



NUTRITIONAL MANAGEMENT OF URINARY DISEASE

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SEPTEMBER | 2022



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IMPORTANCE OF THE DIET HISTORY



- Sherlock
- 7 year old
- MC
- Schnauzer
- History of pancreatitis and urinary stones

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QUESTION



Can we effectively manage Sherlock's pancreatitis with a urinary diet?

- Yes
- No
- Maybe

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ANSWER: IT DEPENDS



Diet history is important



Remember to include treats in analysis

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WHAT IF SHERLOCK HAD STRUVITE UROLITHS?

- DOGS: often associated with a bacterial urinary tract **infection** with urease-producing bacteria
- CATS: **Sterile** struvite uroliths typically form in cats between 1 - 10 years
- Urine must be oversaturated with **magnesium, ammonium, and phosphate** ions
- Alkaluria (high pH): increased risk for struvite formation



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NUTRITIONAL MANAGEMENT STRATEGIES FOR STRUVITE UROLITHS

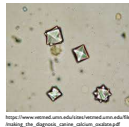
- Struvite uroliths can be dissolved
- Manage urinary tract infection
- Nutrients of concern:
 - Feed low **magnesium and phosphorous**
 - Feed low to moderate protein
- Induce aciduria relative to maintenance diets
- Promote increased urine volume
- Provide opportunities to urinate frequently



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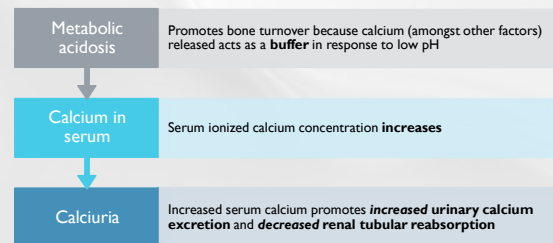
WHAT IF SHERLOCK HAD CALCIUM OXALATE UROLITHS?

- Risk factor for calcium oxalate urolithiasis:
 - Acidifying diets
- Aciduria promotes bone mobilization and *increases urinary calcium excretion*
- Inhibitors form soluble salts with calcium or oxalic acid
 - citrate
 - magnesium
 - pyrophosphate
- Aciduria promotes hypocitraturia and impairment of endogenous urolith inhibitors.



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HYPERCALCIURIA AND ACIDOSIS



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CALCIUM OXALATE- DIETARY PREVENTION

Nutritional management strategies:

- Reduce urine calcium and oxalate concentration
- Increase concentrations and activity of **uroolith inhibitors** (potassium citrate)
- Increase pH
- Promoting dilute urine

Feed high moisture food (>75% moisture)

Urine specific gravity goal

- <1.035 cats
- <1.030 dogs (some say <1.020)

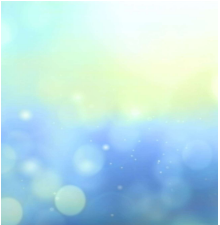
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VITAMINS AND CALCIUM OXALATE UROLITHS

Vitamin D: excess dietary vitamin D promotes intestinal absorption of calcium

Vitamin C: vitamin C is a precursor of oxalic acid and supplementation should be avoided

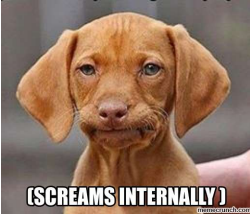
Vitamin B6: The diet should be fortified with vitamin B6 to avoid endogenous production of oxalates resulting in urinary oxalate concentration



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CHALLENGES PREVENTING CALCIUM OXALATE UROLITHS

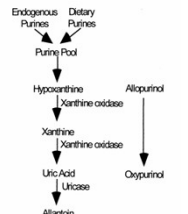
- Clinical trials evaluating urolith recurrence are limited
- Exact mechanisms of calcium oxalate urolith formation are not completely understood
- Factors correlated with calcium oxalates in epidemiological studies may not cause disease
- Tools available to measure therapeutic efficacy such as relative supersaturation may not actually correlate with calcium oxalate urolith formation



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WHAT IF SHERLOCK HAD URATE UROLITHS?

- Ammonium urate
 - most common form of naturally occurring purine uroliths in dogs and cats
 - the monobasic ammonium salt of uric acid
- Underlying disease
 - Hepatic portosystemic vascular anomalies
 - Inherited alteration of the urate transporter encoded by the SLC2A9 gene



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PURINES

- Nucleic acids in DNA
- Examples of purines
 - Adenine
 - Guanine
 - Hypoxanthine
 - Xanthine
- Source of energy
 - ATP, GTP, UTP, AMP
- High protein diets provide more dietary purines

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graph TD
    EP[Endogenous Purines] --> PP[Purine Pool]
    DP[Dietary Purines] --> PP
    PP --> H[Hypoxanthine]
    H -- Xanthine oxidase --> X[Xanthine]
    X -- Xanthine oxidase --> UA[Uric Acid]
    UA -- Uricase --> A[Allantoin]
    Allopurinol -- Inhibits --> XO[Xanthine oxidase]
            
```

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RISK FACTORS FOR URATE UROLITHIASIS

Diet	Patient	Urine	Drugs
<ul style="list-style-type: none"> • High purine content • Acidifying diet • Low moisture • Vitamin B6 deficiency 	<ul style="list-style-type: none"> • Male • Breed • Hepatic disease • Neoplasia with rapid cell destruction 	<ul style="list-style-type: none"> • Increased uric acid • Increased ammonia • Acidic pH • Concentrated urine • Urine retention • Ureaase producing bacteria 	<ul style="list-style-type: none"> • Urine acidifiers • Salicylate • Chemotherapeutics • 6-mercaptopurine


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DIETARY MANAGEMENT OF URATE UROLITHS

Goals:	Purine restricted, alkalinizing, high moisture diet
Consider medical dissolution of urate uroliths before removal <ul style="list-style-type: none"> • Dissolution can take 4 weeks • Feed purine-restricted, alkalinizing, diuretic diet. • Xanthine oxidase inhibitor <ul style="list-style-type: none"> • allopurinol: 15 mg/kg PO q12 h (ACVIM consensus statement urolithiasis) Reduce urine concentration of: <ul style="list-style-type: none"> • Uric acid • Ammonium ion • Hydrogen ion (which will alkalinize the urine- goal urine pH >7) 	<ul style="list-style-type: none"> • Diet: feed a protein-restricted alkalinizing diet • Diets available: <ul style="list-style-type: none"> • Hill's Prescription diet u/d dog food • Royal Canin Urinary UC Low Purine dog food • Purina Pro Plan Veterinary Diet HA Vegetarian dog food

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WHAT IS NEXT FOR SHERLOCK?




- 7-year-old, MC, Schnauzer
- History of pancreatitis and urinary stones
- 10 kg, BCS 5/9, normal muscle mass
- Good appetite, normal stool

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BEFORE SELECTING A DIET EVALUATE THE CURRENT DIET

- Sherlock's diet history:
 - Current diet
 - Hill's c/d- 1/2 cup per day (375 kcal per cup)
 - Chicken and rice (1 cup per day 1:1 ratio)
 - Question: Is Sherlock's diet complete and balanced?
 - Yes
 - No



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DIET ASSESSMENT AND PLANNING

- Calculate kcal per day
- Assess risk for malnutrition
- Assess current diet for nutrients of concern
 - Determine caloric distribution
 - Determine g/1000 kcal or g/100 kcal

Use product guides when available

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SHERLOCK'S COMMERCIAL DIET



Caloric Content	
375 kcal/cup	
Guaranteed Analysis	
Crude Protein	18.0% min
Crude Fat	13.0% min
Crude Fiber	5.0% max
Calcium	0.45% min
Phosphorus	0.4% min
Phosphorus	0.7% max
Sodium	0.3.0% max
Magnesium	0.06% min
Magnesium	0.2% max
Omega-3 Fatty Acids	0.45% min

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SUMMARY OF INGREDIENTS & AMOUNTS COMPARED TO SELECTED REQUIREMENT

(25044) Rice, white, long-grain, regular, enriched, cooked 78,000 g, 1/2 of a cup 152.55 kcal
 (100000) Chicken breast, skinless, boneless, roasted (BalanceTec.com) 70,000 g, 1/2 of a cup, chopped or sliced 115.55 kcal
Totals: 148,000 g 268.10 kcal

1.452 kcal/gram w/o added water; 66.95 % moisture w/o added water; 4422.44 kcal/kg DM; 24.00 LAA-AA-EPA-DHA ratio

Ingredient	Amount	% ME Protein	% ME Fat	% ME Carbohydrate
Protein	437.5% 109.451 g (55 to 100 mg/g)	100.0%	4.375%	0.000%
Arginine	275.0% 4.835 g (0.88 to 100 mg/g)	100.0%	1.414%	0.000%
Aspartic	692.4% 3.333 g (0.48 to 100 mg/g)	100.0%	1.890%	0.000%
Aspartic acid	954.4% 2.600 g (0.50 to 100 mg/g)	100.0%	11.860%	0.000%
Aspartic acid	487.5% 8.287 g (1.7 to 100 mg/g)	100.0%	1.888%	0.000%
Aspartic acid	1902.3% 8.830 g (0.88 to 100 mg/g)	100.0%	1.622%	0.000%
Aspartic acid	360.1% 2.989 g (0.80 to 100 mg/g)	100.0%	1.801%	0.000%
Aspartic acid	375.0% 4.465 g (1.63 to 100 mg/g)	100.0%	1.804%	0.000%
Aspartic acid	360.1% 4.479 g (1.13 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	441.5% 8.170 g (1.65 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	425.1% 4.558 g (1.08 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	364.5% 1.276 g (0.35 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	425.0% 5.541 g (1.20 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	30.5% 12.459 g (13.9 to 17.5 g)	100.0%	1.800%	0.000%
Aspartic acid	275.0% 2.511 g (0.5 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	100.0% 102.174 g (0.4 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	44.4% 182.341 mg (40 to 200 to 100 mg/g)	100.0%	1.800%	0.000%
Aspartic acid	510.3% 364.681 mg_DFE (87.5 to 100 mg_DFE)	100.0%	1.800%	0.000%
Aspartic acid	192.9% 49.422 mg (8.25 to 100 mg)	100.0%	1.800%	0.000%
Aspartic acid	100.0%	1.800%	0.000%	0.000%

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DIET ASSESSMENT

Calculate current kcal per day – 405 kcal per day
 Compare to Resting Energy Requirement (RER)

- 10 kg, BCS 5/9, normal muscle mass
- RER: $(BW \text{ in kg})^{0.75} \times 70$
- 393 kcal per day

Assess risk for malnutrition

- 53% of calories coming from chicken and rice
- Limit treats to < 10% of total caloric intake



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DIET ASSESSMENT

Nutrients of concern:

- Uroliths
 Magnesium, phosphorus, protein, calcium, acidifiers
- Pancreatitis
 Fat

Two ways to evaluate nutrients in a diet

- Caloric distribution- % of metabolizable energy
- Determine g/1000 kcal or g/100 kcal


Use product guides when available

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THE GUARANTEED ANALYSIS

What does the % on the guaranteed analysis reflect?



- a. Grams of nutrient per 100 kcal
- b. Grams of nutrient per serving
- c. Grams of nutrient per 100 grams of food



Caloric Content	
375 kcal/cup	
Guaranteed Analysis	
Crude Protein	18.0% min
Crude Fat	13.0% min
Crude Fat	18.0% max
Crude Fiber	5.0% max
Calcium	0.45% min
Calcium	0.8% max
Phosphorus	0.4% min
Phosphorus	0.7% max
Sodium	0.30% max
Magnesium	0.06% min
Magnesium	0.02% max
Omega-3 Fatty Acids	0.45% min

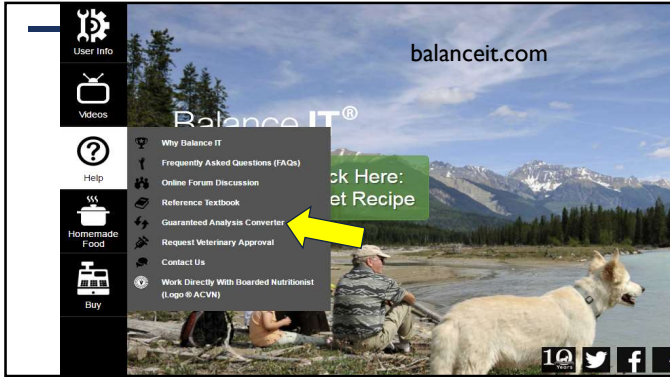
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A POUND OF BUTTER VS A POUND OF LETTUCE

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Guaranteed Analysis Converter

It can be difficult to compare the protein, fat and carbohydrate levels between different foods by using the information on a package's label. This is especially difficult when comparing pet foods with large differences in moisture (can vs. dry) or fiber level.

Please note that the values that are calculated may be slightly different from the values used by the manufacturer since the actual digestibility of protein, fat and carbohydrate and at times ash must be estimated. In addition, minimum values can differ greatly from the typical or actual value, therefore, care should be used as protein and fat levels may actually be higher than the label indicates.

Guaranteed Analysis Values	Caloric Distribution Estimate*
% Crude Protein, min = 18%	10.83% ME Protein
% Crude Fat, min = 13%	53.01% ME Fat
% Moisture, max = 10%	
% Fiber, max = 5%	
% Ash, max = 8%	
% CHO (by difference) = 48%	48.13% ME Carb.

Caloric Content
375 kcal/cup

Guaranteed Analysis	Caloric Content
Crude Protein	18.0% min
Crude Fat	13.0% min
Crude Fat	18.0% max
Crude Fiber	5.0% max
Calcium	0.45% min
Calcium	0.9% max
Phosphorus	0.4% min
Phosphorus	0.7% max
Sodium	0.30% min
Sodium	0.60% max
Magnesium	0.02% min
Magnesium	0.02% max
Omega-3 Fatty Acids	0.45% min

* The following "modified Atwater" factors are used 3.5 kcal/g protein, 8.5 kcal/g fat, and 3.5 kcal/g carbohydrate.

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CALORIE CONTENT BASIS

- Grams of nutrient per calorie
 - g/100 kcal
 - g/1000 kcal
- Equation:
 - (% nutrient/ kcal per kg) X 10,000= nutrient g/1000 kcal
 - OR
 - (% nutrient/ kcal per kg) X 1000= nutrient g/100 kcal

Caloric Content	375 kcal/cup	3775 kcal per kg
Guaranteed Analysis		
Crude Protein	18.0% min	
Crude Fat	13.0% min	
Crude Fat	18.0% max	
Crude Fiber	5.0% max	
Calcium	0.45% min	
Calcium	0.9% max	
Phosphorus	0.4% min	
Phosphorus	0.7% max	
Sodium	0.30% min	
Sodium	0.60% max	
Magnesium	0.02% min	
Magnesium	0.02% max	
Omega-3 Fatty Acids	0.45% min	

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CALORIE CONTENT BASIS

- Equation:
 - (% nutrient/ kcal per kg) X 10,000= nutrient g/1000 kcal
- Example:
 - Crude fat%
 - (13/3775) X 10,000 = 34 g/1000 kcal
 - (max 48 g/1000 kcal)
 - OR
 - (13/3775) X 1000 = 3.4 g/100 kcal
 - (max 4.8 g/100 kcal)

Caloric Content	375 kcal/cup	3775 kcal per kg
Guaranteed Analysis		
Crude Protein	18.0% min	
Crude Fat	13.0% min	
Crude Fat	18.0% max	
Crude Fiber	5.0% max	
Calcium	0.45% min	
Calcium	0.9% max	
Phosphorus	0.4% min	
Phosphorus	0.7% max	
Sodium	0.30% min	
Sodium	0.60% max	
Magnesium	0.02% min	
Magnesium	0.02% max	
Omega-3 Fatty Acids	0.45% min	

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INGREDIENTS		DRY	
<p>c/d® Multicare Canine: Whole Grain Corn, Chicken Meal, Pork Fat, Corn Gluten Meal, Soybean Meal, Egg Product, Soybean Meal, Chicken Liver Flavour, Wheat Gluten, Soybean Oil, Lactic Acid, Flavour, Pork Liver Flavour, Lycopodium, Calcium Sulfate, Fish Oil, Potassium Chloride, Indioed Salt, Choline Chloride, Potassium Citrate, Vitamin E Supplement, Niacin Supplement, Thiamine Mononitrate, Pyridoxine Hydrochloride, Calcium Pantothenate, Riboflavin Supplement, Biotin, Vitamin B12 Supplement, Vitamin A Supplement, Folic Acid, Vitamin D3 Supplement, Taurine, minerals (Ferrous Sulfate, Zinc Oxide, Copper Sulfate, Manganese Oxide, Calcium Iodate, Sodium Selenite), L-Carnitine, Mixed Tocopherols for Freshness, Natural Flavour, Beta-Carotene.</p>			
AVERAGE NUTRIENT CONTENTS			
	As Fed ¹	Dry Matter ²	As Fed, Caloric Basis ³
Protein	19.3 %	21.0 %	5.1 g
Fat	15.9 %	17.3 %	4.2 g
Carbohydrate (NFE)	50.0 %	54.3 %	13.2 g
Crude Fiber	2.7 %	2.9 %	0.7 g
Calcium	0.59 %	0.64 %	156 mg
Phosphorus	0.48 %	0.5 %	127 mg
Sodium	0.23 %	0.25 %	63 mg
Potassium	0.63 %	0.68 %	167 mg
Magnesium	0.091 %	0.099 %	24 mg
Vitamin E	654 IU/kg	711 IU/kg	17,400IU/kg
Total Omega-3 Fatty Acids	0.64 %	0.70 %	170 mg
METABOLIZABLE ENERGY			
kcal/kg	3,775	4,103	
kcal/cup	375		
Weight out/cup	3.5		
Cups per lb.	4.6		
% Calories from:	Protein 18	Fat 36	Carbohydrates 46


Our calculations:
Caloric distribution
19% Protein ME
38% Fat ME
48% Carbohydrate ME

Calorie content basis
34-48 g/1000 kcal
OR
3.4-4.8 g/100 kcal

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SUMMARY OF SHERLOCK'S DIET ASSESSMENT

- 50% of calories coming from treats- risk for malnutrition
- Chicken and rice is limiting effectiveness of diet
- Amount of fat in urinary diet could complicate management of pancreatitis
 - Low fat diet: <20% fat ME
 - Current diet: 38% fat ME (with chicken amount of fat is reduced to approximately 25% fat ME)
 - BUT....What was Sherlock being fed when he was diagnosed with pancreatitis???



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QUESTION: IS SHERLOCK'S CURRENT DIET LOW ENOUGH IN FAT FOR MANAGEMENT OF PANCREATITIS?






INGREDIENTS		DRY	
<p>c/d® Multicare Canine: Whole Grain Corn, Chicken Meal, Pork Fat, Corn Gluten Meal, Soybean Meal, Egg Product, Soybean Meal, Chicken Liver Flavour, Wheat Gluten, Soybean Oil, Lactic Acid, Flavour, Pork Liver Flavour, Lycopodium, Calcium Sulfate, Fish Oil, Potassium Chloride, Indioed Salt, Choline Chloride, Potassium Citrate, Vitamin E Supplement, Niacin Supplement, Thiamine Mononitrate, Pyridoxine Hydrochloride, Calcium Pantothenate, Riboflavin Supplement, Biotin, Vitamin B12 Supplement, Vitamin A Supplement, Folic Acid, Vitamin D3 Supplement, Taurine, minerals (Ferrous Sulfate, Zinc Oxide, Copper Sulfate, Manganese Oxide, Calcium Iodate, Sodium Selenite), L-Carnitine, Mixed Tocopherols for Freshness, Natural Flavour, Beta-Carotene.</p>			
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Magnesium	0.091 %	0.099 %	24 mg
Vitamin E	654 IU/kg	711 IU/kg	17,400IU/kg
Total Omega-3 Fatty Acids	0.64 %	0.70 %	170 mg
METABOLIZABLE ENERGY			
kcal/kg	3,775	4,103	
kcal/cup	375		
Weight out/cup	3.5		
Cups per lb.	4.6		
% Calories from:	Protein 18	Fat 36	Carbohydrates 46

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DIET SELECTION FOR SHERLOCK FOR STRUVITE OR CALCIUM OXALATE UROLITH MANAGEMENT


- Diet options:
 - Royal Canin
 - Urinary SO
 - Hill's Multicare c/d
 - Purina Veterinary Diet UR Urinary Ox/St

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Materials and Methods


- 12 from Colorado shelters with cystoliths were enrolled in this IACUC approved study.
- Chemistry, CBC, UA, Urine Culture, abdominal radiographs and abdominal ultrasound performed on all cats enrolled in the study.
- The cats were fed the study diet ad libitum and assessed by abdominal radiographs weekly.
- Cats with cystoliths that resolved based on two sequential weekly radiographs and confirmatory ultrasound examination, were considered diet successes.
- Cats with no change in cystolith size after two to four weeks, underwent cystotomy



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RESULTS

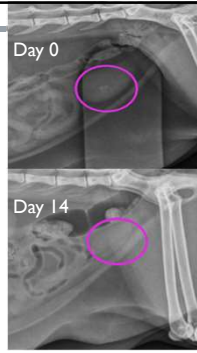
- 5 cats were considered diet success
- 7 cats had stones not expected to dissolve with dietary management



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RESULTS- DIET SUCCESS (N=5)


- Resolution by week two in 4 cats
- Resolution by week one in 1 cat
- On Day 0:
 - Mean urine specific gravity was 1.051 (range 1.048-1.051)
 - All five cats had a urine pH of 6
 - Moderate amorphous crystaluria was present in two cats



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CATS WITH STONES NOT EXPECTED TO DISSOLVE WITH DIET (N=7)

- 7 cats had a cystotomy to remove the cystolith
- On Day 0:
 - Mean urine specific gravity was 1.051 (range 1.040 to >1.073)
 - Average pH of the urine was 6.3
 - Three cats had crystaluria- two with amorphous crystals, and one with struvite crystals.



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DON'T EXPECT WHAT YOU DON'T INSPECT

- Repeat urinalysis monthly, then every 3- 6 months
- Repeat imaging every 6-9 months
- If USG >1.030 consider adding water to food



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QUESTIONS?


Remember to **download the CE certificate** in the handouts panel of the webinar control panel.
NOTE: CE certificate not available for watching the recording.

Questions about CE?
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Questions about topic?
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THANK YOU

CAMILLE TORRES DVM DABVP
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 CONSULTANT TO HESKA



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