The Veterinary Journal 201 (2014) 385–389

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

# Pancreas-specific lipase concentrations and amylase and lipase activities in the peritoneal fluid of dogs with suspected pancreatitis

Marie A. Chartier [a,b,*], Steve L. Hill [a], Sarena Sunico [a], Jan S. Suchodolski [c], Jane E. Robertson [d], Joerg M. Steiner [c]

[a] Veterinary Specialty Hospital of San Diego, 10435 Sorrento Valley Road, San Diego, CA 92121, USA
[b] IVG MetroWest, 5 Strathmore Road, Natick, MA 01760, USA
[c] Gastrointestinal Laboratory, Department of Small Animal Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, 4474 TAMU, College Station, TX 77843, USA
[d] IDEXX Laboratories, 1 Idexx Drive, Westbrook, ME 04092, USA

ARTICLE INFO

*Article history:*
Accepted 21 July 2014

*Keywords:*
Canine
Acute pancreatitis
Pancreas-specific lipase immunoreactivity
Lipase
Amylase
Peritoneal fluid

ABSTRACT

Diagnosing acute pancreatitis in the dog can be challenging. The aim of this study was to determine the concentrations of pancreas-specific lipase immunoreactivity (cPLI), and the activities of amylase and lipase, in the peritoneal fluid from a population of dogs diagnosed with acute pancreatitis based on clinical signs, ultrasonographic findings and serum cPLI concentrations. In a prospective study, cPLI concentrations, and amylase and lipase activities, were measured in the peritoneal fluid of 14 dogs with pancreatitis and 19 dogs with non-pancreatic disease.

The sensitivity and specificity of peritoneal fluid cPLI concentration (cut-off value 500 μg/L) were 100.0% (95% confidence interval, CI, 80.7–100.0%) and 94.7% (95% CI 76.7–99.7%), respectively. The sensitivity and specificity of peritoneal fluid amylase (cut-off value 1050 U/L) and lipase activities (cut-off value 500 U/L) were 71.4% (95% CI 44.5–90.2%) and 84.2% (95% CI 62.8–95.8%) for amylase activity, and 92.9% (95% CI 69.5–99.6%) and 94.7% (95% CI 76.7–99.7%) for lipase activity, respectively. In conclusion, peritoneal fluid cPLI concentration was highly sensitive as a complementary diagnostic tool in a group of dogs with suspected acute pancreatitis. Peritoneal fluid lipase activity was not as sensitive as cPLI concentration, but may also support a diagnosis of acute pancreatitis in dogs.



## Introduction

Acute pancreatitis (AP) is a common disease in dogs presenting with non-specific clinical signs, such as anorexia, vomiting, weakness and abdominal discomfort. The frequent lack of specific routine laboratory abnormalities makes the diagnosis challenging (Hess et al., 1998; Steiner, 2003). Abdominal ultrasonography is commonly used as an aid in the diagnosis of AP. Common ultrasonographic findings in dogs include an enlarged, irregular, hypoechoic, or even mass-like, pancreas with peripancreatic hyperechoic mesentery and peritoneal effusion. Other abnormalities may include gastroparesis, corrugation of the duodenum, distended, hypomotile intestines (functional ileus) and biliary distension due to extrahepatic biliary obstruction (Hecht and Henry, 2007).

Although these ultrasonographic parameters may support a diagnosis of AP, their validity has not been assessed critically in dogs. The sensitivity of abdominal ultrasonography in cases of fatal AP in dogs has been reported as 68% (Hess et al., 1998). Abdominal ultrasonography has also been shown to have only fair agreement with serum canine pancreatic lipase immunoreactivity (cPLI), which is the most sensitive and specific non-invasive test for diagnosing AP in dogs (Kook et al., 2014).

Historically, serum amylase and lipase activities have been used for the diagnosis of pancreatitis in dogs (Brobst et al., 1970; Mia et al., 1978; Strombeck et al., 1981). However, there are extrapancreatic sources of amylases and lipases (Simpson et al., 1991). Pancreatic biopsy is considered to be the most definitive diagnostic test for pancreatitis, although lesions can be missed even with multiple biopsies (Newman et al., 2004), and obtaining pancreatic biopsies is invasive.

Assays for the measurement of serum cPLI are commonly used as diagnostic tools, since they specifically measure lipase from pancreatic acinar cells (Steiner et al., 2002; Huth et al., 2010). One of the most common assays used to measure cPLI concentrations in dogs is the Spec cPL assay. In one study, Spec cPL had a specificity of 97.5% for diagnosis of AP in dogs, while in another large clinical trial the specificity was estimated to be 77% using a Bayesian model. The reported sensitivity of this assay ranged between 63.6 and 82%.

* Corresponding author. Tel.: +1 508 3192117.
*E-mail address:* mchartier@ivghospitals.com (M.A. Chartier).

http://dx.doi.org/10.1016/j.tvjl.2014.07.014
1090-0233/Published by Elsevier Ltd.

However, many of the dogs in these studies had only mild pancreatitis on histopathological examination (Steiner et al., 2008; Neilson-Carley et al., 2011; McCord et al., 2012). More recent studies have shown that Spec cPL is most useful in cases of moderate to severe pancreatitis, with sensitivities and specificities (cut-off value 400 μg/L) in these cases in the ranges 71.0–77.8% and 80.5–100%, respectively (Trivedi et al., 2011; Mansfield et al., 2012; McCord et al., 2012).

It is not uncommon for dogs with AP to have peritoneal effusions. In human beings and dogs with pancreatitis, amylase and lipase activities are increased in peritoneal fluid (Geokas and Rinderknecht, 1974; Dubick et al., 1987; Frossard et al., 2000; Guija De Arespacochaga et al., 2006). In a study comparing lipase activity in the peritoneal fluid of dogs diagnosed with different diseases, there was significantly higher lipase activity in the peritoneal fluid of dogs with pancreatitis than in dogs with conditions of non-pancreatic etiology (Guija De Arespacochaga et al., 2006).

The utility of measurement of peritoneal fluid cPLI concentrations to aid in the diagnosis of pancreatitis has not yet been evaluated. The aim of this study was to establish the sensitivity and specificity of the Spec cPL to determine cPLI concentrations in the peritoneal fluid in dogs with suspected AP. In addition, peritoneal fluid amylase and lipase activities were evaluated in the same population of dogs.

## Materials and methods

### *Study design*

Dogs with peritoneal effusions as shown by abdominal ultrasonography were prospectively enrolled. Each dog had a physical examination, complete blood count, serum biochemistry profile, abdominal ultrasonography, and peritoneal fluid biochemistry and cytology (Idexx Laboratories). Serum and peritoneal fluid cPLI concentrations were measured using the Spec cPL assay (Idexx Laboratories), and activities of peritoneal fluid amylase (Stanbio Alpha-Amylase LiquiColor, Stanbio Laboratory) and lipase (Diazyme Lipase Assay Kit, Diazyme Laboratories) were determined. The study was approved by the Veterinary Specialty Hospital of San Diego Research Advisory Committee (approval number 6, date of approval 1 June 2011) and informed owner consent was obtained before enrolling any dog in the study.

Concentrations of cPLI and activities of amylase and lipase in peritoneal fluid were compared between dogs with AP and dogs with non-pancreatic disease (NP). Since a priori cut-off values for measurements in peritoneal fluid were not available, sensitivity and specificity were calculated based on a receiver operating characteristic (ROC) curve with a goal of maximizing sensitivity, while reaching a specificity >80%.

### *Selection of dogs with acute pancreatitis*

Dogs were included in the AP group if they had (1) a serum cPLI concentration >400 μg/L, consistent with a diagnosis of pancreatitis; (2) at least two of the following clinical signs consistent with AP: lethargy, inappetence, weakness, vomiting, abdominal pain and/or diarrhea; (3) complete resolution of clinical signs suspected to be secondary to AP; and (4) a real-time ultrasonographic findings supportive of AP without concurrent disease: pancreatic enlargement, pancreatic hypoechogenicity, irregular margins, peri-pancreatic fluid, hyperechoic surrounding mesentery and/or changes to the adjacent intestines. Dogs were excluded from this experimental group if there was evidence of concurrent systemic disease known to cause peritoneal effusion.

### *Selection of dogs with non-pancreatic disease*

Dogs were included into the NP group if they had a final diagnosis of a NP disease, a serum cPLI concentration (<200 μg/L) that did not support a diagnosis of pancreatitis and results of abdominal ultrasound examination that were not consistent with AP.

### *Statistical analysis*

Statistical analyses were performed using Prism 6 for Windows (GraphPad). The data for peritoneal fluid cPLI concentrations, and amylase and lipase activities, were assessed for normality using the D'Agostino and Pearson omnibus normality test. Significance was set at $P < 0.05$. Peritoneal fluid cPLI concentrations and amylase activities were compared between groups using Mann–Whitney tests. Peritoneal fluid lipase activities were compared between groups using a Student's *t* test. Sensitivity and specificity were calculated based on ROC curves with a goal of maximizing sensitivity, while reaching a specificity >80%.

## Results

Thirty-three dogs were enrolled into the study and categorized as either AP ($n = 14$) or NP ($n = 19$). The AP group consisted of eight castrated males and six spayed females. The median age of AP dogs was 8 years (range 3–12 years). Breeds in the AP group were mixed breed ($n = 3$), Yorkshire terrier ($n = 2$), Cocker spaniel ($n = 2$), Miniature Schnauzer ($n = 2$), and one of each Jack Russell terrier, Samoyed, Shetland sheepdog, Corgi and Golden retriever. The NP group consisted of 13 castrated males and six spayed females. NP dogs had a median age of 9 years (range 4–15 years). Breeds in the NP group included mixed breed ($n = 4$), Golden retriever ($n = 2$), and one each of Border collie, Wheaten terrier, Scottish deerhound, Sharpei, Shih-tzu, Doberman, Corgi, Coonhound, Hungarian Viszla, Yorkshire terrier, Australian shepherd, Husky and Bichon Frise.

All AP dogs had at least two clinical signs consistent with AP. The most common clinical signs in dogs with AP were lethargy (11/14, 79%), inappetence (10/14, 71%), abdominal pain (9/14, 64%) and vomiting (8/14, 57%). The most common clinical signs in the NP group were lethargy, inappetence, abdominal pain, vomiting and weakness. Diagnoses in dogs in the NP group included hepatic and/or splenic hemangiosarcoma ($n = 4$), hepatopathy with secondary portal hypertension ($n = 3$), portal thrombosis ($n = 2$), hepatic sarcoma ($n = 2$), protein-losing enteropathy ($n = 1$), aspiration pneumonia with secondary sepsis ($n = 1$), perforated small intestinal stromal tumor ($n = 1$), right-sided congestive heart failure ($n = 1$), urethral tear ($n = 1$), splenic hematoma ($n = 1$), ruptured gallbladder mucocele ($n = 1$) and sepsis of unknown origin ($n = 1$).

On the basis of biochemistry and cytology, peritoneal fluid in dogs with AP was characterized as a transudate ($n = 1$), modified transudate ($n = 5$) or non-septic exudate ($n = 8$). Changes suggestive of infection or neoplasia were not present in any sample from the AP group, and the majority of cells were non-degenerate neutrophils, with smaller percentages of macrophages and small lymphocytes. In the NP group, peritoneal fluid was characterized as a transudate ($n = 4$), modified transudate ($n = 7$), septic exudate ($n = 1$), non-septic exudate ($n = 2$) and hemorrhagic effusion ($n = 5$).

In the AP group, the median peritoneal fluid amylase activity was 2396 U/L (range 255–5179 U/L). In the NP group, the median peritoneal fluid amylase activity was 515 U/L (range 114–1724 U/L). The sensitivity and specificity of peritoneal fluid amylase activity (cut-off value 1050 U/L) for a diagnosis of AP were 71.4% (95% confidence interval, CI, 44.5–90.2%) and 84.2% (95% CI 62.8–95.8%), respectively ($P = 0.0002$; Figs. 1 and 2).

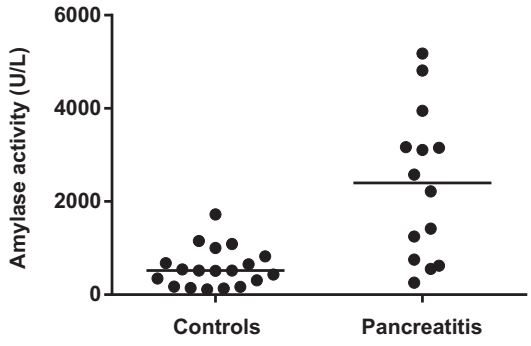


**Fig. 1.** Comparison of peritoneal fluid amylase activities of dogs with acute pancreatitis (AP) and dogs with non-pancreatic diseases (NP). Bars represent the medians for each group. There was a significant difference between the two groups ($P = 0.0002$).