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## Coping with Kidney Stone Disease



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### ABSTRACT

**Introduction:** The kidney stone disease is characterized by the presence of stones in the upper drainage of urinary fate. The disease occurs in people of any age and gender, in every race and country. **Purpose:** The purpose of this review study is to make some important facts about the disease of kidney stones noticeable. **Review Method:** Articles regarding urolithiasis were the material of this study. They were mostly found in electronic databases Medline and the Hellenic academic libraries Link (HEAL-Link). **Results:** Urolithiasis is the creation of stones/stone in kidneys and the drainage system due to supersaturation of ionic elements. The stones can be of potassium oxalate/calcium phosphate, uric acid, struvite and cysteine. There are different measures to prevent any recurrences depending on the type of the stone. The symptoms are intense. There is sudden shooting pain in the middle or abdomen or groin; it depends on the location of the stone in the ureter and it may be accompanied by nausea, vomiting and hematuria. **Conclusions:** It is a prerequisite that the successful treatment of kidney stones and prevention of relapses should be the timely diagnostic approach and treatment as well as the strict obedience of the principles of prevention.



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## INTRODUCTION

The **Kidney stone** is one of the most painful diseases of the urinary tract, which have hurt people for centuries. Scientists have found evidence for *kidney stones* at an Egyptian Mummy that was 7,000-years years old. [1]

After all, nephrolithiasis refers to the formation of solid bodies anywhere in the sewage portion of the kidney, which consist mainly of crystalline substances and of a non-crystalline super molecular substance, the ground substance. Most of the stones are composed of crystals that are normal in urine. The stones may be single or multiple locating in one or both kidneys, and in various locations in the drainage system. Stones occur in people of any age and gender, in every race and country. [2]

The incidence of kidney stones in the general population varies 4-6%. It has been estimated that the patient who developed symptoms of kidney stones has 10% stones to reoccur in a year and a 60-70% chance of recurrence after 7-10 years. [3]

Upper urinary tract calculi are a common phenomenon in developed countries. That disease was almost unknown in Western Europe the last century. It is estimated that 1% of the USA population visits the hospital with urolithiasis every year, while 12% of the population would have at least one stone in their lifetime. Nephrolithiasis usually affects adult men 30-50 years old. [4] The number is triple in men than in women. The prevalence of *kidney stones* increases dramatically as the men enter the fourth decade of their life and it continues growing to 70 years. For women, the prevalence of kidney stones culminates in their fifth decade of their lives. This disease recurs in most patients. The large increase mainly of calcareous stones seems to be associated with diet, mainly when people increase the intake of animal protein. [5]

As the research progresses, scientists can better understand the range of factors that favor the formation of kidney stones; and thus, they may find better treatment for prevention of stones.

## PURPOSE

The purpose of this review study is to highlight the kidney stone disease. Specifically, it refers to the types of kidney stones, laboratory tests and diagnostic approach, symptoms, treatment and prevention of disease.

## REVIEW METHODS

The material of the study have been articles on the subject that have been found mainly in the electronic database Medline and the Hellenic academic libraries Link (HEAL-Link), with the following keywords: urolithiasis, kidney stones, kidney diseases. The criterion for article exclusion was the language except for Greek and English.

## TYPES OF KIDNEY STONES

More often than not, the creation of kidney stones is due to a combination of genetic and environmental factors. Risk factors are obesity, some food, medicine and the decreased fluid intake. The diagnosis is usually based on symptoms, the urination test and some diagnostic imaging methods. [2].

**Kidney stones** may contain various combinations of chemicals. The most common type of **stone** is this that contains calcium combined with either oxalate or phosphate. These chemicals are part of a person's normal diet and are found in important parts of the body, such as the bones and muscles.[6] Therefore, it is manifested that there are multiple types of kidney stones and so, the etiology and proper treatment varies from patient to patient. No Kidney stone should not be ignored without a correct analysis for the ascertainment of its composition, which can be [7]:

- Oxalate calcium-phosphorus. The most frequent, dumbbell stone. It is easily seen in an x-ray (radiopaque). (65-75%)
- Pure uric acid. Non-radiopaque stone. It is easier ascertained with the ultrasound of the kidney. The alkalization of urine is a basic prerequisite for dissolving the stone and for the successful long-term preventative treatment. (10-15%)
- Struvite. A mixture of magnesium, ammonium phosphate. It is the result of chronic infection with a bacterium that breaks down the urea of urine, usually *Proteus mirabilis* (10-15%).
- Cystine. It is an unusual hereditary disease, which leads to urolithiasis at a young age (less than 1%).
- Mixed stones. For example, calcium with uric acid. [8]

A person with a family history with kidney stones may be more likely to develop stones. Urinary tract infections, kidney disorders, such as cystic degeneration of the kidneys, and some metabolic disorders like hyperparathyroidism are associated with the formation of stones.[9]Other causes of kidney stones are the excessive intake of vitamin D, urinary tract infections and urinary tract obstruction. Some pills like diuretics and calcium based antacids may increase the risk of kidney stone formation by increasing the amount of calcium in the urine. [10]

### LABORATORY TESTS – DIAGNOSTIC APPROACH

The diagnostic approach of kidney stones has two objectives [11, 12]:

- Finding stone formation
- Finding factors that favor the formation of stones in order to prevent the creation of new ones.

Regarding *medical history*, the patient's profession, the origin, patient's age of the first episode (for local causes or congenital metabolic disorders), the number of episodes of stone formations and the intervals between them, other diseases (urinary disease, ulcer stomach, gastrointestinal discomfort or interventions in the intestine, prolonged bed rest, diabetes, urinary tract infections) are all interesting. [13, 14]

Family history: it approaches approximately 40%. Dietary history of fluid intake, protein, dairy products, food rich in oxalate, alcohol use, abuse of fruits, industrial sugars etc. Taking medications, especially antacids, analgesics, diuretics, vitamins C and D, laxatives, formulations of calcium, hormones. [15, 16]

*Kidney stones* are often discovered after an x-ray or ultrasound made to someone who visits the emergencies for blood in the urine or sudden pain. These diagnostic tests will give the therapist valuable information on the size and location of the stone. [17] Blood and urine tests might assist in identifying any abnormal substances that could facilitate the creation of the Kidney stone. Briefly, the main laboratory tests that patients are subjected to be diagnosed of kidney stones are the following [17]:

- Stones that contain calcium are visible through a simple radiography of kidney and bladder.

- Stones made of uric acid and cystine look like deficits in an outline of excretory urography. Also, it may seem dilatation of the ureter (hydroureter) or hydronephrosis. [17]
- Examination of the urine sample in the middle of urination in order to exclude infection and find the sterile pyouria or blood in urine. Specify uric acid in serum. [18]
- Specification of calcium, uric acid and cystine in the urine over 24 hours.
- Monitor renal function with the specification of urea and creatine in serum.

The results of all these tests will help the appropriate treatment to be designated.

## SYMPTOMS

After a random check on x-rays taken during a general examination, the so-called "silent" Kidney stone that does not cause symptoms are sometimes discovered. These stones may remain asymptomatic and gradually destroy kidneys. A small neglected stone in the ureter can do significant damage to the kidney. [19] Nevertheless, the stone depending on its location usually causes a series of inconvenience and problems such as [20]:

Pain and burden on the right or left side or back in the kidney area.

- ✓ Acute renal colic. In other words, pain that begins from the renal area back and moves sideways in front and downwards towards the groin and upper thigh.
- ✓ An annoying desire for frequent urination every few minutes.
- ✓ Hematuria seen macroscopically (with a naked eye) or perceived only by urinalysis (microscopic).
- ✓ Blockage of the ureter or part of the kidney with blocking the urine flow, hydronephrosis, pain and gradual hypofunction and atrophy of the kidney.
- ✓ Repeating or constant urinary tract infections with the risk of widespread infection in the blood. [19]

Most common is the pain whose intensity and radiation vary depending on location, size, surface structure and mobility of the stone. Most common type of pain is the colic of the ureter. Aching pain is caused by mobile stones of the ureteric buds or the pelvis, while

nephrocalcinosis, stones inside the kidney, the staghorn calculi and immovable stones of ureteric buds do not cause pain (silent nephrolithiasis). [21]

The reflection of pain depends on the site of impaction of the calculi. The pain may influence patients' quality of life in general, mainly the elderly, who suffer, apart from this problem from other illnesses that reduce their functionality and cause them more intolerable pain. [22]The urine color may be dark (Hematuria), the amount of urine is not usually affected unless the blockage is not complete in one only functioning kidney. Fever is observed only if there is accompanying urinary tract infection. [20]

The differential diagnosis must be done right from colic liver, acute appendicitis and Crohn's disease, left from the acute diverticulitis in both cases of acute pyelonephritis, acute adnexitis or ovarian or bladder torsion in women and of minor pelvis abscess. [23]

## **GENERAL TREATMENT PRINCIPLES**

Generally, a patient in the acute phase of renal colic is treated by using analgesics. A basic prerequisite for the selection of a suitable analgesic is the knowledge of its pharmacokinetic and pharmacodynamic properties, in order to achieve a constant concentration – density of it to the plasma and stable levels of analgesia. [24]

Fluids are administered to cause diuresis throughout the day. If possible, patients are treated as outpatients. Patients with severe pain or unable to receive orally an adequate amount of fluids, due to vomiting, are hospitalized for intravenous administration of fluids and pain relievers. [25] The excretion of stones requires from hours to weeks and then the patient should keep them for checking their composition. The composition of the stone is important for proper medical treatment. If conservative measures fail, an operation takes place. [26]

Patients with fever, chills and renal colic, require immediate hospitalization and surgery. If the presence of infection is confirmed and the ureter is clogged, the coverage with antibiotics and surgical decongestion is mandatory. [9] The 24-hour urine collection should be done after every acid episode, once the patient returns to normal daily activity and nutrition. Calcium, uric acid and creatine levels are calculated with the urinalysis in laboratory. [27]

## TREATMENT

It focuses on addressing the existing stones and preventing the formation of new ones.

The conservative treatment is focused on pharmaceutical preparations which control the amount of acid or alkali in the urine, which are key factors for crystal formation. Allopurinol is a drug that may also be useful in some cases of hyperuricosuria. [17] Furthermore, the control of hypercalciuria so as to prevent the development of calcium stone, includes the administration of certain diuretics, such as hydrochlorothiazide. These drugs reduce the amount of calcium released from kidneys into the urine, favoring the maintenance of calcium in bones. They work best when the intake of sodium (salt) is low. [28]

Patients with hyperparathyroidism sometimes develop calcium stones. The removal of the parathyroid glands cures the problem of the patient. The patient's urine must be tested regularly to ensure that there are no bacteria that can cause infection in case of struvite stones that have been removed completely. [29] As regards the *surgical* removal of stones, this is only used in very rare cases, complications, because it requires significant recuperation time from 4 to 6 weeks. Surgery is used when the stone [30]:

- does not expelled by itself after a reasonable period of time and it causes constant colic episodes.
- is very large and blocks the flow of urine.
- is in a difficult position.
- causes persistent urinary tract infections.
- causes damage to kidney tissue or continuous bleeding.

In modern Therapeutics, the removal of kidney stones, *the removal of stones* is carried out with the *method of lithotripsy*. In most cases the ESWL can be done on outpatient basis. The recovery time is relatively small, and most people can return to normal activities within a few days. [30] Extracorporeal lithotripsy with *shockwaves* (ESWL) is the most commonly used procedure for the treatment of kidney stones. According to this method, shock waves are generated out of the body travel through the skin and tissues of the body until they arrive to knock the stones that have denser texture. The stones are broken down into small particles

that make easier the passing through the urinary tract with urine. Sometimes the *stone* is not completely crushed with a session, and may need additional sessions. [7, 31]

In some cases, the patient is inserted a small tube (pigtail) through the bladder to the ureter, to assist the scrap to descend, because the broken shards of the stone as they pass through the urinary tract, causing small obstruction and may cause irritation. Some patients have blood in their urine for a few days after treatment. So patients should avoid taking aspirin and other medications that affect blood clotting for several weeks before treatment. [32]

Another method of removal of stones is the *percutaneous nephrolithotripsy*, which is used when the *stone* is big enough or in a position that prevents the effective use of extracorporeal lithotripsy. According to this, the urologist does a small 1cm incision on the back of the back and creates a tunnel inside the kidney. Using a tool called nefroskopio, the surgeon detects and removes or splinters the stone into small pieces with the help of laser. Patients often remain in the hospital for a few days and they may have a small tube called a nephrostomy s tube in the kidney during the healing process.[33]

Finally, the *ureteroscopy* can be used for removing the stone through the ureter. According to this, the surgeon passes an ureteroscope through the urethra and bladder into the ureter. Then, he removes the stone with a tweezers or the splinter with the help of laser. A small tube (pigtail) or stent can be left in the ureter for a few days to help the flow of urine. [34]

## **PREVENTING KIDNEY STONES**

A person who had presented more than once kidney stone is likely to present again in the future. So, if possible, prevention is important. Prevention includes dietary measures or medication, as already mentioned, in order to reduce the supersaturation and increase the inhibitory potency of urine. The dietary measures include [35]:

- *Abundant liquid intake* so the next diuresis to exceed 2.5 litres a day, with equal distribution in 24 hours. Especially for the formation of cystine stones, diuresis must be abundant (3.5 litres).
- *Dietary restrictions* that vary depending on the type of the stones. For *uric acid* stones, people ought to avoid purines and limit animal protein. What is more, they must increase the frequency of consumption of plant-based protein like beans [36]. For *calcium oxalate* stones,

individuals should limit foods rich in oxalate, such as beets, okra, spinach, sweet potatoes, nuts, and tea, chocolate and soya products. Limitation of foods rich in oxalate, purines, animal proteins, industrial sugars, sodium for *calcium oxalate stones*. Patients should consult their physician as regards eating foods rich in calcium. [37]

## CONCLUSIONS

Kidney stones often do not have a clear, single cause, although many factors may increase the risk. At the same time, they can affect any part of the urinary system, from kidneys to the bladder. It is a quite painful condition, with severe symptoms, relapses, aggressive therapeutic interventions, repeated hospitalizations, and severe economic costs, psychological and social impact of conservative treatment. A prerequisite for the successful treatment of kidney stones and prevention of relapses is a timely diagnostic approach of the disease, as well as the obedience to the principles of prevention.

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