Gallbladder Mucoceles in Dogs

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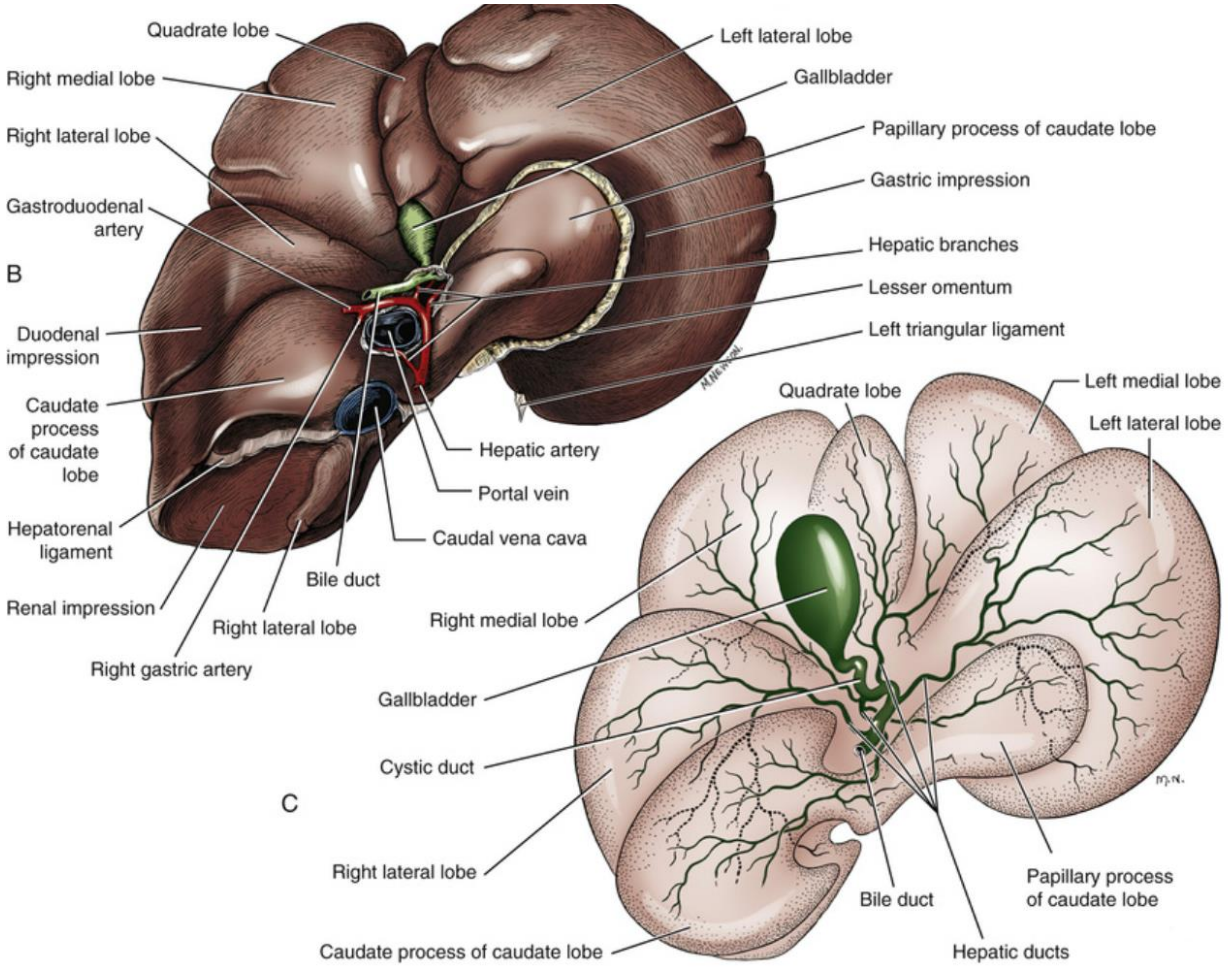
ISU Small Animal Surgical Resident III

Overview

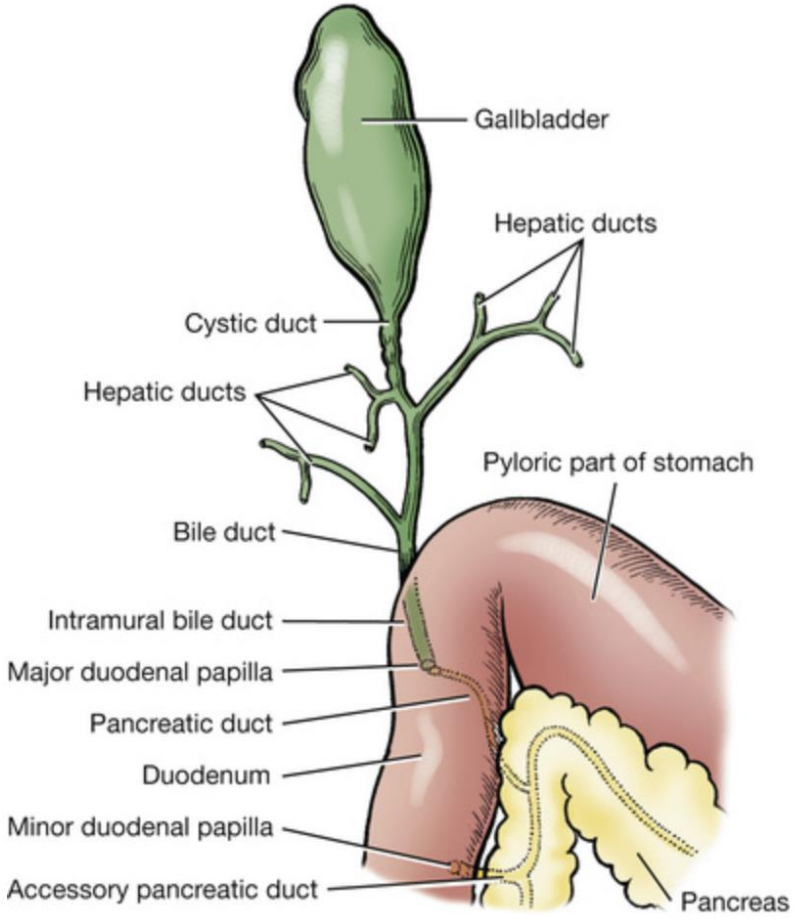
- Hepatobiliary anatomy
- Hepatobiliary physiology
- Gallbladder mucocele pathophysiology
- Diagnosis
- Medical management
- Surgical management

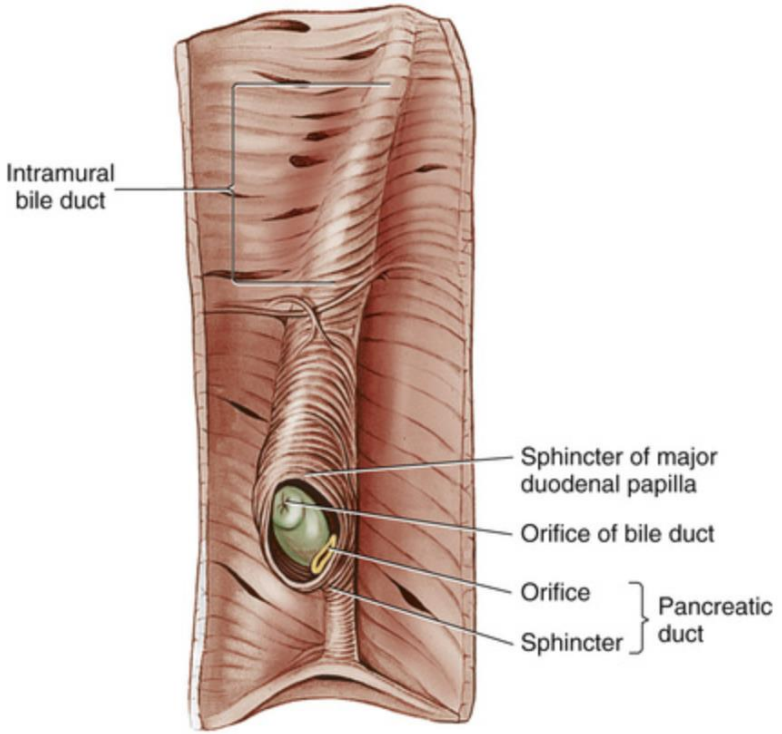
Hepatobiliary Anatomy

- Blood flow:
  - Hepatic artery 20%
  - Portal vein 80%
- Oxygen Supply:
  - Hepatic artery & portal vein 50% each



Hepatobiliary Anatomy





Hepatobiliary Physiology

- Protein synthesis & clearance
- Carbohydrate & lipid metabolism
- Coagulation & anticoagulation factor synthesis
- Immune function modulation
- Hormone synthesis
- Storage for vitamins, fats, glycogen, & trace minerals
- Toxin clearance

Hepatobiliary Physiology

- Bile composed of:
  - Bile acids, bilirubin, cholesterol, phospholipids, water, bicarbonate, & other ions
- ~80% of bilirubin comes from hemoglobin breakdown

Hepatobiliary Physiology

- Bilirubin pathway:
  - Unconjugated bilirubin bound to albumin in systemic circulation
  - Conjugated in hepatocytes to glucuronic acid
  - Conjugated bilirubin excreted into bile canaliculi
  - Transported through hepatic ducts
  - Stored in gallbladder

Hepatobiliary Physiology

- Bile flow continued:
  - Digested food enters duodenum
  - Cholecystokinin released
  - Gallbladder contracts
  - Sphincter of Oddi relaxes
  - Allows passage of bile into duodenum

Hepatobiliary Physiology

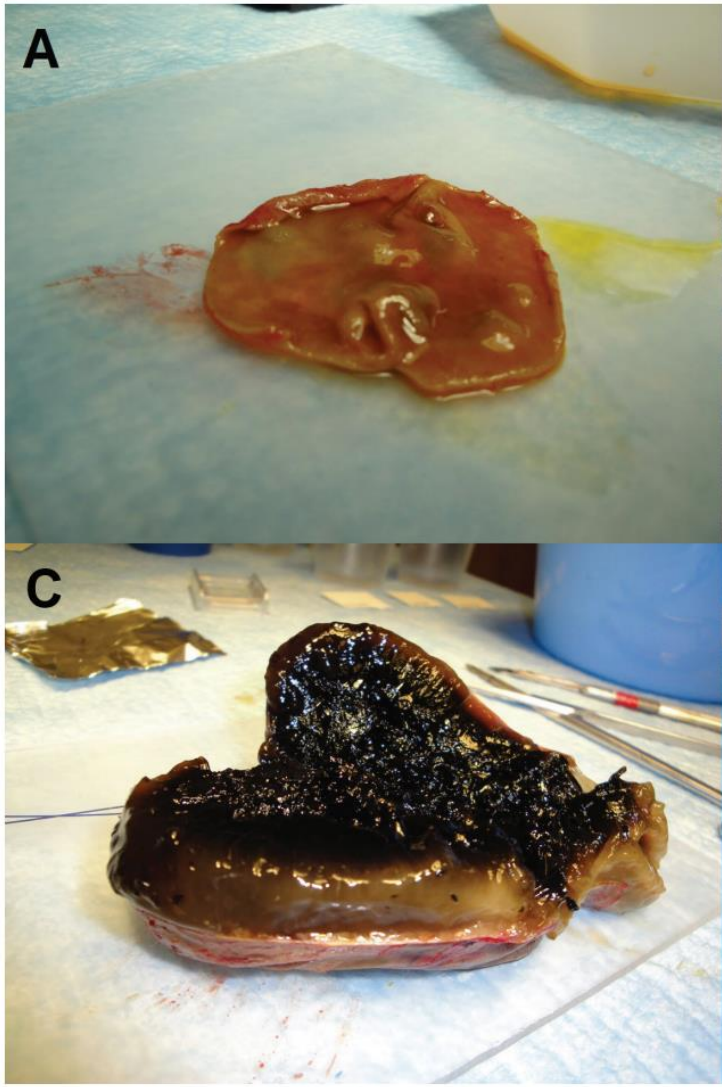
- Becomes more passive/constant flow post-cholecystectomy
- Bile salts emulsify fats & bind endotoxins
- Bilirubin decreased by bacteria in intestines
  - 90% reabsorbed

Extrahepatic Biliary Obstruction

- Causes:
  - Pancreatitis
  - Neoplasia
  - Cholangitis
  - Cholelithiasis
  - Gallbladder mucocele

Gallbladder Mucocele Pathophysiology

- Cystic mucosal hyperplasia
- Genetic predisposition
  - Shetland Sheepdogs, Cocker Spaniels, Mini Schnauzers
    - Advantage (imidaclprid) in Shelties??
  - Deficiency of ABCB4 gene
- Biliary stasis



Gallbladder Mucocele Pathophysiology

- Association with endocrinopathies
  - Hypothyroidism
    - 14% had GBM vs. 5% in control group
    - 3x more likely than dogs with vs. those without
  - Hyperadrenocorticism
    - 21% had GBM vs. 2% in control group
    - 29x more like in dogs with vs. those without

Diagnosis

- Non-specific clinical signs
  - Lethargy
  - Anorexia
  - Vomiting
  - +/- Abdominal pain
  - Signs can wax & wane over days to weeks

Diagnosis

- Laboratory abnormalities:
  - Chemistry: increased ALP, ALT, +/- bilirubin
  - CBC: inflammatory leukogram
  - Peritoneal effusion: 2x serum bilirubin
  - Urinalysis: bilirubinuria or bilirubin crystals
  - Coagulation panel: increased

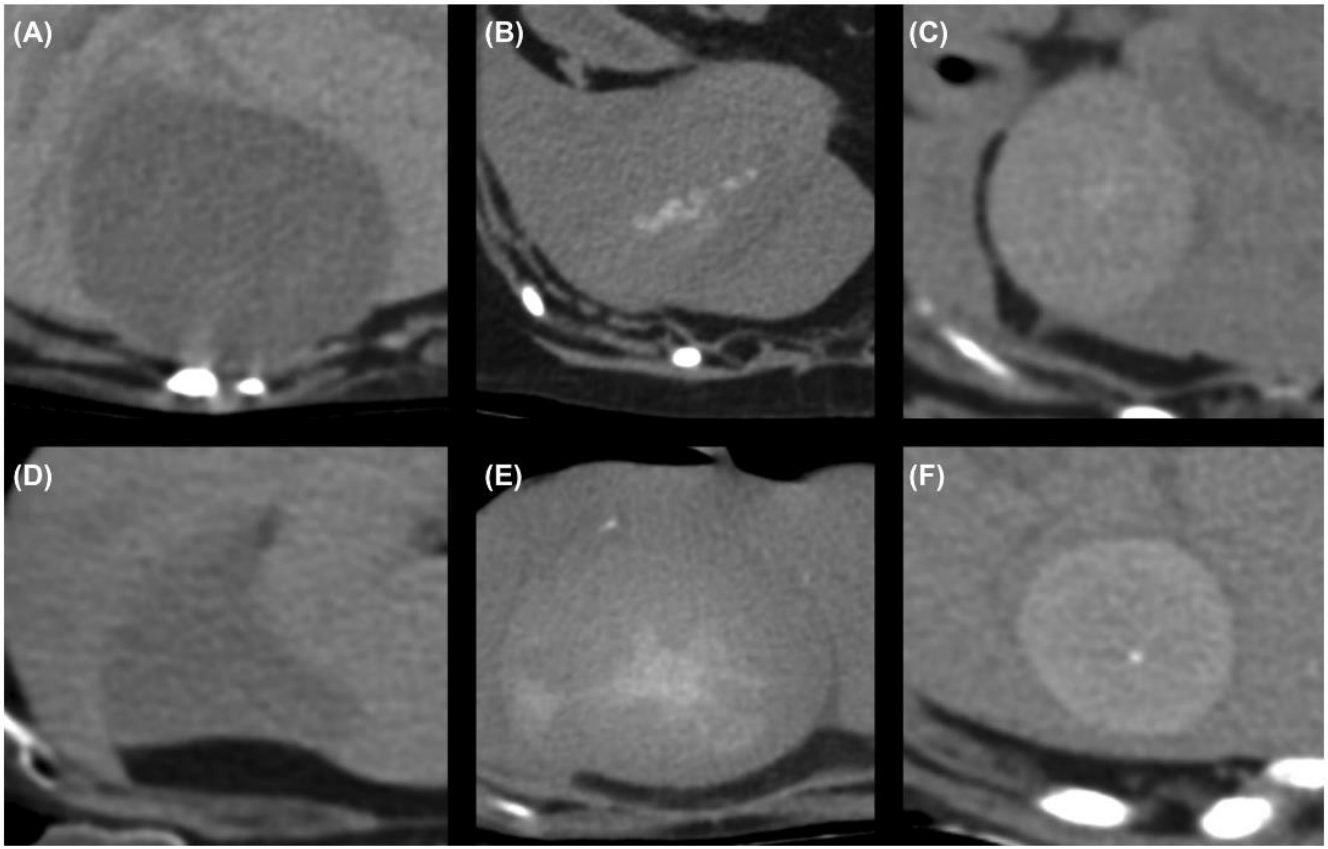


FIGURE 2 Precontrast transverse CT images (window width:400, window length:40) of the gallbladder in sternally positioned dogs with mucoceles. The variation in mucocele appearance is highlighted with examples of mucoceles that are hypoattenuating (A, D), isoattenuating (B, E), and hyperattenuating (C, F) to hepatic parenchyma. Also note the centrally positioned mineral in dogs (B), (C), (E), and (F)

TABLE 1 Median overall Hounsfield units (HU) (range) for each group in each phase of contrast

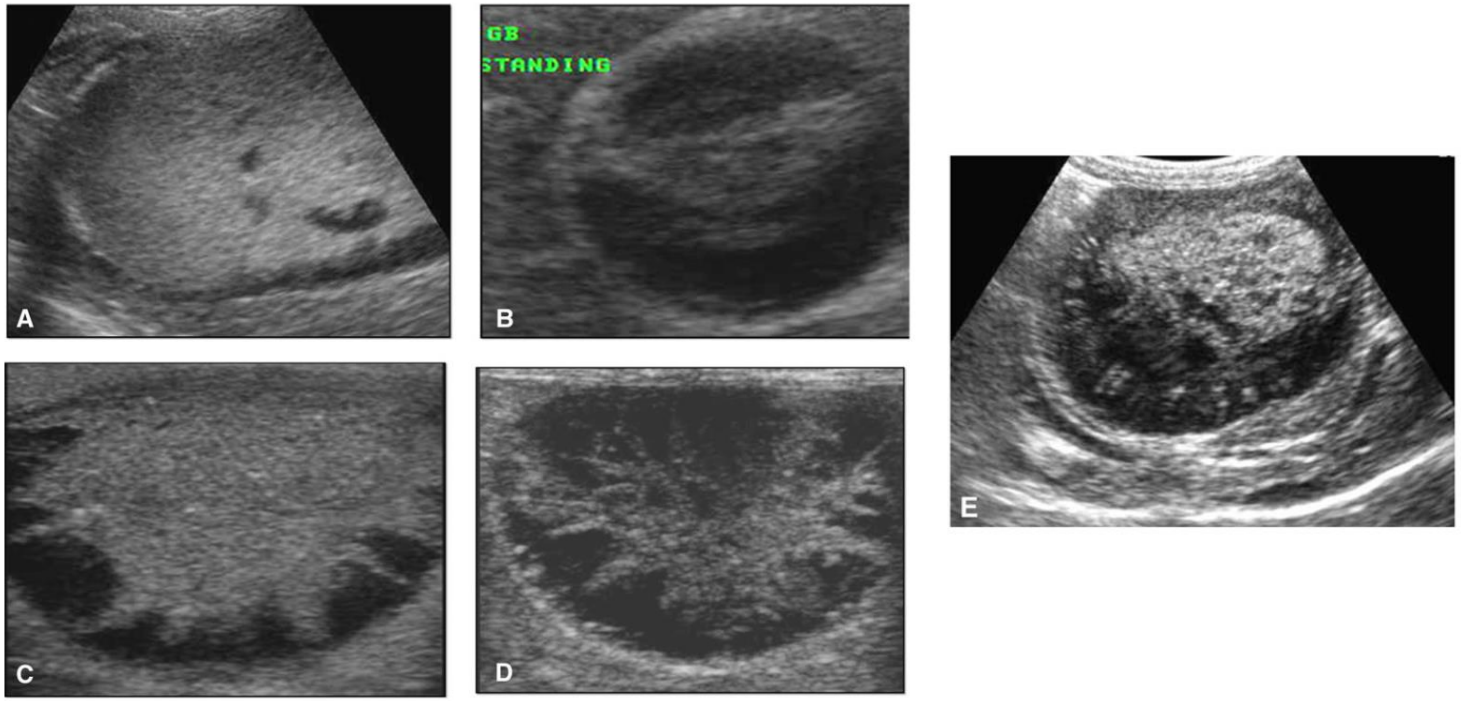
	Precontrast	Arterial	Portovenous	Late venous
No sludge	35.8 (11.2–48.6)	36.5 (11.2–46.5)	36.2 (11.7–50.5)	39.1 (9.4–52.5)
Sludge	39.7 (13.5–83.0)	38.4 (10.2–91.2)	38.7 (14.1–84.5)	41.1 (19.9–88.3)
Mucocele	49.3 (22.8–87.3)*	54.6 (18.0–92.2)*	48.7 (22.1–92.1)*	53.1 (13.1–88.0)*

*indicates significantly higher HU compared to the no sludge and sludge groups.

Fuerst JA, Hostnik ET. CT attenuation values and mineral distribution can be used to differentiate dogs with and without gallbladder mucoceles. *Vet Radiol Ultrasound*. 2019;60(6):689-695.

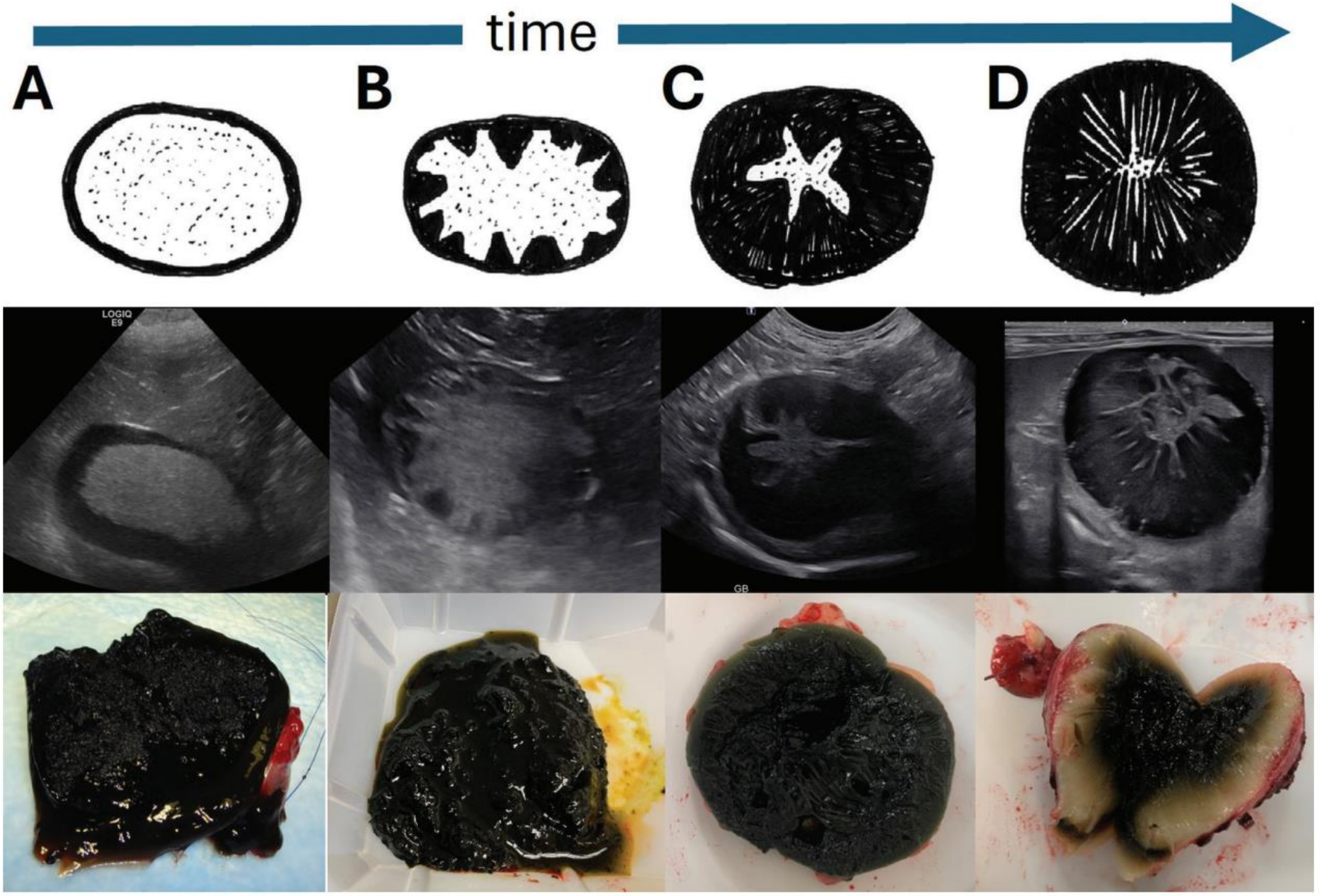
COMPARISON BETWEEN ULTRASONOGRAPHIC AND CLINICAL FINDINGS IN 43 DOGS WITH GALLBLADDER MUCOCELES

JIHYE CHOI, AHYOUNG KIM, SEOYEON KEH, JUYEON OH, HYUNWOOK KIM, JUNGHEE YOON



Choi J, Kim A, Keh S, Oh J, Kim H, Yoon J. Comparison between ultrasonographic and clinical findings in 43 dogs with gallbladder mucoceles. *Vet Radiol Ultrasound*. 2014;55(2):202-207.

Mucocele progression



Gookin JL, Mathews KG, Seiler G. Diagnosis and management of gallbladder mucocele formation in dogs. *J Am Vet Med Assoc*. 2025;263(6):777-785. Published 2025 Mar 19.

EVALUATION OF CONTRAST-ENHANCED ULTRASONOGRAPHY AS A METHOD FOR DETECTING GALLBLADDER NECROSIS OR RUPTURE IN DOGS

PAOLO BARGELLINI, RICCARDO ORLANDI, CHIARA PALONI, GIUSEPPE RUBINI, PAOLO FONTI, MARK E. PETERSON, MARK RISHNIW, CRISTIANO BOITI

- CEUS utilizes gas-filled microbubbles administered IV to obtain real-time perfusion images
- 49 dogs underwent cholecystectomy with 24 having necrosis/rupture
- CEUS was 100% sensitive & specific vs. conventional US at 75% sensitive & 81% specific

Bargellini P, Orlandi R, Paloni C, et al. EVALUATION OF CONTRAST-ENHANCED ULTRASONOGRAPHY AS A METHOD FOR DETECTING GALLBLADDER NECROSIS OR RUPTURE IN DOGS. *Vet Radiol Ultrasound*. 2016;57(6):611-620.

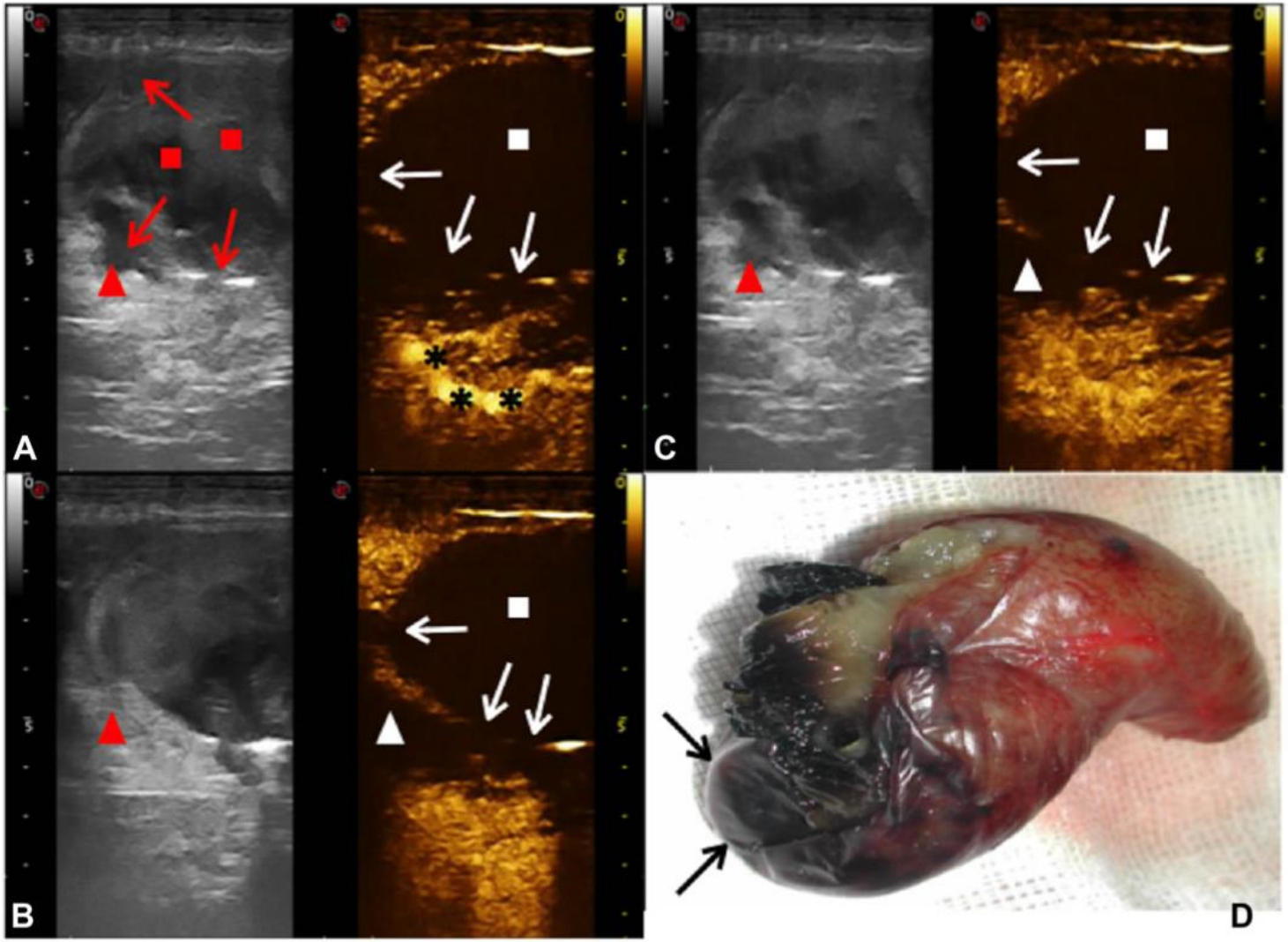


FIG. 2. Mucocele with necrotizing cholecystitis. Baseline sagittal ultrasound scan (A–C) in a 13-year-old German Shepherd showing several hypoechoic lesions of the gallbladder wall with suspected loss of integrity (arrows, A) together with inhomogeneous, hypomobile content (squares, A–C), and focal peritoneal hyper/hypoechogenicity (arrowheads). Representative CEUS images of the gallbladder 13, 22, and 47 s after contrast injection (A–C, respectively). In all distribution phases, some areas of the gallbladder wall (arrows) are not enhanced (i.e., not vascularized) as well as the gallbladder content (squares). In A, black asterisks indicate contrast enhancement of a large hepatic artery. In B and C, during the venous phase, the arrowhead points to a non-enhanced area (i.e., not vascularized) attributable to peritoneal necrosis. Gallbladder following cholecystectomy with extensive necrotic areas of the wall (arrows, D).

AJVR

AVMA

Preoperative serum C-reactive protein concentration can be used to detect gallbladder rupture in dogs with gallbladder mucocele

Makoto Asakawa, BVSc[1]; Mayuko Fukuzawa, BVSc[1]; Midori Goto Asakawa, BVSc[1]; James A Flanders, DVM[2]*

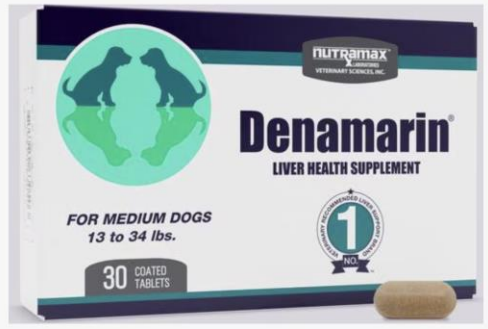
[1]Veterinary Specialists Emergency Center, Saitama Prefecture, Japan
[2]Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY

- 45 dogs included, 15 with gallbladder rupture
- Median pre-op CRP concentration was significantly higher in dogs with rupture
  - 15.1 mg/L vs. 2.65 mg/dL
- Sensitivity, specificity, and accuracy of pre-op CRP concentration to predict GBR was 100%, 67%, & 78%, increased to 100%, 93%, & 96% when combined with US

Asakawa M, Fukuzawa M, Asakawa MG, Flanders JA. Preoperative serum C-reactive protein concentration can be used to detect gallbladder rupture in dogs with gallbladder mucocele. *Am J Vet Res*. 2021;83(1):23-32. Published 2021 Nov 10.

Medical Management

- Considered in early cases
- Medications
  - Ursodiol (ursodeoxycholic acid or UDCA)
    - Synthetic hydrophilic bile that displaces harmful hydrophobic bile acids
    - Has choleretic and anti-inflammatory properties +/- dissolution of choleliths
  - SAMe (S-adenosylmethionine)
    - Donates methyl group which is important for many cellular functions
    - Converted to glutathione (antioxidant)
- Careful monitoring



Cholecystectomy

- Indications:
  - Progressive worsening of biochemical data despite supportive care
  - Imaging showing progressive mucocele formation
  - Symptomatic dogs
  - Gallbladder rupture

Cholecystectomy

- Pre-operative considerations:
  - Hypotension
  - Decreased myocardial contractility
  - Acute kidney injury
  - Coagulopathies
  - Gastrointestinal hemorrhage
  - Delayed wound healing
  - Bile salts cause significant inflammation, hemolysis, tissue necrosis, & hypovolemic shock

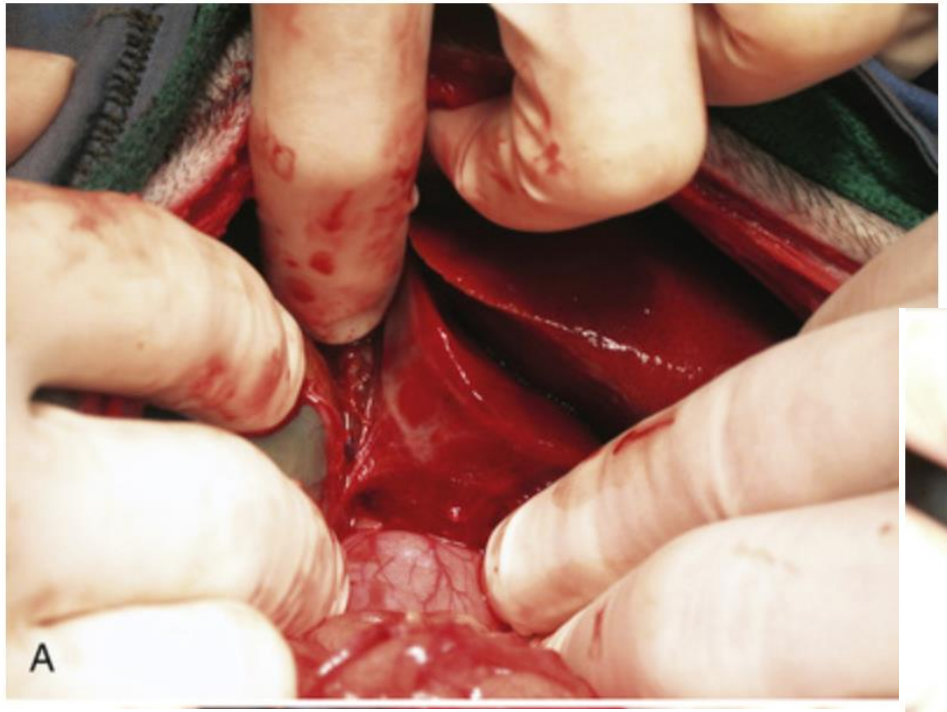
Cholecystectomy

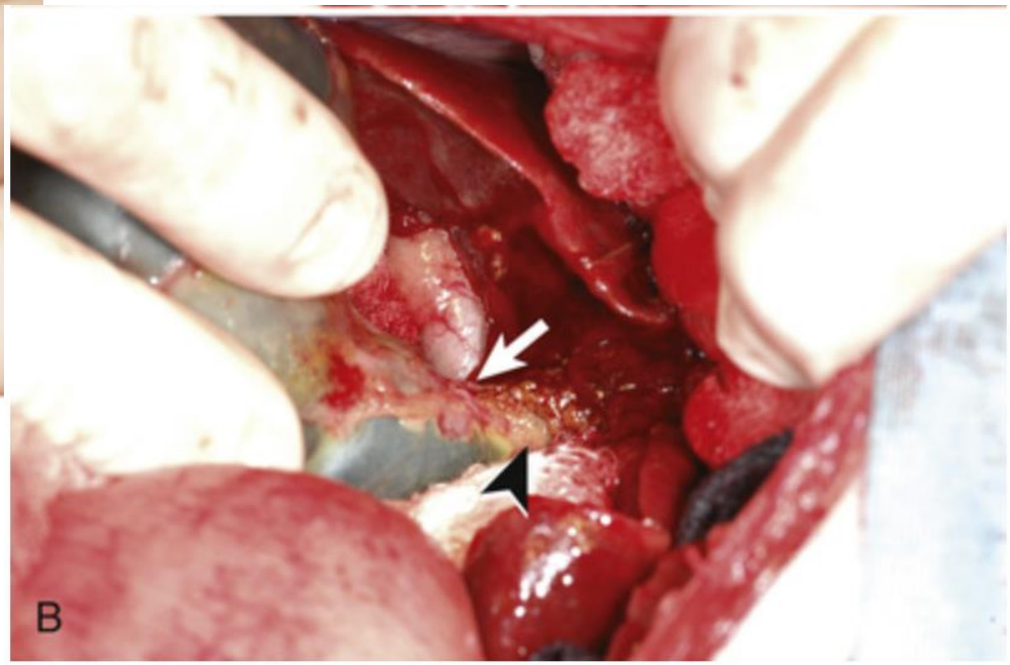
- Pre-operative stabilization:
  - Fluid resuscitation
    - +/- pRBCs, whole blood, or fresh frozen plasma
  - Coagulation profiles, blood typing, +/- cross-matching
    - +/- Vitamin K supplementation
  - Empiric antimicrobial therapy combinations:
    - Fluoroquinolone, penicillin, & metronidazole
    - Fluoroquinolone & amoxicillin-clavulanate
    - Fluoroquinolone & clindamycin

Cholecystectomy

- Full exploratory laparotomy performed
  - Xiphoid to pubis approach
  - Liver biopsy
  - Bile & liver culture & sensitivity
  - Feeding tube
  - Cotton tipped applicators, Frazier suction tip, & bipolar electrocautery key for gallbladder dissection
  - Closed suction drain in cases of bile peritonitis

Cholecystectomy





Cholecystectomy

- Common bile duct flushing indicated if concern for obstruction, cholelithiasis, or mass effect
    - Normograde
        - Stay suture placed at cystic duct stump after cholecystectomy, or through cholecystotomy
    - Retrograde
        - Duodenotomy required

Cholecystectomy

- Ligation of cystic duct & artery performed with 0 or 3-0 dissolvable monofilament suture
- Abdomen lavaged well +/- closed suction drain placed
- Always submit gallbladder for histopathology & obtain aerobic & anaerobic bacterial culture

Association between biliary tree manipulation and outcome in dogs undergoing cholecystectomy for gallbladder mucocele: A multi-institutional retrospective study

Hunter J. Piegols DVM[1] | Galina M. Hayes PhD, DACVS, DACVECC[2] |
Samantha Lin DVM[3†] | Ameet Singh DVM, DVSc, DACVS[4] |
Daniel K. Langlois DVM, DACVIM[5] |
Daniel J. Duffy BVM&S, MS, FHEA, MRCVS, DACVS-SA, DECVS[3]

- Overall incidence of post-op complications similar between groups
- Post-op pancreatitis associated with performing CBD catheterization
  - No difference between normograde & retrograde catheterization
- Catheterization considered carefully during open cholecystectomy

Piegols HJ, Hayes GM, Lin S, Singh A, Langlois DK, Duffy DJ. Association between biliary tree manipulation and outcome in dogs undergoing cholecystectomy for gallbladder mucocele: A multi-institutional retrospective study. *Vet Surg*. 2021;50(4):767-774.

Influence of normograde versus retrograde catheterization of bile ducts in dogs treated for gallbladder mucocele

Allison B. Putterman VMD[1] |
Laura E. Selmic BVetMed (Hons), MRCVS, MPH, DACVS-SA, DECVS[2] |
Cameron Kindra DVM[1] |
Daniel J. Duffy BVM&S (Hons), MS, FHEA, MRCVS, DACVS-SA, DECVS[3] |
Marije Risselada DVM, PhD, DACVS-SA, DECVS[4] | Heidi Phillips VMD, DACVS-SA[1]

- Retrograde catheterization more likely to result in post-op complications (persistence of GI signs)
- Survival to discharge and long-term survival didn't differ
- Total bilirubin decreased 70.3% after normograde, 39.1% after retrograde catheterization

Putterman AB, Selmic LE, Kindra C, Duffy DJ, Risselada M, Phillips H. Influence of normograde versus retrograde catheterization of bile ducts in dogs treated for gallbladder mucocele. *Vet Surg*. 2021;50(4):784-793.

The effect of flushing of the common bile duct on hepatobiliary markers and short-term outcomes in dogs undergoing cholecystectomy for the management of gall bladder mucocele: A randomized controlled prospective study

Tom L. Hernon BVSc CertAVP(GSAS) DipECVS MRCVS |
Ed J. Friend BVetMed CertSAS DipECVS FRCVS |
Guillaume Chanoit DEDV PhD DipECVS DipACVS FRCVS |
Vicki Black MA VetMB DipECVIM-CA MRCVS FHEA |
Lee B. Meakin MA MRes PhD VetMB DipECVS MRCVS

- Marked reduction from pre-op to 3 days post-op for bilirubin, ALP, ALT, GGT, & cholesterol with no difference between flushing & non-flushing groups
- Post-op complications were high (58.1%) & regurgitation was most common (no difference between the two groups)
- No difference in occurrence of pancreatitis between the two groups

Hernon TL, Friend EJ, Chanoit G, Black V, Meakin LB. The effect of flushing of the common bile duct on hepatobiliary markers and short-term outcomes in dogs undergoing cholecystectomy for the management of gall bladder mucocele: A randomized controlled prospective study. *Vet Surg*. 2023;52(5):697-703.

Laparoscopic Cholecystectomy

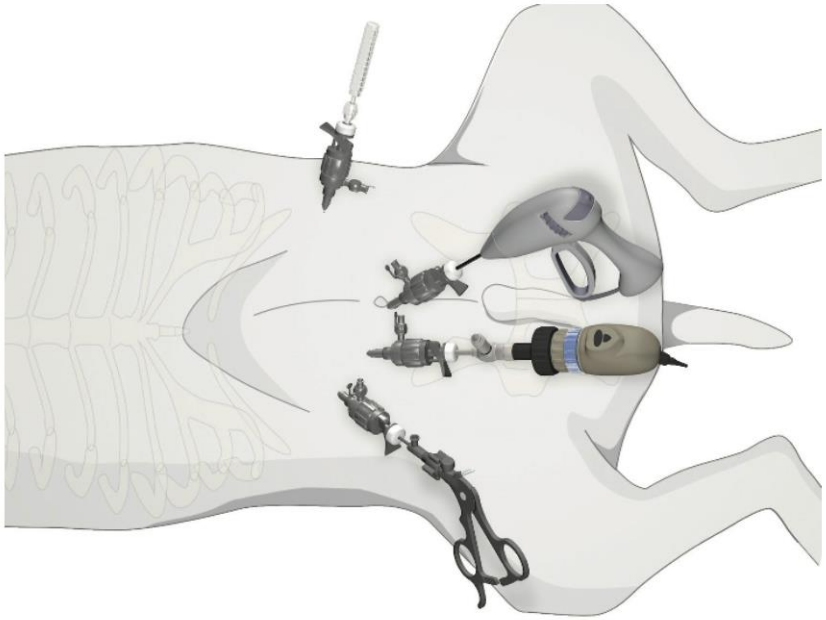


Figure 16.3 Port positioning for the multiport cystic-duct first (CDF) technique. A four-port approach described is shown here. Note the left-sided instrument port that is positioned cranially and dorsally for placement of the fan retractor that will retract the gall bladder cranially during cystic duct dissection.

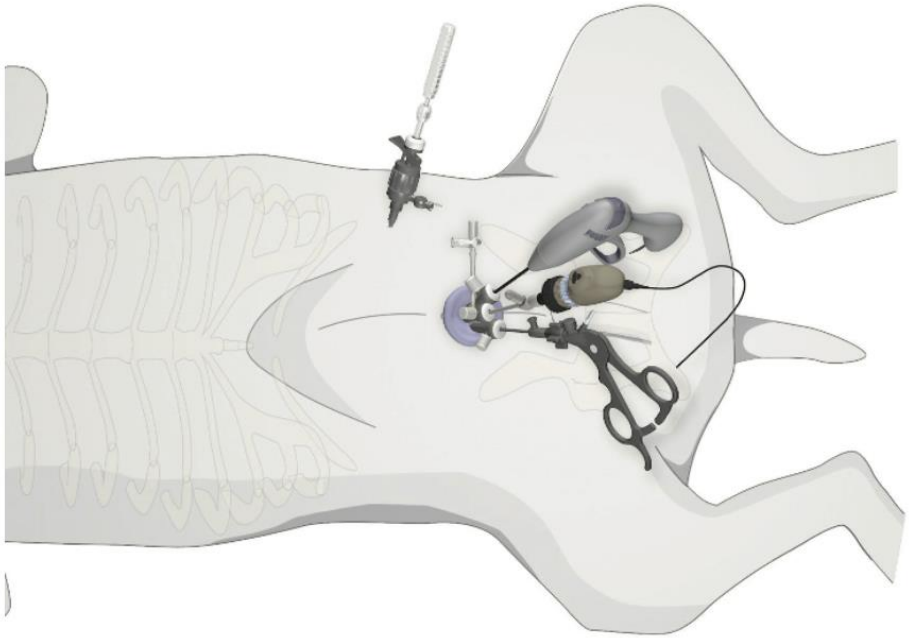


Figure 16.5 Port placement for single-port cholecystectomy is shown. The single-port device is positioned at the level of the umbilicus.

Fransson, B. A., & Mayhew, P. D. (Eds.). (2022). *Small animal laparoscopy and thoracoscopy* (Second edition.). John Wiley & Sons, Inc.

Laparoscopic Cholecystectomy

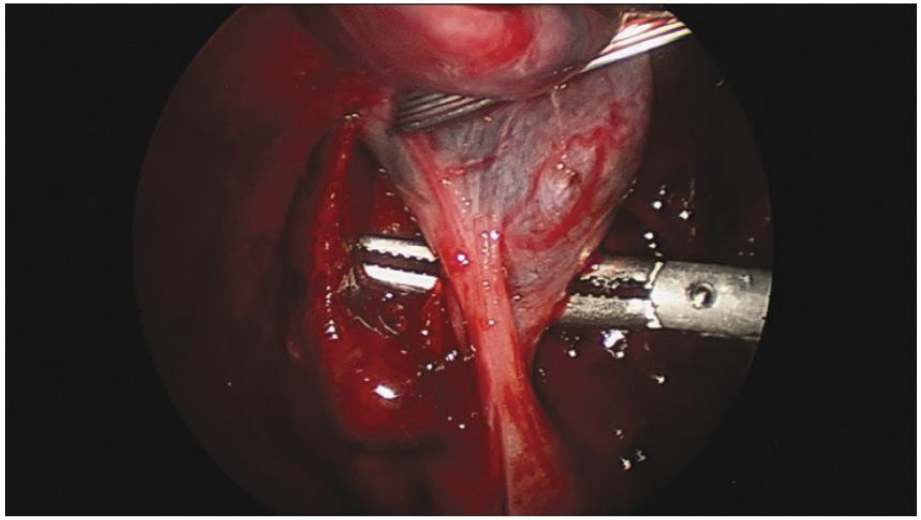


Figure 16.7 Forceps can be seen passing cranial to the cystic duct after dissection of the plane between the cystic duct and the hepatic parenchyma has been completed.

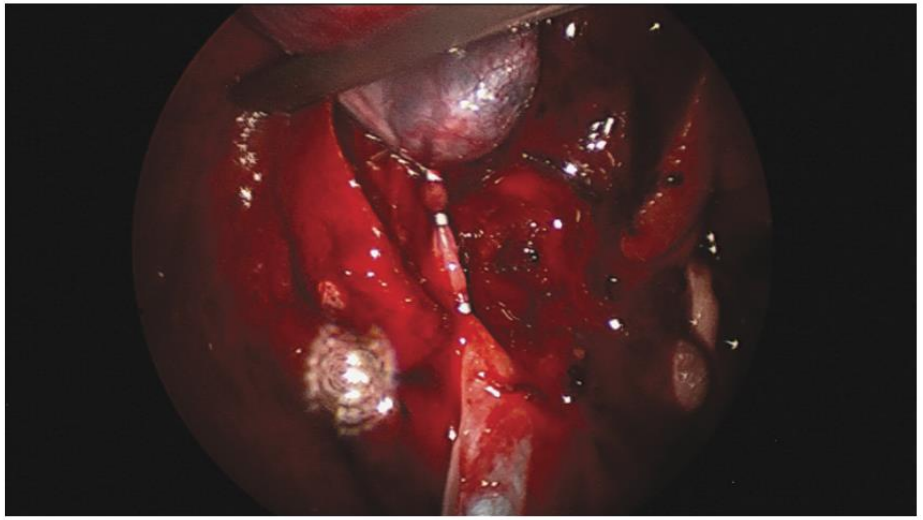


Figure 16.8 Hemostatic clips can be seen in position on the cystic duct prior to sectioning of the duct.

Fransson, B. A., & Mayhew, P. D. (Eds.). (2022). *Small animal laparoscopy and thoracoscopy* (Second edition.). John Wiley & Sons, Inc.

Cholecystectomy

Laparoscopic cholecystectomy using the subserosal layer dissection technique in dogs: 34 cases (2015-2021)

M. Kondo*,†, K. Hagiwara‡, A. Nukaya§, T. Aso¶ and H. Kanai‖,1

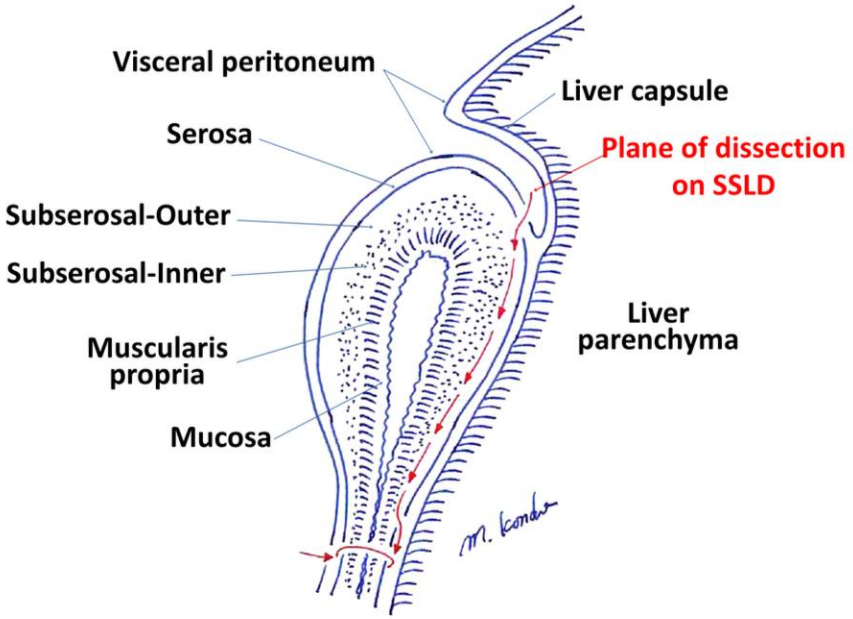


FIG 2. Schema of the plane of dissection in the subserosal layer dissection technique

Kondo M, Hagiwara K, Nukaya A, Aso T, Kanai H. Laparoscopic cholecystectomy using the subserosal layer dissection technique in dogs: 34 cases (2015-2021). *J Small Anim Pract*. 2023;64(4):288-295.

Cholecystectomy

- Complications:
  - Mortality for cholecystectomy 16-40%
    - 21-28% when performed for mucocele
  - Pancreatitis
  - Bile-induced peritonitis
  - Hypotension
  - Biliary leakage
  - Biliary obstruction
  - Pulmonary thromboembolism
  - Aspiration pneumonia
  - Sepsis
  - Multiple organ dysfunction syndrome

Cholecystectomy

- Post-op Considerations:
  - Feeding tube
  - Analgesia
  - Urinary output monitoring
  - Blood pressure
  - Telemetry
  - Address hypercoagulability if present
  - Oxygen supplementation

Standard Article

J Vet Intern Med 2018;32:195–200

Gallbladder Mucocele: Variables Associated with Outcome and the Utility of Ultrasonography to Identify Gallbladder Rupture in 219 Dogs (2007–2016)

J.A. Jaffey, A. Graham, E. VanEerde, E. Hostnik, W. Alvarez, J. Arango, C. Jacobs, and A.E. DeClue

- Dogs with bile peritonitis were 2.7 times more likely to die
- No significant associations between survival and positive bacterial culture, antibiotic administration, or time (days) from ultrasound identification to time of surgery
- Abdominal ultrasound had poor sensitivity (56.1%) & good specificity (91.7%) for identification of gallbladder rupture

Jaffey JA, Graham A, VanEerde E, et al. Gallbladder Mucocele: Variables Associated with Outcome and the Utility of Ultrasonography to Identify Gallbladder Rupture in 219 Dogs (2007-2016). *J Vet Intern Med.* 2018;32(1):195-200.

Factors affecting survival in 516 dogs that underwent cholecystectomy for the treatment of gallbladder mucocele

Monty Galley, Jennifer Lang, Mark Mitchell, Jon Fletcher

- 16.7% mortality within 14 days post-op
- Gallbladder rupture & positive biliary culture in 20.4% & 12.5%
- Dogs with gallbladder rupture and positive biliary culture were 3.1 times more likely to die within 14 days post-op

Galley M, Lang J, Mitchell M, Fletcher J. Factors affecting survival in 516 dogs that underwent cholecystectomy for the treatment of gallbladder mucocele. *Can Vet J.* 2022;63(1):63-66.

Long-term survival of dogs treated for gallbladder mucocele by cholecystectomy, medical management, or both

Max Parkanzky[1] | Janet Grimes[1] | Chad Schmiedt[1] | Scott Secrest[2] | Andrew Bugbee[1]

- Median survival times were 1,802 days, 1,340 days, & 203 days for surgical, medical, and medical-surgical groups
- Higher mucocele type significantly associated with decreased survival in all groups
- Type 2 mucoceles most common (40.2%)
- Suspicions of biliary rupture on AUS were correlated with increased survival in surgical group

Parkanzky M, Grimes J, Schmiedt C, Secrest S, Bugbee A. Long-term survival of dogs treated for gallbladder mucocele by cholecystectomy, medical management, or both. *J Vet Intern Med*. 2019;33(5):2057-2066.

Histologic findings of gastrointestinal biopsies and clinical outcome in dogs undergoing cholecystectomy for gallbladder mucoceles: 71 cases (2014-2021)

M. Gondolfe [1] and E. C. Hans

- Dogs underwent cholecystectomy for GBM with duodenal biopsy
- 85.9% had enteritis with majority being lymphoplasmacytic (53.5%)
- 87.2% dogs survived – 90.4% elective, 86% emergent
- Mortality significantly associated with leukocytosis (mean 27.6 g/dL)
- Obtaining a duodenal biopsy has minimal impact on patient outcome

Gondolfe M, Hans EC. Histologic findings of gastrointestinal biopsies and clinical outcome in dogs undergoing cholecystectomy for gall bladder mucoceles: 71 cases (2014-2021). *J Small Anim Pract.* 2024;65(12):876-887.

STANDARD ARTICLE

Journal of Veterinary Internal Medicine Open Access

ACVIM American College of Veterinary Internal Medicine

Concurrent hepatopathy in dogs with gallbladder mucocele: Prevalence, predictors, and impact on long-term outcome

Sara A. Jablonski[1] | Yue Xiang (Polly) Chen[2] | Jarod E. Williams[2] | Jessica A. Kendziorski[3] | Rebecca C. Smedley[4]

- 98% of dogs had at least one hepatic histologic abnormality
  - Hepatic fibrosis in 37/51 (73%), biliary hyperplasia 29/52 (56%), portal inflammation in 25/52 (48%)
- Proportion of dogs alive vs. dead differed based on fibrosis score at 1, 3, & 12 months post-op

Jablonski SA, Chen YXP, Williams JE, Kendziorski JA, Smedley RC. Concurrent hepatopathy in dogs with gallbladder mucocele: Prevalence, predictors, and impact on long-term outcome. *J Vet Intern Med*. 2024;38(1):176-186.

Conclusions

- GBM patients often have other comorbidities & present with non-specific clinical signs
- Abdominal ultrasound is a great diagnostic tool but use caution so as not to confuse sludge vs. early mucocele
- Mortality rates vary, but are significantly worse with bile peritonitis or septic bile peritonitis
- Common bile duct flushing is not necessarily indicated for every case
- Cholecystectomy patients require 24/7 intensive monitoring & post-op care

References

- Tobias, K. M., & Johnston, S. A. (Eds.). (2018). *Veterinary surgery : small animal* (Second edition.). Elsevier.
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