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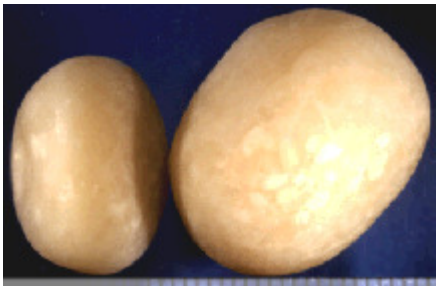
Struvite Stones - Canine



- 85% of patients with struvite bladder stones are female.
- Breeds felt to have an increased risk for the formation of struvite stones are the Miniature Schnauzer, Shih Tzu, Yorkshire terrier, Labrador retriever, and Dachshund.
- The average age of patients with struvite bladder stones is 2.9 years.

Some patients with bladder stones show no symptoms of any kind and the stones are discovered incidentally, but there are some symptoms that might promote a search for stones. Bloody urine, recurrent bladder infection (especially by the same organism), or straining to urinate all would raise suspicion. Fortunately, struvite stones are radio-opaque, which means they show up readily on radiographs (x-rays).

Occasionally stones are simply passed. If this occurs, it is important to have radiographs taken to check to see if there are more stones. If possible, a stone should be sent in for analysis to determine for certain the stone type.

When to Suspect Struvite Stones

Bladder stones come in several mineral compositions. The most common stone types are oxalate and struvite. Since the approach is different for each type, it is crucial to determine the stone type. The stone type can be confirmed if a sample stone is available (either passed naturally or obtained via surgery, voiding urohydropropulsion, or cystoscopy). A laboratory analysis can easily determine the content of the stone and even determine if the stone consists of layers of different mineral types. Without a sample stone, there are still some hints that can be obtained through other tests.

Struvite stones in dogs are almost always formed because of the urinary changes that occur with specific types of bladder infection: almost always staphylococcal infection but occasionally a Proteus infection. If a urine culture from a patient with a bladder stone should grow either Staph or Proteus, this would make struvite more likely than oxalate. Also, struvite requires an alkaline pH to form while oxalate requires an acid pH to form; urine pH is a part of any urinalysis and thus provides another clue as to the stone identity.

An educated guess is better than nothing but does not replace the actual analysis of a stone. Occasionally a stone of one type forms the center of a stone of another type. A complete analysis is needed to effectively prevent recurrence.

How do Struvite Stones Form?

Struvite is the name given to the crystal composed of magnesium, ammonium, and phosphate. (Struvite is also occasionally referred to as "triple phosphate" due to an old erroneous belief that the phosphate ion was bonded to three positive ions instead of just magnesium and ammonium.) Struvite crystals are not unusual in normal urine and are usually of no consequence unless they are accompanied by an infection with a bacterial species that produces an enzyme called urease.

Urea is an important biochemical excreted in urine. When urine is infected with bacteria that are able to digest urea, urea is broken down into ammonia (NH_3). Ammonia in water ionizes into ammonium (NH_4^+). Ammonia is toxic to the cells of the bladder wall and when there it generates inflammation (although the infection also generates inflammation). The proteins released in the inflammatory reaction form a matrix that the struvite crystals use to form a stone. The reaction takes place only in an alkaline pH but ammonia creates just the alkaline pH needed for stone formation.

Bacteria capable of digesting urea are called urease positive bacteria and in most cases we are talking about *Staphylococci.* In dogs, the general rule is: No infection, no bladder stone.

The hereditary situation of the English cocker spaniel is an exception because in at least one genetic line of this breed, the tendency to form a purely metabolic struvite stone has been documented.

What should be done about Struvite Bladder Stones?

Struvite stone can be removed in several ways: surgically; with a technique called voiding urohydropropulsion; with a cystoscope (if they are small enough); or dissolved through diet.

Surgery

Surgical removal is the most direct method. The advantage is that the stones are removed and healing may commence all in one day. The chief disadvantages are those inherent to surgery: anesthetic risks, post-operative pain, risk of contaminating the abdomen with infected urine, possibility that not all stones will be removed, and the possibility that the bladder stitches will not properly hold. These risks are generally considered minor and complications associated with cystotomy (opening of the urinary bladder) are unusual. The patient usually stays in the hospital a day or two to be sure urine production is normal, to properly confine the patient, and to assess pain.

Voiding Urohydropropulsion

If the stones are small enough to pass, the bladder can be manipulated to expel the stones through the urethra. This is called voiding urohydropropulsion and it involves filling the bladder, agitating the bladder so the stones float freely in the urine, and then generating a high pressure urine stream to force the stones out. The patient must typically be held vertically so that gravity can assist in the expulsion. This technique only works if the stones are small and the patient is not too large. If there are numerous stones, often several attempts are needed if this is to be the only means of removal. Often this technique is used to obtain a sample stone for analysis to determine if dietary dissolution is feasible.

Cystoscopy

If one wishes to avoid surgery and the stones are small enough, a cystoscope can be passed into the patient's bladder and the stones retrieved with a type of basket (or fragmented via laser lithotripsy). This requires specific equipment, referral to a specialty practice, and generally greater expense than surgery although recovery time for the patient is typically much faster.

Dietary

Dietary dissolution of stones is possible with struvite bladder stones. Some therapeutic foods are made for the specific purpose of dissolving struvite stones. The therapeutic diet must be the only food fed until the stone is dissolved. Antibiotics are needed as long as stones are in the bladder (bacteria are encrusted within the stone and as the stone dissolves, they are released). On the average, three and a half months are needed to dissolve the stone but the diet should be continued for a full month after the stones are no longer visible on radiographs because there may be small stones that are not large enough to see. Radiographs are taken monthly to monitor progress. If a dry food is used, ideally water should be added to it; the extra water helps keep the urinary crystals diluted and able to dissolve. Talk to your veterinarian about which prescription diet is best for your pet.

Aside from the long treatment time, an important disadvantage of this approach is the possibility of urinary tract obstruction as the stone gets smaller and an unsuccessful attempt to pass the stone occurs. This is potentially a life-threatening hazard for male dogs as they have a narrow urethra.

Some of the appropriate therapeutic diets are high in fat and salt and should not be fed to patients with a past or current history of pancreatitis, patients with heart disease, kidney insufficiency, or high blood pressure.

Recurrence of Stones?

After stones are removed one way or another, the focus shifts to prevention. Often patients are somehow predisposed to bladder infection, which means they are also predisposed to form more struvite bladder stones. A stone can form as quickly as 2 weeks after infection with a urease positive bacterium sets in.

After surgery, antibiotics must be continued until the infection is confirmed to have cleared (i.e., a negative urine culture is obtained). After this, a follow up schedule of radiographs and/or urine testing is recommended. For a single episode, only a few follow-up visits may be necessary. Some individual animals are predisposed to recurring bladder infections and these individuals may form new struvite stones repeatedly. Obviously, if stones were to recur, a more regular monitoring schedule would have to be revised.

Dietary therapy to prevent struvite stones is of secondary importance in dogs (with the exception being the English Cocker Spaniel for which this is a hereditary metabolic problem rather than a matter of infection). The focus is on preventing infection. If your dog has had a history of struvite bladder stones, be sure to discuss with your veterinarian long-term monitoring and understand what schedule of testing is best for your pet. Expect periodic urine cultures to be needed.

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