Vomiting is a common clinical sign in small animals. The sign however extends beyond problems associated only with the gastrointestinal system but includes a variety of disorders of many body systems. One should remember that vomiting is only a clinical sign and not a specific disease. Investigation of the vomiting cat should include a complete evaluation to determine the etiology and if identified appropriate therapy initiated. Following is an overview of the pathophysiology, potential causes, antiemetic therapy, and a logical clinical approach to the chronic vomiting canine patient.

**Pathophysiology of vomiting**

The main function of vomiting is to protect the animal from ingested toxins. The vomiting act is the result of a complex reflex pattern of responses that is centrally coordinated. The reflex act is initiated in the brain stem and is referred to conceptually to a specific area called the vomiting center. Whether it is a single defined area or a series of multiple nuclei is still under speculation. Activation of the vomiting center results from either humoral or neural stimuli. Pathways to the vomiting center arise from receptors found throughout the body, from vestibular system, from higher CNS centers and through specialized chemoreceptors in the area postrema that are sensitive to blood-borne substances.

Certain drugs or chemicals provoke vomiting through action on the chemoreceptor trigger zone (CRTZ) located on the floor of the fourth ventricle but outside the blood brain barrier that makes it responsive to substances in the circulation as well as in the cerebral spinal fluid. This center is connected by a specific pathway to the vomiting center. Agents such as uremic or bacterial toxins, certain antibiotics or drugs, changes in osmolality or electrolytes can activate this center. Apomorphine is a dopamine receptor agonist and is a potent emetic of the CRTZ in the dog but not in the cat suggesting cats lack dopamine receptors. Consequently metoclopramide, a dopamine receptor antagonist, may not be useful as an antiemetic in cats as it is in dogs. Xylazine (Rompum® Haver/Diamond Scientific 0.44 mg/kg IM), an alpha-2 agonist, is a more potent emetic drug in cats that works specifically at the CRTZ.

Vestibular receptors in the labyrinth, upon stimulation, reach the vomiting center by way of the vestibulochochlear (VIII) cranial nerve. Motion sickness, inflammation of the semicircular canals or lesions in the cerebellum result in vomiting via this pathway. Idiopathic feline vestibular syndrome is also associated with vomiting through this pathway. Antihistamines (H-1 histaminergic antagonists) are reported to be poorly effective in blocking stimuli from vestibular receptor input.

Vomiting may also be elicited by a number of specialized peripheral receptors arising in almost any site in the body. These receptors respond to stimuli associated with irritation, inflammation or stretching. Stimuli associated with pain are particularly emetic. Receptors in the stomach, intestine, bile ducts, gallbladder and peritoneum convey afferent fibers primarily through the vagus (X cranial) nerve. A common clinical sign of cats with heartworm disease is also vomiting presumably also due to stimulation of vagal receptors in the great vessels. Receptors in the kidneys, uterus, and urinary bladder send afferent impulses via sympathetic nerves. There are also receptors located in the pharynx and tonsilar fossae, which transmit impulses through afferent fibers of the glossopharyngeal (IX cranial) nerve. It is not unusual to identify cats with pharyngitis secondary to upper respiratory tract infections have vomiting
part of the clinical presentation. Anticholinergic drugs (cholinergic antagonists) may block peripheral input to the emetic center but are also associated with side effects of decreasing gastrointestinal motility.

The 5HT3 antagonists such as ondansetron, works on 5HT3 receptors found in the emetic center, CRTS and also peripheral vagal afferents. A newer NK1 antagonist maropitant (Cerenia™) has been approved in dogs and is very effective as an antiemetic blocking receptors found in emetic center, CRTZ and vagal afferents. Published study in cats found it to be very effective at 1 mg/kg SQ or IV q 24 hours. Research we have performed in a visceral pain model found Cerenia to block visceral pain similar to a narcotic agent. It can be given safely IV and can be given longer than 5 days. Published study showed no side effects in dogs or cats treated for 4 weeks. Cerenia is metabolized in the liver and with liver disease a lower dose should be used (ie 0.5 mg/kg). Another drug that is a 5HT2 and 5HT3 antagonist is a tetracyclic antidepressant Mirtazapine (Remaron™). It also is a 5HT1 receptor agonist and stimulates the appetite and most effective in cats. It is dosed at 1/8 to of a 20 mg tablet every day for cats.

CLINICAL APPROACH TO THE VOMITING PATIENT

When dealing with the vomiting patient, there are four key aspects to determine in the overall history:(1) the patient actually vomiting, (2) a detailed vomiting record, (3) a drug and diet history, and (4) other signs associated with the vomiting. The history should confirm that the patient is truly vomiting and that the signs described are not associated with gagging, coughing, dysphagia, or regurgitation, all of which may be confused with vomiting by the client. In some cases, the distinction may be challenging to differentiate based on history alone.

Patient signalment may also be helpful. For example, young unvaccinated animals are more susceptible to infectious disease, such as parvovirus or distemper; but older animals generally elicit another set of differentials. Vaccination status, travel history, previous medical problems, as well as medication history should be determined. The history should then focus on the actual vomiting episodes. There are 5 important things one must obtain in the history; 1) the duration, 2) the frequency, 3) character of the vomit, 4) association with eating or drinking and 5) prior treatments that may have been given. A dietary history, including the type of diet or a recent diet change, is equally important because vomiting can be associated with an adverse reaction to food. Vomiting in the immediate postprandial period may suggest either an adverse reaction to food or simply overeating. Vomiting undigested or a partially digested meal, especially when the vomiting occurs more than 6 to 8 hours following eating (a point at which the stomach should normally be empty), suggests a gastric outflow obstruction or a primary gastric hypomotility disorder.

Gastric outflow obstructions occur because of foreign bodies, mucosal hypertrophy, tumors, or polyps. Vomiting of bile-tinged fluid, especially in the early morning, often results from enterogastric reflux syndrome. The presence of blood in the vomitus, either as fresh "bright red" blood or digested blood that has a "coffee grounds" appearance, indicates gastrointestinal erosion or ulceration. Hematemesis with metabolic-related ulcers, such as is seen with hypoadrenocorticism or uremia, drug-induced ulceration, gastritis, or gastric neoplasia, are possible causes.

A complete physical examination may provide important information. Careful evaluation for abnormalities can be a clue to the cause of vomiting. The abdomen should be carefully palpated to check for bowel distention, effusion, masses, or organomegaly. A rectal examination provides characteristics of colonic mucosa and feces. Melena suggests upper gastrointestinal bleeding, and the presence of foreign material in the feces helps support a foreign-body diagnosis. Patients with colitis or severely obstipated animals often vomit.
DIAGNOSTIC PLAN

The history, physical examination, and basic laboratory findings should direct the clinician to a diagnosis or to the next step in the workup. Because most cases of acute vomiting are associated with “garbage gut” and few to no diagnostics are required, a response to symptomatic therapy confirms the diagnosis. In severe cases or in patients with chronic vomiting, laboratory diagnostics are indicated and should include a minimum database (complete blood cell count, biochemical profile, and urinalysis), fecal examination, and abdominal radiographs. This basic evaluation is essential to excluding all nongastrointestinal causes of vomiting. If no abnormalities are identified, then chronic vomiting patients should next be classified as having mild disease with minimal debilitation. Those patients with a considerable vomiting history should be classified as having serious debilitation.

Animals with mild disease are generally treated symptomatically first. If they fail to respond to symptomatic therapy, then they require an in-depth diagnostic workup. Patients having significant or serious disease require an in-depth diagnostic workup, with emphasis on the gastrointestinal tract, including contrast studies, ultrasound examination, and endoscopy.

Animals with mild signs and minimal debilitation should first undergo dietary manipulation with food trials and treatment for gastrointestinal parasites. These therapeutic trials are very appropriate in this classification of cases. Adverse reactions to food consist either of food allergies or food intolerances. Intolerances refer to direct reactions to a particular substance in the diet, such as a preservative or dye. An allergy is a specific immunologic reaction mediated against a protein antigen. Both can result in variable inflammatory gastric mucosal changes and vomiting. Dietary food intolerances are probably the most common cause of chronic intermittent vomiting. Most animals appear healthy and vomit intermittently, primarily food, shortly after eating. Removal of the causal agent often results in prompt improvement. Food allergies result from reaction to a specific protein antigen, usually the major antigen in the diet.

Animals suspected of having food-related reactions should be placed on a hypoallergenic diet for a minimum 2-week trial. Although food allergies causing dermatologic signs may require prolonged dietary trials to demonstrate a response, GI-related signs tend to respond within several weeks. No universal ideal diet exists, so various dietary trials may be required. If the patient is diet-responsive, then the response supports the diagnosis. There is evidence that many dogs having GI disease or IBD respond to hydrolyzed diets. Response rates as high as 50% is reported. It may actually not be what is in the hydrolyzed diets but rather what is not there as these tend to be free of “other stuff.”

Parasites must always be considered when dealing with chronic vomiting in animals that show little debilitation. Giardia sp, ascarids, and whipworms are diagnosed by using proper fecal examination techniques. Giardia need not only cause diarrhea but can cause nausea, and bilious vomiting. Physaloptera spp infection in dogs is uncommon but may be underestimated due to the difficulty of diagnosis. Prevalence rates in the United States range from 1% to 25%. The worm burden need not be large to cause clinical signs; in fact, it is not unusual to find only one or two worms causing significant clinical signs, including chronic intermittent vomiting. The adults produce few eggs and, because the eggs are larvated, they may not float during routine fecal flotation. Diagnosis is most frequently made during endoscopy simply by viewing the parasite in the stomach or proximal duodenum. When symptomatic therapy is indicated in a chronic vomiting case, anthelmintic trial therapy can rule out parasites as a cause. The author usually prescribes febendazole at 50 mg/kg daily for 3 to 5 days.
An in-depth GI evaluation should be considered for the vomiting animal with significant or severe gastric or GI disease or in the patient that has failed to respond to adequate dietary and anthelmintic therapy. Persistent vomiting, hematemesis, weight loss, and debilitation signify the need for further diagnostic evaluation. Diagnostic techniques for the stomach involve radiology, ultrasonography, endoscopy, surgery, or any combination. Radiology should be performed when a gastric lesion, foreign body, or outflow obstruction is suspected.

Endoscopy offers the best means of examining the gastric mucosal surface and lumen and obtaining a gastric mucosal biopsy. When evaluating the vomiting patient, the author always obtains duodenal biopsies to rule out inflammatory bowel disease, performs gastric mucosal brush cytology for *Helicobacter* sp, and obtains a gastric mucosal biopsy sample to check a urea culture for *Helicobacter* sp.

If endoscopy is unavailable, then exploratory surgery and full-thickness biopsy may be indicated. The clinician should evaluate the entire abdomen, carefully noting the liver, pancreas, and bowel. Full-thickness biopsy of the duodenum, jejunum, and ileum, in addition to the stomach, is always performed in patients with gastrointestinal signs.

**GASTRIC DISORDERS**

If nongastric causes of vomiting have been eliminated, then gastric causes should be considered. Gastric disorders can be basically grouped into conditions of mucosal involvement, those causing gastric outflow obstruction, and gastric motility disorders. Inflammatory gastric mucosal disorders most commonly include lymphocytic-plasmacytic, eosinophilic, or granulomatous gastritis. These conditions are diagnosed by biopsy. Inflammatory gastric disease can occur alone or in conjunction with inflammatory changes in bowel (inflammatory bowel disease [IBD]). The role of *Helicobacter* sp in gastric disease is uncertain because the organism is found in many normal dogs and cats. Dogs that have both *Helicobacter* sp infection and concurrent gastritis, however, should be treated accordingly; and many will improve. Current recommendations for *Helicobacter* sp infection include combinations of metronidazole and amoxicillin with an acid-blocking drug given for 2 to 3 weeks. Other antibiotic combinations, such as clarithromycin (7.5 mg/kg/da) and amoxicillin, have also been used without the need for acid blockage. If I have a chronic vomiting case with minimal signs that has failed to resolve with diet and febendazole I will consider a trial course of Helicobacter therapy before in depth diagnostic testing. Less common mucosal disorders include conditions causing gastric ulcerations, fungal disease, and neoplasia.

Conditions that cause gastric outflow obstructions are most often associated with gastrointestinal foreign bodies or neoplasia. Antral-pyloric mucosal hypertrophy is an uncommon condition characterized by hypertrophy of the mucosa in the antral and pyloric regions of the stomach, which causes obstruction of gastric outflow. We tend to see this in older small breed dogs. The syndrome is associated with chronic vomiting of food or gastric secretions, the diagnosis is made by identifying distinct mucosal folds in the antral region of the stomach and gastric retention on a barium contrast study. It is confirmed endoscopically finding large mucosal folds proximal to the pylorus. Therapy involves surgery (pyloric opening techniques) and generally has a good prognosis.

If inflammatory and obstructive gastric disorders have been eliminated, then gastric motility disorders should be considered. Most gastric motility disorders result in delayed gastric emptying, with gastric retention and vomiting. The vomiting may occur at any interval following a meal; however, the relationship to eating is important, as the normal stomach should be empty of a meal in approximately 6-8 hours (cats are usually faster; 4-6 hours). Vomiting of a meal more than 10 hours after eating is suggestive of abnormal gastric
retention (obstructive or motility) as the primary disease or part of a other disorder. For example hypokalemia, severe stress or local inflammation can alter gastric motility. Animals having hypomotility may respond to frequent small amounts of semi-liquid diets and gastric prokinetic agents, such as metoclopramide, cisapride, or erythromycin.

Bilious vomiting syndrome, or reflux gastritis, is a condition commonly observed in older dogs. It is generally associated with early morning vomiting of bile without food. The condition is thought to result from reflux of duodenal fluid into the gastric lumen, bile in the stomach then gastric mucosal irritation and vomiting. Reflux may result from duodenal irritation (IBD or giardia) or as a primary abnormal gastric motility disorder. The latter is ruled out by eliminating a duodenal disorder. Most dogs with this syndrome respond to a late bedtime meal. Food may buffer the bile or actually increase motility. If diet fails then prokinetic agents with diet should be used. Prokinetic drugs include metoclopramide, cisapride and erythromycin. Metoclopramide is a poor prokinetic and cisapride is the most potent. Erythromycin is a novel prokinetic that is quite effective. It binds to motilin receptors in the GI tract having a motilin like effect (increasing GI motility). Pharmacologic doses (sub-antibiotic dose) of 0.5-1 mg/kg (usually in the evening) is used.

SUMMARY
Vomiting is a common clinical sign in small animals and can result from many causes. Understanding the pathophysiology and potential etiologies a logical clinical approach to the vomiting canine patient can be. The therapy is first directed at treating the inciting cause. Next, antiemetics may be given to control nausea and vomiting and in preventing further fluid and electrolyte loss. Often controlling the vomiting may return the dog to an earlier state of positive nutrition.