

From Inflammation to Incision: Pancreatitis & Pancreatic Surgery

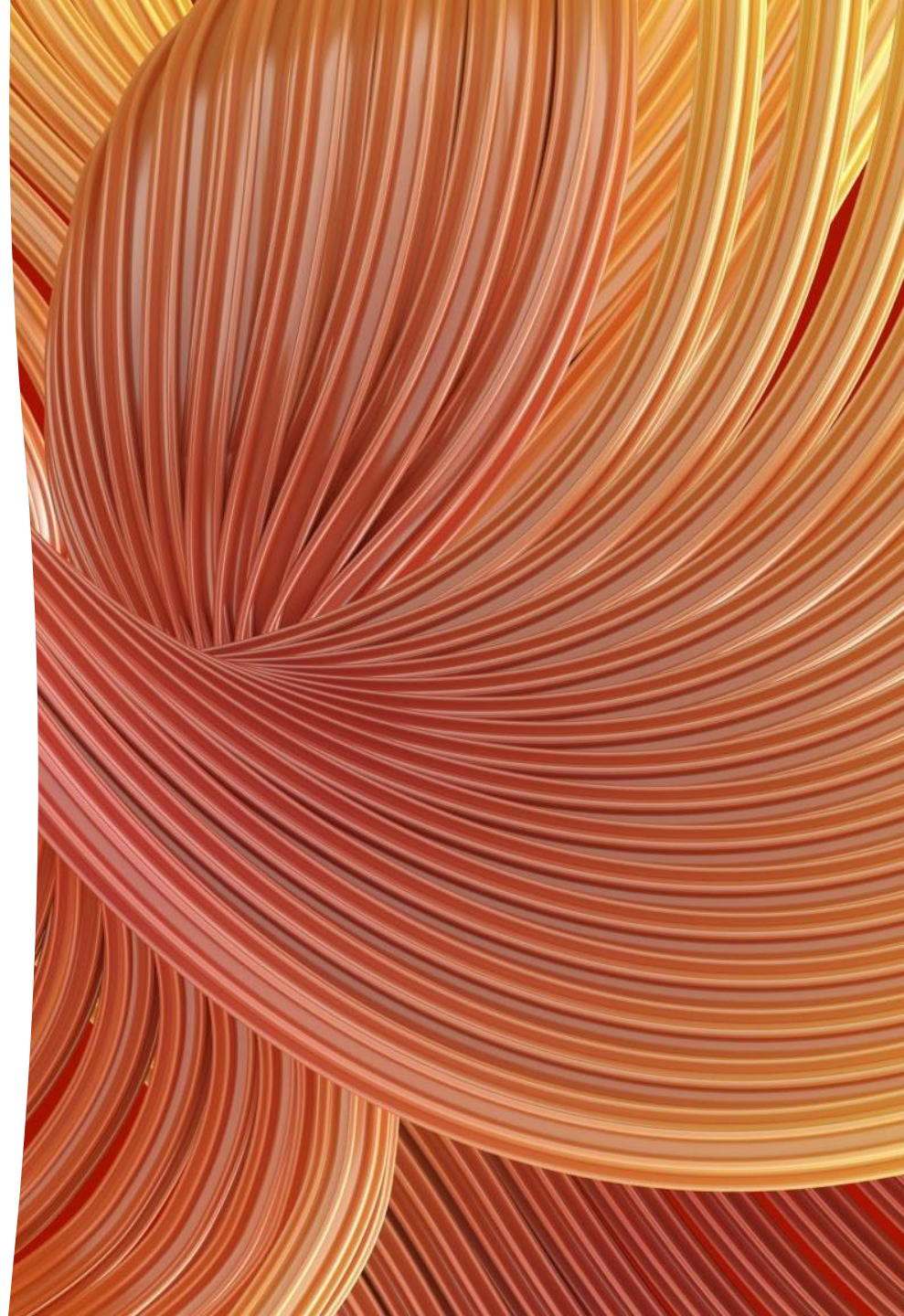
Presented By: Joseph Polit,
DVM, DACVECC, Second Year
Surgery Resident

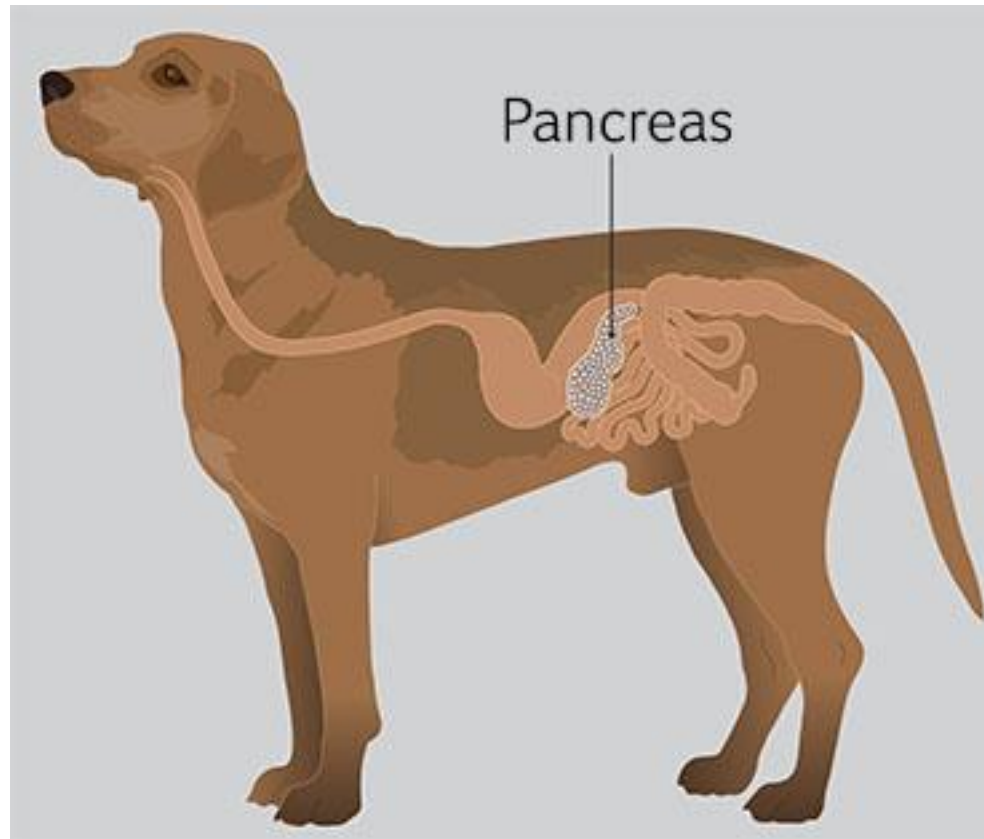
Cape Cod Vet Specialists



Overview & Learning Objectives

- Refresh surgical anatomy & physiology of the pancreas (dog & cat)
- Diseases of the pancreas (pancreatitis)
- Summarize diagnostics and treatments
- Surgical diseases of the pancreas
- Peri-operative care, complications, outcomes





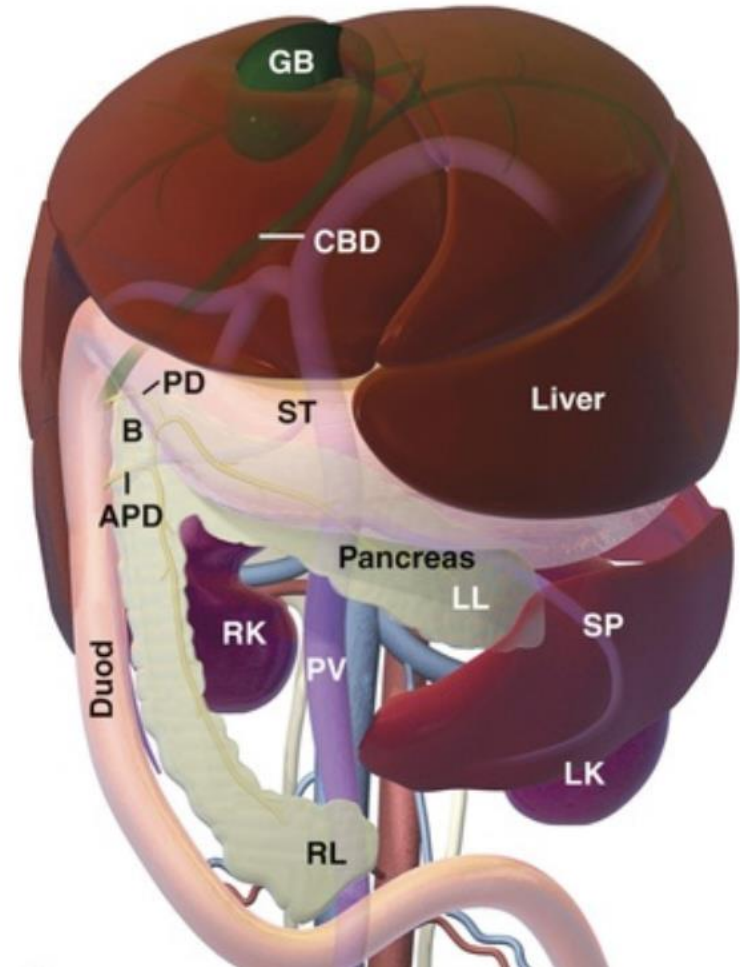
<https://www.pdsa.org.uk/pet-help-and-advice/pet-health-hub/conditions/pancreatitis-in-dogs>

Pancreatic Anatomy

Anatomy

Lobes & ducts

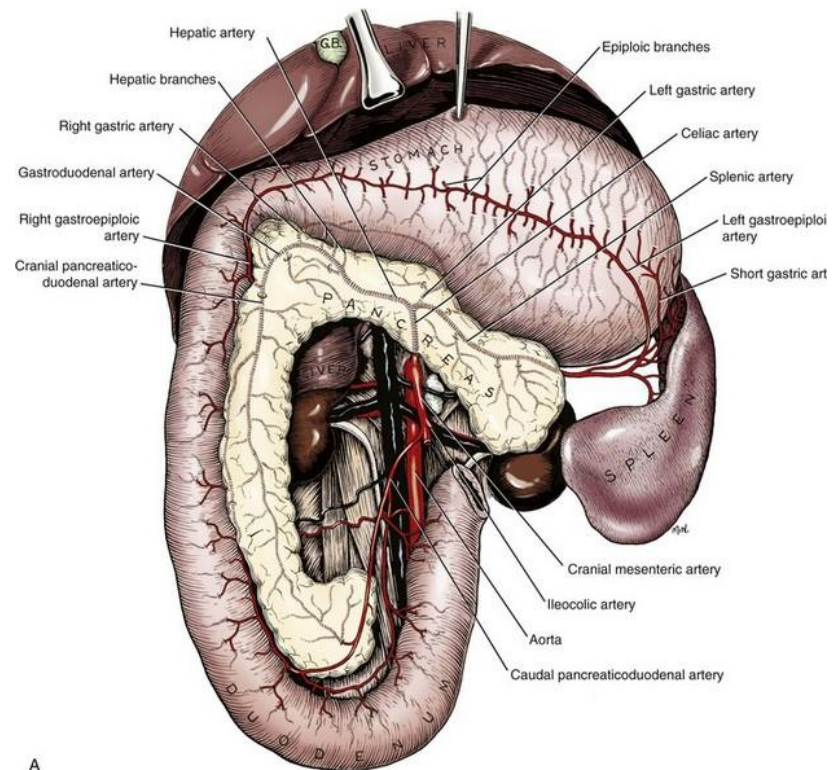
Right & left lobes joined by body;
duct(s) open into proximal
duodenum



<https://veteriankey.com/pancreas-2/>

Anatomy Con't

- Vascular & lymphatic
 - Pancreaticoduodenal arteries/veins → portal
 - Lymph to hepatic & pancreaticoduodenal nodes



Vascular Supply

- Majority originating from the celiac artery
- Splenic artery
- Hepatic artery
- Cranial pancreaticoduodenal artery
- Cranial mesenteric artery
- Caudal pancreaticoduodenal artery

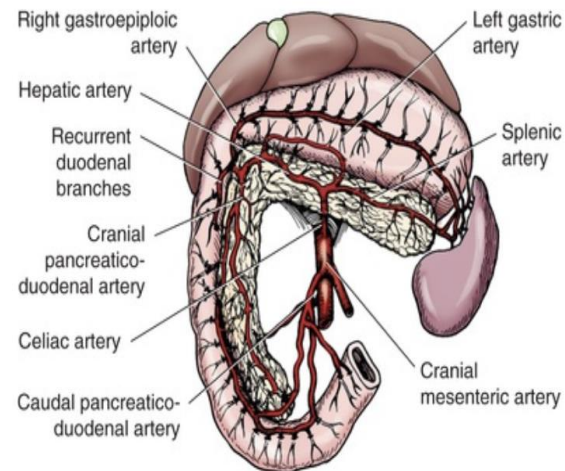
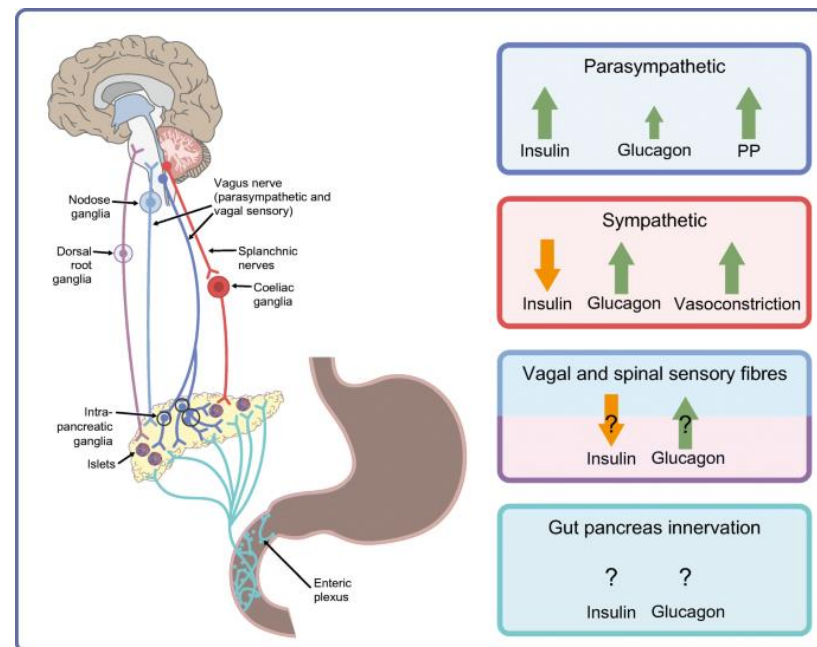


FIGURE 97.3 Arterial supply of the canine pancreas. (Copyright University of Georgia, 2001.)

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery : Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

Pancreatic Innervation

- Enteric nervous system
- Vagus nerve
- Celiac and cranial mesenteric plexus
- Cholinergic neurons
- Parasympathetic and sympathetic activity



Hampton, R.F., Jimenez-Gonzalez, M. & Stanley, S.A. Unravelling innervation of pancreatic islets. *Diabetologia* 65, 1069–1084 (2022). <https://doi.org/10.1007/s00125-022-05691-9>

Pancreatic Ducts

- Accessory pancreatic duct
- Pancreatic duct
- Minor duodenal papilla
- Major duodenal papilla

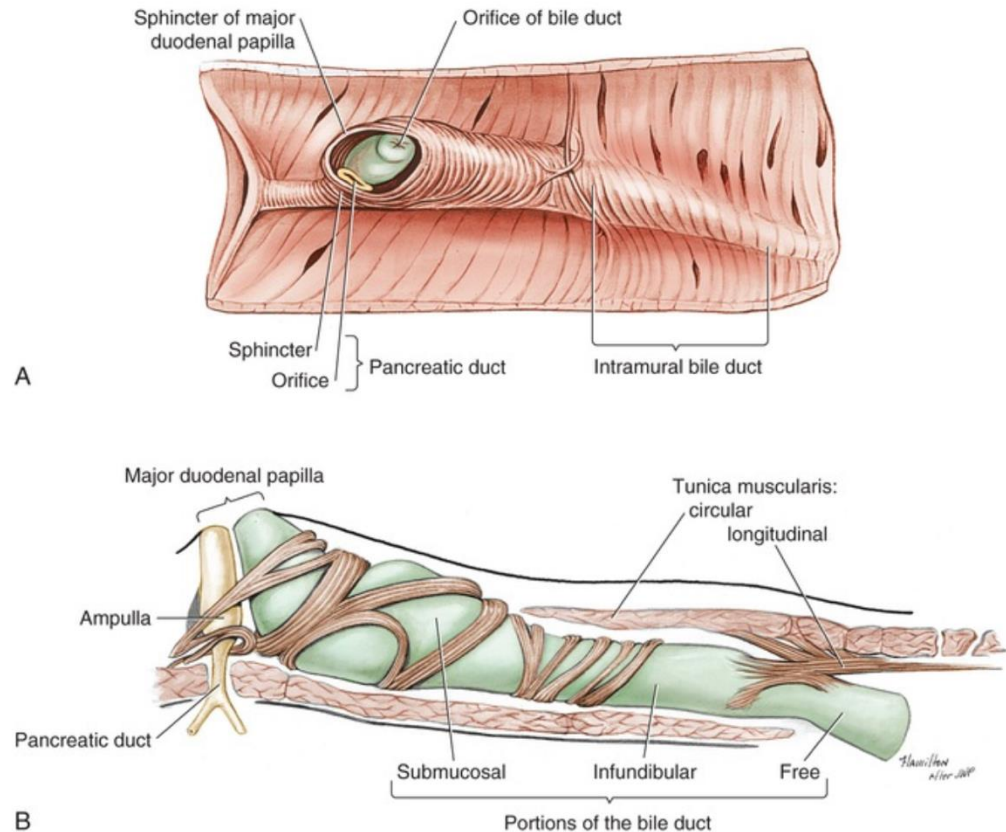
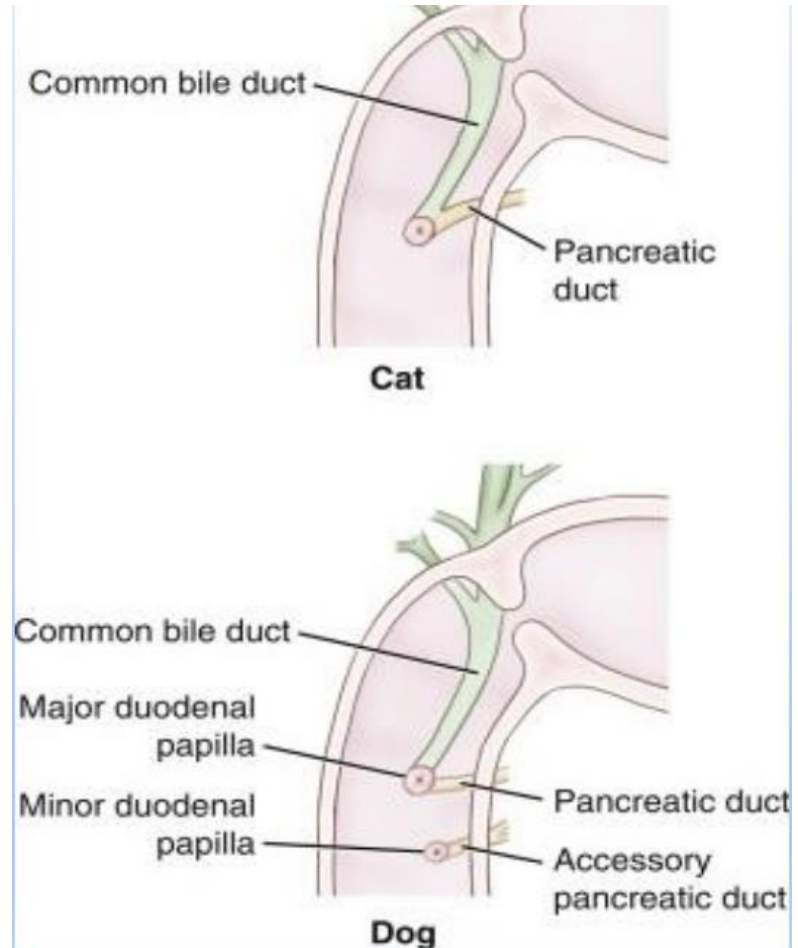


FIGURE 97.5 A, Anatomy of the major duodenal papilla in the dog. B, Entrance of the pancreatic duct adjacent to the opening of the bile duct at the major duodenal papilla in the dog. (From Evans HE, de Lahunta A: *Miller's anatomy of the dog*, ed 4, St Louis, 2013, Saunders/Elsevier.)

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery: Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

Pancreatic Ducts Con't

- Accessory pancreatic duct is larger
- Cats have a single pancreatic duct fusing with the common bile duct



Anatomy Con't

- Exocrine and Endocrine components
- Pancreatic lobules; acinar cells
- Islets of Langerhans

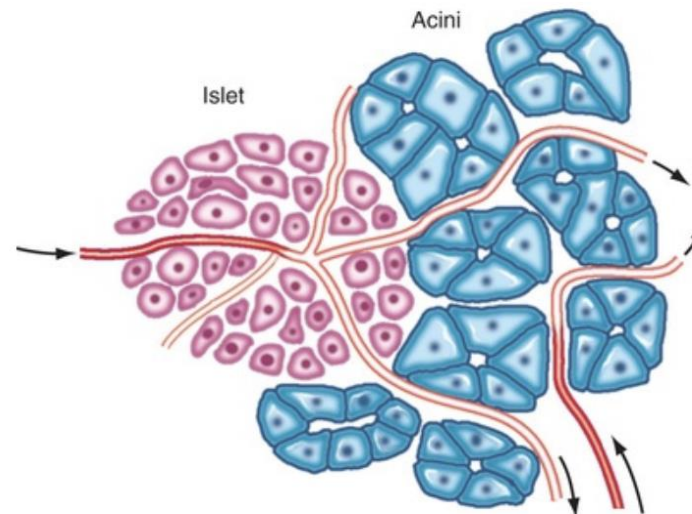
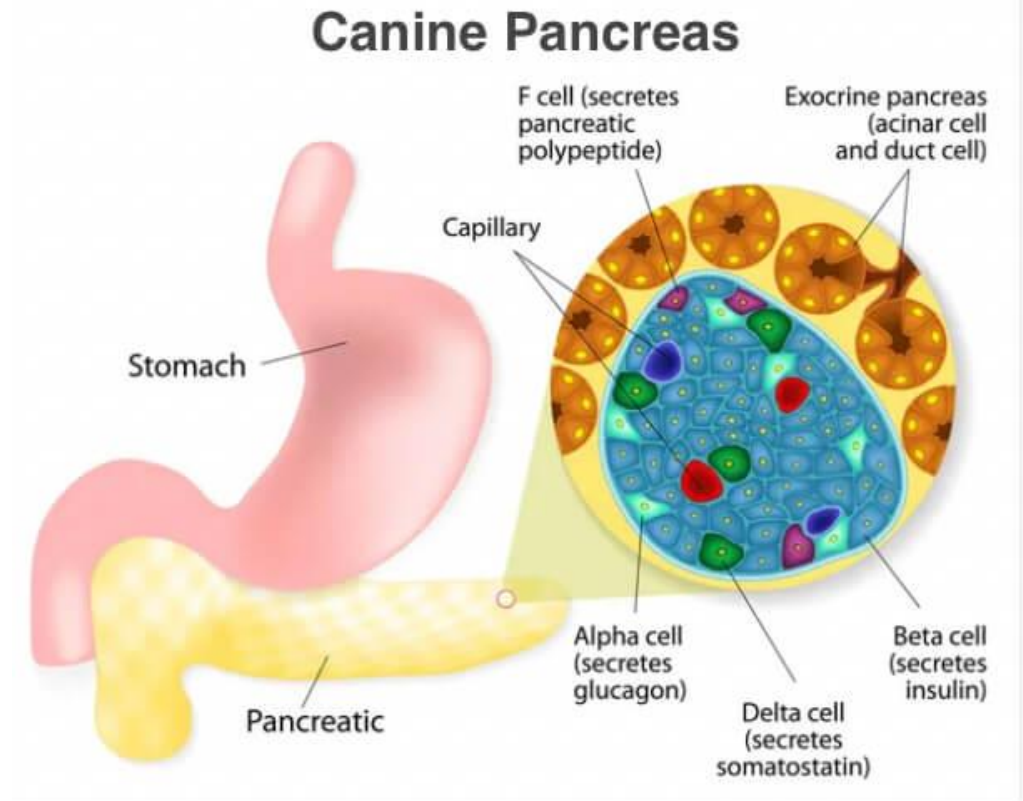


FIGURE 97.2 Schematic diagram of pancreatic lobule showing the intimate relationship of acinar cells (the exocrine pancreas) with islet cells (the endocrine pancreas). (From Goldfine ID, Williams JA: Receptors for insulin and CCK in the acinar pancreas: relationship to hormone action. *Int Rev Cytol* 85:1, 1983.)

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery : Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

Physiology: Endocrine

- Insulin lowers glucose via GLUT4- mediated uptake
 - Controls glucose efflux
 - Suppresses hepatic gluconeogenesis
- Glucagon
 - Controls glucose influx
 - Counterregulatory in hypoglycemia
- Somatostatin
 - Paracrine inhibition of insulin and glucagon



<https://www.kingsdale.com/what-is-exocrine-pancreatic-insufficiency-in-dogs>

Physiology: Exocrine

- Digestion

Products of the Pancreatic Acinar Cells and Their Functions

Proteases		
Function to breakdown protein in the duodenal lumen		
Zymogen (Secreted Inactive Precursor)	Activator	Active Enzyme and Function of Enzyme
Trypsinogen	Enterokinase	Trypsin endopeptidase
Chymotrypsinogen	Trypsin	Chymotrypsin endopeptidase
Proelastases	Trypsin	Elastase endopeptidase
Procarboxypeptidases	Trypsin	Carboxypeptidase exopeptidase
Amylases		
Function to digest starch and glycogen in the duodenal lumen		
Status at Time of Secretion	Function	Final Product
Active	Hydrolysis	Glucose
Lipases		
Function to hydrolyze triglyceride molecules		
Inactive Form Secreted	Active Form	Other Factors Required for Function
Prophospholipase A ₂	Phospholipase A ₂	Bile salts
		Colipase
None	Lipase	Bile salts
		Colipase
None	Carboxylesterase	Bile salts
		Colipase
Inhibitors		
Pancreatic secretory trypsin inhibitor		Inhibits activation of trypsin within the pancreatic tissue

Digestion Con't

- Inactive zymogens
- Coenzymes
- Enzymes
- Inhibitors

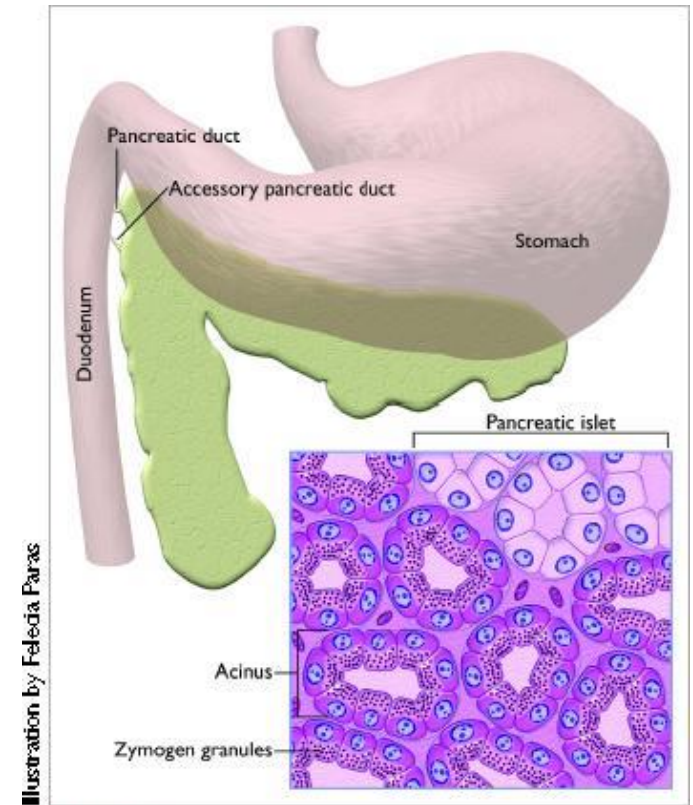


Figure 1. Most dogs have both a pancreatic duct and an accessory pancreatic duct. The exocrine pancreas comprises most of the pancreatic tissue. Pancreatic islets of Langerhans' comprise less than 5% of the pancreatic tissue.

<https://nutricanine.ca/blogs/dog-digest/pancreatitis-in-dogs?srsId=AfmBOorMclI5kgymMmFnNhcu-x3cMQOh2dtO0Q7LcktCaF4B8hQN8ePf>

Digestion Con't

- Inorganic components
 - Water
 - Sodium
 - Potassium
 - Chloride
 - Bicarbonate



Digestion Con't

Cephalic/gastric phases:
vagal stimulation; gastric
distension

Intestinal phase: CCK
(fat/protein) → enzyme
secretion; Secretin (acid)
→ bicarbonate & water

Digestion Con't

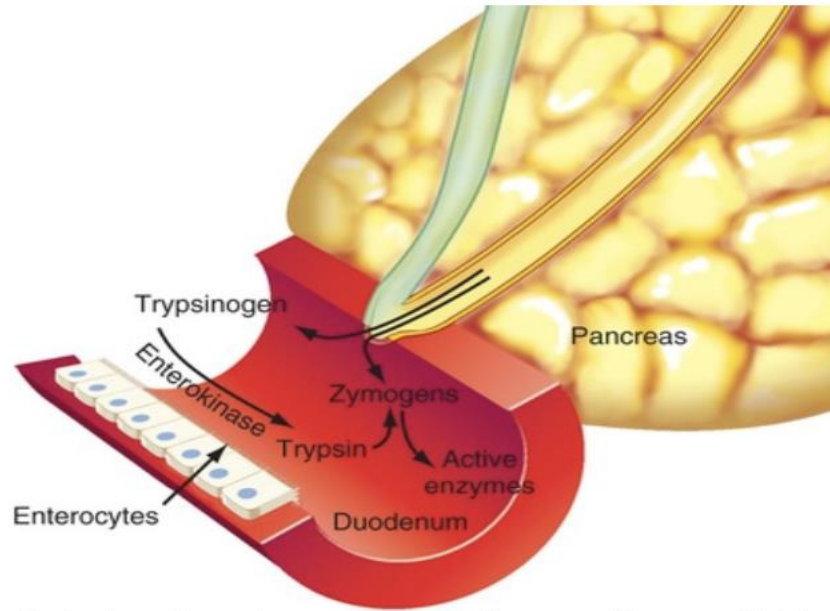


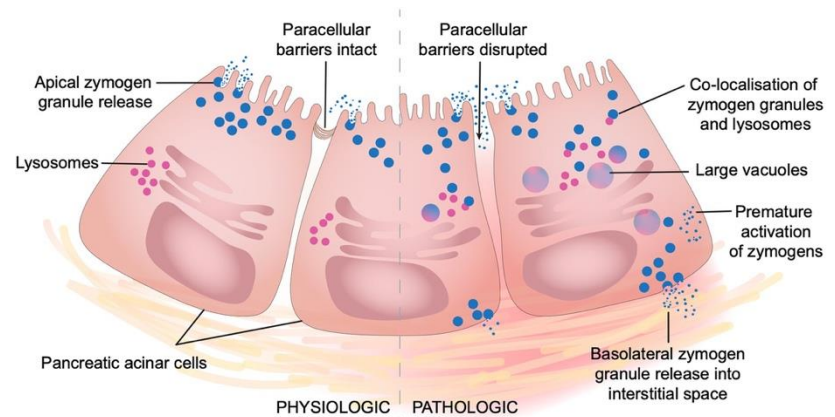
FIGURE 97.7 Activation of trypsinogen to trypsin by enterokinase, which is produced by the enterocytes. Trypsin then converts the other proenzymes to active forms through proteolytic cleavage. (From Feldman EC: *Sleisenger and Fordtran's gastrointestinal and liver disease*, ed 9. Copyright 2010 Saunders, an imprint of Elsevier. Adapted from Gorelick F, Pandol SJ, Topazian M: *Pancreatic physiology, pathophysiology, acute and chronic pancreatitis*. Gastrointestinal Teaching Project. Bethesda, MD, 2003, American Gastroenterological Association.)

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery: Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

- Enterokinase in duodenal brush border converts trypsinogen → trypsin → activates other zymogens

Prevention of Autodigestion

- Three mechanisms
 - Packaging of zymogens
 - Segregated storage of granule-lysosome
 - Trypsin inhibitor



Criddle H, Lim SY, Algül H, Steiner JM. New insights into the etiology, risk factors, and pathogenesis of pancreatitis in dogs: Potential impacts on clinical practice. *J Vet Intern Med.* 2022; 36(3): 847-864. doi:[10.1111/jvim.16437](https://doi.org/10.1111/jvim.16437)

Microanatomy Recep

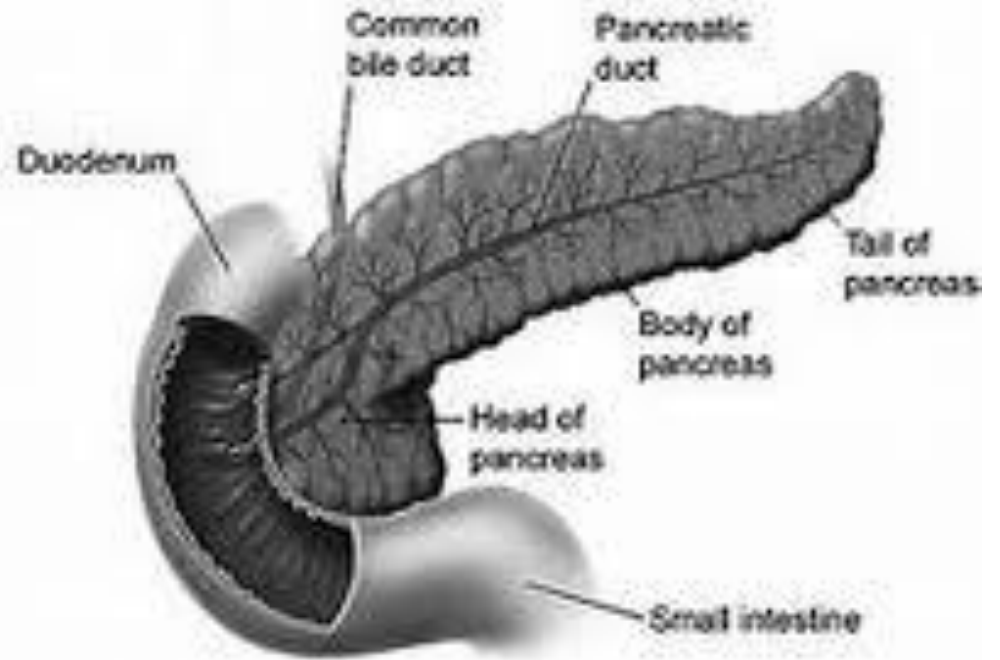
Exocrine acini → zymogen granules
(trypsinogen, chymotrypsinogen,
lipase, amylase, phospholipase A2)

Ductal cells → bicarbonate-rich fluid
(secretin-driven)

Endocrine islets (α , β , δ , PP, ϵ cells) →
glucagon, insulin, somatostatin,
pancreatic polypeptide, ghrelin

Trypsin inhibitor proteins protect
against premature activation

Diseases of the Pancreas



Pancreatitis

- Acute Pancreatitis
- Chronic Pancreatitis
- Range of clinical signs
 - Mild to severe



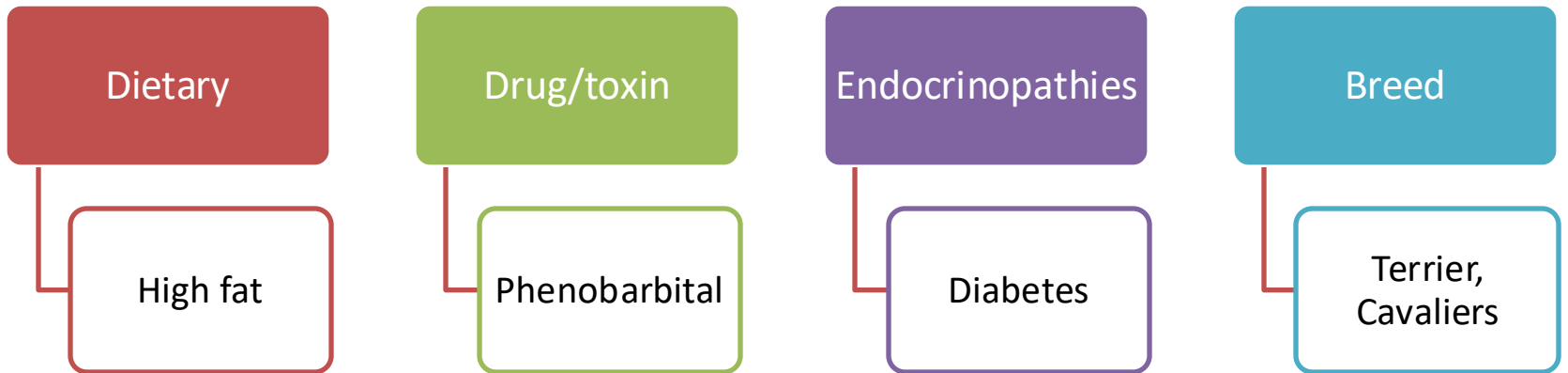
Etiology of Pancreatitis

- 95% of the cases are idiopathic
- Multiple risk factors
- Trauma
- Autoimmune
- Any surgical procedure

New insights into the etiology, risk factors, and pathogenesis of pancreatitis in dogs: Potential impacts on clinical practice

[Harry Cridge](#)^{1,8}, [Sue Yee Lim](#)², [Hana Algül](#)³, [Jörg M Steiner](#)²

Etiology Con't



Etiology Con't

Trauma

- Vehicular or high rise syndrome

Autoimmune

- Type 1
- Type 2

Surgery

- Hypotension

Pathophysiology of Pancreatitis



Acute Pancreatitis

Etiologies overwhelm safeguards: premature trypsin activation → enzyme cascade
Stimulation of inflammatory pathway
Trypsin contribution

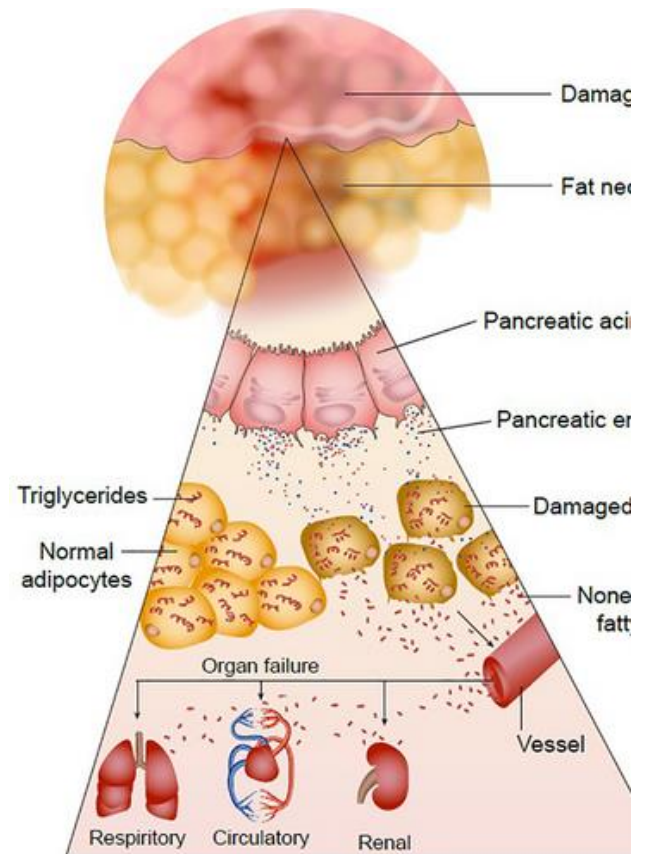


Chronic Pancreatitis

Independent of acute pancreatitis
Cell injury: Ca²⁺ overload, mitochondrial dysfunction, ROS; microvascular ischemia



Systemic spillover of inflammation



ACVIM consensus statement on pancreatitis in cats

[Marnin A Forman](#)¹, [Joerg M Steiner](#)^{2,8*}, [P Jane Armstrong](#)³, [Melinda S Camus](#)⁴, [Lorrie Gaschen](#)⁵, [Steve L Hill](#)⁶, [Caroline S Mansfield](#)⁷, [Katja Steiger](#)⁸

Cridge H, Lim SY, Algül H, Steiner JM. New insights into the etiology, risk factors, and pathogenesis of pancreatitis in dogs: Potential impacts on clinical practice. *J Vet Intern Med.* 2022; 36(3): 847-864. doi:10.1111/jvim.16437

Clinical signs

- Dogs: vomiting, cranial abdominal pain, prayer posture, anorexia, diarrhea
- Cats: vague—lethargy, hyporexia, dehydration, weight loss; vomiting less consistent
- Differentials: foreign body, GDV, hepatobiliary disease, pyelonephritis, peritonitis, Addison's, etc.



Screening test

CBC

Chemistry

UA

C-reactive
protein

Coagulation
times

Laboratory Diagnosis of Pancreatitis

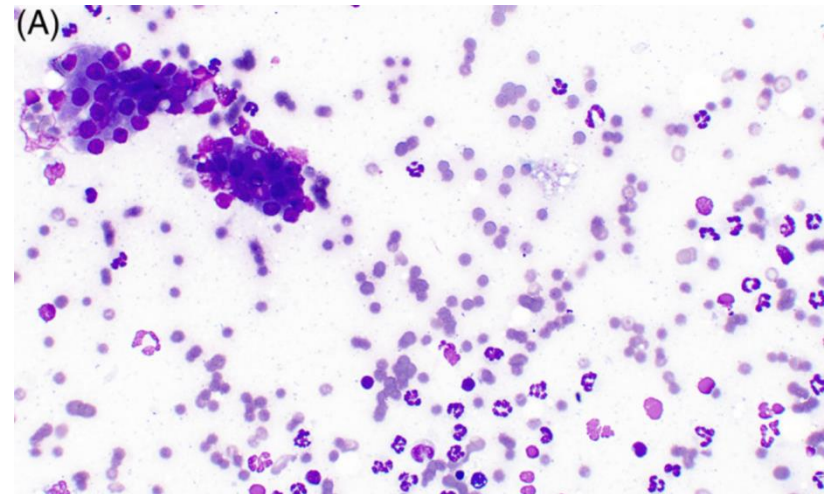
Adam J Rudinsky ¹

Markers of Pancreatitis

- Amylase and Lipase
- Precision PSL
- V-LIP-P
- Spec cPL/fPL
- Snap PL
- VetScan cPL, Vcheck canine specific lipase
- TLI, Phospholipase A2, Pancreatic elastase 1, and more



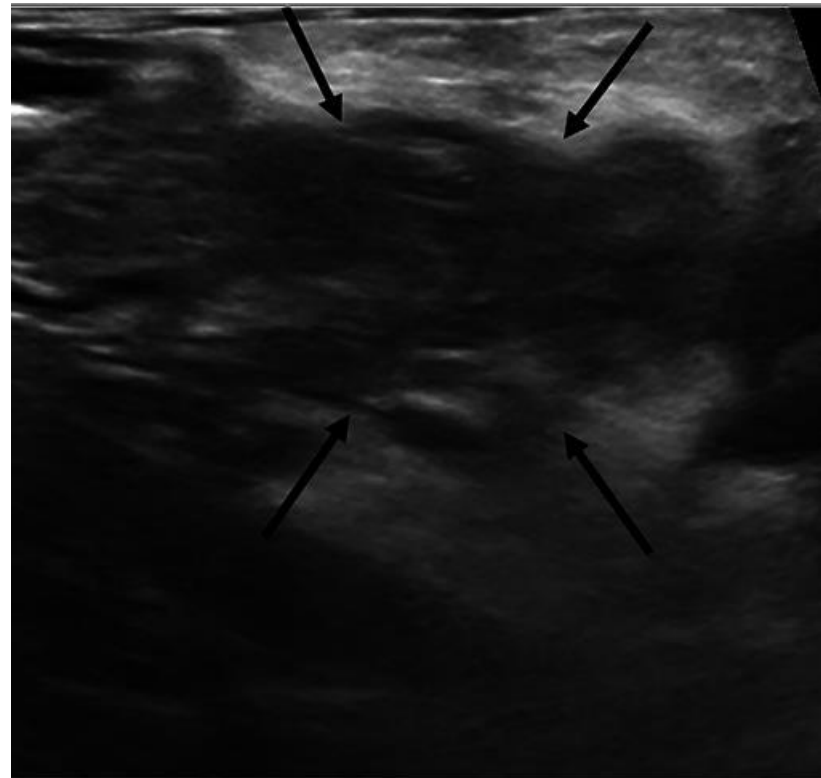
Xenoulis, Panagiotis G.; Steiner, Jörg M. (2016). *SNAP Tests for Pancreatitis in Dogs and Cats: SNAP cPL and SNAP fPL. Topics in Companion Animal Medicine*, (), S1938973616300319–. doi:10.1053/j.tcam.2016.10.005



Cridge H, Twedt DC, Marolf AJ, Sharkey LC, Steiner JM. Advances in the diagnosis of acute pancreatitis in dogs. *J Vet Intern Med*. 2021 Nov;35(6):2572-2587. doi: 10.1111/jvim.16292. Epub 2021 Nov 9. PMID: 34751442; PMCID: PMC8692219.

Imaging

- Radiographic: decreased serosal detail within the right cranial quadrant
- Ultrasound: enlarged hypoechoic pancreas, hyperechoic adjacent mesentery, fluid, biliary dilation
- CT: enhancing pancreas



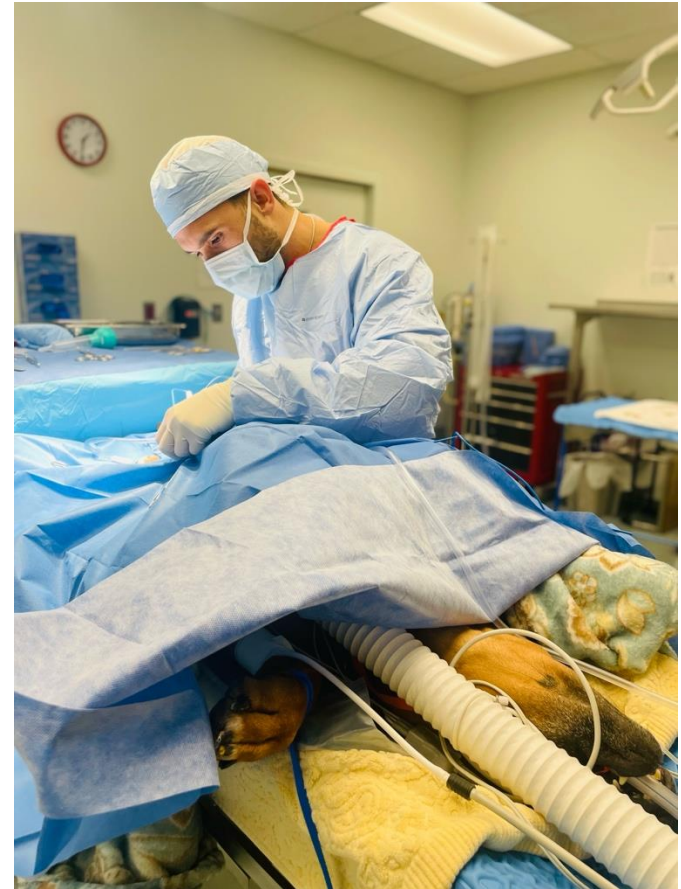
Treatment

- Medical Management
 - IV crystalloids
 - Analgesia
 - Nutrition
 - Gastric medications
 - Panoquell



Treatment Con't

- Surgical Management
 - Confirmed/strongly suspected infected necrosis or abscess not responding to medical management
 - Symptomatic pseudocyst or cyst (pain, rupture risk, hemorrhage)
 - Persistent/complete extrahepatic biliary obstruction (especially cats)
 - Concurrent surgical disease (e.g., gallbladder mucocele, perforation)



Surgical Management Con't

- Ventral midline celiotomy; wide exposure
- Gentle tissue handling
- Vascular control
- Duct preservation
- Minimize contamination
- +/- intraoperative glucose monitoring

Complications

- SIRS/MODS, DIC, ARDS/ALI; myocardial arrhythmias; AKI; hepatobiliary cholestasis
- Pancreatic effusions, pseudocysts, abscess/phlegmon; ileus
- Endocrine fallout: transient DM or EPI after severe necrosis



<https://www.istockphoto.com/photo/complications-ahead-road-sign-gm155098709-18158558>

Prognosis

- Medical management produces a successful outcome in mild to moderate cases
 - Feline acute pancreatitis; Mortality 10-40%
 - Canine acute pancreatitis; Mortality ~25%
- Surgical management had a fair prognosis

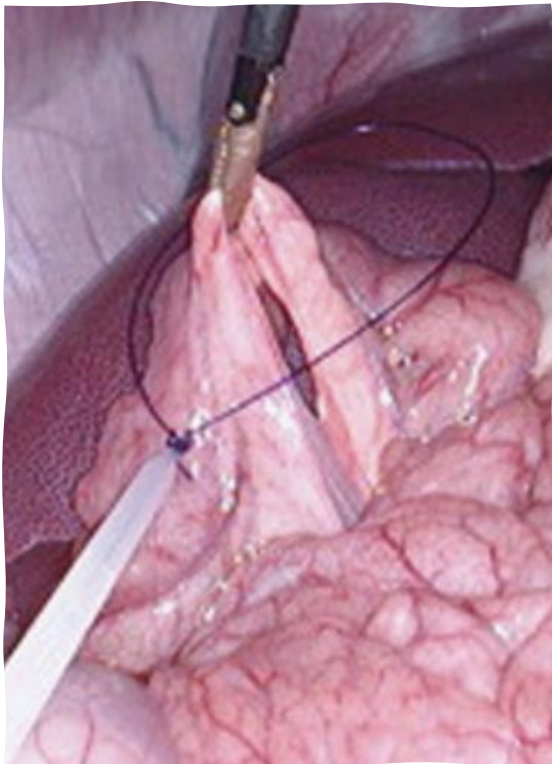


shutterstock.com · 2630906945

Characteristics and outcomes in surgical management of severe acute pancreatitis: 37 dogs (2001–2007)

Lisa J. Thompson DVM, Ravi Seshadri DVM, DACVECC, DAVBP, Marc R. Raffe DVM, MS, DACVA, DACVECC

Surgical Diseases



Pancreatic Abscess/phlegmon

- Most commonly a sequela to pancreatitis
- Sterile abscesses

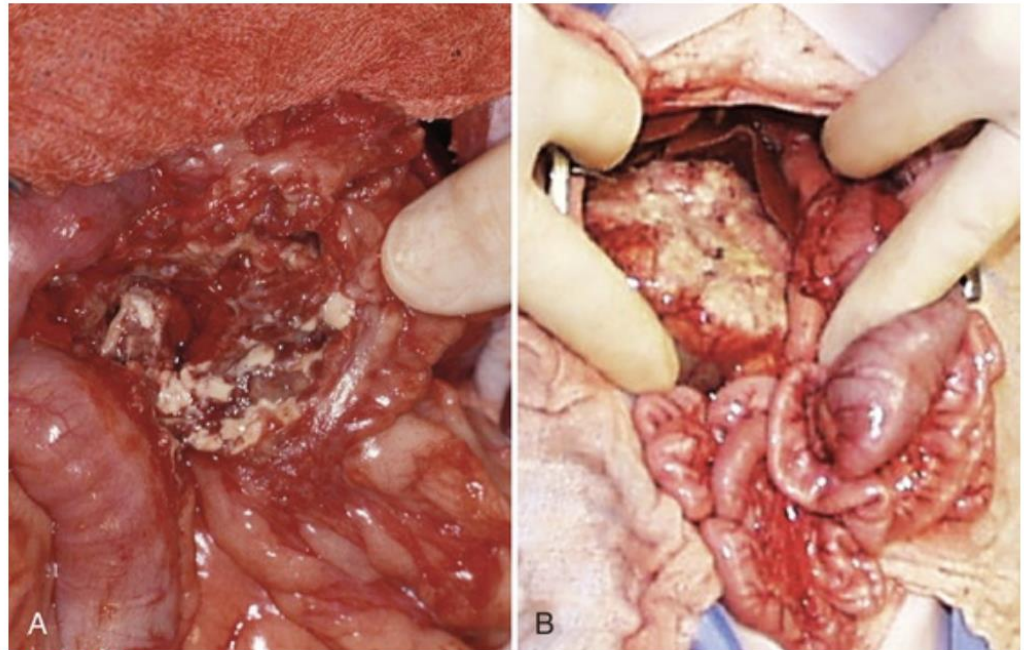


FIGURE 97.11 Pancreatic abscess. A, Note purulent material inside the cavity of the abscess. B, Large pancreatic abscess associated with the right limb of the pancreas.

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery : Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

Clinical Findings

Vomiting

Anorexia

Lethargy

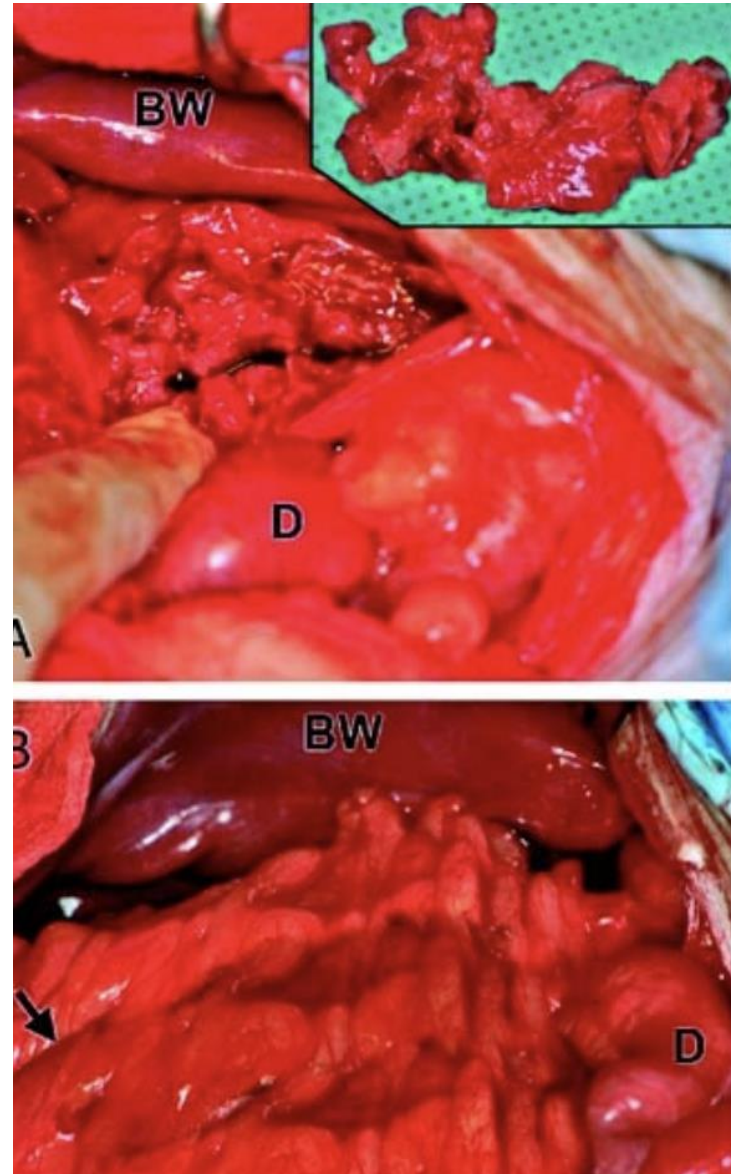
Diarrhea

Loss of
serosal detail

Gas

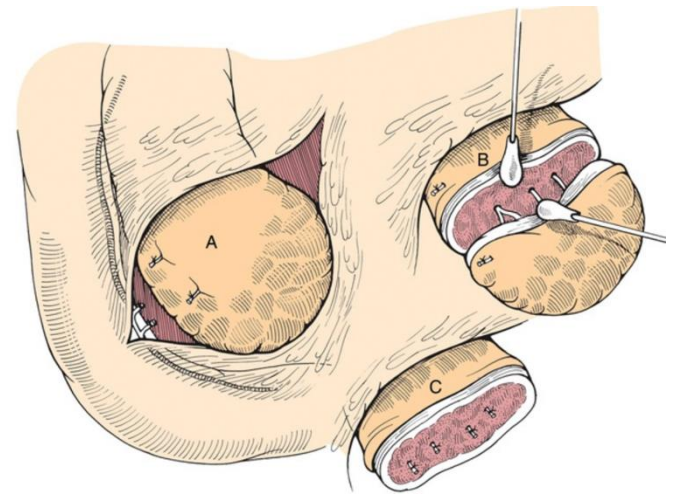
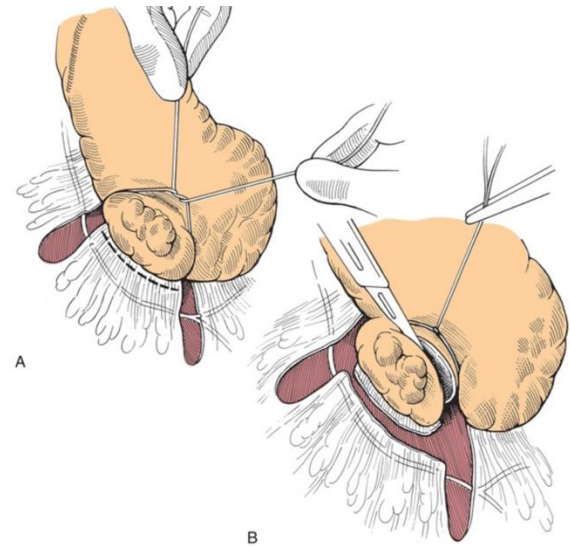
Surgical Management

- Drain, debride non-viable tissue; send cultures (aerobic/anaerobic)
- Omentalization and closed-suction drains; staged re-exploration if needed



Surgical Management Con't

- Partial Pancreatectomy
 - Isolate affected segment
 - Blunt dissection technique v. suture fracture technique v. alternatives
 - Gentle hemostasis



Post Operative Management

- Intensive care
 - IV crystalloids
 - Antibiotics
 - Analgesia
 - Nutrition
 - Gastric medications
 - Serial monitoring and blood work

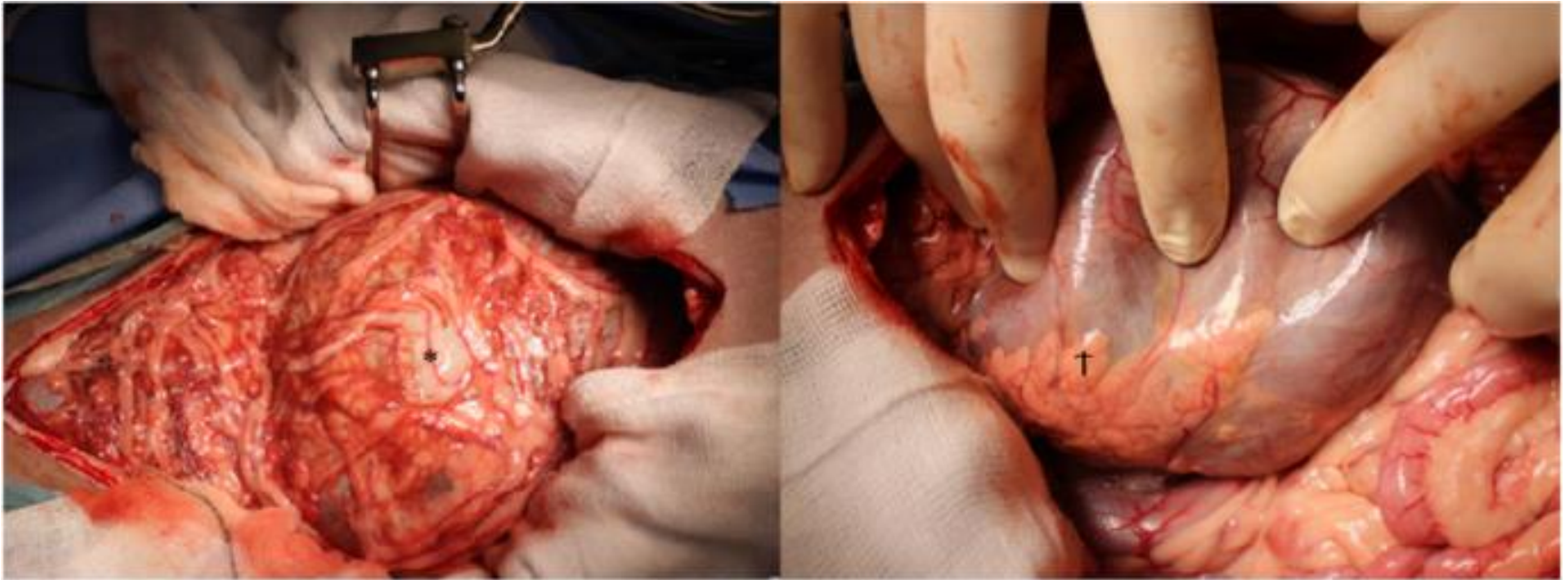
Prognosis

Survival rates
range from 15-
55%

60% survival
with
omentalization

Pancreatic Pseudocysts

- Collection of pancreatic secretions within a non-epithelialized fibrous sac
- Exact causation unknown



Healy, D.M., Cassidy, J.P. & Martin, S.A. A true congenital pancreatic cyst in a dog. *BMC Vet Res* 18, 304 (2022). <https://doi.org/10.1186/s12917-022-03215-6>

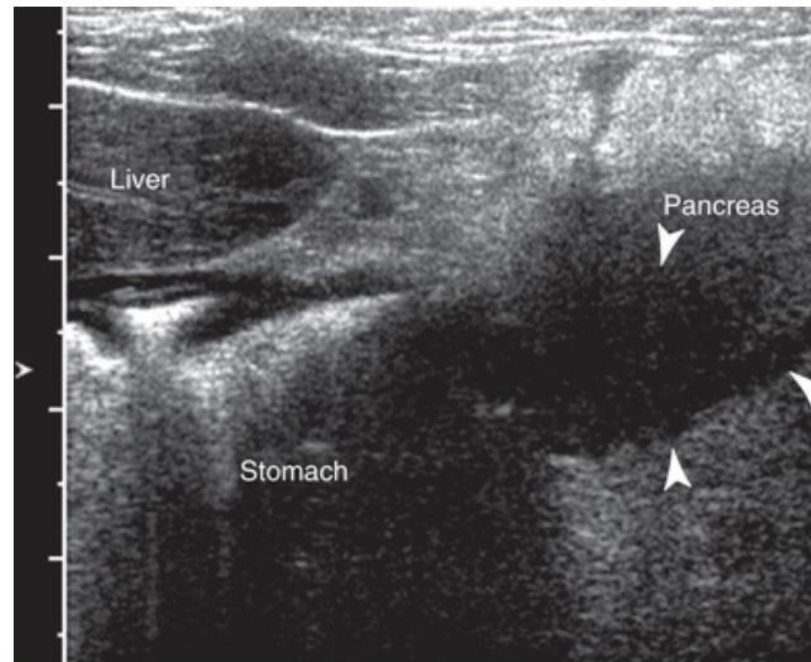
Clinical Findings

- Reported in dogs and cat
- Clinical signs attributed to pancreatitis
 - Vomiting
 - Anorexia
 - Lethargy



Diagnosis

- Ultrasound
- Fine needle aspirates
- Radiographs



! Pancreatic pseudocyst. The *arrowheads* indicate the hypoechoic walls of the pseudocyst.
Hecht S, Henry G: Sonographic evaluation of the normal and abnormal pancreas. *Ultrasound in Medicine and Biology* 2007;35:115-121. © 2007 Elsevier Inc.)

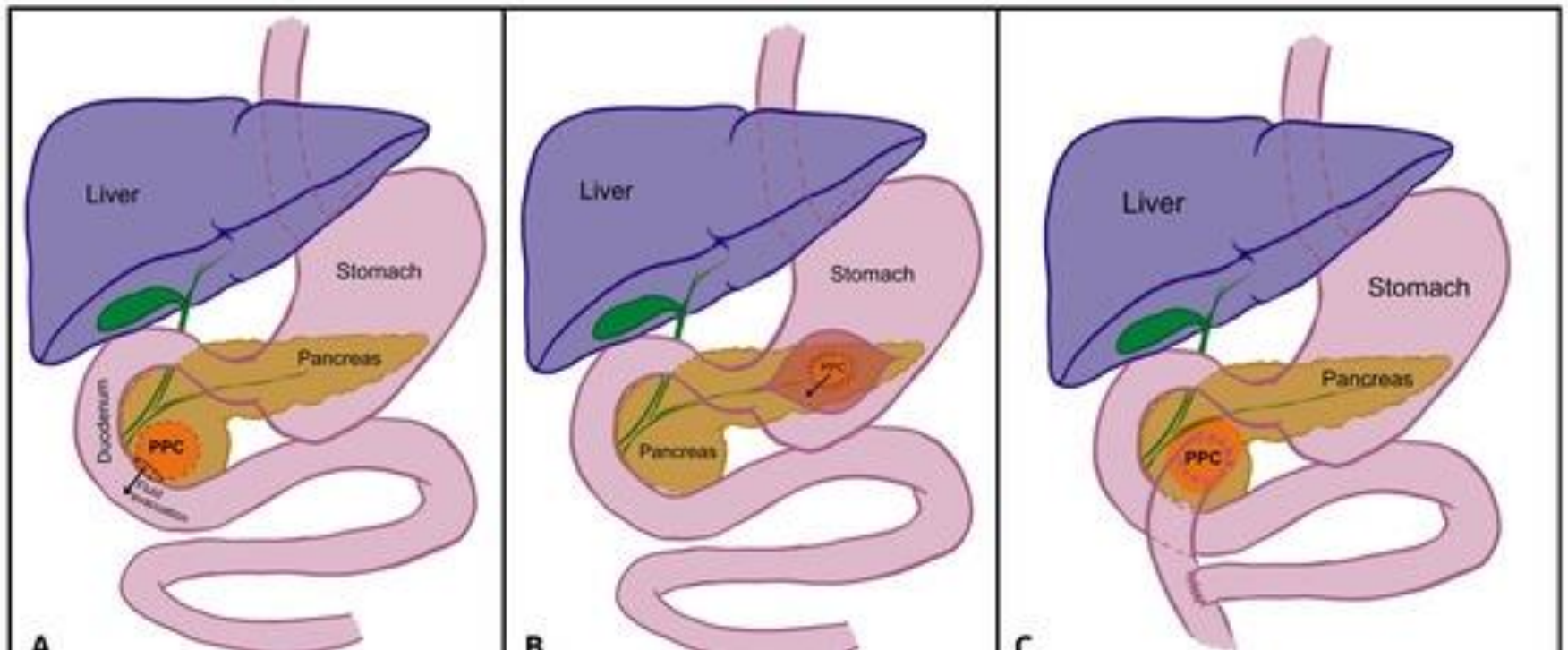
Therapeutic Intervention

Based on
Guidelines used
in humans

Does not always
necessitate
treatment

Surgical techniques

- Cystoduodenostomy
- Cystojejunostomy
- Cystogastrotomy
- Omentalization
- Complete excision



Prognosis

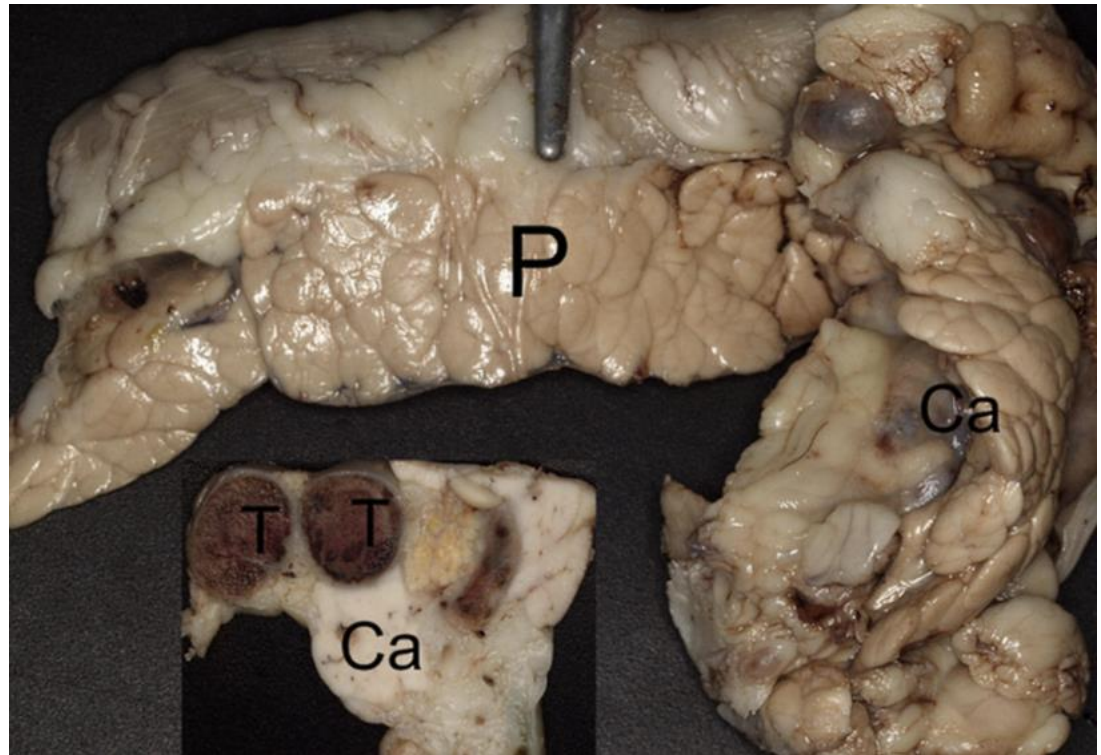
Good prognosis



<https://www.vecteezy.com/png/51226640-happy-dog-with-raised-paw-looking-at-camera-isolated-on-transparent-background-cute-pet-portrait-for-animal-themed-designs-and-advertising>

Pancreatic Exocrine Tumors

- Adenocarcinoma
- Acinar cell carcinoma
- Adenoma
- Pancreatoblastoma
- Adenosquamous carcinoma



Aupperle-Lellbach H, Törner K, Staudacher M, et al. Histopathological findings and canine pancreatic lipase immunoreactivity in normal dogs and dogs with inflammatory and neoplastic diseases of the pancreas. *J Vet Intern Med.* 2020; 34: 1127–1134. <https://doi.org/10.1111/jvim.15779>

Exocrine Tumor Clinical Findings and Diagnostics

Weight loss

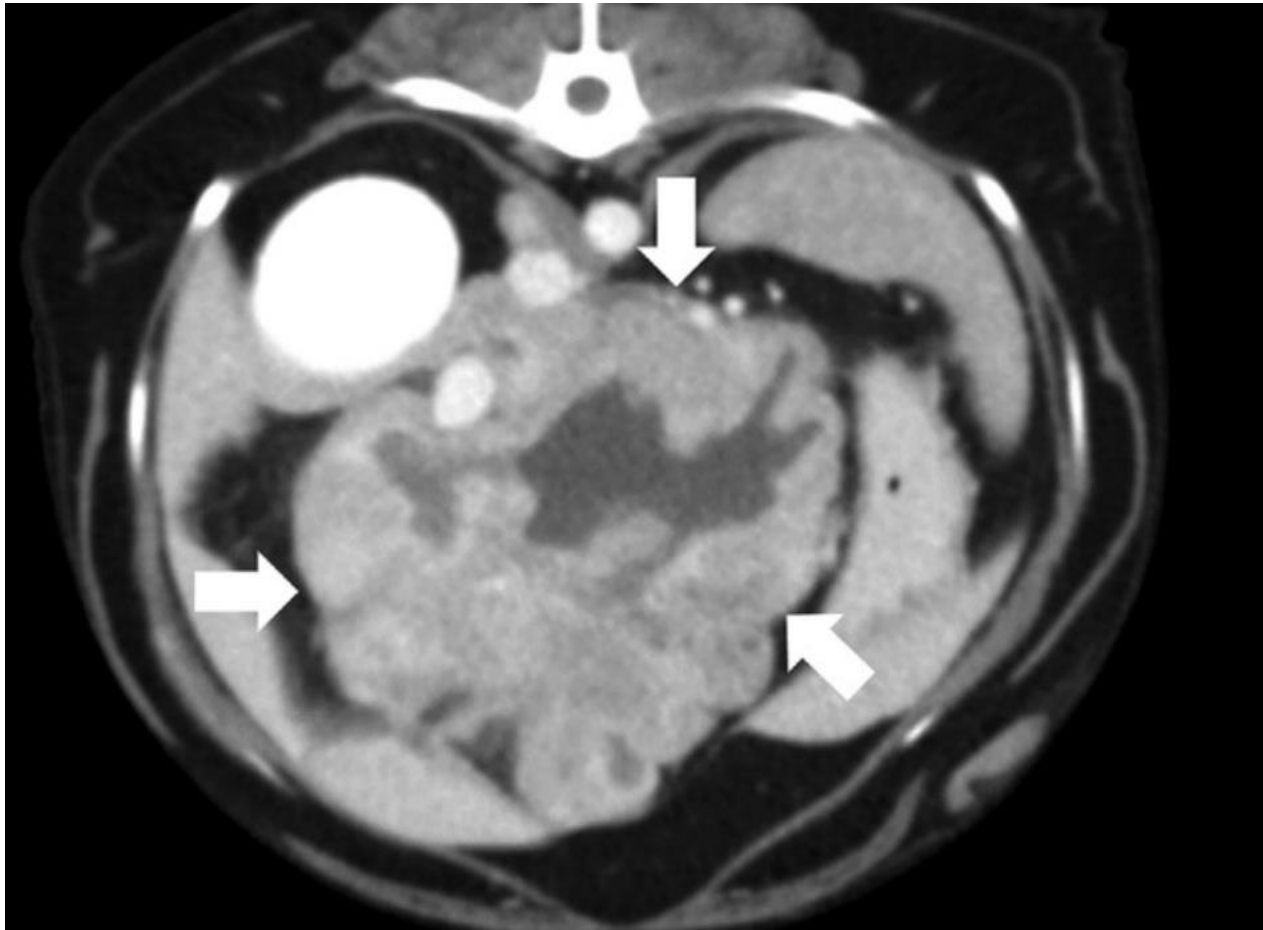
Anorexia

Vomiting

Icterus

Paraneoplastic alopecia

Abdominal effusion

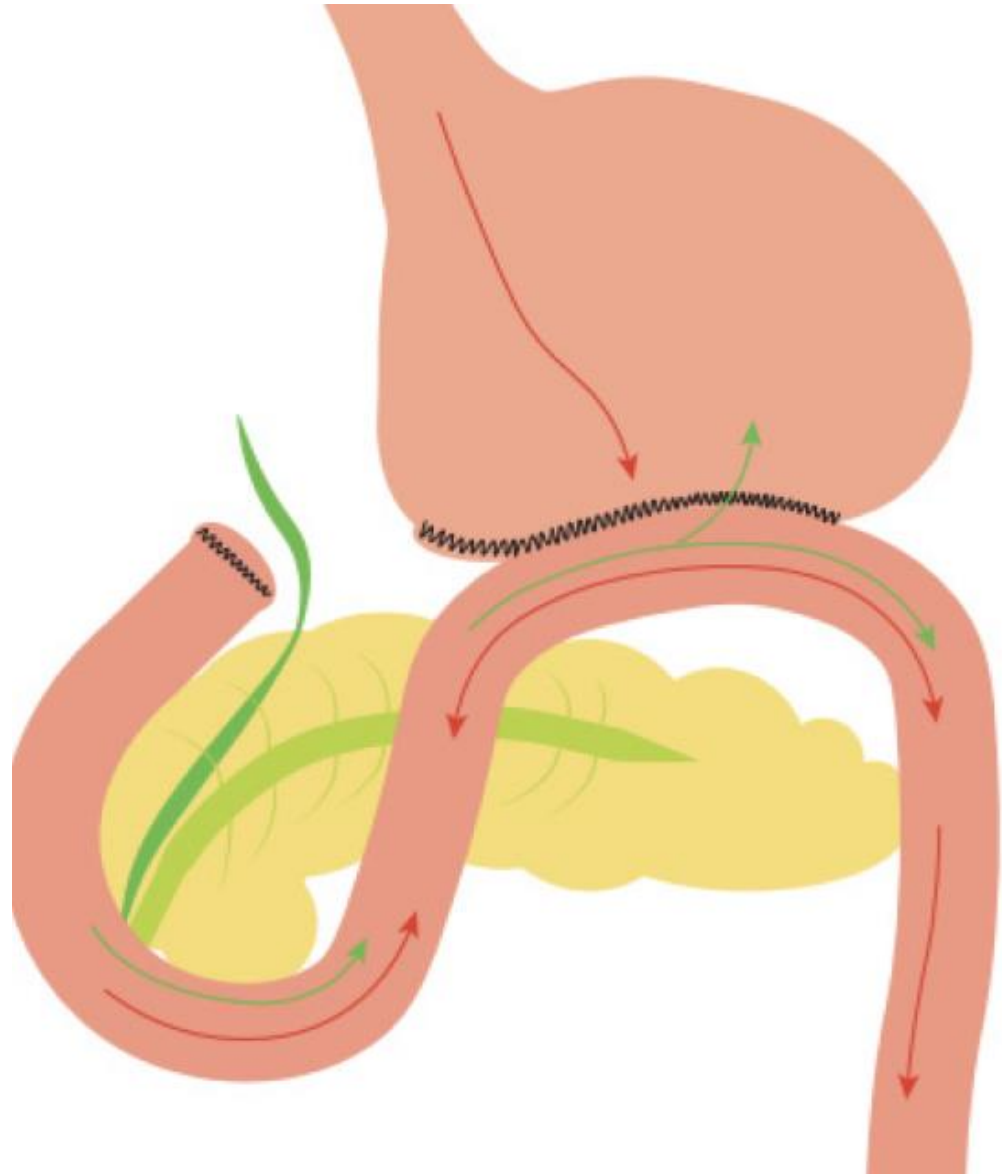


Computed tomographic features of exocrine pancreatic carcinomas in dogs and cats

Alexandra Dunn, Sangeeta Rao, Brian Husbands, Nicholas Petrovitch, Samantha Loeber, Tobias Schwarz, Kelsey Cline, Wilfried Mai, Heather Spain, Kaitlin Curran, Kate Vickery, Angela Marolf [✉](#)

Surgical Treatment

- Required for a definitive diagnosis
- Exploratory celiotomy
 - Pancreatectomy
 - Pancreaticoduodenectomy
 - Gastrojejunostomy



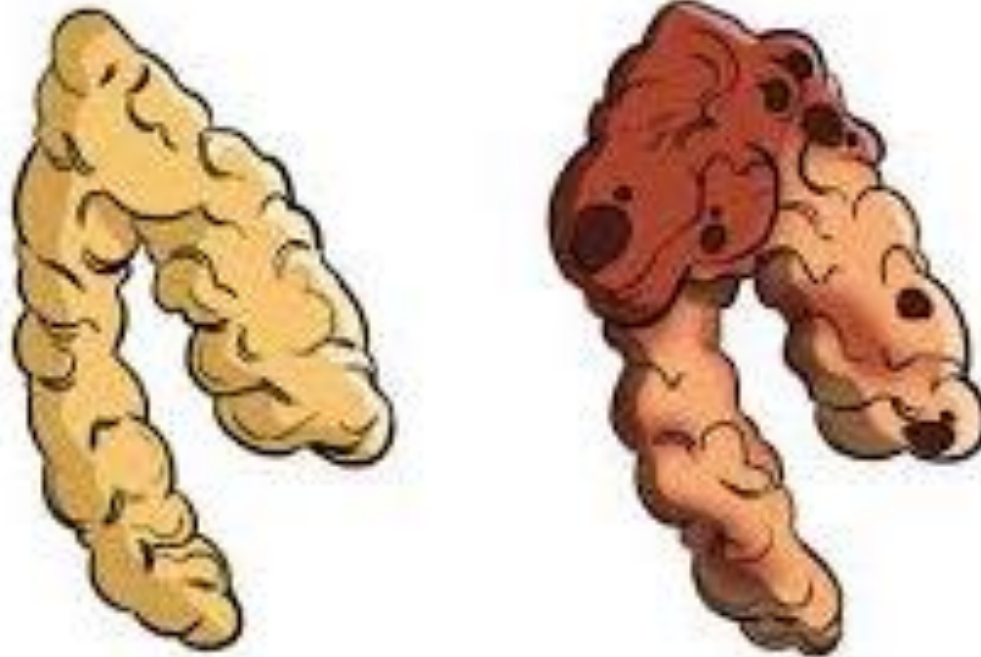


Prognosis

Extremely poor for
adenocarcinomas

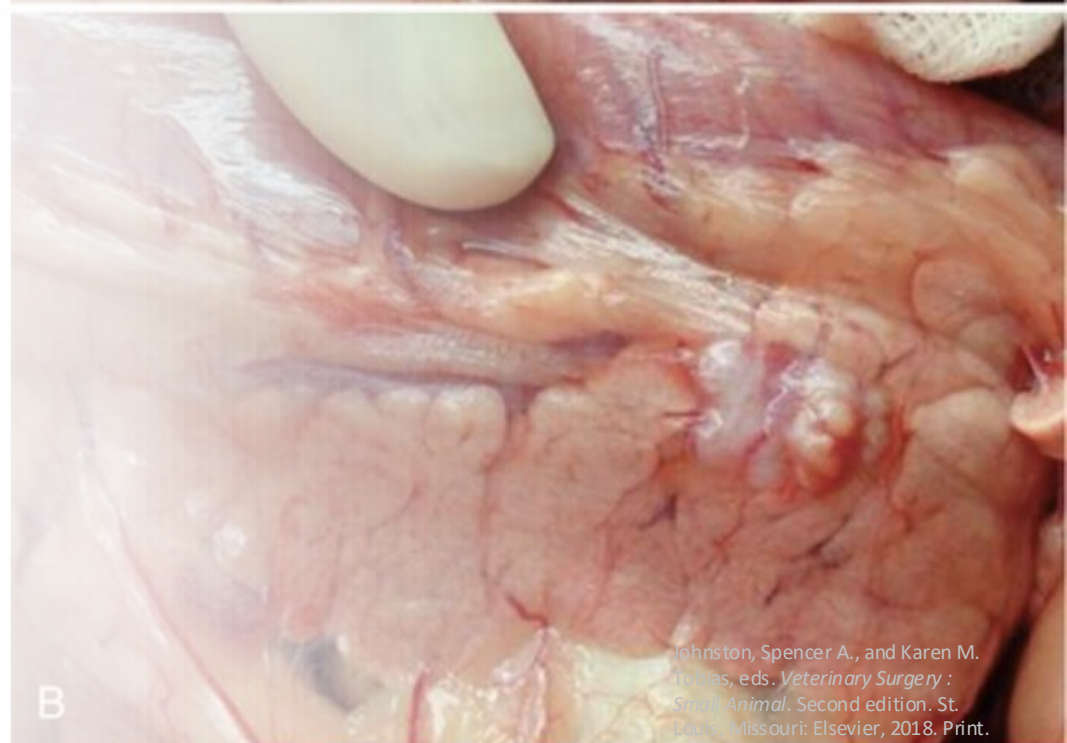


Endocrine Pancreatic Tumors



Insulinoma

- Arise from Beta cells
- Primarily secrete insulin
- Histologic criteria appear benign
- Regional lymph nodes and liver



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FIGURE 97.13 Insulinomas. A, An easily identified well-circumscribed insulinoma. B, A small, poorly circumscribed mass in the center of the right limb of the pancreas.

Clinical Signs

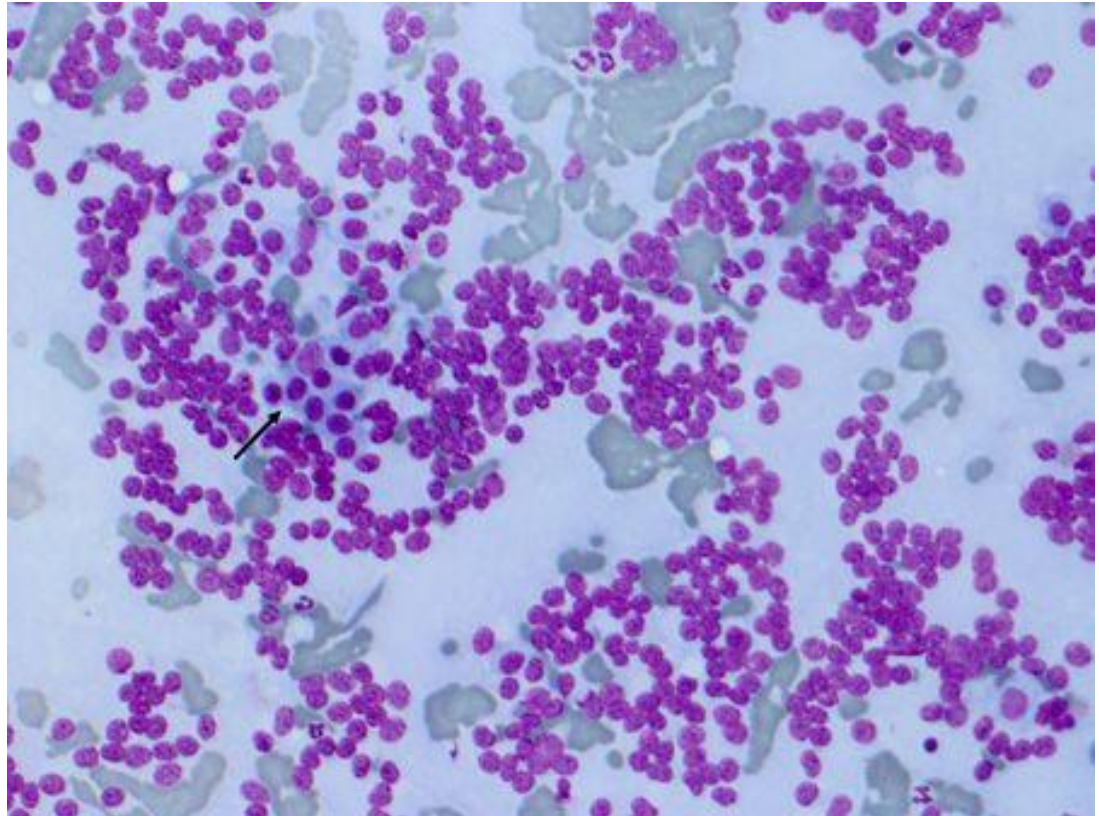
- Most reported in medium-large breeds
- Mean age 9-10 years
- Seizures
- Weakness
- Collapse
- Ataxia
- Neuronal demyelination and axonal degeneration



<https://vetneuro.com/neurological-signs-diseases/seizures/>

Laboratory Findings

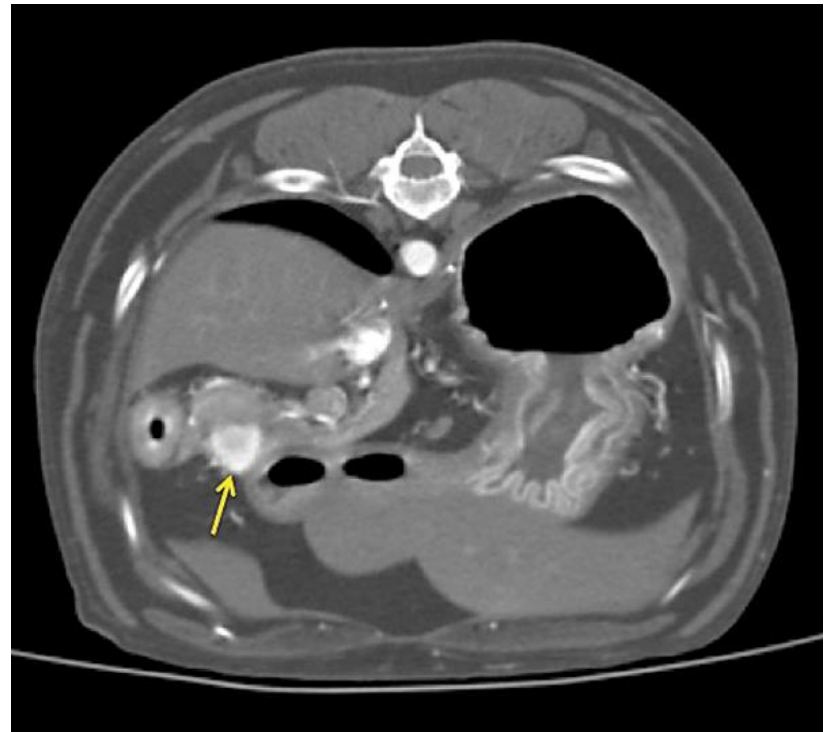
- Hypoglycemia may be consistent or intermittent
- Insulin glucose ratio
- Decreased fructosamine concentration
- Lack pink zymogen granules



By:Dr. Lisa Viesselmann

Imaging

- Ultrasound most common modality used
- Appear hypoechoic compared to the surrounding tissue
- Uniformly hypervascular
- CT



Preoperative Management

Frequent small meals

Glucocorticoids

Dextrose

Glucagon

Fasting
contraindicated

Use of a bipolar vessel-sealing device in resection of canine insulinoma

E G H Wouters¹, F O Buishand, M Kik, J Kirpensteijn

Surgical Treatment

- Essential for appropriate management
- Improves response to medical management and survival time
- Requires critical monitoring of glucose

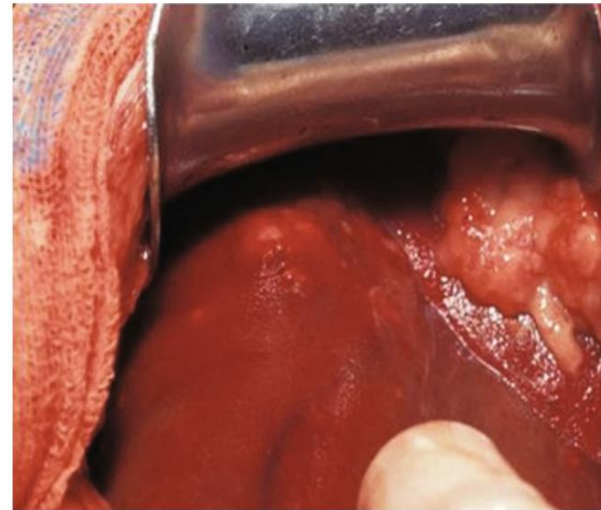
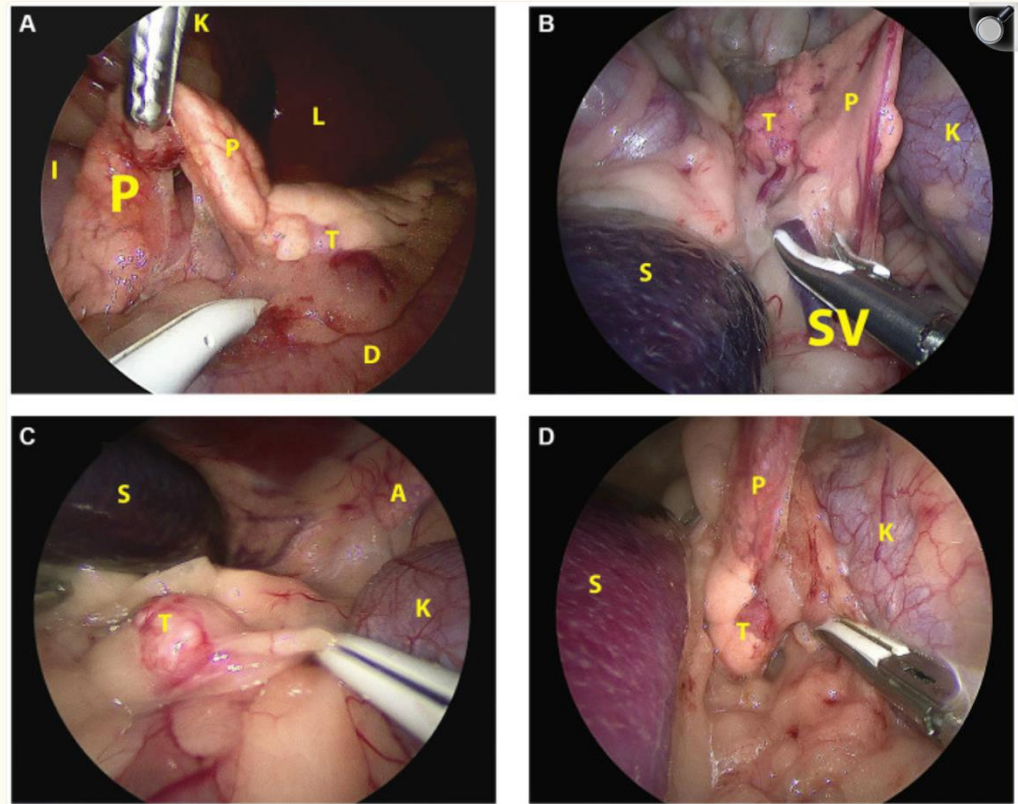


FIGURE 97.14 Metastatic insulinoma. Multiple raised pale foci are identified within the liver parenchyma.

Johnston, Spencer A., and Karen M. Tobias, eds. *Veterinary Surgery: Small Animal*. Second edition. St. Louis, Missouri: Elsevier, 2018. Print.

Surgical Treatment Con't

- Can be present in any limb
- Require gentle palpation of the entire pancreas
- Most commonly a partial pancreatectomy with a BVSD
- May require a venotomy
- Biopsy regional lymph node and liver



[Open in a new tab](#)

Laparoscopic image of the insulinoma situated in the affected pancreatic lobe during pancreatectomy in sternal recumbency in each patient. (A): Case 1, right flank approach, mid right lobe; (B): case 2, left flank approach, mid left lobe; (C): case 3, left flank approach, distal left lobe; (D): case 4, left flank approach, proximal left lobe. A: adrenal gland; D: duodenum; I: ileum; K: kidney; L: liver; P: pancreas; S: spleen; SV: splenic vein; T: tumor.

Laparoscopic partial pancreatectomy through an advanced lateral approach as treatment for insulinoma in dogs: a case series

Surgical Treatment Con't

- Sterile methylene blue can aid in identification
- Multiple pancreatic biopsies



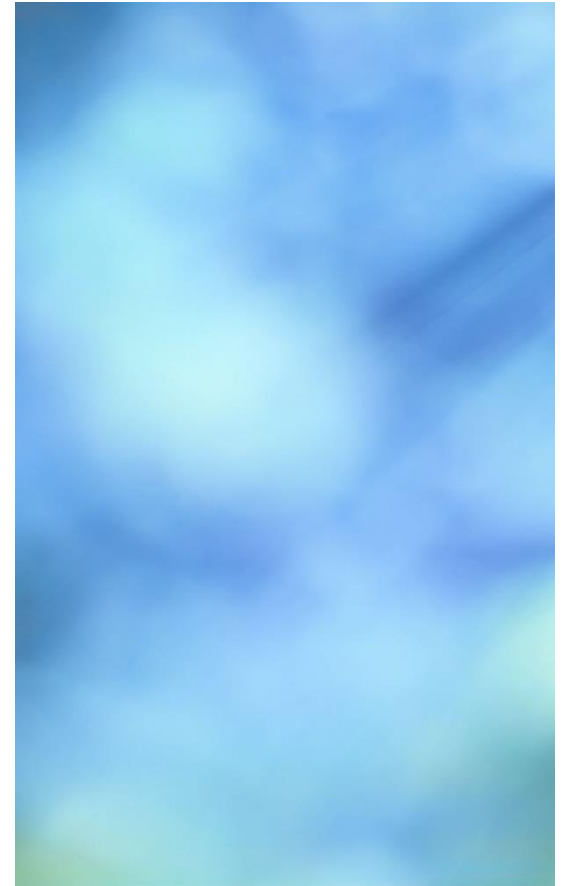
Post operative Care and Complications

Serial glucose monitoring

Transient hyperglycemia

Persistent hypoglycemia

Pancreatitis management



Persistent/Recurrent Hypoglycemia

Management directed at killing neoplastic cells or treating hypoglycemia

Glucocorticoids

Streptozocin

Diazoxide

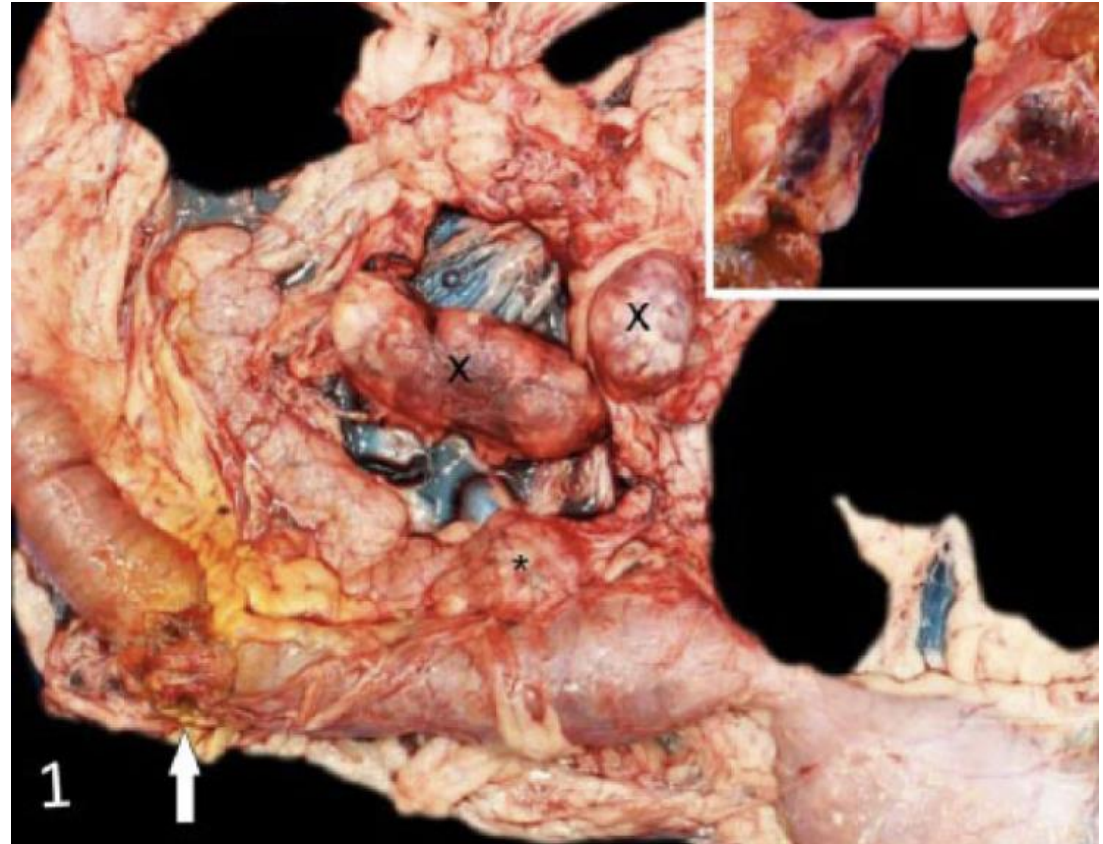
Octreotide

Prognosis

- Variable
- Surgery and medical management have longer survival times
- Any reduction in burden improved success
- Poor prognosis
 - $>2\text{cm}$
 - Evidence of metastasis
 - $\text{Ki67} >2.5\%$

Gastrinoma

- Pancreatic islet cell tumors
- Secrete excessive amounts of gastrin
- Esophageal and gastroduodenal erosions
- Enzymatic maldigestion
- Zollinger-Ellison syndrome
- Can also arise from the duodenum, peri-pancreatic/mesentery lymph nodes
- High rate of metastasis

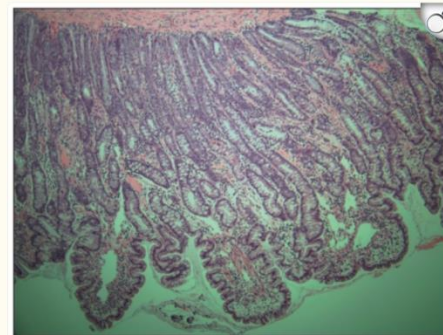


Struthers JD, Robl N, Wong VM, Kiupel M. Gastrinoma and Zollinger–Ellison syndrome in canids: a literature review and a case in a Mexican gray wolf. *Journal of Veterinary Diagnostic Investigation*. 2018;30(4):584-588. doi:[10.1177/1040638718779638](https://doi.org/10.1177/1040638718779638)

Clinical Findings/Diagnosis

- Most commonly vomiting and weight loss
- Diarrhea
- Regurgitation
- Ulceration
- Fasting serum gastrin concentration
- Histopathology

Figure 1.

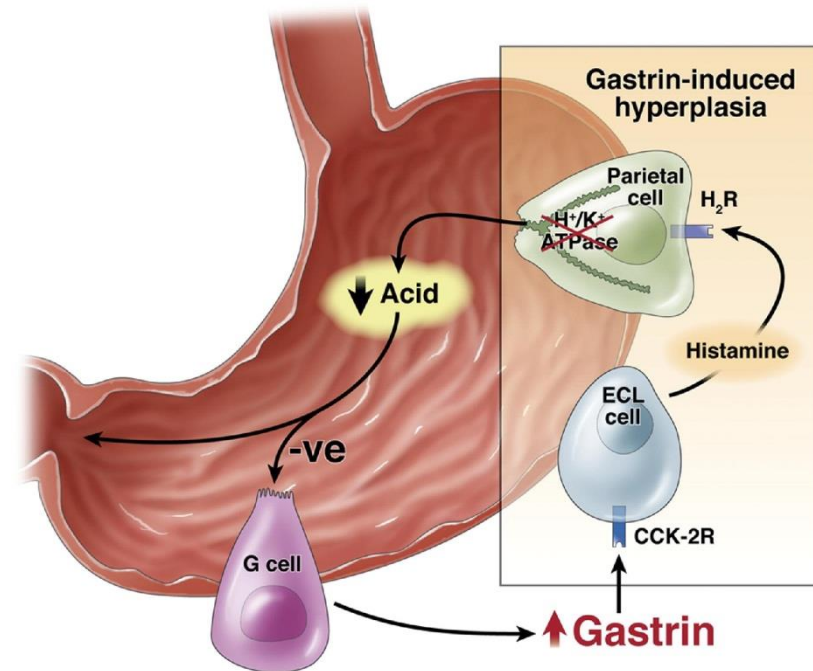


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Multifocal necrosuppurative ulcerative gastritis in the stomach of a dog with gastrinoma.
Hematoxylin and eosin (H&E) stain (40×).

Medical Management

- Gastric acid inhibitors
- Gastroprotectants
- Suppression of gastrin secretion



Surgical Treatment

- Abdominal explore
- Partial pancreatectomy
- Biopsy



Postoperative Management, Complications and Prognosis

Medical
management for
ulceration
continued

Aggressive
treatment for
pancreatitis

Poor prognosis

Glucagonoma

- Glucagon producing tumors of Alpha cells
- Hyperglycemia
- Diabetes Mellitus
- Superficial necrolytic dermatitis
- +/- hepatopathy



Oberkirchner, U., Linder, K.E., Zadrozny, L. and Olivry, T. (2010), Successful treatment of canine necrolytic migratory erythema (superficial necrolytic dermatitis) due to metastatic glucagonoma with octreotide. *Veterinary Dermatology*, 21: 510-516. <https://doi.org/10.1111/j.1365-3164.2009.00876.x>

Clinical Signs

- Skin
 - Erythema
 - Ulcerations/excoriations
 - Foot pad hyperkeratosis/fissures
- Signs associated with hyperglycemia



Mizuno, T., Hiraoka, H., Yoshioka, C., Takeda, Y., Matsukane, Y., Shimoyama, N., Morimoto, M., Hayashi, T. and Okuda, M. (2009), Superficial necrolytic dermatitis associated with extrapancreatic glucagonoma in a dog. *Veterinary Dermatology*, 20: 72-79. <https://doi.org/10.1111/j.1365-3164.2008.00729.x>

Diagnosis/Treatment/Prognosis

Serum glucagon concentration

Histopathology

Surgical excision; partial pancreatectomy

High rate of early metastasis

Poor prognosis

References

- Cridge H, Twedt DC, Marolf AJ, Sharkey LC, Steiner JM. Advances in the diagnosis of acute pancreatitis in dogs. *J Vet Intern Med.* 2021 Nov;35(6):2572-2587. doi: 10.1111/jvim.16292. Epub 2021 Nov 9. PMID: 34751442; PMCID: PMC8692219.
- Cridge H, Lim SY, Algül H, Steiner JM. New insights into the etiology, risk factors, and pathogenesis of pancreatitis in dogs: Potential impacts on clinical practice. *J Vet Intern Med.* 2022 May;36(3):847-864. doi: 10.1111/jvim.16437. Epub 2022 May 12. PMID: 35546513; PMCID: PMC9151489.
- Rudinsky AJ. Laboratory Diagnosis of Pancreatitis. *Vet Clin North Am Small Anim Pract.* 2023 Jan;53(1):225-240. doi: 10.1016/j.cvsm.2022.07.015. PMID: 36400472.
- Kuzi S, Mazor R, Segev G, Nivy R, Mazaki-Tovi M, Chen H, Rimer D, Duneyevitz A, Yas E, Lavy E, Aroch I. Prognostic markers and assessment of a previously published clinical severity index in 109 hospitalised dogs with acute presentation of pancreatitis. *Vet Rec.* 2020 Jul 25;187(2):e13. doi: 10.1136/vr.105364. Epub 2019 Oct 29. PMID: 31662578.
- Pinard CJ, Hocker SE, Weishaar KM. Clinical outcome in 23 dogs with exocrine pancreatic carcinoma. *Vet Comp Oncol.* 2021 Mar;19(1):109-114. doi: 10.1111/vco.12645. Epub 2020 Aug 28. PMID: 32803885.
- Thompson, L.J., Seshadri, R. and Raffe, M.R. (2009), Characteristics and outcomes in surgical management of severe acute pancreatitis: 37 dogs (2001–2007). *Journal of Veterinary Emergency and Critical Care*, 19: 165-173. <https://doi.org/10.1111/j.1476-4431.2009.00401.x>
- Talbot CT, Cheung R, Holmes EJ, Cook SD. Medical and surgical management of pancreatic fluid accumulations in dogs: A retrospective study of 15 cases. *J Vet Intern Med.* 2022 May;36(3):919-926. doi: 10.1111/jvim.16411. Epub 2022 Mar 23. PMID: 35319111; PMCID: PMC9151450.
- Lim SY, Cridge H, Twedt DC, Ohta H, Nuruki T, Steiner JM. Management of acute-onset pancreatitis in dogs: a Narrative Review. *J Am Vet Med Assoc.* 2024 Jun 5;262(9):1231-1240. doi: 10.2460/javma.24.02.0107. PMID: 38838711.
- Johnson MD, Mann FA. Treatment for pancreatic abscesses via omentalization with abdominal closure versus open peritoneal drainage in dogs: 15 cases (1994-2004). *J Am Vet Med Assoc.* 2006 Feb 1;228(3):397-402. doi: 10.2460/javma.228.3.397. PMID: 16448365.

References

- Daravigka A, Ninis S, Bourdekas P, Konstantinidis AO, Ginoudis A, Adamama-Moraitou KK, Lyraki M, Soubasis N. Successful Management of a Pancreatic Abscess in a Dog with Juvenile Diabetes Mellitus Through Ultrasound-Guided Drainage and Medical Therapy. *Vet Sci*. 2025 Jun 20;12(7):604. doi: 10.3390/vetsci12070604. PMID: 40711264; PMCID: PMC12300859.
- Hughes, SM (2006). *Canine gastrinoma: A case study and literature review of therapeutic options*. *New Zealand Veterinary Journal*, 54(5), 242–247. doi:10.1080/00480169.2006.36705
- Anderson, Jonathan R.; Cornell, Karen K.; Parnell, Nolie K.; Salisbury, S. Kathleen (2008). *Pancreatic Abscess in 36 Dogs: A Retrospective Analysis of Prognostic Indicators*. *Journal of the American Animal Hospital Association*, 44(4), 171–179. doi:10.5326/0440171
- Keulen JNP, van Nimwegen SA. Laparoscopic partial pancreatectomy through an advanced lateral approach as treatment for insulinoma in dogs: a case series. *Front Vet Sci*. 2024 Jan 8;10:1278218. doi: 10.3389/fvets.2023.1278218. PMID: 38260191; PMCID: PMC10800787.
- Kluszczuk P, Tobiasz A, Madej A, Wosiewicz P, Mrowiec S, Jabłońska B. Pancreatic Pseudocysts: Evolution of Treatment Approaches. *Journal of Clinical Medicine*. 2025; 14(17):6152. <https://doi.org/10.3390/jcm14176152>
- Aupperle-Lellbach H, Törner K, Staudacher M, et al. Histopathological findings and canine pancreatic lipase immunoreactivity in normal dogs and dogs with inflammatory and neoplastic diseases of the pancreas. *J Vet Intern Med*. 2020; 34: 1127–1134. <https://doi.org/10.1111/jvim.15779>
- Buishand FO. Current Trends in Diagnosis, Treatment and Prognosis of Canine Insulinoma. *Vet Sci*. 2022 Sep 29;9(10):540. doi: 10.3390/vetsci9100540. PMID: 36288153; PMCID: PMC9611890.
- Gal A, Ridgway MD, Fredrickson RL. An unusual clinical presentation of a dog with gastrinoma. *Can Vet J*. 2011 Jun;52(6):641-4. PMID: 22131581; PMCID: PMC3095163.
- Struthers JD, Robl N, Wong VM, Kiupel M. Gastrinoma and Zollinger–Ellison syndrome in canids: a literature review and a case in a Mexican gray wolf. *Journal of Veterinary Diagnostic Investigation*. 2018;30(4):584-588. doi:[10.1177/1040638718779638](https://doi.org/10.1177/1040638718779638)

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