

# STRUVITE UROLITHIASIS IN THE DOG

## (STRUVITE STONES IN THE URINARY TRACT OF DOGS)

### BASICS

#### OVERVIEW

- “Urolithiasis” is the medical term for the presence of stones (uroliths) in the urinary tract
- The most common minerals found in the stones (uroliths) are used to name the particular stone; in this type of stone, struvite makes up the composition of the stone, and thus the name “struvite urolithiasis;” struvite is magnesium ammonium phosphate
- The urinary tract consists of the kidneys, the ureters (the tubes running from the kidneys to the bladder), the urinary bladder (that collects urine and stores it until the animal urinates), and the urethra (the tube from the bladder to the outside, through which urine flows out of the body)
- Struvite urolithiasis is the formation of crystalline stones (uroliths) composed of magnesium ammonium phosphate, or struvite, in the urinary tract

#### GENETICS

- The high incidence of struvite stones (uroliths) in some breeds of dogs (such as the miniature schnauzer) suggests a familial tendency; it is hypothesized that susceptible miniature schnauzers inherit some abnormality of local host defenses of the urinary tract that increases their likelihood to develop urinary tract infection (UTI)
- Sterile struvite uroliths were found in a family of English cocker spaniels

#### SIGNALMENT/DESCRIPTION of ANIMAL

##### *Species*

- Dogs

##### *Breed Predilection*

- Miniature schnauzer, shih tzu, bichon frise, miniature poodle, cocker spaniel, and Lhasa apso
- Any breed may be affected

##### *Mean Age and Range*

- Mean age, 6 years (range, less than 1 year to greater than 19 years of age)
- Most stones (uroliths) in immature dogs are infection-induced struvite

##### *Predominant Sex*

- More common in females (85%) than males (15%), which may be related to the greater likelihood of females developing bacterial urinary tract infections (UTIs)

#### SIGNS/OBSERVED CHANGES in the ANIMAL

- Some affected dogs have no signs of disease (known as “asymptomatic”)
- Signs depend on location, size, and number of stones (uroliths)
- Typical signs of stones in the bladder (known as “urocystoliths”) include abnormal frequent passage of urine (known as “pollakiuria”); difficulty urinating (known as “dysuria”) and blood in the urine (known as “hematuria”); sometimes small, smooth stones (uroliths) are passed when the animal urinates (voids)
- Typical signs of stones in the urethra (the tube from the bladder to the outside, through which urine flows out of the body; stones known as “urethroliths”) include abnormal frequent passage of urine (known as “pollakiuria”); difficulty urinating (known as “dysuria”), and sometimes small, smooth stones (uroliths) are passed when the animal urinates (voids)
- Struvite stones of the kidney (nephroliths) may be associated with signs of kidney insufficiency or failure (such as increased urination [known as “polyuria”] and increased thirst [known as “polydipsia”])
- Obstruction to urine outflow with bacterial urinary tract infection may result in inflammation/infection of the kidney (known as “pyelonephritis”) and generalized disease caused by the spread of bacteria in the blood (known as “septicemia” or “blood poisoning”); signs might include increased urination (polyuria), increased thirst (polydipsia), abdominal or lumbar pain, and fever
- Struvite stones may be felt in the urinary bladder and/or urethra during physical examination
- Blockage or obstruction of the urethra may cause enlargement of the urinary bladder
- Obstruction of a ureter (the tube running from the kidney to the bladder) may cause enlargement of the associated kidney

#### CAUSES

- Urinary tract disorders that increase the likelihood of infections with bacteria that produce urease, an enzyme that breaks down urea to carbon dioxide and ammonia, disease-causing fungus; or *Ureaplasma* (a type of bacteria that breaks down urea to ammonia) in patients whose urine contains a large quantity of urea (urea is the final compound in the breakdown of protein in the body)
- Specific causes of sterile struvite stones (uroliths) are unknown; sterile struvite stones are ones that are free of the presence of microorganisms, such as bacteria

## RISK FACTORS

- High concentrations of steroids (either from excess production by the adrenal glands or from use of steroid-containing medications) increase the likelihood of bacterial urinary tract infection
- Abnormal retention of urine
- Alkaline urine decreases the solubility of struvite and increases the likelihood of struvite stone formation

## TREATMENT

### HEALTH CARE

- Removal of the stones can be performed by flushing stones located in the urethra (the tube from the bladder to the outside, through which urine flows out of the body) back into the urinary bladder to re-establish opening of the urethra or by positioning the dog and using gentle compression of the bladder to allow the dog to urinate and “pass” the stones to eliminate bladder and urethral stones; medical procedure in which the stone is broken up within the urinary tract using some type of energy (procedure known as “shock-wave lithotripsy”) and/or surgery require short periods of hospitalization
- Medical dissolution of struvite stones (uroliths) is an outpatient strategy
- Struvite stones in the ureters (ureteroliths) or urethra (urethroliths) cannot be dissolved

### ACTIVITY

- If dietary management is used, monitor outdoor activity in order to limit access to other foods and treats

### DIET

- Sterile and infection-induced struvite stones in the bladder (urocystoliths) and in the kidneys (nephroliths) may be dissolved by feeding a diet designed to eliminate stones (Hill’s Prescription Diet® Canine s/d®)
- Continue diet therapy for 1 month after X-ray evidence showing that the stone (urolith) has dissolved
- If dietary management is used, limit access to other foods and treats
- Avoid use of the protein-restricted diet in patients with protein-calorie malnutrition; the diet to eliminate stones is designed for short-term (weeks to months) dissolution therapy, rather than long-term (months to years) stone prevention—if diet is used to eliminate stones, monitor the patient for evidence of protein malnutrition; avoid prolonged feeding of the diets intended to eliminate stones in immature dogs

### SURGERY

- Struvite stones in the ureters (ureteroliths) cannot be dissolved; consider surgery or medical procedure in which the stone is broken up within the urinary tract using some type of energy (shock-wave lithotripsy) for persistent ureteroliths associated with clinical signs
- Struvite stones in the urethra (urethroliths) cannot be dissolved medically; attempt removal of the stones by flushing stones located in the urethra (the tube from the bladder to the outside, through which urine flows out of the body) back into the urinary bladder or by positioning the dog and using gentle compression of the bladder to allow the dog to urinate and “pass” the stones; consider medical procedure in which the stone is broken up within the urinary tract using some type of energy (shock-wave lithotripsy)
- Immovable stones in the urethra (urethroliths) may require surgery, such as a surgical incision into the urethra to reach and remove the stones (known as “urethrotomy”) or a surgical procedure in which a new permanent opening is made into the urethra to allow passage of urine out of the body (procedure known as “urethrostomy”)
- Struvite stones in the kidney (nephroliths) causing blockage or obstruction of urine flow or associated with nonfunctioning kidneys cannot be dissolved medically; consider surgical correction if stones (uroliths) are blocking urine outflow, and/or if correctable abnormalities increasing the likelihood of recurrent urinary tract infection are identified by X-rays or other means

## MEDICATIONS

Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive.

- Dissolving infection-induced struvite stones in the bladder (urocystoliths) or in the kidney (nephroliths) requires administration of appropriate antibiotics, chosen on the basis of bacterial culture and susceptibility tests
- Give antibiotics at therapeutic dosages, until the urinary tract infection is eradicated and no X-ray evidence of bladder stones exists
- Patients with infection-induced struvite stones in the bladder (urocystoliths), associated with persistent bacterial infection with urease-producing bacteria, that are not responsive to dietary and antibiotic treatment to dissolve the stones may be given AHA (acetoxyhydroxamic acid; Lithostat™, Mission Pharmacal)—AHA is a urease inhibitor that blocks hydrolysis of urea to ammonia
- Difficulty urinating (dysuria) may be minimized by treatment of bacterial urinary tract infection with antibiotics, and by administration of an anticholinergic drug (such as propantheline bromide) to relax the bladder

## FOLLOW-UP CARE

### PATIENT MONITORING

- Check rate of stone (urolith) dissolution at monthly intervals by urinalysis, urine culture, X-rays, or ultrasound
- Monitor patients, in which the urine has been acidified, for calcium oxalate crystals in the urine (crystalluria); change management protocol if persistent calcium oxalate crystalluria develops

### PREVENTIONS AND AVOIDANCE

- Eradicating and controlling infections by urease-producing bacteria may prevent infection-induced struvite stones
- Recurrent struvite stones (uroliths) that are free of the presence of microorganisms, such as bacteria (that is, sterile struvite uroliths) may be prevented by using acidifying, magnesium-restricted diets (Hill's Prescription Diet® Canine s/d®) or urine acidifiers
- In patients at risk for both struvite and calcium oxalate crystals in the urine, focus on preventing calcium oxalate stones (uroliths); struvite uroliths may be dissolved medically; recurrent calcium oxalate uroliths cannot be dissolved

### POSSIBLE COMPLICATIONS

- Benefits and risks are associated with feeding diets designed to eliminate struvite stones; not all patients qualify for dietary medical management, including those with (1) abnormal fluid accumulation, (2) primary kidney failure with excess levels of urea and other nitrogenous waste products in the blood (known as "uremia" or "azotemia"), and (3) increased likelihood to develop inflammation of the pancreas (known as "pancreatitis"), especially miniature schnauzers with increased levels of lipids (a group of compounds that contain fats or oils, condition known as "hyperlipidemia")
- Struvite stones in the bladder (urocystoliths) may pass into and block the urethra (the tube from the bladder to the outside, through which urine flows out of the body) of male dog, especially if the patient persistently has difficulty urinating (dysuria); urethral blockage or obstruction may be managed by flushing stones located in the urethra back into the urinary bladder or by a medical procedure in which the stone is broken up within the urinary tract using some type of energy (shock-wave lithotripsy)
- Dogs that do not consume their daily requirement of the diet intended to eliminate struvite stones (uroliths) may develop varying degrees of protein-calorie malnutrition; this complication can be prevented by proper calculation of the daily dietary requirement and adjustment in the quantity of diet fed on the basis of serial physical examination
- Diet-associated increased urination (polyuria) will result in voiding increased urine volume; the increased volume may be associated with varying degrees of inability to control urination or urine leakage (known as "urinary incontinence") in spayed female dogs that have a tendency for estrogen-responsive incontinence

### EXPECTED COURSE AND PROGNOSIS

- Dissolving struvite stones takes time; the mean time for dissolving infection-induced stones in the bladder (urocystoliths) was approximately 3 months (range, 2 weeks to 7 months); the mean time for dissolution of infection-induced struvite stones in the kidney (nephroliths) was 6 months (range, 2 to 10 months)
- The mean time for dissolving sterile struvite stones in the bladder was 6 weeks (range, 4 to 12 weeks)
- Following dietary recommendations is suggested by finding a reduced concentration of urea in blood testing and a low urine specific gravity (indicating dilute urine) on urinalysis
- If uroliths increase in size during dietary management or do not begin to decrease in size after approximately 4 to 8 weeks of appropriate medical management, alternative methods should be considered
- Difficulty in inducing complete dissolution of struvite stones after creating urine under-saturated with struvite should prompt consideration that (1) the wrong mineral component was identified, (2) the center (nucleus) of the stone (urolith) has a different mineral composition than other portions of the urolith, and/or (3) the owner is not complying with medical recommendations

### KEY POINTS

- If dietary management is used, limit access to other foods and treats
- Short-term treatment with a diet designed to eliminate stones (Hill's Prescription Diet® Canine s/d®) and administration of antibiotics has been effective in dissolving struvite stones (uroliths)
- Comply with dosage schedule for antibiotic therapy