IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2018 5766

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 63(2)
*Section 67 of the **Coroners Act 2008***

Findings of:	Caitlin English, Deputy State Coroner
Deceased:	Eoghan Jerome Arnold
Date of birth:	21 May 1976
Date of death:	16 November 2018
Cause of death:	1(a) Hypoxic ischaemic brain injury 1(b) Cardiac arrest secondary to massive pulmonary embolism 1(c) Deep venous thrombosis post tibial fracture in MVA
Place of death:	Royal Melbourne Hospital, 300 Grattan Street, Parkville, Victoria

INTRODUCTION

1. On 16 November 2018, Eoghan Jerome Arnold was 42 years old when he died after sustaining an injury in a motor vehicle accident. At the time of his death, Mr Arnold lived at Kurunjang with his partner, Michelle Harwood, and their young daughter. They were awaiting the birth of their second child at the time of Mr Arnold's death.

THE CORONIAL INVESTIGATION

2. Mr Arnold's death was reported to the Coroner as it fell within the definition of a reportable death in the *Coroners Act 2008* (**the Act**). Reportable deaths include deaths that are unexpected, unnatural or violent, or result from accident or injury.

3. The role of a coroner is to independently investigate reportable deaths to establish, if possible, identity, medical cause of death, and surrounding circumstances. Surrounding circumstances are limited to events which are sufficiently proximate and causally related to the death. The purpose of a coronial investigation is to establish the facts, not to cast blame or determine criminal or civil liability.

4. Under the Act, coroners also have the important functions of helping to prevent deaths and promoting public health and safety and the administration of justice through the making of comments or recommendations in appropriate cases about any matter connected to the death under investigation.

5. The Victoria Police assigned an officer to be the Coroner's Investigator for the investigation of Mr Arnold's death. The Coroner's Investigator conducted inquiries on my behalf, including taking statements from witnesses – such as family, the forensic pathologist, treating clinicians and investigating officers – and submitted a coronial brief of evidence.

6. As part of my investigation I also obtained advice from the Court's Health and Medical Investigation Team and statements from Mr Arnold's treating clinicians.

7. This finding draws on the totality of the coronial investigation into Mr Arnold's death, including evidence contained in the coronial brief and the additional statements. Whilst I have reviewed all the material, I will only refer to that which is directly relevant to my findings or

necessary for narrative clarity. In the coronial jurisdiction, facts must be established on the balance of probabilities.[1]

MATTERS IN RELATION TO WHICH A FINDING MUST, IF POSSIBLE, BE MADE

Identity of the deceased

8. On 15 November 2018, Eoghan Jerome Arnold, born 21 May 1976, was visually identified by his partner, Michelle Harwood.

9. Identity is not in dispute and requires no further investigation.

Medical cause of death

10. Senior Forensic Pathologist, Dr Michael Burke, from the Victorian Institute of Forensic Medicine (**VIFM**), conducted an inspection on 18 November 2018 and provided a written report of his findings dated 21 November 2018.

11. Dr Burke provided an opinion that the medical cause of death was *"1(a) Hypoxic ischaemic brain injury"*, *"1(b) Cardiac arrest secondary to massive pulmonary embolism"*, and *"1(c) Deep venous thrombosis post tibial fracture in MVA"*.

12. I accept Dr Burke's opinion.

Circumstances in which the death occurred

13. Mr Arnold's medical history included appendectomy, cholecystectomy, childhood asthma, and he was on the autism spectrum. Mr Arnold was a non-smoker and had a body mass index (known as a 'BMI') of 46.[2] Ms Harwood also noted that her partner had high cholesterol, joint pain, Gilbert's Syndrome, and had previously suffered malaria and had had skin cancers removed.

14. At the time of his death, Mr Arnold was employed at KM Tubular Industries in Altona North.

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[1] Subject to the principles enunciated in *Briginshaw v Briginshaw* (1938) 60 CLR 336. The effect of this and similar authorities is that coroners should not make adverse findings against, or comments about, individuals unless the evidence provides a comfortable level of satisfaction as to those matters taking into account the consequences of such findings or comments.

[2] Obesity is classed using the Body Mass Index (**BMI**), which is an index of weight-for-height that is commonly used to classify underweight, overweight and obese adults. A BMI of greater than 40 kg/m2 is Grade III (morbid) obesity.

15. On 31 October 2018, Mr Arnold woke Ms Harwood between 5.00am and 6.00am to say goodbye. She noted that his behaviour was normal that morning.

16. That day, Mr Arnold was performing delivery duties in a 1994 Isuzu small truck. At approximately 3.00pm, Mr Arnold headed to Campbellfield to complete his final delivery for the day and drove along Hume Highway (also known as Sydney Road).

17. Hume Highway in Campbellfield runs in a north south direction. The road is a bitumen surface and was in excellent condition at the relevant time. Three lanes ran in a northbound (outbound) direction. There is an intersection with Somerset Road, which is managed by traffic lights. At the relevant time, the speed limit was 70 kilometres per hour.

18. The weather was fine and clear, and the road was dry.

19. Mr Arnold was driving in the far right of the three northbound lanes when he subsequently collided with the vehicle in front of him at approximately 3.15pm. This in turn caused a shunting effect whereby three other vehicles in front of Mr Arnold's truck formed part of the collision.

20. The collision occurred approximately adjacent to 1515 Hume Highway, Campbellfield, and one kilometre north of the Western Ring Road. According to Sergeant Dean Pickering, Coroner's Investigator, it appears that the traffic lights at the intersection of Hume Highway and Somerset Road were either red, turning red, or had recently been red. Approaching traffic was slowed due to slow or stopped traffic at the intersection. The traffic was moderately heavy at this time of day.

21. As a result of the collision, the Isuzu truck sustained extensive damage to the front end and the cabin. There was significant cabin intrusion with the dash area and steering column sustaining damage and displacement. The steering column had shifted to pin Mr Arnold to the seat by his legs.

22. Emergency services attended the scene and the Metropolitan Fire Brigade extricated Mr Arnold from the truck using road rescue machinery.

23. Mr Arnold telephoned his partner at 3.26pm to inform her about the accident.

24. Sergeant Pickering noted that there was no evidence of Mr Arnold braking prior to the collision. There were no obvious skid marks on the road at the collision scene and no witnesses

recalled hearing any skidding. It appeared that Mr Arnold had not reacted or taken action to avoid the collision. Data from a dashcam installed in Mr Arnold's vehicle was unsalvageable.

25. The cause for the collision therefore remains unknown, however Sergeant Pickering referred to Mr Arnold possibly suffering a sneezing fit immediately prior to the collision (as reported to attending emergency responders) or the possibility that he may have been distracted while using his mobile phone (for which his employer had given previous verbal warnings). He tested negative for alcohol and illicit drugs.

26. While the truck was 24 years old, Sergeant Pickering noted that it appeared to be in a satisfactory and roadworthy condition prior to the collision. The front tyres were in excellent condition and the rear tyres were satisfactory. The truck was due for its next service in approximately 10,000 kilometres.

27. The three other vehicles involved in the collision were also in a roadworthy condition and also sustained extensive damage as a result of the collision.

28. As a result of the collision, Mr Arnold sustained an open right tibial plateau fracture and was subsequently transported to Royal Melbourne Hospital, arriving at 4.22pm.

29. On 1 November 2018, Mr Ruban Ambikaipalan, surgeon, performed an external fixation[3] of the right tibial fracture and wound debridement. The procedure was uneventful with no complications. Mr Arnold received intravenous antibiotics until 2 November 2018 to prevent infection.

30. On 5 November 2018, Mr Arnold was transferred to Brunswick Private Hospital for rehabilitation under the care of Dr Steven Hill, rehabilitation physician. He was due to return to Royal Melbourne Hospital on 12 November 2018 for open reduction and internal fixation of the tibial fracture.

31. Upon admission to Brunswick Private Hospital, Mr Arnold's temperature spiked at 38.2 Celsius and intravenous antibiotics were re-commenced and continued throughout his admission to prevent infection.

[3] A surgical method for immobilising a particular body part post fracture. It can keep the fractured bone stabilised and within alignment. Pins are inserted through the skin into the bone and held in place by an external frame.

32. On 12 November 2018, Mr Arnold returned to Royal Melbourne Hospital for the planned surgery by Mr Andrew Oppy, orthopaedic surgeon. Surgery commenced at approximately 1.30pm.

33. At approximately 1.44pm and soon after anaesthetic induction, Mr Arnold became hypoxic,[4] with the end-tidal[5] carbon dioxide monitoring dropping, hypotension,[6] and tachycardia.[7] With a consideration that this may be related to anaphylaxis,[8] the 'arrest buzzer' was activated, adrenaline immediately administered, and oxygen increased. With progressive haemodynamic instability, Mr Arnold then had a pulseless arrest.[9]

34. Cardiopulmonary resuscitation[10] was commenced and continued for an hour. A large saddle pulmonary embolism[11] was identified by a trans-oesophageal echocardiogram,[12] and the cardiothoracic team performed a pulmonary embolectomy.[13]

35. Mr Arnold was placed on extra-corporeal membrane oxygenation (**ECMO**)[14] and transferred to the Intensive Care Unit where he required multiple vasopressor support.

36. On 13 November 2018, Mr Arnold's sedation was ceased and on 14 November 2018 his pupils were noted to be fixed and dilated with no cough or gag reflex.

37. Mr Arnold showed minimal neurological activity therefore an electroencephalography[15] and a four-vessel angiogram[16] was performed. As the results indicated only a trickle of blood flow, a decision was made to provide palliative care.

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[4] Deficiency in the amount of oxygen reaching body tissues.
[5] Measurement of maximal concentration of carbon dioxide at the end of an exhaled breath.
[6] Low blood pressure.
[7] High heart rate.
[8] Anaphylaxis is a severe, generalised acute allergic reaction warranting immediate intervention.
[9] An organised heart rhythm without sufficient mechanical contraction to produce a palpable pulse or measurable blood pressure. This is a medical emergency and requires initiation or continuation of cardiopulmonary resuscitation.
[10] Performed in the event of cardiac and respiratory arrest and may involve interventions such as airway support, ventilation, chest compressions, the administration of cardiac resuscitation medications such as adrenaline, and cardiac defibrillation.
[11] A large thrombus lodged at an arterial bifurcation, where blood flows from a large-bore vessel to a smaller one. Most pulmonary emboli arise from thrombi in the deep venous system of the lower extremities.
[12] A TOE involves ultrasound imaging of the heart under light sedation via a transducer placed in the oesophagus which enables closer and much clearer views of the heart muscle, heart valves and the sac around the heart.
[13] Surgical removal of pulmonary embolus.
[14] Extracorporeal membrane oxygenation (ECMO) is a device/technique utilised which can provide both cardiac and respiratory support oxygen to patients whose heart and lungs are so severely diseased or damaged that they can no longer serve their function. Extracorporeal life support is a type of cardiopulmonary bypass.
[15] Medical test used to measure the electrical activity of the brain, via electrodes applied to the patients' scalp.
[16] Four-vessel angiography is direct injection of contrast medium into both carotid arteries and both vertebral arteries.

38. On 16 November 2018, Mr Arnold was extubated, and ECMO and supports were ceased. Mr Arnold passed away at 11.29am.

MS HARWOOD'S CONCERNS REGARDING MR ARNOLD'S MEDICAL TREATMENT

39. Ms Harwood attached detailed notes to her statement to police, which raised the following areas of concern:

    (a) Mr Arnold's leg appeared swollen and hot at various times during his admission, which was not adequately addressed or noted by hospital staff;

    (b) appropriate strategies to minimise Mr Arnold's risk of deep vein thrombosis were not taken, such as starting him on blood thinners immediately after his first surgery on 1 November 2018 and making him ambulate; and

    (c) when Mr Arnold deteriorated on 12 November 2018, it took seven minutes for medical staff to decide to call a cardiologist to attend because staff believed he was experiencing an anaphylactic reaction to the anaesthesia.

40. In July 2020, Ms Harwood's legal representative submitted further concerns, which included:

    (a) there were discrepancies between Ms Harwood's accounts of Mr Arnold's pain and the appearance of his leg and the medical records;

    (b) adequate assessments and vital sign observations were not conducted;

    (c) mechanical prophylaxis was not used;

    (d) anticoagulation was ceased;

    (e) there were deficiencies in communication between Royal Melbourne Hospital and Brunswick Private Hospital;

    (f) Mr Arnold should not have been transferred to Brunswick Private Hospital for rehabilitation; and

    (g) medical records appeared incomplete.

FURTHER INVESTIGATION INTO THE CIRCUMSTANCES OF MR ARNOLD'S DEATH

41. In light of Ms Harwood's concerns about the medical treatment her partner received and as part of my coronial investigation, I obtained advice from the Court's Health and Medical Investigation Team (**HMIT**) and statements Mr Ruban Ambikaipalan, orthopaedic surgeon at Royal Melbourne Hospital, Julie Dowd, Director of Clinical Services at Brunswick Private Hospital, and Dr Steven Hill, rehabilitation medicine consultant at Brunswick Private Hospital.

42. The HMIT is staffed by healthcare professionals, including practising physicians and nurses. Importantly, these healthcare professionals are independent of the health professionals and institutions under consideration. They draw on their medical, nursing, and research experience to evaluate the clinical management and care provided in particular cases by reviewing the medical records, and any particular concerns which have been raised.

Mr Arnold's risk of deep vein thrombosis

43. The HMIT advised that Mr Arnold had risk factors for developing thromboembolism, which included recent orthopaedic surgery, reduced mobility, and obesity.

44. In his statement, Dr Hill elaborated on Mr Arnold's risks. He noted that Mr Arnold had substantial external fixation around his right leg, which meant mobilisation was very difficult. When coupled with the injury that Mr Arnold had sustained, there was a significant risk of a blood clot. This was the reason why mobilisation and an anticoagulant are used prophylactically to minimise the risk of deep vein thrombosis.

Prophylaxis therapy

45. Mr Arnold was discharged from Royal Melbourne Hospital to Brunswick Private Hospital with prescribed enoxaparin[17] 40 milligrams daily subcutaneously, a plan for early mobilisation, and TED™[18] stockings.

46. Mr Arnold's medication chart indicates enoxaparin was administered on 1 to 4 November 2018 whilst at Royal Melbourne Hospital and from 5 to 10 November 2018 at Brunswick Hospital, with it being withheld on 11 November 2018 for surgery on 12 November 2018.

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[17] Clexane injection contains the active ingredient Enoxaparin, which is a type of medicine called a low molecular weight heparin. It is used to stop blood clots forming within the blood vessels.
[18] Anti-embolism stocking.

47. Ms Dowd stated that Royal Melbourne Hospital provided instructions for anticoagulants to be withheld on 11 November 2018.

48. Mr Ambikaipalan was asked whether there were any considerations to increase the dosage of Clexane. He stated:

> *Mr Arnold was a large man with an increased BMI. Giving higher doses of clexane to overweight/obese patients has been discussed and studied extensively in the literature and at our Unit Journal Clubs. There is insufficient evidence to demonstrate that increasing the dose beyond 40 mg daily significantly decreases the risk of DVTs. Furthermore, this does not outweigh the risk of excessive bleeding and worsening of the swelling, which would prolong the period to definitive fixation.*
>
> *This dosage of 40 mg/daily clexane [...] is in line with Hospital and Unit policy for DVT prophylaxis.*

49. In his statement, Dr Hill stated:

> *This is a standard prophylactic regimen for deep vein thrombosis (DVT). I saw no reason to modify RMH's treatment plan in this respect. Mr Arnold continued to receive subcutaneous Clexane 40 milligram injections up until Sunday 11 November 2018. On Sunday, Clexane was withheld in anticipation of his upcoming surgery at RMH on Monday 12 September. This is standard practice to lessen the risk of excessive bleeding during surgery.*

50. Dr Hill explained that it was necessary to cease the Clexane due to increased risk of bleeding during surgery. He acknowledged the difficulty in having to balance the competing priorities of deep vein thrombosis prophylaxis and risks during surgery. He felt it was appropriate to continue the Clexane as late as possible, being 11 November 2018.

51. However, Mr Ambikaipalan stated that when an internal review was conducted after Mr Arnold's death, it was identified that Clexane should not have been withheld prior to surgery (unless it was large pelvic or spinal surgery). Despite this, he also noted that the withholding of Clexane one night before would *not* have been the decisive factor in Mr Arnold's pulmonary embolism and subsequent death.

52. The HMIT concluded that the prophylactic treatment was appropriate and reasonable.

Mobilisation

53. Mr Arnold was reviewed by the physiotherapist and commenced sitting out of bed, at times Mr Arnold declined input and there was a slight delay in obtaining an appropriate chair.

54. Mr Arnold required staff assistance to transfer from bed to chair as he was non-weight bearing on his right leg with external fixation across his knee joint in situ. He used the assistance of a wheelchair to mobilise and he was assisted with showering and dressing.

55. According to Dr Hill, Mr Arnold was encouraged to perform bed exercises to maintain blood flow. He noted that there were practical limits to what Mr Arnold could undertake given the external fixation and his risk of falls.

Mr Arnold's pain management and appearance of his leg

56. Ms Harwood gave the following accounts regarding Mr Arnold's pain and the appearance of his leg:

    (a) on 6 November 2018, Mr Arnold's foot appeared pale. When Ms Harwood scratched his knee upon request, she felt that it was extremely hot and it appeared red;

    (b) on 10 November 2018, Mr Arnold was in pain, wincing on occasion, and needed medication. His leg was very pale, red, and swollen again; and

    (c) on 12 November 2018, Mr Arnold was in pain. He reported that his leg was still hot, and his right foot was pale.

57. On transfer to Brunswick Private Hospital from Royal Melbourne Hospital, the following pain management regime for Mr Arnold was in place:

    (a) paracetamol 1 gram four times a day;

    (b) Targin 5/10 milligrams twice daily;

    (c) gabapentin 200 milligrams three times a day; and

    (d) Endone 5 to 10 milligrams, three to four hourly for breakthrough pain.

58. Mr Arnold was noted to have a temperature on 5 November 2018 of 38.2 degrees. Blood cultures were obtained and antibiotics were prescribed. Otherwise, Mr Arnold's observation

chart recordings were within normal limits, with minimal pain and oxygen saturations at normal limits with no supplemental oxygen being required.

59. Throughout Mr Arnold's admission to Brunswick Private Hospital, the medical file also did not highlight any shortness of breath or alteration in limb sensation.

60. Dr Hill noted that Mr Arnold was continued on regular Targin throughout his admission. However, he constantly declined gabapentin and did not require Endone until 10 November 2018.

Pain on 9 November 2018

61. The medical file documents that Mr Arnold complained of right lower leg pain to the occupational therapist on 9 November 2018. Nursing and medical documentation does not otherwise readily discuss or highlight calf pain.

62. Dr Hill stated that on his review on 9 November, Mr Arnold was pain free:

> *... which surprised me given the severity of his injury. Throughout his inpatient stay at Brunswick, he was in less pain than I would have expected from someone with this injury. This was confirmed in the recording of pain scores (range: 0-2/10) in the nursing observation chart throughout his inpatient admission at Brunswick.*

Pain on 10 November 2018 and thereafter

63. Dr Hill confirmed that Mr Arnold did not require Endone until 10 November 2018, at which time he required it on two occasions, which had good effect.

64. Dr Hill went on to explain that while Mr Arnold did require Endone for breakthrough pain that day, he did not require it the next day. He explained pain levels are expected to fluctuate in these types of conditions.

Indication of possible deep vein thrombosis or pulmonary embolis

65. Mr Ambikaipalan stated that while he was not involved in Mr Arnold's care when he returned to Royal Melbourne Hospital, from discussion with Mr Arnold's treating team, it was his understanding that:

> *He did not have any clinical signs or symptoms of a DVT or PE leading up to his death. He did not experience excessive calf pain or swelling out of proportion to the*

swelling expected from a tibial plateau fracture with pin sites from an external fixator. Furthermore, he did not complain of chest pain/breathing difficulties or pleuritic chest pain. According to these doctors he also didn't have episodes of oxygen desaturation or tachypnoea to suggest a catastrophic pulmonary embolus may occur or be developing. Also, the patient had no history of clotting disorders and no family history of clotting problems to suggest he was at higher risk.

66. Dr Hill explained that a diagnostic (Doppler) ultrasound can be used to identify blood clots, which can enable earlier treatment to prevent a clot travelling to the lungs. However, ultrasounds are usually only undertaken when symptoms and signs indicate the potential formation of a clot. He noted that that while Mr Arnold experienced increased pain on 10 November 2018, there were other possible reasons for this. If he had been made aware that Mr Arnold was experiencing a cold and painful calf and a painful and hot back of knee, an ultrasound may have been clinically indicated. However, nursing staff were not aware of those symptoms.

Conclusion regarding pain and appearance

67. While I accept Mrs Harwood's account of her observations, they do not appear to be fully reflected in the medical records. It is unclear whether this was because these observations were not reported to medical staff or that (multiple) medical staff failed to record those symptoms.

68. It is not uncommon for discrepancies to occur in relation to recollection of events. As noted above, had medical staff become aware of some of these symptoms, it may have triggered further assessment. However, in the absence of a concurrent medical record, I am satisfied that the pain assessment was reasonable, and Mr Arnold was treated appropriately.

Delay in providing care to Mr Arnold in response to his deterioration

69. Ms Hardwood's legal representative submitted that there was a delay in providing Mr Arnold appropriate care once he deteriorated and a Code Blue was called. They noted:

(a) the Code Blue was called at 1.50pm (three minutes after the intraoperative electrocardiogram changes were detected);

(b) it took another 32 minutes (until 2.22pm) for cardiology to arrive; and

(c) one hour and 18 minutes (3.08pm) for definitive surgery to begin.

70. They submitted that this was in the face of detection of a massive pulmonary embolism at 2.06pm and concerning blood gasses at 2.02pm.

71. I note that Dr Ping Chia, anaesthetic fellow, captured the events in a retrospective note in the medical records at 9.00pm on 12 November 2018. He noted that upon Mr Arnold's sudden deterioration, the treating team had an initial working diagnosis of possible anaphylaxis. The theatre arrest buzzer was activated, and adrenaline boluses administered immediately.

72. The HMIT noted that as the cardiac arrest was proximate to induction of anaesthesia, it was appropriate to consider that the arrest was due to anaphylaxis. The HMIT did not consider there to be a delay in the theatre arrest buzzer being activated.

Hospital internal reviews

73. In her statement, Ms Dowd explained that Brunswick Private Hospital conducted a comprehensive review of Mr Arnold's care and subsequently presented at the Medical Advisory Committee's Patient Care Review Committee. No recommendations for improvement were advised following the review or Patient Care Review Committee.

74. Mr Ambikaipalan provided the following information about the Royal Melbourne Hospital internal review:

> *The case was discussed and reviewed extensively at the Orthopaedic Unit's Trauma meeting and the Unit XR meeting/morbidity and mortality meeting the week after Mr Arnold's death. It was also discussed at the Unit's Annual Audit.*
>
> *The issues discussed were ... Not to withhold clexane the night prior to surgery which did occur in this case. It is not Unit protocol except in large pelvic/spinal surgery to withhold clexane but it seems this was done by the team at Brunswick Rehab and steps have been taken to address this issue with the Rehab team. Furthermore, it was felt that the withholding of clexane one night before would not have been the decisive factor in the PE and subsequent death occurring.*

75. Mr Ambikaipalan outlined the recommendations for improvement as follows:

> *Stronger communication between Rehab and the acute orthopaedic team*

Consideration of pre-op lower limb ultrasounds in high risk patients (ie those who have travelled, patients with clotting disorder/symptoms of DVT). There is no evidence that this is of benefit and Mr Arnold also did not fit into the high risk category.

76. Mr Ambikaipalan further stated that after discussion with Mr Oppy, he could not identify any clear causes for the pulmonary embolism or whether they would have changed the way Mr Arnold was managed.

Conclusion

77. After reviewing the evidence, which included Mr Arnold's medical records and the statements referred to above, the HMIT concluded that the care and treatment provided at Royal Melbourne Hospital and Brunswick Private Hospital were both appropriate and timely and the recommendations for improvement made during internal reviews were appropriate. The HMIT did not identify any opportunities for prevention. I accept and agree with the HMIT's advice.

78. I understand that Mr Arnold's family may still have questions about specific areas of the treatment he received. They may wish to be provide these to Royal Melbourne Hospital and Brunswick Private Hospital for response.

FINDINGS AND CONCLUSION

79. Pursuant to section 67(1) of the Act I make the following findings:

(a) the identity of the deceased was Eoghan Jerome Arnold, born 21 May 1976;

(b) the death occurred on 16 November 2018 at Royal Melbourne Hospital, 300 Grattan Street, Parkville, Victoria, from hypoxic ischaemic brain injury, cardiac arrest secondary to massive pulmonary embolism, and deep venous thrombosis post tibial fracture in MVA; and

(c) the death occurred in the circumstances described above.

COMMENTS

Pursuant to section 67(3) of the Act, I make the following comments connected with the death.

1. Venous thromboembolism is estimated to be one of the leading preventable causes of death in hospital. It is estimated that pulmonary embolism accounts for seven percent of all deaths in Australian hospitals every year.[19]

2. The risk of postoperative venous thromboembolism (deep venous thrombosis and pulmonary embolism) in orthopaedic patients is among the highest of all surgical specialties.[20]

3. Current venous thromboembolism prophylaxis options are divided into pharmacological prophylaxis and mechanical prophylaxis.

4. Pharmacological prophylaxis is the use of an anticoagulant medication to prevent the formation of blood clots within blood vessels. Recommended medications included low molecular weight heparin, fondaparinux, dabigatran, or rivaroxaban.

5. Mechanical prophylaxis is usually provided in the form of antiembolic stockings (compression stockings) or intermittent pneumatic leg compression.

6. Multimodal venous thromboembolism prophylaxis is ideally started during hospitalisation, either before, or shortly after surgery, and continued at least until the person is fully ambulatory.

The Australian Commission on Safety and Quality in Health Care guidelines

7. The Australian Commission on Safety and Quality in Health Care (**ACSQH**)[21] has developed the *Venous Thromboembolism Prevention Clinical Care Standard*[22] to support high-quality care to prevent venous thromboembolism in hospital and following discharge. The goal of the

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[19] Australian Commission on Safety and Quality in Health Care, Venous Thromboembolism Prevention Clinical Care Standard, https://www.safetyandquality.gov.au/standards/clinical-care-standards/venous-thromboembolism-prevention-clinical-care-standard.

[20] Prevention of venous thromboembolism in adult orthopaedic surgical patients, Pai and Douketis, Up To Date, last update 8 July 2020.

[21] Australian Commission on Safety and Quality in Health Care, Venous Thromboembolism Prevention Clinical Care Standard, https://www.safetyandquality.gov.au/standards/clinical-care-standards/venous-thromboembolism-prevention-clinical-care-standard.

[22] A Clinical Care Standard is a nationally agreed statement on the care patients should be offered by health professionals and health services for a specific clinical condition in line with current best evidence. The Clinical Care Standards are succinct statements on key areas of clinical practice for a specific condition where there is evidence of variation from best practice: Australian Commission on Safety and Quality in Health Care, Clinical Care Standards FAQs, https://www.safetyandquality.gov.au/sites/default/files/migrated/Clinical-Care-Standards-FAQs-clinicians-and-health-services.pdf.

Clinical Care Standard is to ensure all hospitalised adults have an assessment of venous thromboembolism risk which is formally documented and aims to ensure that venous thromboembolism prevention is appropriately prescribed. I note the clinical care standard is not a clinical guideline and clinicians are encouraged to use their own clinical judgment and consider individual circumstances.

8. In December 2020, the ACSQH produced the *Venous Thromboembolism Prevention Clinical Care Standard: Implementation Guide,* which sets out tips for implementation, case studies, examples of prevention strategies, and useful resources.[23]

9. As acknowledged by the Standard, there is currently no consensus among evidence-based guidelines regarding the preferred method of venous thromboembolism assessment[24] and one has been proven to be better than the other.

10. It is also important to remember that medicines used to prevent venous thromboembolism, specifically anticoagulants, are considered high-risk medicines and can increase the risk of bleeding. Also, the safety and efficacy of venous thromboembolism prevention doses in extremities[25] of body weight is not fully known.[26]

Lack of standard Australian guidelines

11. Previous coronial cases have addressed the lack of a standard Australian guideline.

12. On 20 July 2015, I finalised my investigation into the death of Hazel Bampton[27] who had died of a pulmonary embolism secondary to deep vein thrombosis in the convalescent phase of left lower leg trauma. I made the following recommendations:

    (a) the National Health and Medical Research Council (**NHMRC**) should consider commissioning a working group, to collate and analyse evidence concerning thromboprophylaxis for outpatients who have a body mass index over 30. This would include those at increased risk of venous thromboembolism, such people with trauma, requiring limb immobilisation. This evidence should be collated and analysed with a

[23] Australian Commission on Safety and Quality in Health Care, Venous Thromboembolism Prevention Clinical Care Standard: Implementation Guide, https://www.safetyandquality.gov.au/publications-and-resources/resource-library/venous-thromboembolism-prevention-clinical-care-standard-implementation-guide.
[24] Quality statement 1 – Assess and document VTE risk, page 14.
[25] Extremities of body weight (less than 50kg or over 120kg, or body mass index (BMI) greater than 30kg/m2).
[26] Quality statement 1 – Assess and document VTE risk, page 26.
[27] See Finding Into Death Without Inquest into the death of Hazel Angela Bampton, delivered 20 July 2015.

view to creating guidelines for hospitals and the health care system regarding their treatment and management of such patients; and

(b) the Victorian Health Department should consider a public education campaign to raise awareness of the potential risk of venous thromboembolism and the importance of early mobilisation for people who have a body mass index over 30 and find themselves immobilised after discharge from hospital for any other reason.

13. The NHMRC provided a response to these recommendations on 13 October 2015. The NHMRC requested that the ACSQHC take over the role of creating venous thromboembolism prevention guidelines. However, as stated above, the ACSQHC were unable to produce a standard Australian clinical practice guideline for venous thromboembolism prophylaxis as there was no consensus regarding preferred assessment.

14. In 2016, an expert orthopaedic surgeon, Associate Professor Andrew Bucknill, was commissioned to review the coronial case of Anna Bowditch.[28] Ms Bowditch died of a stroke caused by a clot dislodging from a leg deep vein thrombosis after operative fixation of an ankle fracture. Associate Professor Bucknill provided evidence regarding several misconceptions about deep vein thrombosis, pulmonary embolism, and pharmacological venous thromboembolism prophylaxis. He stated that the current 2009 NHMRC guidelines are based on assumptions that are not supported by contemporary evidence.

15. He stated that the risks of pulmonary embolism, even following major orthopaedic surgery are low and may not be related to increased rates of lower limb deep vein thrombosis. That is, a deep vein thrombosis and pulmonary embolism are two different problems, with deep vein thrombosis being due to stasis (sluggish blood flow) of the venous circulation and pulmonary embolism due to a systemic response to surgical trauma. He also stated that there is no proof that pharmacological prophylaxis leads to lower mortality from pulmonary embolism and that the risks of pharmacological prophylaxis are underestimated, especially in the case of complications of orthopaedic surgery (risks of bleeding and infection).

Case study of similar circumstances

16. As part of my investigation, and in addition to previous coronial case, I also considered a case study that appeared in the July 2019 Victorian Audit of Surgical Mortality (**VASM**) Case Note

[28] See Finding Into Death With Inquest into the death of Anna Agnieszka Bowditch, delivered on 3 December 2018.

Review Booklet, which made reasonable recommendations in a case with similar circumstances to Mr Arnold's death.[29]

17. By way of background, the VASM is a systematic peer review audit of deaths associated with surgical care within Victorian hospitals. The VASM assessor reviews all medical records and patient information which is de-identified.

18. 'Case 13' related to a routine Achilles tendon repair. Case 13 presented for semi-elective orthopaedic repair two weeks after the injury. The assessor made the following suggestions:

(a) unless the patient was undergoing immediate surgery following lower limb trauma, then preoperative anticoagulation should be considered. However, while anti-coagulation can reduce risk of deep vein thrombosis, there is *no* evidence that anticoagulation will reduce the risk of fatal pulmonary embolism;

(b) with extended delay to surgery (in Achilles tendon surgery) for more than five to seven days and without prior anticoagulation, a Doppler venous ultrasound should be considered, especially if the patient shows any signs of deep vein thrombosis such as calf swelling and pain above the area of trauma/ rupture (or other associated risk factors for deep vein thrombosis). However. the difficulty with such investigations is the uncertainty of managing small non-deep vein thrombosis and its relevance to risk of pulmonary embolism. Anti-coagulation also can increase the risk of wound problems following surgery;

(c) while in hindsight this death may have been preventable, it would have required identification of the deep vein thrombosis prior to surgery. It appeared from the clinical notes that there were minimal clinical signs of the deep vein thrombosis and the impending pulmonary embolus. Preoperative anticoagulation may have reduced the risk of deep vein thrombosis but there is little evidence on its effect on rates of fatal pulmonary embolism; and

(d) the way forward is increased vigilance on the part of all surgeons performing such lower limb surgery, specifically in careful preoperative assessment of the calf, use of venous Doppler ultrasound, and preoperative anticoagulation in cases of surgical

[29] Victorian Audit of Surgical Mortality, Case Note Review Booklet, Eleventh Edition, July 2019, https://www.surgeons.org/-/media/Project/RACS/surgeons-org/files/surgical-mortality-audits/vasm/2019-07-02-case-note-review-booklet-v11.pdf?rev=02e81daccfaf48f0b867a74160248567&hash=027A67EFD95A384EDFFB86F275323902.

delay. Despite all of this, fatal pulmonary embolism remains a challenging problem, and in some cases, impossible to prevent despite best practice.

Conclusion

19. The incidence of venous thromboembolism among hospitalised patients is 100 times greater than in the community[30] and the risk of developing venous thromboembolism also continues after discharge from hospital. Hospitalisation is a major risk factor for venous thromboembolism, with about 74 percent of venous thromboembolism cases occurring up to three months after hospital discharge.[31]

20. Despite this significant burden of disease, there is still no current Australian best practice guideline for venous thromboembolism prophylaxis management. The newly published ACSQH *Venous Thromboembolism Prevention Clinical Care Standard*, published in October 2018 does not provide a specific guideline and continues to state that, *"There is no consensus among evidence-based guidelines regarding the preferred method of VTE assessment and there is no evidence suggesting that one assessment tool is better than another."*

21. The Standard does not provide any recommendation into which of the 19 published guidelines was preferred. While it provides a summary of the current research, it leaves the onus on the individual health service to create their own guideline. It appears that due to the wide range of evidence-based clinical guidelines available locally and internationally, a single consensus guideline cannot be agreed upon and there is no evidence suggesting that one assessment tool is better than another.

22. Despite this, I note that in December 2018, Queensland Health published the comprehensive *Guideline for the Prevention of Venous Thromboembolism (VTE) in Adult Hospitalised Patients.*[32] Given a national guideline appears to be unachievable, I will make a recommendation so that steps be taken to develop a Victorian guideline with the goal to create consistency across the state.

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[30] Heit JA, Melton LJ, III, Lohse CM, Petterson TM, Silverstein MD, Mohr DN, et al. Incidence of venous thromboembolism in hospitalized patients vs community residents. Mayo Clinic Proceedings. 2001.76(11):1102-10.
[31] Spencer FA, Lessard D, Emery C, Reed G, Goldberg RJ. Venous thromboembolism in the outpatient setting. Archives of Internal Medicine. 2007;167(14):1471-5.
[32] Queensland Government, *Guideline for the Prevention of Venous Thromboembolism (VTE) in Adult Hospitalised Patients,* https://www.health.qld.gov.au/__data/assets/pdf_file/0031/812938/vte-prevention-guideline.pdf.

RECOMMENDATIONS

Pursuant to section 72(2) of the Act, I make the following recommendation:

1. I recommend Safer Care Victoria develop an evidence-based guideline for venous thromboembolism prophylaxis consistent with the Queensland Health guideline. The guideline could be incorporated into a local standard care pathway to ensure that appropriate consideration of venous thromboembolism prophylaxis is given to all patients according to their level of risk.

I convey my sincere condolences to Mr Arnold's family for their loss.

Pursuant to section 73(1A) of the Act, I order that this finding be published on the Coroners Court of Victoria website in accordance with the rules.

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

Michelle Harwood, senior next of kin (care of Slater and Gordon Lawyers)
WorkSafe Victoria (care of Wisewould Mahony)
Dr Steven Hill (care of Avant Pty Ltd)
Brunswick Private Hospital
Royal Melbourne Hospital
Safer Care Victoria
Sergeant Dean Pickering, Victoria Police, Coroner's Investigator

Signature:

CAITLIN ENGLISH
DEPUTY STATE CORONER
Date: 25 June 2021

NOTE: Under section 83 of the ***Coroners Act 2008*** (the Act), a person with sufficient interest in an investigation may appeal to the Trial Division of the Supreme Court against the findings of a coroner in respect of a death after an investigation. An appeal must be made within six months after the day on which the determination is made, unless the Supreme Court grants leave to appeal out of time under section 86 of the Act.