GENTLY DOES IT

KIDNEY AND URETERAL STONE RETRIEVAL BY SUR-CATCH NT BASKET FROM OLYMPUS

Stonemanagement
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INTRODUCITION

Kidney stones and stones in the ureter (nephrolithiasis or urolithiasis) are among the most common diseases of the kidneys. They occur when substances dissolved in the urine separate out into fine crystals and clump together in these organs to form bigger clusters (calculi).

Around five to ten percent of adults in Central and Western Europe suffer from kidney and ureteral stones\(^1\). Men are affected around twice as often as women.

About 80 percent of all kidney stones pass out of the body with the urine. In the remaining 20 percent, medical assistance is required for removal. One option is to recover the stone(s) with a small basket-like device (endoscopic stone removal). This is a non-invasive, gentle treatment. This brochure outlines the benefits of the treatment of kidney and ureteral stones with innovative tipless retrieval baskets.

\(\text{Fig. 1}:\) Kidney and lower urinary tract.

\(^1\)Dtsch Arztebl 2004; 101(19): A-1331 / B-1101 / C-1065
Kidney and ureteral stones are solid formations that occur when substances normally dissolved in the urine are separated out and deposited as fine crystals in those organs. These formations gradually clump together to form bigger clusters, called calculi. The accumulation of numerous small kidney stones is also known as “renal gravel”.

Kidney stones can be found in the renal calyces, the renal pelvis and the lower urinary tract (ureter, bladder, urethra). Kidney stones vary greatly in size. They can be as small as a pinhead, but can also become so big that they fill the entire renal pelvis. Depending on their shape, the stones are referred to as duct, staghorn, coral or struvite stones.

One important factor impacting treatment of kidney stones is their composition. The most common type of stone (70 to 80 percent) contains calcium. Two thirds of these are calcium oxalate stones and one third are calcium phosphate stones.

*Fig. 2: Longitudinal cut through a human kidney.*
In Europe as a whole, around five to ten percent of all adults suffer from kidney stones at least once in their lifetime. The disease most commonly occurs between the ages of 30 and 50. In the industrialised countries, around twenty percent of men and around seven percent of women have an increased risk of forming kidney stones. Once a kidney stone has been detected, the risk of recurrence is considerably increased, at around 60 percent.

**CAUSES**

Urine can only dissolve a limited quantity of substances. If the body does not receive sufficient fluid by drinking or if the body loses too much fluid as a result of fever, sweating etc., this causes salts to build up in the urine. As a result of this “oversaturation”, the salts are unable to dissolve. Instead, they clump together and form small stones which can grow over the course of time.

In particular, risk factors for stones include:

- Inadequate fluid intake (The German Nutrition Society recommends a daily intake of 2.3 to 2.7 litres, at least 1.3 to 1.5 litres of which should be in the form of water.)
- Disturbances in uric acid metabolism, as in gout (hyperuricaemia)
- Frequent urinary tract infections
- Diseases of the parathyroid gland with increased calcium excretion in the urine (hyperparathyroidism)
- Excessive consumption of foods containing oxalic acid, such as spinach, nuts, rhubarb, beetroot, cocoa, chocolate, coffee, black and green tea (oxalic acid combined with calcium can cause the formation of calcium oxalate stones)
PREVENTION

In many cases, the development of kidney stones can be prevented and recurrence can be avoided. It is very important to drink sufficient fluids (at least 2.3 to 2.7 litres of fluid every day), preferably water or unsweetened tea. Around two litres of urine should be passed every day. Drinking about one third of the daily fluid amount before going to bed is enough for the kidneys to produce sufficient urine in the night. Likewise, excessive sweating as a result of exercise or sauna has to be compensated by drinking more fluids.

SYMPTOMS

Depending on their shape, size and position, kidney and ureteral stones can cause various symptoms. Initially, many of those affected are not aware of any symptoms (i.e. they have dormant or silent stones) and the stones are often discovered only by chance during an ultrasound or X-ray examination.

Small stones or so-called gravel (accumulation of the smallest fragments) are usually problem-free and without symptoms so long as they remain quietly in the kidney. However, if a stone shifts in the kidney, it can cause a sensation of pressure and pain in and around the kidneys as well as backache.
The movement of the stone can also injure and irritate the mucous membrane, causing blood loss. If the stones are in such an unfavourable position that they prevent or impede the flow of urine, this causes a backflow of urine. The pressure in the renal pelvis increases and the person affected experiences dragging, piercing or dull pains in and around the kidneys or the back. If the kidney stone changes its position again, the pain can subside and the stone is dormant again for a certain length of time.

If the stone leaves the kidney and migrates to the ureter, it can block the ureter. The possible result of this is ureteric colic. The pain concurrent with colic is described as coming in waves and cramp-like, interspersed with symptom-free intervals. Very frequently, migrating stones get caught at three typical sites of ureteral narrowing, namely where the ureter exits the renal pelvic, where it transverses the common iliac or external iliac artery and where it enters the urinary bladder.

Hallmark symptoms begin in the area of the kidneys and move along the ureter into the lower abdomen. Pain may also be noticeable in the back. If the stone is in a very low position, the pain can radiate into the scrotum or the labia. The stomach can be bloated during the colic. Some affected persons also suffer from nausea and vomiting. Colic of this type can be over in a few minutes, but may also last for hours.
Fig. 3: Kidney stones cause a sensation of pressure or pain around the kidneys and in the back.

If the ureter is completely blocked by the stone, the affected kidney at first continues to produce urine. The urine builds up in front of the stone causing the blockage. This build-up of urine makes it easier for bacteria to penetrate the urinary tract. The build-up of urine and the infection can result in more bacteria being washed into the bloodstream and can cause life-threatening blood poisoning (urosepsis).

In some cases, it can also cause the kidneys to shrink, thereby permanently destroying kidney tissue so that the kidneys can no longer perform their function. Once a stone has migrated through the ureter, arrived in the bladder and then moved on to the urethra, the irritation to the mucous membranes often results in the loss of a large quantity of blood. This blood is visible to the naked eye and referred to as “macrohaematuria”.
Diagnosis

If a patient is suspected of having kidney or ureteral stones, their history (repeatedly passing stones, other family members affected, lifestyle and dietary habits, medication) can give clues as to the cause of the stones. The physician can palpate whether the patient feels pressure around their kidneys. A urine test will then usually detect blood (haematuria) and sometimes also white blood cells (leukocyturia) in the urine. In this case, certain parameters in the blood are tested, such as uric acid, calcium or creatinine, to determine if the patient has any risk factors for stone formation.

Fig. 4: Stones in the kidney and the ureter.
**TREATMENT**

**Endoscopy of the ureter**  
(Ureteroscopy or Ureterorenoscopy; URS)

Ureteroscopy is a minimally invasive procedure by which a flexible endoscope (ureteroscope) is passed through the urethra into the ureter. The instrument is equipped with an optical light source and a camera that allows the entire urinary tract to be examined from inside. The urinary stone in the ureter or kidney is viewed directly, can be broken down manually or using laser, kinetic or mechanical energy, after which the stone fragments are recovered with the aid of a small basket. One of the particular advantages of this technique is that no incisional operation is required, and, for that reason, in most cases the patient can be discharged quickly from hospital. In contrast to alternative methods, the stones can be completely retrieved within a single session in almost all cases.

**Disintegration of kidney stones**  
(extracorporeal shockwave lithotripsy; ESWL)

Using this technique, the stones can be broken down into pieces from outside the body using shockwaves under X-ray or ultrasound guidance. The stone is pulverised and the pieces are passed with the urine or retrieved in an operation. This non-invasive treatment has its limitations, however, especially when the patient needs rapid and complete relief from the stones and all the fragments.

**Kidney stone removal via puncture**  
(percutaneous nephrolitholapaxy; PCNL)

This method is used for larger stones in the kidneys or upper ureteral tract. Under general anaesthesia, an
endoscope is passed into the kidney through a small cut in the skin and the stone is then broken up and retrieved.

**Surgical stone retrieval**

Nowadays, most stones can be retrieved using endoscopic techniques or shockwave therapy. The rate of open stone retrieval from the kidney has fallen to around one percent of all stone retrievals.

**BASKET RETRIEVAL: THE PROCEDURE**

Whereas the most common procedure for decades was the disintegration of kidney stones, in recent years endoscopic techniques are becoming increasingly important thanks to innovative materials and finer instruments. Nowadays, the procedures are more precise and the new videoscopes guarantee better visualisation options.

Before ureteroscopy (endoscopy of the ureter) is carried out, the anatomical conditions of the urinary tract are examined with the aid of ultrasound and X-ray to gain a picture of the disease and the anatomical circumstances. The patient’s blood and urinary status are also assessed.

The treatment is carried out under a general or spinal anaesthetic. The optical instrument – the ureteroscope – is passed into the bladder via the urethra with the aid of a Guidewire. The ureteroscope is an instrument equipped with a light source and a camera with which the physician can look inside the urinary tract and the kidneys.
The ureteroscope provides crystal-clear, 3-times larger images that allow excellent visualisation of suspicious tissue and, together with NBI technology, make diagnostics more effective and accurate.

The fine diameter of modern ureteroscopes means that treatment is gentle and virtually pain-free. The ureteroscope was specially developed to retrieve kidney and ureteral stones quickly and easily and with low risk of injury or bleeding. The ureteroscope bends readily and adapts very good to anatomical conditions. The ureteroscope affords the doctor a good and flexible view and guaranteed simple handling.

Additional safety features include the option to use the Access Sheath and the dilator. These options offer the best possible protection of ureter and ostia. Swelling and perforation can be avoided because less force and pressure are exerted on the tissue.

The basket, which is initially folded flat, is inserted via the ureteroscope through an Access Sheath and advanced towards the kidney or ureteral stones. The practical one-handed operation of the Access Sheath with dilator also ensures effective and quick handling for the physician. Because the soft kidney stone basket opens so gently, the risk of injury is extremely low. The physician then collects the stones or stone fragments in the unfolded nitinol basket where they are reliably secured. The basket with the captured stones is then extracted back out through the ureteroscope. In most cases, a ureteral stent is left in place at the end of the operation to ensure the flow of urine from the kidney to the bladder and is generally removed after 48 hours.
Ureteroscopy utilising innovative, rounded and flexible retrieval baskets is a particularly gentle procedure for the treatment of urinary and kidney stones. The treatment usually leaves no scars and is generally considered to be very low-risk.

With the new, thin instruments, serious injuries to the ureter or the kidney are extremely rare. The latest endoscope technology makes handling quick and effective for the physician – meaning that in many cases only a single procedure is required to retrieve all stones and stone fragments. In the ideal case, no further procedures are required.

**Fig. 5:** The new ureteroscope with the flexible and tipless nitinol basket.

**The stone retrieval basket**

Conventional stone retrieval baskets are pointed and therefore might injure organs if they are not manipulated carefully. New, state-of-the-art baskets are engineered with rounded wire tips (see Fig. 6). This reduces the risk of injury to surrounding tissue during treatment and makes the procedure as painless as possible.
Legend: Conventional versus tipless wire design

The latest retrieval baskets are additionally composed of a nitinol alloy – a flexible material with shape memory properties, which gives the basket its predetermined shape when unfolded (see “Nitinol” box). The specially developed wire design means it can also be used for small stones or stone fragments of less than one centimetre in diameter. The innovative steel construction and flexible handling make it easy to reach difficult and poorly accessible areas, for example in the lower kidney areas.

Nitinol – A material with a memory

Nitinol was invented in 1962 by a laboratory of the United States Navy (US Naval Ordnance Laboratory in White Oak, Maryland). At the time, the aim was to discover an antimag-netic metal for the submarine fleet that was tremendously hard and corrosion-proof. The alloy was created by melting together around 55 percent nickel and 45 percent titanium. The word nitinol was made up from the letters for nickel and titanium naval ordnance laboratory. Nitinol is what is called a “memory metal“. Memory metals can be bent into any desired shape at a low temperature, but when heated briefly always return to their pre-defined shape as if they remembered it. This “remembering“ can happen many millions of times over without material fatigue.

By improved imaging technology in the ureteroscope, OLYMPUS enables outstanding diagnostics whilst offering the complete therapeutic portfolio like Access Sheath/dilator and the Sur-Catch Retrieval Basket NT.
1. What are the side effects/risks of the ureteroscopy procedure?
In general the side effects and risks of an ureteroscopy are very low. In small amounts of cases there are some short lasting hematuria’s causes from trauma of the ureter that pass off on its own. Aside, fever could appear in very rare cases, which could be treated with a short-term antibiotic therapy. Serious and severe complications, such as rupture of the ureter, require the surgeon to convert to open surgery. With the new, thin instruments, however, these complications of the kidney and ureter are extremely rare.

2. Does it retrieve all stones from the kidney and the ureter?
Most stones can be removed from the kidney and ureter in one single treatment.

3. What are the advantages offered by the ureteroscopy procedure with a tipless nitinol retrieval basket?
Ureteroscope URF-V offers:
• Smooth insertion through the urinary tract.
• Excellent illustration of suspicious tissue allowing a better diagnosis.
• Easy access to all areas of the kidney.

Sur-Catch Retrieval Basket NT offers:
• Flexibility allows better access in difficult anatomical spaces of the ureter and lower calyces.
• It is gentle and provides more safety.
• Reduced trauma, bleeding and reduced procedure time.

Deutsche Gesellschaft für Urologie e.V. “Was tun gegen Harnsteine” Ausgabe 1/2010
4. How painful is treatment with a tipless nitinol retrieval basket?

Treatment with the Sur-Catch basket NT is usually not painful. The invasion is performed with general or spinal anesthesia to allow pain-free treatment. If postoperative pressure or minimal pain occurs low dosed analgesia are recommended\(^2\).

5. How long does endoscopic treatment with the retrieval basket last?

Depending on the size and location of the stone the treatment lasts normally between half an hour and one hour\(^2\).

6. Can I go home straight afterwards and will I have any pain?

Yes, you usually can go home after the treatment. Ureteroscopy is a day case procedure. You will have no or minimal pain that could be treated by low dosis analgesics.

Olympus, the manufacturer, is one of the technology leaders for urological, endoscopic products developed in collaboration with physicians and backed by over 100 years of experience. In the treatment of kidney and ureteral stones, Olympus offers the physician a complete portfolio of innovative products required for ureteroscopy procedures.

The information in this brochure does not replace medical advice.