

# Struvite Urolithiasis and Obesity – Feline

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## Definition

**Obesity** is defined quantitatively as 15% to 20% above ideal body weight. Functionally, obesity impairs health and is sufficient to cause diseases. Specific distribution of fat in the body is known to be important as seen in “metabolic disease” in humans. **Struvite urolithiasis** is a lower urinary tract disease often resulting in one or more of the signs of hematuria, dysuria, pollakiuria, urethral obstruction, and inappropriate urination. For more on obesity in cats, see pages 36–37; for more on struvite urolithiasis in cats, see pages 90–91.

## Key Diagnostic Tools and Measures

Current body weight, body condition scoring (BCS) (see Appendix I), and a complete diet history should be obtained in evaluation of an obese cat with suspected struvite urolithiasis (see Appendix II). Urinalysis (sample collected by cystocentesis), analysis of urolith or plug if retrieved, and urine sediment analysis (this test should be done immediately after collection to evaluate crystalluria; false results are often obtained with cooled urine) should be evaluated. On urine culture, less than 1% of cats less than 10 years of age have bacterial cystitis whereas 45% of cats over 10 years of age with lower urinary tract signs have bacterial cystitis. Bacterial infections are often secondary to renal failure, diabetes, mellitus, feline leukemia virus, etc. Abdominal radiography for potential uroliths (struvite uroliths are radiodense) and blood testing to rule out other diseases related to obesity or secondary to bacterial cystitis are recommended. Advanced testing could include cystoscopy (limited to urethral diameter), ultrasonography, and dual energy x-ray absorptiometry (DEXA) analysis for lean body mass to fat mass ratio.

## Pathophysiology

Obesity occurs when caloric intake exceeds the cat’s energy requirements such as basal metabolic rate, exercise and other energy expenditures. Obesity is a disease with increases in inflammatory mediators, insulin resistance and abnormal blood lipids. Diseases such as diabetes mellitus, cardiovascular changes, pancreatitis, lipidosis, osteoarthritis, lower urinary tract disease, cancer, constipation and lower urinary tract disease have been associated with obesity.

The multiple effects of obesity suggest a link between obesity and lower urinary tract diseases such as struvite urolithiasis, although the exact pathophysiology is unknown. The most common struvites in cats are sterile; however, cats do form struvites uroliths if they develop a urinary tract infection with a urease-producing bacterium, typically a *Staphylococcus* spp. “Struvite” mineral composition is magnesium, ammonium phosphate hexahydrate. Struvite solubility is dependent on concentrations of magnesium, ammonium, phosphate, and urine pH. Struvite solubility decreases as urine pH exceeds 6.8, and sterile struvite uroliths form with concurrent urine oversaturation of minerals and alkaline urine. Struvite is the most common mineral seen in urethral obstructive due to a urolith or urethral plugs. Sterile struvite uroliths form because of dietary composition as well as other unknown risks factors for urolith formation.

## Signalment

Obesity occurs most often in cats between 5 and 10 years of age. These cats are at a greater risk of early morbidity and almost 3 times the average rate of mortality. Overall lower urinary tract disease in cats is seen between 4 and 10 years of age. Struvite urolithiasis typically occurs in cats less than 10

years of age with no gender or breed predisposition. Bacterial-induced struvite urolithiasis is seen most often in cats greater than 10 years of age and is often secondary to another disease. Neutered male cats less than 10 years of age have a higher incidence of urethral plugs, which most commonly contain struvite.

## Key Nutrient Modifications

In nutritional management of obesity, low-calorie diets must provide all the essential nutrients balanced to the calorie intake. Low-fat diets decrease dietary calorie content because fat provides two times more calories per gram than protein or carbohydrates. High-fiber diets are used to decrease caloric intake and increase satiation for weight loss. Weight loss programs have been achieved with low-carbohydrate, high-protein diets in some cats. Canned diets with more water may increase satiety and increase fluid intake decreasing concentration of minerals in the urine.

Key modifications in management of struvite urolithiasis include dietary phosphorus restriction, dietary magnesium restriction, avoidance of excess protein intake as this decreases urinary ammonia concentration, avoidance of alkalinizing foods (e.g., renal failure diets or plant-based protein diets), and inducing acid urine. Cats produce an alkaline urine after a meal that is more prolonged with meal feeding rather than ad libitum. Thus, cats that consume small quantities of food rather than one or two large meals per day reduce less struvite crystalluria. Ad libitum feeding still requires calorie management in struvite-forming, obese cats. Sodium intake decreases urine saturation of struvites; sodium’s exact role in urine saturation and resulting struvite and calcium oxalate urolithiasis is an area of investigation.

## Recommended Ranges of Key Nutrients

Nutrient	% DM	g/100 kcal	% DM	g/100 kcal
	Recommended dietary level		Minimum dietary requirement*	
Fat	7–10	2.3–4	9	2.3
Fiber	4–13	1.2–4	n/a	n/a
Protein	30–44	9–15	26	6.5
Phosphorus	0.6–1.1	0.1–0.3	0.5	0.13
Magnesium	0.06–0.08	0.01–0.02	0.04	0.01
Sodium	0.1–1.1	0.05–0.35	0.2	0.05

Modified intake of these nutrients may help address metabolic alterations induced by disease states. The recommended dietary composition is shown as percent of dietary dry matter (DM) and as g or mg per 100 kcal metabolizable energy. All other essential nutrients should meet normal requirements adjusted for life stage, lifestyle, and energy intake.

\*Nutrient requirement for adult animals as determined by the Association of American Feed Control Officials

Increased water intake should be encouraged. Use of canned, high moisture diets or sodium-supplemented diets may help increase water intake.

## Therapeutic Feeding Principles

Obese cats need low-calorie, low-fat, and moderate- to high-fiber diets. Some obese cats seem to respond to high-protein diets for weight loss, but these diets would be inappropriate for a cat with struvite urolithiasis. The dietary goal of managing obese cats with struvite uroliths is to ensure decreased caloric intake (using a moderate- to high-fiber, low-fat approach) while maintaining low phosphorus and moderate high-quality protein levels. Ad libitum feeding must be calorie controlled. Restrict dietary levels

of magnesium, protein, and phosphorus to produce less urine saturation of these minerals and dissolution of struvite uroliths or crystals. Induce and maintain acid urine for both under saturation and dissolution. Encourage water intake for both urine saturation and the cat's satiation.

■ **Treats** – Avoid treats that are high in calorie, fat, protein and phosphorus and magnesium (% ash). Encourage water intake with canned diets or flavored water. Avoid alkalinizing treats and medications (such as potassium citrate or sodium bicarbonate).

■ **Tips for Increasing Palatability** – Attempt to transition the cat to an appropriate canned diet. Add flavoring agents such as appropriate broth or gravy. Warm canned foods. Offer fresh canned food frequently. Put small bowls of dry food around the house

■ **Diet Recommendations** – Diets that meet the following criteria are recommended: Low phosphorus and magnesium; acidifying; moderate amounts of high-quality protein; and low-fat, high-fiber diets for weight loss. Struvite dissolution and preventative diets are commercially available.

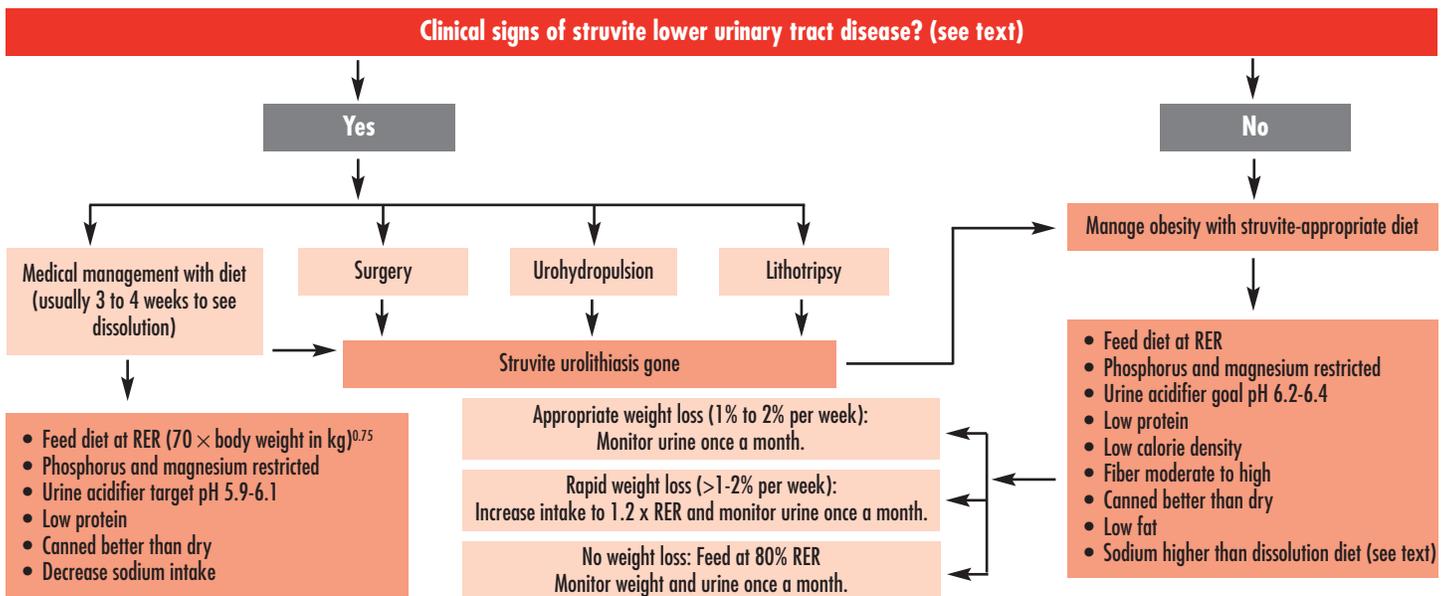
### Client Education Points

- Obesity in cats is related to lower urinary tract disease such as struvite urolithiasis.
- A weight loss program should be designed for a 1% to 2% weight loss per week using an appropriate struvite prevention or dissolution diet.
- Cats cannot be “starved” into eating a recommended diet; slow diet transition is necessary.
- If diet modification is not maintained, reformation of struvite uroliths and crystals can occur.
- Older cats can have struvite secondary to bacterial infections.

### Common Comorbidities

Bacterial urinary tract infection can be seen in older cats with struvite urolithiasis. Urethral strictures may occur concurrently with struvite urolithiasis. Conditions commonly seen in obese cats include diabetes mellitus, pancreatitis, inflammatory bowel disease, chronic constipation, osteoarthritis, and other lower urinary tract diseases.

## Algorithm – Nutritional Management of Concurrent Feline Obesity and Struvite Urolithiasis



### Interacting Medical Management Strategies

**Steroids** for administered for post-obstruction inflammation increase susceptibility to bacterial cystitis. **Appetite stimulants** for diet transition are contraindicated in a weight loss program. **Nonsteroidal anti-inflammatory drugs (NSAIDs)** may cause acute anorexia, gastrointestinal ulcers, and perforation. **Urinary acidifiers** may be used if dietary acidification is not adequate.

### Monitoring

Utilizing an appropriate diet for struvite urolithiasis, a weight loss program should be designed to obtain safe weight reduction of 1% to 2% per week. Monthly weights should be charted and dietary intake adjusted accordingly. Once optimal weight and body condition has been achieved the cat's weight can be checked every 4 to 6 months with urinalysis and to assure weight is maintained.

When monitoring for **dissolution** of struvite uroliths, keep in mind that sterile struvite uroliths typically dissolve in 2 to 4 weeks when feeding a struvite dissolution diet. Infection-induced struvite uroliths typically dissolve in 8 to 10 weeks when feeding a struvite dissolution diet and administering appropriate antibiotics. Urinalysis and radiographs should be monitored monthly until uroliths are dissolved. Look for acid urine (pH <6.8), urine specific gravity < 1.030, no crystalluria on sediment evaluation (urine collected by cystocentesis and analyzed immediately; false results are often obtained with cooled urine), resolution of hematuria, and no inflammation.

When monitoring for **prevention** of struvite uroliths, urinalysis and radiographs should be checked monthly to evaluate effectiveness of the diet. Look for acid urine (pH <6.8), urine specific gravity < 1.030, no crystalluria on sediment evaluation (urine obtained by cystocentesis and analyzed within 15 minutes of collection), resolution of hematuria, and no inflammation or signs of lower urinary tract disease. If the diet seems to be effective, urinalysis can be done every 4 to 6 months. With any signs of lower urinary tract disease, radiographs, urinalysis, and blood work as discussed above should be performed.