Urine Crystals and Bladder Stones in Cats: Formation, Diet and other Treatment

Drs. Foster & Smith Educational Staff

Some cats develop microscopic crystals in their urine. These may or may not be associated with a urinary tract infection. These crystals, which are like very fine sand, irritate the bladder. In male cats, the crystals may plug the urethra (the tube that carries urine from the bladder, through the penis, to the outside of the body). This is a life-threatening condition, since the cat would be unable to urinate.

In some cats, larger stones can develop. These are called urinary calculi and the condition is referred to as urolithiasis. Stones may actually form anywhere in the entire urinary tract. The urinary stones in cats can be found in the kidneys, ureters (tiny tubes that carry urine from the kidneys to the bladder), bladder, or urethra (the tube from the bladder to the outside of the animal). They can also obstruct the outflow of urine.

Signs and diagnosis of bladder stones in cats

Cats with bladder stones may have blood in their urine and may urinate frequently, passing only small quantities of urine each time. Often, they will strain while urinating, holding their body in the urinating posture for much longer than normal. They may lick their genital area more than usual. If your cat is straining to urinate and produces little urine or no urine at all, it is considered an extreme emergency.

Some cats with bladder stones may show no signs at all, and the stones are discovered while palpating the abdomen during a routine physical exam.

If the stones cannot be diagnosed through palpation, the diagnosis of bladder stones in cats is made or confirmed with abdominal x-rays or ultrasound. Most stones are radiopaque, meaning they show up on the radiographic film as obvious white circles or shapes just as bones do. A few are radiolucent, where the x-ray beams pass right through and therefore, they do not show up on the finished film. To confirm the presence of these types of stones, a special dye is passed into the bladder and it outlines the stones in the x-ray. With this method, we see a white area (the dye in the bladder) with a black hole in the center (the stone).

How bladder stones are formed

Bladder stones are formed by minerals, which first precipitate out in the urine as individual microscopic crystals. Over time, these crystals unite and small grains of sand-like material may be formed. Once these first grains are present, additional precipitation forms on their surface and the tiny specks are gradually built into stones that sometimes reach over 1” in diameter.

The effect of diet on urinary stone and treatment

It appears that diet may increase the risk of a cat developing urinary crystals, stones, and urethral plugs. The development of crystals and stones is mostly dependent upon:

- Urine pH
- Concentration of minerals in the urine

Whether a cat is allowed to eat throughout the day (free choice or ad libitum feeding) or has specific mealtimes may influence lower urinary tract health. Genetics also appears to play a role.

Three common crystals (and stones) in cats are struvite, oxalate, and urate.

<table>
<thead>
<tr>
<th>Struvite Crystals and Stones</th>
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<tbody>
<tr>
<td>Formation</td>
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Struvite crystals are made up of magnesium, ammonium, and phosphate. The crystals and stones are more likely to develop in alkaline urine. The main dietary factors which appear to affect the development of struvite crystals are urine pH and water consumption. In the past, crystals and stones made of struvite were more common in cats. As a result, diets were

<table>
<thead>
<tr>
<th>Type of Stone</th>
<th>Percent of Stones in 1984</th>
<th>Percent of Stones in 2007</th>
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Several types of bladder stones

If your cat is straining to urinate and produces little urine or no urine at all, it is considered an extreme emergency.
developed to minimize the risk of forming struvite. These diets were low in magnesium and cats eating them produced an acidic (low pH) urine. As more cats were fed these diets, both for treatment and prevention of struvite, the percentage of cats with struvite stones decreased, but the incidence of calcium oxalate crystals and stones increased. Struvite is still, by far, the most common component of urethral plugs.

Treatment and Prevention

The treatment of struvite stones may include surgical removal, urohydropropulsion (both described in more detail at the end of the article), dietary changes, or a combination of techniques.

Surgery: If there are urethral plugs or any other type of urinary obstruction, we cannot wait for special diets to dissolve the stones, but must quickly surgically remove the stones or use urohydropropulsion (detailed below) to eliminate the stones.

Diet Modifications: When struvite is a problem, special diets are available to make the urine more dilute and more acidic. Too much acidification of the urine can result in serious health problems, so urinary acidifiers should never be used in conjunction with diets that are formulated to produce an acidic urine. Since the safety of these products for kittens and pregnant or nursing queens has not been established, it is recommended that these products not be used for these life stages.

Those diets that are designed to actually dissolve urinary stones include Hill's s/d, Royal Canin Dissolution, and Royal Canin Urinary SO. Hill's s/d should only be used on a short-term basis, however, since it is not balanced for long-term use. Those diets that are available to help prevent stones and crystal formation in cats that are susceptible to them include Purina CNM UR-Formula, Royal Canin Urinary SO, Royal Canin Control, and Hill's c/d, w/d, and r/d. All of these diets have a balanced level of the minerals that make up the crystals such as magnesium and phosphorous. In addition to being formulated to produce an acid urine, they are also formulated to produce more dilute urine, so crystals are less likely to form. The diets are available through your veterinarian.

Prior to the development of specialized diets, urinary acidifiers such as vitamin C or dl-methionine were sometimes used to lower the pH of the urine in cases of struvite stones, for example. Specialty diets are now preferred since they alter not only the pH, but the concentration of stone-forming constituents. Remember: Do NOT give urinary acidifiers when you are using one of the specialty diets that also acidify urine.

Feeding methods: It is recommended that cats who are at risk for developing struvite crystals or stones should be fed ad libitum. After eating a large meal, the pH of the urine usually becomes more alkaline. By eating small meals throughout the day, the urine pH will stay more acidic.

Increased Water Consumption: An important influence on the development of urinary crystals and stones is the consumption of water. As more water is consumed, the urine is less concentrated, and crystals are less likely to form. Also, since there is more urine, the cat will urinate more frequently, and the urine will be present in the bladder for a shorter period of time. This also decreases the chance of crystal and stone formation. Provide fresh, clean water at all times, and preferably in several areas around the house. For information on how to increase your cat's water intake see Drinking Water: How can I encourage my cat to drink more? For some animals with a history of urinary tract infections or crystals, a canned diet is recommended. Canned diets contain larger amounts of water and may help dilute the urine and make crystals less likely to form.

<table>
<thead>
<tr>
<th>Type of stone</th>
<th>Tends to form in:</th>
<th>Initial treatment</th>
<th>Diet recommended for dissolving stones**</th>
<th>Diet recommended for crystal/stone prevention in cats susceptible to them**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Struvite</td>
<td>75</td>
<td>49</td>
<td></td>
<td>Cats who are on diets designed to acidify the urine should NOT be given additional urinary acidifiers.</td>
</tr>
<tr>
<td>Oxalate</td>
<td>2</td>
<td>41</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Struvite</th>
<th>Alkaline urine</th>
<th>Diet to dissolve stones unless there is an obstruction; surgical removal or urohydropropulsion if there is an obstruction</th>
<th>Hill's s/d Royal Canin Dissolution Royal Canin Urinary SO</th>
<th>Hill's c/d, w/d, or r/d Royal Canin Control Royal Canin Urinary SO Purina CNM UR Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxalate</td>
<td>Acidic urine</td>
<td>Surgical removal or urohydropropulsion</td>
<td>Hill's c/d or x/d Royal Canin Urinary SO Purina CNM UR Formula</td>
<td></td>
</tr>
<tr>
<td>Urate</td>
<td>Acidic urine; cats with certain liver diseases</td>
<td>Surgical removal or urohydropropulsion; treat any liver disease</td>
<td>Hill's k/d or l/d* Royal Canin Renal LP*</td>
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</tbody>
</table>

*No specific diets are available; these diets are lower in protein, which is recommended.
**With all diets, it is extremely beneficial to also increase the amount of water consumption.

**Oxalate Crystals and Stones**

**Formation**
Oxalate crystals and stones are more likely to occur in acidic urine and if the cat has high calcium levels in the blood. This could be caused by excessive intake of calcium, protein, sodium, or vitamin D. Some metabolic disorders such as hyperparathyroidism, some cancers, and Cushing's disease may also contribute to the development of oxalate stones. Unfortunately, oxalate stones often occur in cats with normal blood calcium levels, as well.

**Treatment and Prevention**
Surgery: Surgical removal or hydropulsion (described in more detail below) are the only available treatment for oxalate stones. There are no diets that will dissolve them.

Diet Modification: Special diets are available that decrease the probability of oxalate crystals and stones forming in the urine. These include Hills x/d, Royal Canin Urinary SO, and Purina CNM UR-Formula. Urinary acidifiers should not be used with these diets since the goal is to make the urine more alkaline.

Increased Water Consumption: As with struvite, another goal of therapy is to produce dilute urine, so any method to increase water consumption should be used. Again, canned diets may be recommended.

**Urate Crystals and Stones**

**Formation**
Urate stones are more common in certain breeds of dogs, such as Dalmations, although they have been diagnosed in cats. They are more likely to occur in acidic urine. They can also be seen with some liver disorders and metabolic diseases.

**Treatment and Prevention**
Surgery: If there are urethral plugs or any other type of urinary obstruction, we cannot wait for special diets to dissolve the stones, but must quickly remove the stones by surgery or urohydropropulsion (see description later in article).

Diet Modification: There are no specific diets for urate stones in cats, however diets lower in protein are often recommended. These include Hill's k/d or l/d, and Royal Canin Renal LP. Urinary acidifiers should also not be used with these diets since...
the goal is to make the urine more alkaline.

Increased Water Consumption: Again, increase water consumption as much as possible and use canned diets as recommended.

Other treatment techniques

Surgery
The surgical removal of stones within the bladder is referred to as a cystotomy, meaning an opening of the bladder. With the cat under anesthesia and lying on its back, an incision is made through the abdominal wall in front of the pelvis. The bladder is exposed and lifted out through the incision. Urine is collected for culture and analysis. The bladder is then opened and the stones are removed. The bladder and urethra are flushed with sterile saline solution to wash out any small or microscopic particles. The bladder is then closed with sutures as is the abdominal wall. The patient is placed on antibiotics and usually sent home the following day. The bladder stones are sent to a laboratory for analysis to determine their chemical make-up and the remainder of the therapy will vary depending on the results.

Urohydropropulsion
To perform urohydropropulsion, the cat is anesthetized and a urinary catheter is placed. Through the catheter, the bladder is filled with sterile saline. The cat is then held in an upright position and, by hand, the veterinarian compresses the bladder, forcing the solution back out, and with it, the stones. Urohydropropulsion is used when the stones are very small and are sure to pass through the urethra.

Emergencies
In situations where a stone has lodged in the ureters or urethra, the condition is a life or death matter that must be resolved immediately. Urinary obstructions lead to kidney shut down and death. If there are stones or crystals caught in the urethra, which is especially common in male cats, the veterinarian would first provide pain medication and intravenous fluids. The cat is anesthetized and the veterinarian will try to back-flush the plug or obstruction into the bladder before it is opened. If this cannot be done, a very small endoscope may be used to try to remove the obstruction. In the rare case where stones are lodged in a ureter, an incision would have to be made at the site. This is extremely delicate surgery since the ureters is such a find tube-like structure.

Some work is being done using ultrasonic waves to destroy stones in these situations, but it is not readily available for all practices. This technique is common in human medicine and may eliminate surgery.

Summary
Urinary stones and crystals can cause severe disease in cats. Depending on the type of crystals or stones seen in your cat's urine, a different diet may help prevent the recurrence of the problem. It is important to work closely with your veterinarian in the diagnosis, treatment and monitoring of urinary crystals and stones. Using the wrong diet not only won't help, it could actually increase the chances of crystal or stone formation.