

What is a kidney stone?

A **kidney*** stone is a solid piece of material that forms in a kidney when there are high levels of certain substances in the urine. These substances are normally found in the urine and do not cause problems at lower levels.

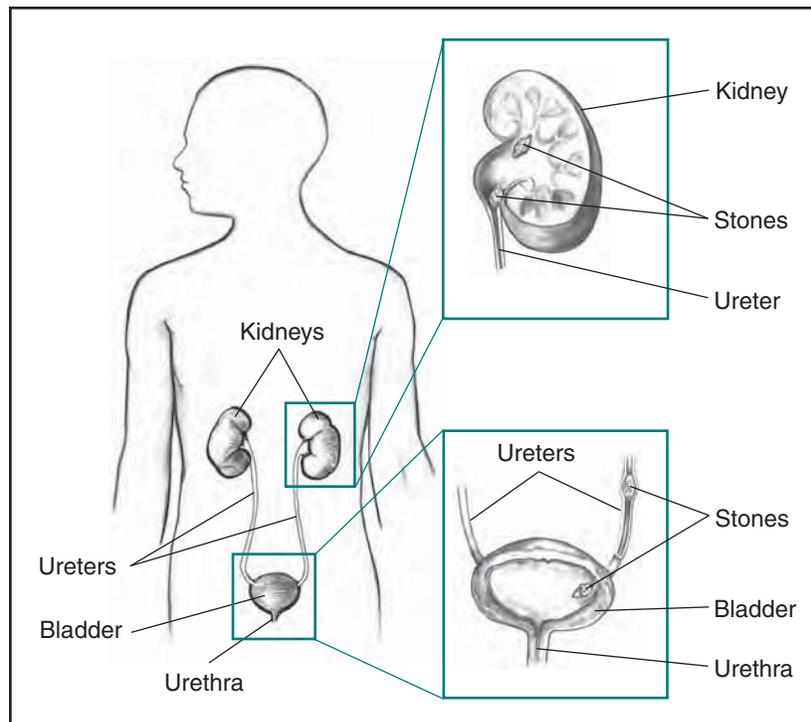
A stone may stay in the kidney or travel down the **urinary tract**. Kidney stones vary in size. A small stone may pass on its own, causing little or no pain. A larger stone may get stuck along the urinary tract. A stone that gets stuck can block the flow of urine, causing severe pain or bleeding.

What is the urinary tract?

The urinary tract is the body's drainage system for removing wastes and extra water. The urinary tract includes two kidneys, two **ureters**, a **bladder**, and a **urethra**. The kidneys are two bean-shaped organs, each about the size of a fist. They are located near the middle of the back, just below the rib cage, one on each side of the spine. Every day, the two kidneys process about 200 quarts of blood to produce about 1 to 2 quarts of urine, composed of wastes and extra water. The urine flows from the kidneys to the bladder through tubes called ureters.

*See page 18 for tips on how to say the words in **bold** type.

The bladder stores urine until releasing it through **urination**. When the bladder empties, urine flows out of the body through a tube called the urethra at the bottom of the bladder.



Kidney stones in the kidney, ureter, and bladder

What causes kidney stones?

Kidney stones are caused by high levels of calcium, **oxalate**, and **phosphorus** in the urine. Some foods may cause kidney stones in certain people. You may be more likely to get a kidney stone if you have

- a condition that affects levels of substances in your urine that can cause stones to form
- a family history of kidney stones
- repeating, or recurrent, urinary tract infections
- blockage of your urinary tract
- digestive problems

You may also be more likely to get a kidney stone if you don't drink enough fluids or if you take certain medicines.

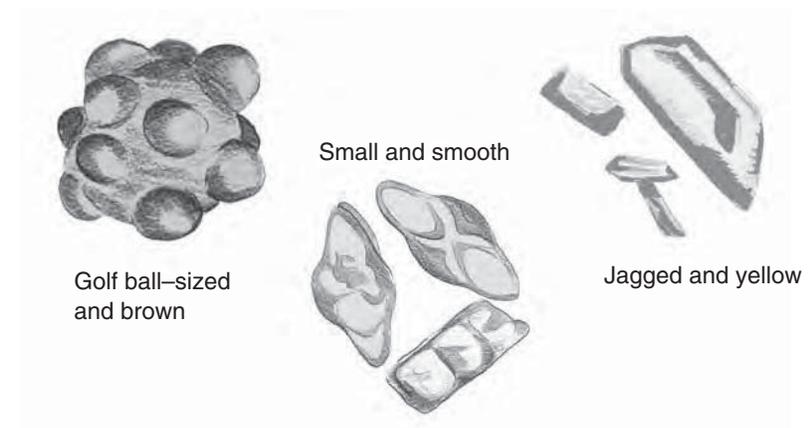
What are the types of kidney stones?

Doctors have found four main types of kidney stones:

- The most common types of stones contain calcium. Calcium is a normal part of a healthy diet. Calcium that is not used by the bones and muscles goes to the kidneys. In most people, the kidneys flush out the extra calcium with the rest of the urine. People who have calcium stones keep the calcium in their kidneys. The calcium that stays behind joins with other waste products to form a stone. People can have calcium oxalate and calcium phosphate stones. Calcium oxalate stones are more common.
- A uric acid stone may form when the urine contains too much acid. People who eat a lot of meat, fish, and shellfish may get uric acid stones.
- A **struvite** stone may form after you have a kidney infection.
- **Cystine** stones result from a genetic disorder, meaning a problem passed from parent to child. The disorder causes cystine to leak through the kidneys and into the urine.

What do kidney stones look like?

Kidney stones vary in size and shape. Stones may be as small as a grain of sand or as large as a pearl. Some stones are even as big as golf balls. Stones may be smooth or jagged and are usually yellow or brown.



Kidney stones vary in size and shape. These stones are not actual size.

What are the symptoms of kidney stones?

You may have a kidney stone if you

- have pain while urinating
- see blood in your urine
- feel a sharp pain in your back or lower **abdomen**—the area between your chest and hips

The pain may last for a short or long time. You may have **nausea** and **vomiting** with the pain.

If you have a small stone that passes on its own easily, you may not have symptoms at all.

When should I call a doctor?

You should call a doctor if you have any of the following:

- extreme pain in your back or lower abdomen that won't go away
- blood in your urine
- fever and chills
- vomiting
- urine that smells bad or looks cloudy
- pain when you urinate

These problems may mean you have a kidney stone or a more serious condition.

How are kidney stones diagnosed?

To diagnose kidney stones, your doctor will do a physical exam and ask about your medical history. The doctor may ask if you have a family history of kidney stones and about your diet, digestive problems, and other health problems. The doctor may perform urine, blood, and imaging tests to complete the diagnosis.

- Urine tests can show whether you have an infection or your urine contains substances that form stones.
- Blood tests can show problems that lead to kidney stones.
- Imaging tests are used to find the location of kidney stones in your body. The tests may also be able to show problems that caused a kidney stone to form.

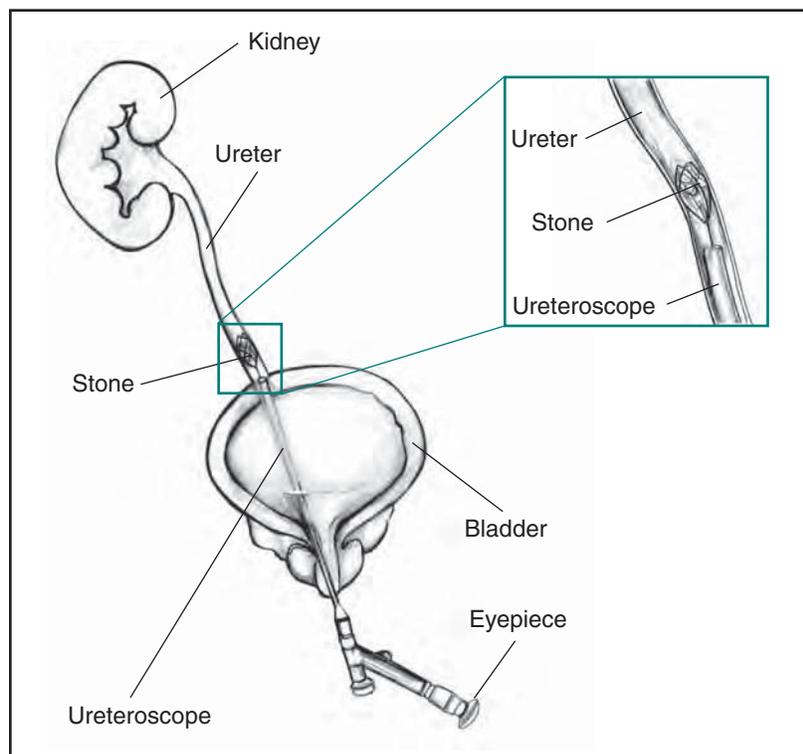
How are kidney stones treated?

The treatment for kidney stones usually depends on their size and what they are made of. Kidney stones may be treated by your regular doctor or by a **urologist**—a doctor who specializes in the urinary tract. You may need treatment if you have symptoms or if a kidney stone is blocking your urinary tract. Small stones don't usually need treatment. Still, you may need pain medicine. You should also drink lots of fluids to help move the stone along. If you are vomiting often or don't drink enough fluids, you may need to go to the hospital and get fluids through a needle in your arm.

If you have a large kidney stone or your urinary tract is blocked, the urologist can remove the stone or break it into small pieces with the following treatments:

- **Shock wave lithotripsy.** The urologist can use a shock wave machine to crush the kidney stone. The shock waves go from the machine to your body. The smaller pieces of the stone then pass through your urinary tract.

- **Ureteroscopy.** The urologist uses a long, tubelike tool with an eyepiece, called a ureteroscope, to find the stone. The tool is fed into the urethra and through the bladder to the ureter. Once the stone is found, the urologist can remove it or can break it into smaller pieces with laser energy.



Ureteroscopy

- **Percutaneous nephrolithotomy.** The urologist uses a wire-thin viewing tool, called a nephroscope, to locate and remove the stone. The tool is fed directly into the kidney through a small cut made in your back. For larger stones, shock waves may also be used to break the stone into smaller pieces.

How can I prevent kidney stones?

To prevent kidney stones, you need to know what caused your kidney stone. Your doctor may ask you to try to catch the kidney stone as it passes in your urine. The kidney stone can then be sent to a lab to find out what type of stone it is. If you have treatment in the hospital and the doctor removes the stone, it will also be sent to a lab for testing.

Your doctor may ask you to collect your urine for 24 hours after the stone has passed or been removed. Your doctor can then measure how much urine you produce in a day and mineral levels in the urine. You are more likely to form stones if you don't make enough urine each day or have a problem with mineral levels.

Once you know what type of kidney stone you had, you can make changes in your eating, diet, and nutrition and take medicines to prevent future kidney stones.

Eating, Diet, and Nutrition

You can help prevent kidney stones by making changes in how much you consume of the following:

- fluids
- sodium
- animal protein
- calcium
- oxalate

Drinking enough fluids each day is the best way to help prevent most types of kidney stones. You should drink 2 to 3 liters of fluid a day. If you had cystine stones, you may need to drink even more. Though water is best, other fluids may also help prevent kidney stones, such as citrus drinks.



You should drink 2 to 3 liters of fluid a day.

You can make the following changes to your diet based on the type of kidney stone you had:

Calcium Oxalate Stones

- reduce sodium
- reduce animal protein, such as meat, eggs, and fish
- get enough calcium from food or take calcium supplements with food
- avoid foods high in oxalate, such as spinach, rhubarb, nuts, and wheat bran

Calcium Phosphate Stones

- reduce sodium
- reduce animal protein
- get enough calcium from food or take calcium supplements with food

Uric Acid Stones

- limit animal protein

More information about how changes in diet affect kidney stone formation can be found in the National Kidney and Urologic Diseases Information Clearinghouse fact sheet *Diet for Kidney Stone Prevention* at www.kidney.niddk.nih.gov.

Medicines

Your doctor may prescribe medicines based on the type of kidney stone you had and any health problems you have that make you more likely to form a stone.

Points to Remember

- A kidney stone is a solid piece of material that forms in a kidney when there are high levels of certain substances in the urine. These substances are normally found in the urine and do not cause problems at lower levels.
- Kidney stones are caused by high levels of calcium, oxalate, and phosphorus in the urine.
- You may have a kidney stone if you
 - have pain while urinating
 - see blood in your urine
 - feel a sharp pain in your back or lower abdomen
- If you have a small stone that passes on its own easily, you may not have symptoms at all.
- To diagnose kidney stones, your doctor will do a physical exam and ask about your medical history. The doctor may perform urine, blood, and imaging tests to complete the diagnosis.

- The treatment for kidney stones usually depends on their size and what they are made of. You may need pain medicine. You should also drink lots of fluids. If you have a large kidney stone or your urinary tract is blocked, the urologist can remove the stone or break it into small pieces with shock wave lithotripsy, ureteroscopy, or percutaneous nephrolithotomy.
- To prevent kidney stones, you need to know what caused your kidney stone.
- Once you know what type of kidney stone you had, you can make changes in your eating, diet, and nutrition and take medicines to prevent future kidney stones.

Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) funds research on the causes, treatments, and prevention of kidney stones. The International Registry for Hereditary Kidney Stone Diseases, funded under National Institutes of Health (NIH) clinical trial number NCT00588562, collects medical information from a large number of patients with kidney stones to create a registry that will help researchers compare similarities and differences in patients and their symptoms.

The Study of the Biological and Physical Manifestations of Spontaneous Uric Acid Kidney Stone Disease, funded under NIH clinical trial number NCT00904046, aims to determine how much fat accumulates within cells and how it affects the kidneys by correlating kidney fat content with urine test results. A second aim is to evaluate the effect of the medicine thiazolidinedione on excess fatty acid accumulation in kidney tissue and its correlation with uric acid stone formation.

Tamsulosin for Urolithiasis in the Emergency Department, funded under NIH clinical trial number NCT00382265, studies the effectiveness and safety of tamsulosin in treatment of kidney stones. Other areas of focus include reduction in time to pain-free recovery, decrease in narcotic medicine for pain, less need for follow-up, decrease in the need for surgery, and cost savings.

Clinical trials are research studies involving people. Clinical trials look at safe and effective new ways to prevent, detect, or treat disease. Researchers also use clinical trials to look at other aspects of care, such as improving the quality of life for people with chronic illnesses. To learn more about clinical trials, why they matter, and how to participate, visit the NIH Clinical Research Trials and You website at www.nih.gov/health/clinicaltrials. For information about current studies, visit www.ClinicalTrials.gov.

Pronunciation Guide

abdomen (AB-doh-men)

bladder (BLAD-ur)

cystine (SISS-teen)

kidney (KID-nee)

nausea (NAW-zee-uh)

oxalate (OK-suh-layt)

percutaneous nephrolithotomy

(PUR-kyoo-TAY-nee-uhss) (NEF-roh-lih-THOT-uh-mee)

phosphorus (FOSS-for-uhss)

shock wave lithotripsy (shok) (wayv)
(LITH-oh-TRIP-see)

struvite (STROO-vyt)

ureteroscopy (yoo-REE-tur-OSS-kuh-pee)

ureters (YOOR-uh-turz)

urethra (yoo-REE-thruh)

urinary tract (YOOR-ih-NAIR-ee) (trakt)

urination (YOOR-ih-nay-shuhn)

urologist (yoo-ROL-uh-jist)

vomiting (VOM-it-ing)

For More Information

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