possible complications created by your ureteral stone disease.

How does the urinary tract work under normal conditions?

The urinary tract is similar to a plumbing system, with special pipes that allow water and salts to flow through them. The urinary tract includes two kidneys, two ureters and the urethra.

The kidneys act as a filter system for the blood, cleansing it of poisonous materials and retaining valuable glucose, salts and minerals. Urine, the waste product of the filtration, is produced in the kidney and trickles down hours a day through two 10- to 12-inch long tubes called ureters, which connect the kidneys to the bladder. The ureters are about one-fourth inch in diameter and their muscular walls contract to make waves of movement to force the urine into the bladder. The bladder is expandable and stores the urine until it can be conveniently disposed of. It also closes passageways into the ureters so that urine cannot flow back into the kidneys. The tube through which the urine flows out of the body is called the urethra.

What is a ureteral stone?

A ureteral stone is a kidney stone that has moved down into the ureter. The stone begins as a tiny grain of undissolved material located where urine collects in the kidney. When the urine flows out of the kidney, this grain of undissolved material is left behind. The material deposited is usually a mineral called calcium oxalate. Other less common materials that may also form a kidney stone are cystine, calcium phosphate, uric acid and struvite. Over time, more undissolved material is deposited and the stone becomes larger. Most stones enter the ureter when they are still small enough to move down into the bladder. From there, they pass out of the body with urination. Some stones, however, have grown larger by the time they leave the kidney. They may become lodged in a narrow part of the ureter, causing pain and possibly blocking the flow of urine. These stones may need to be treated.

What are the signs of a problem?

Usually, the symptom of a kidney stone is extreme pain. Having been described as being worse than childbirth, the pain often begins suddenly as the stone moves in the urinary tract, causing irritation and blockage. Typically, a person feels a sharp, cramping pain in the back and in the side of the area of the kidney or in the lower abdomen, which may spread to the groin. Also, sometimes a person will have blood in the urine, nausea and/or vomiting.

Occasionally, stones do not produce any symptoms. But while they may be "silent," they can be growing, even threatening irreversible damage to kidney function. More commonly, however, if a stone is not large enough to prompt major symptoms, it still can trigger a dull ache that is often confused with muscle or intestinal pain.

If the stone is too large to pass easily, pain continues as the muscles in the wall of the tiny ureter try to squeeze the stone along into the bladder. One may feel the need to urinate more often or feel a burning sensation during urination. In a man, pain may move down to the tip of the penis. If the stone is close to the lower end of the ureter at the opening into the bladder, a person will frequently feel like they have not fully completed urination.

Stones as small as 2 mm have caused many symptoms while those as large as a pea have quietly passed. If fever or chills accompany any of these symptoms, then there may be an infection. You should contact your urologist immediately.

How are ureteral stones diagnosed?

Sometimes "silent" stones — those that cause no symptoms — are found on X-rays taken during a general health exam. These stones would likely pass unnoticed. If they are large, then treatment should be offered. More often, ureteral stones are found on a X-ray or sonogram taken on someone who complains of blood in the urine or sudden pain. These diagnostic images give the doctor valuable information about the stone's size and location. Blood and urine tests also help detect any abnormal substance that might promote stone formation.

If your doctor suspects a stone but is unable to make a diagnosis from a simple X-ray, he/she may scan the urinary system with intravenous pyelography (IVP). It is an imaging technique that utilizes radiopaque injections of dye followed, during excretion by the kidneys, by abdominal X-rays. A kidney obstructed by a stone will not be able to excrete the dye as quickly and may also appear enlarged when compared to the normal organ. Since this technique requires preparation, it has been replaced in many hospitals by an abdominal/pelvic CT scan, an extremely accurate diagnostic tool that can detect almost all types of ureteral stones painlessly.

What are some treatment options?

Treating kidney stone disease depends largely on the size, position and number of stones in your system. Luckily, the majority of small stones (0.2 inch or 5 mm in diameter) that are not causing infection, blockage or symptoms will pass if you simply drink plenty of fluids each day. Consuming two to three quarts of water increases urine production, which eventually washes kidney or other stones out of the system. Once they have passed, no other treatment is necessary. The doctor usually asks one to save the passed stone(s) for testing. A cup or tea strainer can be used for this purpose. However, recent studies have suggested that the majority of stones (95 percent) that are capable of spontaneous passage will pass within six weeks. After that time, continued observation is probably not warranted.

Also, the sudden pain that occurs when small stones start down the ureter can usually be treated with rest and analgesics or painkillers. Certain types of stones, such as those made of uric acid, can be shattered with medical therapy. The majority, however, are composed of calcium and are not responsive to medicine.

Surgery should be reserved as an option for cases where other approaches have failed or should not be tried. Surgery may be needed if a stone:

- does not pass after a reasonable period of time and causes constant pain
- is too large to pass on its own
- blocks the flow or urine
- causes ongoing urinary tract infection
- damages kidney tissue or causes constant bleeding
- has grown larger (as seen as follow-up X-ray studies)

Until recently, surgery to remove a stone was very painful and required a lengthy recovery time (four to six weeks). Today, treatment for these stones is greatly improved and many options do not require major surgery. Some of the major treatments include:

Extracorporeal shock wave lithotripsy (ESWL®). Shock wave treatment that uses a machine called a lithotripter. Lithotripsy fragments a stone into pieces small enough to pass out with urination. "Extracorporeal" means the shock waves come from outside the body. For treatment with ESWL®, the patient is placed in a tub of water or against a water-filled cushion or mattress. A lithotripter makes shock waves, and the doctor, using ultrasound or X-rays, focuses the waves exactly on the ureteral stone inside the patient's body. They travel easily through both the water and the patient's soft body tissues, until they hit the stone. The impact causes stress on the stone. Repeated shock waves cause more stress, until the stone eventually crumbles into small pieces. Because of possible discomfort during the procedure, the patient may need general, regional or local anesthesia or some form of sedation. Also, a plastic tube, called a stent, may be temporarily inserted through the urethra and bladder and into the ureter. The stent may assist in locating the stone or in helping the fragments pass following treatment. ESWL® is the least invasive of the four active treatments and has a short recovery time. Most patients can resume normal activities in a few days. However, one ESWL® session by itself may not free the ureter of all stone material.

A repeat ESWL® session may be necessary. ESWL® is not the ideal treatment choice for all patients. Patients who are pregnant or have abdominal aortic aneurysms, urinary tract infections or uncorrected bleeding disorders should not have ESWL®. In addition, certain factors such as stone size, location and composition may require other alternatives for stone removal.

While shock wave lithotripsy is considered safe and effective, it can still cause complications. Most patients have blood in their urine for a few days after treatment. Bruising and minor discomfort in the back or abdomen from the shock waves are also common. To reduce the risk of complications, urologists usually tell their patients to avoid aspirin and other drugs that affect blood clotting for several weeks before treatment. Another complication may occur if the shattered stone particles cause discomfort as they pass through the urinary tract. In some cases, the urologist will insert a small tube called a stent through the bladder into the ureter to help the fragments pass.

Ureteroscopy (URS). Ureteroscopy involves the use of ureteroscopes, small flexible or semi-rigid telescopes that can be inserted up the urethra, through the bladder and into the ureter without an incision. These instruments allow the doctor to view a ureteral stone directly. They also have small working channels through which various devices can be passed to remove or fragment the stone. Anesthesia is generally used, and a stent is left in the ureter for a few days after treatment while healing takes place. Ureteroscopy was developed in the 1970s and came into wide use during the 1980s. Before then, a type of treatment called "blind basketing" was often used. A basket-like device was passed — blindly, with no viewing instrument — through the urethra and bladder and into the ureter to pull out the stone. This type of "blind" treatment risks injury to the ureter and is less effective than other methods used today. In particular, as ureteroscopy has advanced with continual instrument improvements, blind basketing is no longer a satisfactory treatment choice. The risks of ureteroscopy include perforation or stricture (scar tissue), especially if the stone has been impacted or embedded within the wall of the ureter for longer than two months. The majority of ureteroscopic procedures can be performed as day surgery and most individuals can return to work within one to two days following the procedure.

Percutaneous nephrolithotomy (PNL). This procedure is the treatment of choice for patients with ureteral stones that are larger are in a location that does not allow effective use of SWL or cause a blockage so severe that they cannot be bypassed using stent.

In this procedure, the surgeon makes a tiny cut in the flank area and then uses an instrument called a nephroscope to locate and remove the stone. For larger stones, a type of energy probe (ultrasonic, electrohydraulic or hydraulic) may be needed to break the stone into small pieces. All of this is done while the patient is sedated or under anesthesia.

One advantage of this procedure over SWL is that the surgeon removes the stone fragments instead of relying on their natural passage from the ureters. Generally, patients stay in the hospital two to three days and may have a small catheter in the kidney during the healing process. Most patients can resume light activity in one to two weeks.

Open surgery. Is the most invasive treatment and is rarely performed these days. In open surgery for ureteral stones, the doctor makes a surgical cut to expose the ureter where the stone is located. Another cut is made in the ureter itself, and the stone is directly removed. Open surgery is usually reserved for complicated, difficult cases. Most patients need about six weeks to recover after the operation.

What can be expected after treatment?

Although stone recurrence rates differ with individuals, in general you have a 50 percent chance of redeveloping stones within the next five years. So prevention is essential. Your urologist may follow-up with several tests to determine which factors — e.g., medication or diet — should be changed to reduce your further risk. Tables 1 and 2 show likely benefits and risks of the four active treatment choices: ESWL®, URS, PNL and open surgery. For some treatments, benefits and risks may differ depending on whether the stone is located in the upper or lower ureter. Thus, there are two tables — Table 1 for stones in the upper ureter and Table 2 for stones in the lower ureter.

Table 1. Estimated outcomes for treatments of ureteral stones in the UPPER ureter</TD< TR>

Outcomes	SWL	URS	PNL	Open Surgery
Chances of being stone free with stones less than 1 cm. wide (small to medium stones)	84%	56%	76%	84%
Chances of being stone free with stones more than 1 cm. wide (large stones)	72%	44%	74%	71%
Chances of significant acute complications (e.g., death, loss of kidney and need for blood transfusion)	4%	11%	9%	8%
Chances of unplanned secondary interventions	15%	27%	15%	11%
Chances of long-term complications (e.g., ureteral stricture)	No data	2%	8%	1%

Table 2. Estimated outcomes for treatments of ureteral stones in the LOWER ureter

Outcomes	SWL	URS	PNL	Open Surgery
Chances of being stone free with stones less than 1 cm. wide (small to medium stones)	85%	89%	No data	90%
Chances of being stone free with stones more than 1 cm. wide (large stones)	74%	73%	No data	84%
Chances of significant acute complications (e.g., death, loss of kidney and need for blood transfusion)	4%	9%	No data	No data
Chances of unplanned secondary interventions	10%	7%	No data	18%
Chances of long-term complications (e.g., ureteral stricture)	No data	1%	No data	No data

Frequently asked questions:

How can I prevent ureteral stones?

A good first step for prevention is to drink more liquids — water is the best. If you tend to form stones, you should try to drink enough liquids throughout the day to produce at least two quarts of urine in every 24-hour period. People who form calcium stones used to be told to avoid dairy products and other foods with high calcium content. However, recent studies have shown that foods high in calcium, including dairy foods, help prevent calcium stones. Taking calcium in pill form, however, may increase the risk of developing stones. Women taking vitamin D and calcium pills in the post-menopausal period to prevent osteoporosis, especially with family history of stones, need to be careful. If you are at risk for developing stones, your doctor may perform certain blood and urine tests to determine which factors can best be altered to reduce the risk. Some people will need medicines to prevent stones from forming.

My stone has not passed, do I need surgery?

In general, you are facing surgery if your stones are large enough to obstruct urine flow, if they are potentially harmful to your kidneys or if they are causing symptoms for which medication does not help.

Will my children get stones because I have them?

Any person with a family history of stones may be at higher risk. Stone disease in a first degree relative, such as a parent or sibling, can dramatically increase the probability for you. In addition, more than 70 percent of people with certain rare hereditary disorders are prone to the problem. Those conditions include cystinuria, an excess of the amino acid, cystine, that does not dissolve in urine and instead forms stones of cystine; and primary hyperoxaluria, an excess production of the compound oxalate, which also does not dissolve in urine, forming stones of oxalate and calcium.

What can be expected after treatment for kidney stones?

Recovery times vary depending upon treatment, with the less invasive procedures allowing shorter recovery periods and quicker return to activity.

Shock Wave Lithotripsy (SWL): Patients generally go home the same day as the procedure and are able to resume a normal activity level in two to three days. Fluid intake is encouraged, as larger quantities of urine can help stone fragments to pass. Because the fragments need to pass spontaneously down the ureter, some flank pain can be anticipated. It is possible that the stone may not have shattered well enough to pass all of the fragments. If so, a repeat SWL treatment or other option may be required. If a stent was placed prior to SWL, this will need to be removed in your urologist's office within a few weeks. Stents are usually well tolerated by patients but can occasionally cause some bladder irritation and frequent urination.

Ureteroscopy (URS): Patients normally go home the same day and can resume normal activity in two to three days. As with SWL, if your urologist places a stent, it will need to be removed in approximately one week.

Percutaneous nephrolithotomy (PNL): After PNL, patients usually spend two to three days in the hospital. Your urologist may choose to have additional X-rays done while you are still in the hospital to determine if any stone fragments are still present. If some remain, your urologist may want to look back into the kidney with a nephroscope to remove them. This secondary procedure usually can be done with sedation and through the existing tract into the kidney. Once the stones have been removed, the stent coming out of the flank is removed and the patient can be discharged. Normal activity can be resumed after approximately one to two weeks.

Open surgery: Because these procedures are the most invasive and painful, patients often spend up to five to seven days in the hospital. Full recovery may take up to six weeks.

Postoperatively, your urologist will encourage a high fluid intake, to keep the daily volume of urine produced greater than two liters a day. In addition, you may need to undergo additional blood and urine tests to determine specific risk factors for stone formation and help minimize the chance for future stones. Although stone recurrence rates differ with each individual, a good estimate to keep in mind is a 50 percent chance of redeveloping a stone within a five-year period.

What are the risks or potential complications of the various treatments?

Each treatment has its own inherent risks. Some risks that can be associated with all surgical procedures are the possibility of bleeding and infection. It is extremely rare for patients undergoing shock wave lithotripsy (SWL) or ureteroscopy (URS) to have any problems with blood loss or infection. The probability is higher with more invasive treatments such as percutaneous nephrolithotomy (PNL) or open surgery. In most cases, patients do not require transfusion unless the procedure is unusually difficult.

With SWL, except in emergencies, patients must avoid aspirin, non-steroidal anti-inflammatory drugs such as ibuprofen or other blood thinners, as these can cause significant bleeding around the kidney. It is important that these medications be stopped at least one week prior to treatment if possible. SWL is

generally a very safe treatment. Long-term follow up of patients has shown a slight increase in blood pressure, but no lasting adverse effect on kidney function has been noted.

In URS, there is a small possibility that the ureteral wall could be damaged or torn during the procedure. If this occurs, placement of a stent for two to three weeks is usually sufficient to allow the damaged area to heal. A complete tear of the ureter is very rare and requires open surgery to repair.

When PNL is performed, there is a small chance of air or fluids forming around a lung if the access channel is made toward the upper portion of the kidney. These entities are treated with a chest tube, which allows drainage of the fluid from around the lung. Other rare complications include injury to the bowel and injury to blood vessels within the kidney.

Will I have significant pain after the procedure?

Some discomfort is inevitable after surgical intervention for stones. The degree of discomfort is directly related to the invasiveness of the procedure. If needed, your urologist will prescribe medication to help control the pain during the recovery period.

What are signs of a problem postoperatively?

It is not uncommon for a patient to have a low-grade fever for the first 48 hours after surgery. However, if the fever continues or rises above 101.5° F (38.5° C) it could be a sign of active infection and should be reported to your urologist. Flank discomfort is also common after surgical interventions. However, if the pain becomes increasingly worse or unbearable, despite medication, your urologist should be notified.

How many times will I need to be treated?

The answer to this question depends on the size of stone and the treatment used. The chances for re-treatment are highest after SWL if the stone is large, extremely hard or in the lower portion of the kidney. PNL and open surgery tend to produce the highest stone-free rates.