STRUVITE UROLITHIASIS IN CATS
(STRUVITE STONES IN THE URINARY TRACT OF CATS)

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 stones (uroliths) and accumulations of struvite and inflammatory materials in a matrix (known as "struvite urethral plugs") are different in physical characteristics and causes; thus, these terms should not be used as synonyms—struvite stones (uroliths) are crystalline concretions, composed primarily of magnesium ammonium phosphate and small quantities of matrix while struvite urethral plugs commonly are composed of large quantities of matrix mixed with crystals (especially, magnesium ammonium phosphate); some urethral plugs are composed primarily of organic matrix, sloughed tissue, blood, and/or inflammatory cells

SIGNALMENT/DESCRIPTION of ANIMAL

Species
- Cats

Mean Age and Range
- Mean age at time of diagnosis is approximately 7 years (range, less than 1 year to 22 years of age)
- Struvite stones (uroliths) that are free of the presence of microorganisms, such as bacteria (that is, "sterile struvite uroliths"), do not affect immature cats; infection-induced struvite stones may occur in immature cats

Predominant Sex
- Struvite stones (uroliths) are more common in females (55%) than in males (45%)
- Accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs) primarily affect males

SIGNS/OBSERVED CHANGES in the ANIMAL
- Some affected cats have no signs of disease (known as "asymptomatic")
- Depend on location, size, number and cause of the 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")
- 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); signs (such as lack of appetite [anorexia] and vomiting) of excess levels of urea and other nitrogenous waste products in the blood are found in some cats with blockage or obstruction of urine flow out of the body (condition known as "postrenal uremia")
- Signs of kidney insufficiency or failure (such as increased urination [known as "polyuria"] and increased thirst [known as "polydipsia"]) are found in some cats with stones in the kidneys (stones known as "nephroliths")
- Signs typical of inability to urinate because of blockage or obstruction of the urethra (the tube from the bladder to the outside, through which urine flows out of the body), such as difficulty urinating (dysuria), large painful urinary bladder, and signs of postrenal uremia are found in cats with accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs)
- A thickened, firm, contracted bladder wall is detected on physical examination in some cats with stones in the bladder (urocystoliths)
- Accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs) or struvite stones in the urethra (urethroliths) may be detected during physical examination of the penis and penile urethra (the part of the urethra that is enclosed by the penis)

RISK FACTORS
- For formation of sterile struvite stones (uroliths)—include the mineral composition, energy content, and moisture content of the diet being fed; compounds in the diet that make the urine more alkaline (that is, have a higher pH); quantity of diet consumed; free-choice versus meal-feeding schedules; formation of concentrated urine; and retention of urine
- Probable for formation of infection-induced struvite stones (uroliths)—include urinary tract infection with bacteria that produce urease, an enzyme that breaks down urea to carbon dioxide and ammonia (urea is the final compound in the breakdown of protein in the body); abnormalities in local host defenses that allow bacterial urinary tract infections; and the quantity of urea (the substrate of urease) excreted in urine

• The normal small diameter of the end of the urethra in male cats makes them susceptible to blockage with plugs and stones (urethroliths)

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, flushing the urethra to remove accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs), or by positioning the cat and using gentle compression of the bladder to allow the cat to urinate and "pass" the stones to eliminate bladder and urethral stones, and/or surgery require short periods of hospitalization
• Dissolving the struvite stones (uroliths) medically 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® Feline s/d®)
• Continue diet therapy for 1 month after X-ray evidence showing that the stone (urolith) has dissolved
• Struvite crystals in the urine (crystalluria) may be minimized by feeding magnesium-restricted urine-acidifying diets
• If dietary management is used, limit access to other foods and treats
• Canned (moist) foods help to reduce urine concentration of stone-forming compounds and promote increased frequency of normal urination

SURGERY

• Struvite stones in the ureters (ureteroliths) cannot be dissolved; consider surgery 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 cat and using gentle compression of the bladder to allow the cat to urinate and "pass" the stones or urethral plugs, or flushing the urethra to remove accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs)
• Immovable stones in the urethra (urethroliths), recurrent accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs), or narrowing (known as "strictures") of the end of the urethra (the tube from the bladder to the outside, through which urine flows out of the body) may require surgical removal of the penis with creation of a new opening into the urethra (surgical procedure known as "perineal urethrostomy")
• Medical procedure in which the stone is broken up within the urinary tract using light energy (known as "laser lithotripsy") may be used for struvite stones in the bladder (urocystoliths) and/or the urethra (urethroliths)
• Struvite stones in the kidneys (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
• Struvite stones (uroliths) and accumulations of struvite and inflammatory materials in a matrix (struvite urethral plugs) should be localized, before considering surgical correction
• X-rays should be obtained immediately following surgery to verify that all stones (uroliths) were removed

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
• 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

• 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 or urine acidifiers—do not administer urine acidifier medications with acidifying diets
• 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
• Infection-induced struvite stones in the urinary tract (urolithiasis) can be prevented by eradicating and controlling urinary tract infections; use of magnesium-restricted, acidifying diets is an another method of prevention, but often is not required

POSSIBLE COMPLICATIONS

• 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 cats, 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
• A urinary catheter in the urethra (known as an "indwelling transurethral catheter") increases the risk for introduction of bacteria and resulting bacterial urinary tract infection and/or narrowing of the urethra (urethral stricture)

EXPECTED COURSE AND PROGNOSIS

• Dissolving struvite stones that are free of the presence of microorganisms, such as bacteria (that is, sterile struvite uroliths) in the bladder takes time; the mean time reported was 1 month (range, 2 weeks to 5 months)
• The mean time for dissolution of infection-induced struvite stones in the bladder (urocystoliths) was 10 weeks (range, 9 to 12 weeks)

KEY POINTS

• If dietary management is used, limit access to other foods and treats
• Short-term (weeks to months) treatment with a diet designed to eliminate stones (Hill's Prescription Diet® Feline s/d®), with or without antibiotics (as needed), is effective in dissolving struvite stones in the kidney (nephroliths) and bladder (urocystoliths); avoid feeding these diets to immature cats
• Comply with dosage schedule for antibiotic therapy, if the cat has infection-induced struvite stones in the bladder (urocystoliths)