What is Percutaneous Nephrolithotomy?

Percutaneous Nephrolithotomy, or PCNL, is a procedure for removing medium-sized or larger renal calculi (kidney stones) from the patient's urinary track created in the patient's back. PCNL was first performed in Sweden in 1973 as a less invasive alternative to open surgery on the kidneys. The term 'percutaneous' means that the procedure is done through the skin. Nephrolithotomy is a term formed from two Greek words that mean 'kidney' and 'removing stones by cutting'.

PURPOSE

The purpose of PCNL is the removal of renal calculi in order to relieve pain, bleeding into or obstruction of the urinary tract, and/or urinary tract infections resulting from blockages. Kidney stones range in size from microscopic groups of crystals to objects as large as golf balls. Most calculi, however, pass through the urinary tract without causing problems.

Renal calculi are formed when the urine becomes supersaturated (overloaded) with mineral compounds that can form stones. This super saturation may occur because the patient has low urinary output, is excreting too much salt, or has very acid urine. Urolithiasis is the medical term for the formation of kidney stones; the word is also sometimes used to refer to disease conditions associated with kidney stones.

There are several different types of kidney stones, in terms of chemical composition:

- Calcium oxalate calculi. About 80% of calculi found in patients in the United States are formed from calcium combined with oxalate, which is a salt formed from oxalic acid. Some foods, such as rhubarb and spinach, are high in oxalic acid. Oxalic acid is also formed in the body when vitamin C is broken down. Oxalic acid is ordinarily excreted through the urine but may be absorbed in large amounts due to chronic pancreatic disease or surgery involving the small intestine.
- Uric acid calculi. These stones develop from crystals of uric acid that form in highly acidic urine. Uric acid calculi account for about 5% of kidney stones. In addition, some kidney stones are a combination of calcium oxalate and uric acid crystals.
- Cystine calculi. Cystine calculi represent about 2% of kidney stones. Cystine is an amino acid found in proteins that may form hexagonal crystals in the urine when it is excreted in excessive amounts. Kidney stones made of cystine indicate that the patient has cystinuria, a hereditary condition in which the kidneys do not reabsorb this amino acid.
- Struvite calculi. Struvite is a hard crystalline form of magnesium aluminum phosphate. Kidney stones made of this substance are formed in patients with urinary tract infections caused by certain types of bacteria. Struvite calculi are also known as infection calculi for this reason.
- Staghorn calculi. Staghorn calculi are large branched calculi composed of struvite. They are often discussed separately because their size and shape complicate their removal from the urinary tract.

CONTACT DETAILS
Telephone: +61 03 8415 1500 Fax: +61 03 8415 1555
Email: enquiries@davidwebburology.com
Web: www.davidwebburology.com

OUR LOCATION
Suite 103, First Floor Freemasons Hospital Medical Centre
320 Victoria Parade East Melbourne 3002 Victoria Australia

Some people are more likely than others to develop renal calculi. Risk factors for kidney stones include:

- Male sex
- Family history. Having a first-degree relative with urolithiasis increases a person's risk of developing kidney stones.
- Age over 30
- Diet, people whose diet is high in protein or who eat foods rich in oxalate are more likely to develop kidney stones.
- Dehydration. People who do not drink enough fluid each day to replace what is lost through perspiration and excretion produce very concentrated urine. It is easier for crystals to form in concentrated urine and to grow into kidney stones.
- Metabolic disorders affecting the body's excretion of salt or its absorption of calcium or oxalate. Most cases of urolithiasis in children are related to metabolic disorders.
- Intestinal bypass surgery and ostomies. People who have had these surgical procedures lose larger than average amounts of water from the digestive tract.

DESCRIPTION OF STANDARD PCNL

A standard percutaneous nephrolithotomy is performed under general anaesthesia and usually takes about three to four hours to complete. After the patient has been anesthetized the surgeon makes a small incision, about 0.5 in (1.3 cm) in length in the patient's back on the side overlying the affected kidney. The surgeon then creates a track from the skin surface into the kidney and enlarges the track using a series of Teflon dilators or bougies. A sheath is passed over the last dilator to hold the track open.

After the track has been enlarged, the surgeon inserts a nephroscope, which is an instrument with fiberoptic light source and two additional channels for viewing the inside of the kidney and irrigating (washing out) the area. The surgeon may use a device with a basket on the end to grasp and remove smaller kidney stones directly. Larger stones are broken up with an ultrasonic or electrohydraulic probe, or a holmium laser lithotripter. The holmium laser has the advantage of being usable on all types of calculi.

A catheter is placed to drain the urinary system through the bladder and a nephrostomy tube is usually removed while the patient is still in the hospital but may be left in after the patient is discharged.

DIAGNOSIS

Kidney stones may be discovered during a routine x ray study of the patient's abdomen. These stones, which would ordinarily pass through the urinary tract unnoticed, are sometimes referred to as silent stones. In most cases, however, the patient seeks medical help for sudden intense pain in the lower back, usually on the side of the affected kidney. The pain is caused by the movement of the stone in the urinary tract as it irritates the tissues or blocks the passage of urine. If the stone moves further downward into the ureter (the tube that carries urine from the kidney to the bladder), pain may spread to the abdomen and groin area. The patient

CONTACT DETAILS
Telephone: +61 03 8415 1500 Fax: +61 03 8415 1555
Email: enquiries@davidwebburology.com
Web: www.davidwebburology.com

OUR LOCATION
Suite 103, First Floor Freemasons Hospital Medical Centre
320 Victoria Parade East Melbourne 3002 Victoria Australia

may also have nausea and vomiting, blood in the urine, pain on urination, or a need to urinate frequently. If the stone is associated with a UTI, the patient may also have chills and fever. The doctor will order both laboratory studies and imaging tests in order to rule out such other possible causes of the patient's symptoms as appendicitis, pancreatitis, peptic ulcer and dissecting aneurysm.

The imaging studies most commonly performed are x ray and ultrasound. Pure uric acid and cystine calculi, however, do not show up well on a standard x ray, so the doctor may also order an intravenous pyelogram, or IVP. In an IVP, the radiologist injects a radioactive contrast material into a vein in the patient's arm, and records its passage through the urinary system in a series of x ray images. Blood and urine samples will be taken to test for indications of a urinary tract infection. If the patient passes the kidney stone, it is saved and sent to the laboratory for analysis.

PREPARATION

Most hospitals require patients to have the following tests before a PCNL: a complete physical examination; complete blood count; an electrocardiogram (EKG); a comprehensive set of metabolic tests; a urine test; and tests that measure the speed of blood clotting.

Aspirin and arthritis medications should be discontinued seven to 10 days before a PCNL because they thin the blood and affect clotting time. Some surgeons ask patients to take a laxative the day before surgery to minimize the risk of constipation during the first few days of recovery.

The patient is asked to drink only clear fluids (chicken or beef broth, clear fruit juices, or water) for 24 hours prior to surgery, with nothing by mouth after midnight before the procedure.

AFTERCARE

A standard PCNL usually requires hospitalization for five to six days after the procedure. The urologist may order additional imaging studies to determine whether any fragments of stones are still present. These can be removed with a nephroscope if necessary. The nephrostomy tube is then removed and the incision covered with a bandage. The patient will be given instructions for changing the bandage at home.

The patient is given fluids intravenously for one to two days after surgery. Later, he or she is encouraged to drink large quantities of fluid in order to produce about 2 qt (1.2 l) or urine per day. Some blood in the urine is normal for several days after PCNL. Blood and urine samples may be taken for laboratory analysis of specific risk factors for calculus formation.

CONTACT DETAILS
Telephone: +61 03 8415 1500 Fax: +61 03 8415 1555
Email: enquiries@davidwebburology.com
Web: www.davidwebburology.com

OUR LOCATION
Suite 103, First Floor Freemasons Hospital Medical Centre
320 Victoria Parade East Melbourne 3002 Victoria Australia

RISKS

There are a number of risks associated with PCNL:

- Inability to make a large enough track to insert the nephroscope. In this case, the procedure will be converted to open kidney surgery.
- Bleeding. Bleeding may result from injury to blood vessels within the kidney as well as from blood vessels in the area of the incision.
- Infection
- Fever. Running a slight temperature (101.5^{o} F; 38. 5^{o} C) is common for one or two days after the procedure. A high fever or a fever lasting longer than two days may indicate infection, however and should be reported to the doctor at once.
- Fluid accumulation in the area around the incision. This complication usually results from irrigation of the affected area of the kidney during the procedure.
- Formation of an arteriovenous fistula. An arteriovenous fistula is a connection between an artery and a vein in which blood flows directly from the artery to the vein.
- Need for treatment. In general, PCNL has a higher success rate of stone removal than extracorporeal shock wave lithotripsy (ESWL), which is described below. PCNL is considered particularly effective for removing stones larger than 1 in (0.5 cm); staghorn calculi; and stones that have remained in the body longer than four weeks. Retreatment is occasionally necessary, however, in cases involving very large stones.
- Injury to surrounding organs. In rare cases, PCNL has resulted in damage to the spleen, liver, lung, pancreas or gallbladder.

NORMAL RESULTS

PCNL has a high rate of success for stone removal, over 98% for stones that remain in the kidney and 88% for stones that pass into the ureter.

CONTACT DETAILS
Telephone: +61 03 8415 1500 Fax: +61 03 8415 1555
Email: enquiries@davidwebburology.com
Web: www.davidwebburology.com

OUR LOCATION
Suite 103, First Floor Freemasons Hospital Medical Centre
320 Victoria Parade East Melbourne 3002 Victoria Australia