What's NEW in GDV

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Gastric-dilatation-volvulus (GDV) is a common and frustrating disease in practice, particularly E Today, we will address newer developments in GDV treatment, prevention and research. Specifically, we will cover

1) Education and outreach
2) Gastropexy
3) Multiple organ dysfunction
4) Recent publications

Education and Outreach

While GDV is familiar to breeders of large and giant breed dogs, many pet owners are less familiar with this condition. The AKC and Morris Animal Foundation have spear-headed educational efforts in recent years with over half a million dollars in research efforts, including owner-directed webinars. However, the bulk of the day-to-day education is the responsibility of the primary practitioner, with advice and education materials. The benefits of early education and preventive gastropexy can not be overstated. Handouts (see last page) can be provided at puppy visits. Show dogs may be pexied and still shown.

Preventative gastropexy

In the dog breed considered at high or even moderate risk of GDV, prophylactic gastropexy should be strongly advised by primary care veterinarians before they are faced with a middle of the night decision. Surgically, the procedure technically far easier that the overweight Labrador spay! The challenge is performing an elective surgery in an otherwise healthy dog; however if we compare this to spay or neutering, the potential health, cost and life-saving benefits are far greater when with pexy than spay or neuter. While early spay prevents mammary cancer, and spay at any point eliminates pyometra or dystocia, and castration prevents BPH (but not prostatic cancer) and testicular tumors; it is unclear the actual percentage of dogs affected with these conditions. Thus, while the veterinary community has until at least recently in the USA embraced spay-neuter for all pets, enthusiasm is still developing for pexy. There is no evidence yet for early pexy (< 16 weeks), but it could be considered for future evaluation.

There is single study that tries to evaluate the economic ramification of the prophylactic gastropexy versus the emergent pexy, in this study by Ward and colleagues a break-even point of cost effectiveness when the lifetime risk was approximately 33% such as in Danes. However, this scenario suggested the cost for management of GDV was close to

$1500, when in current economic climate, it is typically much greater. However, in all dogs preventive surgery was associated with decrease risk of death as death from GDV was for all intents and purposes this risk was removed.

Thus, there are two compelling reasons to consider a prophylactic pexy, which are saving of life and saving of cost. The saving of life includes not only the relatively low risk of death associated with the surgical therapy and stabilization, but more importantly the risk of euthanasia at diagnosis due to the associated costs (minimum of 20-30% at most ERs) The costs of prophylactic gastropexy is variably depending on the technique and if it combined with another surgery, such as spay or foreign body. However, in all cases is it less that urgent stabilization and surgery for GDV. ER and Primary care doctors who are in the abdomen for another reason should with owner consent and patient stability perform gastropexies. Drawback of pexys are considered rare but potential complications include kinked pyloric outflow tract causing recurrent vomiting and infection at site if the lumen of the stomach is penetrated.

Prophylactic pexy may be accomplished using a number of techniques including open incisional or other surgical pexy techniques. Clients are often reluctant to a dog undergo a celiotomy strictly for a prophylactic pexy, but as above, primary care veterinarians are well be familiar with this surgical approach, similar to a spay or other abdominal procedure. Laproscopic or lap-assisted pexy is also popular, but requires more advanced training and equipment. Endoscopic –assisted pexy (similar to a PEG tube) is also a possible option as in a flank approach. No study has convincingly shown that one pexy technique is preferable to another.

MODS

Multiple organ dysfunction syndrome is an pervasive feature of canine critical illness. Development of increasing numbers of organ failure is associated with increasing mortality. Prior mortality studies in dogs have described risk factors for death associated with GDV as splenectomy, gastric resection, and cardiac arrhythmias; however it is important recognize that these are not actually causes of morbidity/mortality, but rather risk factors for developing other organ dysfunction. Kenney and colleagues described MODS in dogs with septic abdomens using the following criteria. (Kenney, JAVMA 2010):Organ systems that were evaluated included the renal, cardio- vascular, respiratory, hepatic, and coagulation systems. Dogs were considered to have renal dysfunction if creatinine concentration increased $\geq$ 0.5 mg/dL from the preoperative value and there was no evidence of prerenal or postrenal azotemia. Prerenal azotemia was excluded if there was clinical evidence of adequate hydration or if central venous pressure was > 10 cm H2O; postrenal azotemia was excluded if there was no evidence of urinary obstruction. Dogs were considered to have cardiovascular dysfunction if they had hypotension sufficiently severe to require vasopressor treatment after surgery. Dogs were considered to have respiratory dysfunction if supplemental oxygen administration or mechanical ventilation was required. The need for supplemental oxygen administration was determined on the basis of results of arterial blood gas analysis (ie, alveolar-arterial gradient in partial pressure of oxygen > 10 mm Hg) or results of pulse oximetry (Spo2 < 95%) or if results of clinical assessment indicated a need for oxygen supplementation. Dogs

were considered to have hepatic dysfunction if the highest measured value for bilirubin concentration was > 0.5 mg/dL. Dogs were considered to have coagulation dysfunction if PT or PTT was > 25% above the upper reference limit, if platelet count was ≤ 100,000/µL, or both."Other organ systems that may be evaluated in other studies include neurological (mentation, and neuromuscular function) and gastrointestinal (ileus). In almost all situations, death in treated dogs with GDV is due to MODS, which is much more likely in dogs with gastric resection or splenectomy.

Similar criteria can be applied to dogs with GDV. The $64,000 question is why does MODS develop, both globally and more specifically in dogs with GDV. In people, common pathways include sepsis, vasculitis, hypotension, reperfusion injury and microvascular thrombi. The specific areas that are most important in dogs are not yet elucidated, but likely include all of the above. In specific, potential therapeutic avenues include anticoagulant therapy if dogs are hypercoagulable, prevention of hypotension, early surgical therapy and careful monitoring for any evidence of sepsis or disseminated intravascular coagulation (DIC). DIC in particular is an area of great interest as dogs with GDV that die from their disease invariably suffer form DIC. DIC is recognized as first a hypercoagulable condition, but that later progresses to hypocoagulable. Thromboelastography may be useful in highlighting these changes of hypercoagulability; recall that PT and aPTT are minimally helpful in detecting HYPERcoagulation.

Cardiac ectopy is particularly common in dogs with GDV, with many (most) dogs developing ventricular ectopy, an accelerated idioventricular rhythm, or ventricular tachycardia. The mechanism of ectopy is unclear, but may reflect electrolyedisturbances, pain, microvascular cardiac thrombi or altered cytokine profiles. The treatment of ventricular ectopy is controversial. Some clinicians advocate lidocaine as a CRI for the beneficial effect on ectopy as well as potential benefits in reperfusion injury. Others only advise therapy if there is evidence of decreased perfusion. Troponin levels have been profoundly elevated in dogs with severe ectopy. Telemetry may be useful to document ectopy, as intermittent pulse checks are less useful. For example, this dog would have had a normal auscultation at some phases, despite the presence of significant ectopy.

Prevention of MODS

As with all critical illness, successful therapy is most likely successful if initiated prior to the onset of multiple organ failure. Possible sepsis, such as due to aspiration pneumonia or to incisional infections should be treated early and aggressively, rather than taking a "wait and see" approach. Respiratory distress should be treated with supplemental oxygen and careful assessment given to if this is volume overload (uncommon in GDV dogs without significant pre-existing cardiomyopathy) , pneumonia or acute lung injury. Tachypnea can occasionally represent pain or metabolic acidosis. Chest radiographs are commonly very useful in these determinations. Cardiac ectopy is common, and in of itself does not indicated cardiac dysfunction. However, ectopy may be treated with lidocaine as a CRI or with oral medications such as sotalol (1-2mg/kg po q 12). Some clinicians debate the value of treated ventricular ectopy, and from a cardiac point of view, VPCs are rarely a huge concern. Lidocaine has some anti-oxidant properties, and may also have a slight analgesic effect, and thus may be useful for more than just ectopy. For true cardiovascular failure, evidenced by hypotension, early use of vasopressors after circulating volume has been restored is wise. The best vasopressor is unknown, but options include dopamine at 10-20mcg/kg/min or if myocardial depression is considered likely, dobutamine at 5-15 mcg/kg/min. As always, vasoactive drugs should be used with an infusion pump by personnel familiar with their use. As most GDV dogs are large breeds, it is a good idea to place arterial catheters in the dorsal pedal artery for post-operative monitoring, and in order to have an adequate skill set to place them in those dogs that are actually critical in is necessary to place them frequently.

Coagulopathy or DIC is considered common in dogs with GDV, and microthrombi or hemorrhage can easily impact clinical outcome. In "healthy" GDV, no monitoingof coagulation may be acceptable, but in dogs with more severe clinical disease, early and frequent monitoring of PT and aPTT, and platelets is advised. Thromboelastrography may ultimately be very useful in identifying the more hypercoagulable phases of GDV. In hypercoagulable conditions, early therapy with heparin may be useful in reversing DIC, particularly when combined with aggressive supportive care.

The majority of this presentation will review the recent (< 3 year) literature on GDV.

The *Topics in Companion Animal Medicine* September 2014, was entirely devoted to GDV, with the following review articles.

a. Inherited and predisposing factors in the development of gastric dilatation and volvulus in dogs by Jerry S. Bell
b. The relationship between gastrointestinal motility and gastric dilatation-volvulus in dogs by Krista Gazzola and Laura Nelson
c. Cardiovascular and systemic effects of gastric dilatation and volvulus in dogs by Claire Sharp and Elizabeth Rozanski
d. Lactate in GDV by Erin Mooney and Dez Hughes
e. Gastropexy techniques by Phil Allen andr April Paul
f. Post-operative management and managing complications of GDV byYaronBuchim and EfratKelmer

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Specific studies we will cover include

1) Van Kruiningen HJ, Gargamelli C, Havier J, Frueh S, Jin L, Suib S.
Stomach gas analyses in canine acute gastric dilatation with volvulus. J Vet Intern Med. 2013 Sep-Oct;27(5):1260-1.

BACKGROUND:
The origin of the gas in the stomachs of dogs with acute gastric dilatation or gastric dilatation with volvulus (GDV) often is disputed.

HYPOTHESIS:
We tested the hypothesis that gaseous distention resulted from aerophagia.

ANIMALS:
Ten cases of GDV that were submitted to an emergency clinic were sampled intraoperatively.

METHODS:
With the abdomen open, the needle of a vacutainer blood collection set was inserted into the distended stomach, and gas was collected into 10 mL glass vacutainer vials with rubber stoppers. These were stored at room temperature for 1-7 days and then analyzed by gas chromatography and mass spectroscopy.

RESULTS:
CO2 composition ranged from 13 to 20%. One dog had an H2 concentration of 29%.

CONCLUSIONS:
Because the CO2 content of atmospheric air is less than 1%, these findings suggest that the gaseous gastric distention in GDV is not the result of aerophagia.

2.) Sartor AJ, Bentley AM, Brown DCAssociation between previous splenectomy and gastric dilatation-volvulus in dogs: 453 cases (2004-2009). J Am Vet Med Assoc. 2013 May 15;242(10):1381-4.

OBJECTIVE:
To evaluate the association between previous splenectomy and gastric dilatation-volvulus (GDV) in dogs.

DESIGN:
Multi-institutional retrospective case-control study. Animals-151 dogs treated surgically for GDV and 302 control dogs with no history of GDV.

PROCEDURES:
Computerized records of dogs evaluated via exploratory laparotomy or abdominal ultrasonography were searched, and dogs with GDV and dogs without GDV (control dogs) were identified. Two control dogs were matched with respect to age, body weight, sex, neuter status, and breed to each dog with GDV. Data were collected on the presence or absence of the spleen for both dogs with GDV and control dogs. Conditional logistic regression analysis was used to investigate the association of previous splenectomy with GDV.

RESULTS:
6 (4%) dogs in the GDV group and 3 (1%) dogs in the control group had a history of previous splenectomy. The odds of GDV in dogs with a history of previous splenectomy in this population of dogs were 5.3 times those of dogs without a history of previous splenectomy (95% confidence interval, 1.1 to 26.8).

CONCLUSIONS AND CLINICAL RELEVANCE:
For the patients in the present study, there was an increased odds of GDV in dogs with a history of

splenectomy. Prophylactic gastropexy may be considered in dogs undergoing a splenectomy, particularly if other risk factors for GDV are present.

3.) Grange AM, Clough W, Casale SA.
Evaluation of splenectomy as a risk factor for gastric dilatation-volvulus. J Am Vet Med Assoc. 2012 Aug 15;241(4):461-6.

OBJECTIVE:
To evaluate whether dogs undergoing splenectomy had an increased risk of gastric dilatation-volvulus (GDV), compared with a control group of dogs undergoing enterotomy.

DESIGN:
Retrospective case-control study.

ANIMALS:
219 dogs that underwent splenectomy for reasons other than splenic torsion (splenectomy group; n = 172) or enterotomy (control group; 47) without concurrent gastropexy.

PROCEDURES:
Medical records were reviewed for information on signalment, date of surgery, durations of surgery and anesthesia, reason for splenectomy, histopathologic findings (if applicable), whether gastropexy was performed, duration of follow-up, and date of death (if applicable). Follow-up information, including occurrence of GDV, was obtained via medical records review and a written client questionnaire.

RESULTS:
Reasons for splenectomy included splenic neoplasia, nonneoplastic masses, infarction, traumatic injury, and adhesions to a gossypiboma. Incidence of GDV following surgery was not significantly different between dogs of the splenectomy (14/172 [8.1 %]) and control (3/47 [6.4%]) groups. Median time to GDV for the 17 affected dogs was 352 days (range, 12 to 2,368 days) after surgery. Among dogs that underwent splenectomy, sexually intact males had a significantly higher incidence of GDV (4/16) than did castrated males and sexually intact or spayed females (10/156). Incidence of GDV among sexually intact male dogs did not differ between groups.

CONCLUSIONS AND CLINICAL RELEVANCE:
Results did not support a recommendation for routine use of prophylactic gastropexy in dogs at the time of splenectomy. Other patient-specific risk factors should be assessed prior to recommending this procedure.

4) Beer KA, Syring RS, Drobatz KJEvaluation of plasma lactate concentration and base excess at the time of hospital admission as predictors of gastric necrosis and outcome and correlation between those variables in dogs with gastric dilatation-volvulus: 78 cases (2004-2009). J Am Vet Med Assoc. 2013 Jan 1;242(1):54-8.
OBJECTIVE:
To determine the correlation between plasma lactate concentration and base excess at the time of hospital admission and evaluate each variable as a predictor of gastric necrosis or outcome in dogs with gastric dilatation-volvulus (GDV).

DESIGN:
Retrospective case series.

ANIMALS:
78 dogs.

PROCEDURES:
For each dog, various data, including plasma lactate concentration and base excess at the time of hospital admission, surgical or necropsy findings, and outcome, were collected from medical records.

RESULTS:
Gastric necrosis was identified in 12 dogs at the time of surgery and in 4 dogs at necropsy. Sixty-five (83%) dogs survived to hospital discharge, whereas 13 (17%) dogs died or were euthanized. Of the 65 survivors and 8 nonsurvivors that underwent surgery, gastric necrosis was detected in 8 and 4 dogs, respectively. Via receiver operating characteristic curve analysis, an initial plasma lactate concentration cutoff of 7.4 mmol/L was 82% accurate for predicting gastric necrosis (sensitivity, 50%; specificity, 88%) and 88% accurate for predicting outcome (sensitivity, 75%; specificity, 89%). Among all dogs, the correlation between initial plasma lactate concentration and base excess was significant, although base excess was a poor discriminator for predicting gastric necrosis or outcome (area under the receiver operating characteristic curve, 0.571 and 0.565, respectively).

CONCLUSIONS AND CLINICAL RELEVANCE:
In dogs with GDV, plasma lactate concentration at the time of hospital admission was a good predictor of gastric necrosis and outcome. However, despite the correlation between initial base excess and plasma lactate concentration, base excess should not be used for prediction of gastric necrosis or outcome in those patients.

5.) Green JL, Cimino Brown D, Agnello KA.
Preoperative thoracic radiographic findings in dogs presenting for gastric dilatation-volvulus (2000-2010): 101 cases. J Vet EmergCrit Care (San Antonio). 2012 Oct;22(5):595-600.

OBJECTIVE:
To identify the incidence of clinically significant findings on preoperative thoracic radiographs in dogs with gastric dilatation-volvulus (GDV) and to determine if those findings are associated with survival.

DESIGN:
Retrospective study from 2000 to 2010.

SETTING:
Urban university small animal teaching hospital.

ANIMALS:
One hundred and one dogs diagnosed with GDV that had thoracic radiographs obtained preoperatively, and medical records available with the following information available: signalment, time of presentation, respiratory status, plasma lactate, presence of cardiac arrhythmias, reason for thoracic radiographs, radiographic findings, and outcome.

INTERVENTIONS:
None.

RESULTS:
Findings on preoperative thoracic radiographs included small vena cava (40%), esophageal dilation (39%), microcardia (34%), aspiration pneumonia (14%), cardiomegaly (5%), pulmonary nodule (4%), pulmonary edema (2%), sternal lymphadenopathy (1%), and pulmonary bullae (1%). Eighty-four percent of dogs (85 out of 101) survived to discharge. Dogs without cardiomegaly on presenting thoracic radiographs had a 10.2 greater odds of surviving to discharge.

CONCLUSIONS:
The most common findings on preoperative thoracic radiographs include esophageal dilation, microcardia, and a small vena cava while the incidence of pulmonary nodules was low. A negative association between survival and presence of cardiomegaly on preoperative thoracic radiographs in dogs with GDV supports the need to obtain these images for prognostic information in spite of the emergency surgical nature of the GDV. The main limitations of this study include the possibilities of type I and type II errors, the retrospective nature of the study, and the lack of well-defined criteria for obtaining thoracic radiographs.

6) deBattisti A, Toscano MJ, FormagginiLGastric foreign body as a risk factor for gastric dilatation and volvulus in dogs. J Am Vet Med Assoc. 2012 Nov 1;241(9):1190-3.

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OBJECTIVE:
To evaluate whether the presence of a gastric foreign body (gFB) is a significant risk factor for gastric dilatation and volvulus (GDV) in dogs and to quantify the change in likelihood of developing GDV associated with the presence of a gFB.

DESIGN:
Retrospective case-control study.

ANIMALS:
118 large- or giant-breed dogs treated surgically for an episode of GDV and 342 large- or giant-breed dogs (> 12 months old) that underwent abdominal surgery for reasons other than GDV.

PROCEDURES:
During exploratory celiotomy, all dogs underwent palpation and visual examination of the entire gastrointestinal tract. A foreign body was defined as nondigestible or slowly digestible material palpated during gastrointestinal tract examination that was causing clinical signs or was > 10 cm in length or > 2 cm in width.

RESULTS:
The incidence of gFBs was significantly higher in the group of dogs with GDV. The presence of a gFB, age, weight, and purebred status were significant risk factors for GDV. Odds ratios were calculated for gFB (OR, 4.920), age (OR, 1.157), weight (OR, 0.958) and purebred status (OR, 4.836).

CONCLUSIONS AND CLINICAL RELEVANCE:
Gastric foreign body was found to be a significant risk factor for GDV in dogs. The study findings suggested that a large- or giant-breed dog with a gFB was approximately 5 times as likely to develop GDV as a similar dog with no gFB. Results indicated that there was a strong correlation between gFB and GDV in dogs. However, further cohort studies are needed to determine whether there is a causal relationship between the presence of a gFB and the development of GDV in dogs.

7) Haak CE, Rudloff E, Kirby R.Comparison of Hb-200 and 6% hetastarch 450/0.7 during initial fluid resuscitation of 20 dogs with gastric dilatation-volvulus. J Vet EmergCrit Care (San Antonio). 2012 Apr;22(2):201-10.

OBJECTIVE:
To compare the use of polymerized stroma-free bovine hemoglobin (Hb-200) and 6% hetastarch 450/0.7 (HES 450/0.7) in 0.9% saline during fluid resuscitation of dogs with gastric dilatation-volvulus (GDV).

DESIGN:
Prospective, randomized clinical case series.

SETTING:
Private specialty and referral clinic.

ANIMALS:
Twenty client-owned dogs presenting with GDV.

INTERVENTIONS:
Dogs presenting with GDV and abnormal perfusion parameters first received rapid IV infusion of a buffered isotonic replacement crystalloid (15 mL/kg) and IV opioids. Patients were then randomized to receive either Hb-200 (N = 10) or HES 450/0.7 (N = 10). Balanced isotonic replacement crystalloids (10-20 mL/kg IV) were rapidly infused along with either Hb-200 or HES in 5 mL/kg IV aliquots to meet resuscitation end

points.

MEASUREMENTS AND MAIN RESULTS:
Resuscitation was defined as meeting at least 2 of 3 criteria: (1) capillary refill time 1-2 seconds, pink mucous membrane color, strong femoral pulse quality; (2) heart rate (HR) ≤ 150/min; or (3) indirect arterial systolic blood pressure (SBP) > 90 mm Hg. HR, SBP, packed cell volume, hemoglobin, glucose, venous pH, bicarbonate, base excess, anion gap, and colloid osmotic pressure were compared at hospital entry and within 30 minutes post-resuscitation. Compared to the HES group, the Hb-200 group required significantly less colloid (4.2 versus 18.4 mL/kg) and crystalloid (31.3 versus 48.1 mL/kg) to reach resuscitation end points (P = 0.001). Time to resuscitation was significantly shorter in the Hb-200 group (12.5 versus 52.5 min).

CONCLUSIONS:
Dogs with GDV receiving Hb-200 during initial resuscitation required smaller volumes of both crystalloid and colloid fluids and reached resuscitation end points faster than dogs receiving HES 450/0.7 (P = 0.02).

8) Bruchim Y, Itay S, Shira BH, Kelmer E, Sigal Y, Itamar A, Gilad S.
Evaluation of lidocaine treatment on frequency of cardiac arrhythmias, acute kidney injury, and hospitalization time in dogs with gastric dilatation volvulus. J Vet EmergCrit Care (San Antonio). 2012 Aug;22(4):419-27.
OBJECTIVE:
To assess the efficacy of IV lidocaine in decreasing complication rate and improving the outcome in dogs with gastric dilatation volvulus (GDV).

DESIGN:
Prospective non-controlled study of 83 lidocaine-treated dogs with GDV compared to 47 untreated historical controls with GDV.

SETTING:
University veterinary teaching hospital.

ANIMALS:
One hundred and thirty client-owned dogs with naturally occurring GDV.

INTERVENTIONS:
Study group dogs were treated at presentation with lidocaine (2 mg/kg, IV bolus) followed by constant rate infusion (CRI) of 0.05 mg/kg/min for 24 h. Historical control dogs did not receive any lidocaine.

MEASUREMENTS AND MAIN RESULTS:
There were no group differences in age, body weight, time lag from onset of clinical signs to presentation, rectal temperature and pulse rate at presentation, and proportion of gastric wall necrosis. The proportions of cardiac arrhythmias and acute kidney injury (AKI) were significantly (P< 0.001 and P = 0.045, respectively) lower in the lidocaine group (10/83 [12%] versus 18/47 [38.3%] and 3/83 [3.6] versus 0/47). Median hospitalization time period was shorter (P = 0.05) in the lidocaine group compared to the controls (median 48 h; range 24-360 h versus median 72 h; range 24-144 h, respectively).

CONCLUSION AND CLINICAL RELEVANCE:
Early treatment with IV lidocaine bolus, followed by CRI of lidocaine for 24 h post presentation decreased the occurrence of cardiac arrhythmias, AKI and hospitalization time period significantly in lidocaine-treated dogs with GDV compared to untreated historical controls. Due to the nonblinded, placebo-uncontrolled, nonrandomized nature of the current study, further evaluation of the efficacy of lidocaine in dogs with GDV is warranted.

9) Israeli I, Steiner J, Segev G, Kass PH, Suchodolski JS, Sattasathuchana P, Bruchim Y, Yudelevitch S, ArochSerum pepsinogen-A, canine pancreatic lipase immunoreactivity, and C-reactive protein as

prognostic markers in dogs with gastric dilatation-volvulus. J Vet Intern Med. 2012 Jul-Aug;26(4):920-8

I.

BACKGROUND:
Pepsinogens are proenzymes secreted by gastric chief cells. In humans, their serum concentrations reflect gastric mucosal morphological and functional status.

OBJECTIVES:
To evaluate serum canine pepsinogen-A (cPG-A), C-reactive protein (CRP), and canine pancreatic lipase immunoreactivity (cPLI) concentrations in dogs with gastric dilatation-volvulus (GDV).

ANIMALS:
Sixty-six dogs presented with GDV and 79 healthy controls.

METHODS:
Blood was collected prospectively, and records retrospectively reviewed.

RESULTS:
Median cPG-A concentration was higher in GDV dogs (median, 397 μg/L; range, 37-5,410) compared to controls (median, cPG-A 304 μg/L; range, 18-848; P = .07). Mortality rate in GDV dogs was 22.7%. In nonsurvivors of GDV, median cPG-A was higher compared to survivors (median, 746 μg/L; range, 128-5,409 versus median, 346; range, 36-1,575, respectively; P = .003). The proportion of dogs with increased cPG-A increased with gastric wall damage score (P = .007). An ROC analysis of cPG-A as a predictor of death showed an area under the curve (AUC) of 0.75, higher than lactate (AUC 0.66), and corresponded to a sensitivity and specificity of 53% and 88%, respectively. CRP was increased in 48 dogs (75%), cPLI was >200 μg/L in 26 dogs (39.4%) and >400 μg/L in 12 dogs (18.2%) but both analytes had no association with outcome.

CONCLUSIONS:
PresurgicalcPG-A concentration was positively and significantly associated with gastric wall lesion severity, but, based on ROC analysis, it was only a moderate outcome predictor. CRP and cPLI were commonly increased in dogs with GDV.

10.) Pipan M, Brown DC, Battaglia CL, Otto CM.An Internet-based survey of risk factors for surgical gastric dilatation-volvulus in dogs. J Am Vet Med Assoc. 2012 Jun 15;240(12):1456-62

OBJECTIVE:
To evaluate risk factors for gastric dilatation-volvulus (GDV) in a large number of privately owned dogs across a wide geographic area.

DESIGN:
Internet-based, cross-sectional study.

ANIMALS:
2,551 privately owned dogs.

PROCEDURES:
A questionnaire addressed dog-specific, management, environmental, and personality-associated risk factors for GDV in dogs. Respondents were recruited through the posting of the electronic link to the questionnaire on websites for dog owners; the information was also disseminated at meetings of dog owners and via newsletters, e-mail lists for dog owners and breeders, owner-oriented dog publications, and e-mails forwarded by participants. Descriptive statistics and logistic regression analysis were performed.

RESULTS:
Factors significantly associated with an increased risk of GDV were being fed dry kibble, anxiety, residence in the United Kingdom, being born in the 1990s, being a family pet, and spending at least 5 hours a day with

the owner. Factors associated with a decreased risk of GDV were playing with other dogs and running the fence after meals, fish and egg dietary supplements, and spending equal time indoors and outdoors. A significant interaction between sex and neuter status was observed, with sexually intact females having the highest risk for GDV.

CONCLUSIONS AND CLINICAL RELEVANCE:
In dogs with a high risk of GDV, regular moderate daily and postprandial activity appeared to be beneficial. Feeding only commercial dry dog food may not be the best choice for dogs at risk; however, supplements with fish or eggs may reduced this risk. The effect of neuter status on GDV risk requires further characterization.

11) Green TI, Tonozzi CC, Kirby R, Rudloff E.
Evaluation of initial plasma lactate values as a predictor of gastric necrosis and initial and subsequent plasma lactate values as a predictor of survival in dogs with gastric dilatation-volvulus: 84 dogs (2003-2007). J Vet EmergCrit Care (San Antonio). 2011 Feb;21(1):36-44.

OBJECTIVE:
To test whether an initial plasma lactate ≥ 6.0 mmol/L is associated with the presence of macroscopic gastric wall necrosis and overall survival in dogs presenting with gastric dilatation-volvulus (GDV). Additionally, if no association was identified we sought to identify a different predictive initial plasma lactate concentration and to examine whether serial plasma lactate concentrations provide better prediction of survival.

DESIGN:
Retrospective study over a 5-year period (2003-2007).

SETTING:
Urban private referral small animal teaching hospital.

ANIMALS:
Eighty-four client-owned dogs with a diagnosis of GDV and plasma lactate measurements.

INTERVENTIONS:
None.

MEASUREMENTS AND MAIN RESULTS:
There was no statistically significant relationship found between survival and the presence of macroscopic gastric wall necrosis with the initial plasma lactate ≥ 6 mmol/L. There was a significant relationship between the initial plasma lactate >2.9 mmol/L for predicting necrosis and <4.1 mmol/L for predicting survival to discharge. Forty dogs that had an increased initial plasma lactate (>2.5 mmol/L) also had a subsequent plasma lactate measured within 12 hours of presentation, with 37/40 dogs surviving and 70% of these surviving dogs having the subsequent lactate decrease by ≥ 50% within 12 hours. The 3/40 that died failed to decrease their plasma lactate by ≥ 50% from the initial blood lactate.

CONCLUSION:
The results of this study indicate that an initial presenting plasma lactate concentration ≥ 6.0 mmol/L is not predictive of macroscopic gastric wall necrosis or survival in dogs presenting with GDV. A decrease in plasma lactate concentrations ≥ 50% within 12 hours may be a good indicator for survival. Limitations to the study include its retrospective nature, the small number of patients, and the number of dogs that were euthanized rather than allowed to progress to a natural outcome.

12.) Zacher LA, Berg J, Shaw SP, KudejRK.Association between outcome and changes in plasma lactate concentration during presurgical treatment in dogs with gastric dilatation-volvulus: 64 cases (2002-2008). J Am Vet Med Assoc. 2010 Apr 15;236(8):892-7.

OBJECTIVE:
To determine whether changes in presurgical plasma lactate concentration (before and after initial fluid resuscitation and gastric decompression) were associated with short-term outcome for dogs with gastric dilatation-volvulus (GDV).

DESIGN:
Retrospective case series.

ANIMALS:
64 dogs.

PROCEDURES:
Medical records were reviewed, and signalment, history, resuscitative treatments, serial presurgical lactate concentrations, surgical findings, and short-term outcome were obtained for dogs with confirmed GDV.

RESULTS:
36 of 40 (90%) dogs with an initial lactate concentration <or= 9.0 mmol/L survived, compared with only 13 of 24 (54%) dogs with a high initial lactate (HIL) concentration (> 9.0 mmol/L). Within HIL dogs, there was no difference in mean +/- SD initial lactate concentration between survivors and nonsurvivors (10.6 +/- 2.3 mmol/L vs 11.2 +/- 2.3 mmol/L, respectively); however, there were significant differences in post-treatment lactate concentration, absolute change in lactate concentration, and percentage change in lactate concentration following resuscitative treatment. By use of optimal cutoff values within HIL dogs, survival rates for dogs with final lactate concentration > 6.4 mmol/L (23%), absolute change in lactate concentration <or= 4 mmol/L (10%), or percentage change in lactate concentration <or= 42.5% (15%) were significantly lower than survival rates for dogs with a final lactate concentration <or= 6.4 mmol/L (91%), absolute change in lactate concentration > 4 mmol/L (86%), or percentage change in lactate concentration > 42.5% (100%).

CONCLUSIONS AND CLINICAL RELEVANCE:
Calculating changes in plasma lactate concentration following initial treatment in dogs with GDV may assist in determining prognosis and identifying patients that require more aggressive treatment.

13.) Evans KM, Adams VJ.Mortality and morbidity due to gastric dilatation-volvulus syndrome in pedigree dogs in the UK. J Small AnimPract. 2010 Jul;51(7):376-81.
OBJECTIVES:
To estimate breed-specific risk of death due to, and prevalence of, gastric dilatation-volvulus (GDV) in UK pedigree dogs.

METHODS:
Data were available on the reported cause of and age at death and occurrence of and age at diagnosis of disease from the 2004 purebred dog health survey. A total of 15,881 dogs of 165 breeds had died in the previous 10 years; GDV was the cause of death in 65 breeds. There were 36,006 live dogs of 169 breeds of which 48 breeds had experienced > or =1 episodes of GDV. Prevalence ratios were used to estimate breed-specific GDV mortality and morbidity risks.

RESULTS:
Gastric dilatation-volvulus was the cause of death for 389 dogs, representing 2.5% (95% CI: 2.2-2.7) of all deaths reported and the median age at death was 7.92 years. There were 253 episodes in 238 live dogs. The median age at first diagnosis was five years. Breeds at greatest risk of GDV mortality were the bloodhound, Grand Bleu de Gascogne, German longhaired pointer and Neapolitan mastiff. Breeds at greatest risk of GDV morbidity were the Grand Bleu de Gascogne, bloodhound, otterhound, Irish setter and Weimaraner.

CLINICAL SIGNIFICANCE:
These results suggest that 16 breeds, mainly large/giant, are at increased risk of morbidity/mortality due to GDV.