Ten abnormalities apparently healthy pets can be hiding:
How to find them. What to do.

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IDEXX Medical Education

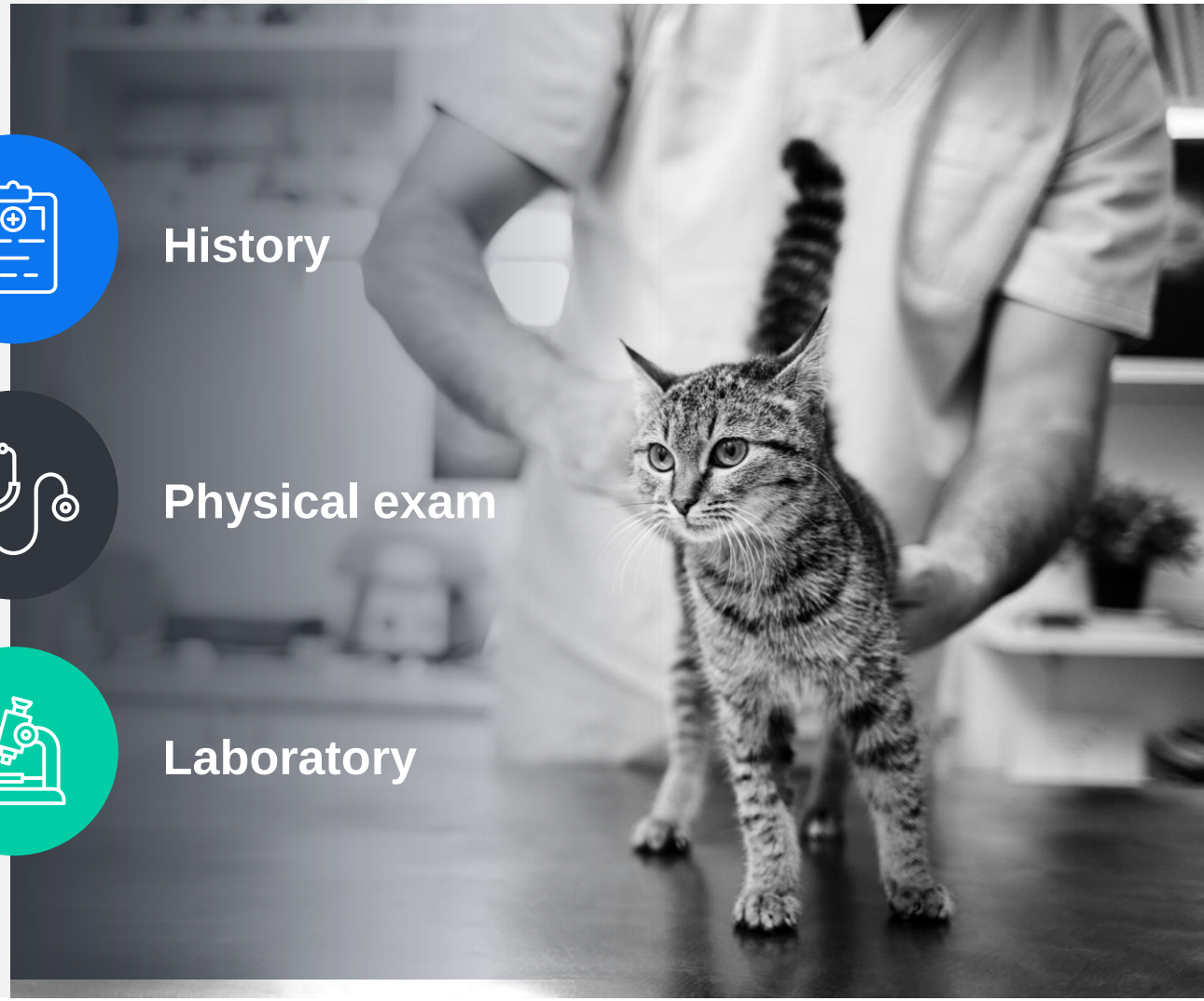
Disclosure:
Full-time Employee of IDEXX

Learning objectives:

- Review updated recommendations for life stage guidelines in dogs and cats
- Emphasize the value of establishing individual patient normals and trending of relevant laboratory diagnostics
- Highlight important aspects of the history and physical examination that can aid in early detection of subclinical disease
- Discuss selected unexpected laboratory and other abnormalities in healthy pets and provide current recommendations for further evaluation and treatment

Preventive care for every life stage includes assessing:

- Lifestyle effect on patient safety
- Zoonotic and human safety risk
- Parasite control
- Behavior
- Elimination (cats)
- Nutrition
- Vaccination
- Dental health
- Reproduction
- Breed-specific conditions
- Baseline diagnostic profile



10 important findings with preventive care: What they mean and what to do.

Cat has decreased frequency of defecation

Dehydration: *interstitial* fluid loss detectable on physical examination.

Estimated dehydration	Physical examination reveals:
<5%	Not detectable
5-6%	Dry, ‘tacky’ mucous membranes
6-8%	Mild decrease skin turgor
8-10%	Obvious decrease skin turgor, retracted globes
10-12%	Persistent skin tenting, dull corneas, hypovolemia
>12%	Death due to hypovolemic shock

- Assume 5% and correct if inappetence
- Formula: % dehydration as decimal x BW (kg) x 1000 = ml to administer over 4-24 hr
  e.g., 5% dehydrated, 5 kg cat
  0.05 x 5 = 0.25 L x 1000 = 250 ml.

Hopper, Deborah S. *Small Animal Critical Care Medicine*. Available from: Pageburstls, (3rd Edition). Elsevier Health Sciences (US), 2022.

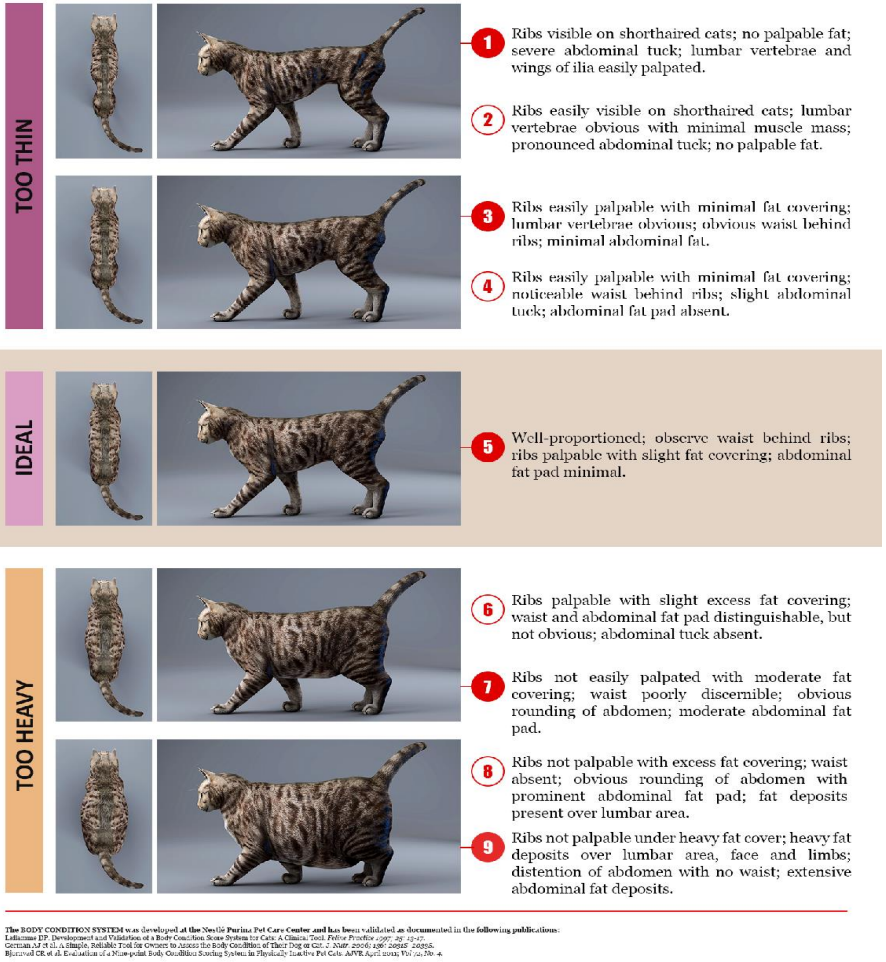
Cat has lost body weight and/or muscle mass

BCS and MCS every pet, every exam.

Lateral and vertical pics.

PURINA Institute
Advancing Science for Pet Health

BODY CONDITION SYSTEM

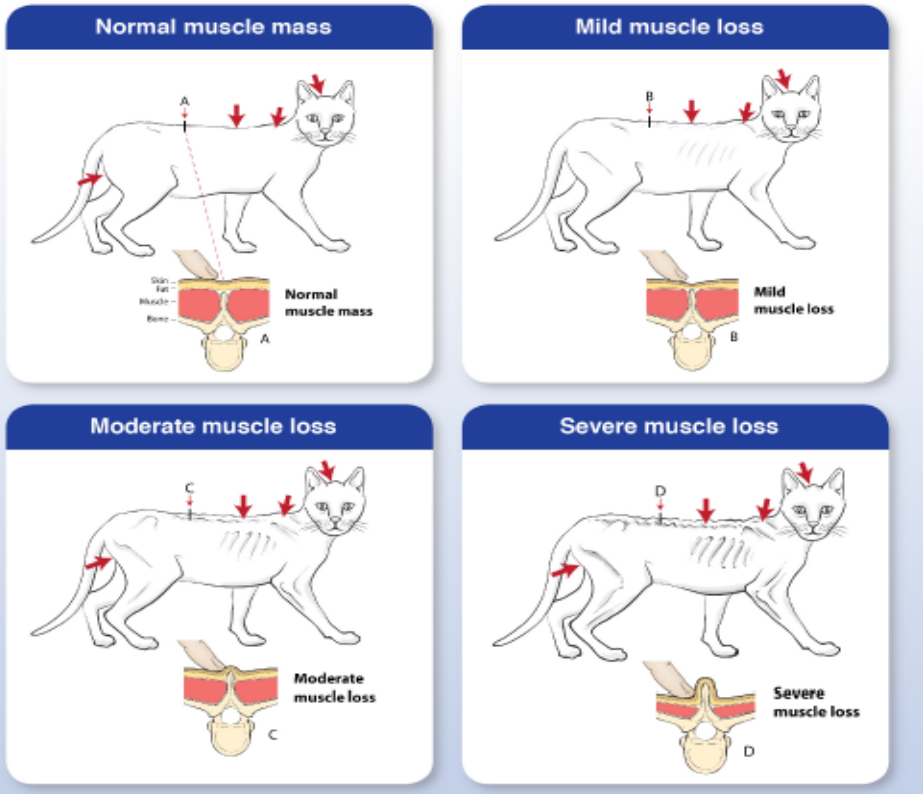


The BODY CONDITION SYSTEM was developed at the Nestlé Purina Pet Care Center and has been validated as documented in the following publications:
Laflamme DP. Development and Validation of a Body Condition Score System for Cats: A Clinical Tool. *Feline Practice* 1997; 25: 13-17.
German AJ et al. A Simple, Reliable Tool for Owners to Assess the Body Condition of Their Dog or Cat. *J Nutr.* 2006; 136: 2031S-2033S.
Bjornvad CR et al. Evaluation of a Nine-point Body Condition Scoring System in Physically Inactive Pet Cats. *ASVR.* April 2011; Vol 72, No. 4.

https://www.purinainstitute.com/

Muscle Condition Score

Muscle condition score is assessed by visualization and palpation of the spine, scapulae, skull, and wings of the ilia. Muscle loss is typically first noted in the epaxial muscles on each side of the spine; muscle loss at other sites can be more variable. Muscle condition score is graded as normal, mild loss, moderate loss, or severe loss. Note that animals can have significant muscle loss even if they are overweight (body condition score > 5/9). Conversely, animals can have a low body condition score (< 4/9) but have minimal muscle loss. Therefore, assessing both body condition score and muscle condition score on every animal at every visit is important. Palpation is especially important with mild muscle loss and in animals that are overweight. An example of each score is shown below.



https://wsava.org/

You find tortuous retinal vessels

CONSENSUS STATEMENT | Open Access

ACVIM consensus statement: Guidelines for the identification, evaluation, and management of systemic hypertension in dogs and cats

Mark J. Acierno, Scott Brown, Amanda E. Coleman, Rosanne E. Jepson, Mark Papich, Rebecca L. Stepien, Harriet M. Syme

First published: 24 October 2018 | https://doi.org/10.1111/jvim.15331

New normal

Normotensive (minimal TOD risk)	SBP <140 mm Hg
Prehypertensive (low TOD risk)	SBP 140-159 mm Hg
Hypertensive (moderate TOD risk)	SBP 160-179 mm Hg
Severely hypertensive (high TOD risk)	SBP ≥180 mm Hg

Treat here

Acclimate 5-20 minutes out of carrier, cuff width 30% limb circumference.

Hypertension: secondary ≥80%, idiopathic 13-20%.

- Cat

  CKD, hyperthyroidism, primary hyperaldosteronism, glomerulopathy, pheochromocytoma

- Dog

  CKD, AKI, Cushing's, diabetes mellitus, glomerulopathy, pheochromocytoma, hypothyroidism (rare)

Cats:
Amlodipine:
<200 mm Hg 0.625 mg SID
≥200 mm Hg 1.25 mg SID

Telmisartan:
2 mg/kg once daily

Dogs:
Benazepril:
0.25-0.5 mg/kg SID
Amlodipine:
0.125-0.25 mg/kg SID
Telmisartan:
1-2 mg/kg SID

Primary hyperaldosteronism in cats

- Hypokalemia, hypertension
- Unilateral adrenal carcinoma / adenoma most common
- Diagnosis → adrenal mass, increased basal aldosterone with hypokalemia sufficient
- Treatment
  - Surgery → adrenalectomy
  - Medical → spironolactone 2 mg/kg q12h, amlodipine 0.1-0.2 mg/kg q24 h, K gluconate 1-6 mEq/cat q12h

11-yr-old, MN, DSH

IDEXX VetConnect PLUS | Home | Directory of Services | Imaging | Telemed

Feline | Feline, Mixed Breed | Male | 11 y | Profile

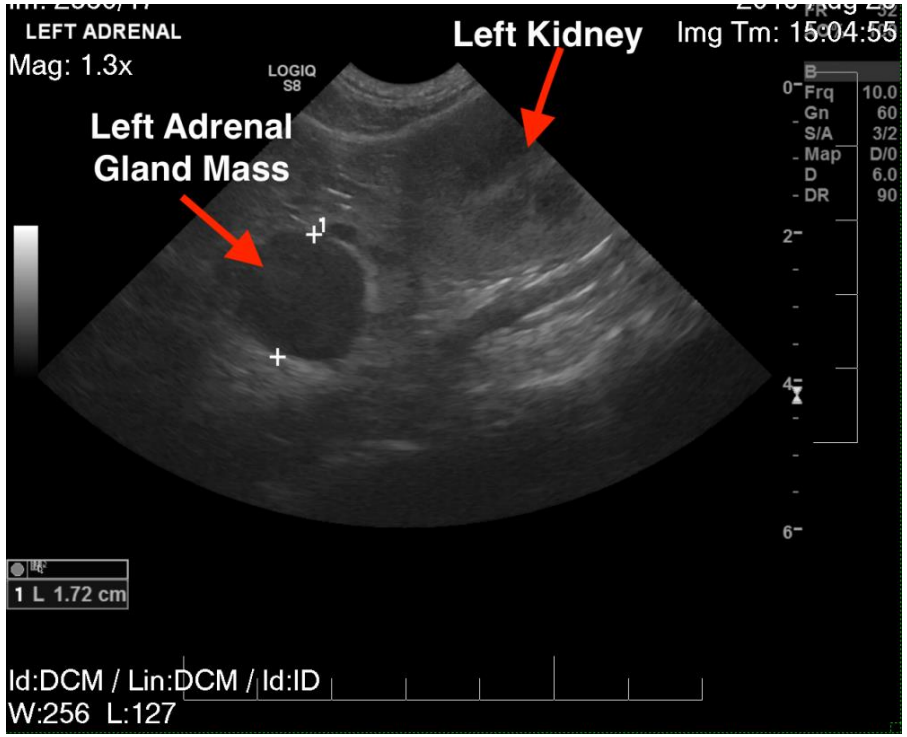
2023 **Feb 28** 2022 **Dec 15** **Feb 12** **Jan 12** 2021 **Dec 2**

Result Details

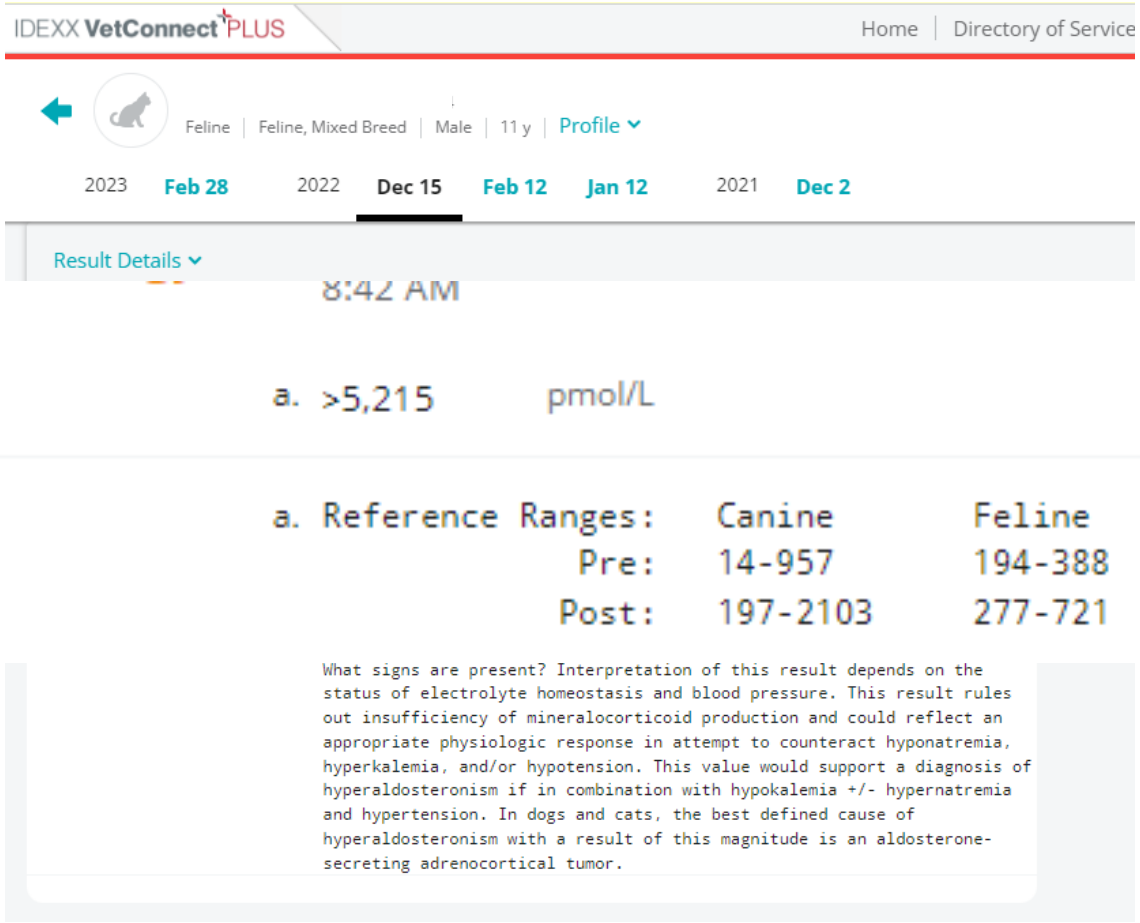
Chemistry	2/28/23 8:20 AM		2/12/22 7:46 AM	1/12/22 7:07 AM
Glucose	88	72 - 175 mg/dL	81	86
IDEXX SDMA	a. 8	0 - 14 µg/dL	d. 8	g. 9
Creatinine	1.2	0.9 - 2.3 mg/dL	1.2	1.5
BUN	14	16 - 37 mg/dL	18	22
Sodium	156	147 - 157 mmol/L	155	154
Potassium	3.3	3.7 - 5.2 mmol/L	3.7	3.5

Sodium	156	147 - 157 mmol/L	155	154
Potassium	3.3	3.7 - 5.2 mmol/L	3.7	3.5
Na: K Ratio	47	29 - 42	42	44
Chloride	115	114 - 126 mmol/L	114	111
TCO2 (Bicarbonate)	26	12 - 22 mmol/L	28	26

Abdominal ultrasound



Basal aldosterone



Don’t mistake primary hyperaldosteronism for CKD. With PHA...

- Imaging reveals unilateral adrenal mass
- Metabolic alkalosis
- Phosphorus normal or low
- Potassium lower +/-
- Blood pressure higher +/-
- Azotemia milder +/-

You hear a gallop rhythm in a cat

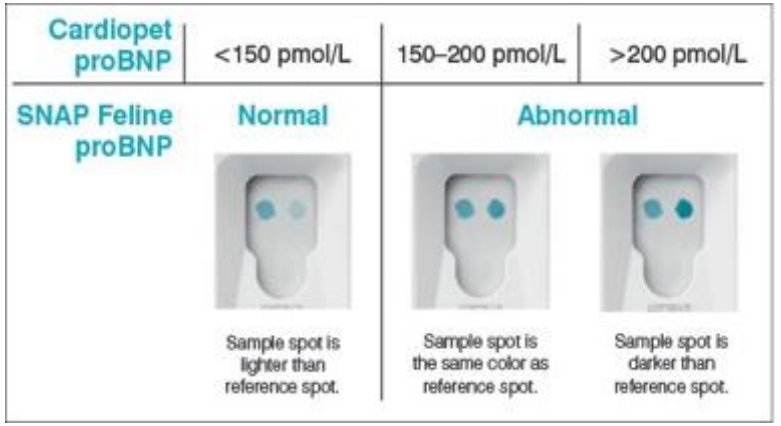
A gallop sound is NOT normal

- Seldom present in healthy cats
- Present in up to ≈20% of cats with subclinical HCM
- Stronger indicator of cardiac disease than murmur
- Indicates stiff or volume-distended ventricle and pending CHF
- Not an arrhythmia
- May be present in large breed dogs with DCM

S3 or S4 or double, early diastolic filling

NT-proBNP to detect occult cardiomyopathy in cats

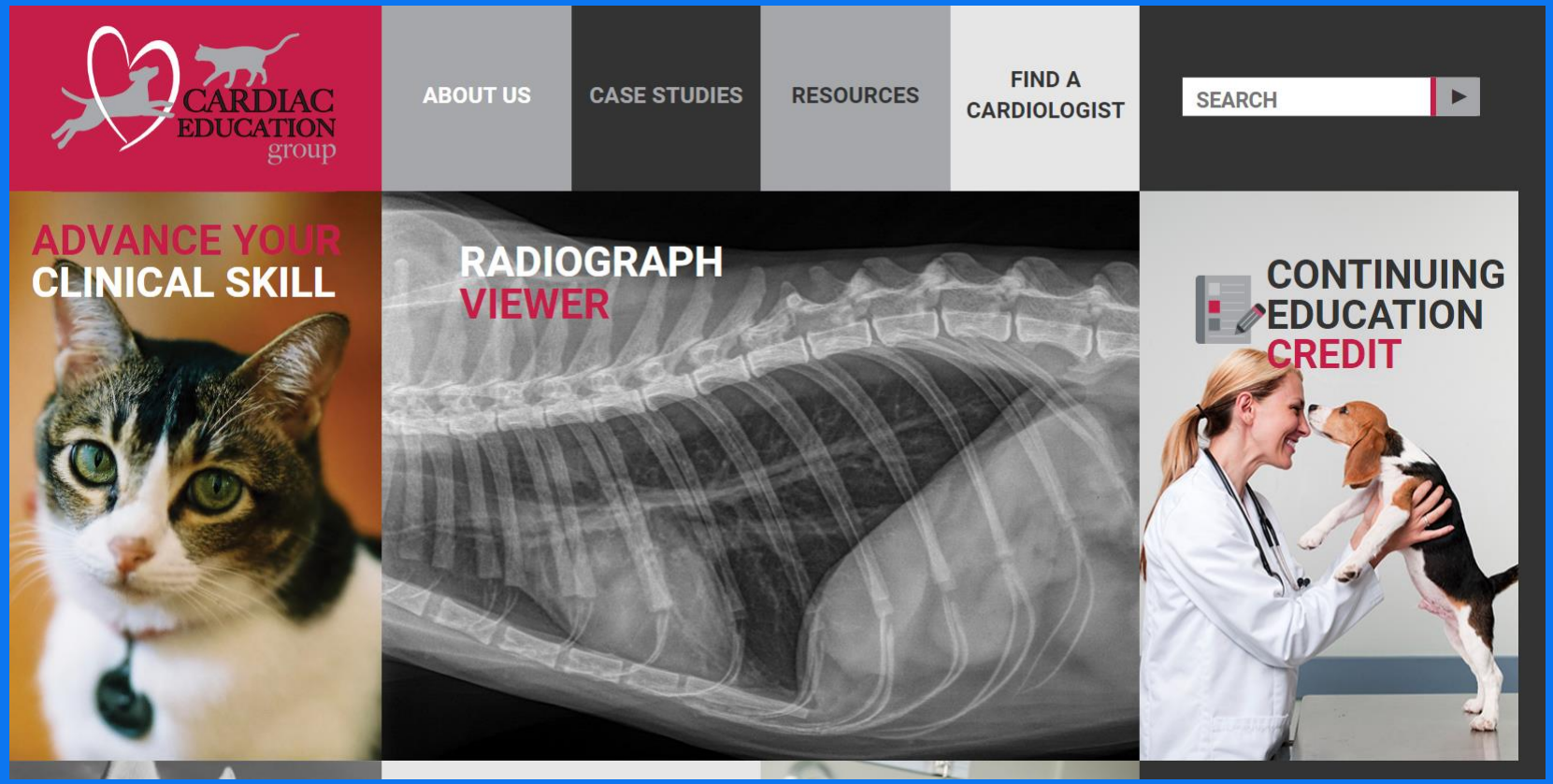
- Cardiopet proBNP > 100 pmol/L indicates cardiomyopathy likely*
  - or SNAP® Feline BNP positive
- Echocardiogram to confirm diagnosis
  - If confirmed radiographs, ECG, blood pressure, T4 (> 7 yr)
  - If echocardiogram normal re-evaluate in 6-12 months
  - NT-proBNP may increase before morphologic changes
- Most reliable if murmur, gallop sound, arrhythmia, cardiomegaly, affected sibling, at risk breed



*Fox PR, Rush JE, Reynolds CA, et al. Multicenter evaluation of plasma N-terminal probrain natriuretic peptide (NT-pro BNP) as a biochemical screening test for asymptomatic (occult) cardiomyopathyin cats. J Vet Intern Med 2011;25:1010–1016.

Feline HCM: what to do in preclinical phase….

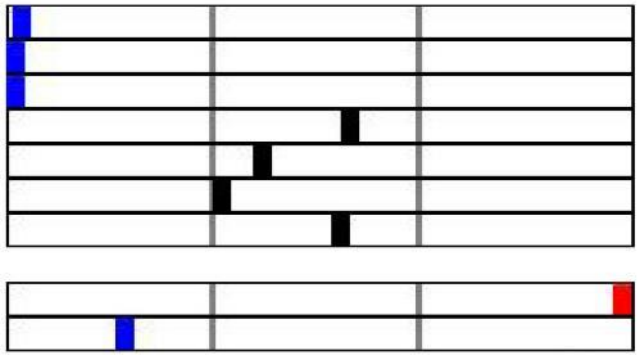
- HCM with normal LA size or mild LA enlargement
  - If no LVOTO no treatment unless arrhythmia
  - If severe LVOTO +/- atenolol 6.25-12.5 mg PO q12h (recent studies no prolonged survival)
- HCM with moderate to severe LA enlargement
  - **Clopidogrel (Plavix®) 18.75 mg PO q24h**
  - Enalapril/benazepril 0.25-0.5 mg/kg PO q12-24h (no proof of efficacy)
  - Atenolol if LVOTO or arrhythmia
  - Buprenorphine 0.15-0.2 ml of 0.3 mg/ml solution pre-filled syringes for home use
  - Home resting/sleeping respiratory rate monitoring → >35 breaths/minute



https://cardiaceducationgroup.org

You find reticulocytosis without anemia

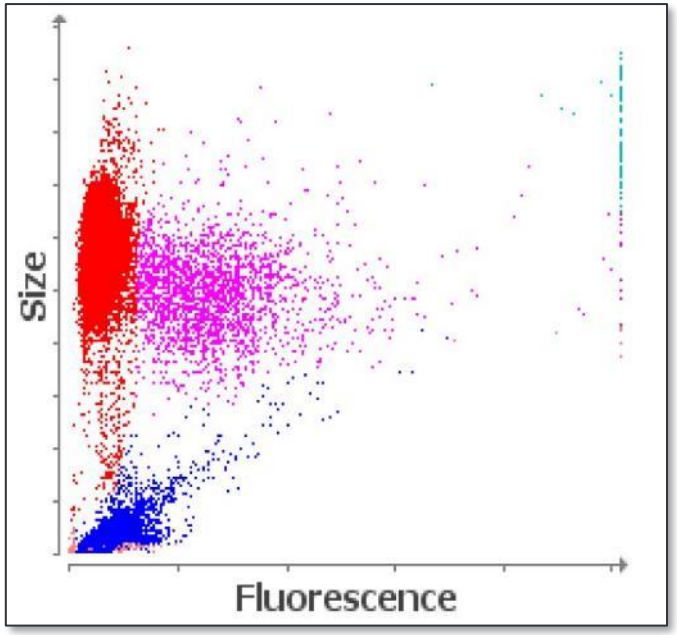
Regenerative or nonregenerative anemia?

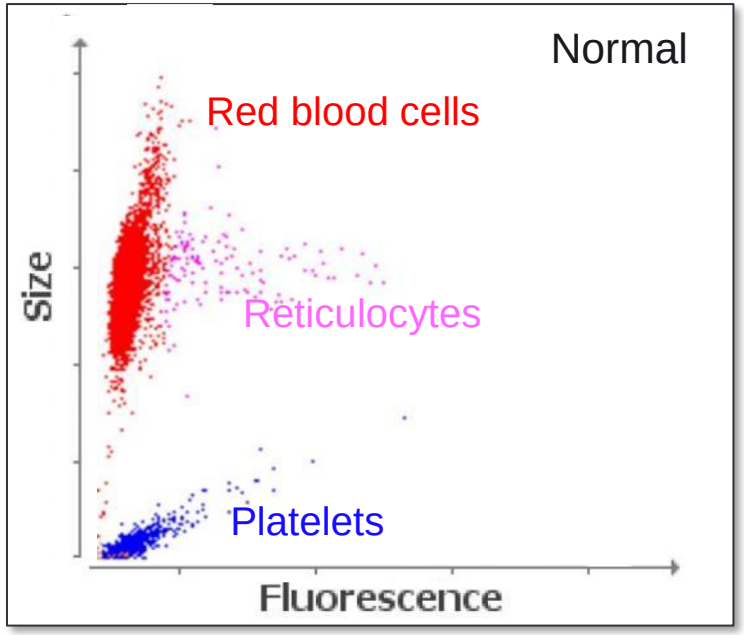
Test	Results	Reference Interval		LOW NORMAL HIGH
ProCyte Dx (May 13, 2019 2:41 AM)				
RBC	2.28 M/µL	5.65 - 8.87	LOW	
HCT	15.9 %	37.3 - 61.7	LOW	
HGB	5.1 g/dL	13.1 - 20.5	LOW	
MCV	69.7 fL	61.6 - 73.5		
MCH	22.4 pg	21.2 - 25.9		
MCHC	32.1 g/dL	32.0 - 37.9		
RDW	18.7 %	13.6 - 21.7		
%RETIC	18.2 %			
RETIC	413.8 K/µL	10.0 - 110.0	HIGH	
RETIC-HGB	17.1 pg	22.3 - 29.6	LOW	

10-year-old, spayed female mixed-breed dog

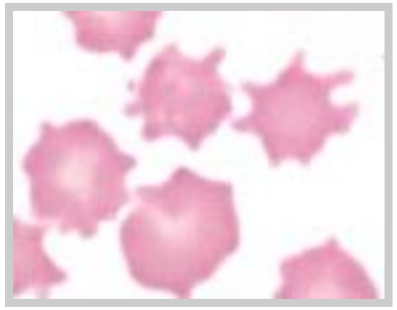
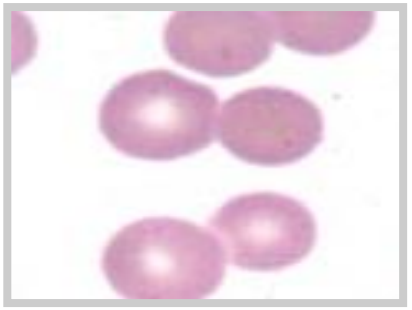
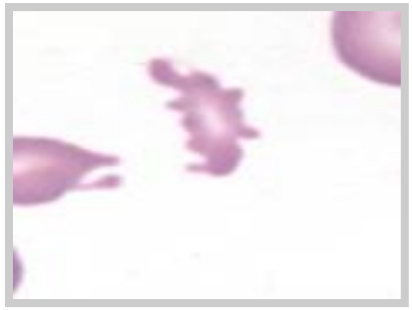
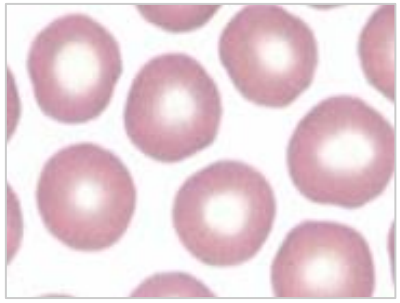
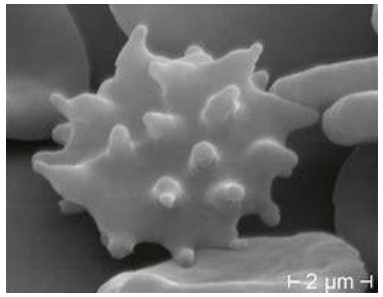
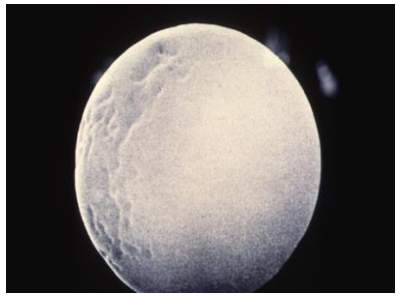
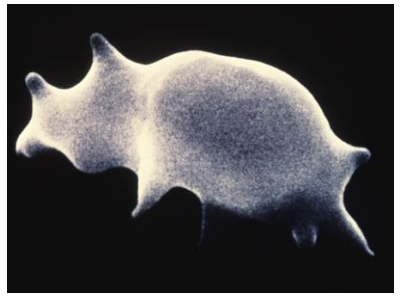
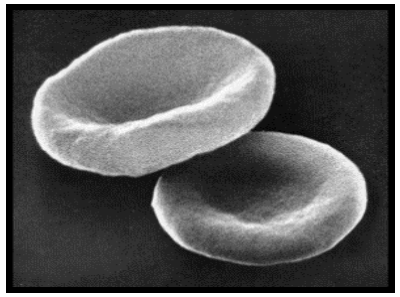
Test	Results	Reference Interval	LOW	NORMAL	HIGH
ProCyte Dx					
RBC	6.2 x10^12/L	5.7 - 8.9			
HCT	43.2 %	37.5 - 61.7			
HGB	14.4 g/dL	13.1 - 20.5			
MCV	69.4 fL	61.6 - 73.5			
MCH	23.1 pg	21.2 - 25.9			
MCHC	33.3 g/dL	32.0 - 37.9			
RDW	19.1 %	13.6 - 21.7			
%RETIC	3.6 %				

Are they really reticulocytes? Graphics are your friend…





If dot plot abnormal → review blood film

Acanthocyte	Spherocyte	Schistocyte	Normal
			
			

Reticulocytosis without anemia

(≈10% of dogs and cats worldwide)

Healthy excited pet

<120,000/uL

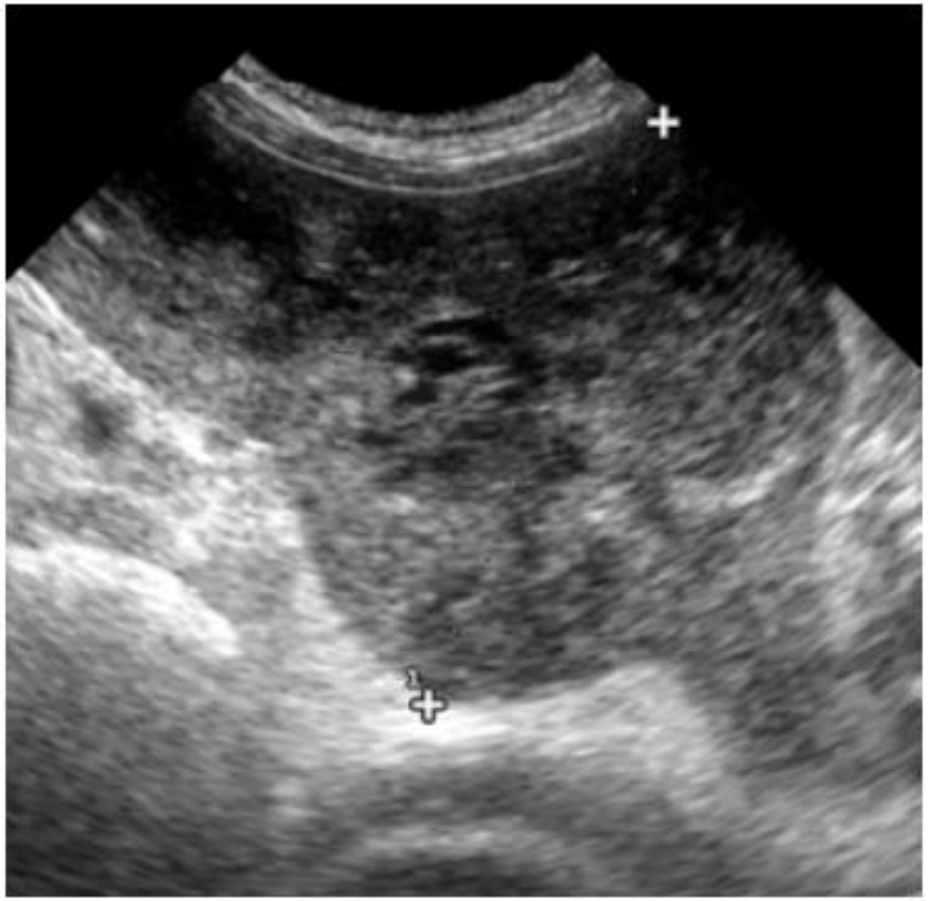
- Splenic contraction
- *Mild* bleeding/hemolysis
- Hookworms

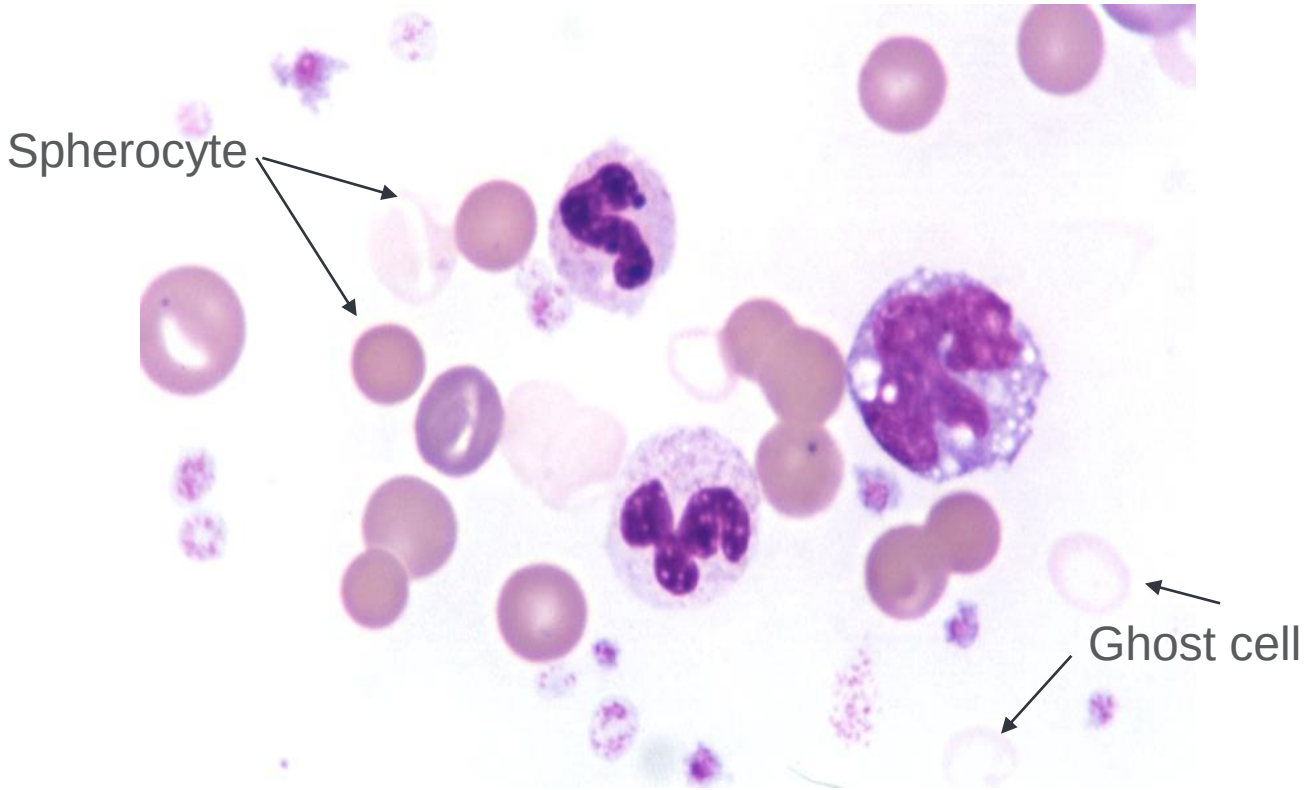
‘ADR’ or older pet

>130,000/uL

- Neoplasia
- *Occult* bleeding/hemolysis
- Infection
- Cardiac, respiratory
- Other…

Find more of these with retics on all CBCs





GFR biomarkers don’t agree

GFR biomarker ideally:	BUN (early 1900s)	Creatinine (1926)	SDMA (2015)
Produced at constant rate			X
Freely filtered at glomerulus	X	X	X
No tubular secretion/reabsorption			X
No nonrenal elimination		X	X
Physiologically inert		X	X

- BUN > creatinine = dehydration, upper GI bleed, high protein diet, glomerular
- ↑ Creatinine only = increased muscle mass, recent high protein meal…
- ↑ SDMA = decreased GFR

Assess multiple causes of decreased GFR when biomarkers increased

1

Prerenal

- **Dehydration**
- **Trauma/shock—hypotension**
- **Anesthesia**
- **Cardiac disease**
- Sepsis
- Thrombosis, infarct
- Burn injury, heat stroke
- Transfusion reaction
- Hyperviscosity, polycythemia

2

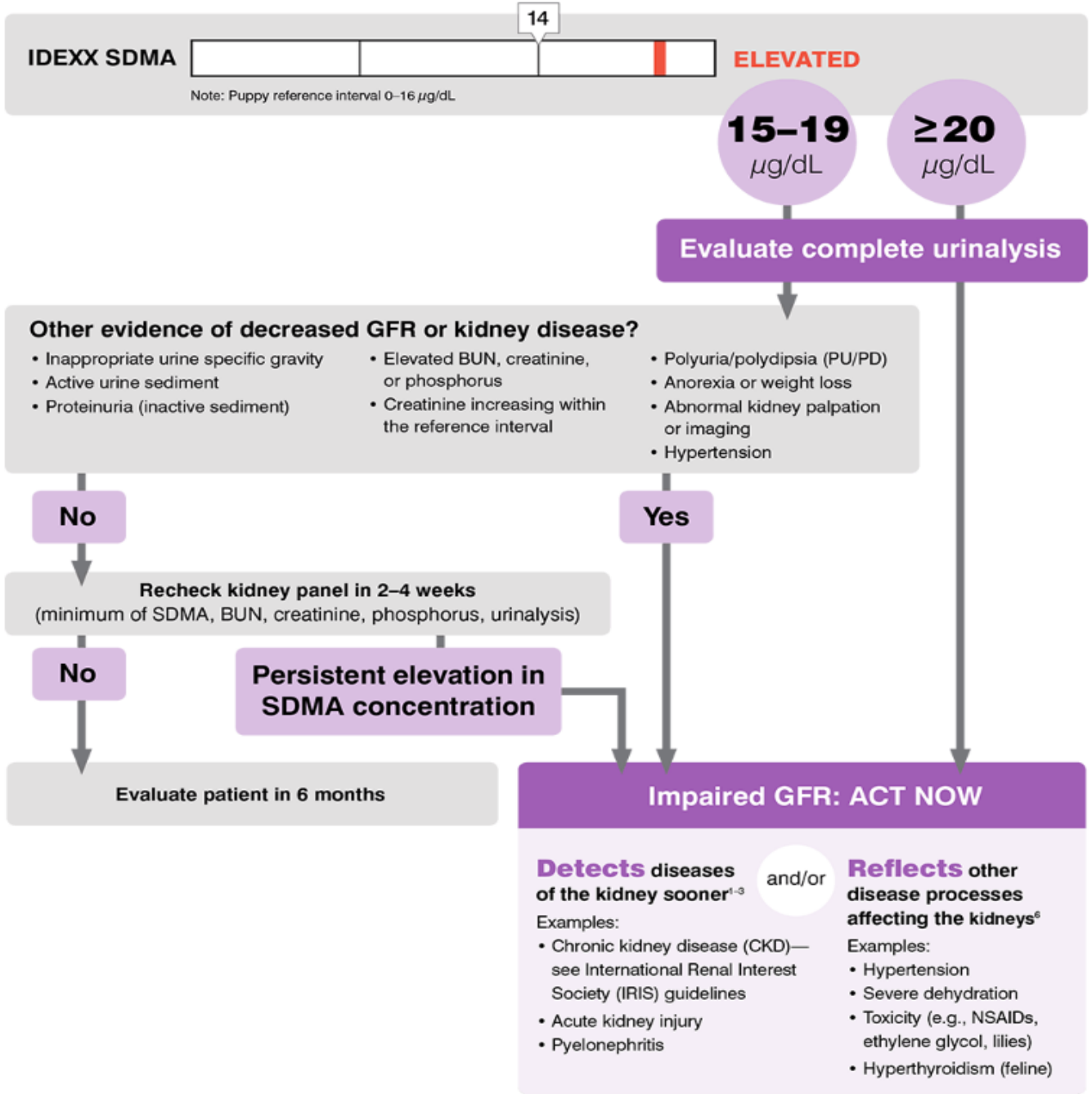
Renal

- Kidney disease: CKD, acute kidney injury, kidney stones
- Infection/infectious: **Pyelonephritis**, FIP, sepsis, heartworm
- Immune mediated: **Lyme nephritis**, vasculitis
- Metabolic: **Pancreatitis**, hypercalcemia
- Neoplasia: **Lymphoma**
- Toxin: **Lily, NSAID**, ethylene glycol (antifreeze), aminoglycoside antibiotics

3

Postrenal

- **Urethral obstruction**
- **Ureteral obstruction**
- Urinary tract trauma/disruption: Tear, rupture, blood clot



You notice ALT is trending up in a Labrador retriever

Copper-associated liver disease: treatment

- Diet
  - Royal Canin Hepatic®, Hill's l/d®
  - Supplemental protein with cottage cheese, chicken, beef (not organ meats, nuts, grains, shellfish)
  - No Cu-containing mineral supplements, treats
- Penicillamine chelation when hepatic copper >600-1000 ug/g DW
  - Compounded formulation effective
  - 7.5-10 mg/kg q12h 1 hr before or 2 hr after meal, 1 hr apart from other drugs
  - GI side effects in ≈30% (decrease dose, divide in 3-4 smaller doses, with small amount of food)
- Antioxidants
  - Vitamin E, 100-400 IU/d
  - SAMe, silybin…
- Treat all - unbound copper causes hepatocellular injury regardless of etiology

Which is clue to copper-associated hepatopathy?

- Proteinuria
- Decreased specific gravity
- Bilirubinuria
- Glucosuria
- Urate crystals

You find normoglycemic glucosuria

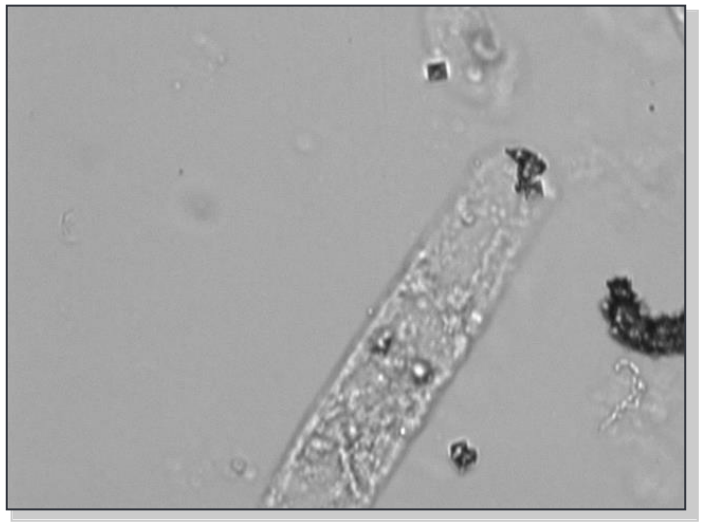
Normoglycemic glucosuria

- Proximal tubular dysfunction or damage
  - Inherited, e.g., primary renal glucosuria, Fanconi syndrome
  - Acute kidney injury
  - Tubular damage, e.g., drugs, infection, ischemia, toxicity

- False positive
  - Hypochlorite, chlorine, hydrogen peroxide, formaldehyde
  - Repeat sample if from tabletop or container…

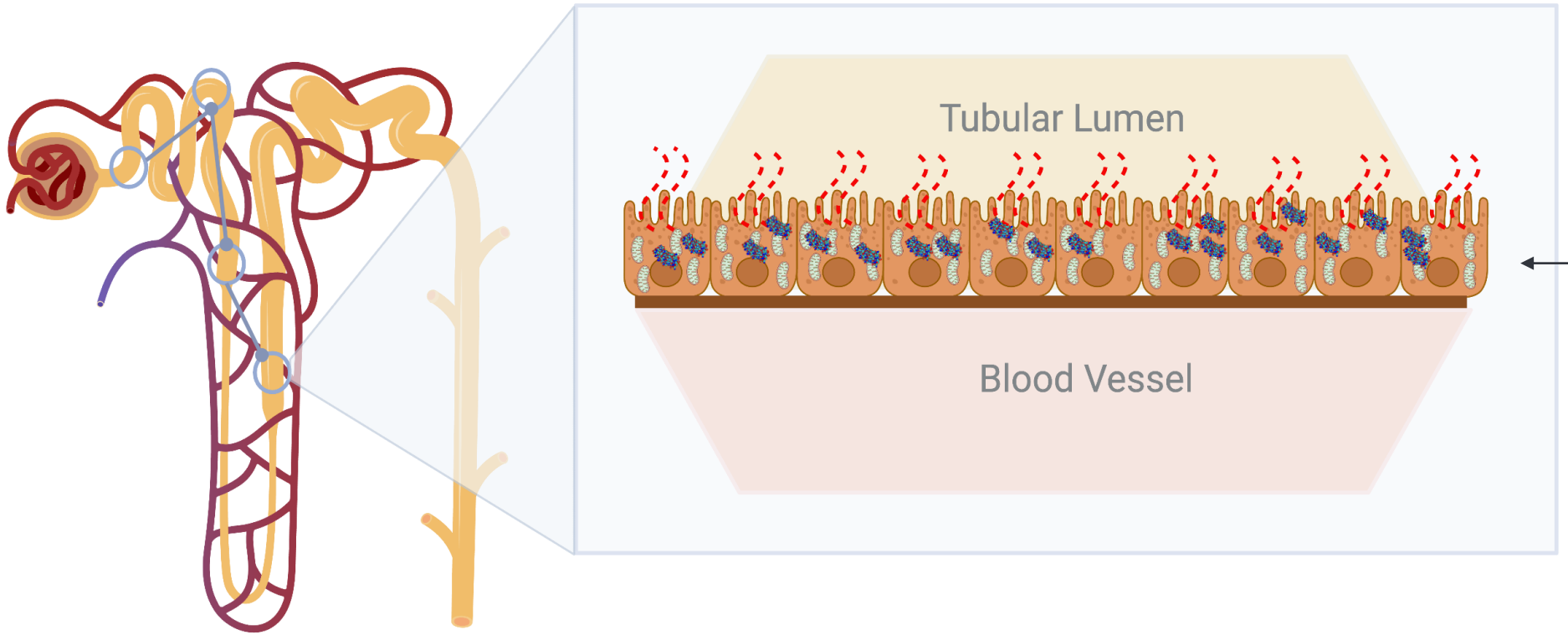
AKI: tubules hit first. Evidence is in URINE.

- Proteinuria
- Hematuria
- Pyuria
- Bacteriuria
- Renal epithelial cells
- Glucosuria
- + Urine culture
- Granular casts ≈16%
- Decreased urine production
- Decreased USG

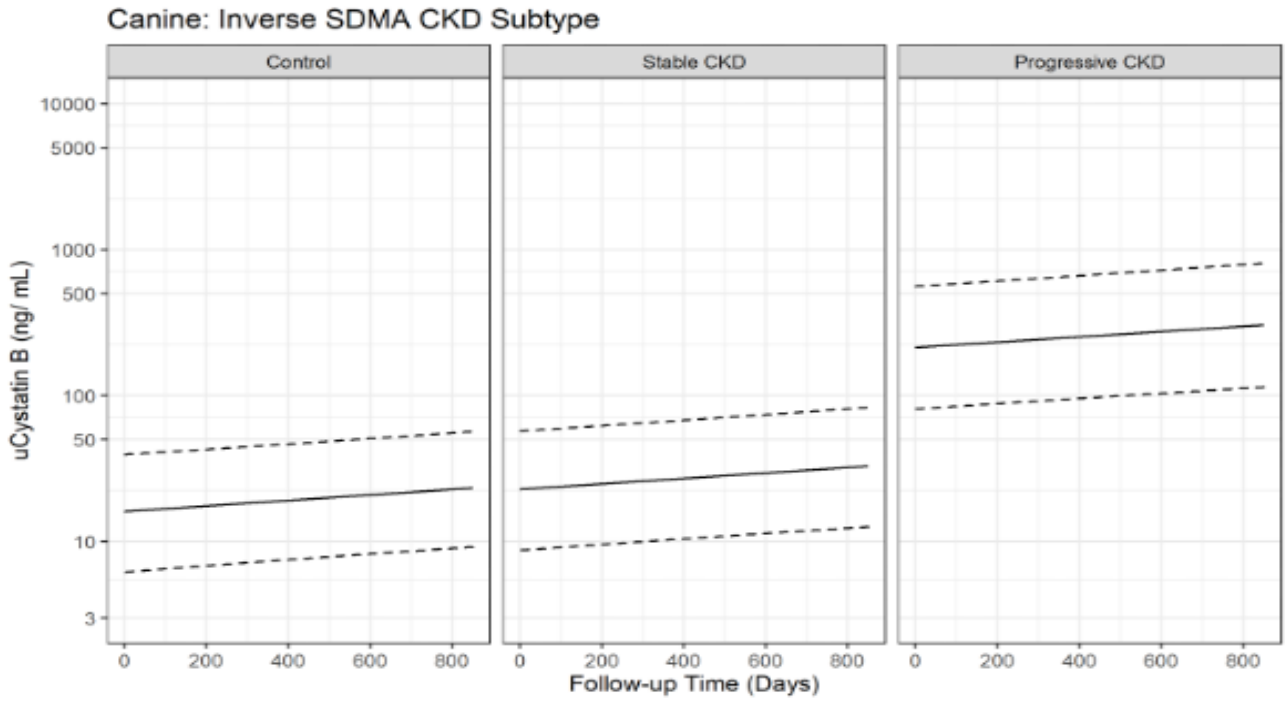


Urine Cystatin B detects *active* kidney tubular damage

(ALT of the kidney)



uCystatin B predicts progression of CKD



Segev G, Vaden S, Ross S, et al. Urinary cystatin B differentiates progressive versus stable IRIS Stage 1 chronic kidney disease in dogs. J Vet Intern Med. 2023; 1-10. doi:10.1111/jvim.16887

Consider uCystatin B with:

- AKI
  - Confirm active injury following toxin exposure
  - Monitor treatment and recovery from acute injury event
  - Monitor high risk patient on NSAIDs
  - Monitor kidneys during shock, heat stroke, pancreatitis, envenomation…
- CKD
  - Predict progression of Stage 1 CKD in dogs
  - Identify early CKD (?)
- Others…??

You find proteinuria

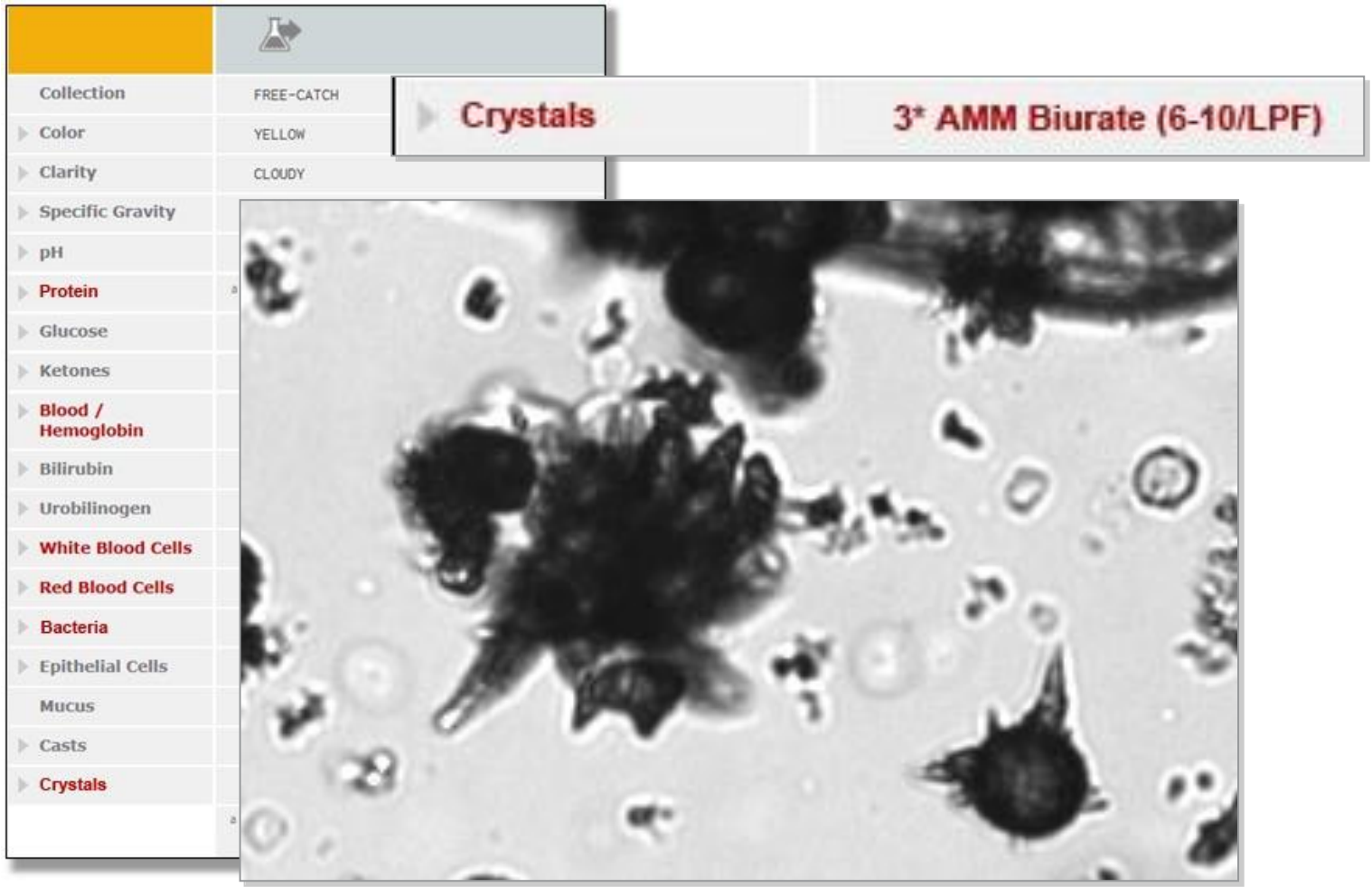
Don’t ignore proteinuria

- Dipstick to identify and determine persistence
- Sediment exam to rule out post-renal proteinuria
- UP/C to quantitate, treat, monitor

Renal diet
Telmisartan 0.5-1 mg/kg/day up to 2 mg/kg/day
Clopidogrel 1-4 mg/kg/day (dogs), 18.75 mg/cat/day if albumin <2.0 mg/dl
Consider:
- Adding benazepril if UP/C does not improve
- Adding amlodipine if hypertension does not resolve with telmisartan
- Omega-3 fatty acids

Monitor:
- SDMA/creatinine, K, blood pressure 5-7 d after start and dose change
- UP/C, albumin 2-4 wk after start and dose change

You find ammonium biurate crystals in urine



IDEXX SediVue Dx™ Urine Sediment Analyzer image

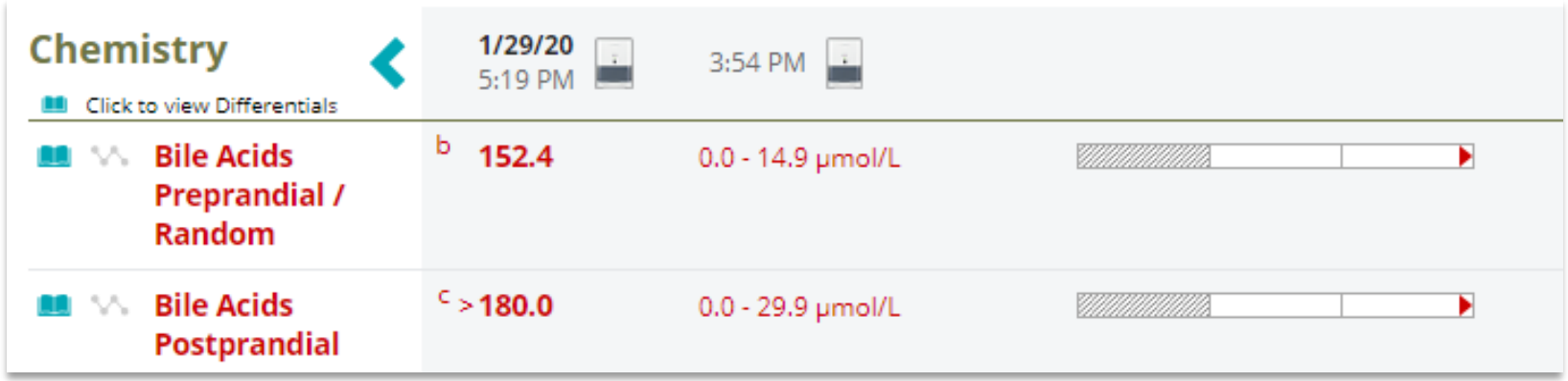
Paired bile acids or resting ammonia?

- No paired bile acids if
  - Bilirubin increased
  - Icterus
  - Neurologic signs
- Resting NH3
  - Fasting sample adequate
  - Test of choice with neurologic signs
  - Must run in clinic within minutes

Bile acids stimulation test

- Protocol:
  - Pre-prandial sample:
    - +/- 12-hour fast
  - Feed small meal
    - 2 tsp from small pets (<5-7kg)
    - 2 Tbsp for large pets
  - 2 hr postprandial sample
- Type of food
  - Ideally “high-fat” meal
  - If encephalopathic effects of protein anticipated, use restricted-protein food mixed with small amount of corn oil

Source: Cocker S, Richer K. Diagnostic evaluation of the liver. In: Ettinger S, Feldman E, Cote E, eds. *Textbook of Veterinary Internal Medicine: Diseases of the Dog and Cat*. 8th ed. St Louis, MO: Elsevier Saunders; 2017:1611–1621.



	Portosystemic Shunt	Portal Vein Hypoplasia
Clinical signs	+/-	No
Urate crystals	+/-	No
Increased bile acids	Yes	Yes
Shunt vessel on AUS	+/-	No
Protein C	<70%	≥70%

You find roundworm eggs on fecal exam in a dog.

CAPC GI parasites: flotation w centrifugation + fecal Ag

- Fecal antigen = worm biomarker removes confusion with:
  - Prepatent period
  - Intermittent shedding, uneven ova distribution
  - Dense, low numbers of eggs (whipworm)
  - Single sex infections
  - Coprophagy, pseudoparasites

Resources:

- Kreevy KE, Grady J, Little SE, et al. 2019 AAHA Canine Life Stage Guidelines. J Am Anim Hosp Assoc 2019; 55:267–290. DOI 10.5326/JAAHA-MS-6999
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Thank you.

Happy to take questions