Biochemistry Changes in in Small Animals with Endocrine Disease



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One-Lab. Mou choose.



To start.....

- Endocrine diseases are CLINICAL syndromes
 - Hx
 - PE
 - Minimum Data Base
 - Confirmatory tests
- Abnormalities on blood tests are RARELY the first clue!





- Most fat dogs are fat because they eat too much
- Are there supporting clinical signs?
 - Appetite
 - Coat and skin
 - Energy level
 - Concurrent illness and medication



	23 23	2/2/2016 (Order Received) 3/2/2016 @ 7:30 AM (Last Updated)	IDEXX Reference Laboratories
▶ Total T4	^a 11.8	13.0 - 51.0 nmol/L	
	^a Low total seen as a in partice administra range. If required, hypothyro: wanted. Sh which can thyroglobe	T4 could support hypothyroidism but result of a wide variety of underlyi ular glucocorticoids, phenylbutazone, ation. Hyperadrenocorticism or diabet clinical signs are suspicious for hy endogenous TSH (cTSH) assay is recom idism when other non-thyroidal factor hould results remain equivocal with o be run alone or as part of a panel (ulin autoantibodies].	reduced concentrations of this hormone can be ing conditions, disease states, and medications, , anticonvulsants or chronic sulphonamide tes mellitus may also result in T4 values in this ypothyroidism and additional confirmation is mmended. A low T4 and increased cTSH support rs have been excluded. Please ring if cTSH is cTSH testing, additional tests include free T4 (Canine Thyroid Panel) [Total T4, FT4, cTSH and
	Please not range with For hypoth post pill Dosage ad hypothyro:	te that sight-hounds (Greyhound, Whip hout being hypothyroid. hyroid dogs on L-thyroxine therapy, t depending on the formulation) should justment and further monitoring are idism persist.	opet, Lurcher) commonly have total T4 in this the recommended peak level (between 3 and 6 hours d be in the upper half of the reference interval. indicated, especially if clinical signs of



Total T4	^a 6.5	13.0 - 51.0 nmol/L	
cTSH	1.81	0.00 - 0.50 ng/mL	
	^a Low total T4 seen as a re in particula administrati range. If cl required, en hypothyroidi wanted. Shou which can be thyroglobuli Please note range withou For hypothyr post pill de Dosage adjus hypothyroidi	<pre>4 could support hypothyroidism but esult of a wide variety of underlyin ar glucocorticoids, phenylbutazone, ion. Hyperadrenocorticism or diabet linical signs are suspicious for hyp adogenous TSH (cTSH) assay is recom ism when other non-thyroidal factor uld results remain equivocal with c a run alone or as part of a panel (i in autoantibodies]. that sight-hounds (Greyhound, Whip ut being hypothyroid. roid dogs on L-thyroxine therapy, t epending on the formulation) should stment and further monitoring are ism persist.</pre>	reduced concentrations of this hormone can be ng conditions, disease states, and medications, anticonvulsants or chronic sulphonamide es mellitus may also result in T4 values in this pothyroidism and additional confirmation is mended. A low T4 and increased cTSH support s have been excluded. Please ring if cTSH is TSH testing, additional tests include free T4 Canine Thyroid Panel) [Total T4, FT4, cTSH and pet, Lurcher) commonly have total T4 in this he recommended peak level (between 3 and 6 hours be in the upper half of the reference interval. indicated, especially if clinical signs of

Minimum Data Base

- Haematology
 - Mild non regenerative anaemia
- Urinalysis
 - NSF





▶ Urea	5.2	3.1 - 10.1 mmol/L	
Creatinine	73	20 - 144.5 µmol/L	
SDMA	^a 9	1 - 14 µg/dL	
Phosphorus	0.99	0.80 - 1.60 mmol/L	
Calcium	2.52	2.36 - 2.84 mmol/L	
Magnesium	0.84	0.70 - 1.00 mmol/L	
Sodium	149.0	135.0 - 155.0 mmol/L	
Potassium	4.29	3.60 - 5.60 mmol/L	
Na:K Ratio	34.73	28.80 - 40.00	
Chloride	110.0	100.0 - 116.0 mmol/L	
Total Protein	62.8	54.9 - 75.3 g/L	
Albumin	33.0	26.3 - 38.2 g/L	
Globulin	29.8	23.4 - 42.2 g/L	
Alb:Glob Ratio	1.11	0.70 - 1.40	
▶ ALT	100.5	19.8 - 124.0 U/L	
▶ ALP	283.0	<= 130.0 U/L	
Bilirubin - Total	1.6	0.1 - 4.2 µmol/L	
Cholesterol	14.77	3.20 - 6.20 mmol/L	
Triglyceride	8.68	0.30 - 1.20 mmol/L	
Creatine Kinase	232.0	20.0 - 225.0 U/L	
Bile Acids Preprandial / Random	1.8	0.1 - 5 µmol/L	

Glucose	4.5	3.6 - 7.0 mmol/L	
▶▶ Urea	6.0	3.1 - 10.1 mmol/L	
Creatinine	126	20 - 144.5 µmol/L	
SDMA Learn More	^a 15	1 - 14 µg/dL	
Phosphorus	1.21	0.80 - 1.60 mmol/L	
Calcium	2.50	2.36 - 2.84 mmol/L	
> Sodium	140.0	135.0 - 155.0 mmol/L	
Potassium	4.82	3.60 - 5.60 mmol/L	
Na:K Ratio	29.05	28.80 - 40.00	
Chloride	107.0	100.0 - 116.0 mmol/L	
> Total Protein	67.2	54.9 - 75.3 g/L	
Albumin	31.4	26.3 - 38.2 g/L	
Globulin	35.8	23.4 - 42.2 g/L	
Alb:Glob Ratio	0.88	0.70 - 1.40	
ALT	138.5	19.8 - 124.0 U/L	
	223.0	<= 130.0 U/L	
Bilirubin - Total	0.2	0.1 - 4.2 µmol/L	
Cholesterol	>18.00		
Creatine Kinase	164.0	20.0 - 225.0 U/L	
Bile Acids Preprandial / Random	6.1	0.1 - 5 µmol/L	
-	^a SDMA is a new k: information vis:	idney biomarker; results >14µg/o it http://idexx.eu/sdma	dl are suggestive of kidney disease. For more

A word about free T4

- Immulite
- Equilibrium dialysis



Glucose	6.0	3.6 - 7.0 mmol/L	
▶ Urea	2.9	3.1 - 10.1 mmol/L	
Creatinine	34	20 - 144.5 µmol/L	
SDMA Learn More	b 7	1 - 14 µg/dL	
Phosphorus	1.84	0.80 - 1.60 mmol/L	
Calcium	2.44	2.36 - 2.84 mmol/L	
Sodium	145.0	135.0 - 155.0 mmol/L	
Potassium	4.43	3.60 - 5.60 mmol/L	
Na:K Ratio	32.73	28.80 - 40.00	
Chloride	107.0	100.0 - 116.0 mmol/L	
> Total Protein	67.1	54.9 - 75.3 g/L	
Albumin	36.8	26.3 - 38.2 g/L	
Globulin	30.3	23.4 - 42.2 g/L	
Alb:Glob Ratio	1.21	0.70 - 1.40	
▶ ALT	40.0	19.8 - 124.0 U/L	
▶ ALP	193.0	<= 130.0 U/L	
▶ GGT	13.2	2.5 - 10.6 U/L	
Cholesterol	4.12	3.20 - 6.20 mmol/L	

- Cushings is a clinical syndrome
 - No clinical signs means it's NOT Cushings!!
 - Most common clinical sign is PUPD
 - Check urine SG

- Elevated ALKP
 - Bone (2-3 x elavation)
 - Liver/cholestasis (>10 x elevation)
 - Corticosteroid induction (include topicals)
 - Endogenous (< 3 x elevation)
 - Exogenous (>100 x elevation)
- Consider nodular hyperplasia in older dogs
- "Vacuolar hepatopathy"

Does my Diabetic dog have Cushings too?



Concurrent Cushings and Diabetes

- Cushings then Diabetes
- Diabetes then Cushings
- HALLMARK = INSULIN RESISTANCE



Diabetes mellitus

Cushings

BIOCHEMISTRY

BIOCHEMISTRY

Test	Result	Alert	Units	Reference Range	Test	Result	Alert	Units	Reference Range
Total Protein	69.6		g/L	54.9 - 75.3	*Total Protein	60.6		g/L	54.9 - 75.3
Albumin	33.8		g/L	26.3 - 38.2	*Albumin	27.4		q/L	26.3 - 38.2
Globulin	35.8		g/L	23.4 - 42.2	*Globulin	33.2		a/L	23.4 - 42.2
AG Ratio	0.94			0.70 - 1.40	*AG Batio	0.83		5, -	0.70 - 1.40
Urea	3.7		mmol/L	3.1 - 10.1	*	10.0	<i>Ui c</i> h	mmo1 /T	3.1 - 10.1
Creatinine	77.0		umol/L	20.0 - 144.5	rorea	19.0	нідп		5.1 - 10.1
SDMA	9		ug/dL	1 - 14	*Creatinine	124.0		umol/L	20.0 - 144.5
					*ALT (SGPT) 37°C	146.2	High	U/L	19.8 - 124.0
SDMA is a new kidney	hiomarker: re	sults >14a/dl	are suggestive	e of	*Alk. Phosphatase 37°C	691.0	High	U/L	<=130.0
kidney disease. For m	ore informati	on visit http:	//idexx.eu/sd	ma	*Total Bilirubin	0.8		umol/L	0.1 - 4.2
ALT (SGPT) 37°C	231.0	High	U/L	19.8 - 124.0	*CK (CPK) 37°C	255.0	High	U/L	20.0 - 225.0
Alk. Phosphatase 37°C	1259.0	High	U/L	<=130.0	*Bile Acids (fasting)	36.6	High	umol/L	0.1 - 5.0
Gamma GT 37°C	<0.1	Low	U/L	2.5 - 10.6	*Cholesterol	10.21	High	mmol/L	3.20 - 6.20
Cholesterol	9.57	High	mmol/L	3.20 - 6.20	*Sodium	147.0		mmol/L	135.0 - 155.0
Sodium	137.0		mmol/L	135.0 - 155.0	*Potassium	5.31		mmol/L	3.60 - 5.60
Potassium	5.55		mmol/L	3.60 - 5.60	*Sodium/Potassium	27.68	Low		28.80 - 40.00
Sodium/Potassium ration	o 24.68	Low		28.80 - 40.00	ratio				
			. /-		*Chloride	103.0		mmol/L	100.0 - 116.0
Chloride	96.0	Low	mmol/L	100.0 - 116.0	*Inorganic phosphorus	1.25		mmol/L	0.80 - 1.60
Inorganic phosphorus	1.23		mmol/L	0.80 - 1.60	*Calcium	2.78		mmol/L	2.36 - 2.84
Calcium	2.72		mmol/L	2.36 - 2.84	*Glucose	4.5		mmol/L	3.6 - 7.0

Biochemical abnormalities in Cushings and Diabetes

Diabetes

- Increased ALKP
- Increased cholesterol
- Increased ALT
- Increased fasting BG
- Increased bile acids

Cushings

- Increased ALKP
- Increased cholesterol
- Increased ALT
- Increased fasting BG
- Increased bile acids
- Decreased urea
- Stress leukogram

Stress leukogram

Biochemical abnormalities in Cushings and Diabetes

- Go back to history
 - Polyuria
 - Polydipsia
 - Polyphagia
 - Symmetric alopecia
 - Abdominal distension
 - Weight Gain (C) vs Weight Loss (DM)

Cushings Biochemistry Abnormalities

- ALKP can be very high
 - Glucocorticoid induction in liver
 - Perpetuated by vacuolization with glycogen
 - Elevated in 90% of dogs with Cushings
 - Steroid induced iso-enzyme elevation non specific and of limited used.
- Cholesterol elevation
 - Increased lipolysis
 - Elevated in >90% of dogs with Cushings

URINE SG <1.020 in >85% of dogs with Cushings

Diabetes Biochemistry Bbnormalities

- ALKP elevation often moderate
 - Hepatic lipidosis
 - Elevated in 90% of dogs with Cushings
 - Steroid induced iso-enzyme elevation non specific and of limited used.
- Cholesterol elevation
 - Increased LDL synthesis from VLDLs
 - Reduced LDL receptor activity
 - Excess consumption of saturated fatty acids
 - Triglycerides normally more elevated than cholesterol
- URINE SG <1.030 in most diabetics</p>

Concurrent Cushings and Diabetes

- Stabilize diabetes first
- Only consider Cushing's if insulin resistant
- ACTH stimulation
 - Fewer false positives

Mystery Case

- 5 year male neutered GD
 - 2 days of lethargy and some inappetence
 - Unable to walk on arrival
 - Progressive
 - Mild bilateral epistaxis
 - Progressively obtunded virtually non responsive.



Mystery Case

- Physical exam
 - T 37.5C
 - P 120 and weak
 - R 20
 - CRT slow
 - Gums pale
 - Blood on thermometer
 - Otherwise unremarkable



HAEMATOLOGY

Test	Result	Alert	Units	Reference Range
Red cells	6.41		10^12/L	5.50 - 8.50
Haemoglobin	13.2		g/dL	12.0 - 18.0
Hct	0.375	Low	1/L	0.380 - 0.570
MCV	58.5	Low	fL	61.0 - 80.0
МСН	20.6		pq	20.0 - 26.0
MCHC	35.2		a/dL	30.0 - 36.0
Absolute retic. count	48.1		10^9/L	<= 110.0
	If acute haemoly clinically, then	sis or haemo: consider rep	rrhage is a peat haemato	concern ology with
White Cells	17.1	Hiah	уз. 10^9/т.	6.0 - 15.0
Neutrophils (Absolute)	10.26		10^9/T	2.50 - 12.50
Neutrophils	60		8	2100 12100
Lymphocytes (Absolute)	5 47	High	л 10^9/т.	0 50 - 4 80
Lymphocytes	32		%	4.00
Monocytes (Absolute)	0.68		10^9/L	<= 0.80
Monocytes	4		8	
Eosinophils (Absolute)	0.68		10^9/L	0.00 - 0.80
Eosinophils	4		8	
Platelet count	251		10^9/L	150 - 450
Analyser ID	Results generate	d by SYSMEX 1	XT2000	
Morphological	No abnormal cell	s seen.		
Assessment :				

BIOCHEMISTRY

Test	Result	Alert	Units	Reference Range	
*Total Protein	59.7		g/L	55.0 - 75.0	
*Albumin	22.7	Low	g/L	25.0 - 40.0	
*Globulin	37.0		g/L	20.0 - 45.0	
*AG Ratio	0.61			0.60 - 1.50	
*Urea	5.1		mmol/L	2.5 - 6.7	
*Creatinine	98.9		umol/L	20.0 - 150.0	
*ALT (SGPT) 37°C	39.4		U/L	5.0 - 60.0	
*Alk. Phosphatase 37°C	36.4		U/L	<= 130.0	
*Gamma GT 37°C	4.8		U/L	0.1 - 9.0	
*Total Bilirubin	0.9		umol/L	0.1 - 5.1	
*CK (CPK) 37°C	148.0		U/L	20.0 - 225.0	
*Bile Acids (fasting)	1.5		umol/L	0.1 - 5.0	
*Cholesterol	2.90	Low	mmol/L	3.20 - 6.20	
*Triglycerides	0.31		mmol/L	0.30 - 1.20	
*Amylase. 37°C	1617.4	High	U/L	100.0 - 1200.0	
*Lipase 37°C	96.4		U/L	0.1 - 200.0	
*Sodium	145.9		mmol/L	135.0 - 155.0	
*Potassium	5.10		mmol/L	3.60 - 5.60	
*Sodium/Potassium	28.61	Low		28.80 - 40.00	
ratio					
*Chloride	113.1		mmol/L	100.0 - 116.0	
*Inorganic phosphorus	1.44		mmol/L	0.80 - 1.60	
*Calcium	2.58		mmol/L	2.45 - 3.10	
*Glucose	5.0		mmol/L	3.6 - 7.0	
	Please note the new reference interval for Glucose,				
	effective 06/12/	12. This glu	cose result	was obtained	
	from the submitt	ed serum sam	ple.		
	Accurate blood g	lucose result	ts require p	prompt	
	separation of the serum once clotting is complete,				
ideally within 30-40 minutes of sampling.					

ACTH	Stimulation	Test
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*Cortisol pre ACTH <10.0 *Cortisol post ACTH

<10.0

Low Low nmol/L 25.0 - 125.0 nmol/L 125.0 - 520.0



Low Sodium:Potassium ratio

Aldosterone deficiency

Let's talk about the Na:K ratio

- Not cast in stone
- Look at both values individually
- Look at the patient





Other Changes with Addison's disease

- High Urea
 - Prerenal
 - Poor perfusion
 - GI bleed
- Low Cholesterol
 - Lipid metabolism (maybe)
- Low Albumin
 - GI bleed?
- Low Glucose
 - Reduced gluconeogenesis
- High Calcium
 - unclear







Can you tell them apart?

HGE

- Severe haemoconcentration
- Stress leukogram
 - Neutrophilia/paenia
 - Toxic neutrophils
- Azotaemia
- Hypoglycaemia

Addison's

- Mild anaemia mild haemoconcentration
- "relaxed leukogram"
 - Lymphocytosis
- Azotaemia
- Hypoglcaemia

ACTH stimulation

ENDOCRINOLOGY

Test	Result	Alert	Units	Reference Range
Cortisol pre ACTH	1308.0	High	nmol/L	25.0 - 125.0
Cortisol post ACTH	968.0	High	nmol/L	125.0 - 520.0

Basal cortisol can rule Addison's out

A Tale of 2 Scrawny Old Cats

Lou

- 16y MN DSH
- Weight loss
- T4 55 nmol/L

Cleo

- 15y FN DSH
- Weight loss
- T4 48nmol/L





BIOCHEMISTRY

Test	Result	Alert	Units	Reference Range
*Total Protein	71.5		g/L	60.0 - 80.0
*Albumin	30.1		g/L	25.0 - 45.0
*Globulin	41.4		g/L	25.0 - 45.0
*AG Ratio	0.73			0.60 - 1.50
*Urea	15.0	High	mmol/L	2.5 - 9.9
*Creatinine	154.0		umol/L	20.0 - 177.0
*SDMA	19	High	ug/dL	1 - 14

SDMA is a new kidney biomarker; results >14g/dl are suggestive of kidney disease. For more information visit http://idexy.eu/sdma

*ALT (SGPT) 37°C	61.2	High	U/L	5.0 - 60.0
*Alk. Phosphatase 37°C	29.0	-	U/L	<=60.0
*Gamma GT 37°C	1.8		U/L	0.1 - 9.0
*Total Bilirubin	<0.1		umol/L	0.1 - 5.1
*CK (CPK) 37°C	126.0		U/L	20.0 - 225.0
*Bile Acids (fasting)	0.9		umol/L	0.1 - 5.0
*Cholesterol	1.69	Low	mmol/L	2.20 - 4.00
*Triglycerides	0.24	Low	mmol/L	0.30 - 1.20
*Amylase. 37°C	1102.0		U/L	100.0 - 1200.0
*Lipase 37°C	20.0		U/L	0.1 - 89.0
*Sodium	146.0		mmol/L	145.0 - 157.0
*Potassium	5.26		mmol/L	3.50 - 5.50
*Sodium/Potassium	27.76	Low		28.00 - 40.00
ratio				
*Chloride	115.0		mmol/L	100.0 - 124.0
*Inorganic phosphorus	1.84		mmol/L	0.90 - 2.20
*Calcium	2.20		mmol/L	2.05 - 2.95
*Glucose	5.6		mmol/L	3.9 - 8.0
*	~~~~			

Cleo

BIOCHEMISTRY

Test	Result	Alert	Units	Reference Range
Total Protein	62.4		g/L	60.0 - 80.0
Urea	18.3	High	mmol/L	2.5 - 9.9
Creatinine	112.0		umol/L	20.0 - 177.0
Coming 1 January 2016 information visit htt	- SDMA - a ne p://idexx.eu/s	ew kidney bioma sdma	rker. For more	

ALT (SGPT)	37°C	147.5	High	U/L	5.0 -	60.0
Glucose		5.4		mmol/L	3.9 -	8.0

Lou

ENDOCRINOLOGY

Test	Result Alert	Alert	Units	Reference Range
Free T4 (Immulite)	12.4		pmol/L	9.0 - 33.5

Cleo

ENDOCRINOLOGY

Test	Result	Alert	Units	Reference Range
Free T4 (Immulite)	>77.2	High	pmol/L	9.0 - 33.5

A Tale of 2 Scrawny Old Cats

- Lou
 - Start further investigations



- Cleo
 - Start thyroid suppressants



Monitoring Response to Treatment

TT4

Lower half of reference interval

Water Deprivation Tests

- Forget what I said last year
 - Well not entirely
 - SDMA allows you to diagnose renal insufficiency and rule that in a lot earlier than creatinine and USG
 - MODIFIED WATER DEPRIVATION



ANY QUESTIONS

