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24 September 2019

9(2)(a) [redacted]

[redacted]

[redacted]

RE Official Information Act request CDHB 10167

I refer to your email dated 15 August requesting the following information under the Official Information Act from Canterbury DHB.

- **The Canterbury DHB protocol for diagnosing primary Aldosteronism?**
- **A copy of the interpretation of the results of the test as well?**

The screening and diagnosis of primary Aldosteronism is a complex topic. The various screening and confirmatory tests that we do may vary accordingly to the clinical context (e.g. of the estimated pre-test probability of the condition based on the clinical presentation).

In summary, we generally do screening on those with a higher pre-test probability of having the condition (to try to reduce the number of false positive results). The patients referred to us may have risk factors such as young age of hypertension, severity of hypertension, hypokalaemia or an adrenal incidentaloma with hypertension (these risk factors are detailed on Community HealthPathways). Please find information from HealthPathways attached as **Appendix 1.** There is also information publicly available on the HealthInfo website. https://www.healthinfo.org.nz/

HealthPathways is designed and written for use during a consultation. Each pathway provides clear and concise guidance for assessing and managing a patient with a particular symptom or condition. Pathways also include information about making requests to services in the local health system.

Content is developed collaboratively by general practitioners, hospital clinicians, and a wide range of other health professionals. Each pathway is evidence-informed, but also reflects local reality, and aims to preserve clinical autonomy and patient choice. HealthPathways serves to reduce unwarranted variation and accelerate evidence into practice.

We screen using the aldosterone/renin ratio (details attached **Appendix 2**). For confirmatory testing we perform a saline suppression test (details attached). If primary hyperaldosteronism looks likely, we then go on to consider the cause, which, depending on the clinical circumstances and potential fitness for surgery, would likely include CT imaging of the adrenals and possibly going on to adrenal vein sampling if there is the potential for a good outcome from adrenalectomy (details attached as **Appendix 2**).

With regards to interpretation of the various tests, this can be challenging, and can be affected by many things (including the patient's volume status, their medications, the absolute level of aldosterone, etc.).

There are further details given in the attached protocols (**Appendix 2**), but for some of the testing there is no clear cut-off, with interpretation being done in our multidisciplinary meetings based on local laboratory reference ranges, published literature and expert opinion given the patient's individual clinical context.

I trust that this satisfies your interest in this matter.

Please note that this response, or an edited version of this response, may be published on the Canterbury DHB website after your receipt of this response.

Yours sincerely

Carolyn Gullery
Executive Director
Planning, Funding & Decision Support

APPENDIX 1

Hyperkalaemia

Red flags

Potassium of 7 mmol/L or more

Electrocardiograph (ECG) changes

Background

About hyperkalaemia

About hyperkalaemia

Hyperkalaemia is a serum potassium concentration of greater than 5.0 mmol/L. It is a potentially life-threatening emergency, and can result in cardiac arrhythmias and sudden death.

Medications, especially those used in the settling of renal impairment, are the most common causes of hyperkalaemia in general practice.

Assessment

1. Hyperkalaemia is often an incidental finding on routine blood tests:
    - Check for previous high potassium levels.
    - Consider repeating the blood test.
    - Determine the severity of hyperkalaemia.

      Severity rate

        - Mild – 5 to 5.9 mmol/L
        - Moderate – 6 to 6.4 mmol/L
        - Severe – 6.5 mmol/L and greater
2. History:
    - Ask about symptoms, e.g. nausea and vomiting, muscle pain or weakness, and palpitations.
    - Consider causes of hyperkalaemia, especially medications.

      Medications

        - Potassium-sparing diuretics, such as spironolactone or amiloride hydrochloride
        - Excessive potassium supplement use
        - ACE inhibitors
        - Angiotensin-II receptor antagonists
        - Non-selective beta blockers, e.g. propranolol hydrochloride, labetalol hydrochloride
        - Digoxin toxicity
        - NSAIDs and COX-2 inhibitors
        - Antibiotics, e.g. trimethoprim, pentamidine isetionate, some penicillins

- Direct renin inhibitors
- Calcineurin inhibitors, e.g. tacrolimus, ciclosporin
- Dietary salt substitutes that contain potassium rather than sodium chloride

Causes of hyperkalaemia

- Pseudohyperkalaemia:
  - Blood sampling error, e.g. long tourniquet time, traumatic phlebotomy
  - Test tube haemolysis, delayed analysis
  - Exercise
- Ineffective excretion:
  - Acute or chronic renal failure
  - Aldosterone deficiency or resistance
- Excessive release from cells:
  - Rhabdomyolysis, burns, tumour lysis syndrome, crush injuries
  - Massive haemolysis
  - Shifts/transport out of cells, e.g. due to acidosis, low insulin levels, or medications
- Excessive intake:
  - Oral supplements
  - Potassium containing intravenous (IV) fluids and drugs
  - Massive blood transfusion

3. Examination:
   - Look for clinical features of hyperkalaemia.

Clinical features of hyperkalaemia

- Cardiac, e.g. arrhythmias
- Neuromuscular, e.g. ascending muscle weakness beginning in the legs and progressing to the trunk and arms
- Hyperkalaemia can be initially asymptomatic, or can present with severe symptoms and signs.
- Severity of clinical features may not correlate to absolute potassium concentration, but to how fast concentration rises.

   - Check pulse, blood pressure, pulse oximetry, muscle strength.
4. Investigations:
   - If potassium result does not fit with clinical picture, consider repeating test, e.g. pseudohyperkalaemia due to haemolysis or delay in sample process.
   - Blood tests, e.g. sodium, potassium, creatinine, urea, glucose, calcium, digoxin levels if appropriate.
   - Investigate any suspected adrenal insufficiency causing aldosterone deficiency.
   - If potassium is 6 mmol/L or higher, do an ECG looking for changes associated with hyperkalaemia.

ECG changes

- Peaked T waves
- PR prolongation
- P wave loss
- QRS widening
- Sine wave
- Ventricular arrhythmias, asystole

   - Assess the trend of elevated potassium over 12 to 24 hours, if possible.

Assess trend of elevated potassium

- A rapid rise in potassium warrants acute referral to secondary care even if the severity of the elevation is only moderate. This can occur in the setting of acute renal failure.
- A rise of greater than 0.5 mmol/L over 12 hours is considered high risk of developing cardiac conduction problems.

Management

1. Request acute general medicine assessment if:
    - potassium is 7 mmol/L or higher, or
    - any symptoms or ECG changes associated with hyperkalaemia.

      ECG changes

        - Peaked T waves
        - PR prolongation
        - P wave loss
        - QRS widening
        - Sine wave
        - Ventricular arrhythmias, asystole
2. Manage underlying causes and contributing co-morbidities, e.g:
    - chronic kidney disease.
    - heart failure.
    - suspected adrenal insufficiency.
3. Otherwise, manage according to potassium levels:
    - If potassium 5 to 5.9 mmol/L

      Potassium level 5 to 5.9 mmol/L

        - Rarely an issue unless an acute rise from very low concentration. Recommend a low potassium diet for some patients with chronically elevated levels.
        - If a medication is implicated, consider whether to stop the medication or monitor the potassium levels.
    - If potassium 6 to 6.4 mmol/L

      Potassium level 6 to 6.4 mmol/L

        - Withhold ACE inhibitors, angiotensin-II receptor antagonists, and potassium-sparing diuretics. Consider restarting or substituting at a later date.
        - Stop any NSAIDs or potassium supplements.
        - Rehydrate if dehydrated (sodium chloride 0.9% is best).
    - If potassium level of 6.5 to 6.9 mmol/L, seek general medicine registrar advice. Acute general medicine assessment is recommended if:
        - acute intercurrent illness,
        - acute kidney injury or change in kidney function, or
        - increasing potassium level.

Request

Request acute general medicine assessment if:

- potassium is 7 mmol/L or more.
- hyperkalaemia with any ECG changes or symptoms.

- potassium is between 6.5 and 6.9 mmol/L, with acute intercurrent illness, kidney injury or change in kidney function, or increasing potassium level.

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Hypokalaemia

Red Flags

- Potassium ≤ 2.5 mmol/L
- Electrocardiograph (ECG) changes

Background

About hypokalaemia

Assessment

1. Hypokalaemia is often an incidental finding on routine blood tests:
    - Check for previous low potassium levels.
    - Consider repeating the blood test.
    - Determine the degree of hypokalaemia.

      Degrees of hypokalaemia

      Mild

        - Potassium 3 to 3.5 mmol/L
        - Often well tolerated in otherwise healthy people
        - Patients are usually asymptomatic
        - Signs and symptoms may be more apparent if the level has decreased rapidly
        - In patients with co-morbidities (e.g., hypertension, underlying heart disease or cirrhosis), mild hypokalaemia is associated with an increased incidence of life-threatening cardiac arrhythmias, sudden death, and (rarely) hepatic coma.

      Moderate

        - Potassium 2.6 to 2.9 mmol/L

      Severe

        - Potassium 2.5 mmol/L or less
2. History:
    - Ask about symptoms, which usually occur when serum potassium is ≤ 2.5 mmol/L, but may occur at higher levels.

      Symptoms

        - Cardiac e.g., hypotension, bradycardia, tachycardia
        - Muscular e.g., weakness, fasciculations
        - CNS e.g., lethargy, paraesthesia, mental status change
        - Gastrointestinal e.g., constipation
    - Consider:
        - causes of hypokalaemia

Causes of hypokalaemia

- Increased excretion:
  - urinary excretion e.g., diuretics, corticosteroids, vomiting, Cushing syndrome, hyperaldosteronism, rare renal causes.
  - losses from other sites e.g., gastrointestinal tract (diarrhoea, purging, intestinal fistula), excessive sweating.
- Redistribution of potassium from extracellular to intracellular fluid e.g., alkalosis, trauma, periodic paralysis, and medicines e.g., high dose insulin.
- Decreased dietary intake of potassium. This may be a contributor but is rarely the sole cause.

- medication. Diuretics are the most common single cause of hypokalaemia.

Medication history

- Loop and thiazide diuretics
- High dose insulin e.g., for the treatment of non-ketotic hyperglycaemia
- Sympathomimetic drugs e.g., salbutamol, theophylline
- Corticosteroids
- Excessive use of laxatives

- surreptitious diuretic or laxative use.

3. Examination:
   - Consider clinical features of hypokalaemia

Clinical features of hypokalaemia

- Cardiac e.g., hypotension, arrhythmias, cardiac arrest
- Neuromuscular e.g., weakness, fasciculations, tetany, decreased tendon reflexes
- Gastrointestinal muscle weakness e.g., constipation, ileus
- Respiratory muscle weakness e.g., hypoventilation, respiratory distress

   - Pulse, blood pressure, and pulse oximetry
   - Muscle strength
   - Evidence of purging behaviours

Evidence of purging behaviours

- Facial puffiness
- Parotid or submandibular gland enlargement
- Irritation or cracking of skin around the mouth
- Mouth ulcers
- Acid damage to nails of fingers or callous over dorsum of dominant hand due to self-induced vomiting

4. Investigations:
   - If potassium ≤ 3 mmol/L, or if pulse is abnormal, request and interpret ECG.

ECG changes in hypokalaemia

Hypokalaemia may cause premature beats, bradycardia, heart block, tachycardia, or fibrillation.

ECG changes include:

        - ST-segment depression
        - T-wave flattening or inversion
        - Prolonged QRS
        - Presence of U waves
    - If the cause of hypokalaemia is unclear, repeat potassium and check magnesium and bicarbonate level.
    - Consider checking plasma glucose, digoxin level (if relevant), and creatine kinase if rhabdomyolysis is suspected.
    - If no obvious cause for hypokalaemia, arrange 24 hour urine collection for potassium, or spot urine for potassium/creatinine ratio. Arrange before potassium replacement, unless hypokalaemia is severe. Interpret ⌄ results of urine tests if required.

      Results of urine tests

        - If high urine potassium excretion (over 30 mmol/L) and blood pressure is elevated, consider hyperaldosteronism. Check plasma renin/aldosterone ratio and seek non-acute endocrinology advice.
        - If high urine potassium excretion (over 30 mmol/L) and blood pressure is normal, rule out diuretics or vomiting as a cause, and seek non-acute nephrology advice.
        - If urine potassium excretion is normal or appropriately reduced (at or below 30 mmol/L), consider gastrointestinal losses.

Management

1. If any red flags, significant symptoms, or comorbidities, request acute general medicine assessment.
2. If eating disorder present:
    - If patient otherwise well, and potassium > 2.5 mmol/L, replace according to the ⌄ Eating Disorders Unit guideline.
        - If ⌄ purging is ongoing, seek eating disorders specialised assessment, as a much higher rate of potassium replacement may be needed.

      Ongoing purging

      Ongoing purging may cause metabolic alkalosis and secondary hyperaldosteronism, with significant urinary potassium loss.

3. If a medicine is implicated, consider whether it can be stopped.
4. If eating disorder not present, manage hypokalaemia according to severity:
    - ⌄ Moderate (potassium 2.6 to 3 mmol/L and no symptoms or ECG changes).

      Moderate hypokalaemia

      Arrange potassium replacement:

        - Potassium chloride modified release tablet (⌄ Span K) 2 tablets four times daily, **or**
        - Potassium chloride effervescent tablet (⌄ Chlorvescent) 1 tablet four times daily.

      Arrange potassium levels daily:

        - If levels are decreasing or symptoms develop, request acute general medicine assessment.
        - When level is greater than 3, manage as mild.
    - Mild (potassium 3.1 to 3.4 mmol/L and no symptoms).

      Mild hypokalaemia

      Arrange oral potassium replacement:

        - Potassium chloride modified release tablet (Span K) 1 tablet three times daily, **or**

          Span K

          Potassium chloride 600 mg tablet containing 8 mmol of potassium per tablet.

        - Potassium chloride effervescent tablet (Chlorvescent) 1 tablet twice daily.

          Chlorvescent

            - Each tablet contains 14 mmol of potassium.
            - Useful in patients with swallowing difficulties or a nasogastric tube.
            - Salty with a strong blackcurrant flavour which may not be tolerated.

      Arrange potassium levels every 1 to 2 days, until normal.

      Once potassium level is normal, recheck in one week. If medication is causing hypokalaemia, recheck potassium at least 6-monthly while continuing on the medication.

5. Correct magnesium deficiency as hypomagnesemia may prevent recovery from hypokalaemia.

   Magnesium deficiency

    - Usually due to renal or gastrointestinal losses, or drugs which reduce absorption e.g., omeprazole.
    - Can increase risk of arrhythmia.
    - If severe (magnesium < 0.5 mmol/L) and symptomatic (e.g., arrhythmia or tetany), request acute general medicine assessment.
    - Otherwise, arrange oral magnesium:
        - Various unfunded formulations are available. An initial supply costs around $20.
        - Contact the patient's community pharmacist for advice on current availability, cost and prescribing.
        - Explain you want to prescribe **elemental** magnesium orally 500 mg total per day (equivalent to around 20 mmol per day) in divided doses. Choose a duration e.g., 2 weeks. The patient can reduce the dose, if needed, to avoid diarrhoea.
        - Examples include magnesium chelate and Magnesium Complete™.

          Magnesium Complete

            - Magnesium Complete capsules 1 capsule twice or three times a day.

- Each capsule contains 12 mmol magnesium.

Magnesium chelate

- Magnesium chelate orally one to two capsules three times a day, up to a maximum of 6 capsules a day.
- Each capsule contains 4 mmol magnesium.

- Arrange repeat blood tests in a week.

6. Use caution when prescribing other medication, as there is a higher risk of QT prolongation when hypokalaemia is present.

Request

- Request acute general medicine assessment if:
  - red flags
  - significant symptoms or comorbidities
  - serum potassium < 3 mmol/L and decreasing
- If ongoing purging in patient with eating disorder, seek eating disorders specialised assessment.
- Seek non-acute endocrinology advice if high urine potassium excretion (over 30 mmol/L), and elevated blood pressure.
- Seek non-acute nephrology advice if high urine potassium excretion (over 30 mmol/L, normal blood pressure and diuretics or vomiting are not the cause.

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Hypertension

See also Hypertension in Pregnancy and Postpartum.

Assessment

Make the diagnosis

- Take recommended blood pressure measurements.

  Blood pressure measurements

  Before starting antihypertensive medication, it is recommended that:

  - an average of 2 seated blood pressure measurements is taken after resting, for at least 5 minutes.
  - blood pressure measurements are repeated on 3 separate occasions.
  - the correct size blood pressure cuff is used.
- Consider ambulatory blood pressure monitoring or “home” monitoring.

  Blood pressure monitoring

  Consider ambulatory blood pressure monitoring:

  - if blood pressure shows unusual variability.
  - if blood pressure is resistant to multiple-therapy.
  - in suspected "white coat" hypertension.
  - to evaluate treatment efficacy.

Ambulatory blood pressure monitors can be hired from some general practitioners and private cardiologists (or, in Ashburton, from hospital outpatients).

Use validated machines, not wrist monitors.

Once hypertension is confirmed

1. Check history and family history for vascular risk factors e.g., stroke, TIA, MI, angina, diabetes, peripheral vascular disease.
2. Consider common causes of hypertension.

   Common causes of hypertension

   - High alcohol intake
   - Sleep apnoea
   - Obesity
   - Medications (e.g., combined oral contraceptives, glucocorticoids, NSAIDs, liquorice)
   - White coat effect
3. Examination.

   Hypertension examination

   - Full cardiovascular examination including peripheral pulses
   - Consider assessing checking for radio-femoral delay, abdominal bruits, and endocrine causes such as Cushing syndrome.
   - Look for any end organ damage e.g., fundoscopy, urinalysis, and ECG (for left ventricular hypertrophy).
4. Investigations to consider: random lipids, HbA1c, creatinine, sodium, potassium, calcium, LFTs, urinary albumin:creatinine ratio (ACR), ECG.
5. Assess cardiovascular risk
6. If severe or resistant hypertension, especially in younger patients, consider secondary causes.

   Secondary causes

   Secondary hypertension is uncommon, but consider if:

   - aged < 40 years and new onset blood pressure > 160/100, or
   - severe or resistant hypertension, especially in younger patients, e.g., systolic ≥ 180 or diastolic ≥ 110
   - Coarctation of the aorta
   - Kidney disease

     Suspected kidney disease

     - Suspected chronic kidney disease:
       - If GFR < 60 AND
       - decrease GFR ≥ 15 within 12 months
       - requiring 3 or more antihypertensive agents,

       follow Chronic Kidney Disease (CKD) pathway.

     - If renal artery stenosis is suspected:
       - GFR decrease ≥ 25% after commencing ACE inhibitor or ARB
       - worsening of previously well-controlled blood pressure

        - multiple medicines to control blood pressure
        - high blood pressure younger than 35 years

    request nephrology advice. Radiology imaging before referral is not recommended.

    - If suspected urinary obstruction, arrange non-acute urology assessment.

- Endocrine causes

  Endocrine causes are uncommon, but important causes of hypertension:

  Discuss with the endocrinology laboratory before arranging these tests.

  - Cushing syndrome
    - Consider if suggestive clinical features.
    - Arrange a dexamethasone suppression test or a 24 hour urine cortisol.
  - Hyperaldosteronism
    - Consider if aged < 40 years, spontaneous or provoked hypokalaemia, or resistant hypertension.
    - Arrange ambulatory morning plasma aldosterone and renin.
  - Phaeochromocytoma
    - Consider in young patients with hypertension, or any patient with variable blood pressure or resistant hypertension, unexplained 'spells', hypertension and an adrenal incidentaloma.
    - Arrange a 24 hour urine for catecholamines and metanephrines.

- Baroreflex failure

  Baroreflex failure

  - Baroreflex failure is a neurologic dysfunction of baroreceptors which causes volatile blood pressure and heart rate, especially in response to stress.
  - Blood pressure at rest can be normal, or even low.

  See the Clinical Resources section for more information.

Management

1. If patient presents with severely elevated blood pressure e.g., systolic ≥ 180 or diastolic ≥ 110, look for evidence of malignant hypertension.

   Malignant hypertension

   - Is a rare potentially life-threatening condition which requires immediate treatment.
   - Is severely elevated blood pressure with rapidly progressive end organ damage, e.g., retinopathy, including papilloedema, encephalopathy, acute left ventricular dysfunction and renal failure.
   - Symptoms include blurred vision, headaches, fits, confusion, weakness, numbness, nausea and vomiting, chest pain, shortness of breath.
   - If suspected, arrange acute admission under General Medicine for confirmation and treatment.

   Note: Severe hypertension without any features of malignant hypertension can be managed with oral antihypertensives in the community.

2. Provide lifestyle interventions:
    - Smoking cessation
    - Physical activity
    - Dietary advice

      Dietary advice

        - HealthInfo – How to Lose Weight
        - National Heart Foundation – Healthy Eating Section
        - NZ Primary Care Handbook 2012 – New Zealand Cardioprotective Dietary Pattern
    - Dietary salt reduction

      HealthInfo – How to Reduce Your Salt Intake

    - Reduced alcohol intake
3. If patient is pregnant or postpartum or planning a pregnancy, see Hypertension in Pregnancy or Postpartum.
4. The decision to start blood pressure lowering medication depends on many factors and is not covered in this pathway[1,2]

   Blood pressure-lowering medication

    - Recent studies have shown that the amount of blood pressure lowering is more important than the choice of antihypertensive drug.
    - Initial choices for management can be a thiazide, an ACE inhibitor, or a calcium channel blocker, unless there is a specific indication for a particular class of drug. There is evidence chlortalidone may be more effective than other blood pressure lowering medication at reducing adverse cardiovascular outcomes. [3]
    - All three can be used in combination if monotherapy is inadequate.
    - Consider adding spironolactone 25 to 50 mg for patients not responding to the combination of the above 3 classes in maximally tolerated doses.[4] Monitor potassium levels.
    - Reserve beta blockers for when there is inadequate blood pressure control with the other three main classes, or if there are specific indications, i.e:
        - Women of childbearing potential
        - Patients with:
            - evidence of increased sympathetic drive
            - an intolerance of ACE inhibitors
            - heart disease.
    - More than one drug is often required to achieve optimum blood pressure levels.
    - Low dose combinations can maximize effectiveness and minimise side effects.
    - See also: ACE Inhibitor Dosing in Renal Impairment, NZF - Hypertension and Heart Failure.
5. Hypertension is mostly managed in primary care, but if the criteria listed below are met, consider specialist assessment.

Request

The Cardiology Department does not see patients with hypertension only.

- If severe or malignant hypertension, seek urgent general medicine advice, as admission or urgent assessment may be required.

  Malignant hypertension

Is a rare potentially life-threatening condition which requires immediate treatment.
Is severely elevated blood pressure with rapidly progressive end organ damage, e.g., retinopathy, including papilloedema, encephalopathy, acute left ventricular dysfunction and renal failure.
Symptoms include blurred vision, headaches, fits, confusion, weakness, numbness, nausea and vomiting, chest pain, shortness of breath.
If suspected, arrange acute admission under General Medicine for confirmation and treatment.

Note: Severe hypertension without any features of malignant hypertension can be managed with oral antihypertensives in the community.

- If poorly controlled hypertension despite treatment with 3 concurrent medications at adequate doses (or unacceptable side-effects) and:
  - aged older than 65 years with comorbidities, request older persons health assessment.
  - otherwise, request non-acute general medicine assessment.
- For suspected secondary cause of hypertension, request non-acute general medicine assessment.
- If secondary cause of hypertension is identified as:
  - endocrine, request endocrine specialist assessment.
  - renal, request non-acute nephrology specialist assessment.
- Your patient may also wish to consider private referral.

APPENDIX 2

ASY-853.1: Ambulatory aldosterone and renin measurement for possible primary hyperaldosteronism

ASY-853.2: Associated Documents

Patient information sheet for Ambulatory Blood Test

ASY-853.3: Distribution of Documents

Copy No	Number	Location
1		Quality Centre
2	3.1	Endocrine Test Centre, Laminated copy
3	3.20	G:\Division\NDO\common\ETCProtocols\

ASY-853.4: Review of Document

Date	Signature	Next review	Sign when read

G:\Division\NDO\common\ETCProtocols\0853 - Ambulatory aldosterone and renin for possible hyperaldosteronism.doc

ASY-853.5: Purpose of Ambulatory aldosterone and renin measurement for possible primary hyperaldosteronism

Ambulatory aldosterone and renin measurement is performed as a case-detection test for primary hyperaldosteronism in patients at increased risk of secondary hypertension.

ASY-853.6: Precautions

The test results may be misleading if:

- **a** The patient is on interfering drugs (see below).
- **b** Serum potassium <3.0mmol/L.

ASY-853.7: Procedure for Ambulatory aldosterone and renin measurement

- **a** Prior to the appointment, send the patient the Ambulatory Blood Test information sheet.
- **b** Check the patient's medications, and check that patient has followed the doctor's instructions for stopping any prior to the test. If concerns that patient is still on interfering medications (see below), check with requesting doctor before proceeding.
- **c** Patients should be given an appointment time before 10am (non-fasting).
- **d** On arrival, while patient is still standing, document any interfering medications (see below). List these in Health Connect South, when informing GP that the procedure has been done.
- **e** Ensure patient has been "ambulatory" on the morning of the test. This means walking around for at least 30mins, and preferably 2 hours, prior to the blood test.
- **f** The patient should be seated for 5 to 15minutes, and then a blood sample is drawn for sodium, potassium, creatinine, aldosterone and renin. Samples should be received by the lab ASAP, and within 4 hours.

ASY-853.8: Interfering medications

Most antihypertensive medications can be continued for this screening test**.** However, there are potentially clinically important issues with the following drugs:

- **a** Mineralocorticoid receptor antagonists (spironolactone, eplerenone). These block the aldosterone receptor, which allows sodium loss, reduced plasma volume and resultant increase in renin, making the aldo/renin ratio less interpretable. **These drugs should be stopped 6 weeks prior to aldo/renin testing**.
- **b** ACE inhibitors, angiotensin receptor blockers (ARBs) and direct renin inhibitors can increase the renin and have variable effects on the aldo/renin. Therefore**, if these are non-essential, then stop them 2 weeks before sampling**.

	Plasma renin	Plasma aldosterone	Aldosterone to renin ratio
Spironolactone / eplerenone	↑	↑	↓
Diuretics	↑	→↑	↓
ACE Inhibitors	↑	↓	↓
Angiotensin II receptor blockers	↑	↓	↓
Ca channel blockers (dihydropyridine)	↑	↓	↓
β blockers	↓	↓	↑
Central α2 agonists (clonidine, methyldopa)	↓	↓	↓

Likely effect of anti-hypertensive medications on Aldosterone/renin ratio.

ASY-853.9: Interpretation

If serum potassium is <3mmol/L, the aldosterone may be low, and the test may need to be repeated after steps are taken to normalise the potassium

For those <u>not</u> on potentially interfering drugs:

Primary aldosteronism should be suspected when renin is low, plus the aldo is >250pmol/L, and the aldo/renin ratio is >30 (pmol/L/mIu/L), and the patient does not have renal failure. If the aldo renin is >30, then further testing is usually required to confirm the diagnosis (such as saline suppression test).

For those on potentially interfering drugs (ACE Inhibitors and ARBs):

In a patient treated with one of these drugs, a detectable renin level or a low aldo/renin ratio does **not** exclude the diagnosis of primary aldosteronism. On the other hand, a strong predictor for primary aldosteronism is an undetectable renin in a patient taking one of these drugs.

ASY-827.1: Adrenal vein sampling for possible Conn's syndrome

ASY-827.2: Associated Documents

ASY-827.3: Distribution of Documents

Copy No	Number	Location
1		Quality Centre
2	3.1	Endocrine Test Centre laminated page 3, master copies of page 5 and 6, copies of page 7, 8 and 9
4	Section ASY-827.8:	Laminated on sample trolley
5		G:\Division\NDO\common\ETCProtocols\0827-Adrenal Vein Sampling for possible Conn's syndrome.doc

ASY-827.4: Review of Document

Date	Signature	Next review	Sign when read

Table of Contents

G:\Division\NDO\common\ETCProtocols\0827-Adrenal Vein Sampling for possible Conn's syndrome.doc

ASY-827.5: Blood sampling during venogram (Conn's syndrome)

ASY-827.6: Sampling procedure

ASY-827.6.1: If possible

a Sample L adrenal + take concurrent peripheral samples for aldo and cortisol

b Sample R adrenal + take concurrent peripheral samples for aldo and cortisol

c Samples taken:

i Aldosterone (Aldo)

ii Cortisol

Samples to be drawn at same rate from all sites.

Peripheral samples taken from IV luer (R arm) or sheath (ask Radiologist) if staff available in DSA.

ASY-827.6.2: If above is not possible

a Sample from IVC

i Below glands + take concurrent peripheral samples for aldo and cortisol

ii Between glands + take concurrent peripheral samples for aldo and cortisol

iii Above R gland + take concurrent peripheral samples for aldo and cortisol

b Samples taken for aldo and cortisol.

c Ask radiologist to withdraw 2 ml from catheter prior to drawing samples (and reject sample as "dead space").

d Note carefully time and site of samples and label accordingly.

ASY-827.7: Protocol for low dose ACTH infusion for Adrenal Vein Catheterization

a Cannulate L arm (preferably AC fossa).

b **Dose**: Synacthen 1.25µg/hr.

c Add 250µg synacthen to 500ml Gelofusine = 5µg/10ml or 1µg/2ml.

d Add 12.5 ml (6.25µg) of above solution to 500ml saline.

e Infuse 100ml/hr (1.25µg/hr).

f Start 45 minutes before adrenal vein sampling.

g Continuous infusion until end of sampling.

ASY-827.8: Sampling trolley set up

ASY-827.8.1: Top shelf

- **a** 5ml EDTA tubes..... x6 peripheral (labelled in black P1-P6)
- **b** 5ml EDTA tubes..... x6 right side (labelled in red R1-R6)
- **c** 5ml EDTA tubes..... x2 left side (labelled in blue L1-L2)

ASY-827.8.2: All together in metal tray

- **a** Spare 5ml EDTA tubes..... x6
- **b** 20G cannula..... x3
- **c** Saline in 10ml syringes x5
- **d** 3ml syringes..... x12
- **e** 5ml syringes..... x12
- **f** 18G needles x 1" x20
- **g** Transpore tape 1" wide
- **h** Plasters
- **i** Tourniquet
- **j** Alcohol/chlorhexidine swabs x5
- **k** Marker pens..... blue, black and red
- **l** Ballpoint pens..... blue, black and red
- **m** Clipboard with protocol, sample time sheet and diagram sheet (hormone lab forms and labels can remain in Endocrine Tests Centre)

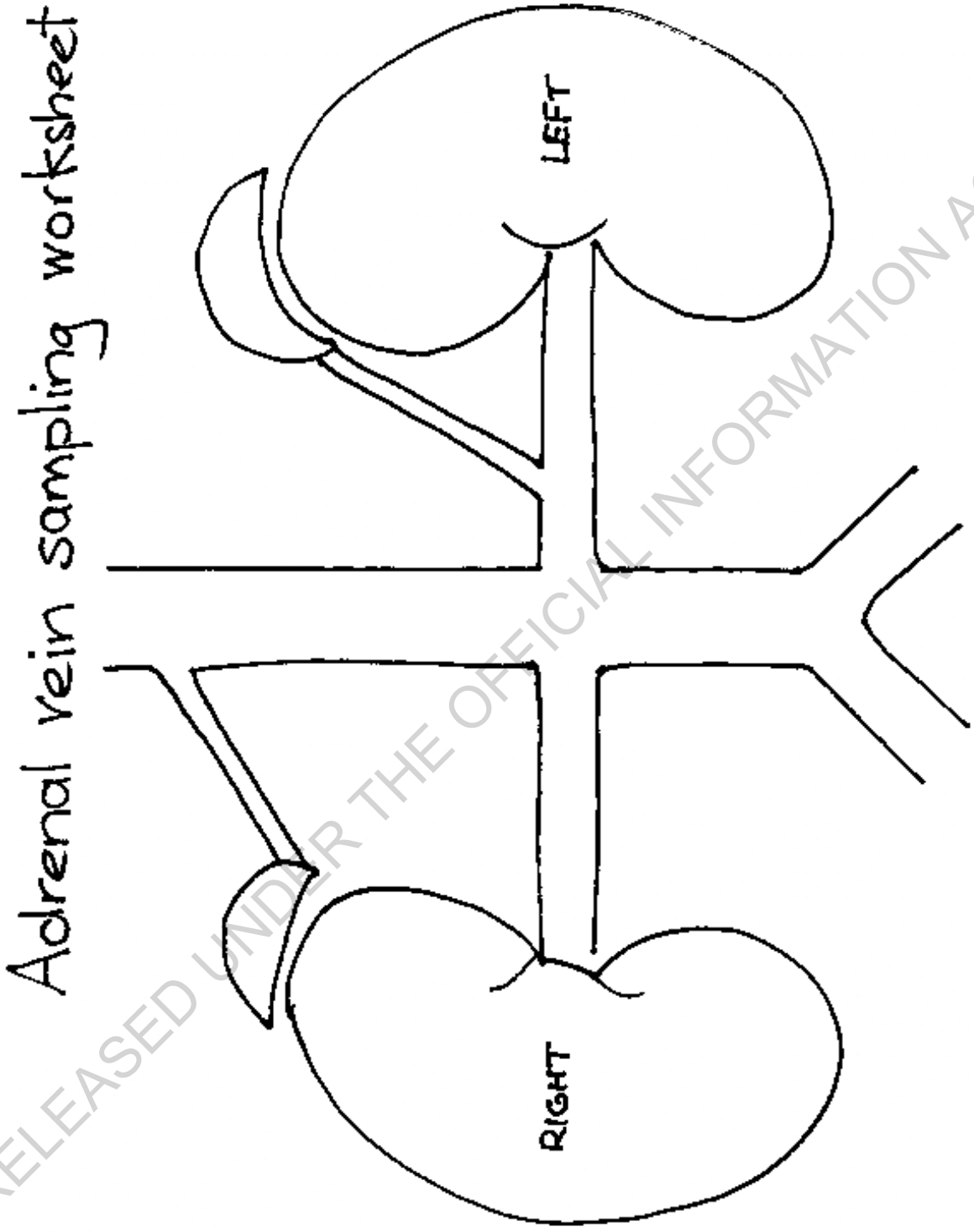
ASY-827.8.3: Bottom shelf

- **a** 5ml syringes..... x20
- **b** Sharps bin
- **c** Chilly bin and ice
- **d** Rubbish bag clipped to side of trolley

ASY-827.9: Venogram worksheet 1

Site					
Left		Right		Peripheral	
Ref	Time	Ref	Time	Ref	Time
L1		R1		P1	
L2		R2		P2	
		R3		P3	
		R4		P4	
		R5		P5	
				P6	
				P7	

ASY-827.10: Venogram worksheet 2



ASY-827.11: Patient information sheet before procedure:

Adrenal vein sampling with ACTH stimulation

You have been diagnosed with a condition known as Primary Hyperaldosteronism, one type of which is known as Conn's syndrome, which results from excessive production of the hormone aldosterone made by the adrenal glands. It is one of the hormonal conditions which can lead to high blood pressure, and is usually associated with low levels of potassium in the blood. There are two adrenal glands (right and left). They sit on top of the kidneys and have their own blood supply. Sometimes this condition is caused by a small benign tumour on one adrenal gland, while on other occasions it can be caused by generalised overactivity of both adrenal glands.

This test relies on the fact that if the source of your high aldosterone is only one adrenal gland, blood levels taken from the vein which come directly from that gland will be higher than the blood level on the other adrenal gland or from an arm vein. If both adrenal glands are involved in the overproduction of the aldosterone, levels will be similarly high in both adrenal veins.

Preparation

You are allowed water only from midnight the night before (nothing else to eat or drink).

Procedure

Forty-five minutes before the procedure, an intravenous infusion ("drip") will be commenced containing ACTH. This is the hormone, which controls the adrenal gland. Giving this will ensure that your adrenal glands are evenly stimulated throughout the procedure, allowing the results to be interpreted more easily. You will then be taken to the Radiology Department, where the procedure will take place. You may be given a light sedative, but will be awake during the procedure. The radiologist will place some local anaesthetic into the groin on one side, over the main vein that drains blood from the leg. Then a fine bore catheter will be passed up the vein, and into the vein that drains the adrenal gland on one side. Once the catheter is in place, blood samples will be taken from the adrenal vein and an arm vein at exactly the same time. The procedure is repeated for the other adrenal vein. X-ray screening guides the radiologist to know where the catheters are positioned. Sometimes the radiologist may have some difficulty finding the opening of the adrenal vein, particularly the right adrenal vein.

You will have to remain lying on your back for at least one hour afterwards, which helps to minimise bruising and you should be able to go home later that same day.

Risks

This procedure is very safe when performed by an experienced radiologist. There are no expected side effects from the infusion of the ACTH. Bruising in the groin can occur when the catheter is removed.

ASY-827.12: Patient information sheet

Discharge Following Venous Sampling

What to expect:

When you have been discharged from hospital we do not expect you to have any problems with the incision site.

Mild oozing from the site is normal within the first 24-48 hours.

During this time, if coughing, sneezing or straining occurs, support the site with your hand.

Potential problems:

You may experience some discomfort, bruising or swelling in the groin area where the sheath was inserted.

Some bruising or superficial discolouration may spread out from the site and remain for up to 14 days.

If you experience any bleeding from the site, press firmly on the site for at least 10 minutes. It is better for someone else to do the pressing and for you to be lying down.

Should bleeding persist, please contact us as detailed below

Activities:

- Avoid heavy lifting or climbing stairs for 48 hours
- Do not sit in a bath or pool of water for 48 hours.
- Paracetamol may be taken for any groin discomfort.
- Keep the site clean and dry.
- Do not use lotions until the skin incision is completely healed.

Discharge plan:

Outpatient follow up will be arranged with your Endocrinologist. You will receive a letter confirming the time and date.

Emergency contact:

Telephone Christchurch Hospital on (03)364 0640 during working hours and ask for the "**On-Call Endocrine Registrar".** After hours ask for the "**Acute Medical Registrar**".

Endocrine Tests Centre, 2nd Floor Riverside Block, Christchurch Hospital
Phone: (03)364 0934 Fax: (03)364 1159

ASY-827.13: Staff Information sheet

Patient Care Post Venous Sampling

- Sheath removed and digital pressure applied to puncture site until haemostasis is achieved – in DSA.
- Lie patient flat for 1 hour post removal of sheath and then sit up.
- Assess patient before ambulation, mobilise for a short walk after 2 hours. Recheck site for bleeding and/or haematoma. If no complications, encourage regular short walks (20-30 minutes).
- ½ hourly recordings for 1 hour, then hourly until discharge (BP/pulse/puncture site and circulation of affected limb). Check patient's temperature before discharge.
- Place band aid over puncture site before discharge.
- Offer fluids/food to ensure adequate dehydration/diet.
- If bleeding or haematoma occurs, lay patient flat and apply pressure to site. Review observations. Inform the Endocrine Registrar on call, extend discharge time or admit overnight as necessary.
- Document events on Observation sheet and/or in patient's notes.
- Document whether patient has passed urine post procedure.
- If a phone call is received from a patient/family member requesting advice post procedure, complete the Health Advice by Telephone form (C000841).
- Endocrinologist / Registrar reviews patient before discharge.
- Ensure adequate arrangements have been made. Provide patient with "Discharge advice following venous sampling" information sheet. Outpatient follow up is arranged by Endocrinologist.

Endocrine Tests Centre, 2nd Floor Riverside Block, Christchurch Hospital
Phone: (03)364 0934 Fax: (03)364 1159

ASY-839.1: 4hr Saline Loading for Hyperaldosteronism

ASY-839.2: Associated Documents

ASY-839.3: Distribution of Documents

Copy No	Number	Location
1		Quality Centre
2	3.1	Endocrine Test Centre, Laminated copy
3	3.20	G:\Division\NDO\common\ETCProtocols\

ASY-839.4: Review of Document

Date	Signature	Next review	Sign when read

G:\Division\NDO\common\ETCProtocols\0839 - 4hr saline loading for hyperaldosteronism.doc

ASY-839.5: Purpose of 4hr saline load suppression test

A 2L saline load is performed to diagnose excessive production of the hormone aldosterone, which can cause hypertension.

ASY-839.6: Precautions

Do not proceed, but discuss with Endocrinologist if:

- **a** The initial BP is markedly raised, ie systolic >200 or diastolic >130.
- **b** Serum potassium <3.0mmol/L.
- **c** Elderly or have a history of angina.
- **d** Patient on any BP lowering medication apart from alpha blocker and/nor non-dihydropyridine calcium antagonist.

This procedure can be carried out following the 4hr-posture test.

ASY-839.7: Procedure for saline load test (morning) and combined posture/saline load test

Rest supine 30 minutes after finishing posture test.

- **a** The patient lies supine, BP and pulse are checked.
- **b** IV cannula (20G or 22G) to be inserted.
- **c** Blood is then drawn for renin, aldo, Na + K (and other blood tests if requested). Check biochemistry is within normal range.
- **d** Saline infusion commenced 2 L (NaCl 0.9%) infused over 4 hours.
- **e** Patient to remain supine during infusion.
- **f** To use urinal/bedpan if required
- **g** When the infusion is completed, blood is drawn from non-infusion arm, for renin, aldo, Na + K (and other blood tests if requested).
- **h** IV cannula removed
- **i** BP checked prior to discharge and documented.

ASY-839.8: Supervision

Patient call bell to be available at all times.

ASY-839.9: Interpretation

The normal response is a fall in the plasma level of aldosterone in response to the saline load. A post-saline aldosterone of >210 pmol/L suggests primary hyperaldosteronism. There is a grey zone of 140-210 pmol/L, while a value of <140 pmol/L essentially excludes hyperaldosteronism.