

Review on Types of Kidney Stones

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Date of Submission: 25-1-2021

Date of Acceptance: 05-02-2021

ABSTRACT: - kidney stones are a formation of crystals in the kidney due to many different reasons .stones vary in size and type, they have specific causing factors and their treating methods. There are four different varieties of kidney stones which are calcium stones, uric acid stones, struvite, and cysteine stones.

KEYWORDS: calcium oxalate, uric acid, crystals, stones.

I. INTRODUCTION:

kidney stone is the formation or the presence of stone on the kidney when there is a decrease in the volume of the urine of the presence of chemicals or substance which are excess- urine forming such as calcium oxalate. They are common in the world and there are several cases registered for kidney stones per day. Some people could pass the stones before they got any larger and show any symptoms. The larger stone is painful and they block the flow of urine and makes it difficult to relieve oneself easily. The stones most of the time affect the pelvis, calyces, ureter, bladder, and urethra. They are more frequently occurring in men than women 13% and 7 % respectively. They can be treated by shockwave lithotripsy, ureteroscopy, percutaneous nephrolithotomy, and nephrolithotripsy. 5 years after the diagnosis of a kidney stone the probability of having the stone again is fair, once a person is diagnosed With kidney stones, there is a greater possibility to have a reduction in some renal functions.

Kidney stones are formed when the quantity of a certain substance increased in the urine, these elements stick together and crystalize. As the crystallization continues it grows out to be a stone, the presence of stone is dependent on the lifestyle a person leads, diet.

In most people, there is enough liquid or other chemicals to wash the stone out or to stop the occurrence of crystallization further the stone formation. Chemicals that form the stone are

calcium. Oxalate, urate, cysteine, xanthine, and phosphate. [1]

TYPES OF KIDNEY STONE

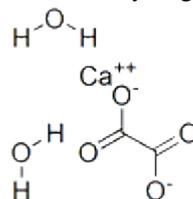
There are different kinds of kidney stones which are having different cause .the most common type of kidney stone is calcium stones, the others are uric acid stones, struvite infection stones, and cysteine stones. [1]

CALCIUM STONE

Calcium stones are the most common type of kidney stone, there are two kinds of them which are calcium oxalate stones (more common) and calcium phosphate stone(less common).

CALCIUM OXALATE CRYSTALS.

The calcium oxalate crystals occur when the calcium binds with an oxalic acid (a waste material that's removed by the kidney and poisonous if consumed in huge amounts, containing two carbon atoms and 4 oxygen atoms, and two atoms of hydrogen. The oxalate atom contains two negative charges where one of them attract positively charged calcium and the other one attract the hydrogen of water.



There are two varieties of calcium oxalate stones, Calcium oxalate monohydrate Calcium oxalate dihydrate Calcium oxalate monohydrate is harder making them resistance to fragmentation by lithotripsy, calcium oxalate monohydrate occur more often when the oxalate level in urine increase.

CALCIUM OXALATE STONE FORMERS

Systemic disease

Some systemic disease which may cause nephrolith is bowel disease, primary hyperoxaluria. The explanation for the disease can only be known after a doctor's diagnosis.

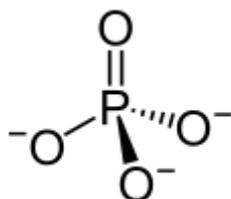
Idiopathic

This kind of stone arises from the interplay between inheritances, diet, and lifestyle of an individual. The word Idiopathic is a Greek word that stands for "idios" which means one's own and "pathos means" suffering .for these types of stones both the patient and also the doctors are responsible for the treatment, changing the lifestyle, and also the diet schedule are the task the patients are expected to try and do and if this isn't helping that's when the physicians are giving out medication. [10]

CALCIUM PHOSPHATE CRYSTALS.

The calcium phosphate crystals occur when the calcium binds with phosphoric acid instead of oxalic acid to produce calcium phosphate kidney stones.

Phosphoric acid is a phosphorous atom with 4 oxygen atoms bonded to it, where one of the oxygen atoms is bonded with a double bond. The oxygen bonding with double bond shows no charge for creating a crystal (stone). The other three oxygens are bonded by a single bond and they carry a negative charge for attraction.



From the three negatively charged oxygen atoms one is rarely attracted to a hydrogen atom in the urine except in acidic solution. The second oxygen atom is usually drawn to the hydrogen atom in the urine. This makes the third oxygen atom a tie-breaker because it is variably attracted to the hydrogen atom.

When urine is having a pH of around 6, the tiebreaker oxygen will have their hydrogen to leave the phosphate ion with only one negative charge and this is not enough to make a crystal. For this reason, calcium phosphate kidney stones tend to occur in alkaline urine. [2]

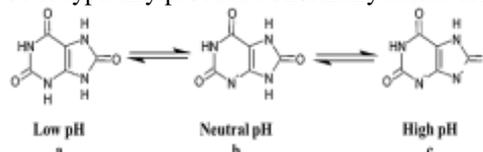
CALCIUM PHOSPHATE STONE FORMER

Systematic disease

Renal tubular acidosis and hyperparathyroidism shows a less alkaline character in urine and encourage the occurrence of calcium phosphate kidney stones.

URIC ACID STONES

Uric acid is a less soluble compound that is a breakdown product of nitrogenous metabolism, DNA, and RNA. People who are obese and diabetic typically produce abnormally acidic urine.



Uric acid has two carbon rings linked together with Nitrogen (N), Oxygen (O), and hydrogen (H). Interposed into them.

It has two charged sites, nitrogen atom is present at the bottom of the rings. At a pH of 6 in urine one nitrogen lack hydrogen so it carries a single negative charge. Whereas in a more alkaline solution both nitrogens lack hydrogens but, for urine to achieve alkalinity the pH had to be greater than 8. [9]

For both nitrogens to carry hydrogen the pH had to be less than 5.5 allowing the molecule not to have a charged site so water can no longer find a hold on the molecule.

Uric acid stones are peculiar kinds of stones caused by low pH and any kind of treatment that could raise the pH of urine could prevent them. [6]

URIC ACID STONE FORMER

The stones can be red-orange, large, and numerous.

Uric acid absorbs a hemoglobin breakdown product that is red-orange making the stones change the colors. The formation of uric acid does not require the reaction of uric acid with some other atom or molecule as the calcium stones do. at low pH uric acid could crystallize easily and change color and if retained it could grow to larger crystals. The amount of uric acid in urine exceeds that of oxalic acid, uric acid stones are formed rapidly.

Urine pH control stone formation.

The whole process of uric acid stone formation depends on the acidity of urine. This fact made it easy to treat them. A little modification to the solution with alkali will help the patient and the hydrogen atom from the nitrogen got removed. Water can now bond so uric acid remains in the solution. [9]

Mixed stones require special care.

There are some unfortunate times where stones exist mixed, (calcium oxalate and uric acid) at this condition it has to be traced down what is the cause of calcium stones and one has to make enough alkaline solution for the uric acid stone. [4]

The possibility of calcium phosphate and uric acid mixing is rare because alkaline urine is used to remove the hydrogen atom from phosphate so it has two negative charges and so it binds efficiently with the calcium atom. At higher pH, uric acid will have its charge site and remain in the solution.

STRUVITE STONES

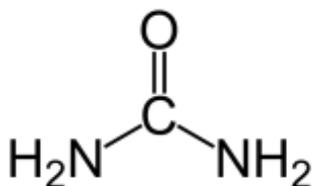
Urea and the planet

Kidneys do not make struvite, bacteria do those that thrive in the soil, and these bacteria produce kidney stones named struvite after Heinrich Christian Gottfried von Struve (de) (1771-1851). [8]

Animals discharge urea when they urinate which is not used by the plants.

Nitrogen and oxygen are essential to life yet dangerous, and it is integral in proteins, DNA, and RNA. As these molecule's broken down their nitrogen slips away and can be dangerous by forming poisonous compounds.

Urea contains 2 nitrogen atoms bound to a single carbon atom.



Reptiles and birds excrete most of their nitrogen as uric acid which was discussed above, whereas mammals like us excrete our nitrogen as urea.

As animals urinate on the soil, urea will bring the nitrogen atom to the roots of the plants, even though the plant cannot use them as they can't release the nitrogen from the carbon atom that is bound. Bacteria that make struvite crystals carry an enzyme that is called urease, this enzyme helps the plants to release the nitrogen from the carbon bind.

As nitrogen is released from its carbon bind, the nitrogen reacts with proton atom and form ammonia (NH₃) which will then takes up another proton atom. At this time the bacteria's surround themselves with alkaline fluid containing

ammonium ion (NH₄) carrying a positive charge, a phosphate without its protons (an ion with three negative charges), and soil magnesium (an atom with two positive charges) forming triple salt with three negative charges from. Phosphate. Two positive charges from magnesium and one positive charge from ammonium (NH₄).

How does struvite stone form?

Soil bacteria can get into the urinary tract and break down urea to ammonia and create struvite from magnesium and phosphate. The bacteria enter the urinary tract when we eat uncooked meals and they become part of the intestine. In women whose urethra is shorter makes it easier for entry. [5]

Soil bacteria can easily initiate resistance to the antibiotic given for urinary tract infection, the antibacterial will kill sensitive bacteria's and leave out the resistant one. Soil bacteria are capable of forming struvite and mixed stone along with calcium stones. The struvite grows in size and the bacteria injure the kidney and enter the bloodstream and cause sepsis.

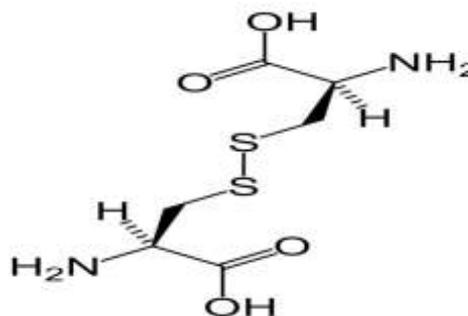
Treatment for this kind of stone is done by surgery and taking some antibiotics after surgery. [7]

CYSTEINE STONE

Cysteine stones are caused by a rare disorder called cystinuria inherited from one parent to a child. In this condition the kidney functions well but, they permit a greater amount of amino acid (4) to enter the urine. The presence of three amino acids doesn't matter, the fourth amino acid makes the crystals which makes the cysteine kidney stone. [3]

CYSTINE

A reaction between two identical amino acids called cysteine, they are coupled together with a sulfur atom.

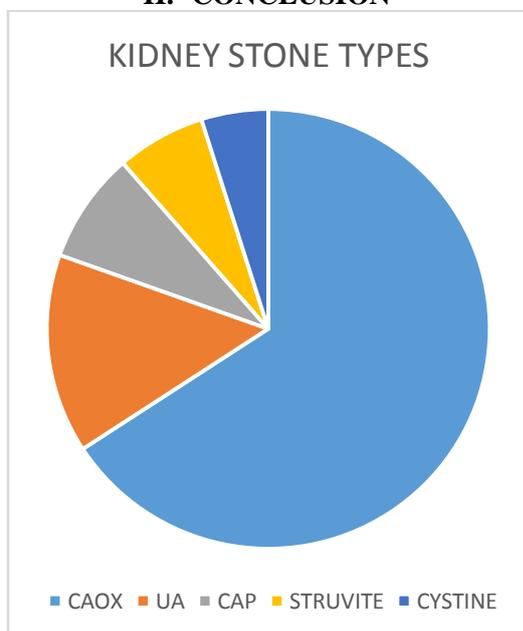


Each amino acids contain two carbon atom where one carbon atom had 2 oxygen atom bonded to it: the other carbon has one nitrogen, hydrogen, and one sulfur atom.

Since sulfur atom has a negative charge cysteine is soluble, but the bigger and longer molecules have a very little charge because sulfurs bind to each other, cysteine loses its reaction with water and leaves as a crystal and this process occurs real fast.

As cystinuria are inherited diseases, they are likely to start in childhood. They are treated by consuming a large amount of fluid to dilute the stones. Another way the treating them would be the use of drugs which are having a similar structure to the amino acid cysteine. [5]

II. CONCLUSION



Crystals make stones and one can tell what kind of stone they are just from their name. They are:

CAOX stands for calcium oxalate.

CAP stands for calcium phosphate.

UA stands for uric acid.

Cysteine.

And struvite.

As it is shown in the chart calcium oxalate stones are the predominant type of stone taking up most of the percentage. Each kidney stone has its specific character and treatment that's is the main reason it was needed to specify them in names after diagnosis.

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