Liver Disease: Common, Wild, and Weird

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A Review of Leakage Enzymes

ALT

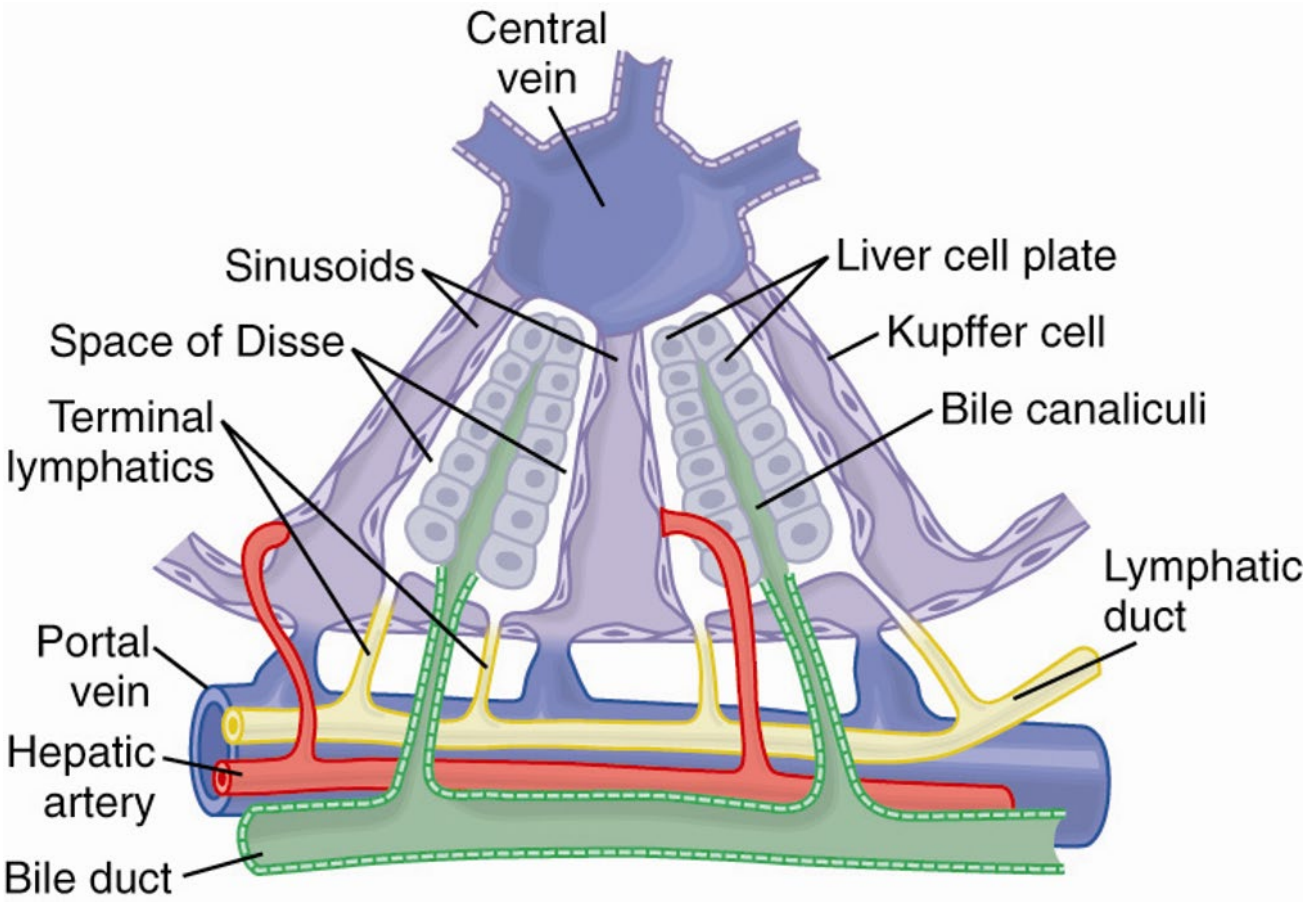
- Mild, moderate, or severe elevations with ANY hepatocellular damage/death
- Degree of elevation depends on how bad the hepatocyte damage is AND how many hepatocytes are still alive
  - May only be mildly elevated in severe disease if hepatocytes are nearly all wiped out

AST

- Mild, moderate, or severe elevations with ANY hepatocellular damage

Types of Injuries That Release ALT/AST

Infection	Inflammation	Toxin	Poor perfusion
Hypoxia	Trauma	Cholestasis	Infarction


Central vein
Sinusoids
Liver cell plate
Space of Disse
Kupffer cell
Terminal lymphatics
Bile canaliculi
Lymphatic duct
Portal vein
Hepatic artery
Bile duct

Leakage Enzymes (ALT/AST)

Elevation of ALT and/or AST localizes the disease to (at least in part to), the liver parenchyma

The degree of elevation correlates with the degree of damage

Initially, with any type of injury, these enzymes increase then decrease upon recovery or successful treatment

- Use enzymes as a marker of recovery

Table 25-5 Approximate Half-life of Serum Hepatic Enzyme Activities (Hours) for the Dog and Cat

Enzyme	Dog	Cat
ALT (alanine aminotransferase)	60	3.5
GLD (glutamate dehydrogenase)	18	Not determined
AST (aspartate aminotransferase)	12	1.5
LALP (liver alkaline phosphatase)	66	6

Other Markers of Hepatocyte Injury

- Hypoalbuminemia
- Hypoglycemia
- Decreased BUN
- Hypocholesterolemia

Bad News

Occasionally, with severe liver disease, hepatocyte death is so widespread, there is NO ALT left to leak

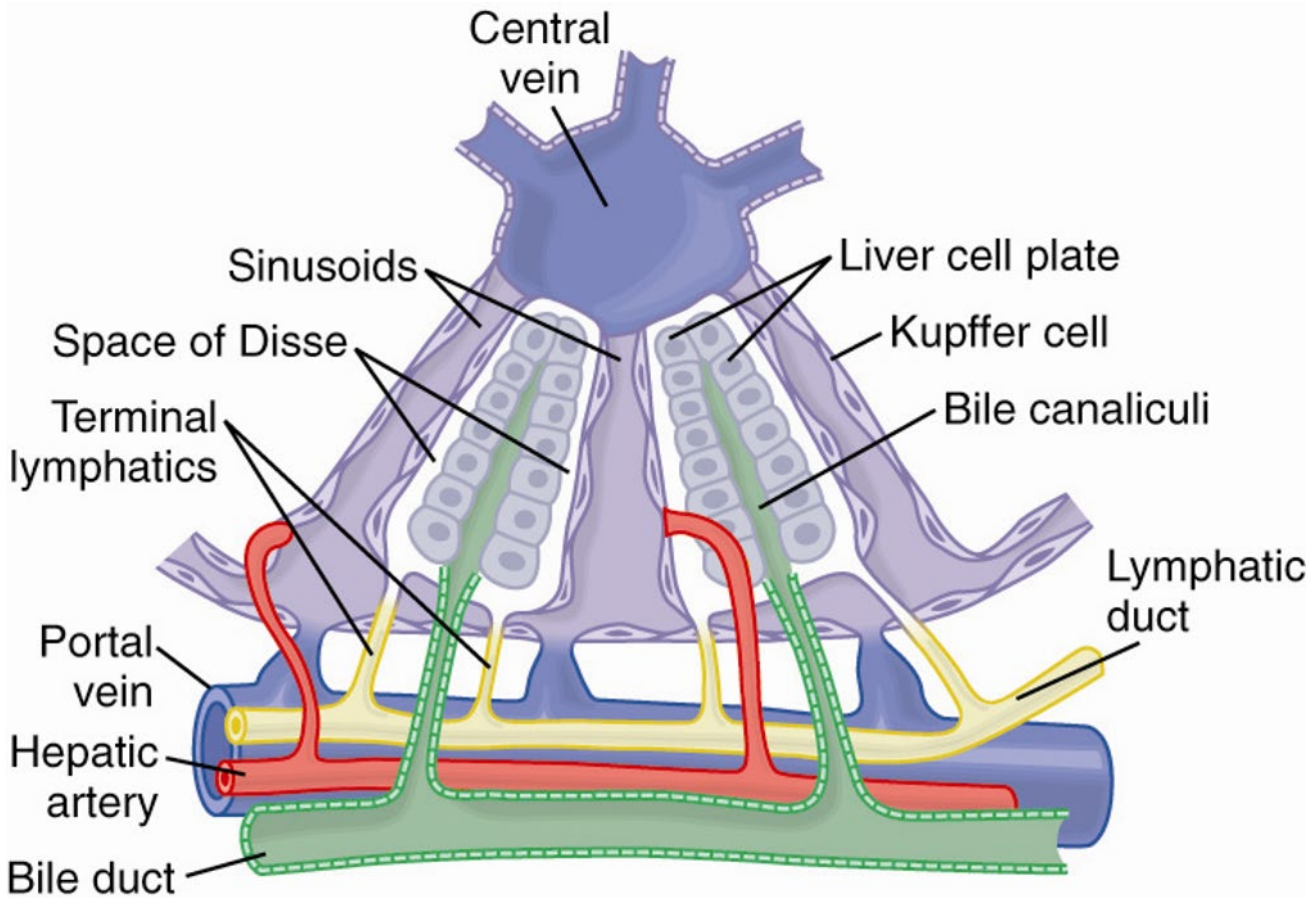
ALT may be normal or mildly elevated in severe or chronic diseases

nevertheless

ALT/AST> CHOLESTATIC ENZYMES IS VERY INDICATIVE OF HEPATIC DISEASE

A Review of Cholestatic Enzymes

- ALP and GGT are inducible enzymes released from bile canalicular membrane or hepatocyte membrane
  - Release due to cholestasis INSIDE OR OUTSIDE the liver


Central vein
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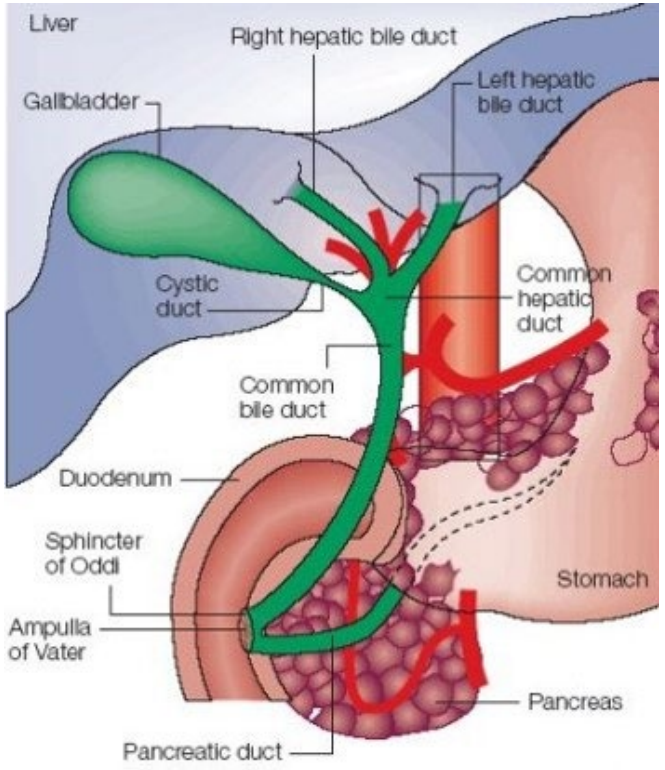
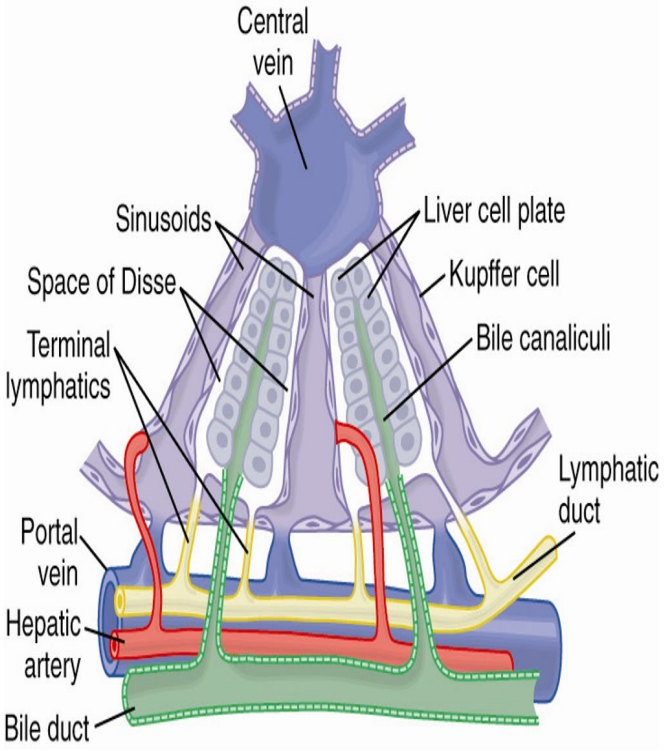
Bile canaliculi
Lymphatic duct
Portal vein
Hepatic artery
Bile duct

Cholestatic Enzymes

- ALP and GGT
  - Mild to severe elevations with intrahepatic or extrahepatic cholestasis
  - Higher values associated with more severe cholestasis

Intrahepatic Biliary System





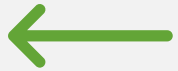
Intrahepatic Cholestasis

- Occurs due to compression of bile canaliculi due to hepatocyte swelling during or after hepatocyte injury
- Occurs due to obstruction or compression of bile canaliculi or bile ducts
  - Hepatic mass
  - Fibrosis
  - Cirrhosis
  - Biliary neoplasia
  - Choledocholith

ALT Elevation Then ALP/GGT Elevation

- In hepatic diseases, it is common to have an initial rise in ALT, followed by a rise in ALP/GGT days to weeks later, as damaged hepatocytes swell and compress bile canaliculi
  - ALP/GGT in these cases are usually mild to moderate
- Common pattern after toxicities or hepatic infections/inflammation
- Chronic hepatopathies

Mixed ALT/ALP and GGT Patterns

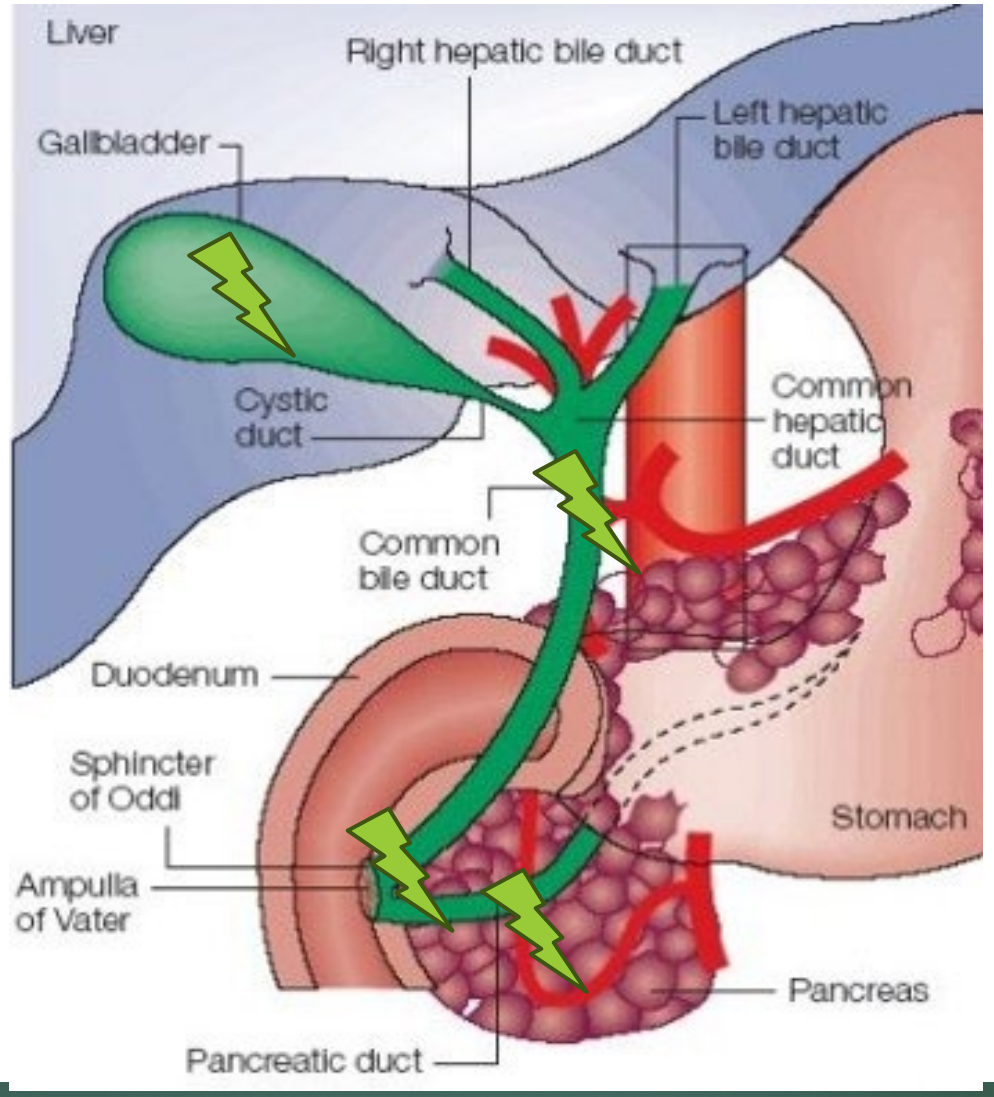


Localizes to the liver OR the post-hepatic biliary system

Best interpreted along with abdominal imaging and pancreatitis testing

Extrahepatic Cholestasis

- Cholestasis in the bile ducts OUTside of the liver
  - Cystic duct
  - Gallbladder
  - Common bile duct
  - Proximal duodenum


Liver
Right hepatic bile duct
Left hepatic bile duct
Gallbladder
Cystic duct
Common hepatic duct
Common bile duct
Duodenum
Sphincter of Oddi
Stomach
Ampulla of Vater
Pancreas
Pancreatic duct

Extrahepatic Bile Duct Diseases (EHBD)

- Cholangitis
- Cholecystitis
- Biliary tumors
- Gallbladder mucocele
- Choleliths
- Pancreatitis!!!

Extrahepatic Bile Duct Diseases (EHBD0)

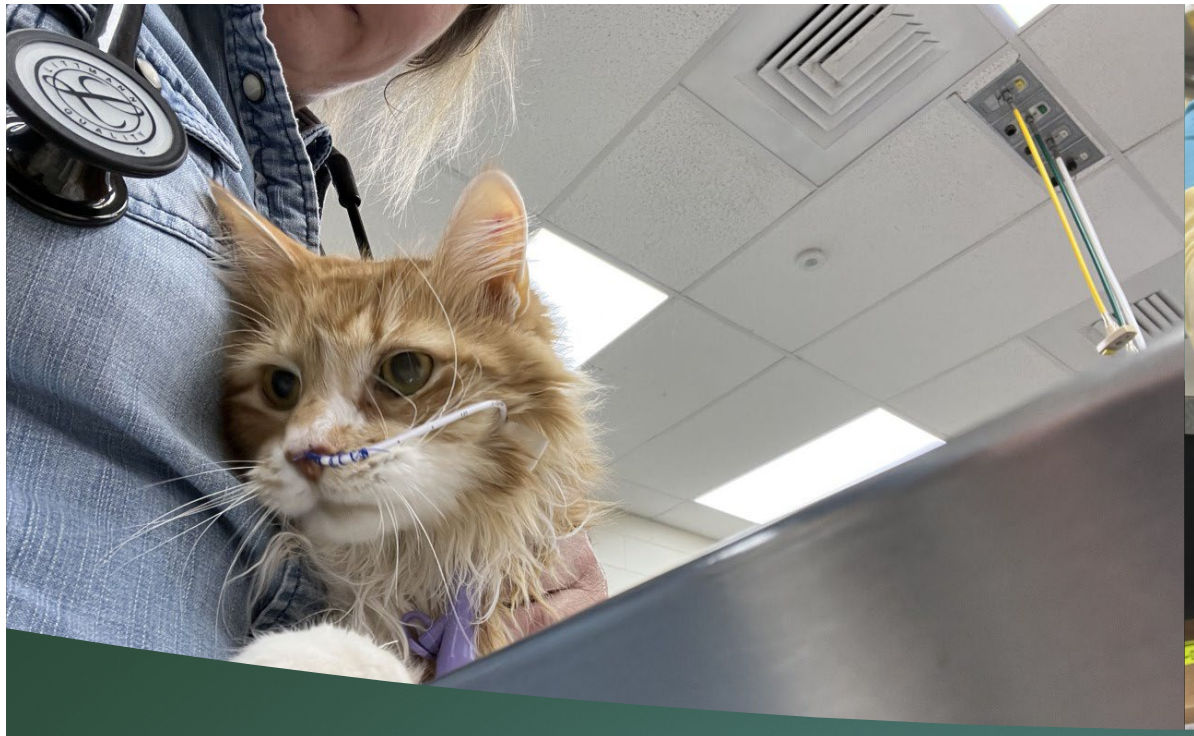
ALP/GGT mild to severe elevations

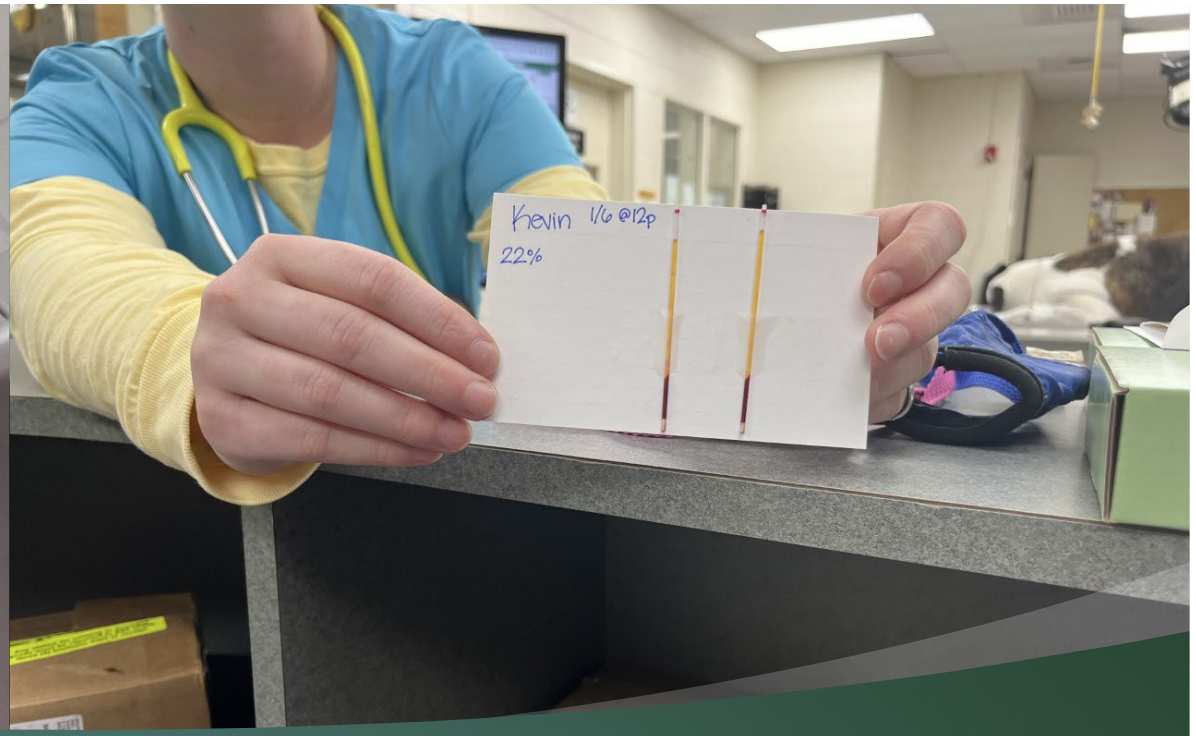
ALT is usually normal or mildly elevated

Cholestasis “downstream” causes hepatocytes “upstream” to leak ALT/AST bc bile stasis is irritating to membranes

Extrahepatic Bile Duct Diseases (EHBD)

- Pancreatitis is different
- Pancreatitis may cause more significant hepatocyte damage due to local inflammation
  - Mild to severe ALT elevation
- Mixed pattern or predominantly cholestatic
- Rarely, just ALT elevation



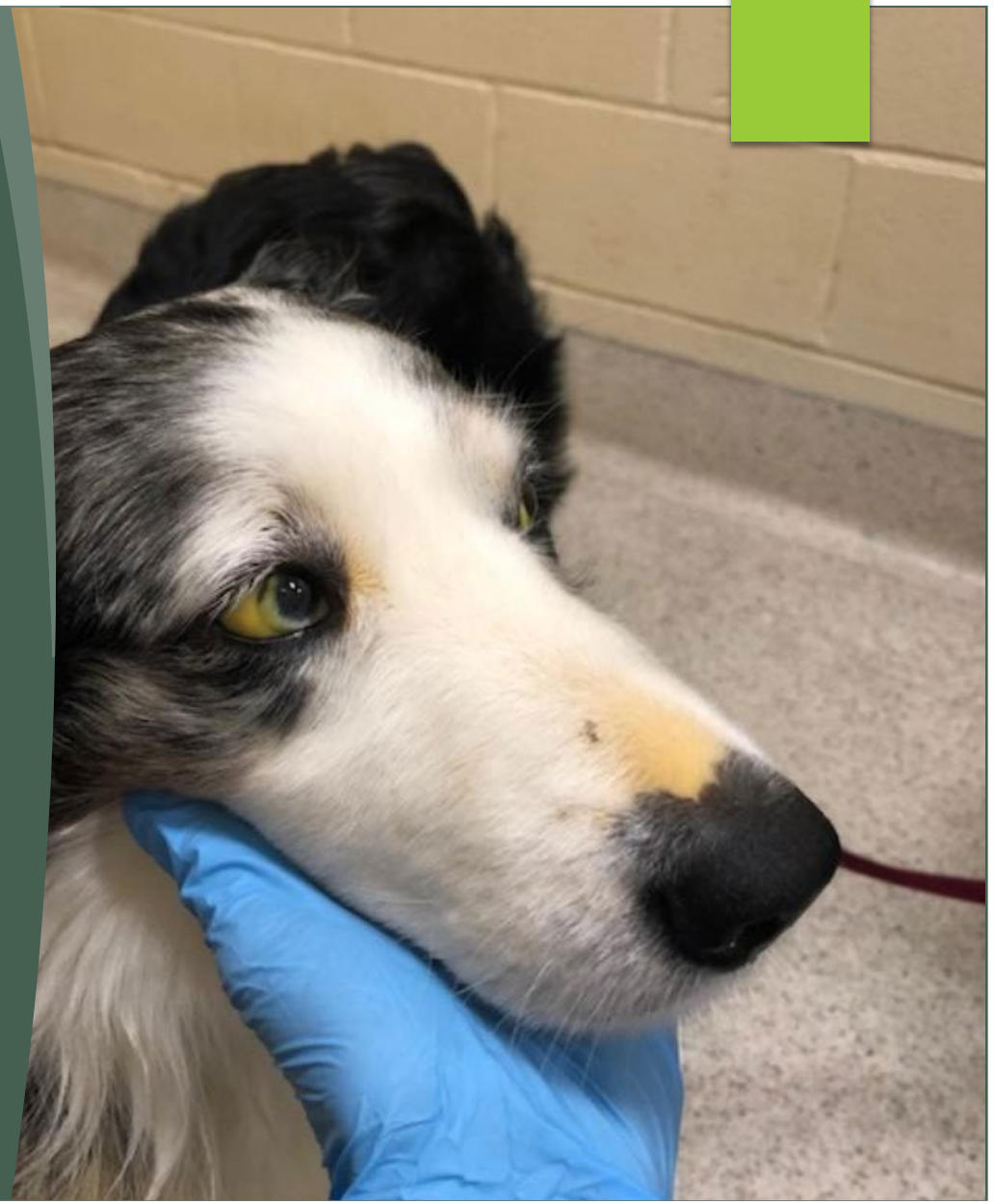


A Review of Icterus: Causes

- Liver dysfunction (hepatic)
  - Icterus due to decreased hepatocyte uptake and conjugation of bilirubin

A Review of Icterus: Causes

- Cholestasis
  - Icterus due to impaired flow of bile through intrahepatic or extrahepatic biliary system
  - Intrahepatic cholestasis
  - Extrahepatic cholestasis

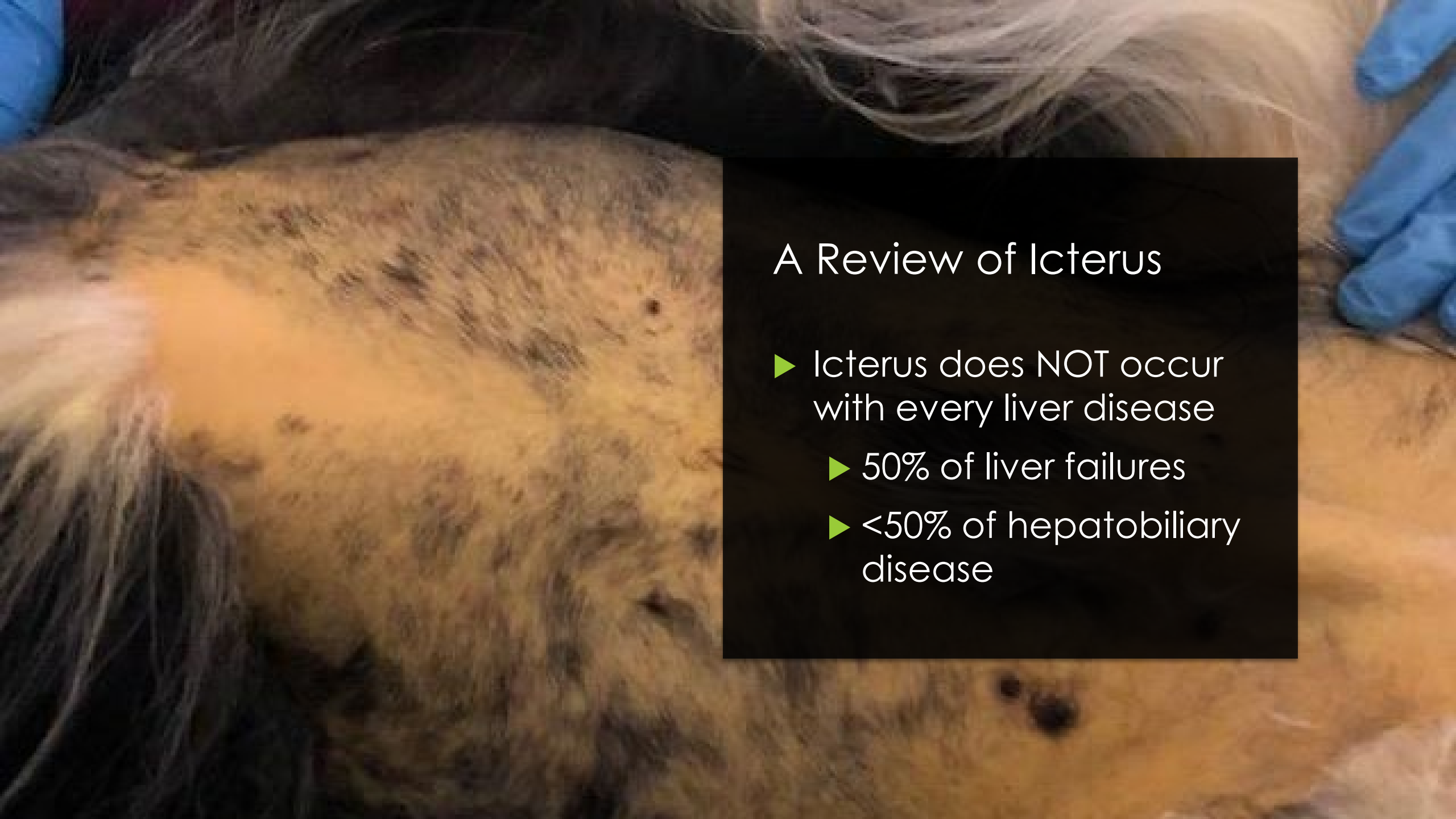


Localizing Causes of Icterus

- Liver function tests help determine if there is a hepatic cause of icterus
  - A failed liver function proves the liver cannot take up and conjugate bilirubin
- Does not rule out an extrahepatic component
- Bile acid assay or ammonia tolerance testing
  - But…..Cannot interpret BA assay if patient is icteric

Localizing Causes of Icterus

- **Bloodwork**
  - ALT/ AST > ALP/GGT in acute hepatitis /acute hepatotoxicity
  - ALP/GGT > ALT/AST in extrahepatic disease
  - Biochemical markers of liver dysfunction occur with hepatic cause of icterus
  - BOTH ALT/AST and ALP/GGT may elevated in some cases
    - Pancreatitis
    - Chronic hepatopathies
    - Days after onset of acute hepatopathy



A Review of Icterus

- Icterus does NOT occur with every liver disease
  - 50% of liver failures
  - <50% of hepatobiliary disease

Localizing Hepatobiliary Disease

IMAGING AND ASPIRATES

RADIOGRAPHS AND ULTRASOUND

+/- CT SCAN

CHOLECYSTOCENTESIS

LIVER BIOPSIES


RIGHT

Liver Biopsies

- What to submit
  - Routine histopathology
  - Liver culture
  - Liver tissue for mineral analysis
    - No formalin
    - Wrap in dry gauze
  - Bile cytology
  - Bile culture
  - Save tissue for
    - FISH
    - PCR

Now For Some Cases!

Gray Epperson

- Gray is a 2-3 year old male, neutered, domestic short hair that presenting the morning of 5/25/23 for lethargy and not eating breakfast. He was his typical, feisty self the night of 5/24/25 and did not greet the owners on 5/25/23. Mrs. Epperson fed him canned turkey food and Gray did not eat it, instead, he covered it with a towel. Mrs. Epperson knowns that Gray defected twice on 5/24/23 but was unsure about urination. Mrs. Epperson reports that Gray was sitting by the window the night of 5/24/35 with one of the other cats and the morning of 5/25/23, multiple things around there were knocked down and moved. Gray is known to scrap with the other cats and up until the morning of 5/25/23 Gray has been normal. Gray was found in the barn in November of 2022 and was taken into the house with 2 other cats and a dog in late November/early December. He was FeLV/FIV/HW Ag tested in December of 2022 and was below detectable limits. He was vaccinated in December of 2022 and January 2023. He was also neutered in January

CBC, SA

Animal ID	Gray				
Sample	Blood, Purple Top - CBC, Small Animal				
Instrument Type	Advia 2120i				
WBC	17.08	H	10^3/ul	4.60 - 16.70	05/25/2023 01:24 PM
RBC	8.95		10^6/ul	6.40 - 10.10	05/25/2023 01:24 PM
HGB	13.4		g/dl	9.1 - 15.2	05/25/2023 01:24 PM
HCT	37.7		%	32.0 - 48.0	05/25/2023 01:24 PM
MCV	42.2		fL	40.0 - 54.0	05/25/2023 01:24 PM
MCH	15.0		pg	13.0 - 19.0	05/25/2023 01:24 PM
MCHC	35.6	H	g/dl	28.0 - 35.0	05/25/2023 01:24 PM
RDW%	13.2		%	13.0 - 23.0	05/25/2023 01:24 PM
Platelets	20	L	10^3/ul	187 - 559	05/25/2023 01:24 PM
Tech Instrument	Chayse Culbert, ELT				
PCV	38.0		%	30.0 - 46.4	05/25/2023 01:24 PM
PP	7.7		g/dl	6.4 - 9.0	05/25/2023 01:24 PM
Seg %	85	H	%	47 - 79	05/25/2023 01:24 PM
Segs	14518.0	H	/ul	2300.0 - 11900.0	05/25/2023 01:24 PM
Lymph %	13.0		%	9.1 - 47.1	05/25/2023 01:24 PM
Lymph	2220.4		/ul	1000.0 - 4500.0	05/25/2023 01:24 PM
Mono %	1.0		%	0.0 - 7.9	05/25/2023 01:24 PM
Mono	170.8		/ul	0.0 - 700.0	05/25/2023 01:24 PM
Eos %	1		%	0 - 12	05/25/2023 01:24 PM
Eos	171		/ul	0 - 1600	05/25/2023 01:24 PM
Platelet Estimate	Appears Decreased				
Plt. Est. Number	20				

Neuro Chem SAP Panel

Animal ID	Gray				
Sample	Blood, Red Top - NEURO Chemistry Panel				
Instrument Type	Axcel				
Sodium	151.8		mmol/L	148.0 - 159.0	05/25/2023 10:54 AM
Potassium	3.64		mmol/L	3.50 - 5.50	05/25/2023 10:54 AM
Chloride	118.2		mmol/L	114.0 - 127.0	05/25/2023 10:54 AM
CO2	18.7		mEq/L	16.0 - 30.0	05/25/2023 10:54 AM
ANGAP	19			10 - 20	05/25/2023 10:54 AM
Glucose	179	H	mg/dl	70 - 160	05/25/2023 10:54 AM
BUN	19		mg/dl	10 - 40	05/25/2023 10:54 AM
Creatinine	0.92		mg/dl	0.40 - 2.00	05/25/2023 10:54 AM
ALT	742	H	U/L	7 - 60	05/25/2023 10:54 AM
ALP	40		U/L	10 - 42	05/25/2023 10:54 AM
TBili	0.3		mg/dl	0.1 - 0.5	05/25/2023 10:54 AM
Total Protein	7.7		g/dl	6.5 - 8.4	05/25/2023 10:54 AM
Albumin	3.1		g/dl	2.2 - 3.2	05/25/2023 10:54 AM
Globulin	4.6		g/dl	4.1 - 6.0	05/25/2023 10:54 AM
AG	0.70			No Ref Interval	05/25/2023 10:54 AM
Calcium	9.3		mg/dl	8.2 - 10.6	05/25/2023 10:54 AM
Phosphorus	3.0		mg/dl	2.6 - 5.7	05/25/2023 10:54 AM
Cholesterol	215	H	mg/dl	95 - 200	05/25/2023 10:54 AM
OSMO	299		mOsm/kg	295 - 320	05/25/2023 10:54 AM
Magnesium	2.3		mg/dl	1.9 - 2.6	05/25/2023 10:54 AM
CK	369	H	U/L	50 - 225	05/25/2023 10:54 AM

Gray

- Normal baseline ammonia
- Normal coagulation times
- Normal thoracic radiographs
- Abdominal ultrasound and liver aspirates
- Toxoplasmosis titers

Findings:
There is echogenic debris within the gallbladder that settles to the dependent aspect of the lumen throughout the course of the exam. The common bile duct is normal in size and content. There is a small volume of anechoic peritoneal effusion multifocally throughout the abdomen. There is a moderate, diffuse reticulonodular pattern throughout the splenic parenchyma. Echogenic debris is suspended within the urinary bladder. The pancreaticoduodenal and right colic lymph nodes are mildly enlarged, rounded, and hyperechoic. The cecal wall is mildly thickened with mild loss of normal layering.

Conclusion:
- Gallbladder sludge which may be associated with cholangiohepatitis or cholestasis.
- Suspect typhlitis, with differentials to include inflammatory etiologies (as with lymphoplasmacytic) and infectious etiologies (parasitic, bacterial, FIP, mycotic). Neoplasia (round cell, neoplastic) is also considered.
- Mild multifocal lymphadenopathy with differentials to include reactive etiologies and multicentric/metastatic neoplasia.
- Small volume peritoneal effusion (modified transudate, exudate, neoplastic).
- Diffuse moderate reticulonodular pattern within the spleen. Differentials include lymphoid hyperplasia, extramedullary hematopoiesis, infectious etiologies (mycotic, FIP) , an age-related change (depending on the patient's true age), and round cell neoplasia.
- Lipid/proteinaceous/cellular urinary bladder debris

- N-Acetylcysteine (200) (70) 1.6 mls IV Q6
  - Add 1.6 mls of N-acetylcysteine with 4.8 mls of D5W
- Cerenia (10_ (1) 0.47 mls IV Q24
- Mirtazapine 1/4 inch strip transdermally Q24
- Gabapentin (100) (11) 0.52 mls PO Q8
- Clindamycin (25) (10.6) 2 mls PO Q12
- Ondansetron (2) (1) 2.6 mls IV Q8

Spec #	Animal Id	Test	Interpretation	Result
1	Gray C23-12264	Toxoplasma gondii-IgM	< 1:32	Negative
1	Gray C23-12264	Toxoplasma gondii-IgG	1:1024	**POSITIVE**

Baseline dilution = 1:32

Monkey

Monkey is an approximately 9-year-old male neutered DSH that presented to MSU-CVM Internal Medicine service on 3/9/21 for further evaluation of chronic vomiting and elevated liver enzymes. Per Stephanie, he has been vomiting for years; however, has increased in severity in the last few months. In February, he was vomiting yellow bile with observed abdominal contraction 3-4x intermittently throughout the day. Bloodwork performed at the rDVM revealed elevated liver enzymes (ALP 104, ALT 611). He was hospitalized for a few days which improved his vomiting to approximately 1x/day. At the beginning of March, he was hyporexic and lethargic with decreased water intake. Repeated bloodwork at the rDVM revealed elevated liver enzymes (ALP 142, ALT 473). He was hospitalized on IV fluids with repeat bloodwork displaying steady decline of the elevated liver enzymes (3/6 ALT 123, ALP 109), but new hyperbilirubinemia at 2.2. He was discharged from Mitchell Animal Clinic on 3/6. Afterwards, his hyporexia progressed to anorexia, further decreased water intake, and worsening lethargy with jaundice now present. Stephanie reports he has lost weight recently. His bowel movements are formed. He is strictly indoors with one other cat who is not displaying clinical signs. He is not on heartworm or flea preventative. Monkey also has a historical heart murmur at a grade II/VI that is treated with Enalapril 1.25mg BID. Stephanie does not report any tachypnea, dyspnea, coughing, or exercise intolerance

Neuro Chem SAP Panel

Animal ID	Monkey				
Sample	Blood, Red Top - NEURO Chemistry Panel				
Sodium	152.7		mmol/L	148.0 - 159.0	03/09/2021 04:39 PM
Potassium	4.38		mmol/L	3.50 - 5.50	03/09/2021 04:39 PM
Chloride	115.1		mmol/L	114.0 - 127.0	03/09/2021 04:39 PM
CO2	21.8		mEq/L	16.0 - 30.0	03/09/2021 04:39 PM
ANGAP	20			10 - 20	03/09/2021 04:39 PM
Glucose	112		mg/dl	70 - 160	03/09/2021 04:39 PM
BUN	16		mg/dl	10 - 40	03/09/2021 04:39 PM
Creatinine	1.71		mg/dl	0.40 - 2.00	03/09/2021 04:39 PM
ALT	146	H	U/L	7 - 60	03/09/2021 04:39 PM
ALP	220	H	U/L	10 - 42	03/09/2021 04:39 PM
TBili	6.1	H	mg/dl	0.1 - 0.5	03/09/2021 04:39 PM
Total Protein	7.4		g/dl	6.5 - 8.4	03/09/2021 04:39 PM
Albumin	2.9		g/dl	2.2 - 3.2	03/09/2021 04:39 PM
Globulin	4.5		g/dl	4.1 - 6.0	03/09/2021 04:39 PM
AG	0.60			No Ref Interval	03/09/2021 04:39 PM
Calcium	9.4		mg/dl	8.2 - 10.6	03/09/2021 04:39 PM
Phosphorus	3.8		mg/dl	2.6 - 5.7	03/09/2021 04:39 PM
Cholesterol	236	H	mg/dl	95 - 200	03/09/2021 04:39 PM
OSMO	296		mOsm/kg	295 - 320	03/09/2021 04:39 PM
Magnesium	2.5		mg/dl	1.9 - 2.6	03/09/2021 04:39 PM
CK	137		U/L	50 - 225	03/09/2021 04:39 PM
Sample Condition	3+ Icteric				

•**CBC**
•RBC: 6.02 **L** 10^6/ul (reference interval: 6.40 - 10.10)
•HGB: 8.9 **L** g/dl (reference interval: 9.1 - 15.2)
•HCT: 26.7 **L** % (reference interval: 32.0 - 48.0)
•PCV: 26.0 **L** % (reference interval: 30.0 - 46.4)
•Segs: 13137.0 **H** /ul (reference interval: 2300.0 - 11900.0)

•**Coagulation profile**PT:
•9.7 sec (reference interval: 5.0 - 10.0)
•PTT: 148.2 **H** sec (reference interval: 15.0 - 25.0)

•**Ammonia Challenge**Baseline Ammonia: 43.00
•Post Ammonia: 141.0

Comparative Coagulation

Director Dr. Marjory Brooks - 607-253-3648

CF12, Factor XII Coagulant Activity

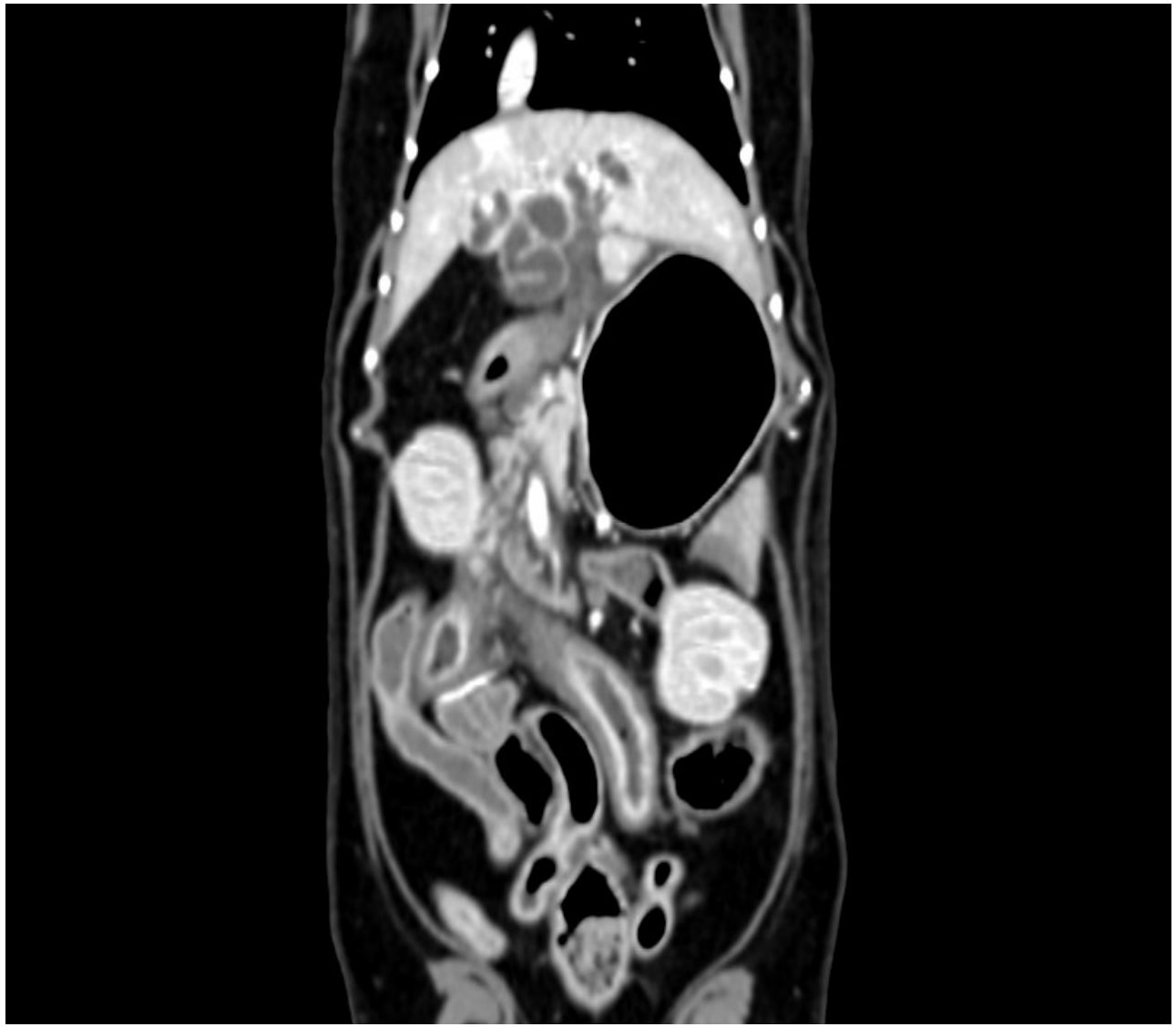
Item		Result	Reference Interval
1	Monkey - Feline Domestic Shorthair Castrate Plasma, Citrate	FXII:C: 6 %	60 - 150

Comments: These results are compatible with a diagnosis of hereditary Factor XII deficiency (Hageman trait). Factor XII deficiency in cats is an autosomal recessive trait. Homozygotes have low Factor XII:C (usually less than 10%) and it is likely that this cat's low Factor XII activity is an indication of homozygosity for the Hageman trait. Factor XII is a contact group factor. Deficiency of Factor XII and the other contact group factors (prekallikrein, high molecular weight kininogen) cause marked prolongation of in vitro clotting time in the aPTT screening test however, Factor XII deficiency does not cause an in vivo bleeding diathesis.

•Medications Day 1
•Cerenia 10mg/mL: 1mg/kg (0.54mL) IV q24h
•Vitamin K: 1mL SQ q8h
•Mirtazapine 5mg transdermal: 1.5inch strip applied to pinna topically q24h
•Plasmalyte: 7mL/hr IV CRI

•Medications Day 2
•Cerenia 10mg/mL: 1mg/kg (0.54mL) IV q24h
•Vitamin K: 1mL SQ q8h
•Mirtazapine 5mg transdermal: 1.5inch strip applied to pinna topically q24h
•Plasmalyte: 7mL/hr IV CRI
•Acetylcysteine 200mg/mL: 70mg/kg (1.9mL) IV through filter q8h
•Carnitine: 250mg capsule PO (via NE tube) q24h
•Lactulose: 1mL PO q8h
•Veraflox: 25mg: 1.62mL PO q24h
•Atenolol


CHI
Frq 8.0
Gn 59
S/A 4/4
Map A/0
D 4.5
DR 81
0
1
2
3
4



Interpretation:
- A definitive structural cause for the intra- and extrahepatic biliary duct dilation is not identified on the present study. Consideration is given to severe cholecysitis/cholangiohepatitis, pancreatitis and/or duodenitis, particularly given the diffuse intestinal lesions. Other differentials include choledochocyst causing segmental dilation* or trematode (fluke) infection.
- Focal narrowing of the common bile duct near the pancreaticobiliary junction could suggest extramural compression caused by pancreatitis or stricture formation. Early infiltrative neoplasia here, with mural compression, is a less likely possibility.
- The hyperdense biliary contents are consistent with inspissation or mild mineralization.
- Mild, diffuse pancreaticomegaly and pancreatic duct dilation, without surrounding steatitis. This may be a normal finding (anatomic variation and age-related duct dilation), nodular hyperplasia or pancreatitis.
- Inflammatory bowel disease or less likely round cell neoplasia (given the lack of a lymphadenopathy) are differentials for the multifocal duodenal and jejunal thickening
- Differentials for the small volume peritoneal effusion include modified transudate, exudate, bile, and hemorrhage
- Differentials for the changes to the spleen include extramedullary hematopoiesis, lymphoid hyperplasia, infectious/inflammatory etiologies, and round cell neoplasia
- The enlarged cisterna chyli and mildly enlarged caudal thoracic duct is of unknown clinical significance.
- Multifocal renal cortical infarction
- The left ventricular thickening is consistent with the reported hypertrophic cardiomyopathy.
- Iatrogenic gas from sedative administration
- Bilateral coxofemoral osteoarthrosis with fragmented osteophytes or osteochondromas

Ursodiol

- To use or not to use???

River Barrett

- Chronic enteropathy
- Progressive hyporexia
- Multiple diagnostics performed step-wise
- Presented to IMED for E-tube and consultation

- **RELEVANT PATIENT HISTORY:**

River, a 6.5 year old, MC FeLV positive cat presented to MSU-CVM Internal Medicine Service on 8/2/2023 regarding diarrhea, hyporexia, and hepatic lipidosis. We previously saw River on 7/14/2023 for diarrhea and hyporexia, and at this appointment we performed a giardia snap test and fecal parasite flotation, which did not detect any intestinal protozoal organisms or parasites. River was sent home on Metronidazole and Proviable Forte. At a recheck appointment on 7/17/2023, a CBC/CHEM/T4/Urinalysis tests were performed, with CBC results revealing decreased protein and globulins. T4 results were low which is suggestive of Euthyroid Sick Syndrome from chronic illness. An abdominal ultrasound and aspirate were performed, and it was determined that River had multifocal thickening of the muscularis layer in the small intestine, mild lymph node enlargement, and hepatic lipidosis (determined by liver FNA). Abdominal radiographs were also performed, and it is determined that River had small intestinal gas, mild splenomegaly, and ill-defined nodules dorsal to the descending colon that may be superimposition of normal structures or due to lymphadenopathy. A gastrointestinal bloodwork panel was sent off to Texas A & M University, and consisted of TLI, PLI, Cobalamin, and Folate levels. All of the levels were within reference interval. On 7/21, river returned for thoracic rads that showed an enlarged and rounded cardiac silhouette. Rivers current medications are Mirtazapine and Entyce. River is still having intermittent diarrhea. He currently is eating half a cup of ZD with cheese and turkey.

Neuro Chem SAP Panel

Animal ID	River				
Sample	Blood, Red Top - NEURO Chemistry Panel				
Instrument Type	Axcel				
Sodium	148.8		mmol/L	148.0 - 159.0	07/17/2023 12:48 PM
Potassium	4.86		mmol/L	3.50 - 5.50	07/17/2023 12:48 PM
Chloride	120.2		mmol/L	114.0 - 127.0	07/17/2023 12:48 PM
CO2	20.3		mEq/L	16.0 - 30.0	07/17/2023 12:48 PM
ANGAP	13			10 - 20	07/17/2023 12:48 PM
Glucose	93		mg/dl	70 - 160	07/17/2023 12:48 PM
BUN	16		mg/dl	10 - 40	07/17/2023 12:48 PM
Creatinine	1.44		mg/dl	0.40 - 2.00	07/17/2023 12:48 PM
ALT	12		U/L	7 - 60	07/17/2023 12:48 PM
ALP	15		U/L	10 - 42	07/17/2023 12:48 PM
TBili	0.3		mg/dl	0.1 - 0.5	07/17/2023 12:48 PM
Total Protein	5.3	L	g/dl	6.5 - 8.4	07/17/2023 12:48 PM
Albumin	2.2		g/dl	2.2 - 3.2	07/17/2023 12:48 PM
Globulin	3.1	L	g/dl	4.1 - 6.0	07/17/2023 12:48 PM
AG	0.70			No Ref Interval	07/17/2023 12:48 PM
Calcium	8.5		mg/dl	8.2 - 10.6	07/17/2023 12:48 PM
Phosphorus	4.8		mg/dl	2.6 - 5.7	07/17/2023 12:48 PM
Cholesterol	145		mg/dl	95 - 200	07/17/2023 12:48 PM
OSMO	288	L	mOsm/kg	295 - 320	07/17/2023 12:48 PM
Magnesium	2.0		mg/dl	1.9 - 2.6	07/17/2023 12:48 PM
CK	365	H	U/L	50 - 225	07/17/2023 12:48 PM
Sample Condition	Normal				

Biopsy

DIAGNOSIS

Liver: Cholangiohepatitis, neutrophilic and lymphoplasmacytic, diffuse, chronic-active, moderate, with portal fibrosis and biliary hyperplasia

Hepatic lipidosis and glycogenosis, diffuse, mild

Small intestine (Duodenum, jejunum, Ileum): Enteritis, neutrophilic, eosinophilic, and lymphoplasmacytic, chronic-active, moderate, with moderate villous blunting and mildly increased intraepithelial lymphocytes (duodenum), mild crypt abscessation (jejunum), and mild fibrosis

Stomach: Gastritis, lymphoplasmacytic, chronic, mild

Findings:

The small intestines are diffusely mildly thickened characterized by thickening of the muscularis layer, with the jejunum measuring up to 3.3 cm in height and the ileum measuring 4.8 cm in height. Multiple intra-abdominal lymph nodes are mildly enlarged, rounded, and hypoechoic to include the right colic and mesenteric lymph nodes, the largest of which (right colic) measures up to 0.44 cm. There is a scant amount of anechoic fluid free throughout the peritoneal space. The spleen has a mottled echotexture characterized by multifocal ill-defined ovoid hypoechoic nodules that measure up to 0.22 cm in height. The gallbladder contains a small amount of gravity dependent echogenic debris.

MEDICATIONS/PRESCRIPTIONS:

- **Prednisolone 10mg/ml** (1mg/kg): Give 0.35mL orally every 24 hours for 21 days.
    - This is a glucocorticoid which are used to treat many conditions in humans and animals, prednisolone has 4 primary uses with accompanying dosage ranges: 1) replacement or supplementation for glucocorticoid deficiency secondary to hypoadrenocorticism, 2) anti-inflammatory agent, 3) immunosuppression, and 4) antineoplastic agent.
- **Pradofloxacin 25mg/ml** (7.5mg/kg): Give 1.05mL orally every 24 hours for 14 days.
    - This is an antibiotic in the fluoroquinolone class that is being used to treat River's cholangitis.
- **Proviable:** Give 1 tablet via e-tube once daily.
    - This is a probiotic supplement.

Shelby Reichtly: 2021

Shelby is a 14.5 year old female spayed DSH with a 1.5 year history of hepatopathy. Her ALT was 2224 U/L in August 2019 but was back down within the normal range by October of 2019. Within the last 24 hours she has been lethargic, had a decreased appetite, and has vomited multiple times (6-8x). This was the same clinical signs that she had in August of 2019. She also has a grade 3 heart murmur and has had an echo in 2019. She is currently not on any medications. She is an indoor cat that has access to the back yard for 15-30 minutes a day

Findings:

The liver is diffusely hypoechoic. The gallbladder is markedly distended with anechoic bile and a small amount of hyperechoic, distally shadowing material in the gravity dependent portion of the gallbladder. The bile duct is moderately to severely dilated diffusely measuring up to 0.91 cm in thickness. Hyperechoic, distally shadowing material is also throughout the dilated bile duct in the gravity dependent portion. A smoothly marginated, irregularly shaped, hyperechoic, distally shadowing structure is within the terminating bile duct extending into the duodenal papilla which measures 0.86 cm in thickness. The small intestines are normal. The pancreas is diffusely hypoechoic and mildly thickened measuring up to 1.11 cm with a large amount of blood flow on color Doppler interrogation. The pancreatic duct is diffusely dilated measuring 0.22 cm in thickness with a moderate amount of hyperechoic, distally shadowing material within the gravity dependent portion of the peripheral regions of the left and right limbs. The renal margins are undulating.

Aerobic C&S & Anaerobic Culture

Animal ID	Shelby
Site	Bile - AER C&S & ANA CULTURE
Prelim Report	Heavy growth of possible Enterococcus or Alpha 10/29/2021.

Organism ID & MIC

Shelby: 2023

- >8 repeat visits for cholangitis/pancreatitis
- Repeat cholecystocenteses: 4
- Different organisms or resistance of organisms as time progressed

Aerobic C&S & Anaerobic Culture

Animal ID	Shelby
Site	Bile - Aerobic & ANA C&S
Prelim Report	Heavy growth of a Gram positive organism and a Gram negative organism. ID and MIC to follow isolation. 8/25/2023 SMD Heavy growth of a Gram positive organism and 2 Gram negative organism. Possible anaerobe isolated. ID and MIC to follow. 8/26/2023 SMD Possible anaerobe isolated. Send to MVRDL in Pearl on 8/28/2023 for ID. 8/27/2023 SMD

Organism ID & MIC

Culture Growth	Heavy growth of
Organism	Elizabethkingia meningoseptica
Organism	Enterococcus faecium
Organism	Escherichia coli
Performed By	Sarah Duncan, MT (ASCP)
Date Completed	August 27, 2023 at 10:35:29 AM CDT

Antibiotic susceptibility Pattern

	Elizabethkingia meningoseptica			Enterococcus faecium			Escherichia coli		
	Interpretation	MIC	Test Range	Interpretation	MIC	Test Range	Interpretation	MIC	Test Range
Amikacin (AMI)	S	16	4-32	R	16.0000	4-32	S	8.0000	4-32
Amox/Clav Acid (AUG)	NI	>1	0.12-1	S	0.5000	0.12-1	R	>1.0000	0.12-1
Ampicillin (AMP)	NI	>1	0.12-1	S	0.5000	0.12-1	R	>1.0000	0.12-1
Cefazolin (FAZ)	R	>8	1-8	R	8.0000	1-8	R	>8.0000	1-8
Cefovecin (FOV)	NI	>4	0.25-4				NI	>4.0000	0.25-4
Cefoxitin (FOX)	NI	16	2-16	R	>16.0000	2-16	I	16.0000	2-16
Cefpodoxime (POD)	NI	>16	2-16	R	>16.0000	2-16	R	>16.0000	2-16

Kevin

Kevin is a 9-year-old male neutered Domestic Long Hair cat that presented to MSU-CVM Emergency Service on 1/4/23 due to icterus. Ms. Fleming reports that she was out of town on 12/21/22 - 1/1/23. During this time, a cat sitter was taking care of Kevin and giving his insulin injections. Kevin typically receives 6 units twice daily. When Ms. Fleming returned home, Kevin was lethargic and not himself. Kevin was brought to the emergency vet on the evening of 1/1/23 where they diagnosed him as having a gastric ulcer. Ms. Fleming brought Kevin to MSU-CVM when she noticed his ears were yellow.

Current medications:
Amoxiclav 80mg/ml susp. - 1.5ml PO q12
Sucralfate 1g tablets - 1/2 tab PO q8
Omeprazole 20mg tablets - 1/4 tab PO q24
Cerenia 16mg tablets - 1 tablet PO PRN

CBC, SA

Animal ID	Kevin				
Sample	Blood, Purple Top - CBC, Small Animal				
Instrument Type	Heska				
WBC	15.45		10^3/ul	4.60 - 16.70	01/09/2023 09:12 AM
NEUT%	67.4		%	47.0 - 79.0	01/09/2023 09:12 AM
NEU#	11.45		10^3/ul	2.30 - 11.90	01/09/2023 09:12 AM
LYMPH%	24.7		%	47.0 - 79.0	01/09/2023 09:12 AM
LYM#	4.19		10^3/ul	1.00 - 4.50	01/09/2023 09:12 AM
MONO%	2.8		%	0.0 - 7.9	01/09/2023 09:12 AM
MONO#	0.49		10^3/ul	0.00 - 0.50	01/09/2023 09:12 AM
EOS%	4.8		%	0.0 - 12.0	01/09/2023 09:12 AM
EOS#	0.81		10^3/ul	0.00 - 1.60	01/09/2023 09:12 AM
BASO%	0.3		%	0.0 - 1.0	01/09/2023 09:12 AM
BAS#	0.06	H		No Ref Interval	01/09/2023 09:12 AM
RBC	4.79	L	10^6/ul	6.40 - 10.10	01/09/2023 09:12 AM
HGB	6.8	L	g/dl	9.1 - 15.2	01/09/2023 09:12 AM
HCT	19.6	L	%	32.0 - 48.0	01/09/2023 09:12 AM
MCV	40.8		fL	40.0 - 54.0	01/09/2023 09:12 AM
MCH	14.1		pg	13.0 - 19.0	01/09/2023 09:12 AM
MCHC	34.7		g/dl	28.0 - 35.0	01/09/2023 09:12 AM
RDW%	18.0		%	13.0 - 23.0	01/09/2023 09:12 AM
Platelets	217		10^3/ul	187 - 559	01/09/2023 09:12 AM
Tech Instrument	Alyssa Heath, ELT				
PCV	18.0	L	%	30.0 - 46.4	01/09/2023 09:12 AM

Neuro Chem SAP Panel

Animal ID	Kevin				
Sample	Blood, Red Top - NEURO Chemistry Panel				
Instrument Type	Axcel				
Sodium	149.7		mmol/L	148.0 - 159.0	01/09/2023 10:51 AM
Potassium	4.62		mmol/L	3.50 - 5.50	01/09/2023 10:51 AM
Chloride	111.3	L	mmol/L	114.0 - 127.0	01/09/2023 10:51 AM
CO2	14.1	L	mEq/L	16.0 - 30.0	01/09/2023 10:51 AM
ANGAP	29	H		10 - 20	01/09/2023 10:51 AM
Glucose	416	H	mg/dl	70 - 160	01/09/2023 10:51 AM
BUN	20		mg/dl	10 - 40	01/09/2023 10:51 AM
Creatinine	1.13		mg/dl	0.40 - 2.00	01/09/2023 10:51 AM
ALT	187	H	U/L	7 - 60	01/09/2023 10:51 AM
ALP	61	H	U/L	10 - 42	01/09/2023 10:51 AM
TBili	2.6	H	mg/dl	0.1 - 0.5	01/09/2023 10:51 AM
Total Protein	6.8		g/dl	6.5 - 8.4	01/09/2023 10:51 AM
Albumin	2.7		g/dl	2.2 - 3.2	01/09/2023 10:51 AM
Globulin	4.1		g/dl	4.1 - 6.0	01/09/2023 10:51 AM
AG	0.70			No Ref Interval	01/09/2023 10:51 AM
Calcium	9.8		mg/dl	8.2 - 10.6	01/09/2023 10:51 AM
Phosphorus	3.5		mg/dl	2.6 - 5.7	01/09/2023 10:51 AM
Cholesterol	250	H	mg/dl	95 - 200	01/09/2023 10:51 AM
OSMO	309		mOsm/kg	295 - 320	01/09/2023 10:51 AM
Magnesium	2.0		mg/dl	1.9 - 2.6	01/09/2023 10:51 AM
CK	1163	H	U/L	50 - 225	01/09/2023 10:51 AM

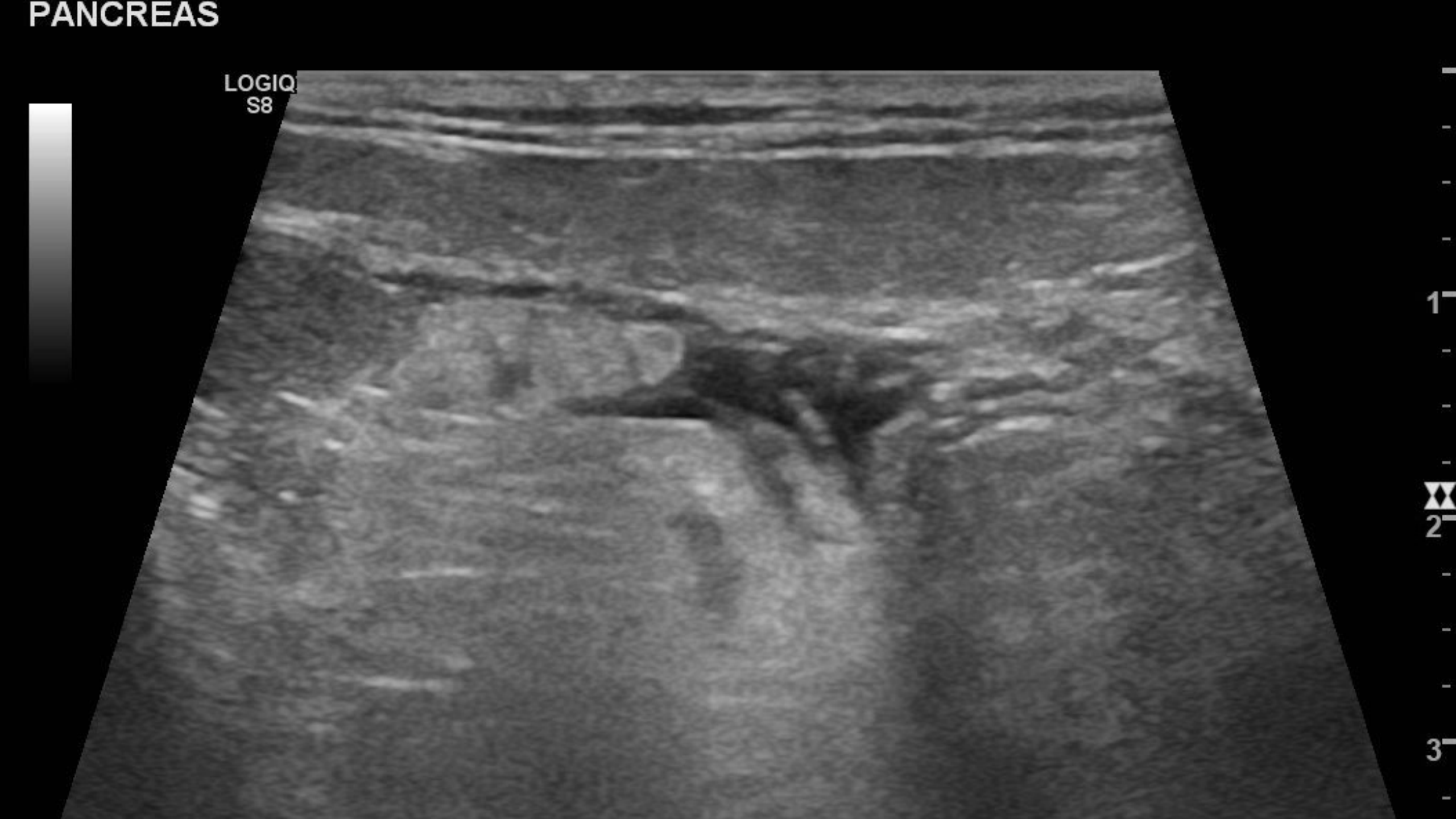
Conclusion:

- Acute pancreatitis with pancreatic edema, peritonitis/steatitis, peritoneal effusion (modified transudate, exudate), multifocal small intestinal muscularis thickening, and gallbladder sludge, consistent with feline triaditis.
- Hepatomegaly and diffusely hyperechoic hepatic parenchyma. This is likely due to a combination of the patient's historical diabetes mellitus and hepatic lipidosis (given the patient's generalized icterus).
- Lipid/proteinaceous/cellular urinary bladder debris.

Cytology

Site	Liver
DIAGNOSIS	Severe hepatic lipidosis Severe cholestasis
Findings	Multiple slides examined. Debris and broken cells are scattered throughout the background. The preparations are cellular and have significant amounts of blood contamination. A mixed population of inflammatory cells were observed that consist of neutrophils, macrophages and small lymphocytes. The inflammatory cells appear relatively proportional to the blood contamination. Scattered throughout the slides are numerous clusters of hepatocytes. Most of them exhibit marked amounts of cytoplasmic vacuolization (lipid accumulation). Numerous bile plugs were observed which indicates cholestasis. No infectious agents or overt evidence of neoplasia were observed.

R PANCREAS


PANCREAS
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Mississippi State CVM
01/05/23 11:37:26AM ADM
Fleming, Kevin
6004923
MI 1.1 TIs 0.3
C3-10
MedAb
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S8
FR 34
AO% 90
CHI
Frq 8.0
Gn 59
S/A 4/4
Map A/0
D 5.0
DR 81
0
2
4

- **Buprenorphine** 0.3mg/mL @0.2mg/kg: 0.31mL IV Q6
- **N-Acetylcysteine** 200mg/mL @70mg/kg: 1.68mL IV Q6
  - Dilution: +5.04mL NaCl (0.45%) - 6.72mL TOTAL
    - *Loading dose (140mg/kg - 3.4mL) given 1/5 @8pm*
- **Metoclopramide** 5mg @0.5mg/kg: 1/4 tab NG Q8
  - If able to place second line- CRI of 2mg/kg/day [1.9mL + 22.1mL NaCl]
- **Ondansetron** 2mg/mL @1mg/kg: 2.4mL IV Q8
  - Switching to ORAL after injectable- 4mg: 1 tablet NG Q8
- **Vitamin K** 10mg/mL @1mg/kg: 0.5mL SQ Q12
- **Cerenia** 10mg/mL @1mg/kg: 0.5mL IV Q24
- **Pradofloxacin** 25mg/mL @7.5mg/kg: 1.4mL NG Q24

.Cobalamin Fasting **Interpretation:** Result is within the reference interval.	290-1500 ng/L	**>1000 ng/L**
.Folate Fasting **Interpretation:** Decreased serum folate concentration. Consistent with proximal or diffuse small intestinal disease. Consider folate supplementation. http://vetmed.tamu.edu/gilab/research/folate-information	9.7-21.6 µg/L	**8 µg/L**
.TLI Fasting **Interpretation:** Values of higher than 100 ug/L can be seen in cats with gastrointestinal disease, pancreatitis, and other conditions. A fPLI will allow for more specific assessment of your patient for pancreatitis. Also consider checking serum cobalamin and folate to assess small intestinal absorption.	12-82 µg/L	**202.3 µg/L**
.Pancreatic Lipase Immunoreactivity Fasting **Interpretation:** Consistent with pancreatitis. Consider investigating for risk factors and concurrent diseases	≤3.5 µg/L	**>50 µg/L**


That’s It