



KIDNEY STONES

What are the kidneys?

Kidneys are as important to your health as your heart or your lungs. Kidneys remove waste products from your body, regulate water and produce hormones. Normally people have two kidneys, one on either side of your spine below your rib cage. Each kidney is reddish brown in colour, shaped like a kidney bean, and about the size of your fist.

How does the urinary system work?

The urinary system is made up of the kidneys, the ureters, the bladder, and the urethra. Each plays an important role in helping your body to eliminate waste products in the form of urine.

The main job of the kidneys is to remove waste products from your blood and return the cleaned blood back to your body. The ureters carry the waste products, in the form of urine, from the kidneys to the bladder. Urine is stored in the bladder until you urinate (pee). It passes out of the body through a tube called the urethra.

The kidneys also control the balance of water and salt in your body, and are involved in the production of Vitamin D and erythropoietin, a hormone that stimulates bone marrow to produce red blood cells.

What is a kidney stone?

A kidney stone can develop when certain chemicals in your urine form a tiny crystal. The crystal may grow into a stone ranging in size from a grain of sand to a golf ball. Although most stones form in the kidneys, they can develop anywhere in the kidney tract. Very small stones can pass through the urinary system without causing problems. However, larger stones travelling from the kidney through the ureter to the bladder can cause severe pain.

Most stones (70-80%) are made of *calcium oxalate*. A smaller number are made of *uric acid*. Less common are infected kidney stones that are made of *magnesium*, *ammonium* and *phosphate*. Rarely, stones are made of *cystine* as a result of an inherited condition. Occasionally stones can be made of drugs or other substances.

Who gets kidney stones?

Kidney stones are common in Canada and appear to be on the rise, especially over the last 25 years. About 12% of men and 6% of women will have a kidney stone at some point in their life. In men, the first kidney stone is usually diagnosed between the ages of 40 and 60. For women, it is somewhat younger, between about 25 and 30 years of age. Once you have had a kidney stone, you're at increased risk of developing another.

What are the risk factors for kidney stones?

Urine normally contains chemicals that prevent crystals from forming. However, some people seem to be more prone to kidney stones than others. If you are prone to kidney stones, these are some of the risk factors that can contribute to their formation:

- 1. Family history.** If one of your relatives has had a kidney stone, you are 2.5 times more likely to develop one yourself. This could be due to both genetic and environmental factors (such as having a similar diet or drinking patterns in families). For most people with kidney stones, no clear genetic cause has yet been found.
- 2. Dietary factors.** Consuming too much *oxalate* (found, for example, in spinach and strawberries) or food that is high in *protein* may lead to kidney stones. For example, meat and other animal proteins increase the amount of *calcium* and *uric acid* in your urine. This makes it more acidic, which can lead to increased stone formation. Too much salt, sugar (such as *fructose*, found in soft drinks), and Vitamins C or D also appear to add to the risk.

Some dietary factors actually reduce the risk of kidney stones. A moderately high calcium* intake (found, for example, in dairy foods) is associated with a lower risk of stone formation. Higher potassium, magnesium and moderate Vitamin B6 (*pyridoxine*) intake may reduce the risk of stones.

***Note:** Some calcium supplements (which often contain Vitamin D) may actually *increase* the risk of stones.

- 3. Under hydration.** Not drinking enough fluids may lead to less urine being produced. A daily urine volume of less than one litre is a big risk factor for kidney stones, because your urine will be more concentrated. This increases the likelihood that crystals will form. Increasing water consumption so that you make more than 2 litres of urine per day is one of the best ways to prevent kidney stones.
- 4. Environmental factors.** A hot climate, lack of access to water, or reduced access to toilet facilities may lead to less urine output, and therefore increase the risk of kidney stones.
- 5. Urinary factors and repeated urinary tract infections.** Stones are formed in concentrated urine, so low urine volume is a feature of people who have kidney stones. There is an increased risk of stones with urinary tract abnormalities (for example, blockage of the

urinary tract), which lead to stagnation of the urine. Recurrent urinary tract infections also increase the risk of kidney stones.

6. **Certain metabolic diseases.** Type 2 diabetes increases the risk of kidney stone formation by 30–50% in women, but not in men.
7. **Body size.** It has recently been noted that increased body size is associated with an increased risk of kidney stones.
8. **Bed rest for several weeks or more.** Prolonged periods of immobility cause a lot of calcium to leak out of your bones into the blood. This calcium has to be removed by your kidneys, which increases the risk of kidney stones.
9. **Certain medications.**
10. **Sometimes no cause can be found.**

What are the symptoms of kidney stones?

Usually, if you are passing a kidney stone, there is sudden, severe pain that starts in your side, in the small of your back under the ribs, or in your lower abdomen. The pain may also move to the groin area. The pain may last for minutes or hours, followed by periods of relief. You may also have nausea and vomiting. You may have difficulty passing urine or see blood in your urine.

If you have a fever, you may also have a urinary tract infection. If this is the case, you may experience burning during urination, the urge to urinate frequently, cloudy or foul smelling urine, chills, and weakness.

Many kidney stones are discovered accidentally when X-rays or ultrasound tests of the abdomen are done for other reasons. Sometimes patients with large kidney stones that have not moved have few or no symptoms.

How are kidney stones diagnosed?

Kidney stones are diagnosed by a medical examination and various tests. You will be asked about past kidney illness, your diet, medications, lifestyle and family background. You will have a spot urine test looking for blood in your urine. A blood test will be done to check your kidney function and to see if you have any problems with your metabolism.

Medical imaging is often used to confirm the diagnosis. These include X-rays, CT scans or ultrasound, and may involve intravenous injection of dye to help see the stones

How are kidney stones treated?

Pain control, fluids and medication.

If there is no infection or change in kidney function, the main treatments are pain control and fluids. 90% of stones smaller than 5 millimeters in diameter will pass through your body by themselves within hours or days. To help this process, your doctor may prescribe painkillers and advise you to drink lots of fluids. Some medications may be prescribed to help you to pass the stone more quickly and with less pain.

Extracorporeal Shock Wave Lithotripsy (ESWL). This is a non-surgical technique that uses high energy shock waves to break the stones into tiny pieces about the size of a grain of sand. These now smaller pieces will pass on their own when you urinate. Sometimes the fragments are substantial and can obstruct the ureter requiring further procedures to remove them. Not all stones are suitable for ESWL. ESWL is most successful when the kidney stones are smaller than two centimeters. Surgery is often needed for larger stones.

Medication. Certain types of stones can be dissolved with medication. However, the most common stones (those containing calcium) cannot be dissolved.

Removal by scope or surgery. If the stone is stuck near the entrance to the bladder, a thin, flexible tube can be passed up the urethra, through the bladder and into the ureter where the stone is located. Special tools can grab the stone or break it into pieces that will pass in your urine. Ureteroscopy is also commonly done for stones in the kidney. Although there are no incisions required for ureteroscopy, an anaesthetic is required.

Removal by surgery. Stones that are too large or awkwardly situated for other treatments may have to be removed surgically. Surgery may also be needed in the following situations:

- Uncontrollable pain
- Severe infection
- Blockage of the outflow of urine from both kidneys
- The stone is stuck in one place for a long period of time
- Your kidney function gets worse
- There's a stone in a transplanted kidney

Today, open surgery is rarely needed. If a stone is stuck in the kidney, keyhole surgery can be performed on the kidney at the site of the stone. The stone will be broken up and taken out through the keyhole, or some of the stone may pass down the ureter into the bladder and out in the urine.

Infected kidney stones will be surgically removed, and you will be prescribed antibiotic medications to treat the infection.

What investigations are needed after kidney stones are diagnosed?

If this is your first kidney stone, you may only need an analysis of the stone and some simple blood tests. This will reveal what your kidney stone was made of, which can help your doctor determine what caused it. Your doctor will then work with you to create a plan to reduce your risk of developing another stone.

If you pass more than one stone, or have many stones in your kidneys, a deeper investigation is necessary. This may include:

- An examination of the stone to see what it's made of
- Blood tests for calcium, parathyroid hormone, bicarbonate, uric acid, and kidney function
- An examination of the urinary concentration of the chemicals that make stones, or normally prevent stones from developing (i.e. *calcium, oxalate, citrate, and uric acid*)
- A measurement of the amount of urine you pass each day to see whether you drink too little liquid
- A measurement of the amount of sodium in your urine each day to check your salt intake
- A urine culture to make sure there is no infection

What are the treatments for recurrent kidney stone disease?

Here are some suggested guidelines for people with recurrent kidney stones:

- Drink more fluids throughout the day so that you pass between 2 and 3 litres of urine every day. If you live in a hot climate or exercise frequently, you may need to drink even more. *This is one of the most important steps you can take to prevent new stone formation.*
- Reduce your salt intake. This will reduce the amount of calcium in your urine so it will be less concentrated.
- Diet changes. Depending on the type of stone, your doctor may suggest additional changes to your diet, such as reducing meat intake.

Your doctor will determine whether you need other treatments, including medications.

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