IN THE CORONERS COURT

OF VICTORIA

AT MELBOURNE

Court Reference: COR 2016 4766

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 60(2)

*Section 67 of the **Coroners Act 2008***

I, AUDREY JAMIESON, Coroner having investigated the death of JOHN RICHARD CONNELLY

without holding an inquest:

find that the identity of the deceased was JOHN RICHARD CONNELLY

born 19 October 1937

and the death occurred on 7 October 2016

at Royal Melbourne Hospital Emergency Department 300 Grattan St, Parkville, Victoria 3052

from:

1 (a) COMPLICATIONS OF BLOOD LOSS FROM FEMORAL FRACTURE SUSTAINED IN HARNESS RIDING INCIDENT IN THE SETTING OF WARFARINSATION AND ISCHAEMIC HEART DISEASE

Pursuant to section 67(1) of the **Coroners Act 2008**, I make findings with respect to **the following circumstances**:

1. John Richard Connelly was 78 years of age and resided in Birchip, Victoria, at the time of his death. He had a son and daughter; his son Robin Connelly lived approximately one and a half hours away in Horsham. Mr Connelly was an experienced horseman who worked in equine breeding and training until the date of his death.

2. On 7 October 2016 at approximately 9.00am, Mr Connelly and his lifelong friend Hayden Hogan were at the trotting track on Berriwillock Road, Birchip. Each man was in a cart being pulled by a horse around the track.

3. Mr Hogan lapped Mr Connelly twice and noticed that his friend's horse reared on its hind legs on the second occasion. Mr Hogan looked back and saw that the other cart was under the track railing and Mr Connelly lay on his back on the nearby embankment.

4. Mr Connelly was still conscious and alert, his knee was badly cut with a large, open wound. He could not feel any pain at that time. Mr Connelly rang his son while Mr Hogan called the Birchip Community Emergency Response Team (**CERT**).

5. At 9.17am, Chairperson and Team Member of the Birchip CERT Gail Sharp arrived at the Trotting Track with fellow CERT volunteer Sharon Foott. They administered advanced first aid until an ambulance was able to transport Mr Connelly to a nearby airport where he was then airlifted to the Royal Melbourne Hospital.

6. At 12.28pm, Mr Connelly was admitted to the Royal Melbourne Hospital emergency department. Despite the administration of medical treatment en route to the Hospital, Mr Connelly had progressed to no cardiac activity and was pronounced deceased at 12.43pm.

INVESTIGATIONS

Forensic pathology investigation

7. Dr Matthew Lynch, Senior Forensic Pathologist at the Victorian Institute of Forensic Medicine (**VIFM**), performed an external examination upon the body of John Richard Connelly, reviewed a post mortem computed tomography (**CT**) scan and referred to the Victoria Police Report of Death, Form 83. Dr Lynch noted a complex laceration involving the right thigh with fracturing of the right femur. He also reported that Mr Connelly's medical history included a coronary artery bypass graft surgery and that he had a prescription for warfarin.

8. Toxicological analysis identified the presence of Amiodarone (~4.0mg/L) and its metabolite Desethylamiodarone (~2.4mg/L). Amiodarone is a class III antiarrhythmic agent which is used to treat irregular heartbeats.

9. Dr Lynch formulated the cause of Mr Connelly's death as complications of blood loss from femoral fracture sustained in a harness riding incident in the setting of warfarinsation and ischaemic heart disease.

Police investigation

10. Leading Senior Constable (**LSC**) Peter Newell was the nominated Coroner's investigator.[1] At my direction, LSC Newell conducted an investigation of the circumstances surrounding Mr Connelly's death, including the preparation of the coronial brief. The coronial brief contained, *inter alia*, statements made by Mr Hogan, Ms Sharp and Robin Connelly.

11. In the course of the investigation, police learned that Mr Connelly would often attend the Birchip Trotting Track as he was a harness racing trainer. Robin Connelly stated that his father prepared horses for racing and increased their fitness. During their telephone conversation on 7 October 2016, Mr Connelly told his son that the horse he was training had bolted and the cart had struck the outside fence, catapulting him onto the rail. Robin Connelly felt that his father was in shock during their conversation.

12. Ms Sharp stated that Mr Connelly was wearing a helmet when they arrived and located him on the ground outside the northern edge of the track. She immediately saw that he had a severe haemorrhage and possibly a compound fracture on his right knee. Ms Sharp and Ms Foott moved Mr Connelly into a head down position to avoid shock and lessen blood loss, they assumed that he had sustained spinal injuries as a precaution.

13. The two CERT members also applied a pressure bandage, to which Ms Foott maintained pressure until the Ambulance Paramedics arrived 55 minutes later. Ms Sharp checked Mr Connelly's blood pressure, pulse and breathing; he was conscious and answering their questions for the entire period.

14. Ms Sharp determined that the Helicopter Emergency Medical Service (**HEMS**) was required to transport Mr Connelly to hospital due to the amount of blood he was losing. She requested one through emergency services dispatch. She administered 3mls of

[1] A Coroner's Investigator is a police officer nominated by the Chief Commissioner of Police or any other person nominated by the Coroner to assist the coroner with his/her investigation into a reportable death. The Coroner's Investigator receives directions from a Coroner and carries out the role subject to those directions.

Penthrane[2] via inhaler with little effect, Mr Connelly's pain levels had progressed to 10 out of 10. A third CERT member, Kevin Reid, arrived at 9.43am. He provided Mr Connelly 100mcg of Fentanyl[3] by intranasal administration to little effect. The CERT team then administered two 50mcg doses of Fentanyl at 9.48am and 9.53am respectively, reducing Mr Connelly's pain level to 6 out of 10.

15. An ambulance arrived from Warracknabeal at approximately 10.10am. Ms Sharp gave a verbal handover to the Ambulance Officers who placed Mr Connelly on a spinal board as Ms Foot continuously applied pressure to the wound. Scott Douglas was one of the attending ambulance officers. He suffered an assault approximately one month after attending to Mr Connelly and commented that the incident has made it difficult for him to complete a full statement for my investigation. Mr Douglas has completed an unsigned and unwitnessed statement for the Court.

16. Mr Douglas stated that he recalled that Mr Connelly had clearly lost a lot of blood when the ambulance arrived but that Birchip CERT were providing exemplary care. Ambulance Officers provided Mr Connelly pain relief and attempted to stem his blood loss while waiting for the arrival of the HEMS. Mr Douglas commented that it was unfortunate that a combat tourniquet was unavailable to the Ambulance on the ground and MICA paramedic on the HEMS.

17. Ms Sharp commented that Mr Connelly, whom she had known for 40 years, was still conscious and said *'thank you, Gail'* as he was moved onto the HEMS transport.

Coroners Prevention Unit Report

18. In light of Mr Douglas' statement, I requested that the Coroners Prevention Unit (**CPU**) review Mr Connelly's medical records to explicate and assess the medical care and treatment provided in the pre-hospital setting. I also requested that the CPU consider Mr Douglas' comment about combat tourniquets and inform me whether this may represent an opportunity for the prevention of Mr Connelly's death or like-deaths.

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2 The generic name is 'methoxyflurane' and it is a volatile inhalational analgesic for short term pain relief.

3 Fentanyl is a schedule 8 opioid drug for severe pain, it is approximately 80 to 100 times more potent than morphine.

Relevant Historical Facts

19. The CPU informed me that Mr Connelly had a medical history of obesity,[4] Diabetes Mellitus, hypercholesterolaemia, ischaemic heart disease,[5] and congestive cardiac failure. He was taking metformin,[6] fluvastatin,[7] frusemide[8] and potassium supplements[9] to treat these conditions.

20. Mr Connelly was also prescribed the anticoagulant medication warfarin. The CPU reported that it was unclear from the medical record why Mr Connelly was anticoagulated. However, given the lack of documented history of stroke or thromboembolism, the most likely reason was atrial fibrillation.[10] The CPU commented that Mr Connelly was surprisingly active despite his health conditions.

Ambulance Victoria Treatment

21. Medical records indicate that the ambulance from Warracknabeal arrived at 10.02am. The Ambulance Officers attempted compressive dressings and direct pressure to control the haemorrhage but were unsuccessful. At 10.12am, Mr Connelly was transported to the Birchip Airport to rendezvous with the HEMS.

22. At 10.42am the HEMS 3[11] team arrived at Birchip airfield where Mr Connelly was waiting. Mr Connelly's condition remained unchanged at the time of their arrival, where he was conscious and alert but with very low and occasionally un-recordable blood pressure. HEMS paramedics found that there was profuse bleeding from a

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4 Mr Connelly was 164cm in height and 114kg in weight; a Body Mass Index (BMI) of 42.

5 Mr Connelly had quadruple Coronary Artery Bypass Graft Surgery in 2014.

6 Oral hypoglycaemic for type 2 diabetes.

7 A statin to treat hypercholesterolaemia.

8 Medication used to treat fluid build-up which may also treat high blood pressure.

9 Frusemide is a diuretic that treats congestive cardiac failure. Its diuresis causes hypokalaemia which is treated with potassium supplements.

10 Irregular heart rhythm that increases risk of thromboembolic strokes. This risk is minimised with anticoagulation with agents like warfarin.

11 There are 5 HEMS located around the state. HEMS 3 which is based 170km away in Bendigo is the closest HEMS base.

compound fracture[12] of the right femur. The paramedics reapplied direct pressure[13] to the limb, with all in agreement that at the time the direct pressure appeared successful in stopping the haemorrhage. As per Ambulance Victoria guidelines[14], no Combat Application Tourniquet (**CAT**)[15] was required to be applied as the haemorrhage appeared controlled by direct pressure.

23. After inserting an intravenous cannula, the HEMS paramedic attempted to fluid resuscitate Mr Connelly's hypotension by the administration of intravenous fluids.[16] Subsequently, two units of red cell concentrate[17] were administered to treat Mr Connelly's hypovolaemia and low blood pressure. This was transiently successful with his blood pressure reaching 139/81 at 12.00pm.

24. At 12.05pm, Mr Connelly became unresponsive with palpable pulses. As Mr Connelly had complained of back pain at the time of his collapse, the HEMS officers suspected intrathoracic bleeding[18] as the cause of his sudden deterioration. The HEMS officers focused on supporting Mr Connelly's breathing with bag valve mask ventilation as there is no specific treatment for intrathoracic bleeding, aside from emergency surgery.[19]

25. At 12.20pm, the HEMS landed at the Royal Melbourne Hospital (RMH). Upon alighting, the HEMS Team 3 were able to see blood on the floor of the aircraft, indicating that Mr Connelly's bleeding was external and not internal as believed.

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12 A fracture which has opened a wound through the skin that allows both ongoing bleeding and is at high risk of infection.

13 An absorbent dressing is placed over the open wound then held in place by a tightly applied crepe bandage. Manual pressure can be applied in addition this.

14 Air Ambulance Victoria CPG: AAV-08.

15 A device that when applied provides consistent controlled circumferential force to a limb in an attempt to control life threatening haemorrhage.

16 Air Ambulance Clinical Practice guideline AAV-08 states 20ml/kg of Normal Saline should be administered in the first case (which in Mr Connelly's case amounted to~ 2400ml). Only if this does not raise the patient's blood pressure to >100mmHg should red cell concentrate be used. In Mr Connelly's case, the fluid made no difference to Mr Connelly's blood pressure.

17 Air ambulance have 4 units of concentrated red blood cell packs to transfuse enroute in the case of exsanguinating trauma.

18 Such as traumatic rupture of the aorta which can occur after sudden deceleration injuries. This injury presents with intrathoracic back pain and hypotension is frequently and rapidly fatal.

19 It is not possible to intubate a patient whilst in flight on the HEMS.

26. On arrival to the RMH Emergency Department, Mr Connelly had a Glasgow Coma Score of 3,[20] was spontaneously breathing but had no palpable pulse. Electrocardiographic monitoring showed that his heart had electrical activity.[21] Mr Connelly was intubated, chest compressions commenced, a CAT was applied and a massive transfusion protocol[22] activated with a further two units of blood administered. A bedside ultrasonography showed no immediately reversible causes of Mr Connelly's cardiac arrest.[23]

27. Despite medical intervention, Mr Connelly's heart ceased to function, as identified by the ultrasonography and electrocardiographic monitoring. The attending Emergency, Trauma Surgery and Anaesthetics Teams agreed that further management would not be successful. Accordingly, resuscitation was ceased and Mr Connelly was pronounced deceased at 12.43pm.

Summary of Contributing Factors

28. The CPU informed me that Mr Connelly's injury circumstances were an unfortunate combination of significant blood loss from trauma in an isolated setting. The CPU confirmed that Mr Connelly was already in haemorrhagic shock at the time he was first assessed by the Birchip CERP. When a patient is haemorrhagic shock, the predicted mortality rate is greater than 90%[24] regardless of the medical treatment available. Additionally, Mr Connelly's use of the anticoagulant warfarin markedly decreased the likelihood of haemorrhage control and increased the likelihood of a fatal outcome.

29. The CPU confirmed that Mr Connelly's injury was an open fractured femur.[25] Fractured femurs are usually closed[26] and can result in significant bleeding into the

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20 Objective score of a patient's conscious state taking into account the patients eye response, verbal response and motor response. A fully conscious patient has a score of 15, a deeply unconscious patient has a score of 3.

21 Non-invasive investigation of the electrical conduction pathway of the heart.

22 Rapid and protocolised replacement of blood and blood products in the event of massive exsanguination.

23 Tension pneumothorax, pericardial effusion, intraabdominal bleeding.

24 Battle Casualty survival with limb tourniquet use to stop limb bleeding. Kragh et al. Journal of emergency medicine 2011 Dec; 41 (6):590-7.

25 An open fracture is where a broken bone penetrates the skin, allowing external bleeding.

26 A closed fracture is where a broken bone does not penetrate the skin and does not cause external bleeding.

thigh muscles. However, the bleeding is contained and eventually stopped by the backpressure of the haematoma onto the broken bone.

30. The treatment for a closed fractured femur is usually a femoral traction splint, such as the CT6, which decreases the volume of space there is to bleed in thus decreasing the amount of blood lost. However, the CPU reported that the application of a CT6 is contraindicated if the fracture is suspected to involve the knee. This is because the application of a CT6 in this area could damage major blood vessels and worsen the bleeding. A CT6 is not a treatment where there is external bleeding as it does not prevent blood escaping from an open wound.

31. A pressure bandage cannot apply pressure to the bleeding marrow of the broken bone which is perpendicular to the wound. As a result, compression dressings are likely to be ineffective in the circumstances of Mr Connelly's injury. The CPU stated that the apparent success of the direct compression bandage applied by the HEMS officers was due to Mr Connelly's low blood pressure, as he had been bleeding for two hours, with a reduced circulating volume. The subsequent treatment of his low blood pressure led to an increased blood pressure and thus the bleeding recommenced.

32. The CPU informed me that Ambulance Victoria guidelines recommend targeting a lower than normal blood pressure[27] a treatment strategy known as "permissive hypotension." Permissive Hypotension attempts to balance the risks of hypoperfusion in major organs against the risks of ongoing bleeding.[28] However, maintaining blood pressure at a particular level is difficult. This is because blood pressure is determined by a multitude of interrelated factors, such as: the fluid administration rate, the type of fluid administered, the rate of fluid loss and other medications.

33. The CPU hypothesised that the HEMS 3 team's delay in recognising Mr Connelly's increased bleeding was partly due to the internal design of the HEMS. The internal configuration is unmovable and confined. The work is challenging in a confined space where one paramedic on the flight is strapped facing backward toward the patient, who is strapped on the stretcher perpendicular to the paramedic. In this instance, the

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27 Ambulance Victoria guidelines: 100mmHg, Victoria State Trauma guidelines: 90mmHg in the presence of normal mentation, NSW State Trauma Guidelines: 80-90mmHg in the presence of normal mentation.

28 Hypoperfusion is the decrease in blood flow through an organ.

paramedic had good vision of Mr Connelly's leg. However, the CPU opined that the increase in bleeding was unseen by the paramedic because the HEMS flies at an upward angle.

34. The medical records indicate that the paramedic on board HEMS 3 was focused on correcting Mr Connelly's blood pressure, communicating condition updates to his flight coordinator (in order to obtain permission to use blood products) and using ultrasound to identify other potential causes of bleeding. With this degree of task saturation, the CPU informed me that it was reasonable that the paramedic elected not to reassess the leg wound haemorrhage which had previously been controlled and looked the same upon visual inspection. Furthermore, if the wound had been assessed, the same limited and ineffectual treatment options remained.

Combat Application Tourniquet

35. The CPU stated that the application of an arterial tourniquet, such as a CAT, only controls bleeding from compressible vessels.[29] However, they are ineffective for vessels found in the bone marrow of a broken bone, as the bone cortex prevents compression. The CPU noted that the medical examiner's report did not mention any injury to the femoral artery,[30] which would have been compressible by a tourniquet. For these reasons, the CPU did not believe that the application of a CAT tourniquet would have changed the outcome in Mr Connelly's case. The CPU also informed me that Ambulance Victoria rolled out provision of two CATs for each Victorian ambulance in 2017.

36. Mr Connelly received two units of red cell concentrate. The CPU estimated he would have required 10 units of red cell concentrate at that time.[31] However, I am informed that HEMS services have limited capacity to carry blood products.[32] In addition,

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29 Compressible vessels may include arteries and veins in muscles.

30 The large artery next to the femur.

31 Nunez TC et al. Early prediction of massive transfusion in trauma: simple as ABC (assessment of blood consumption) j Trauma 2009 Feb;66(2):346-52.

32 Blood is stored in as different components as each component has a different shelf life. Red blood Cells which carry oxygen to organs must be refrigerated have a shelf life of about one month but once out of the fridge need to be used within 2 hours. A continuously refreshing supply is kept at HEMS base.

HEMS services do not have the capacity to carry clotting factors such as platelets and plasma,[33] which are required in massive blood transfusions.

37. Victoria's trauma centres are both located in Melbourne, 300 kilometres from Birchip. The time spanning Mr Connelly sustaining his injury and arriving at hospital was four hours. The CPU informed me that available resources were dispatched in a timely manner and that closer hospitals may not have had the resources and skills to treat Mr Connelly.

Review of Ambulance Victoria guidelines

38. Ambulance Victoria guideline CPG A0801 relates to the treatment of hypovolaemia.[34] CPG AAV-08 is specific to Air Ambulance Victoria and relates to the treatment of inadequate blood flow associated with hypovolaemia, specifically the administration of blood. Both guidelines target a systolic blood pressure of 100mmHg as the end target for treatment.[35] The Victorian state trauma guidelines are directed at hospitals and aim for a systolic blood pressure of 90mmHg with lower blood pressures being acceptable for penetrating and uncontrolled haemorrhage, provided that a patient has a normal conscious state.[36]

39. These differences in the three set of Guidelines are small and there is an argument that the prehospital setting is different to hospital setting. However, the CPU stated that the guidelines were derived from differing expert interpretation of the same trauma literature.

40. The CPU reported that CPG A0801 and CPG AAV-08 do not mention the specific risk of re-bleeding from previously controlled bleeding when correcting hypovolaemia. They do not specifically mention the need to assess the effectiveness of haemorrhage

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33 Platelets which are necessary for blood to clot have a shelf life of five days and need to be kept at room temperature continuously agitated in their container to prevent clotting. Plasma which contains factors necessary for blood clotting needs to be frozen for storage and thawed when used.

34 A condition in which the liquid portion of the blood (plasma) is too low: also known as "volume depletion".

35 With the exception of traumatic head injury where the goal is a systolic blood pressure of 120mmHg and in penetrating trunk injury to the chest where a palpable neck pulse is acceptable.

36 Trauma Victoria guidelines are directed at hospitals.

control with every attempt, whether successful or unsuccessful, to correct the hypovolaemia. I am informed that most paramedics would do this as matter of routine.

COMMENTS

Pursuant to section 67(3) of the **Coroners Act 2008**, I make the following comments connected with the death:

1. Robin Connelly informed me that his father had bred horses for as long as he could remember and that Mr Connelly had learned from his father how to train horses. He indicated that the incident leading to his father's death was a simple accident and nothing could have been done at the time to change the events nor stop them from happening.

2. The role of the coronial system in Victoria involves the independent investigation of deaths to determine the cause of an individual death. However, the role is also intended to contribute to the reduction of the number of preventable deaths in Victoria, for the promotion of public health and safety and the administration of justice.

3. The Victorian state trauma guidelines have a slightly different blood pressure target to CPG A0801 and CPG AAV-08 when treating hypovolaemia. Having consistent goals of care for trauma patients across both the prehospital and hospital setting would be ideal.

4. The risk of re-bleeding from previously controlled bleeding when correcting hypovolaemia and the need to reassess haemorrhage control when attempting to treat hypovolaemia ought to be incorporated in the Ambulance Victoria protocols. Although I am informed that the latter is common practice, it was not a practice employed on the HEMS for Mr Connolly's episode of care. However, I am informed that this was reasonable given the enormity of the task at hand and focus on other areas of care. Even if Mr Connelly's haemorrhage had been reassessed and further bleeding identified, there were very limited treatment options available.

5. Mr Douglas identified his concern that a CAT was not available on the ambulance of HEMS 3. However, the CPU have informed me that this would not have been an appropriate treatment. In 2017, Ambulance Victoria rolled out provision of two CATs for each ambulance. Therefore, I have no further concerns in relation to this issue.

6. I agree with Robin Connelly's sentiment that the incident leading to his father's death was an accident. Mr Connelly's death was not preventable given his clinical state when the Ambulance Victoria paramedics arrived and the nature of his injury. Furthermore, I have found that Birchip CERT, rural ambulance and HEMS officers performed exceptionally in difficult circumstances and were compliant with current Ambulance Victoria guidelines.

RECOMMENDATIONS

Pursuant to section 72(2) of the **Coroners Act 2008**, I make the following recommendations:

1. In the interests of public health and safety and with the aim of preventing like deaths, **I recommend** that Ambulance Victoria review the hypovolaemia guidelines CPG A0801 and CPG AAV-08 to make specific note of the risk of re-bleeding from previously controlled bleeding sites associated penetrating trauma when correcting hypovolaemia.

2. In the interests of public health and safety and with the aim of preventing like deaths, **I recommend** that Ambulance Victoria review the hypovolaemia guidelines CPG A0801 and CPG AAV-08 to make specific note of the need to continuously assess the effectiveness of haemorrhage control following attempts to correct hypovolaemia.

3. In the interests of public health and safety and with the aim of preventing like deaths, **I recommend** that Ambulance Victoria and Trauma Victoria develop consistent practice guidelines pertaining to trauma patients across the prehospital and hospital setting.

FINDINGS

The investigation has identified that medical care and treatment provided to Mr Connelly was exemplary at all stages. It especially highlighted the proficiency of the Birchip Community Emergency Response Team in the face of a severe injury to a fellow long-term community member.

I accept and adopt the medical cause of death as formulated by Dr Matthew Lynch, and I find that Mr Connelly died from complications of blood loss from a femoral fracture sustained in a harness riding incident in the setting of warfarinsation and ischaemic heart disease.

To enable compliance with rule 64(3) of the *Coroners Rules 2009* (Vic), I direct that the Findings will be published on the internet.

I direct that a copy of this finding be provided to the following:

Robin Connelly
Birchip Community Response Team
Ambulance Victoria
Trauma Victoria
Royal Melbourne Hospital
Leading Senior Constable Peter Newell

Signature:

AUDREY JAMIESON
CORONER
Date: **11 October 2018**