Vomiting is among the most common reasons that dogs and cats are presented for evaluation. Because there are a multitude of causes of vomiting, ranging from simple to complex, this can be a challenging problem for clinicians to accurately diagnose and manage. The problem also causes significant concern for pet owners, especially when there is an onset of frequent severe vomiting or when the occurrence becomes more chronic and intermittent without adequate control. However, by following a systematic approach beginning with an accurate history, a thorough physical exam, and appropriate baseline testing (Stage 1), then performing tests more specific for certain conditions or organ systems (e.g., bile acids assay, leptospirosis serology, ACTH stimulation, ultrasonography) (Stage 2), and finally where indicated performing advanced procedures for more thorough examination and biopsy or definitive therapy (endoscopy, exploratory laparotomy), most cases can be diagnosed successfully and managed judiciously. Vomiting does not constitute a diagnosis in itself. It is emphasized that vomiting is simply a **clinical sign** of any of a number of disorders that can involve any organ system in the body. In fact, one diagnostic registry service listed over 400 potential causes of vomiting in dogs! These notes summarize diagnostic approach and various treatment options for managing dogs and cats with vomiting.

Vomiting refers to a forceful ejection of gastric and occasionally proximal small intestinal contents through the mouth. The vomiting act involves three stages: nausea, retching, and vomiting. Serious consequences of vomiting include volume and electrolyte depletion, acid-base imbalance, and aspiration pneumonia.

It is essential that the clinician make a clear differentiation between **regurgitation** and **vomiting** at the outset. Regurgitation is defined as passive, retrograde movement of ingested material, usually before it has reached the stomach. Failure to recognize the difference between regurgitation and vomiting often leads to misdiagnosis. Regurgitation may occur immediately after uptake of food or fluids or may be delayed for several hours or more.

**A Detailed, Accurate History is ESSENTIAL**

One of the most important early considerations is to **determine if any toxins may have been ingested**, since some compounds can cause life threatening sequelae. The earlier a toxicity is identified, the greater the chance for successful management. Currently, **xylitol toxicity** is being recognized more frequently, and **sago palm plants**, which can cause severe hepatotoxicity in dogs and cats, are found in more homes and yards than in previous years. **Cocoa mulch toxicity** (theobromine) is also occasionally seen. Many animals that have ingested toxins are presented with vomiting as a prominent sign. Key summary points about these toxins are listed here.
Three Case Examples of Important Toxins That Can Cause Vomiting as Well as Severe Consequences Including Death
***(Accurate History Obtained Early is Extremely Important)***

**XYLITOL:** Xylitol is a sugar alcohol used as a sweetener in many products, including sugar-free gum and mints, nicotine gum, chewable vitamins, oral-care products, and baked goods. It can be purchased in a granulated form for baking and as a sweetener for cereals and beverages. It has two-thirds the calories of sugars. It is being used more frequently in the U.S. in recent years, and many more toxicity events in animals have occurred concurrently. Xylitol is safe in people but not dogs, where adverse reactions can range from hypoglycemia to acute hepatic necrosis and even liver failure with coagulopathy.

Xylitol has been shown to have some attractive properties in humans, besides a lower calorie count. It has been shown to inhibit the growth of certain bacteria, which makes it useful in preventing bacterial otitis media in children. It also has anticarcinogenic properties because it prevents oral bacteria from producing the acids that damage tooth surfaces. This is why xylitol has seen increased use in sugar-free gum, toothpaste, and other oral care products.

A report from the ASPCA Animal Poison Control Center published in JAVMA in 2006 discussed 8 cases of xylitol toxicity in dogs. These included:
1. A 4 year old Welsh springer spaniel that ingested 4 large chocolate-frosted muffins that contained xylitol
2. A 3 year old standard poodle: 5 or 6 cookies
3. A 5 year old Scottish terrier: 30 pieces of gum
4. A 6 year old Labrador retriever mix: 450 g of xylitol powder
5. A 7 year old miniature dachshund: 100 pieces of gum
6. A 4 year old Australian shepherd: 12 cupcakes
7. A 8 year old Labrador retriever: 140 g of xylitol powder
8. A 6 year old Dalmatian: 8 muffins

5/8 of these dogs were euthanized or died because of liver failure!

We can help our clients by educating them about the dangers of this popular sweetener product for humans! There were no reported cases to the poison control center in 2002-03, but the number increased to 150 reports in 2007-08. Many diagnosed cases go unreported.

**Toxicity levels:**

**Oral xylitol** has a wide margin of safety in most species, **BUT NOT DOGS.**

- **Mice:** Oral LD$_{50}$ >20g/kg
- **Humans:** >130 g/day will cause diarrhea but no other abnormalities
- **Dogs:** >0.1 g/kg can cause hypoglycemia (vomiting is usually the first sign and hypoglycemia can develop in 30-60 minutes). But in some cases of xylitol gum ingestion, hypoglycemia may be delayed for up to 12 hours. Some dogs develop
elevated liver enzymes by 12-24 hours after xylitol ingestion. Liver failure can develop even if hypoglycemia was not seen. **The JAVMA report stated that the lowest estimated dose associated with liver failure was 0.5 g/kg.**

Recommendation from Dr. Eric Dunayer of the ASPCA Animal Poison Control Center: To calculate estimated dose ingested, the following guidelines can be used:
- If xylitol is the first sugar alcohol in the ingredient list, then the dose should be based on the total amount of sugar alcohols per piece even though this will result in an overestimation of the xylitol dose.
- If xylitol is not the first listed sugar alcohol, estimate 0.3 g of xylitol per piece of gum
- For powdered xylitol and home baked goods, 1 cup of xylitol weighs approximately 190 g.

Management of xylitol ingestion:
- Induce emesis only if the animal is asymptomatic (remember that the onset of signs can be rapid)
- Activated charcoal is NOT likely to be beneficial
- Ingestion of 0.1-0.5 g/kg xylitol: Hospitalize and obtain baseline blood glucose, potassium, phosphorus, liver enzymes, total bilirubin levels, and coag tests. Monitor glucose q 1-2 hrs over the next 12-24 hrs. Monitor the other tests every 24 hrs for 3 days.
- If hypoglycemia develops: Administer 1-2 ml/kg 25% dextrose bolus followed by IV fluids containing 2.5-5% dextrose to maintain BG in normal range. Supplement and monitor potassium.
- For ingestion of amounts > 0.5 g/kg - - - start dextrose therapy right away, even if hypoglycemia is not yet evident. Hepatic supportive therapy may be beneficial: (SAMe, milk thistle). The combination product Denamarin (SAMe plus silybin in a phosphatidylcholine complex) from Nutramax provides accurate dosing. If a coagulopathy develops, plasma or blood or both may be indicated.

**References: Xylitol**

**Sago Palm Toxicity**
The Sago Palm (Cycas revoluta) is a stocky, spiky leaved member of the Cycad family of plants. These plants have become increasingly popular in recent years in landscaping around homes. They predominate in the sunny, warmer climates of the southern United States. However, in recent years, miniature or “bonsai” versions of Sago Palm have become increasingly popular as indoor plants in the northern climates. Many pet owners are unaware of the dangers these plants can pose to pets. The plants are very palatable. Sago and other cycad palms contain toxic compounds that can cause vomiting, diarrhea, weakness, seizures, and even liver failure and death in
cats and dogs. Although the seed, or nut, from the female contains the greatest toxin concentration (cycasin), all parts of the plant are toxic, whether male or female.

The ASPCA Animal Poison Control Center has reported an increased incidence in Sago and other Cycad Palm toxicity cases of 200% over the last 5 years. According to the Center's data, mortality ranges from 50-75% of cases.

This example again highlights the importance of obtaining a thorough history in patients presented for vomiting. It is often useful to send the owner back home to search the premises for evidence of anything dangerous that may have been ingested. We have had Sago Palm cases identified after vomiting animals were found to have marked elevations in liver enzymes. Further study of the premises has subsequently sometimes uncovered evidence of partially ingested Sago plants. Treatment is supportive (fluids, SAMe/milk thistle [Denamarin, Nutramax], ursodeoxycholic acid, monitor for coagulopathy, antiemetics to control vomiting [avoid antiemetics that are cautioned for use in animals with significant liver disease; dolasetron or ondansetron represent excellent, safe choices], and an H2-receptor blocker [e.g., famotidine]).

Cocoa Mulch Toxicity

*Cocoa bean shells:*
- By-product of chocolate production
- Sold as mulch for landscaping
- Attractive color, texture, odor
- Shells have a high concentration of methylxanthine

**Problem:**
- Some dogs like to eat and can easily develop methylxanthine toxicosis; deaths have been reported
  **Many pet owners are unaware of the danger**

**Low dose signs:**
- Vomiting
- Diarrhea
- Abdominal pain

**Higher dose signs:**
- Rapid heart rate
- Muscle tremors
- Seizures
- Death

**50 pound dog – ingested amounts:**

<table>
<thead>
<tr>
<th>Cocoa bean mulch</th>
<th>vs.</th>
<th>Milk Chocolate</th>
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<tbody>
<tr>
<td>2 ou GL upset</td>
<td></td>
<td>7.5 ou without GL upset</td>
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<tr>
<td>4.5 ou Inc. HR</td>
<td></td>
<td>Up to a lb, no inc. HR</td>
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<tr>
<td>5.3 ou Seizures</td>
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<tr>
<td>Over 9 ou Death</td>
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History and Clinical Assessment: Clinical Features Of Vomiting

Because of the wide variety of disorders and stimuli that can cause it, vomiting may present the clinician with a major diagnostic challenge. A complete historical review with emphasis on all body systems is essential for determining a realistic and effective initial work-up plan and treatment protocol. All too often concentration on only the gastrointestinal tract leads to an incorrect diagnosis and inappropriate treatment. Consideration of the following features is useful in assessing and diagnosing a patient with vomiting:

1. duration of signs
2. signalment and past pertinent history
3. environment and diet
4. systems review (e.g., history of PU/PD, coughing and sneezing, dysuria or dyschezia, etc.)
5. time relation to eating (vomiting of undigested or partially digested food more than 8-10 hours after eating often indicates a gastric motility disorder [more common] or gastric outlet obstruction [less common])
6. content of the vomitus (food, clear fluid, bile, blood, material with fecal odor), and
7. type and frequency of vomiting (projectile?, chronic intermittent?, cyclic?, morning vomiting only?).

Most Common Causes of Acute or Chronic Vomiting in Dogs

First need to Rule-Out:

**Dietary/ingestive problem**
- Indiscretion (e.g., table scraps, garbage ingestion; toxins, foreign body)
- Food adverse reaction (dietary sensitivity)
- True food allergy

**Parasites**
- Intestinal (including *Giardia*)
- Gastric (*Physaloptera*)

**Drug related problems**
- NSAIDS must always be considered
- Other drugs (e.g., cardiac glycosides, antibiotics, chemotherapeutic agents)
- *Any* drug can potentially cause vomiting

**Metabolic disorders**
- Renal disease
- Liver disease
- Electrolyte abnormalities
- Addison’s disease (some are glucocorticoid and mineralocorticoid deficient and will demonstrate typical electrolyte abnormalities; others are only glucocorticoid deficient and require ACTH stim for diagnosis (JAVMA April 15, 2007, p. 1190-1194))
Rule-Outs for Chronic Vomiting, Once the Causes Listed Above are Ruled Out:

Main Categories:

Motility Disorders
- Gastric hypomotility (an underappreciated disorder)

Inflammatory Disorders
- Chronic gastritis (with or without *Helicobacter*)
- Inflammatory bowel disease

Obstructive Disorders
- Foreign body
- Hypertrophic gastropathy (uncommon)

Neoplasia

Most Common Causes of Chronic Vomiting in Cats

Dietary problem
- Food adverse reaction (dietary sensitivity), up to 25% of cases

IBD
- Hyperthyroidism
- Liver disease
- Renal disease
- GI lymphoma (intestinal is more common)
- Chronic pancreatitis
- Heartworm disease

Intermittent Chronic Vomiting

Chronic intermittent vomiting is a common presenting complaint in veterinary medicine. Often there is no specific time relation to eating, the content of the vomitus varies, and the occurrence of vomiting may be very cyclic in nature. Depending on the disorder, other signs such as diarrhea, lethargy, inappetence, and salivation (nausea) may occur as well. When presented with this pattern of clinical signs, the clinician should strongly consider chronic gastritis, inflammatory bowel disease, irritable bowel syndrome, and gastric motility disorders as leading differential diagnoses. A detailed work-up including gastric and intestinal biopsies is often required for definitive diagnosis in these cases. It is important to note that chronic intermittent vomiting is a common clinical sign of inflammatory bowel disease in both dogs and cats.

Vomiting from systemic or metabolic causes may be an acute or chronic sign and generally there is no direct correlation with eating and no predictable vomitus content.
Diagnostic Plan

If reasonable concern is established based on the history (e.g., patient is inappetent, ingested a toxin, is vomiting frequently) or physical assessment (e.g., patient is listless, dehydrated, in pain), then a minimum data base of CBC, complete biochemical profile (or specific tests for evaluation of liver, kidney, pancreas, electrolytes), complete urinalysis (pre-treatment urine specific gravity extremely important for diagnosis of renal failure), and fecal examination is essential. The best way to screen for GI parasites on a single fecal sample is to run both a centrifugal flotation test and a Giardia antigen test. If only a single zinc sulfate centrifugal flotation is run, 25-30% of Giardia cases will be missed. T4 and both a heartworm antibody test and heartworm antigen test are considered routine baseline tests for vomiting cats (approximately 40% of vomiting cats will have vomiting as a clinical manifestation of the disease). Survey abdominal radiographs are indicated if thorough abdominal palpation is not possible or suggests an abnormality (e.g. foreign body, pancreatitis, pyometra). Unfortunately these tests are often not done early enough. Even if baseline results are unremarkable they are more than justified because they help to rule out serious problems at the outset (e.g., vomiting due to renal failure, diabetes mellitus, liver disease). Alternatively, any abnormalities provide direction for initial treatment and further diagnostics.

The decision for performing more in-depth diagnostic tests is based on ongoing clinical signs, response to therapy, and initial test results. These tests include ACTH stimulation to confirm hypoadrenocorticism in a patient with an abnormal Na:K ratio or to investigate for this disorder if electrolytes are normal, complete barium series or BIPS study (for gastric or intestinal foreign body, gastric hypomotility, gastric outflow obstruction, partial or complete intestinal obstruction), cPLI* or fPLI* (canine and feline lipase immunoreactivity, respectively, for diagnosis of pancreatitis in dogs and cats), and serum bile acids assay (to assess for significant hepatic disease). Barium swallow with fluoroscopy is often necessary for diagnosis of hiatal hernia disorders and gastroesophageal reflux disease. Serum gastrin levels are run if a gastrinoma (Zollinger-Ellison Syndrome) is suspected.

Pancreatitis: Pancreatitis continues to be a challenging disorder to accurately diagnose, short of thorough direct examination and biopsy. Assays for amylase and lipase are of very limited value, especially in cats. In general, the following can be stated regarding the various diagnostic tests for pancreatitis:

Value of the Various Diagnostic Tests for Pancreatitis

Amylase/Lipase
- of value as a screening test in dogs only
- need to be 3x or > above normal reference range in order to suggest pancreatitis
- normal does not rule-out pancreatitis

Abdominal Ultrasound
- highly specific, but not very sensitive, especially in cats

Serum PLI
- highly sensitive for pancreatitis

Pancreatic Lipase Immunoreactivity (cPLI and fPLI)
- Exocrine Pancreatic Insufficiency (EPI)
  o cPLI is reliably significantly decreased
  o cPLI is specific for EPI
- Chronic Renal Failure
  o Increased, but usually still within reference range
- Dogs with Biopsy Proven Pancreatitis
  o cPLI sensitivity is > 80%
  o currently recommended cutoff value for dogs is > 200 ug/L
  o preliminary results are also promising for cats

**Negative contrast gastrography.**
An excellent technique to quickly evaluate the stomach for presence of a nonradiopaque foreign body.
Technique:
- Gastric tube, tranquilize as needed
  (definitely tranq cats)
- Dogs: 8-10 ml/lb air or stop if the animal shows discomfort
- Cats: 5 ml/lb air
- Remove tube, take rads immediately
  (left lateral, VD first)
- Can also use 60 ml carbonated beverage (e.g., Mountain Dew)

**BIPS are barium impregnated polyethylene spheres.** Traditionally, veterinarians have relied on barium liquid as the contrast agent of choice for gastrointestinal studies. However, recognized limitations of barium liquid have led to the development of barium-impregnated solid radiopaque markers for the diagnosis of motility disorders and bowel obstructions. Barium liquid contrast studies are of limited value in detecting hypomotility. Radiopaque markers can be used to investigate a number of common gastroenteric problems. These spheres have been specifically validated for use in dogs and cats and are the only radiopaque markers with which there is extensive clinical experience in veterinary medicine. BIPS are manufactured in New Zealand and are now available in many countries. Information on availability of this product, including instructions on use and interpretation of radiographic studies, can be found at (www.medid.com; 800-262-2399).
One of the most reliable and cost efficient diagnostic tools currently available for evaluation of vomiting is **flexible GI endoscopy**. Endoscopy allows for direct gastric and duodenal examination, mucosal biopsy from these areas, and in many cases gastric foreign body retrieval. Endoscopy is considerably more reliable than barium series for diagnosis of gastric erosions, chronic gastritis, gastric neoplasia, and inflammatory bowel disease (a common cause of chronic intermittent vomiting in dogs and cats). It is stressed that biopsy samples should always be obtained from stomach and whenever possible small intestine regardless of gross mucosal appearance. Normal gastric biopsies may support gastric motility abnormalities, psychogenic vomiting, irritable bowel syndrome, or may be noncontributory (i.e., look elsewhere for diagnosis). Many dogs with vomiting due to inflammatory bowel disease have no abnormalities on gastric examination or biopsy. If only gastric biopsies are obtained, the diagnosis may be missed.

**Ultrasonography** can be useful in the diagnostic work-up of a number of disorders that can cause vomiting. Among the problems that may be detected with ultrasonography are certain disorders of the liver (e.g., inflammatory disease, abscessation, cirrhosis, neoplasia, vascular problems), gall bladder (cholecystitis, choleliths, gallbladder mucocele), GI foreign bodies, intestinal and gastric wall thickening, intestinal masses, intussusception, kidney disorders, and others. Needle aspirations and/or biopsies can be done at many sites under ultrasound guidance.

**Abdominal exploratory** is indicated for a variety of problems including foreign body removal, intussusception, gastric mucosal hypertrophy syndromes, procurement of biopsies, and for resection of neoplasia.

*FPLI* is available at Texas A&M University. Serum samples can either be sent directly to the GI Laboratory at Texas A&M University, or they can be forwarded to Texas A&M by a commercial laboratory.

**The address is:**
GI Lab at Texas A&M University
College of Veterinary Medicine
TAMU 4474
College Station, TX 77843-4474
979-862-2861
[www.cvm.tamu.edu/gilab](http://www.cvm.tamu.edu/gilab)
Diagnosis of Vomiting

Stage 1—Baseline Assessment
- History and physical examination
- Conservative vs. more aggressive diagnostic plan based on patient’s condition and clinician’s concern

<table>
<thead>
<tr>
<th>Conservative Approach</th>
<th>Serious or Systemic Clinical Signs</th>
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<tr>
<td>Fecal examination*</td>
<td>Complete blood count</td>
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<tr>
<td>Selected diagnostics</td>
<td>Complete biochemical profile</td>
</tr>
<tr>
<td>Specific/symptomatic therapy</td>
<td>Urinalysis</td>
</tr>
<tr>
<td>Fecal examination*</td>
<td>Fecal examination*</td>
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<tr>
<td>Parvovirus test if indicated</td>
<td>T4 (cats)</td>
</tr>
<tr>
<td>Survey radiographs</td>
<td>Heartworm antibody test (cats)</td>
</tr>
<tr>
<td>Appropriate specific/supportive therapy</td>
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Stage 2—Further assessment (if vomiting persists or initial tests indicate further investigation should be performed promptly):

- Special Blood Tests
  - Corticotropin stimulation
  - cPLI or fPLI (pancreatitis)
  - Leptospirosis serology
  - Bile acids assay (to assess liver function)
  - Coagulation tests (consider in patients with hematemesis/melena)

- Contrast Radiography
  - Barium contrast
  - Air contrast gastrogram (to further assess for gastric foreign body)
  - BIPS (barium-impregnated polyethylene spheres; with food to assess GI motility)

- Ultrasonography
  - Evidence of GI or non-GI disease
  - Aspirates or biopsy
  - Abdominocentesis
• Nuclear Scintigraphy
  — Transcolonic portal angiography for detection of portosystemic anomaly
  — GI motility study

Stage 3—Invasive Procedures

• Flexible GI endoscopy\(^b\) (minimally invasive)
  — Examination, biopsy, foreign body retrieval

• Laparoscopy
  — Biopsies (e.g., liver, pancreas)
  — Aspirates (e.g., gall bladder, lymph nodes, mass lesion)
  — Intestinal biopsy

• Surgical intervention
  — Therapeutic or exploratory with multiple biopsies

*GI parasites, including *Giardia*, should always be considered in dogs with acute or intermittent vomiting. Best baseline testing on a single fecal sample includes centrifugal flotation and *Giardia* antigen test.

\(^b\) Endoscopy is a diagnostic or therapeutic tool that can be used in Stage 1, Stage 2, or Stage 3, depending on the clinical situation.
References


