A case of hyperuricemia in the ICU

HOSP #		**WARD**	Surgical ICU
CONSULTANT	Heleen Vreede / George van der Watt	**DOB/AGE**	30 year Male

Abnormal Result

The result upon the query being raised by the reviewer was a uric acid of 0.95 mmol/L (0.21-0.43 mmol/L). Three days prior to this result, the patient had a uric acid serum concentration of 0.38 mmol/L.

Presenting Complaint

The patient presented to the hospital with a history of a swollen tonsil unilaterally. This worsened over few days to a severe infection (sepsis) as described below.

History

No significant history. Patient reported sober habits.

Examination

At initial presentation, the patient appeared to have a suppurative tonsillitis. The tonsillitis later developed into a retropharyngeal abscess and soon extended into the thorax, forming a pericardial abscess, which is what was found clinically at the time of admission to Groote Schuur Hospital.

Laboratory Investigations

Date: newest to oldest (only chemistry results included)

Test Set	Test Item	12/01/2019 04:53	11/01/2019 04:18	10/01/2019 04:40	09/01/2019 08:21	09/01/2019 06:57	08/01/2019 05:15	07/01/2019 04:18	06/01/2019 06:11	05/01/2019 15:45
Test Set	Test Item									
NA	Na				δ+ 145				δ+ 140	131 L
K	K				4,6				4,1	INVH
CL	Cl				δ+ 106				98	
UREA	Urea	25,7 H	23,5 H	31,3 H	δ+ 33,3 H	31,6 H	18,4 H	20,7 H	25,1 H	22.0 H
CRT	Creat	172 H	δ- 166 H	307 H	δ+ 396 H	324 H	87	δ- 110 H	198 H	194 H
CRT	MDRD	41	42	21	16	20	>60	>60	35	35
CA	Ca				δ- 1,72 L			δ+ 2,18	1,95 L	
MG	Mg	δ- 0.79	δ- 0.96	1,26 H	1,28 H	1,19 H		δ+ 1,26 H	0.80	
PO4	Phos	δ- 0.69 L	1,83 H	δ+ 1,67 H	0.83	0.70 L		δ- 1,07	2,79 H	
UA	Uric acid				δ+ 0.95 H				0.38	
TP	otal prot		CEGK		CEGK				61	
ALB	Alb		δ+ 16 L		δ- 14 L				26 L	
TBIL	otal bili		22 H		29 H				32 H	
CBIL	Conj bili		22 H		29 H				30 H	
ALT	ALT		48 H		49 H				81 H	
AST	AST		130 H		183 H				223 H	
ALP	ALP		δ+ 129 H		73				68	
GGT	GGT		103 H		136 H				117 H	
LD	LD				415 H				390 H	

Other Investigations

CT scan: images to follow

Final Diagnosis

Retropharyngeal abscess progressing to a thoracic abscess and causing overt signs and symptons of heart failure.

Patient required a thoracotomy and pericardial drainage of the abscess.

Take Home Messages

- Do not take tonsillitis lightly. If not adequately managed, it may cause serious complications.
- Elevated Uric acid is a risk factor for acute kidney injury. This may be by means of acute gouty crystal

deposition, but other crystal-independent roles has also been described.

- Uric acid concentration will rise significantly in severe infection, most likely due to the fast tempo of tissue or DNA turnover, both by bacteria and host tissue breakdown and repair. Uric acid is a product of the metabolic breakdown of purine nucleotides.
- Uric acid, being a heterocyclic compound, I thought could interfere in various assays, and I thought even in the Jaffe reaction for creatinine, but it doesn't seem to be a common interferent when doing a quick literature search.
- Uric acid appears to be the major anti-oxidant in human serum constituting around 61% of total anti-oxidant activity, evidenced by Maxwell et al.:

Table 2. Comparison of antioxidant status in patients with IDDM and NIDDM uncomplicated by microvascular or macrovascular disease and groups of age-matched non-diabetic control subjects

	IDDM	Control	NIDDM	Control
AOA (μmol L^{-1})	320·2 ± 11·3***	427·5 ± 19·2	433·8 ± 25·4	473·9 ± 30·2
Urate (μmol L^{-1})	209·4 ± 10·4***	297·1 ± 16·7	299·5 ± 19·4	324·8 ± 21·4
Vitamin C (μmol L^{-1})	63·6 ± 6·0**	87·5 ± 4·9	38·6 ± 5·7*	58·5 ± 5·3
Vitamin E				
Absolute (μmol L^{-1})	25·2 ± 1·4	27·5 ± 1·4	32·0 ± 1·8	33·3 ± 3·3
Corrected	5·21 ± 0·25	5·79 ± 0·16	5·29 ± 0·23	5·44 ± 0·37
Vitamin A (μmol L^{-1})	1·30 ± 0·05***	1·94 ± 0·10	2·23 ± 0·14	2·23 ± 0·18
Thiols (μmol L^{-1})	458·9 ± 8·0**	499·6 ± 8·7	457·9 ± 7·4*	424·0 ± 15·2
Bilirubin (μmol L^{-1})	8·7 ± 0·9	9·7 ± 0·7	7·5 ± 0·6	7·4 ± 0·5

All values are means ± SE. Antioxidant activity (AOA) is measured in μmol L^{-1} trolox equivalents.
Corrected vitamin E values are absolute concentration (μmol L^{-1}) divided by cholesterol (mmol L^{-1}).
Significant differences between the diabetic patients and their respective control groups are indicated by *P<0·05, **P<0·01 and ***P<0·001.

- Relative contribution to total serum anti-oxidant activity in this study was: urate 65.1%, vitamin C 8.7%, vitamin E 10.6%, vitamin A 5.7%, thiols 7.8% (as in albumin) and bilirubin 1.9%.
- One immediately thinks that a patient with such a rapidly progressing infection has to be immunocompromised, the most common cause(s) in South Africa being HIV or diabetes mellitus. This patient however was HIV negative, according to HIV ELISA and did

not have reported signs and symptoms of diabetes.

A Case of Neurodevelopmental Delay

HOSP #		**WARD**	Neurodevelopmental clinic – Inkosi Albert Luthuli Hospital
CONSULTANT	Prof. George van der Watt	**DOB/AGE**	2y male

Abnormal Result

Urine organic acid analysis was performed upon which a big peak was seen, representative of phenylpyruvate.

Presenting Complaint

The patient was a 2 year old male evaluated at a neurology clinic for neurodevelopmental delay.

History

The patient’s brother died at 3 or 4 years of age with similar neurodevelopmental delay.

Examination

Unfortunately this information was unavailable. The clinician I got hold of at Inkosi Albert Luthuli hasn’t seen the patient himself.

Laboratory Investigations

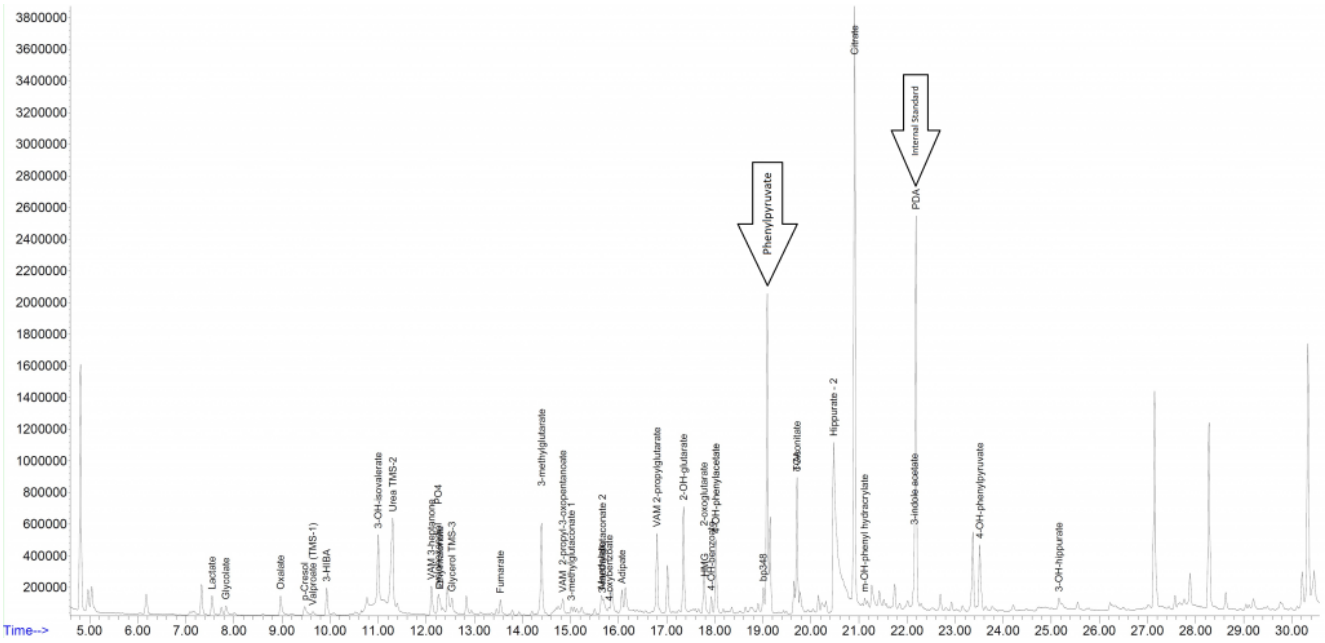


Fig 1 – Urine organic acid screening by GCMS demonstrates elevations of the phenylketones: phenylpyruvate and 4-OH phenylpuyruvate. These findings are indicative of a diagnosis of phenylketonuria due to autosomal recessive deficiency of phenylalanine hydroxylase.

Other Investigations

The urine amino acid analysis yielded a significantly raised phenylalanine: 672 umol/L (ref <67)

Final Diagnosis

This is a case of phenylketonuria

The diagnosis is also supported by a plasma phenylalanine of 672 umol/L (ref < 67).

Take Home Messages

Build-up of phenylalanine gets metabolised to phenylpyruvate (which is seen in urine at high levels).

> *Phenylalanine levels >600 umol/L in serum is highly indicative of phenylketonuria*
>
> *Prof. George van der Watt*

Biopterin cycling defects usually cause levels >125 umol/L.

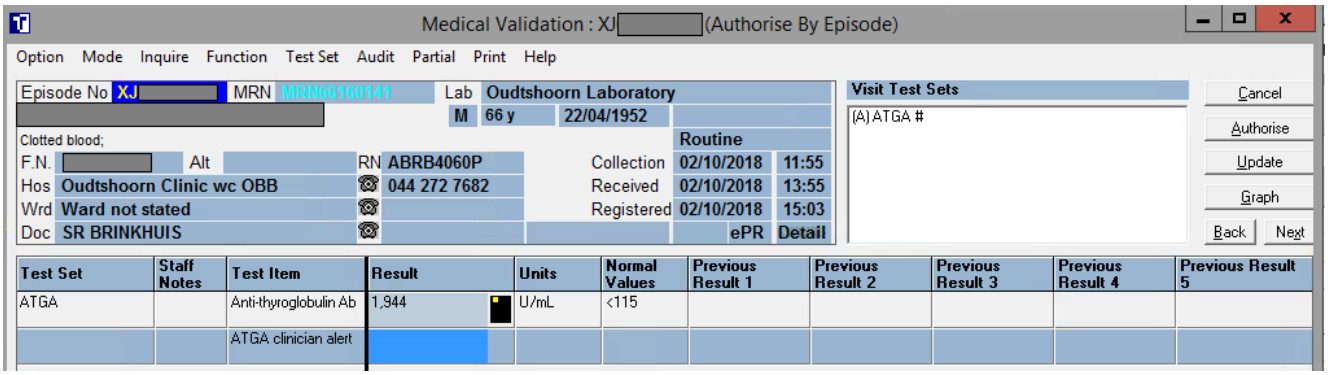
This deficiency is 4-monooxygenase deficiency.

Management of PKU is with a phenylalanine restricted diet.

Elevated anti-Thyroglobulin Antibodies

HOSP #		**WARD**	Oudtshoorn Clinic
CONSULTANT	George van der Watt & David Marais	**DOB/AGE**	66y Male

Abnormal Result



Presenting Complaint

Mr. X, a 66 year old male, complained of chest pain, was seen at the Oudtshoorn Emergency department and a myocardial

infarction was excluded by three serial point-of-care (POC) Troponin I results.

History

- Known with hypothyroidism, but the cause was not defined yet.
- On Eltroxin 150 ug daily PO
- No other treatment.
- Various stool analyses had been sent in for culture, with no definitive result.

Examination

Unfortunately not known.

Laboratory Investigations

Free T4: 24.6 pmol/L (7.6 – 16.1 pmol/L)

Anti-Thyroglobulin Antibody levels were elevated at **1944 U/mL** (ref. <115 U/mL).

Other Investigations

Later, by retrospective viewing of the patient’s results it was revealed:

Total Cholesterol (TC) was elevated at 7.6 mmol/L. Hypothyroidism is associated with hypercholesterolemia. It can be concluded by the retrospective overview of results that upon an episode of hypothyroidism, the patient had hypercholesterolemia. This was most likely due to cessation of Thyroxine treatment, to whatever reason.

Test Item	15/04/2019 17:38	11/01/2019 17:44	31/10/2018 18:32	31/10/2018 00:24	30/10/2018 17:21	02/10/2018 15:03	03/09/2018 15:13	31/08/2018 18:19	23/02/2018 14:30
Total chol	7,55							3,78	
Comment	CHOLC2							CHOLC2	
CRP								1	
Total PSA									
CEA									
Comment									
TSH	δ+25,53 H	δ+ 1,34			<.01 L			<.01 L	<.01 L
Free T4	δ- <3.2 L	δ- 8,9			δ- 15,9	δ- 24,6 H	34,3 H		27,6 H
Free T3							8,9 H		
Anti-thyrogl Ab						1944 H			

Index sample marked by the yellow shade. TC result which is raised (upper left corner) corresponds to the severely hypothyroid episode as revealed by the low T4 on that same sample.
Investigations also confirmatory for auto-immune hypothyroidism are:

- Anti-Thyroid peroxidase antibodies
- Anti-TSH receptor antibodies

Final Diagnosis

Auto-immune hypothyroidism

Take Home Messages

> *Interestingly, numerous patients with hypothyroidism is diagnosed at our Lipid Clinic at Groote Schuur Hospital. Patients are being referred for hypercholesterolaemia. Generally referral to this clinic happens when TC > 7.5 mmol/L. These patients are referred as presumed to have familial hypercholesterolaemia, but upon further work-up it is found that many of these patients have long-standing untreated hypothyroidism.*

Prevalences of antithyroid antibodies as summarized by Up-to-date:

Estimated prevalence of antithyroid antibodies (in percent)

Group	Anti-TSHR Ab	Anti-Tg Ab	Anti-TPO Ab
General population	0	5 to 20	8 to 27
Graves' disease	80 to 95	50 to 70	50 to 80
Autoimmune thyroiditis	10 to 20	80 to 90	90 to 100
Relatives of patients with autoimmune thyroiditis	0	30 to 50	30 to 50
Type 1 diabetes	0	30 to 40	30 to 40
Pregnant women	0	about 14	about 14

Anti-TSHR Ab: antithyrotropin receptor antibodies; Anti-Tg Ab: antithyroglobulin antibodies; Anti-TPO Ab: antithyroid peroxidase antibodies.

Thyroid Carcinoma

A case of Thyroid carcinoma

Hyperaldosteronism

HOSP #		WARD	Murraysburg Hospital, Female Ward
CONSULTANT		DOB/AGE	51 y female

Abnormal Result

Aldosterone: 1380 pmol/L

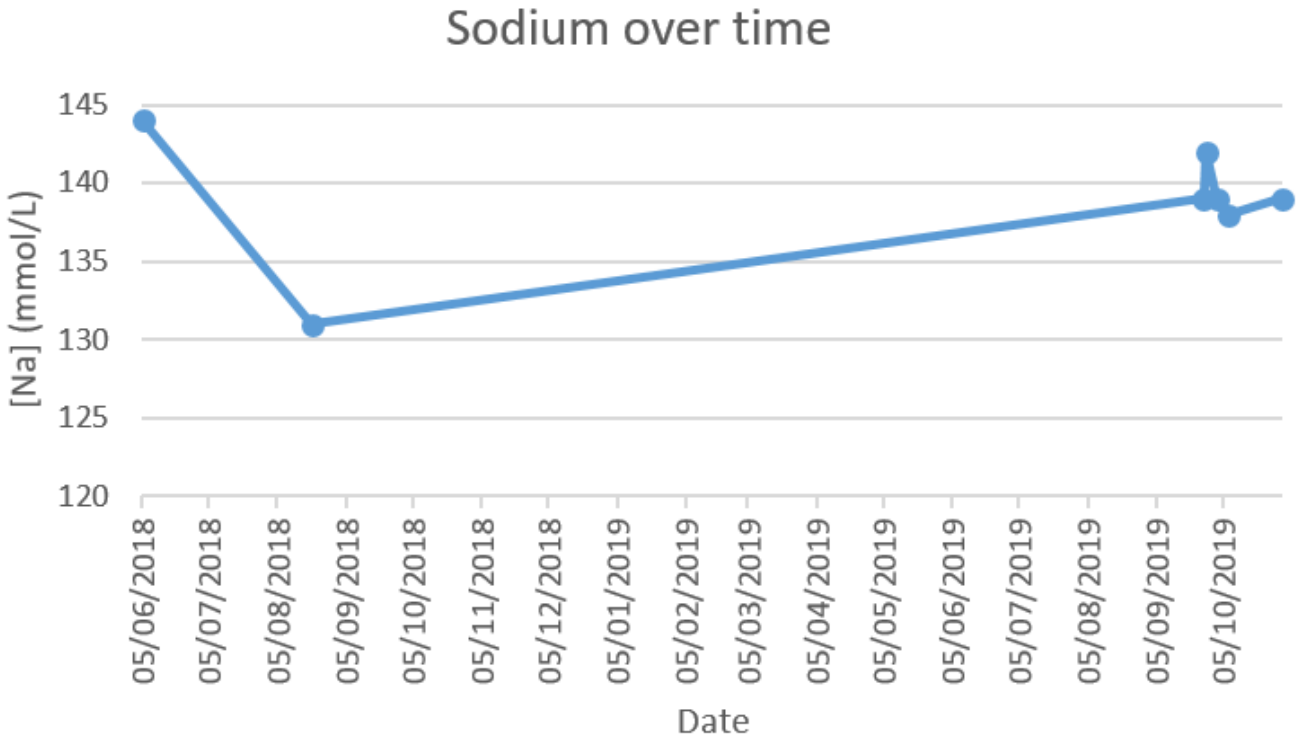
Renin: 2.1 ng/L

Aldosterone: Renin ratio: 657.14 pmol/ng

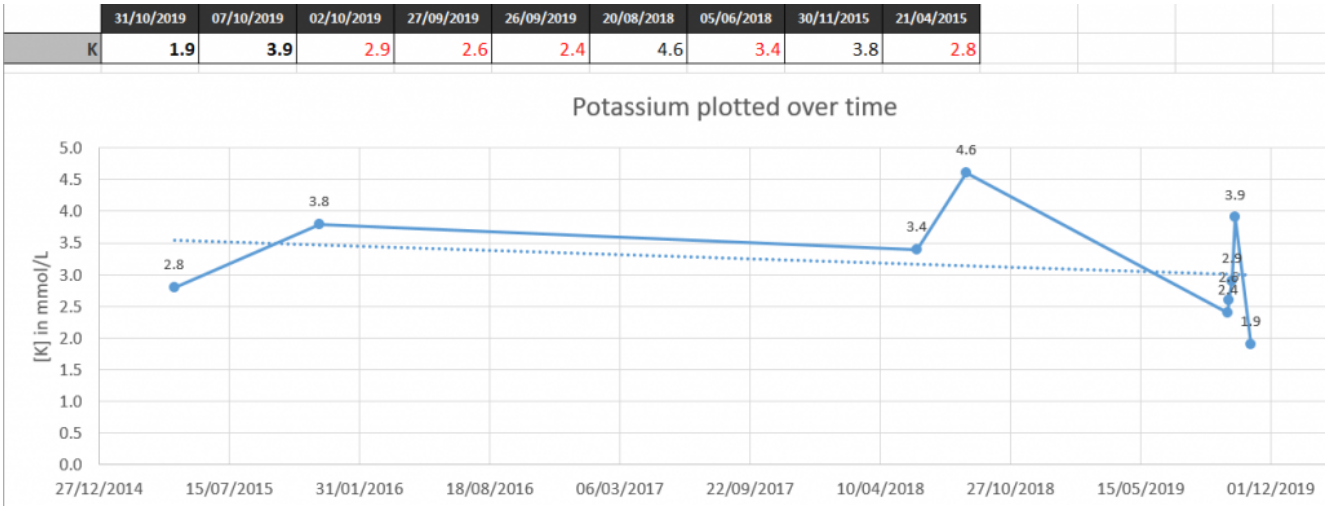
Presenting Complaint

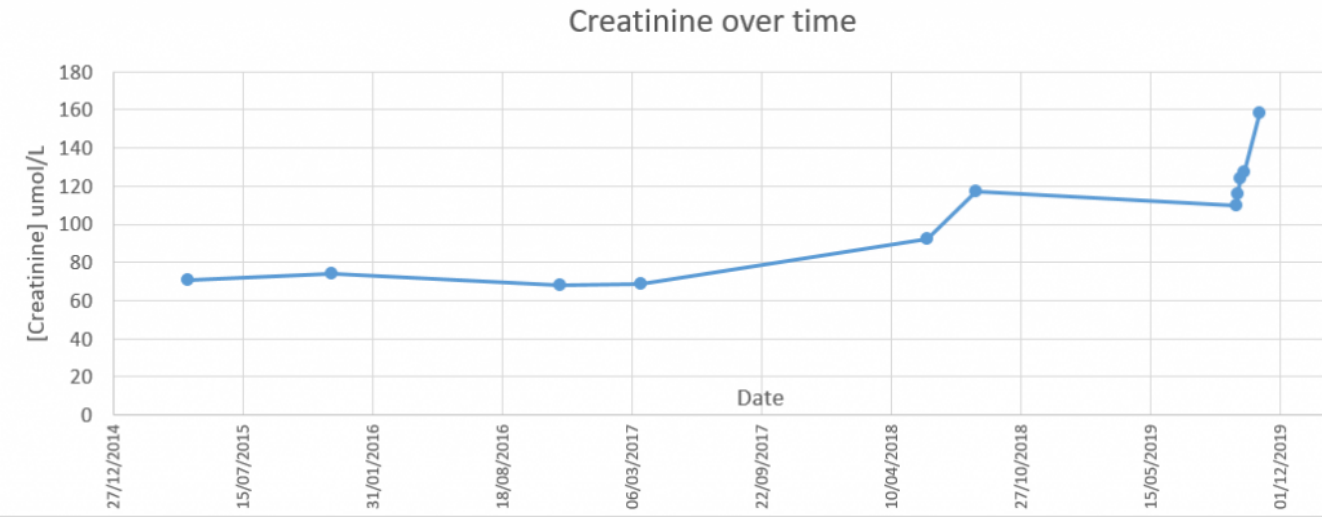
Uncontrolled Hypertension, unresolved on maximum dose of 3 antihypertensives.

History



	31/10/2019	07/10/2019	02/10/2019	27/09/2019	26/09/2019	20/08/2018	05/06/2018	30/11/2015	21/04/2015
K	**1.9**	**3.9**	2.9	2.6	2.4	4.6	3.4	3.8	2.8





Examination

Laboratory Investigations

Hos	Murraysburg Hospital wc MBH	☎	049 844 0053	Received	07/10/2019	17:57
Wrd	Female Ward	☎		Registered	07/10/2019	17:58
Doc	DR HUMAN	☎			ePR	I Deta

Test Set	Staff Notes	Test Item	Result	Units	Normal Values	Previous Result 1
ALDOS	✓	Aldosterone	1,380.0	pmol/L		
		Patient condition				
		Aldosterone auto comm	ALDO4			
RENIN		Renin mIU		mIU/L		
		Renin ng	2.1	ng/L		
		Aldosterone : renin ratio	657.14	pmol/ng		

Other Investigations

Urine electrolytes

	01/10/2019 15:32
UNa	59
UK	27,5
Ucreat	4,1
Uprotein	0,27
Uprot:creat	0,066

Serum Results

Date	Sodium mmol/L	Potassium mmol/L	eGFR ml/min	GGT U/L	Chol mmol/L	TSH mIU/L	T4 pmol/L	FreeT3 pmol/L	Cort nmol/L
21/04/2015		2,8	>60		5,07				
30/11/2015		3,8	>60		4,53				
15/11/2016			>60		4,04				
20/03/2017			>60		4,36				
05/06/2018	144	3,4	56		4,39	1,79	11,9	5	394
20/08/2018	131	4,6	42						
21/08/2018									
24/08/2018									
26/08/2018									
26/08/2018									
26/09/2019	139	2,4	45			0.81			
27/09/2019	142	2,6	43						
01/10/2019									
02/10/2019	139	2,9	40			CEGK			
03/10/2019									
07/10/2019	138	3,9	38						
31/10/2019	139	1,9	30	28					

Urine metanephrines

Urine collection period	24 h	Reference value
Urine volume	3080 ml	
Ucreat	2,2 mmol/L	
Umetadren	160 nmol/L	
Unormetadren	870 nmol/L	
dUmetadren	493 nmol/24h	152-913
dUnormetadren	2680 nmol/24h	699-2643
Umetadren:cr	73 nmol/mmol creat	17-91
Unormetad:cr	395 nmol/mmol creat	75-309

Final Diagnosis

Primary hyperaldosteronism causing secondary hypertension with accompanying renal injury.

Take Home Messages

Reference Ranges for Aldosterone:

- Upright 70 – 1066 pmol/L
- Supine 49 – 643 pmol/L

Screening for primary hyperaldosteronism: most sensitive when **>350** pmol/L

Reference Ranges for Renin:

- Upright: 2.7 – 27.7 ng/L
- Supine: 1.7 – 23.9 ng/L

Beta-blockers suppress renin levels and should be stopped 2 weeks before testing.

Aldosterone: Renin Ratio:

Most sensitive when the ratio is **>118** pmol/ng.

Effects of hyperaldosteronism

- One’s expectation is a high serum sodium, but since it normalizes with an increase in fluid volume, hence hypertension as in this case, there is normal sodium.
- Low serum potassium due to loss in urine, although this can also be normal.
- Increased urine potassium concentration (>30 mmol/L) in a random urine specimen suggests increased mineralocorticoid effect.
- The renin:aldosterone ratio is used to compensate for

the increase in aldosterone which is caused by an increase in renin (for instance which is caused by hypovolemia or low blood pressure).
- Some studies recently published are suggesting that the prevalence of hyperaldosteronism are significantly more than was (and is) thought, and hence urinary (24 hour) aldosterone measurement may be more accurate to screen for hyperaldosteronism. The authors of recent estimates of the prevalence of hyperaldosteronism are of opinion that hyperaldosteronism may be the cause of around 10% of unexplained “essential” hypertensives (see attached articles).

Hyperaldo-prevalence-2020Download
Primary-hyperaldo-Editorial-2020Download

Drip line contamination – Ringers Lactate

A case of drip line contamination.

Hypernatremia

Case of a child with extreme hypernatremia.

Prolactin

HOSP #		WARD	ENT Clinic
CONSULTANT		DOB/AGE	35 Y Male

Abnormal Result

Prolactin 10 986.0 ug/L (4-15.2)

Dilutions:

1/10 >4700;

1/100 = 10821;

1/50 = 10 986.

Presenting Complaint

Epistaxis

History

Patient with epistaxis referred to the ENT specialist clinic. No relevant medication history.

Examination

35 y male with a large left post-nasal space mass, a vascular mass involving the pituitary fossa.

?NBL (non-benign lesion)

?Sinonasal malignancy

?Pituitary Tumour

Laboratory Investigations

TSH 0.91 pmol/L (0.27-4.20)

Free T4 15.7 pmol/L (12-22)

FSH 0.8 IU/L ↓ (1.5-12.4)

LH 0.2 IU/L ↓ (1.7-8.6)

Testosterone 0.2 nmol/L ↓ (8.6-29.0)

PTH 1.7 pmol/L (1.6-6.9)

Prolactin measuring method:

The Elecsys prolactin sandwich immunoassay uses two monoclonal antibodies directed against human prolactin.

R1 = biotinylated antibody – recognizes the N-terminal end of the
prolactin molecule

R2 – ruthenium complexed antibody probably reacts with a region in the
middle of the prolactin molecule.

1st incubation: a biotinylated monoclonal prolactin-specific antibody and a monoclonal prolactin-specific antibody labeled with a ruthenium
complex form a sandwich complex.

2nd incubation: after addition of streptavidin-coated microparticles, the complex becomes bound to the solid phase via interaction of
biotin and streptavidin.

Reaction mixture aspirated into the measuring cell where microparticles
are magnetically captured into the surface of the electrode.

Unbound substances are then removed with ProCell.

Application of a voltage to the electrode then induces chemiluminescent emission which is measured by a photomultiplier, results calculated by a standard curve.

Other Investigations

Monomeric prolactin – 7744 ug/L (70% recovery after PEG precipitation)

Biopsy: confirmed tumour stained strongly positive with prolactin suggesting a prolactinoma.

Final Diagnosis

Pituitary Macroprolactinoma

Take Home Messages

Sandwich immunoassays are prone to high dose hook-effect. There are various ways to overcome this effect. (This will later be expanded on – see AFP / Beta-HCG).

Prolactin appears in the serum as:

1. Active monomeric prolactin (“little”) (80%) 23kDa
2. Inactive dimeric prolactin (“big”) (5-20%) 50-60kDa
3. Low activity tetrameric prolactin (“big-big”) (0.5-5%) 150-170kDa

Precipitation by PEG yields the active monomeric

prolactin, expressed as a percentage recovery after precipitation. Big-big prolactin consists of an antigen-antibody complex of monomeric prolactin-immunoglobulin G and is defined as macroprolactin. This has a long half-life in blood when compared to normal prolactin and gives false high readings of prolactin, leading to unnecessary investigations in certain cases. A high prolactin should thus be confirmed by doing a PEG precipitation.

Fluid Triglycerides

A case of high fluid triglycerides

ACTH

HOSP #		**WARD**	G16 Medical Ward
CONSULTANT		**DOB/AGE**	54 y Female

Abnormal Result

21/08/2018 Two ACTH tests (referred to another laboratory) and two Cortisol levels (at our laboratory) were done.
At first it was thought to be a dexamethasone suppression

test, but then
realized the clinicians were suspecting hypopituitarism.

10h05: **ACTH 0.7 pmol/L ↓** (1.6-13.9) Cortisol 8 nmol/L ↓ (Morning: 133- 537; Afternoon 68 – 327)

10h35: ACTH 1.8 pmol/L N (1.6-13.9)
Cortisol 68 nmol/L ↓ (Morning: 133- 537; Afternoon 68 – 327)

Presenting Complaint

? hypopituitarism

History

Known with a pituitary macroadenoma, previously seen at the Radiotherapy clinic in 2016.

Examination

No clinical info available.

For Primary adrenal insufficiency one would expect: Hyperpigmentation
(due to ↑ ACTH), +/- hyperkalemia/hyponatremia (aldosterone effect), +/-
virilization.

For Secondary adrenal insufficiency there is subtle symptoms, electrolytes are not deranged significantly because aldosterone function is preserved. See table on Bishop 7th ed. p. 459.

Laboratory Investigations

Measurement of
plasma ACTH concentration is used to assess Cushing’s disease,

adrenal tumors,
ectopic ACTH-producing tumors, Addison's disease, Nelson's syndrome, and
hypopituitarism.

The
laboratory diagnosis of hypopituitarism, however is relatively straightforward.
In contrast to the primary failure of an endocrine gland that is accompanied by
dramatic increases in circulating levels of the corresponding pituitary tropic
hormone, secondary failure (hypopituitarism) is associated with low or normal
levels of tropic hormone. This is the
diagnosis in this case with the history of previous radiotherapy which was
given for a macro-adenoma.

Other Investigations

Free T4 on 19/04/2018 was 7.8 pmol/L (12-22), also suggesting possible hypopituitarism, although a TSH would be helpful.

Final Diagnosis

Hypopituitarism confirmed.

Take Home Messages

Dexamethasone suppression test need only measurement of cortisol, not accompanying ACTH, except in extended work-up however, where a Cosyntropin (CRH) stimulation test can be done to distinguish between pituitary or hypothalamic insufficiency.

Evaluation of pituitary function need the Primary hormone

(Cortisol) as well as the tropic hormones from the pituitary (ACTH).

Paracetamol Overdose

HOSP #		**WARD**	C15 Casualties
Consultant		**DOB/AGE**	33 year Female

Abnormal result

Paracetamol 25ug/ml (163 umol/L) Serum osmolarity 310mmol/L

Presenting Complaints

Brought to casualties with stupor from Mitchells Plein Hospital.

History

33 y female presented with stupor after ingestion of an unknown amount of pills. Empty container of Amitriptiline and Paracetamol was found with her.

Examination

Non-specific neurologic signs, but delirium present. Patient did have an episode of vomiting. No pathological signs on abdominal examination.

Laboratory Investigations

12/08/2018: Na 156 mmol/L (H) Urea 4.2mmol/L Tot. Bili 4 umol/L K 1.9 mmol/L (L) Creat 88 umol/L ALT 82 U/L Cl 97.9 mmol/L (L) Gluc 3.52 mmol/L AST 238 U/L Ammonia 35 umol/L Bicarb 16.6 mmol/L (L) Osmol 310 mmol/L (H) Osmolar gap: -10 mM Anion Gap: 47 mmol/L

Marked elevation of hepatocellular enzymes, ductal enzymes within normal range. Within the course of three days the patient developed Klebsiella Pneumoniae on intubation in ICU with DIC and marked renal failure (Creat 506, Urea 26.8) and demised in ICU 3 days after admission, although liver enzymes were not markedly more deranged as initial presentation.

Paracetamol: The Paracetamol level was never repeated after admission. Doing an in-house experiment with calibrator and spiking the calibrator samples with N-acetylcysteine correlating with therapeutic plasma levels, I demonstrated that our method on the Roche analyzer, with the enzymatic assay, causes a clinically significant negative interference in the measured paracetamol.

The enzymatic assay principle:

arylacylamidase hydrolysis o-cresal + periodate catalyst

Acetaminophen→ p-aminophenol+acetate → indophenol (measured @600nm)

Other Investigations

Tricyclic antidepressant levels 58 ug/L ([TCA] in overdose patients range from 29-1732ug/L, but has not been found to

correlate to clinical outcome, unless plasma level is more than 1000ug/L).

Final Diagnosis

Klebsiella Sepsis (confirmed on blood culture 1 day after death) DIC with marked renal failure.

Take Home Messages

- Paracetamol reporting units must be confirmed, we generally use ug/ml, but it has created confusion previously, as nomograms used in South Africa generally use ug/ml.
- N-acetyl cysteine may cause negative interference with the measurement of paracetamol in the enzymatic assay. Sampling for Paracetamol levels should thus be done before an IV dose of NAC is given to eliminate this possible error. National guidelines with toxicology will likely be amended.