



CORONERS COURT NEW SOUTH WALES

Inquest:	Inquest into the death of Dr Peter Domachuk
Hearing dates:	24, 25, 27 August 2015
Date of findings:	2 December 2015
Place of findings:	Coroner's Court, Glebe
Findings of:	Magistrate C. Forbes
Catchwords:	CORONIAL LAW-Cause and manner of death-undiagnosed Addison's disease-discharge from hospital
File number:	2013/973
Representation:	Mr A. Casselden, Counsel Assisting instructed by Ms A. McCarthy, Crown Solicitor's Office Ms K. Morgan representing the Northern Sydney Local Health District and NSW Health Pathology Mr R. Hewson representing Dr Felicity Keller Mr G. Gregg representing Dr Joseph Rutovitz Ms M. Fleton for the Domachuk family
Findings:	I find that Peter Domachuk died sometime between 30 and 31 December 2012 at 54A The Esplanade, Thornleigh, NSW. I am satisfied the cause of his death was due to presumed fatal cardiac arrhythmia in the presence of coronary artery atherosclerotic disease and Addison's disease. The manner of his death was natural causes.

REASONS FOR DECISION

Introduction

1. This is an inquest into the death of Dr Peter Domachuk. Dr Domachuk was only 33 years of age at the time of his death. He died during the course of the evening of 30 December 2012 or early in morning on 31 December 2012 at his home. The expert evidence is that he suffered a presumed cardiac arrhythmia in the presence of coronary artery atherosclerotic disease and Addison's disease. He had been discharged from Hornsby Hospital only a day or two earlier.
2. The role of a Coroner as set out in s.81 of the *Coroners Act 2009* ("the Act") is to make findings as to:
 - (a) the identity of the deceased;
 - (b) the date and place of the person's death;
 - (c) the physical or medical cause of death; and
 - (d) the manner of death, in other words, the circumstances surrounding the death.

Section 82 of the *Act* also permits a Coroner to make recommendations that are considered necessary or desirable in relation to any matter connected with a death that relates to issues of public health and safety.

3. The focus of this inquest has been to see if there were any lessons that might be learned that will help to prevent a similar death in the future.
4. This inquest has been assisted by the expert evidence of the following independent experts:
 - Associate Professor Roderick Clifton-Bligh, Endocrinologist.

- Dr John F. England, Cardiologist.
- Dr Robert Day, Emergency Physician.

Dr Peter Domachuk

5. Dr Domachuk's parents are devastated by their loss. Their son was a brilliant research physicist. In 2006 he completed his PhD in optofluidics and in that year he won the CUDOS Centre of Excellence Sydney University student prize.
6. From 2006-2009 he took a postdoctoral position researching the topic of photonic crystal fibres and silk photonics at Tufts University, Boston USA.
7. In 2009 he returned to Sydney and was awarded the prestigious Australian Research Council Postdoctoral Fellowship where he continued his research on silk microchips.
8. In 2010 he won the Fresh Science Prize for his work on silk microchips.
9. He was the coordinator for the University of Sydney's Masters in Photonics Program and Chair of the Institute of Phototonics and Optical Science Symposium.
10. At the time of his death he had published 36 papers on the topic of optofluidics and biophotonics and as a result his work has been cited close to 1000 times.
11. He was much loved by his parents and friends and his sudden death left them shocked and bewildered as to how he could have been discharged from hospital only one or two days before he passed away.

What happened?

12. On 27 December 2012 Dr Domachuk presented to Hornsby Hospital Emergency Department. He complained of left knee and ankle pain, abdominal pains, nausea and vomiting. He had been taking diclofenac (NSAID) for the joint pain. He had a

previous history of a left knee anterior cruciate ligament repair and type 2 diabetes for which he was taking an anti-diabetic medication, metformin.

13. On admission his blood pressure was slightly below the normal range at 97/61 mmHg. He had a raised pulse rate of 116/minute. Blood tests revealed low sodium at 129mmol/L, normal potassium at 4.8mmol/L, raised lactate at 4.01mmol/L, impaired renal function with urea at 20.3mmol/L and creatinine at 194mmol/L. The white cell count was raised at $13.9 \times 10^9/L$ and haemoglobin was raised at 185g/L. An ultrasound of the kidneys and renal tracts revealed no abnormalities. X-rays of the left ankle and left knee showed fluid in the left knee joint and evidence of the previous knee surgery.
14. Dr Domachuk was examined by Dr Sutrave, the Registrar who consulted with the on-call staff specialist, Dr Rutovitz. As a result Dr Domachuk was admitted to a ward. The provisional diagnosis was gastritis induced by the diclofenac he had been taking and gout or rheumatoid arthritis. He was admitted with the following management plan:
 - Intravenous fluids
 - Protein pump inhibitor for gastritis
 - Cease NSAIDs (diclofenac)
 - Eat and drink
15. The next morning at 8:30 am Dr Sutrave saw Dr Domachuk on his rounds.
16. Later that day at about 2:30 pm Dr Domachuk was reviewed by Dr Rutovitz Consultant, Dr Sutrave and the Junior Resident Medical Officer Dr Keller on their rounds.
17. Dr Sutrave gave evidence that by this afternoon ward round he began to suspect Addison's disease because of that morning's blood results. He said that he raised this possibility with Dr Rutovitz and that Dr Rutovitz indicated that an early morning cortisol test should be considered for the next day. No record was made in the notes of this discussion. Dr Keller says that she did not recall that discussion. Dr Rutovitz says that he has no recollection of it either.

18. Dr Sutrave says that a plan was also made that if there was no improvement over the week end to prescribe a high dosage of 50 mg of prednisone as analgesia for the joint pain and/or gout and to cover for any possible adrenal insufficiency.
19. Dr Rutovitz says that he has no recollection of discussing a high dosage of prednisone with Dr Sutrave. He gave evidence that the plan for prednisone was as an anti-inflammatory only and that 20-50 mg was too high for that purpose.
20. In the Registrar's hand over notes Dr Sutrave made no mention of Addison's disease as a differential diagnosis, he did however make a note that if pains were to persist and there is decreased mobility on 29 December 2012 start 50 mg prednisone daily for three days.¹ This was consistent with his version that 50 mg of prednisone was considered as appropriate as analgesia and to cover any possible adrenal insufficiency. Dr Sutrave also requested Dr Keller to arrange for a cortisol test the next morning. This is also consistent with his version that Addison's disease was being considered. Dr Keller gave evidence that she ordered the cortisol test on 28 December 2012 to be done on 29 December 2012. No notation was made in the progress notes that the test was ordered.
21. At 7:20 am the next morning (29 December 2012) the cortisol test was done. No notation was made in the progress notes that the test was done.
22. The cortisol test was sent to the pathology laboratory but no pathology staff were made aware of the result because at that time cortisol tests required examination by endocrinology staff at the laboratory and they were not rostered between 29 December 2012 and 1 January 2013.
23. At noon on 29 December 2012 Dr Domachuk was reviewed and a decision was made to discharge with GP follow up, by Dr Claire Lee the Weekend Registrar.
24. Her evidence was that her decision to discharge Dr Domachuk was based on the fact that his blood tests had shown an improvement in his renal function consistent with improving hydration. His clinical status during the time of his admission and following the treatment plan had improved. His pain was decreasing

¹ Ex 1, Vol 1, Tab15B

25. Dr Lee was not aware that a cortisol test had been ordered. Apparently the computer system at the Hospital has two separate screens for blood tests ordered and blood test results. She did not look to see if there were any blood tests pending as there was no indication in the progress notes that any further test had been done. If the results and tests pending had been on the same screen Dr Lee may have noticed that a cortisol test had been ordered. I am informed by the Local Health District that this system is being changed. At the moment there are some technical difficulties, however it is expected that the two pieces of relevant information will appear on the one screen by the end of the year.
26. She said that she was aware Dr Sutrave had suggested in the handover notes that Dr Domachuk be prescribed 50 mg predisone but that she considered that too high a dosage for pain relief in a person with high blood sugar levels and reduced the dosage to 5 mg as his knee pain was improving and his mobility had improved.
27. Dr Domachuk's friend, Ms Champ, gave evidence that upon discharge his colour, his appetite, his mobility and his lethargy had all improved since his admission.
28. He returned to his unit in Thornleigh. Sometime during the next evening or following morning he passed away.

Cause of death

29. Dr Brouwer, Forensic Pathologist, conducted an autopsy on Dr Domachuk on 2 January 2013. At that time she was not aware a cortisol test had been done. She observed critical narrowing of a coronary artery. She determined that the cause of death was presumed fatal cardiac arrhythmia due to coronary artery atherosclerotic disease.
30. Dr England, Cardiologist, reviewed the post mortem report by Dr Brouwer and the brief of evidence and stated in his report dated 15 August 2013 that "the acute cause

of death was most likely due to cardiac arrhythmia... due to 80% stenosis of the major proximal coronary arteries"².

31. Subsequently, Dr Domachuk's family became aware of the results of the cortisol test that was undertaken on the day he had been discharged from hospital. These results were forwarded to the Forensic Pathologist. She reviewed these results and formed the opinion, with this additional information and the histological changes observed in the adrenals at autopsy, that Dr Domachuk had Addison's disease. She reported that Addison's disease cannot be diagnosed at autopsy without relevant clinic-pathological correlation. She says that she could not say whether it was the Addison's disease or coronary artery atherosclerotic disease that was the primary cause of death but that they both probably played a part. She said that the arrhythmia could have been caused by either condition and each condition could have contributed. Her opinion is that the most appropriate cause of death is that Dr Domachuk died due to a presumed fatal cardiac arrhythmia in the presence of coronary artery atherosclerotic disease and Addison's disease.
32. Associate Professor Clifton-Bligh, expert specialist in Endocrinology agrees that there was sufficient evidence of Addison's disease. Dr Day, expert specialist Emergency Physician also concluded that Dr Domachuk had undiagnosed Addison's disease. Both of them have come to the same conclusion as Dr Brouwer that it is impossible to state which of his two conditions, his atherosclerotic disease or the Addison's disease were the primary antecedent cause of Dr Domachuk's arrhythmia. Both conditions were present and they agree with Dr Brouwer that it would be most appropriate to note them both as underlying antecedent causes to a fatal cardiac arrhythmia.
33. When Dr England became aware of the cortisol results he changed his opinion as to the cause of death. He states that the cause of Dr Domachuk's death was an Addisonian crisis. He said that he came to that conclusion when he became aware of the cortisol results combined with the fact that there was no evidence at autopsy of an acute coronary event.

² Ex 2, Vol 1, Tab 22A

34. The lack of evidence of an acute coronary event did not trouble him in August 2013. I note that Dr Brouwer explained in her autopsy report why there may be no evidence of an acute coronary event at autopsy.³ I accept her opinion that:

“The degree of coronary artery atherosclerotic disease observed here exposes the individual to the development of acute myocardial ischemia which may cause sudden death due to fatal cardiac arrhythmia. Changes of myocardial ischemia (infarction-‘heart attack’) may however not be apparent in sudden death due to insufficient time for changes to become apparent.”

35. I note that Dr England stated in 2013 that “with little potential for collateral blood supply the heart muscle would be in jeopardy and become electrically irritable and could fire off life threatening cardiac arrhythmias leading to cardiac arrest and sudden death”.⁴

36. Associate Professor Clifton-Bligh stated that Addison’s disease would result in poor intravascular volume, electrolyte imbalance and low blood pressure which could have rendered Dr Domachuk more susceptible to the arrhythmia but also that it would still have been possible for death to have occurred from cardiac disease.

37. I accept the opinions of the three expert specialists that agree that the most appropriate description of Dr Domachuk’s death is presumed fatal cardiac arrhythmia in the presence of coronary artery atherosclerotic disease and Addison’s disease.

Addison’s disease

38. Addison’s disease, also known as primary adrenal insufficiency, is related to the lack of cortisol and aldosterone being produced by the adrenal cortex. In Australia autoimmune disease is the most common cause. Rarer causes are destruction of the

³ Ex 2 Vol 1 Tab 5

⁴ Ex 2, Vol 1, Tab 22A

adrenals by infection, haemorrhage or infiltration by tumours; tuberculosis; drugs; congenital adrenal hypoplasia or errors in metabolic pathways.⁵

39. The expert witness Associate Professor Clifton-Bligh stated that it is rare in the general population, with ~1 case per 10,000, and is uncommon even among patients presenting with dehydration and hypernatremia. Dr Day gave evidence that Emergency Departments would not see a new case of adrenal insufficiency each year and individual doctors would see a case much less frequently.

40. Dr Day described the signs and symptoms of Addison's disease as :

- Easy fatigue and lack of energy
- Weight loss, anorexia
- Myalgia, joint pain, muscle cramps
- Chronically low blood pressure with postural hypotension
- Unexplained fevers
- Abdominal pain, nausea, vomiting, diarrhoea
- Low blood sugar
- Changes in skin colour with pigmentation
- Electrolyte abnormalities on routine blood tests such as low sodium, high potassium or mildly raised creatinine.

41. He said that because the adrenal hormones affect many organs systems that the initial symptoms are often non-specific and may mimic more common diseases which frequently results in delay in diagnosis. He said that about 25% of patients with Addison's disease first present with an adrenal crisis which often occurs in the setting of another acute illness. The signs and symptoms of adrenal crisis are:

- Low blood pressure not responsive to normal treatment progressing to hypovolaemic shock
- Tachycardia
- Acute abdominal pain and tenderness with fever
- Confusion and delirium which can progress to coma

⁵ Ex 2, Vol 2, tab 28

- Seizures due to low sodium levels
 - Cardiac rhythm abnormalities due to severe electrolyte disturbance
42. A single morning blood test to measure the cortisol level with a result below 100nmol/L is diagnostic of adrenal insufficiency. Further testing including plasma ACTH level, plasma rennin, aldosterone levels and serum anti-adrenal antibodies confirm Addison's disease.⁶
43. The primary initial treatment is intravenous or oral hydrocortisone. Associate Professor Clifton-Bligh states that once Addison's disease is diagnosed that the patient should be carefully instructed on the need for lifelong cortisone replacement.
44. The available window of treatment of Addison's disease depends on the clinical situation. Both Associate Professor Clifton-Bligh and Dr Day agree that treatment of suspected Addison's disease should not be delayed by diagnostic procedures.
45. Dr Day explains that where an adrenal crisis is suspected and a patient is not responding to standard treatment then treatment should be administered prior to confirmation. However, in cases where a patient's condition is stable, treatment for adrenal insufficiency can wait until diagnosis.
46. Associate Professor Clifton-Bligh explained that Addison's disease presents with malaise, fatigue, nausea, vomiting, abdominal pain, muscle pain and dehydration leading to hypotension. Typical laboratory findings are low serum sodium, elevated potassium and increased creatinine. He also explained that none of the above clinical and biochemical features are specific for adrenal crisis and indeed many patients with these features will prove not to have Addison's disease after further testing.

⁶ Ex 2, Vol 1, Tab 25B p 3

Hornsby Hospital

47. It is not in dispute that during his presentation and admission at Hornsby Hospital Dr Domachuk's symptoms were consistent with Addison's disease
48. Dr Rutovitz, Consultant, had no recollection that Addison's disease was considered or discussed as a differential diagnosis.
49. Dr Sutrave, Registrar, stated that it was and that that is why he arranged for a cortisol test. The junior medical officer, Dr Keller, says that she does not recall it being discussed but that she did order the cortisol test at Dr Sutrave's request.
50. I am not in a position to make a finding as to who has the correct recollection. However, I am satisfied Dr Sutrave considered Addison's disease because he arranged for the cortisol serum test. Clearly the index of suspicion for Addison's disease was not high. The treating team had made a diagnosis of acute kidney injury secondary to NSAIDs. Associate Professor Clifton-Bligh and Dr Day agree that this initial diagnosis was reasonable on the basis of the presenting features. His clinical status improved following the intravenous fluids and cessation of the NSAIDs and metformin. The clinical suspicion for Addison's disease was no doubt further reduced.
51. Dr Day states that the indicators of the adrenal insufficiency, such as his lower than expected blood pressure and continued low sodium level, were not significant enough to form the opinion that Addison's disease should have been diagnosed while he was in hospital. He says that he would not be critical of the medical team for not making a diagnosis of adrenal insufficiency as the findings were explainable by other common causes. Associate Professor Clifton-Bligh agrees that the initial diagnosis was reasonable on the basis of the presenting clinical features.
52. Associate Professor Clifton-Bligh stated that he is reluctant to make a definitive statement in hindsight as to whether Dr Domachuk should have been discharged. He acknowledges that it was difficult for the treating team due to the improvement in Dr

Domachuk's clinical status. He said that if the result for the cortisol test had been known it would not have been appropriate to discharge however at the time of discharge there was a reasonably low clinical suspicion of Addison's disease. Dr Domachuk's renal failure, hydration, electrolyte abnormalities and joint pain had improved during his admission. Associate Professor Clifton-Bligh explained that the absence of an elevated potassium reading made Addison's disease less likely and the index of suspicion would also have reduced with the improvement in the blood pressure.

53. Dr Day explained that a decision to discharge a patient from hospital is more related to clinical presentation than pending results and as the medical conditions for which Dr Domachuk had been admitted had improved considerably over the two days in hospital and he appeared fit for discharge it was reasonable for Dr Domachuk to be discharged with referral to his GP.
54. I note that the discharging registrar Dr Lee stated that she would not have discharged Dr Domachuk if she knew the cortisol test was pending. Her hindsight view is not supported by the independent experts. They agree that patients are often discharged with pending test results. In Dr Domachuk's case his symptoms were a common cause of admission and had improved with the treatment he was given. He had responded to hydration without steroids. Associate Professor Clifton- Bligh explained that Addison's disease is very rare and that the clinical suspicion for the disease was not high. He said many more patients present with the clinical features without the disease than with the disease. Dr Day agrees and stated that in Dr Domachuk's case he was improving with treatment and that it was appropriate to discharge and wait for a diagnosis.
55. The clear and significant sub-standard feature in Dr Domachuk's care and treatment was the communication between his treating practitioners and poor hand over.
56. In Dr Domachuk's case there was no documentation that adrenal insufficiency was being considered as a possible diagnosis. It was not documented in the progress notes

or in the hand over documents by either Dr Sutrave or Dr Keller that a cortisol test was ordered. It was not documented in the progress notes that the test was done. The discharge summary did not mention Addison's disease as a possible diagnosis, the cortisol test or the need for a follow up. There was clearly inappropriate hand over and follow up by the staff at Hornby Hospital.

57. Dr Ah Kit, Director of Medical Services at Hornsby Ku-ring-gai Health Service, gave evidence that clinical handover is an area of ongoing consideration within the Health Service. He is aware of the shortcomings in the documentation in Dr Domachuk's case. He says that it is accepted practice that when tests are ordered that it must be documented in the progress notes. He stated that ultimately the progress notes should be the "sole source of truth" that contains everything so as to allow others to continue with care.
58. He said the Health Service has responded by running various education initiatives to try to ensure this does not happen again. It ran a session this year on diagnosis of difficult endocrine cases and the importance of documentation. The Health Service has dedicated the month of September each year as "clinical documentation month". This includes a variety of educational activities and events.
59. He said since April 2015 the handover now includes an electronic task list which details the tasks to be performed by the receiving team. This task list is the first major change and the feedback has been positive. Further tools to assist with the handover process are currently being tested and trialled. A broader rollout of electronic medical records is expected next year.
60. In relation to follow up, it seems unlikely that Dr Domachuk was notified that a blood test had been taken to investigate adrenal insufficiency. It certainly was not mentioned in the discharge summary or summary of care that was prepared for his GP. He was probably unaware of the need for this test to be followed up. Nothing in the hospital system would have resulted in the test being followed up. I am informed that if the test had been properly documented by Dr Sutrave and Dr Keller that this would not have occurred.

The cortisol pathology

61. Mr Chesher , Staff Specialist Chemical Pathologist, Pathology North, NSW Health Pathology stated that up to October 2012, Pathology North had two physically separate pathology laboratories for clinical biochemistry and endocrinology. The Department of Clinical Biochemistry conducted routine blood biochemistry pathology testing. It operated 24 hours a day 7 days a week. The endocrinology department performed specialist endocrinology pathology testing. It operated during business hours and Saturday mornings.
62. In October 2012 these two testing laboratories were combined. They were co-located and began to use a common set of analytical equipment. However, in December 2012 the two laboratories still operated separately to the extent endocrinology staff were still required to validate endocrinology blood specimen results.
63. The endocrinology blood results were subjected to manual validation by endocrinology laboratory staff and not released to clinical staff until after manual validation.
64. Dr Domachuk's blood for the cortisol test was collected at 7:20 on 29 December 2012 and logged at arriving at the laboratory at 12:20. The cortisol test was processed and entered into the Auslab system at the laboratory. There was no staff in the endocrinology part of the laboratory until Tuesday 2 January 2013. On that day the cortisol result was validated at 14:27 and transmitted to the electronic medical records.
65. The clinical biochemistry laboratory did and does maintain a critical result notification list. If results of tests on this list lie outside the limits, then the laboratory telephones the requesting clinician with the results. In December 2012 cortisol was not included on the critical result notification list.

66. Subsequent to the tragic outcome in Dr Domachuk's case changes have been made to this system. The validation process for cortisol has changed to follow the 24 hour 7 day per week procedures of the clinical biochemistry laboratory. Cortisol results <80 nmol/L are now included on the critical results notification list so that the requesting clinician will be contacted by the laboratory with the results.
67. I am informed that these changes are in the process of being rolled out state wide to each of the NSW Pathology Networks.

What more can be done?

68. Dr Ah Kit has informed this court that the interns within the Health Service receive regular mandatory education. In 2014 and 2015 there were approximately 50 sessions. Many of the sessions are directly or indirectly clinically relevant to Dr Domachuk's clinical care. The Health Service also runs regular Grand Rounds that are provided as an educational opportunity for senior and junior medical staff. One session each year is focussed on endocrinology and in 2013 the session focussed on Addison's disease. Two of the weekly Friday education sessions at the Hospital have focussed on Addison's disease. The Health Service runs 3-4 sessions focussing on clinical quality projects per year. The session in June 2015 focussed on diagnosis of difficult endocrine cases such as Addison's disease and the importance of documentation. The trainee registrars at the Hospital attend a two week full time course which includes complex adrenal and endocrinological diagnoses at the level of a specialist-in-training.
69. Dr Day has informed this court that adrenal insufficiency and adrenal crisis is covered in the training syllabus of the Australasian College of Emergency Medicine.
70. I have been informed by the Clinical Excellence Commission that the most appropriate vehicle for a safety alert for Addison's disease in the NSW public health system would be a Patient Safety Watch that features the challenges in diagnosing and managing Addison's disease, with reference to Dr Domachuk's case. I am informed the

Clinical Excellence Commission is developing the publication in consultation with the Emergency Care Institute and Endocrinology committees of the Agency for Clinical Innovation.

71. The abnormal cortisol results became available to the Hospital on the same day the forensic pathologist was conducting the autopsy. They were not sent on. The Local Health District does not have a procedure in place of forwarding test results to the Department of Forensic Medicine that become available after the patient is discharged or deceased or after the medical records have been sent to the Department of Forensic Medicine. This is less than satisfactory and resulted in the determination of an incomplete and inaccurate cause of death.

72. I will now turn to the formal findings and recommendations.

FINDINGS

I find that Peter Domachuk died sometime between 30 and 31 December 2012 at 54A The Esplanade, Thornleigh, NSW. I am satisfied the cause of his death was due to presumed fatal cardiac arrhythmia in the presence of coronary artery atherosclerotic disease and Addison's disease. The manner of his death was natural causes.

RECOMMENDATIONS

To the NSW Minister for Health

1. I recommend that the NSW Ministry of Health consider publishing a Patient Safety Watch to Local Health Districts with the aim of increasing awareness of the potentially catastrophic outcome of undiagnosed adrenal insufficiency/Addison's disease.
2. I recommend that the NSW Ministry of Health Chemical Pathology, Chemical Stream, continue with the proposed implementation of a state-wide critical results notification policy and the development of a state-wide guideline for notifiable thresholds for all critical results, including cortisol.
3. I recommend that the NSW Ministry of Health provide a procedure whereby abnormal cortisol test results are sent to the Department of Forensic Medicine and to the State Coroner as a matter of course in circumstances where the relevant hospital has become aware of the patient's death.


Magistrate C Forbes

Deputy State Coroner

2 December 2015