

Center for Urologic Health

PHYSICIANS

DENNIS F. BENTLEY, M.D.
RAYMOND A. BOLOGNA, M.D.
TODD F. BREAU, M.D.
GREGORY G. DANESIS, M.D.
JOSEPH S. DANKOFF, M.D.
LAWRENCE L. GELLER, M.D.
HOWARD B. MINOTT, M.D.
BRADFORD L. MOSS, M.D., FACS
MICHAEL D. SERENE, M.D., FACS
KEVIN A. SPEAR, M.D.
JOHN D. WEGRYN, M.D.
JOHN Y. ZHAO, M.D.

OFFICE LOCATIONS

95 ARCH STREET SUITE 165
AKRON, OHIO 44304

P: 330.375.4848
F: 330.376.4066

2651 WEST MARKET STREET
FAIRLAWN, OHIO 44333

P: 330.864.8008
F: 330.864.1207

ANSWERING SERVICE:
P: 330.379.0379

6693 NORTH CHESTNUT STREET
RAVENNA, OHIO 44266

P: 330.296.6441
F: 330.296.2818

550 EAST ROBINSON AVENUE SUITE 2
BARBERTON, OHIO 44203

P: 330.864.8008
F: 330.864.1207

ANSWERING SERVICE:
P: 330.379.0379

3869 DARROW ROAD SUITE 206
STOW, OHIO 44224

P: 330.864.8008
F: 330.864.1207

ANSWERING SERVICE:
P: 330.379.0379

CENTER for UROLOGIC HEALTH

320 WEST EXCHANGE STREET
AKRON, OHIO 44302

P: 330.535.4428
F: 330.535.4451

PHYSICIANSUROLOGY.com

Kidney Stone Treatment Options

BY TODD BREAU, M.D.

Natural Progression

The natural course of kidney stones without treatment must be balanced against the relatively limited risks of treatment that are now possible with minimally invasive surgical techniques. Kidney stones that are more than 1 cm. in size (about 1/2 an inch) within the kidney will rarely pass through the urinary system without complications. Therefore, treatment is recommended for kidney stones larger than 1 cm (and many smaller stones within the kidney).

A kidney stone is most likely to cause symptoms once it has passed into the ureter, the narrow tube that connects the kidney to the bladder. If the stone blocks urine flow, pressure builds up in the ureter and kidney, causing the classic rhythmic spasms of pain associated with kidney stones. Pain medication is required for these cases, and infection behind a stone must be aggressively managed. But what happens to the stone if it's not removed?

The chance of a ureteral stone passing is proportional to the width of the stone. For stones less than 3mm, the chance of spontaneous stone passage is very high. However, only about 20% of stones 8mm or greater will pass spontaneously over a one year period and, therefore, will typically require surgical intervention. In general, earlier treatment is suggested for larger stones, while smaller stones can be managed conservatively as long as pain and infection are controlled.

Conservative Therapy

Hydration

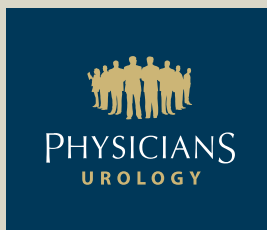
Hydration has remained the mainstay of any treatment program aimed at preventing kidney stones. Because stones form by the crystallization of one or more substances in concentrated urine, hydration will dilute the urine, thus decreasing the chance of additional crystallization. There are no strict recommendations with regards to the number of glasses of fluid to drink, so the goal should be to achieve a urine output of greater than two liters per day.

Diet

Dietary modifications can reduce the chance of stone formation for certain stone types, so each patient should seek the advice of their urologist for recommendations. In general, a diet low in animal protein, sodium, and oxalate (chocolate, tea, spinach, asparagus, and nuts) while maintaining normal calcium can reduce the chance of calcium oxalate stone formation. Patients should not restrict dairy products, but should avoid more than 3 glasses of milk a day. A diet rich in fiber is also advised.

Medications

- *Allopurinol* can decrease the formation of uric acid and therefore is often used in patients with uric acid stones.
- *Thiazide diuretics (e.g. hydrochlorothiazide)* can decrease calcium concentrations in the urine by promoting its reabsorption by the kidney. Thiazides are useful in some patients with calcium oxalate stones.
- *Citrate* is an important inhibitor of stone formation. Administered as potassium citrate, it causes alkalization of urine (elevates urinary pH) and is given to patients with uric acid stones and cystine stones, which crystallize in acidic urine. Uric acid stones can often be completely dissolved if adequate alkalization of urine can be maintained (urinary pH > 7). Citrate can also inhibit the crystallization of calcium in the urine and is used in conjunction with thiazides to treat calcium stones.



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Surgical Therapy

Surgical intervention may be warranted for stones that are resistant to conservative therapy, large stones, obstructing stones, or for patients with anatomic abnormalities of their urinary tract that may prevent the passage of even small stones. Several types of surgical therapies are available and are discussed below.

Extracorporeal Shock Wave Lithotripsy (ESWL)

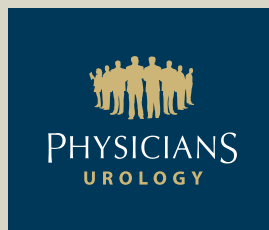
- *General* - ESWL is a noninvasive method of breaking kidney stones using high-energy shock waves. The shock waves are generated outside of the body by a lithotripter machine. They travel through the body and are focused directly onto the stone by X-ray guidance. The stone is fragmented into smaller pieces, which then can pass spontaneously.
- *Indications* - ESWL can be used for any type of stone, however, in general ESWL works best for softer stones such as uric acid stones and are less successful with hard stones like calcium oxalate monohydrate or cystine stones. ESWL is commonly used for stones located in the kidney and those that are less than 1 to 2 centimeters. Multiple ESWL treatments may be required for larger or multiple stones.
- *Procedure* - ESWL can be performed with either intravenous sedation or general anesthesia. Because ESWL is a noninvasive procedure, an incision is not required. During ESWL the patient typically lies flat on the lithotripter table, although older models require the patient to be partially submerged in a water bath. A small flexible plastic internal tube (called a ureteral stent) is sometimes passed into the ureter from the bladder using a cystoscope to promote passage of stone fragments and to prevent obstruction from the stones. An ESWL procedure typically takes 1-2 hours to perform.
- *Contraindications* - Contraindications to ESWL include bleeding tendencies, pregnancy, uncontrolled hypertension, active urinary tract infection, morbid obesity, and certain anatomic abnormalities of the urinary tract.
- *Postoperative* - This is generally an outpatient procedure. A small amount of bleeding in the urine is expected after this procedure. Mild postoperative pain and bruising on the flank are possible.

Ureteropyeloscopy And Laser Lithotripsy

- *General/Indications* - For stones that get caught in the ureter during passage to the bladder, urinary obstruction due to impaction of the stone can occur. This is often due to stones larger than 5 mm in size. If these stone fragments do not pass spontaneously after conservative therapy (i.e. hydration and pain medication) then ureteropyeloscopy and laser lithotripsy may be required.
- *Procedure* - Ureteropyeloscopy is usually performed under general anesthesia. A small telescope (called a ureteroscope) is passed through the urethra, into the bladder, and up the ureter until the stone is encountered. Under direct visualization, a laser fiber can be used to fragment the stone into smaller pieces. A ureteral stent is often required with this procedure. Ureteropyeloscopy with laser lithotripsy can take 1-3 hours, depending on the size and location of the stone within the urinary tract. The patient goes home the same day.
- *Contraindications* - Contraindications to ureteropyeloscopy include bleeding tendencies, active urinary infections, or patients deemed unsuitable for general anesthesia.
- *Postoperative* - A small amount of bleeding in the urine is expected after this procedure. Postoperative complaints include the urge to urinate from irritation of the bladder and urethra from passage of the ureteroscope. Overnight stay in the hospital is typically not required.

Percutaneous Nephrostolithotomy (PCNL)

- *General/Indications* - For kidney stones larger than 2 centimeters in size or for hard stones, a more invasive but extremely effective therapy called percutaneous nephrostolithotomy is generally recommended.



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- *Procedure* - PCNL must be performed under general anesthesia. This procedure involves direct fragmentation of the kidney stone through a small incision made in the back through which a telescope (called a nephroscope) is passed directly into the kidney. Ultrasonic, electrohydraulic, or laser fragmentation of the stone can then be performed under direct vision. A plastic tube (called a nephrostomy tube) is temporarily left in the kidney, exiting the back in order to optimize drainage of the urine from the kidney following PCNL.
- *Contraindications* - Contraindications to PCNL include bleeding tendencies and active urinary infection.
- *Postoperative* - PCNL often requires a one to two night stay in the hospital. Mild to moderate bleeding in the urine is common after PCNL. Patients often have a mild to moderate amount of pain at the site of the nephrostomy tube, which is easily managed with oral pain medications.

Open Surgical Techniques

- *General/Indications* - With the advent of ESWL and PCNL techniques, open surgical procedures on the kidney have been made virtually obsolete. There are, however, specific indications warranting open surgery. These include:
 - Failure of ESWL or PCNL to fragment the entire stone
 - Large stone burden that would require multiple ESWL and/or PCNL procedures or certain anatomic abnormalities of the urinary tract.
- *Procedures* - All open surgical techniques require a general anesthesia and an incision usually in the flank region overlying the kidney. Because of their more invasive nature, open surgical procedures do result in a greater blood loss during surgery than the above less invasive surgeries, but blood transfusions are rarely needed. Pyelolithotomy is a surgical technique used to remove large stones situated in the renal pelvis (i.e. the main collecting system of the kidney). An incision is made in the renal pelvis in order to remove the large stone. Anatomic nephrolithotomy is reserved for large stones occupying the entire renal pelvis and extending into the calyces within the substance of the kidney. An incision is made along the long axis of the kidney, thus allowing the kidney to be opened like a book. After all stone fragments are removed, the kidney is sewn back together. A nephrostomy tube or ureteral stent is often left in place to optimize drainage of urine from the kidney and allow for adequate healing. Partial nephrectomy or simple nephrectomy is the surgical removal of a portion or the entire kidney, respectively. This is only performed for long-standing stones, which cause recurrent infections, damage to the kidney, thus rendering the kidney nonfunctional.
- *Postoperative* - Hospital stays range from 3 to 5 days depending on the type of surgery. Postoperative pain is typically mild to moderate and is easily controlled with intravenous or oral pain medication. An epidural anesthetic can also be used to control postoperative pain.