Bladder Stones (Urinary Calculi) in Dogs

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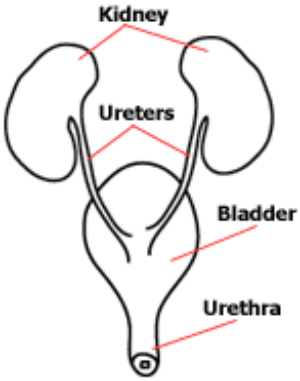
Although we often call them "bladder stones" in dogs, they are also known as urinary calculi and the condition is referred to as urolithiasis. Stones may actually form anywhere in the entire urinary tract. The urinary stones in dogs can be found in the kidneys, ureters (tiny tubes that carry urine from the kidneys to the bladder), bladder, or urethra (the tube from the bladder to the outside of the animal). However, in the dog, over 85% of stones are found within the bladder itself.

Signs and diagnosis of bladder stones in dogs



Dogs with bladder stones may have blood in their urine and may urinate frequently, passing only small quantities 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 normal. Some dogs with bladder stones may show no signs at all, and the stones are discovered while palpating the abdomen during a routine physical exam.

In other cases, the diagnosis of bladder stones in dogs is made or confirmed with abdominal x-rays. 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) 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 3" to 4" in diameter.

Types of bladder stones in dogs

There are several different types of bladder stones in dogs, depending on their chemical make-up. Struvite stones are composed of magnesium ammonium phosphate. Others are made of calcium oxalate, calcium phosphate, cystine, ammonium urate, or other chemical compounds. Some stones can actually be a combination of these. Each type of stone has its own different peculiarities as to which breed is most often affected and what factors affect the formation.

What causes bladder stones in dogs?

The process by which bladder stones develop is really quite simple, but what causes it to occur only in certain dogs, cats, or humans? Factors that influence the development of stones include genetic predisposition, the concentration of the stone constituents in the urine, urine pH, and the presence of bacterial infections.

Genetics: The genetically controlled physiology of some animals causes them to produce within their bodies the higher levels of the substances that are precursors of the crystals. They are then excreted or formed in the urine. We have no way of testing to predetermine in which individual dog or line of dogs this will occur.

Concentration of stone constituents: The higher the urine concentration of the constituents that make up the stones, the higher the risk that stones will form. The concentration of these constituents can be influenced by the amount of minerals and protein in the diet, the amount of water the animal drinks, and the animal's unique metabolism.

Urine pH: The acidity or alkalinity of the urine influences whether the stone constituents will remain dissolved or form stones. Some stones, such as struvite, form in alkaline urine, whereas others, including calcium oxalate stones, are more apt to form in acidic urine. The urine pH is largely influenced by diet.

Bacterial Infections: Bacterial infections of the bladder (referred to as cystitis) play the major role in struvite stone information for two reasons:

Bacterial infections tend to make the urine more alkaline (with a pH higher than 7.0) which enhances the formation of struvite crystals. This is important in this specific condition as struvite crystals are more apt to remain in solution if the liquid is acidic (with a pH lower than 7.0). That is, they would continue to be dissolved in the liquid and no crystals would form.

By-products of bacterial metabolism may enhance crystal formation. Many of the bacteria that cause a cystitis (bladder infection) also produce an enzyme (a compound that causes chemical reactions to occur) called urease. Urease reacts with urea molecules found in the urine to form ammonia and carbon dioxide. The ammonia is slowly converted to ammonium ions, while the carbon dioxide unites

> Struvite crystal formation is usually caused by urease-producing bacteria in the bladder, so struvite crystals are an indication of bladder infection and thus require antibiotics to

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with other compounds, freeing up phosphates. Then, through a chain of chemical reactions that seem to feed on each other, the magnesium that is normally present within the urine unites with the ammonium and phosphate to form magnesium ammonium phosphate crystals (struvite). If the crystals are formed rapidly and in large quantities, they will unite together to form stones. However, if only small amounts are formed over a longer period of time, they would simply be flushed out in the urine without producing any problems.

resolve the problem.

Treatment of bladder stones in dogs

Treatment of bladder stones may involve choices for the owners and veterinarians - that is, either to treat medically or surgically. Options vary according to the size, type and location of the stone(s).

Surgery: The surgical removal of stones within the bladder is referred to as cystotomy, meaning an opening of the bladder. With the dog under anesthesia and lying on his 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 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 dog is anesthetized and a urinary catheter is placed. Through the catheter, the bladder is filled with sterile saline. The dog 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.

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 caught in the urethra, which is especially common in male dogs, we try to back-flush them into the bladder before it is opened. If this cannot be done, an incision must be made directly through the urethral wall where the stone is located. In the rare case where stones are lodged in a ureter, an incision would have to be made at the site. Some work is being done using ultrasonic waves to destroy stones in these situations, but it is not readily available. This technique is more common in human medicine and may eliminate the need for surgery.

Medical Management: Struvite and ammonium urate stones are examples of stones that may be able to be dissolved through dietary management. For struvite stones, it is also very important to control urinary tract infections. Calcium oxalate stones, on the other hand, generally need to be removed through surgery or urohydropropulsion.

Medical therapy can be used by itself or in conjunction with the surgery. After the diagnosis and x-rays, pretreatment laboratory work entails culturing the urine for bacteria and a performing a urinalysis to determine what type of crystals are present along with the pH of the urine. After we determine what crystals are present in the urine, we know what type of stone is probably present and we try to modify the environment in the dog's bladder to prevent further formation of stones. This may be done through a combination of antibiotic therapy, use of special foods, increasing water consumption, and inhibiting the activity of urease in cases involving struvite stones.

Treatment of urinary tract infections: In the case of struvite bladder stones in dogs, it is vitally important to treat any urinary infections and prevent further infections from occurring. If there is a an infection present, a culture and sensitivity is done to determine the appropriate antibacterial medications to use and then treatment is initiated.

Diet Alteration: Diet alternation may be helpful in the medical treatment of struvite and ammonium urate stones. Specially formulated diets can actually cause the stones - even large ones - to dissolve completely. These diets take time, often 60 to 150 days, to work. To take struvite and Hill's s/d diet as an example, the principle by which s/d works is that it contains lower than normal levels of large proteins, magnesium, and phosphorous. Less protein means less urea, and therefore, less ammonium and carbon dioxide formed by the action of urease. Remember that struvite is made up of magnesium and phosphate ions, so lower levels of these materials also decrease the quantity of crystals that can potentially be formed. Feeding s/d helps the urine become more acidic. And last but not least, Hill's has slightly increased the sodium chloride (normal table salt) to increase water consumption by the animal, thereby increasing a flushing action through the bladder and better keeping the crystals in solution.

However, s/d cannot be used indefinitely as a preventive because it is not considered a complete diet. Also, it is not recommended for use in patients suffering from heart failure or kidney disease because of its salt and protein levels. After the initial 60 to 150 day period, when medical therapy is actively attempting to dissolve the stones or sand that is present in the bladder, the animal is removed from s/d and placed on a maintenance diet such as Hill's c/d or w/d. Royal Canin, Purina, and some other companies have also developed specialized diets for use with dogs with urinary stones. If a dog is reluctant to eat one manufacturer's diet, it is advisable to try diets produced by another company.

NOTE: Do NOT use a urinary acidifier and s/d, c/d, or a similar diet at the same time.

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

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the pH, but the concentration on stone-forming constituents. Remember: Do NOT give urinary acidifiers when you are using one of the specialty diets that also acidify urine.

Increase Water Consumption: Water consumption may be increased by using canned diets instead of dry foods. Also, plain water can be added to dry diets. Using flavored dilute broths, water in which hot dogs have been boiled, etc., may also increase water consumption. Some owners have used clicker training as a way to increase their dog's water consumption.

The Formation, Treatment, and Diet Modifications for Urinary Stones and Crystals in Dogs				
Type of stone	**Tends to form in:**	**Initial treatment**	**Diet recommended for dissolving stones****	**Diet recommended for crystal/stone prevention in dogs susceptible to them****
Struvite	Alkaline urine	Treat urinary tract infection; use diet to dissolve stones unless there is an obstruction; surgical removal if there is an obstruction	Hill's s/d Royal Canin Urinary SO	Hill's c/d or w/d Royal Canin Control Royal Canin Urinary SO
Oxalate	Acidic urine	Surgical removal		Hill's u/d* Royal Canin Urinary SO Purina NF Kidney Function
Urate	Dalmations and bulldogs; acidic urine; certain liver diseases	If not liver disease, Hill's u/d* with the medication allopurinol; surgical removal if there is obstruction or liver disease		Hill's u/d* Royal Canin Vegetarian
*If used long-term, veterinarian should monitor for signs of protein depletion. **With all diets, it is extremely beneficial to also increase the amount of water consumption.				

Summary

Urinary stones may be found in any portion of the urinary tract. Based on the composition of the stone, size, and location, the stone may be physically removed or a special diet may be used to dissolve the stone. To prevent recurrence, special diets are fed, water consumption is increased, and the pH of the urine is managed. Controlling urinary tract infections is especially

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important in preventing recurrence of struvite stones.

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