ACUTE PANCREATITIS
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Pancreatitis is a commonly seen disease presenting to the emergency room. Technicians often can get a hint from the history, (“Oh he got into the trash last night”), and are ready to implement orders and treat these patients. But what about some of the nuances like: nutrition, pathophysiology, and even critical care if these patients go south? This lecture will present a holistic view of acute pancreatitis, focused on the dog, but some information about feline pancreatitis will be presented as well.

Pathophysiology
The pancreas is a glandular organ in the cranial abdomen. It is attached to the wall of the duodenum and it lies between the duodenum and the stomach on the right side of the body. It has two lobes; the right and left. The right lobe extends down the duodenum and the left lobe angles medially, underneath the body of the stomach.

The major function of the exocrine pancreas (endocrine pancreas secretes insulin) is to store and then release inactive enzymes for digestion of nutrients. The acinar cells produce these and store them in granules. Dogs have two pancreatic ducts, the pancreatic and accessory pancreatic ducts which attach to the duodenum, where the enzymes are released. Cats only have one duct. The majority of the pancreatic cells are consumed in this function.

Pancreatic enzymes digest tissue, and thus are relatively toxic to the body if activated. The pancreas creates and stores the enzymes in an inactive form, called zymogens. The zymogens are sequestered into granules, so they will not come into contact with other pancreatic tissue and cells. Once the inactive zymogens are secreted into the duodenum they are activated by enzymes in the small intestine. Trypsinogen is a major pancreatic enzyme, and is converted into its active form, trypsin. In a cascade-like effect, trypsin activates other pancreatic enzymes.

The pancreas also has inhibitor enzymes, preventing the body from being over-run by these irritating chemicals. Trypsin inhibitor is produced and stored in the pancreas and inhibits trypsin activity. In addition to local pancreatic anti-enzyme chemicals, are the circulating anti-proteases; the primary one is α-macroglobulin among others. However, there is only a certain amount of these anti-enzyme inhibitors and once they are consumed, pancreatic enzymes are free to wreak havoc with bodily tissue.
Acute pancreatitis is seen relatively frequently in the veterinary hospital. It results from an inappropriate activation of the typically inactive zymogens, inside the pancreas, causing autodigestion of the pancreas. Pancreatic inflammation, cellular edema, and necrosis typically occur. Once the pancreatic cells rupture, they leak active pancreatic enzymes in the peritoneum and systemic circulation. This causes widespread systemic inflammation causing a SIRS syndrome. In rare cases, these pancreatic enzymes and systemic inflammation can cause coagulation cascade activation, and thus DIC, and multiple organ dysfunction and death.

Pancreatitis can take the form of severe or non-severe acute pancreatitis. Chronic pancreatitis also exists, but a different approach to treatment is often taken. Severe acute pancreatitis is elicited when systemic signs of pancreatitis occur with multiple organ involvement or dysfunction. Pancreatic necrosis, abscesses, or pseudocysts are typically found in these patients.

**History/Physical examination**

Due to the variability of the disease, some patients remain in a subclinical phase, or have mild GI signs. Anecdotally, miniature schnauzers are more prone to the disease; however, this has yet to be proven. In addition, gluttony, and the consumption of a fatty meal, or “garbage gut” is also thought of in conjunction with pancreatitis.

Owners will often report GI signs such as anorexia, and vomiting. Diarrhea may occur. Patients are often lethargic. The signs may mimic an upper GI obstruction, so it is important to carefully evaluate the patient and perform timely diagnostic tests.

Patients will often present with dehydration, fever, icterus (if biliary tree is involved), and abdominal pain. Pancreatitis is reported to be a painful human disease, and generally regarded as a painful animal disease as well. These patients may show signs of shock, such as tachycardia, tachypnea, weak pulses, hypotension, mental dullness.

**Diagnostic testing**

*Radiography and Ultrasonography:* Abdominal radiography is recommended in patients suspected of having acute pancreatitis. It is difficult to diagnose pancreatitis via radiography but it is still a useful modality to help rule out upper GI obstruction. Radiographic findings may include: loss of detail in cranial abdomen, displacement of stomach to the left, displacement of duodenum to the right or ventrally. However, only 24% of patients in a large study on fatal pancreatitis had radiographic changes. Ultrasonography is a relatively useful test in diagnosing acute pancreatitis. However, it certainly relies on the skill of the ultrasonographer. Ultrasonographic findings include an enlarged pancreas, hypoechoic pancreatic center, hyperechoic area surrounding the pancreas.
(peripancreatic fat necrosis), and effusion surrounding the pancreas. Ultrasonography is more sensitive (less false negatives) than radiography. In human medicine CT is considered gold standard for evaluation of the pancreas. By contrast, in few limited veterinary studies, CT did not hold up to ultrasonography or serologic testing.

Laboratory analysis: All patients presenting to the emergency room will benefit from a minimum database (PCV, TS, Blood Glucose, BUN, Electrolytes, Venous blood gas), and a complete blood count and biochemical profile. Common findings include: inflammatory leukogram (neutrophilia with left shift and toxic changes), anemia and thrombocytopenia (if patient is in DIC), elevated PCV from dehydration, hemoconcentration, elevated amylase and lipase levels, azotemia, hyperglycemia, hypoglycemia, hypercholesterolemia, elevated liver enzymes and hyperbilirubinemia, and hypocalcemia.

Important testing notes: Elevated amylase and lipase are not highly correlated as diagnostic of pancreatitis. Firstly, the tests run on typical in-house biochemical analyzers are not pancreas specific. Amylase and lipase are found in the oral cavity, GI tract, pancreas, and liver. And decreased glomerular filtration can greatly affect amylase/lipase levels. The reported sensitivities (amount of accuracy compared to false positives) is 50-70%. Meaning 30-50% of increased amylase/lipase enzymes were not associated with actual diagnosis of pancreatitis. Also, normal amylase/lipase levels do not rule out pancreatitis either. As the pancreas is quite near the bile duct, inflammation and swelling can cause an extrahepatic bile duct obstruction. Thus liver enzymes and makers of biliary tree disease, such as total bilirubin levels, may be elevated. Hyperglycemia is a common finding and is either a marker of stress or development of diabetes mellitus. 30% of dogs presenting for pancreatitis were found to be hyperglycemic, and 63% of those were found to be diabetic. Hypocalcemia can result from calcium salt formation in the pancreas, related to pancreatic inflammation. In cats, this finding carries a poor prognosis. The prognostic value of this in dogs is unknown.

Pancreatic markers/inflammatory markers: C-reactive protein is used in humans to determine severity of pancreatitis. It is an acute-phase protein, (one that is induced in inflammatory states) and may have a prognostic value in dogs. Elevated levels were found in dogs with pancreatic abscess compared to those with just pancreatic inflammation. Elevated C-reactive protein levels were found in dogs with acute pancreatitis vs. normal dogs, making it a marker of pancreatitis. However, although it is sensitive, it is not entirely specific to pancreatitis as elevated
levels are found in patients with generalized systemic inflammation. The trypsin-like immunoreactivity (TLI) and pancreatic lipase immunoactivity (PLI) tests are both pancreas-specific tests and are used in the diagnosis of pancreatitis. While the TLI test is useful in diagnosing exocrine pancreatic insufficiency, its sensitivity and specificity with pancreatic inflammation and dysfunction are low. Therefore, the PLI is the preferred test. It reports pancreas-specific lipase, which is chemically unique from other lipases, and is unaffected by renal failure. The fPLI test will run feline specific pancreatic lipase, and the cPLI test will run canine specific lipase. The spec-CPL test (same as cPLI) can be run through commercial laboratories, and a snap test was introduced into the market a few years ago. It is still recommended to follow up a positive snap test with a spec-CPL measurement. The spec-CPL has greater accuracy for canines, than the fPLI test does for felines. Typically values in the dog >400ug/dL are considered diagnostic with a sensitivity of 93%.

**Treatment**

**Fluid therapy:** Patients with pancreatitis are typically dehydrated, and potentially hypovolemic. If there are any perfusion deficits present, boluses of balanced crystalloid solutions should be used to replace intravascular volume. Once perfusion is restored, rehydration and treatment of ongoing losses can occur. Typically a crystalloid solution that is isotonic and contains some trace electrolytes is used. Potassium supplementation may be used to treat losses.

**Anti-emetics:** Patients that are vomiting are typically treated with anti-emetics to prevent further vomiting and fluid loss. Maropitant (Cerenia®) a NK1 receptor antagonist, can be a very useful anti-nausea and anti-emetic drug. It is labeled for SQ use and can sting when injected. Metoclopramide (Reglan®) is a pro-kinetic and anti-emetic drug. It increases lower esophageal sphincter tone, stimulates peristalsis and acts peripherally and centrally to prevent vomiting. The 5-HT3 serotonin receptor antagonists Ondansetron (Zofran®) and Dolasetron (Anzemet®) can be used to treat vomiting as well. Anti-acid drugs, such as H2 receptor antagonists Famotidine (Pepcid®) and Ranitidine (Zantac®) are effective in lower gastric pH to prevent ulcer formation. The proton-pump inhibitor class of antacid medications are superior to the H2 blocker drugs and include Pantoprazole (Protonix®) and Omeprazole (Prilosec®).

**Pain management:** Analgesia is an important part of treating the pancreatitis patient. Pain assessment and scoring should be used to assess the severity of pain. The first important step is observing the patient. Are they hunched? Do they have a praying stance? Are they crouched at the
back of the cage? Are they growling or snarling? Are they attention seeking? These may be signs of pain in addition to physiologic parameters (hyperthermia, hypertension, tachycardia, tachypnea). Pure mu opioids are best at achieving analgesia in these patients. Morphine, Hydromorphone, Oxymorphone or Fentanyl are highly effective. Buprenorphine can be used, but it is a milder analgesic, lasts a long time, and is harder to reverse. I have often found that pure mu opioids need to be given above a Buprenorphine dose for “breakthrough” pain. Fentanyl CR’s are nice in the ICU because they can be titrated to effect. In addition, Lidocaine and Ketamine adjunctive analgesia can be added for additional pain control.

**Nutrition:** This can be very important in pancreatitis. Historically, patients were not fed at all during the course of pancreatitis. Feeding during vomiting is thought to be controversial, and the addition of food to the stomach induces the pancreas to work, and secrete digestive enzymes. So post-pyloric feeding is often indicated. This is accomplished with a jejunostomy tube. Nasojejunostomy tubes are described but rare. Typically a J-tube is fed through a Gastrostomy tube and used that way. However, these require anesthesia for surgical or percutaneous (endoscopic) placement. Diets fed through a J-tube need to be easily digestible and several elemental diets exist (Clinicare®, Vivonex®, Enteral Care®). These diets are not truly balanced in nutrients and not for the long term. Cats also require different combinations of fat, protein, and carbs so Feline Clinicare® may be the better option for them. In cats, pre-pyloric feeding is often well tolerated, (nasogastric, nasoesophageal, or esophagostomy tubes). In my experience, nasogastric tubes in dogs are typically well tolerated. It is advised to use the enteral route whenever possible. If the patient will not tolerate enteral feedings, the parenteral route may be used. Indications for parenteral nutrition include: intractable vomiting, large volume raging diarrhea, or complications with tube placement. Patients with pancreatitis are typically in a catabolic state and thus partial parenteral nutrition is probably not enough. Total parenteral nutrition, or TPN, is often required. This is an expensive and technically demanding nutritional intervention, requiring 24 hour care and central line placement. There are many complications with TPN but it can be a rewarding treatment if successful.

**Rare complications**

If pancreatitis is severe, complications such as DIC and multi-organ failure can result. Careful screening for these problems can help catch them before they have progressed. DIC is a difficult syndrome to treat and is characterized by early hypercoagulability and subsequent hypocoagulability. Fresh frozen plasma and anticoagulants are typically employed in the treatment
of DIC. FFP use prior to DIC is not indicated in the literature. Multi-organ failure can include liver failure, renal failure, pulmonary dysfunction (acute respiratory distress syndrome) or GI dysfunction. Gut necrosis can lead to bacterial translocation and sepsis, despite most uncomplicated pancreatitis being considered a non-infectious disease. Careful nursing monitoring of the hematologic, renal, and GI systems can help prevent these problems from occurring.

Conclusion
Pancreatitis has a favorable outcome if treated early and aggressively. There is no definitive treatment, and most treatments are symptomatic. Early aggressive nutrition can help provide a positive outcome. Careful monitoring of vital signs and organ systems can catch problems early and help guide therapy.

References available upon request.