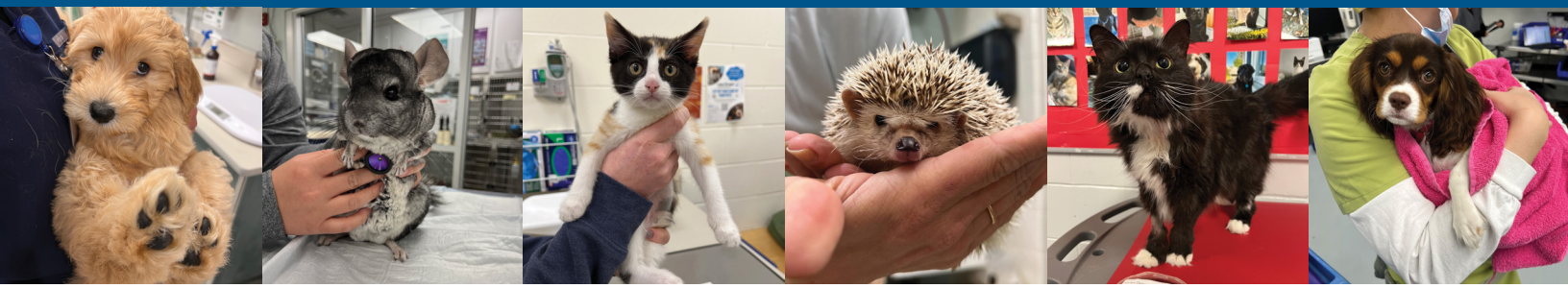
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VETERINARY REFERRAL NEWS FROM ANGELL ANIMAL MEDICAL CENTER



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CARDIOLOGY

## 8 Tools for Workup of Heart Disease in Dogs and Cats

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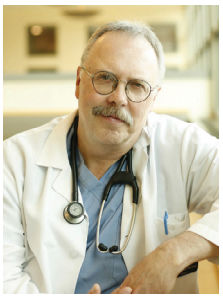
### Introduction

It can sometimes be challenging for a pet owner to establish care with a cardiologist rapidly — partly due to difficulty in scheduling, as well as geographic or financial constraints. However, there are many tests that a general practitioner, ER doctor, or non-cardiology specialist can perform in their practice to aid in the initial diagnostic workup of heart disease. These tests can give the practitioner more confidence in their differential diagnoses and treatment plan, either allowing for full management of that patient's heart disease or bridging the gap until a cardiologist can see the pet. This article discusses eight tools that can be utilized in practice to aid in the workup of heart disease in pets.

### History

Obtaining a thorough history can be of vital importance in any veterinarian-client-patient relationship. This is definitely true when asking more specific, cardiovascular-focused questions in a pet who may be presenting with heart disease. Signalment

(CONTINUED ON PAGE 2)



SURGERY

## Surgery of the Prepuce

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### Introduction

The prepuce is a tubular sheath of skin (parietal layer) lined with mucosa (inner visceral layer), that covers a portion of the penile shaft (pars longa glandis, bulbis glandis). The mucosal layer reflects off the bulbis glandis, forming a fornix, as the mucosa covers the external penis to the urethral orifice or ostium. The skin is firmly attached to and continuous with the ventral abdominal skin, forming a sling to support and protect the penis from trauma and exposure. The cranial 1–3 centimeters of the prepuce protrudes forward from the skin reflecting off the abdominal wall. The preputial orifice normally allows for the unimpeded extrusion and retraction of the penile shaft. The

(CONTINUED ON PAGE 6)

**INSIDE:** REFERRAL CONTACT AND FALL CE WEBINAR INFO ON A REMOVABLE POSTCARD

CARDIOLOGY

## 8 Tools for Workup of Heart Disease in Dogs and Cats

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› Dr. Hogan performs a cardiovascular physical exam



can be used to generalize a patient's potential type of heart disease. For example, chronic degenerative mitral valve disease is more common in older, smaller-breed dogs, whereas dilated cardiomyopathy tends to impact middle-aged-to-older, large-breed dogs. Many times, a pet is asymptomatic for heart disease until later, more severe stages, so it is important to try to pick up on any subtle changes before more emergent concerns arise. A thorough diet history can be helpful in both determining if diet is impacting a pet's cardiac health, as well as determining if changes need to be made in the future.

### Cardiovascular Physical Exam

The patient should be fully examined at each veterinary visit. There are specific areas to focus on, if there's concern for heart disease. Evaluate the mucous membrane color and capillary refill time (CRT). Examine jugular veins for abnormalities. The femoral pulses should be palpated, and specifics should be noted regarding any normal or abnormal findings. Most importantly, cardiopulmonary auscultation should be detailed in exam notes if concerned for cardiac disease, noting abnormal heart sounds (murmur, gallop sounds, arrhythmias) and/or abnormal respiratory auscultation. These findings can be used, alongside other aspects of the history and signalment, to guide the next potential diagnostic test recommendations. Blood pressure should also be included in the standard cardiovascular physical exam, especially in specific scenarios when blood pressure is recommended to be monitored (i.e., either in patients with abnormalities consistent with hypertensive target organ damage or patients who have comorbidities that could predispose to systemic hypertension).

### Lab Work and Biomarkers

There may be findings on routine screening lab work that can help explain some cardiac abnormalities.

In a CBC, for example, anemia could both cause a heart murmur as well as lead to a high-output cardiac state and potentially congestive heart failure. Eosinophilia could be an indication of heartworm disease, while polycythemia could be an indication of a right-to-left shunt.

Chemistry panels can be used to detect electrolyte abnormalities (a potential cause of arrhythmias), diabetes, markers for Cushing's disease, and of course aid in obtaining baseline or for monitoring if patients are started on cardiac medications.

Assessing a T4 can evaluate patients for hypothyroidism or hyperthyroidism, both of which can lead to secondary cardiac abnormalities. Hypothyroidism can lead to bradycardia, low voltage complexes (ECG), and decreased systolic function. Meanwhile, hyperthyroidism can cause cardiac enlargement and potentially high-output congestive heart failure (CHF), arrhythmias, and systemic hypertension.

There are also biomarkers that can help evaluate potential cardiac abnormalities.

NT-pro-BNP can be very important in the diagnosis and monitoring of heart disease in both cats and dogs, especially the former, and there are species-specific assays available. NT-pro-BNP is a hormone produced and secreted by cardiomyocytes in response to excess stretching of heart muscle cells. Excessive stretching of heart muscle cells is common in many forms of heart disease and in the setting of heart failure. The magnitude of NT-proBNP increase typically correlates with the severity of disease. Annual assessment of NT-pro-BNP in asymptomatic cats being seen by their primary veterinarian can allow for potential early detection of heart disease. If the NT-pro-BNP remains normal for years, then becomes elevated > 100, this could be due to heart disease, and further workup (either thoracic radiographs or referral to a cardiologist) is recommended. Assessing NT-pro-BNP in cats who are presenting with respiratory signs can also help differentiate if the respiratory signs are related to heart disease and heart failure (more likely with a BNP > 270) or non-respiratory causes (if BNP < 100, this does not support a diagnosis of CHF).

NT-pro-BNP interpretation is more challenging in asymptomatic dogs; this test should be interpreted with some caution and utilized alongside other diagnostic tools, including thoracic radiographs or focused cardiac ultrasound.

› Blood pressure being taken on a cat using a petMAP.



CARDIOLOGY

## 8 Tools for Workup of Heart Disease in Dogs and Cats

CONTINUED FROM PAGE 2

› Electrocardiogram being performed on a dog.



Troponin I can be a helpful tool for the work-up and monitoring of myocardial disease (i.e., myocarditis, pericardial effusion, myocardial infarction, ischemic injury, cardiotoxicity). Although these diseases can increase cTnI levels in dogs and cats, it is not currently considered a helpful screening test for cardiac disease in animals.

With any of these tests, further evaluation should be done to rule out or confirm a diagnosis.

### Electrocardiogram

An electrocardiogram (ECG or EKG) should be performed, if the practitioner has concerns about a potential arrhythmia, unexplained tachycardia, or bradycardia during a physical exam. In addition to diagnosing arrhythmias that may warrant medical or surgical treatment (e.g., pacemaker), morphology changes on the ECG can be indicative of specific types of heart disease, or raise concern for chamber enlargement or conduction abnormalities. The ECG can be saved electronically and sent to a cardiologist for consultation, if indicated.

### Thoracic Radiographs

Likely the most important tool in the workup of heart disease in primary care practice (following physical exams), thoracic radiographs can provide a vast amount of information in diagnosing the severity and guiding the treatment of heart disease. Specific tools, including vertebral heart size (VHS) and vertebral left atrial size (VLAS), have been shown to correlate with the severity of heart disease and provide some prognostic information. Thoracic radiographs also allow the practitioner to evaluate extra-cardiac structures, specifically the airways and pulmonary patterns, to either diagnose congestive heart failure (i.e., when evidence of pulmonary edema or pleural effusion is present) or assess for other reasons for respiratory symptoms.

### Focused Cardiac Ultrasound and Lung Ultrasound

Focused cardiac ultrasound (FCU) and lung ultrasound can be performed by non-cardiologist practitioners to aid in diagnosing specific cardiac pathology and determining the severity of heart enlargement or respiratory symptoms.

In both feline and canine patients, these tests can help differentiate cardiac from non-cardiac causes of dyspnea. For example, key FCU findings in dilated cardiomyopathy include left ventricular dilation and severe left ventricular systolic dysfunction. FCU may identify subjective right heart enlargement or septal flattening, which can be indicative of pulmonary hypertension.

In dogs, FCU can be helpful to increase or lower one's suspicion of left-sided congestive heart failure (LCHF), which typically manifests as pulmonary edema. Key FCU features include an increased LA/Ao and bilateral, diffuse distribution of B-lines.

In a recent study by Loughran et al., FCU performed by a trained general practitioner allowed for appropriate cardiac assessment and initial workup of patients who presented with respiratory signs. Identification of an enlarged LA/Ao ratio of 2:1, as well as B-line artifacts on lung ultrasound (which can support the presence of pulmonary edema) and/or the presence of pleural and/or pericardial effusion, would dramatically increase the suspicion of congestive heart failure and prompt the clinician to administer a furosemide bolus as the first step in stabilizing the patient. Identification of a normal LA/Ao ratio of 1.2:1 on FCU in a dyspneic feline patient with a history of intermittent coughing episodes may increase the suspicion of primary lower airway disease.

### Consult with a Cardiologist

Veterinary cardiologists are often very willing to assist referring veterinarians in any capacity. Please contact us with your questions, and we will do our best to assist you and your clients.

### Refer to a Cardiologist

While primary care veterinarians can take these initial steps to evaluate their patients for cardiac abnormalities, they may also want to refer them to a board-certified cardiologist for more specialized diagnostics and treatment. In these cases, there are several basic steps to follow:

1. The referring veterinarian and client recognize the need for a referral.

2. The referring veterinarian communicates the reason for the referral, as well as the patient's clinical information, to the specialist.

3. The specialist evaluates the patient's condition.

4. The specialist communicates his/her findings and recommendations to the referring veterinarian.

5. The client, referring veterinarian, and specialist decide about continuing care.

Long-term management of a patient's cardiac disease is typically a collaborative effort between the referring/primary care veterinarian and veterinary cardiologist. Cardiologists are willing to work with you and your client to determine the best plans for each individual patient.

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## CARDIOLOGY

### 8 Tools for Workup of Heart Disease in Dogs and Cats

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| **Ophthalmology** | 11 days | N/A |
| **Surgery** | 2 weeks: TPLO consult<br>2 ½ days: Consult for soft tissue surgery | 9 days: Orthopedic consult<br>8 days: Consult for soft tissue surgery |
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## Surgery of the Prepuce

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primary source of circulation to the parietal and visceral layers is from the external pudendal artery and dorsal artery of the penis. The visceral layer also is supplied to a lesser degree by the artery of the bulb of the penis.

Conditions requiring surgery of the prepuce include trauma, neoplasia, congenital defects, persistent frenulum, phimosis, paraphimosis, and hypospadias. Other subjects that will be discussed in this article include: 1. altering the urine stream for patients urinating on themselves and 2. using the preputial urethrostomy technique as an alternative to scrotal/prescrotal urethrostomy secondary to penile amputation.

### Permanent Enlargement of Preputial Ostium

Permanent treatment of phimosis and paraphimosis may require enlargement of the preputial orifice. A dorsal incision of approximately 10–15mm is made through the entire thickness of the prepuce. The incision can be increased in small increments until the penis can be easily extruded. The skin is sutured to the apposing mucosa with 4-0 absorbable sutures, thereby creating a permanent triangular or "pie-shaped" notch.

**FIGURE 1**

↘ Enlargement of the preputial ostium.



### Paraphimosis Management

There are two basic procedures to cover the protruding penis in dogs: preputial advancement and phallopexy.[1]

Preputial advancement usually is the preferred technique for patients with chronic penile exposure of a congenital or acquired nature. Preputial advancement is accomplished by creating a U-shaped incision anterior to the cranial base of the prepuce. The limbs of the "U" incision are extended caudally to a variable degree, as needed to mobilize the penis. Any restrictive scar bands, secondary to trauma, can be divided at the time of prepuce elevation. Skin hooks or stay sutures are placed at the cranial border of the preputial incision. The prepuce is elevated and stretched forward sufficiently to cover the entire shaft, plus an additional two centimeters, if possible. The point of anterior advancement is marked on the midline with a scalpel blade, and the skin between this point and the base of the prepuce is resected. Upon removal of the skin, the prepuce is advanced and secured to its new location. Nonabsorbable intradermal sutures are used to suture the preputial dermis to the ventral abdominal muscle fascia (this is critical to minimizing a caudal shifting of the prepuce as a result of skin stretching in the days following the procedure). The skin is sutured to complete the procedure. (Note: The patient's rear limbs must be placed in a neutral or slightly retracted position to assure that the tension on the prepuce is not distorted, giving the surgeon

**FIGURE 2**

↘ Preputial advancement.



an inaccurate assessment of how far the prepuce must be advanced to achieve penile coverage.) If 1–2cm of coverage is still required, despite aggressive preputial advancement, the mucocutaneous junction of the ventral preputial orifice can be resected: the mucosa and skin are sutured together to give better ventral penile coverage. However, a reciprocal dorsal preputial incision is required to enlarge the prepuce, as discussed above.

Phallopexy has been described to permanently affix an area of the dorsal penile shaft to the dorsal aspect of the prepuce in a limited number of canine patients. This technique may be a useful alternative to preputial advancement.[2] This technique can be quite useful in correcting paraphimosis. The author has used both the dorsal and ventral approach to phallopexy.

**FIGURE 3**

↘ Absorbable interrupted suture placement in a phallopexy.



### Hypospadias

Surgical management of hypospadias depends on the location and severity of the anomaly. Incomplete formation of the penis, prepuce, and scrotum is common, and the abnormal urethral opening will vary in location. The testes are usually located beneath the skin or portions of the scrotum. If the urethral opening is located anterior to the ischial arch (scrotal or prescrotal area), the patient can urinate relatively normally, in a fashion similar to a dog with a scrotal or prescrotal urethrostomy. If the urethral opening is located in the

# Surgery of the Prepuce

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perineum, a variable degree of urine scalding may be noted. If the urethral opening is adjacent to the anus, ascending infection is fairly common and may necessitate creation of a urethral tube extension using the available hairless skin and uroepithelium present.[3] Many articles advise removal of the rudimentary penis and prepuce at the time of castration. Presence of these tissues may be a source of irritation to the dog. However, in many patients, this is not the case, and the owner may elect not to have these tissues removed unless they do become problematic at a later time.

**FIGURE 4**

› Closure of preputiotomy.



## Preputial Urethrostomy Following Partial Penile Amputation

In the event that partial penile amputation is required after strangulation necrosis secondary to paraphimosis, a ventral midline preputiotomy incision can facilitate penile amputation. In a case study, the author noted that anastomosis of the terminal urethra to the preputial mucosa resulted in a simple and effective alternative to performing a standard scrotal or prescrotal urethrostomy.[4]

## Urine Diversion Surgery by Modifying Preputial Ostium

Male dogs who urinate on their forelimbs or lower thorax, although uncommon, present the owners with the dilemma of keeping the pet constantly clean. The author's urine diversion technique of modifying the preputial ostium can alter the direction of the urine stream ventrally. Essentially, the surgery required closure of the upper 50% of the ostium and reciprocally enlarging the lower half to permit normal extrusion of the penis.[5] As a result, the urine stream from the tip of the penis strikes the inner portion of the closed ostium segment, bending the urine stream downwards and away from the lower thorax and forelimbs.

**FIGURE 5**

› Closure of dorsal ostium to divert urine stream.



## Tumors of the Prepuce

Reconstruction of the prepuce following surgery can be limited to the skin or involve the entire thickness of a portion of the prepuce, including the mucosal lining. There are multiple closure options, many of which include the use of transposition skin flaps.

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# Ethylene Glycol Toxicity

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## Introduction

Ethylene glycol toxicity is one of the most critical toxicologic emergencies in small animal practice, due to the potential for severe metabolic and renal effects if not treated promptly. The sweet taste of ethylene glycol contributes to accidental ingestion by dogs and cats, particularly in household environments where automotive products are present.[1] However, early intervention can markedly improve survival outcomes in these cases.

## Pathophysiology

Ethylene glycol itself has limited inherent toxicity. The majority of clinical effects are due to hepatic metabolism via alcohol dehydrogenase (ADH), which converts ethylene glycol into glycolic acid, glyoxylic acid, and ultimately, oxalic acid.[2] Glycolic acid is responsible for the development of severe high anion gap metabolic acidosis, while oxalic acid complexes with calcium to form calcium oxalate crystals, which precipitate within renal tubules, leading to obstruction and acute tubular necrosis.[2]

Renal damage is the principal cause of mortality and occurs primarily due to calcium oxalate crystal deposition, direct tubular epithelial injury, and severe metabolic acidosis. The minimum toxic dose of ethylene glycol is species dependent:

- Dogs: approximately 4–6 mL/kg of concentrated antifreeze
- Cats: approximately 1.4 mL/kg[1]

Cats appear to be more sensitive due to rapid metabolism and their narrow therapeutic window.[1]

## Clinical Presentation

Ethylene glycol toxicity typically progresses through three clinical stages:

**Stage 1 (0–12 hours):**

- Central nervous system depression, ataxia, vomiting, and polyuria/polydipsia. Signs may resemble ethanol intoxication.[2]

**Stage 2 (12–24 hours):**

- Transient improvement in neurologic signs may occur, while metabolic acidosis worsens. Tachycardia, tachypnea, and dehydration are common.[2]

**Stage 3 (24–72+ hours):**

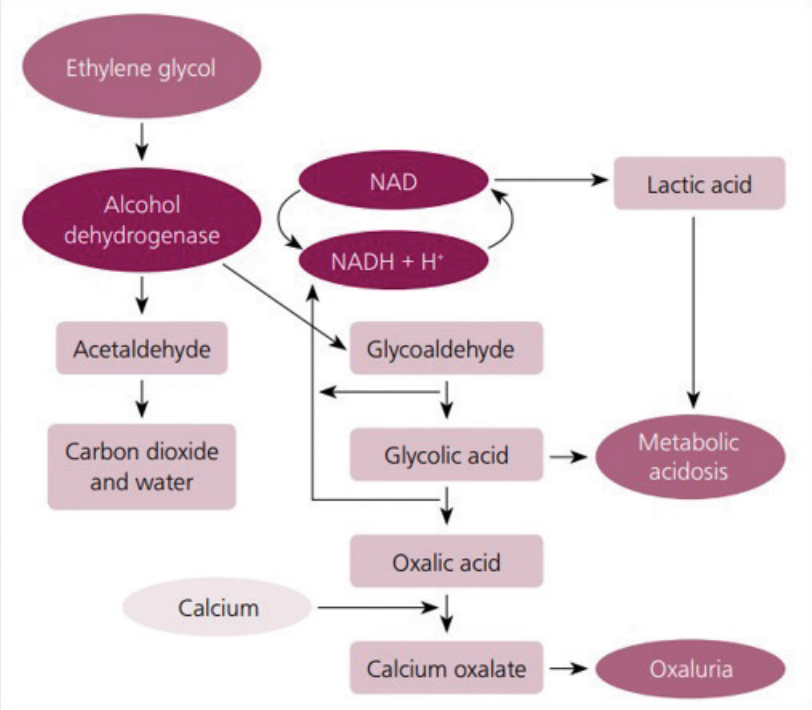
- Acute renal failure develops, characterized by azotemia, hyperphosphatemia, hyperkalemia, and progression to oliguria or anuria.[1]

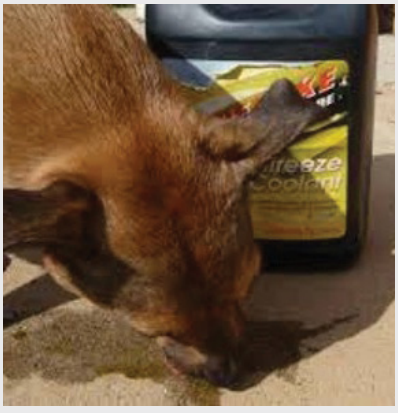
## Diagnostic Evaluation

Diagnosis is based on history, clinical presentation, and laboratory findings. Early laboratory abnormalities include high anion gap metabolic acidosis and decreased bicarbonate concentration. An increased osmole gap may be

**FIGURE 1**

› Mechanism of ethylene glycol toxicity. NAD = nicotinamide adenine dinucleotide.



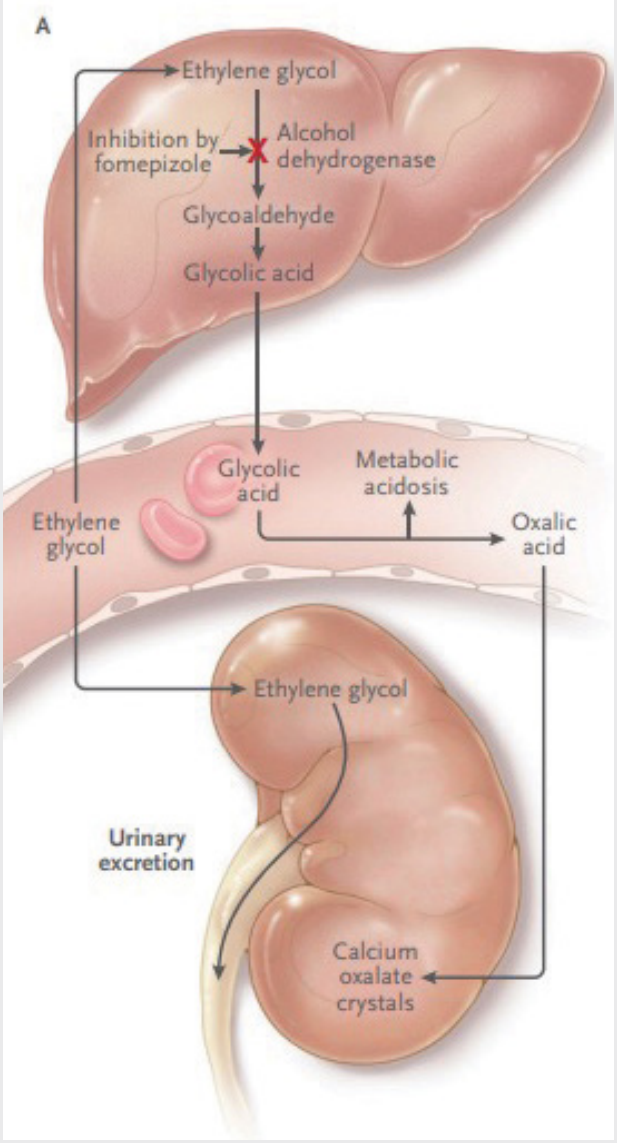
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present prior to full metabolism of ethylene glycol.[2] As renal injury progresses, azotemia, electrolyte abnormalities, and possible hypocalcemia develop.[1] Urinalysis may reveal calcium oxalate monohydrate crystals, which strongly support the diagnosis in the appropriate clinical context.[3]

In-house ethylene glycol assays detect unmetabolized compound and are most reliable within the first several hours after ingestion. Sensitivity declines as metabolism proceeds.[1]

**FIGURE 2**

› Effect of Fomepizole on the Pathophysiological Effects of Poisoning from Ethylene Glycol and Methanol. Panel A shows the metabolic transformation of ethylene glycol to glycolic acid, which is responsible for metabolic acidosis. Glycolic acid is further metabolized through the intermediate glycolic acid to oxalic acid. When the solubility product of calcium oxalate is exceeded, precipitates form in the renal tubules, causing acute kidney injury. In severe cases, calcium oxalate crystals deposit diffusely in multiple organs. Panel B shows similar effects of fomepizole on methanol metabolism.




## Treatment

Treatment success depends primarily on time to intervention. The primary therapeutic objective is inhibition of alcohol dehydrogenase to prevent formation of toxic metabolites.

Fomepizole is a competitive ADH inhibitor and is considered the treatment of choice when available, due to its safety and predictable pharmacokinetics.[1]

Ethanol is an effective alternative but requires intensive monitoring because of risks including CNS depression and hypoglycemia.[3]

Supportive care includes aggressive intravenous fluid therapy, correction of acid-base and electrolyte disturbances, and close monitoring of urine output and renal parameters.[1] In advanced cases with severe azotemia or anuria, hemodialysis may be required to remove toxins and support renal function.[2]

## Prognosis and Prevention

Prognosis is highly time dependent. Dogs treated within approximately five hours of ingestion often recover fully.[1] Cats must be treated even earlier. Once azotemia develops, prognosis declines significantly.[1] Anuric renal failure carries a grave prognosis in the absence of dialysis.[2]

Client education is essential. Safe storage of antifreeze products and prompt cleanup of spills can significantly reduce exposure risk. Propylene glycol–based antifreeze products are less nephrotoxic alternatives, though not entirely benign.[1]

## Key Take-Home Points

- Ethylene glycol toxicity is a true medical emergency.
- Toxicity results from metabolism to glycolic and oxalic acids.
- Early metabolic acidosis precedes renal failure.
- Alcohol dehydrogenase inhibition is the cornerstone of therapy.
- Time to treatment is the most important prognostic factor.

Prompt recognition and rapid intervention can mean the difference between complete recovery and irreversible renal failure.

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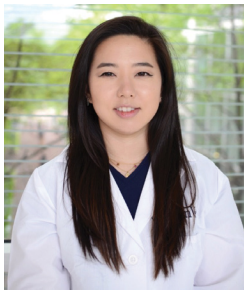
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# Feline Chronic Gingivostomatitis

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## Introduction

Feline Chronic Gingivostomatitis (FCGS) is a severe, painful, and often debilitating oral inflammatory disease in cats, characterized by mucosal inflammation extending beyond the gingiva into deeper tissues. The condition is thought to be immune-mediated, with chronic antigenic stimulation — primarily from oral bacteria and viral infections — leading to a cytotoxic T-cell-driven inflammatory response. While any cat may be affected, FCGS typically occurs in young to middle-aged adults, with an estimated prevalence of 0.7–12%.

## Pathophysiology and Clinical Presentation

FCGS involves a dysregulated immune response to oral antigens, most notably bacterial plaque and viral pathogens, such as feline calicivirus (FCV), feline herpesvirus, feline leukemia virus (FeLV), and feline immunodeficiency virus (FIV). Affected cats exhibit elevated CD8+ T-cell activity, consistent with a cell-mediated cytotoxic immune reaction. Clinically, cats present with ulcerative and/or proliferative inflammation of the gingiva, alveolar, labial, buccal mucosa, and sometimes the tongue or caudal oropharynx. Common clinical signs include drooling, halitosis, oral bleeding, difficulty eating, weight loss, vocalization during feeding, and poor grooming behavior due to oral pain.

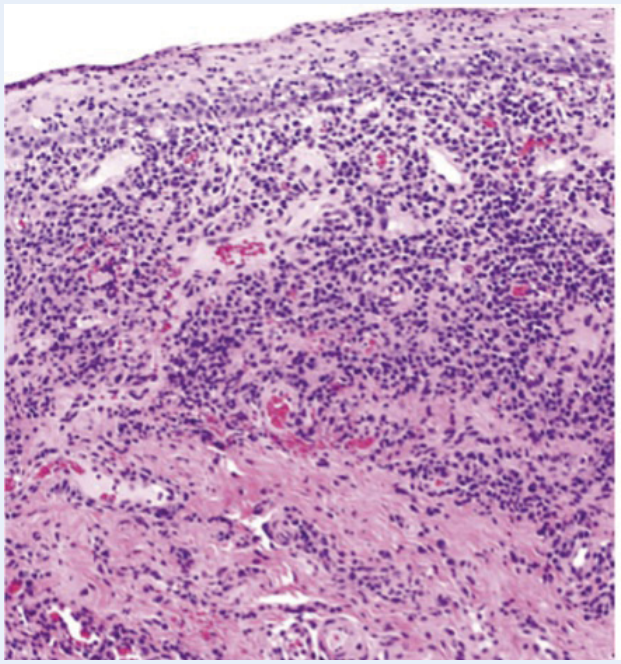
**FIGURE 1**

› Feline Chronic Gingivostomatitis (Soltero-Rivera, 2023).



**FIGURE 2**

› Infiltration of inflammatory cells seen in biopsy. (Lee et al., 2020).



## Etiology and Contributing Factors

The etiology of FCGS is multifactorial, involving an association of infectious, environmental, and immune-mediated factors. Viral infections are associated with the condition, with FCV detected in up to 85–100% of affected cats. In some studies, FeLV and FIV coinfections are linked to poorer treatment outcomes. Bacterial involvement, particularly from gram-negative anaerobes, contributes to the inflammatory burden. The disease is perpetuated by an exaggerated immune reaction leading to persistent inflammation.

## Diagnosis in Clinical Practice

Diagnosis of FCGS is primarily clinical, based on the distribution and nature of oral lesions. A complete blood count and serum chemistry panel often reveal anemia, neutrophilia, and hyperglobulinemia, reflecting chronic inflammation. Biopsy of affected tissue confirms the presence of lymphocytic, plasmacytic, and neutrophilic infiltrates and helps rule out neoplasia. Dental radiographs typically show retained tooth roots, horizontal alveolar bone loss, and various stages of tooth resorption.

DENTISTRY

## Feline Chronic Gingivostomatitis

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### Treatment

Dental extraction remains the cornerstone of management. Extractions eliminate plaque-retentive surfaces and reduce antigenic stimulation. Improvement or complete resolution is reported in approximately 67–80% of affected cats, though clinical recovery may take several months. Many cats require extended medical management following surgery.

Adjunctive and medical therapies can further improve outcomes. Antibiotics may provide temporary suppression of bacterial load, but do not eliminate biofilm. Glucocorticoids may be used in severe or anorexic patients. Cyclosporine has demonstrated approximately 78% clinical improvement in refractory cases by inhibiting T-cell activation and reducing interleukin-2 expression. Recombinant feline interferon omega has antiviral, antiproliferative, and immunomodulatory properties. Lactoferrin provides antimicrobial and anti-inflammatory benefits. Analgesic support with nonsteroidal anti-inflammatory drugs, opioids, or gabapentin, combined with nutritional support through softened diets or temporary feeding tubes, is sometimes required during recovery.

**FIGURE 3**

↘ Dental extractions before (left) and after (right).



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*Brielle Friedman, Manager of Boarding and Grooming, with Nova (left) and Vina (right).*



# Diagnosing and Treating Heavy Metal Toxicosis in Birds

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## Introduction

Heavy metal toxicosis is among the most common toxic diseases that companion avian species experience. Lead and zinc, whose toxicity often presents similar symptoms, are overrepresented in this category, although other metals such as mercury and cadmium may also be present. By identifying common signs of heavy metal toxicosis in avian patients and determining their potential exposure, the appropriate diagnostics and courses of treatment can be used.



## Heavy Metal Exposure

Diagnosis of heavy metal exposure and possible toxicity is based on multiple factors, the first being a thorough patient history and potential for exposure. Toxicity may become a more likely differential if the owner reports any chewing on walls or baseboards. A new enclosure may be the source of heavy metal, in addition to any home construction that may leave a patient susceptible to inhaling lead paint particles. Other sources of exposure to heavy metals may include but are not limited to: paint, plaster, galvanized wire, fishing weights, bullets or ammunition, costume jewelry, stained glass, bells or other toys, twist ties, and linoleum. Clinical signs can vary greatly based on the amount of metal ingested and the species of bird. Ingestion of a large amount of metal may cause acute symptoms or death, while chronic ingestion of smaller amounts may present as worsening symptoms.

## Clinical Signs and Hematologic Changes

As previously mentioned, acute presentation is usually secondary to ingesting a large amount of metal. Common clinical signs include weakness, depression, regurgitation, abnormally colored droppings, and neurologic symptoms, which may be quite pronounced. Ingestion of smaller amounts of metal over a longer period of time may yield a more chronic presentation of symptoms. Weight loss, chronic regurgitation, and increasing paresis or neurologic deficits are the most commonly seen symptoms. Hematuria, heterophilia, and microcytic anemia — thought to be the result of increased fragility of red blood cells — are changes typically seen on the hemogram. Biochemical changes can include some or all of the following: elevated aspartate aminotransferase (AST), lactate dehydrogenase (LDH), creatine kinase (CK), and uric acid.

## Pathophysiology

Lead is rapidly absorbed through the gastrointestinal tract after breaking down within the acidic environment of the stomach. After absorption, lead binds to the red blood cells and is distributed throughout the body via the circulatory system. The majority of lead is stored in the bone marrow (94%), with a small amount circulating in the blood (4%), and an even smaller amount remaining in soft tissue, including nervous tissue (2%). Once in the erythropoietic system, lead denatures multiple enzymes in the hemoglobin synthesis pathway, including porphobilinogen synthase and ferrochelatase. These changes are thought to be the main cause of the microcytic anemia commonly seen in affected animals.

With regards to the nervous system, there are several changes noted following heavy metal toxicity. Lead can substitute itself for calcium in Ca-Na-ATP pumps and also blocks calcium entry into the nerve terminals. A common histopathologic finding in metal toxicity is segmental demyelination resulting from Schwann cell degeneration. This condition also causes peripheral neuropathy in many birds.



## Diagnostics

After physical examination and supportive care to stabilize the patient, it is important to begin the process of diagnostics. Radiographs, tissue sampling, and serum zinc and lead testing are all helpful in obtaining a diagnosis.

Radiographs are helpful when metallic objects can be identified in the gastrointestinal tract. However, note that the absence of these objects on a radiograph does not rule out the presence of heavy metal in the body. Metal forms that would not appear on a radiograph may include paint chips, gaseous fumes, and mobilized lead stores in the bone marrow.

Serum zinc and blood lead levels are probably the most commonly used indicator of both intoxication and response to treatment. Atomic absorption spectrophotometry is the gold standard for testing small amounts (0.2ml) of whole blood or serum, although it requires sending samples to an outside laboratory. Many practices will begin chelation therapy on a patient while waiting for results, which can take one to three or more days. Another option is using an in-house testing kit like the LeadCare testing kit. The downside is that this kit has a high-end cut-off, making it difficult to track progress if the initial value is quite high.

Tissue testing is typically not performed on live animals, but is instead used to help diagnose flock health issues.

## Diagnosing and Treating Heavy Metal Toxicosis in Birds

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› Orthogonal radiographs from a lovebird that had ingested pieces of grout containing lead. Arrows indicate both mineral and metallic material in the GI tract

### Treatment

Whenever possible, patients should be stabilized prior to treatment through rehydration, heat therapy, and gavage feeding, if hyporexic. NSAIDs are frequently used to reduce inflammation around peripheral nerves and help lessen neurologic signs. Antibiotics are used on a case-by-case basis, primarily to rule out secondary infection or GI flora translocation. Chelation therapy is the most important aspect of treatment, but pros and cons of each drug should be weighed before deciding which one to use.

Calcium disodium EDTA has been used since the 1950s to treat lead toxicosis in a number of different species. Nephrosis is a possible side effect with this drug because it binds to lead and is then excreted through the kidneys. This condition, though, does not seem to be seen in avian species. The typical protocol consists of five days of treatment by intramuscular injection, followed by three days off to prevent excessive calcium binding. This protocol has been adopted from mammalian protocols to be as renoprotective as possible, although, as previously mentioned, the risk of kidney damage is much lower in avian species. Calcium EDTA does not cross the blood-brain barrier and should not be given to treat central nervous system signs.

D-penicillamine is a chelating agent that can be given orally to patients with whom regurgitation is controlled. This medication can be given in conjunction with Calcium EDTA in the hospital and then sent home with the patient. Significant side effects involving the hepatic and renal systems have been seen when using this drug in human medicine, but they do not seem to occur nearly as frequently in avian patients. This drug can be used to treat central nervous system signs, as it does cross the blood-brain barrier.

Meso-2, 3-Dimercaptosuccinic acid (DMSA) is an oral chelating agent that is very effective in treating both lead and zinc toxicity. One advantage of this drug is its ability to chelate lead from the nervous system and soft tissue. Unfortunately, it is not able to chelate and remove lead from the bone marrow, which may lengthen the course of treatment.

The main indicators of improvement are cessation or reduction in clinical signs, as well as reduction of the serum lead level to below 20ug/dL. Multiple rounds of treatment are often needed to achieve remission, and some neurologic symptoms may not fully resolve regardless of treatment length. Surgical removal of metallic foreign bodies and bulking agents used to move metal through the GI tract can be used on an individual basis, which can potentially reduce the amount of chelation needed.



# Pyometra

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## Introduction

Pyometra is defined as the acute or chronic suppurative inflammation of the uterine wall. It is commonly characterized by cystic dilation of the endometrial glands (CEH) and accumulation of neutrophil-rich exudate in the uterine lumen. Often, pyometra begins with mild, local signs that, if not treated promptly, can escalate into more life-threatening disease, including peritonitis, sepsis, and multi-organ dysfunction syndrome (MODS).

## Etiology and Pathogenesis

Pyometra is a multifactorial disease that is still not completely understood, therefore its etiology and pathogenesis are still two of the highest-researched topics. Most often, pyometra occurs during the luteal phase (usually within two months after estrus), when progesterone levels have peaked. During diestrus, the increased progesterone levels upregulate the secretory activity of the endometrial glands, promote proliferation of the endometrium, and induce cervical closure. At the same time, they downregulate myometrial contractility and the local leukocyte response. This local environment provides reduced uterine resistance to bacterial infection and an escalated risk of pyometra. It is hypothesized that these effects accumulate with each subsequent cycle.



In this environment, bacterial colonization is typically the cause of pyometra; however, some reports indicate that up to 20–25% of patients with pyometra do not grow any bacterial isolates on uterine culture at the time of diagnosis. Of those bacterial species isolated, E. coli is predominant in both canines and felines. Other bacterial isolates include Staphylococcus spp., Streptococcus spp., Proteus spp., Klebsiella spp., and Pseudomonas spp. at far lower rates.

**FIGURE 1**

› Ultrasound Imaging of a confirmed case of canine pyometra. The patient's urinary bladder (UB) is visible adjacent to distended loops of uterine horn in transverse section, indicated by an asterisk (*). *Reddy et. al. J. Andaman Sci. Assoc.* 29 (2 ):2024




## Prevalence and Clinical Presentation

Pyometra is the most prevalent reproductive disease in both dogs and cats. It is estimated that up to one in four intact female dogs are affected by pyometra, predominantly seen in middle-aged to older dogs. However, juvenile pyometras can and do occur at lower rates. Higher incidence rates in older dogs are thought to be associated with repeated estrous cycles, as stated above. Studies have shown varied and no conclusive evidence for a clear breed predisposition to pyometra.

The most common presenting clinical signs for dogs affected by pyometra include vaginal discharge, polyuria/polydipsia, lethargy/depression, abdominal discomfort/distension, anorexia, vomiting, diarrhea, and fever. In severe and advanced cases, patients can suffer from signs of sepsis and shock, including weakness/collapse, severe dehydration, pale mucous membranes, tachycardia, tachypnea, and weak peripheral pulses.

## Diagnosis

Diagnosis is made by a combination of history, clinical signs, and abdominal imaging. Bloodwork can be beneficial in supporting a diagnosis of pyometra and, more importantly, assessing the patient's systemic health. Overall, ultrasonography is the most helpful diagnostic tool for identifying pyometra. Often, distended fluid-filled loops of the uterus are visible on ultrasound adjacent to the urinary bladder. However, the differential diagnosis of mucometra and hydrometra has been noted to appear similarly on ultrasound. Strictly speaking, a definitive diagnosis of pyometra is made and verified through postoperative macroscopic and histologic examination of the uterus and ovaries, as well as microbiological examination of the uterine content.

CONTINUED FROM PAGE 15

## Treatment and Prognosis

In cases of pyometra, ovariohysterectomy is strongly recommended as a definitive treatment. Although medical therapy for cases of open pyometra is sometimes considered in a young, systemically stable, and healthy breeding animal, it will not be discussed in this article. In cases of pyometra, pre-operative evaluation and stabilization are paramount. Oftentimes, patients require correction of systemic consequences of pyometra mentioned above. Patients are often in need of intravenous fluid therapy, antibiotic therapy, antiemetic and anti-nausea medication, and pain medication. In general, a broad-spectrum antibiotic is started. A common first-choice medication at the time of diagnosis is Clavamox. Although an appropriate choice, a fluoroquinolone antibiotic, such as Enrofloxacin, should be considered if available, given the most common reported bacterial isolates and its broad spectrum of coverage against gram-negative bacteria. Subsequent antimicrobial choices should be guided by culture and sensitivity results.

Overall prognosis for cases of pyometra without the presence of uterine rupture is excellent, with one study reporting a survival rate of 97% in dogs treated surgically. Many studies suggest severe azotemia at the time of diagnosis as a negative prognostic indicator. Acute uterine rupture increases the overall mortality rate to approximately 50% and sometimes higher, depending on the progression and timing of a subsequent septic abdomen.

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(W/B) Services available at both our Waltham and Boston locations
*Boston-based pathologists and radiologists serve both Boston and Waltham locations




## Courtesy Shuttle for Patients Needing Further Specialized Care

Angell Animal Medical Center offers the convenience of our MSPCA-Angell West facility in Waltham, MA. The Waltham facility offers Urgent Care and specialized service appointments. If needed, an oxygen-equipped courtesy shuttle can transport animals to Boston for further specialized care and then return them to Waltham. Whether in Boston or in Waltham, our specialists regularly collaborate and plan treatments tailored to our patients' emergency, surgical, and specialty needs.

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