Endocrine Emergencies: They don’t have to be a crisis.

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Conflict of Interest Disclosure:

Patty Lathan receives honoraria from Idexx, Dechra, and Boehringer Ingelheim. She also consults for Idexx and Boehringer Ingelheim.

Bill Saxon is a full-time IDEXX employee.

TRIAGE/PRIMARY SURVEY: IS IT ENDOCRINE?

A – airway, arterial bleeding

B - breathing

C - circulation

D – disability (neuro)

E – exposure/exsanguination

EMERGENCY LABS: IS IT ENDOCRINE?

- PCV/TS
- Blood glucose
- Lactate

} The ‘Big 4’ immediately

- Electrolytes
- Blood gas (venous *preferred* unless respiratory distress)
- CBC, biochemistry, UA

LABORATORY CLUES TO ENDOCRINE DISEASE

MULTIPLE CHANGES INCREASES ODDS

- CBC

HCT ↑ or ↓

Lack of stress leukogram

- Lymph >1500/uL
- Eos > 500/uL

Thrombocytosis

- Biochemical profile

Glucose ↑ or ↓

Na:K ratio ↓

Calcium ↑ or ↓

ALP increased

Chol and alb ↓

T4 ↑ or ↓

- Urinalysis

USG ↓

Glucosuria

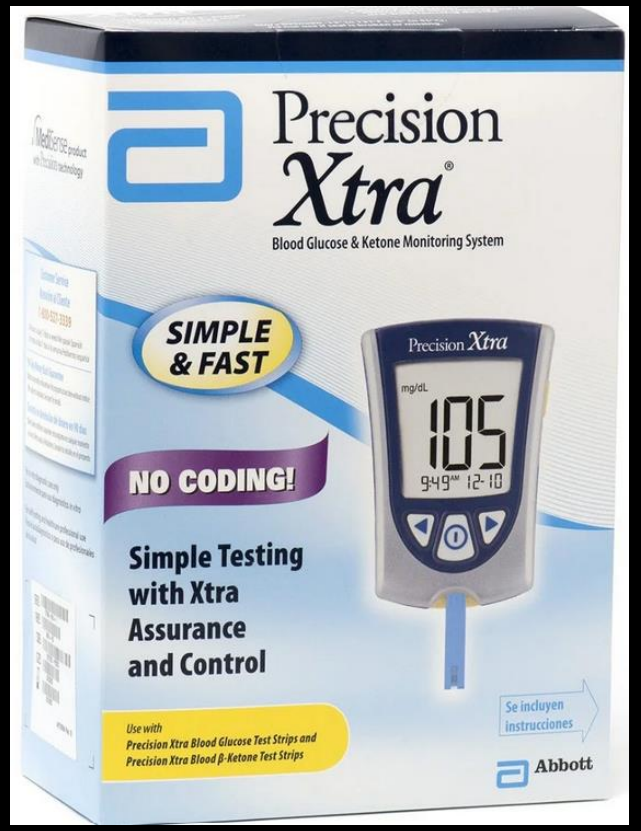
Ketonuria

Proteinuria

UTI

IN CLINIC ENDOCRINE TESTING: NICE TO HAVE…

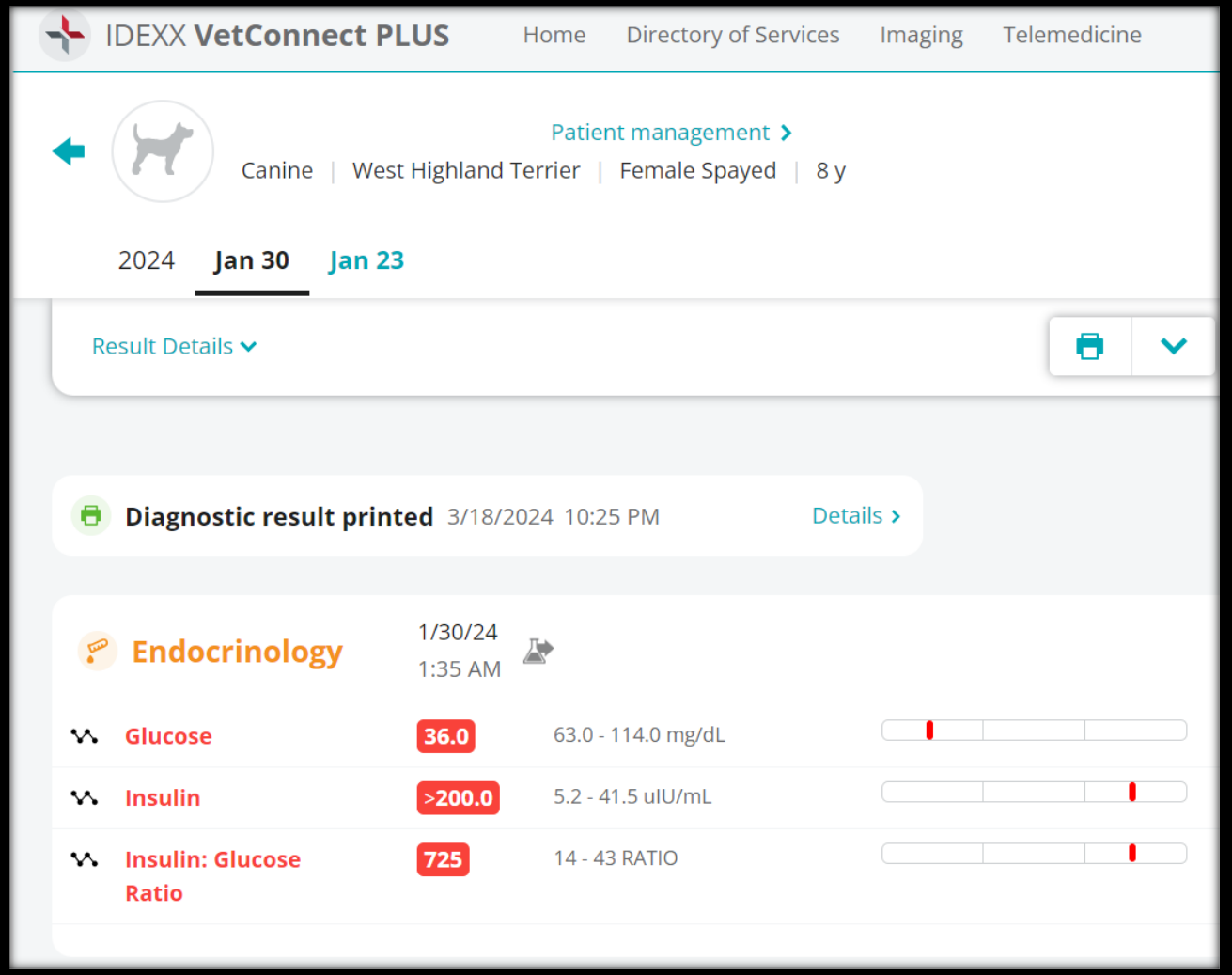
- Cortisol
  - >2 excludes hypoadrenocorticism
  - <2 requires ACTH stim to confirm
- Ketones (beta hydroxybutyrate)
  - Major ketone produced
  - Appears in blood before urine – earlier detection
- T4
  - Hyperthyroidism in cats
  - Myxedema coma (NOT 'standard' hypoT4) in dogs
- Fructosamine
  - Rule out stress hyperglycemia
  - Support for chronic hypoglycemia



IS HYPOGLYCEMIA ENDOCRINE?

- Other more common causes ruled out?
- Insulin overdose ruled out?
- Hypoadrenocorticism → resting cortisol
- Insulinoma → insulin:glucose panel
  - Middle-aged to older large breed
  - BG <60 mg/dL (<50 mg/dL?)
    - Fasting glucose curve if necessary
    - Serum v glucometer
  - If BG on panel comes back >60 mg/dL cannot interpret

Episodic (hunting/small breeds)
Hypoadrenocorticism
Iatrogenic (insulin overdose)
Insulinoma
Juvenile (fasting)
Liver disease
Paraneoplastic
Sepsis
Xylitol


IDEXX VetConnect PLUS
Home
Directory of Services
Imaging
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Patient management
Canine | West Highland Terrier | Female Spayed | 8 y
2024
Jan 30
Jan 23
Result Details
Diagnostic result printed 3/18/2024 10:25 PM
Details
Endocrinology
1/30/24
1:35 AM
Glucose
36.0
63.0 - 114.0 mg/dL
Insulin
>200.0
5.2 - 41.5 uIU/mL
Insulin: Glucose Ratio
725
14 - 43 RATIO

IATROGENIC HYPOBG: INSULIN OVERDOSE

- Diagnosis straight forward (-ish…Breezy!)
- Risk higher w
  - Cats (v dogs), cats on >6 U insulin/dose, inappetance, vomiting post insulin, obesity
- Dextrose IV or feed based on severity of signs
  - 0.5-1 ml/kg 50% dextrose, diluted 1:2-1:4 over 5 minutes, 2.5-5% dextrose in fluids
  - Small amount food q4-6h (Dr. Lathan what do you feed them?)
- Oral glucose (Karo syrup, honey) by owner or if IV access difficult/delayed
  - Effectiveness may require swallowing part of dose
- Duration of hypoglycemia hours to days - not related to type or dose of insulin
- Restart insulin whenever Dr. Lathan tells us to…
  - ¼ to ½ prior dose ?
  - Indication for CBGM?

IS HYPERKALEMIA ENDOCRINE?

- You're sure it's hypoadrenocorticism but resting cortisol >12
- Pseudohyperkalemia?
- Whipworms?
- Urinary system intact?
- Pleural, peritoneal, pericardial effusion?

DIABETIC EMERGENCIES

DKA IN CATS HAS GOTTEN A LITTLE TRICKIER…

EUGLYCEMIC DKA IN CATS ON SGLT2 INHIBITORS.

- Ketosis, acidosis, BG <250 mg/dl (sometimes much lower)
  - If blood gas not available ketosis with normal BG sufficient
- Highest risk within 1st 2 weeks of starting drug (86%)
- No hyperglycemia due to increased renal loss and depleted glycogen stores
- Some insulin (Type 2 DM) but not enough to prevent ketosis
- Ketosis = another disease
  - CBC, biochemistry, UA, pancreatic lipase, retroviral screen to identify
- Use ketone meter for earlier detection of ketones (beta-hydroxybutyrate)
  - Urine dipstick (acetoacetate) fine if all you have

Clinically no different from 'standard' DKA – awareness is key to diagnosis.

Consider with euglycemia, mild hyperglycemia, or mild hyperglycemia…

INSULIN TO STOP KETOSIS EVEN THOUGH BG NORMAL

- Regular insulin as soon as K≥3.3 mEq/L (Must we wait Dr. Lathan?)
  - 0.05-0.1 U/kg/hr (studies on alternative protocols complete?)
- Dextrose immediately
  - 0.25-0.5 ml/kg 50% dextrose bolus, diluted 1:2-1:4
  - 5-10% dextrose added to fluids
- Monitor BG q1-2 h til stable, then q 4-6 h (or so)
- Switch to long-acting insulin when ketosis resolved, eating – 4-7 days usually
  - Provide early (w/in 48 hr) enteral nutritional support
- Insulin required for life – is this true Dr. Lathan?

FLUIDS: WHICH, HOW MUCH, HOW FAST (QUICK PIC)

- Isotonic balanced crystalloid with normal pH (7.4)
  - Normosol-R, Plasma-Lyte A, pHyLyte
- Correct hypovolemia within 30-60 minutes
  - Bolus 15-20 ml/kg dog, 5-10 ml/kg cat over 15-30 minutes, repeat prn
- Correct dehydration over 6-24 hr
  - BW (kg) x percent dehydration (as decimal) x 1000 = ml to administer
- Keep up with ongoing losses and provide maintenance
- Supplement K to maintain serum K ≥3.3 mEq/L
  - Phosphorous and magnesium supplementation if indicated (uncommon)
- NaHCO3 if HCO3- <8 mmol/L, pH <7.1 (uncommon)
- Monitor body weight 2-4x/d and avoid volume overload
  - 5% increase → consider adjusting
  - 10% increase → volume overload

HYPEROSMOLAR HYPERGLYCEMIC STATE (HHS)

- BG >600 mg/dL
  - Vicious cycle of osmotic diuresis/free water loss → hyperglycemia → osmotic diuresis…
  - Reduced GFR required for and exacerbates severe hyperglycemia
- Osmolarity >320-330 mOsm/kg dog, >350 mOsm/kg cat
  - CNS parenchymal dehydration → neuro signs (obtundation, seizures, blindness…)
  - *Effective* osmolality = 2[Na+] + [glucose (mg/dl) ÷ 18]
  - PAY ATTENTION TO THE SODIUM!!!!
- pH >7.3 arterial, pH >7.2 venous, bicarb >15 mmol/L
- No or minimal ketones
  - Usually enough insulin to prevent ketosis but not hyperglycemia
- Cats v dogs if important and any other “Patty Pearls”

FLUID THERAPY FOR HHS: INSULIN CAN WAIT.

- Correct deficits prior to insulin
  - Fluid losses twice that of DKA in humans (10-12% dehydration!)
  - Avoid rapid reduction BG (max decrease 50-75 mg/dl/h) and Na (<0.5-1 mEq/kg/h)
- Normosol R or Plasma-Lyte 148 (higher Na-containing balanced crystalloid)
  - Corrected Na = Na+ (serum) + 1.6 ([measured glucose – 100] ÷ 100)
  - Supplement K (and Phos, Mg prn)
- Regular insulin for nonketotic HHS when…
  - Hypovolemia corrected and dehydration (mostly) corrected
  - BG plateaued or decrease of <50 mg/dL/h
- Regular insulin for ketotic HHS when…
  - It depends…similar to above but how bad is the ketosis?

HHS REGULAR INSULIN THERAPY

- Intermittent IM: 0.1 U/kg then 0.05 U/kg q2-4h
- CRI: 0.5-1 U/kg in 250 ml 0.9% NaCl start at 10 ml/hr

1/2 DKA dose.
Right Dr. Lathan?

- Monitor blood glucose q2h
  - Decrease not to exceed 50-75 mg/dL/h
  - Decrease insulin dose 25-50% +/- dextrose if more rapid decline

BG (mg/dL)	ml /h	% dextrose
>300	10	None
250-300	7	2.5
200-249	5	2.5
100-199	5	5
<100	0	5

ADRENAL EMERGENCIES

BEST FLUID FOR ADRENAL CRISIS?

ADRENAL CRISIS: THE PROBLEM WITH 0.9% NACL

- 0.9% NaCl concerns
  - Acidifying
  - Higher Na concentration may raise serum Na too fast (154 mEq/L)
    - Especially when Na <130 mEq/L
    - Osmotic demyelination syndrome
  - Chloride way too high – may cause renal vasoconstriction, metabolic aid
- LRs advantages
  - Buffered
  - "Safe" Na concentration (130 mEq/L)
  - Na in fluid within 10 mEq/L of patient Na safe
  - Trivial K concentration

ADRENAL CRISIS TREATMENT

- IV fluids
  - 10–20 ml/kg bolus over 15–30 min, reassess, repeat prn
- IV dexamethasone
  - 0.1–0.2 mg/kg IV then 0.05 mg/kg q12h for 24-72h
  - No prednis(ol)one or hydrocortisone until ACTH stim completed
  - No advantage to hydrocortisone CRI v dexamethasone injections
- Dextrose if hypoglycemic
  - 1 gm/kg 50% dextrose diluted 1:4 then add 2.5–5.0% to fluids
- Blood products if severe anemia (GI bleed)
- (Don't forget about whipworms!)

MAINTENANCE TREATMENT IS LIFELONG (QUICK PIC)

Prednisone	DOCP (NEVER sole treatment)	Monitor

▪ 0.1–0.2 mg/kg/day
  ▪ OFTEN LOWER
  ▪ E.g., 0.03 mg/kg/day lg dogs
▪ 0.5 mg/kg initially
▪ 2–10X dose during stress or illness
	▪ 1.1 mg/kg SQ/IM q28 days
	▪ DOCP has no glucocorticoid activity
	▪ Decrease dose 10-15% if hypokalemia or hypernatremia
		▪ Electrolytes at 14 days, then 28 days, eventually q3–6 months
		▪ CBC, biochemical panel, urinalysis at least yearly once stable

CAN ATYPICAL ADDISONIANS PRESENT IN CRISIS…?

THYROID EMERGENCIES

Heads up—Brooklyn is doing some open mouth breathing here. Doesn't seem dyspneic. Minimal B lines. Giving torb. HR 276. Injection is supposed to be at 1 and can't get in touch with owner. I really think this is the thyroid. So we're gonna give some atenolol and move forward with treatment unless you have a gut feeling that owner would rather delay and do a cardio consult. I really think he needs his thyroid to stabilize.

I think owners would trust your judgement for sure. I'll try to call him also.

Thank you!

My call was forwarded :(

He says proceed with I 131

Brilliant—thank you!!!

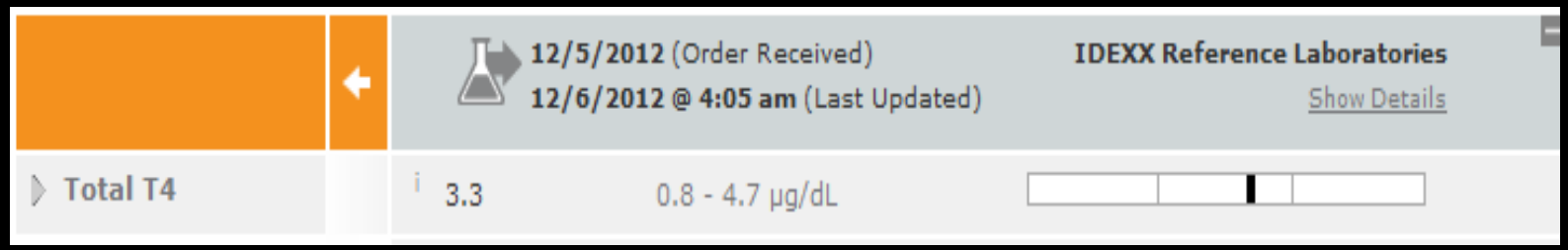
iMessage

Wed, Dec 17 at 2:17 PM

TREATMENT

- Atenolol: 6.25-12.5 mg/cat q 12 h
- (and treat for hyperT4)

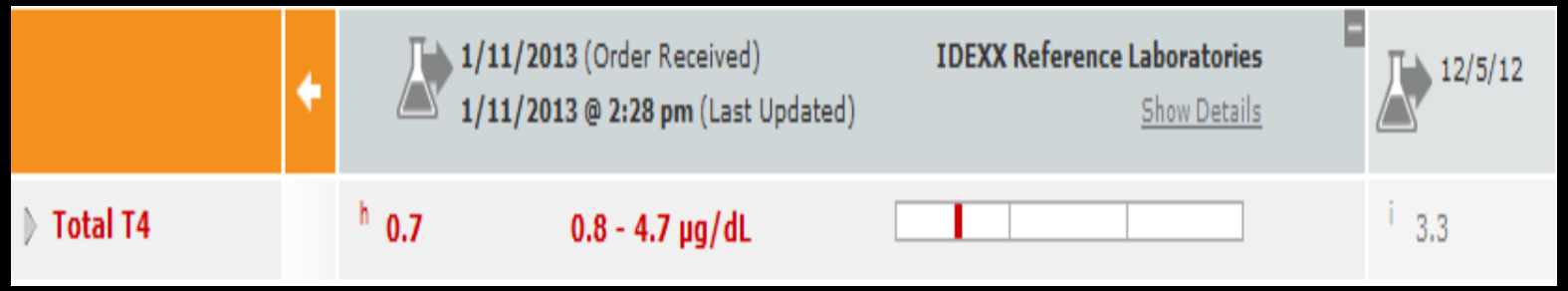
12-YR-OLD NM DOMESTIC SHORTHAIR CAT



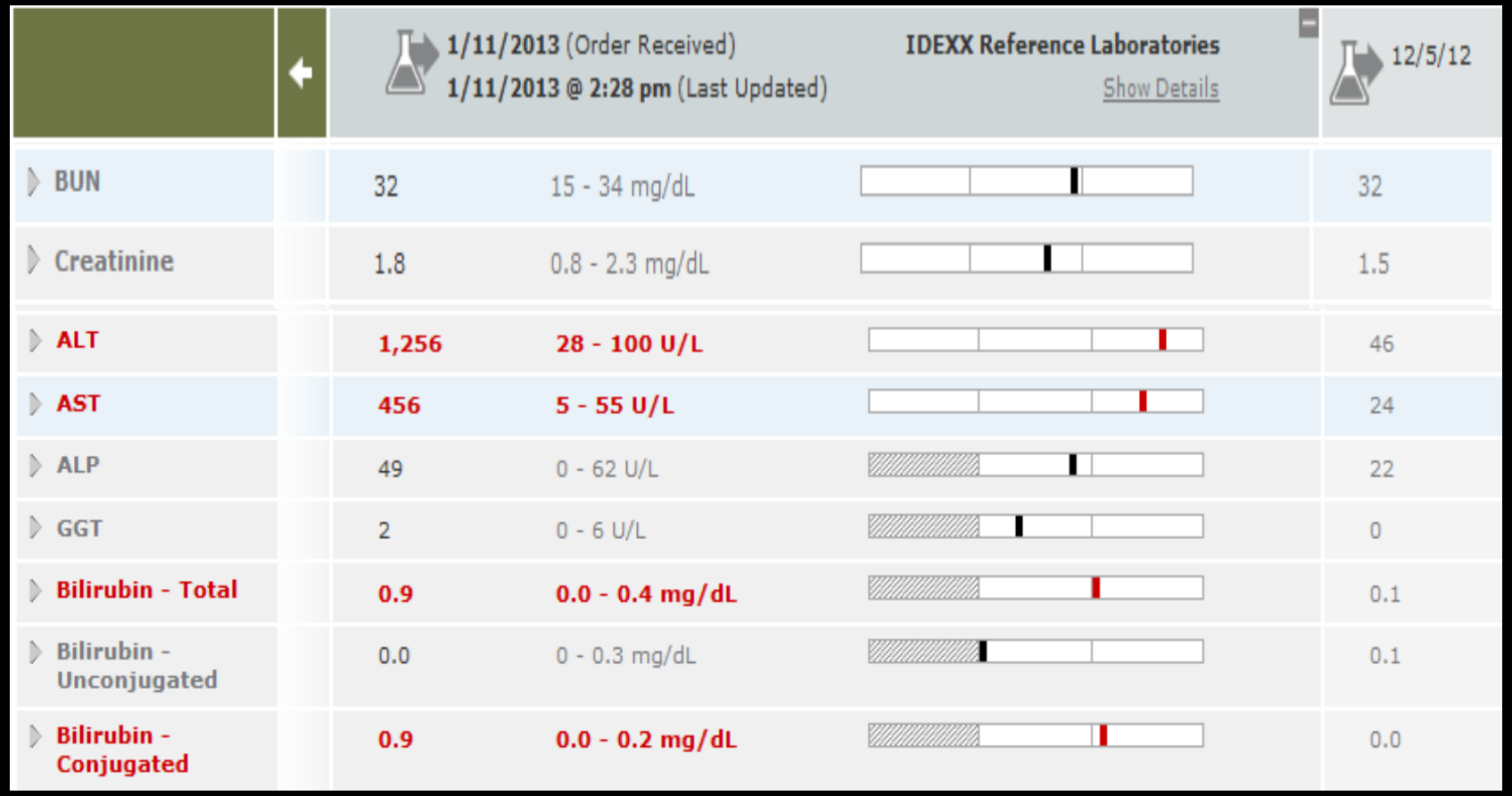
	12/5/2012 (Order Received) **12/6/2012 @ 4:05 am** (Last Updated)		**IDEXX Reference Laboratories** Show Details
Total T4	i 3.3	0.8 - 4.7 µg/dL	

	12/6/2012 (Order Received) **12/6/2012 @ 9:14 am** (Last Updated)		**IDEXX Reference Laboratories** Show Details
Free T4 (ng/dL)	3.0	0.7 - 2.6 ng/dL	
Free T4 (pmol/L)	f 38.6	9.0 - 33.5 pmol/L	

1 MONTH RECHECK T4 (METHIMAZOLE 2.5 MG BID)



OOPS…



			1/11/2013 (Order Received) 1/11/2013 @ 2:28 pm (Last Updated)	IDEXX Reference Laboratories Show Details	12/5/12
BUN		32	15 - 34 mg/dL		32
Creatinine		1.8	0.8 - 2.3 mg/dL		1.5
ALT		**1,256**	**28 - 100 U/L**		46
AST		**456**	**5 - 55 U/L**		24
ALP		49	0 - 62 U/L		22
GGT		2	0 - 6 U/L		0
Bilirubin - Total		**0.9**	**0.0 - 0.4 mg/dL**		0.1
Bilirubin - Unconjugated		0.0	0 - 0.3 mg/dL		0.1
Bilirubin - Conjugated		**0.9**	**0.0 - 0.2 mg/dL**		0.0

METHIMAZOLE SIDE EFFECTS

- Most severe - hepatopathy and blood dyscrasias
- GI upset, facial pruritis, lethargy
- Not dose related
- First 4-6 weeks of therapy
- Less common after 2-3 months of treatment
- Rare
- No more methimazole (what about topical, carbimazole, etc Dr. Lathan?)

5 WEEKS POST ^{131}I

	2/28/2013 (Order Received) 3/1/2013 @ 4:36 am (Last Updated)	IDEXX Reference Laboratories Show Details	1/21/13	1/15/13	1/11/13	12/5/12
Total T4	e 0.5	0.8 - 4.7 µg/dL	f 3.7	g 2.4	h 0.7	i 3.3
BUN	38	15 - 34 mg/dL	31	31	32	32
Creatinine	2.6	0.8 - 2.3 mg/dL	1.6	1.5	1.8	1.5

	3/1/2013 (Order Received) 3/1/2013 @ 11:20 am (Last Updated)	IDEXX Reference Laboratories Show Details	12/6/12
Total T3	37	52 - 182 ng/dL	
Free T4 (ng/dL)	<0.3	0.7 - 2.6 ng/dL	3.0
Free T4 (pmol/L)	h <3.9	9.0 - 33.5 pmol/L	j 38.6
cTSH	i >12.0	0.05 - 0.42 ng/mL	

2 explanations for low T_4?

How to differentiate?

PARATHYROID EMERGENCIES

CLUES THAT CHANGE IN CALCIUM IS DUE TO PARATHYROID DISEASE…

- Primary hyperparathyroidism
  - Pet looks better than it should given a very high calcium
  - Phosphorous low normal or low
  - Anything else Dr. Lathan?

- Primary hypoparathyroidism
  - Posterior lenticular cataracts

THOSE TRICKY IONIZED CALCIUM PTH PANELS

LOOK JUST AT THE CALCIUM FIRST!

TEST		RESULT	REFERENCE VALUE	
Ionized Calcium	a	1.55	1.25 - 1.45 mmol/L	H

a Referral test performed at Michigan State University.

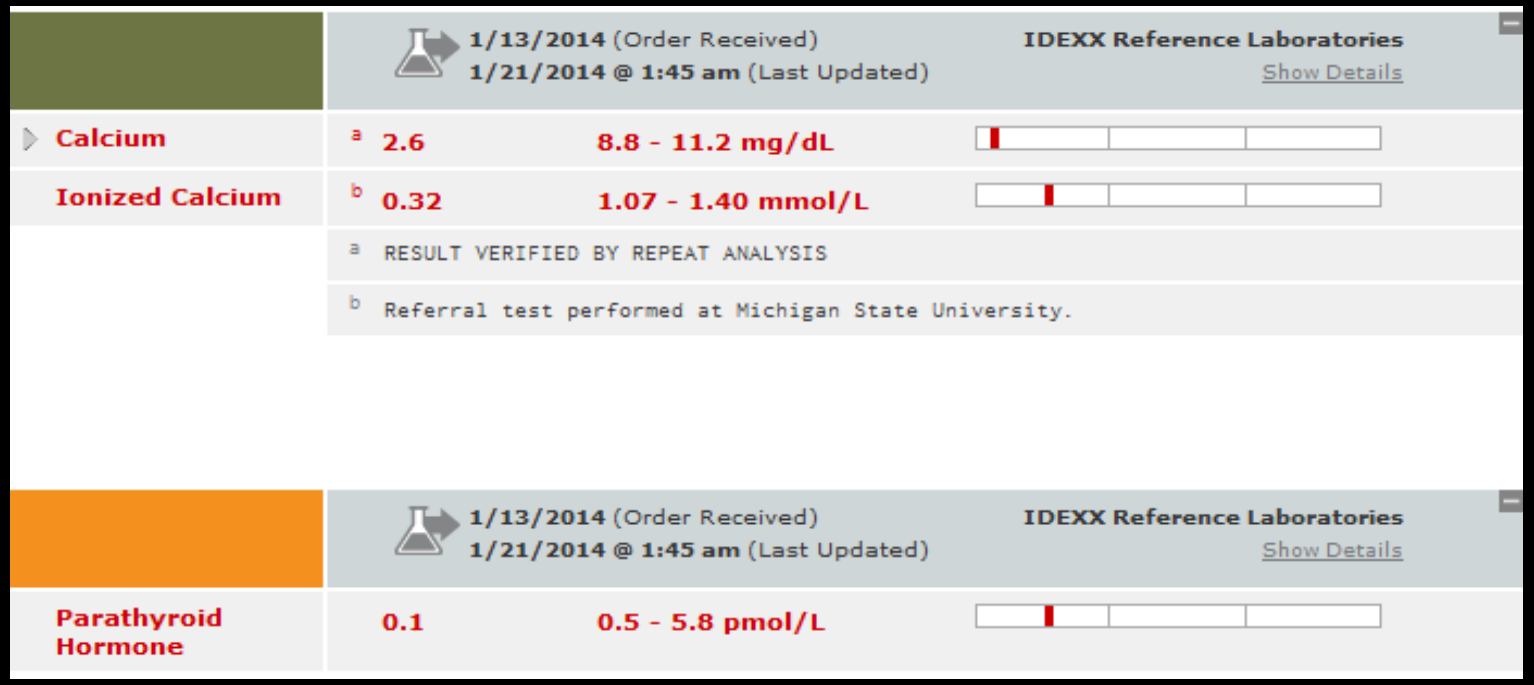
Endocrinology

TEST		RESULT	REFERENCE VALUE		
Parathyroid Hormone	a	5.70	1.10 - 10.60 pmol/L		3.00
Parathyroid Related Protein	b	0.0	0.0 - 1.0 pmol/L		

BISPHOSPHONATES TO RAPIDLY DECREASE CALCIUM

- Zoledronate
  - 0.1-0.2 mg/kg IV diluted in 0.9% NaCl over 15 minutes
- Pamidronate
  - 1.3-2.0 mg/kg IV diluted in 150 mL 0.9% NaCl over 2-4 hr
- 0.9% NaCl good initial fluid
- Caution with furosemide, prednisone

LOOK JUST AT THE CALCIUM FIRST!



1/13/2014 (Order Received)
1/21/2014 @ 1:45 am (Last Updated)

IDEXX Reference Laboratories
Show Details

Calcium	[a] 2.6	8.8 - 11.2 mg/dL	
Ionized Calcium	[b] 0.32	1.07 - 1.40 mmol/L	

[a] RESULT VERIFIED BY REPEAT ANALYSIS

[b] Referral test performed at Michigan State University.

1/13/2014 (Order Received)
1/21/2014 @ 1:45 am (Last Updated)

IDEXX Reference Laboratories
Show Details

Parathyroid Hormone	0.1	0.5 - 5.8 pmol/L	

THANK YOU!