



IN THE CORONERS COURT  
OF VICTORIA  
AT MELBOURNE

Court Reference: COR 2019 1998

**FINDING INTO DEATH WITHOUT INQUEST**

*Form 38 Rule 63(2)*

*Section 67 of the Coroners Act 2008*

*Amended pursuant to section 76 of the Coroners Act 2008 on 8 November 2021<sup>1</sup>*

Findings of:	Caitlin English, Deputy State Coroner
Deceased:	XH
Date of birth:	2 February 1973
Date of death:	20 April 2019
Cause of death:	1(a) Hypoxic ischaemic brain injury complicating a cardiac arrest during anaesthetic induction for an elective inguinal hernia repair
Place of death:	Knox Private Hospital, 262 Mountain Highway, Wantirna, Victoria

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<sup>1</sup> This document is an amended version of the Finding into Death Without Inquest regarding XH dated 25 October 2021. Corrections to paragraphs 25 and 33 have been made pursuant to section 76 of the *Coroners Act 2008* (Vic).

## INTRODUCTION

1. On 20 April 2019, XH was 46 years old when he died while undergoing anaesthetic induction for surgery. At the time of his death, XH lived at Bayswater.

## THE CORONIAL INVESTIGATION

2. XH'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 XH'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. I also obtained statements from the clinicians involved in XH's care and advice from the Coroners Prevention Unit.
6. This finding draws on the totality of the coronial investigation into XH's death, including evidence contained in the coronial brief. 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.<sup>2</sup>

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<sup>2</sup> 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.

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

### **Identity of the deceased**

7. On 21 April 2019, XH, born 2 February 1973, was visually identified by his sister.
8. Identity is not in dispute and requires no further investigation.

### **Medical cause of death**

9. Forensic Pathologist, Dr Victoria Francis, from the Victorian Institute of Forensic Medicine (VIFM), conducted an examination on 26 April 2019 and provided a written report of her findings dated 22 March 2020.
10. Toxicological analysis of post-mortem samples did not identify the presence of any alcohol or any common drugs or poisons.
11. Dr Francis provided an opinion that the medical cause of death was “*1(a) Hypoxic ischaemic brain injury complicating a cardiac arrest during anaesthetic induction for an elective inguinal hernia repair*”.
12. I accept Dr Francis’s opinion.

### **Circumstances in which the death occurred**

13. XH’s medical history included Obstructive Sleep Apnoea,<sup>3</sup> anxiety, depression, previous alcohol abuse, Type 2 Diabetes mellitus, psoriasis, hypertension, asthma,<sup>4</sup> and he was an ex-smoker.
14. On 13 April 2019, XH was admitted to Knox Private Hospital for an elective inguinal hernia repair.
15. Dr Indunil Kumarasinghe, anaesthetist, conducted a pre-anaesthetic assessment via telephone consultation on 7 April 2019 during which time XH informed her he had bronchitis induced by exercise or upper respiratory tract infections, but he was stable at present. He did not inform

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<sup>3</sup> Airway at the back of the mouth obstructs intermittently during sleep, causes snoring and daytime sleepiness. Exacerbated by obesity. Can be treated with CPAP (Continuous Positive Airways pressure) mask whilst sleeping.

<sup>4</sup> Asthma is documented on the Patient Health History (completed by the patient), on the anaesthetic chart is documented as ‘exercise induced bronchitis’ which Dr Kumarasinghe stated was reported to her by XH.

Dr Kumarasinghe whether he was on an inhaler. A further in-person assessment occurred on the day of XH's admission.

16. XH was assessed as having a potentially difficult airway (both intubation and ventilation) due to very poor dentition, a full beard, and a bull neck (increased neck circumference). He was assessed as having a Mallampati score of 3.<sup>5</sup> A plan was made for induction of anaesthesia and intubation using the video laryngoscope (VL).<sup>6</sup>
17. Induction of anaesthesia occurred at 12.20pm with doses of the drugs fentanyl,<sup>7</sup> propofol,<sup>8</sup> and suxamethonium<sup>9</sup>. Dr Kumarasinghe stated XH's vocal cords were visualised (Grade 1<sup>10</sup> view with VL) and the endotracheal tube (ETT) was visualised to pass through the vocal cords. This was also witnessed by the anaesthetic nurse and theatre technician on VL.
18. At approximately 12.31pm, the filter and circuit from the anaesthetic machine<sup>11</sup> were connected to the ETT. XH was difficult to ventilate from the outset with high pressures and the bag<sup>12</sup> was described as "*tight like a brick.*"
19. Dr Kumarasinghe stated she had visual confirmation of correct positioning of the ETT and there was initial presence of End Tidal Carbon Dioxide (ETCO<sub>2</sub>),<sup>13</sup> so she initiated immediate management of bronchospasm<sup>14</sup> and/ or anaphylaxis.<sup>15</sup> Dr Kumarasinghe requested salbutamol,<sup>16</sup> which was not in the room. XH was profoundly difficult to ventilate with rapidly decreasing oxygen saturations from 70 to 40 percent.<sup>17</sup>

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<sup>5</sup> A grading system (1 to 4) based on visualisation of the pharyngeal structures as a predictor of difficulty of intubation, the higher the score the more likely difficulties encountered.

<sup>6</sup> Laryngoscope (device to visualise the larynx and vocal cords for intubation), with a camera, many advantages which include sharing of information amongst the team (team can view the intubation).

<sup>7</sup> Opiate medication (commonly used in induction, faster onset of action than morphine).

<sup>8</sup> Commonly used anaesthetic agent.

<sup>9</sup> Commonly used short term paralysis agent to facilitate intubation.

<sup>10</sup> Classification of views for laryngoscopy with Grade 1 being a full view of the vocal cords, that is a good view.

<sup>11</sup> Breathing circuit for ventilation.

<sup>12</sup> Bag on the ventilation circuit which allows manual ventilation and also the anaesthetist can get an impression of resistance or pressure in the circuit. In this case very hard to ventilate with high pressures.

<sup>13</sup> The CO<sub>2</sub> waveform can be useful to confirm correct ETT placement and ventilator trouble shooting. Normal End tidal CO<sub>2</sub> is approximately 38mmHg and typically there is a square trace which confirms appropriate ventilation. Causes of a flat trace would include ventilator disconnection, airway misplacement, respiratory or cardiac arrest, capnography not connected/ malfunctioning. Causes of Low End tidal CO<sub>2</sub> would include airway obstruction, extubation, apnoea, hyperventilation.

<sup>14</sup> Narrowing of the airways (as in asthma, but there are other causes such as anaphylaxis) this would increase the pressures in the anaesthetic circuit.

<sup>15</sup> Severe potentially life-threatening allergic reaction, signs include rash, shock (drop in Blood Pressure) bronchospasm, nausea and vomiting, triggers include medications (such as suxamethonium), foods.

<sup>16</sup> Medication used to treat asthma and bronchospasm.

<sup>17</sup> Critically low oxygen levels in the blood, normal would be 95 to 100%, 70% critically low.

20. At 12.33pm, the emergency buzzer was activated, and Dr Teresa Trinh, anaesthetist, attended. Dr Trinh auscultated<sup>18</sup> XH's chest and with the manual bag ventilation and reported she heard breath sounds and crackles, which confirmed the correct placement of the ETT. At this point the ETCO<sub>2</sub> was 10mmHg.<sup>19</sup>
21. At 12.34pm, XH had no palpable pulse and advanced life support according to usual protocols was immediately instituted. Dr Kumarasinghe reported a loss of pressure in the anaesthetic circuit, so the machine was checked, but no issues were found.
22. Dr Joseph Isac, anaesthetist attended approximately five minutes after arrest to assist.
23. Dr Kumarasinghe attempted to directly assess the placement of the ETT with the VL on two occasions but was unable to safely reinsert the blade with the movement caused by cardiopulmonary resuscitation.
24. At approximately 12.48pm there was return of spontaneous circulation (**ROSC**).
25. Dr Sophie Georghi,<sup>20</sup> anaesthetist, attended at about this time of shortly thereafter. She subsequently checked the position of the ETT and found it to be in the oesophagus.<sup>21</sup> A new ETT was sited and the ETCO<sub>2</sub> was recorded at 70mmHg. The peak pressure remained high.
26. At approximately 1.50pm, XH was transferred to the intensive care unit. A subsequent MRI indicated severe hypoxic cortical injury.
27. On 20 April 2019, XH was declared brain dead. His family kindly consented to organ donation and he was kept on life support for this purpose until 22 April 2019.
28. In her statements dated 11 September 2019 and 27 November 2020, Dr Kumarasinghe stated she had reflected on this case to a great degree and was confident the ETT was appropriately sited in the trachea but could not exclude the possibility that it moved during cardiopulmonary resuscitation (most likely at the time there was a loss of pressure from the anaesthetic circuit). She stated intubation of the oesophagus results in a different tactile feedback when bag-ventilating (that is easy to ventilate and not tight like a brick). There was no evidence of aspiration/ regurgitation of stomach contents into the lungs and mouth which argues against

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<sup>18</sup> Listened with a stethoscope.

<sup>19</sup> Very low, it would be questionable that adequate ventilation was taking place.

<sup>20</sup> 'Georgi' amended to 'Georghi' pursuant to section 76 of the *Coroners Act 2008* (Vic).

<sup>21</sup> 'laryngeal inlet just above the vocal cords (not in the trachea)' amended to 'oesophagus' pursuant to section 76 of the *Coroners Act 2008* (Vic).

oesophageal intubation. Dr Kumarasinghe also noted that the position of the ETT was checked on three separate occasions by auscultation<sup>22</sup> of the lungs.

29. The high airway pressures from outset, skin erythema,<sup>23</sup> and the fact that she had just administered a muscle relaxant drug known to cause anaphylaxis led to Dr Kumarasinghe's belief that XH was suffering from bronchospasm and/ or anaphylaxis. The high pressures to ventilate XH continued after replacement of the ETT, which supported the diagnosis of bronchospasm that slowly resolved with repeated doses of adrenaline. Dr Kumarasinghe also stated there was no correlation between the change of the ETT and ROSC. Given that ROSC occurred before the ETT was re-sited, this too suggested bronchospasm or anaphylaxis was the most likely cause of the arrest.
30. Dr Kumarasinghe also noted XH had a 1cm patent foramen ovale,<sup>24</sup> which was detected on the heart harvest report and not known previously. She also explained that while there are other methods to confirm correct ETT placement, such as via VL or with direct laryngoscopy, this is difficult when a patient has arrested and cardiopulmonary resuscitation is underway.
31. In her statement dated 4 December 2020, Dr Trinh noted that when she entered the theatre, she observed XH's face to be swollen, and his neck and face were congested and engorged. The ETT was observed to be in situ and fogging with ventilation. She stated that she auscultated XH's chest and the presence of breath sounds bilaterally further confirmed correct placement. The ETCO<sub>2</sub> tracing was present, but with small amplitude and low level. Dr Trinh was of the opinion that XH had experienced bronchospasm, that the initial intubation had been successful, but the tube had migrated during XH's arrest.
32. In his statement dated 27 November 2020, Dr Isac was of the opinion that bronchospasm had caused high airway pressures, which may have resulted in increased intra-thoracic pressure that in turn could have exacerbated a reduction in venous return to the heart,<sup>25</sup> further contributing to cardiovascular collapse. He noted that if the ETT was in the oesophagus for the entire period, he would have expected the ETT to have been soiled with stomach contents.

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<sup>22</sup> Listen with a stethoscope.

<sup>23</sup> Red skin.

<sup>24</sup> Congenital heart lesion (hole between left and right sides of the heart which normally closes shortly after birth), often asymptomatic, can persist into adulthood. Main issue is risk of stroke.

<sup>25</sup> Blood returning through the venous system to the heart.

33. In her statement dated 21 November 2020, Dr Georghi<sup>26</sup> similarly described XH as deeply cyanosed,<sup>27</sup> his epigastrium<sup>28</sup> was very distended and distending with every cardiac compression. There was no ETCO<sub>2</sub> trace despite what appeared to be effective cardiac massage. Dr Georghi<sup>29</sup> stated to the clinicians in the room that she thought the ETT was not in the right place as the monitor showed no CO<sub>2</sub> trace and his abdomen was very distended. She subsequently performed a laryngoscopy and found the ETT was in the oesophagus. She removed the ETT then re-intubated XH. Following this there was a ETCO<sub>2</sub> trace with a usual waveform and ROSC.

## **REVIEWS CONDUCTED AFTER XH'S DEATH**

34. Knox Private Hospital commissioned an independent case review from Professor David Scott, anaesthetist.
35. Professor Scott explained that the use of VL enabled visual confirmation of correct ETT placement by the anaesthetist and others in the room. It remained unclear as to whether the ETT was initially kinked, obstructed or displaced early. He noted that the ETT position was not visually rechecked until late in the arrest. This delay was likely due to a number of factors including confidence in initial ETT placement, small amounts of ETCO<sub>2</sub> initially, chest auscultatory findings, and the focus on the presumed diagnosis of anaphylaxis.
36. He warned that auscultation of the chest for breath sounds on its own can lead to false positive assumptions regarding correct ETT placement and that confidence in the initial correct placement of the ETT should not override the need to formally review the tube's position, especially if the capnography trace is ambiguous. He noted that the Royal College of Anaesthetists (UK) has recently undertaken a widespread education campaign to emphasise the importance of capnography waveform in confirmation of ETT placement.
37. Professor Scott noted that XH's history of drug allergy and asthma added to the risk of allergic response or bronchospasm. Suxamethonium is the most common muscle relaxant to cause anaphylaxis. This can be severe, prolonged, difficult to treat and can initially present as bronchospasm.

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<sup>26</sup> 'Georgi' amended to 'Georghi' pursuant to section 76 of the *Coroners Act 2008* (Vic).

<sup>27</sup> Blue discolouration of the skin due to poor circulation or inadequate oxygenation of the blood.

<sup>28</sup> Upper central region of the abdomen, over the stomach.

<sup>29</sup> 'Georgi' amended to 'Georghi' pursuant to section 76 of the *Coroners Act 2008* (Vic).

38. Professor Scott was of the opinion that the process of management of cardiopulmonary resuscitation appeared to have gone well. However, there were issues with crowd control in the theatre. He suggested a cognitive aid, for example a laminated card, to be used by person running the arrest and clearly identifying key people in the resuscitation team, for example with sticky labels. He raised the question as to whether the use of a mechanical chest compression device considered and noted that theatre technicians not trained in Basic Life Support.
39. Megan Mills, Director of Nursing at Knox Private Hospital, also provided a statement, dated 21 December 2020, and provided me with a summary of the Safer Care Victoria root cause analysis.
40. The root causes identified by the root cause analysis process were as follows:
- (a) dislodgement of the ETT from the trachea of unknown cause, possibly when the stylet<sup>30</sup> was removed, which contributed to the ETT being found in the oesophagus;
  - (b) lack of effective pre-oxygenation prior to induction contributed to the rapid oxygen desaturation and further clinical deterioration;
  - (c) placement of the ETT was not visually inspected until the fourth anaesthetist attended, which contributed to XH suffering a cardiac arrest and subsequent hypoxic brain injury;
  - (d) following being treated for bronchospasm/ anaphylaxis and a failure to improve, concerns regarding the placement of the ETT were not acted upon; and
  - (e) the absence of ETCO<sub>2</sub> did not prompt consideration that the placement of the ETT was incorrect.
41. Ms Mills stated that the following ‘learnings’ were identified:
- (a) a review of the policy regarding cardiac arrest in operating room was needed. The importance of ETCO<sub>2</sub> in confirming the ETT was in trachea and to monitor quality of CPR during cardiac arrest was to be noted. Further methods of confirming placement were also to be noted;

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<sup>30</sup> Metal stylet is within the ETT to aid intubation by increasing rigidity of the tube then removed under direct vision when the ETT has been visualised to pass through the vocal cords.



- (b) theatre technicians are not assessed in basic life support. Assessment commenced a week after this incident;
- (c) the Code Blue team is required to announce their arrival at the incident and is responsible for ensuring there are not excess staff present;
- (d) until a comprehensive central data capture system available, photographs of the physiological and haemodynamic variables must be taken and placed in the medical records;
- (e) documentation on the anaesthesia medical record of drug administration appeared inaccurate; and
- (f) the views of medical practitioners attending emergencies should be considered on merit and not dismissed.

42. Recommendations from the root cause analysis were as follows:

- (a) review of cardiac arrest in the operating room policy. The review included advice regarding alternate steps to verify position of ETT in the absence of capnography, to repeatedly verify correct placement of ETT immediately following the cardiac arrest and every two minutes in line with Advanced Life Support protocol, and lockdown the operating room post critical event to allow examination of data from equipment. This recommendation has been implemented and I was provided with a copy of the new policy;
- (b) discussion with the College of Anaesthetists to determine the establishment of guidelines that emphasise the use of ETCO<sub>2</sub> to confirm ETT placement. This recommendation had not been implemented by the time of Ms Mills's statement;
- (c) clear identification of roles in a medical emergency. This recommendation has been implemented with labelled high visibility vests;
- (d) capnography must be available for all cardiac arrests within the hospital. This recommendation has been implemented; capnography is available on all crash carts;
- (e) centralised monitoring system to access and interrogate data in the operating suite. This recommendation had not been implemented at the time of Ms Mills's statement – funding had been approved, but installation was delayed due to COVID-19; and

- (f) medical practitioners show mutual respect and consider the opinion of all colleagues, sharing appropriate levels of information in emergencies. This recommendation was implemented by way of email communication to medical staff.

## **CONCERNS RECEIVED FROM XH'S FAMILY**

- 43. In December 2019, XH's family submitted a number of concerns about the treatment he received at Knox Private Hospital. A number of these concerns, such as poor recordkeeping, are more appropriately directed to the hospital as they are not directly connected to the cause of XH's death.
- 44. However, in light of the concerns raised about EET placement and reliance on ETCO<sub>2</sub>, I obtained advice from the Coroners Prevention Unit (CPU). The CPU 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.
- 45. The CPU reviewed the pre-anaesthetic assessment and noted that it appeared appropriate.
- 46. The main issue was whether the ETT was positioned correctly in the first instance. The CPU explained that most reliable ways to confirm correct placement are:
  - (a) direct visualisation of the tube passing through the cords; and
  - (b) confirmation of this with ETCO<sub>2</sub> detection and capnography (monitoring the wave form).
- 47. The CPU noted, and I agree, that this was an unfortunate case, and it is difficult in retrospect to determine the exact sequence of events. It would appear that XH was successfully intubated in the first instance as the ETT was visualised to pass through the vocal cords. There was never a normal ETCO<sub>2</sub> trace and possible reasons for this would include early dislodgement, kinking, or obstruction.

48. The CPU considered that there was an anchoring bias<sup>31</sup> on the diagnosis of anaphylaxis, which meant other causes of XH's deterioration were not considered. There was an opportunity during the cardiac arrest to visually check the position of the ETT earlier.
49. The CPU noted that Knox Private Hospital took extra steps in reviewing the circumstances leading to XH's death by commissioning an independent review and referring the case to Safer Care Victoria, which is not mandatory for private hospitals. A number of root causes and learnings were identified during the root cause analysis, and the recommendations have largely been acted upon. I commend Knox Private Hospital for conducting this further investigation and implementing changes.
50. The CPU suggested that I recommend the Australian and New Zealand College of Anaesthetists consider the establishment of guidelines emphasising the use of ETCO<sub>2</sub> in ETT placement. Given the circumstances leading to XH's death, I accept this advice and will make that recommendation.

## **FINDINGS AND CONCLUSION**

51. Pursuant to section 67(1) of the Act I make the following findings:
  - (a) the identity of the deceased was XH, born 2 February 1973;
  - (b) the death occurred on 20 April 2019 at Knox Private Hospital, 262 Mountain Highway, Wantirna, Victoria, from hypoxic ischaemic brain injury complicating a cardiac arrest during anaesthetic induction for an elective inguinal hernia repair; and
  - (c) the death occurred in the circumstances described above.

## **RECOMMENDATIONS**

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

1. I recommend that the **Australian and New Zealand College of Anaesthetists** consider the establishment of guidelines emphasising the use of End Tidal Carbon Dioxide in Endotracheal Tube placement.

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

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<sup>31</sup> A cognitive bias where an individual depends too heavily on an initial piece of information which impairs subsequent judgments in decision making.

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:

Senior next of kin

Dr Theresa Trinh (care of Kennedys Law)

Dr Sophie Georghi (care of Ball + Partners)

Dr John Ding (care of Lander & Rogers)

Dr Joseph Isac (care of Avant Law)

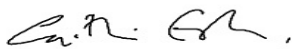
Knox Private Hospital (care of Minter Ellison)

Dr Indunil Kamarasinghe (care of Kennedys Law)

Nigel Fidgeon, Chief Executive Officer, Australian and New Zealand College of Anaesthetists

Senior Constable Jereme Virtue, Victoria Police, Coroner's Investigator

Signature:



Caitlin English, Deputy State Coroner

Date: 25 October 2021

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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 6 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.

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