CITATION: *Inquest into the death of Linda Nha Tran* [2011] NTMC 033

TITLE OF COURT:	Coroner's Court
JURISDICTION:	Alice Springs
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FINDING OF:	Mr Greg Cavanagh SM
CATCHWORDS:	**Unexpected death in hospital, complications arising at birth and treatment thereof, communications between treating medical professionals**

REPRESENTATION:

Counsel:

Assisting:	Jodi Truman
Department of Health:	Michael Maurice QC
Family:	Paul McCaffrey

Judgment category classification:	B
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IN THE CORONERS COURT
AT ALICE SPRINGS IN THE
NORTHERN TERRITORY
OF AUSTRALIA

No. A0032/2010

In the matter of an Inquest into the death of
LINDA NHA TRAN
ON 2 JUNE 2010
AT THE INTENSIVE CARE UNIT,
ALICE SPRINGS HOSPITAL

FINDINGS

(9 September 2011)

Mr Greg Cavanagh:

Introduction

1. Linda Nha Tran ("the deceased") was a Vietnamese female born on 28 October 1975 in Binh Dinh, Vietnam. At approximately 7.30am on Wednesday 2 June 2010, the deceased presented at the Alice Springs Hospital ("ASH") for a scheduled caesarean delivery. Shortly before 1.00pm the deceased was transferred to the operating theatre. Surgery began at 1.20pm and at 1.30pm the deceased gave birth to a baby girl without incident.

2. Approximately 10 minutes after delivery there was a fall in the deceased's blood pressure with an increase in heart rate. At that time the deceased was found to be bleeding from the uterus and emergency management of a massive haemorrhage continued. As will be detailed later in these reasons, the deceased suffered cardiovascular collapse on a number of occasions and despite various attempts made by hospital staff, it was agreed that further treatment was futile. Ms Tran was declared deceased at approximately 6.45pm on 2 June 2010.

3. Her death was unexpected and thus reportable to me pursuant to s12 of the *Coroners Act*. The holding of a public inquest is not mandatory but was

held as a matter of my discretion pursuant to s15 of that Act and particularly as a result of a request from her husband for there to be a public inquiry.

4. Pursuant to s34 of the Act, I am required to make the following findings:

> "(1) A Coroner investigating:
>
> a. A death shall, if possible, find:
>
> (i) The identity of the deceased person.
>
> (ii) The time and place of death.
>
> (iii) The cause of death.
>
> (iv) Particulars required to register the death under the *Births Deaths and Marriages Registration Act*"

5. I note that section 34(2) of the Act also provides that I may comment on a matter including public health or safety connected with the death being investigated. Additionally, I may make recommendations pursuant to section 35 as follows:

> "(1) A Coroner may report to the Attorney General on a death or disaster investigated by the Coroner.
>
> (2) A Coroner may make recommendations to the Attorney General on a matter, including public health or safety or the administration of justice connected with a death or disaster investigated by the Coroner.
>
> (3) A Coroner shall report to the Commissioner of police and Director of Public Prosecutions appointed under the Director of Public Prosecutions Act if the Coroner believes that a crime may have been committed in connection with a death or disaster investigated by the Coroner"

6. Counsel assisting me at this inquest was Ms Jodi Truman. Mr Michael Maurice QC was granted leave to appear as counsel on behalf of the Department of Health instructed by Ms Elizabeth Farquhar. Mr Paul McCaffrey was granted leave to appear as counsel on behalf of the family

instructed by Mr Tom Ballantyne. I thank all Counsel for their very helpful assistance in this matter and their conduct during the course of the inquest.

The Conduct of this Inquest

7. A total of 6 witnesses gave evidence before me. Those persons were:

   7.1 Senior Constable Sean Sandry, the Officer in charge of the Coronial Investigation;

   7.2 Dr Megan Halliday, Obstetrician and Gynaecologist;

   7.3 Dr Jhansi Lakshmi, Staff Specialist, Obstetrician and Gynaecologist;

   7.4 Dr Mahesh Ganji, Specialist Anaesthetist;

   7.5 Dr Penny Stewart, Director of Intensive Care Unit at ASH; and

   7.6 Dr Don Cave, Obstetrician and Gynaecologist and Director of Perinatal Medicine at the Mater Women and Children's Hospital in Brisbane, Queensland.

8. A brief of evidence containing various statutory declarations from relevant medical staff, medical reports, autopsy report, police documentation and other medical records were tendered into evidence (exhibits 1 and 2). The death was investigated by Senior Constable Sean Sandry and I thank him for his investigation.

Formal Findings

9. Pursuant to section 34 of the *Coroners Act* ("the Act"), I find, as a result of evidence adduced at the public inquest as follows:

   i. The identity of the deceased person was Linda Nha Tran, born on 28 October 1975 in Binh Dinh, Vietnam.

ii. The time and place of death was at approximately 6.45pm on 2 June 2010 in the Intensive Care Unit at the Alice Springs Hospital.

iii. Particulars required to register the death:

a. The deceased was female.

b. The deceased's name was Linda Nha Tran.

c. The deceased was of Vietnamese descent.

d. The death was reported to the Coroner.

e. A post mortem examination was carried out by Dr Terence Sinton who confirmed the cause of death as catastrophic post-partum haemorrhage.

f. The deceased lived at 16 Ellery Drive, Alice Springs in the Northern Territory.

g. The deceased was unemployed at the time of her death.

h. The deceased was married to David Scott Robinson.

Circumstances surrounding the death

Background

10. At the time of her death the deceased was 34 years of age. She was born in Binh Dinh, Vietnam on 28 October 1975 and had 3 siblings. In about 1978-1979 the family moved from Vietnam as refugees to Los Angeles, California in the United States of America ("USA"). The family settled in Los Angeles and the deceased completed her schooling graduating from high school and then attending the University of Southern California where she gained her Bachelor's Degree in History.

11. The deceased spent a short time in the US Army and then travelled to South Korea as a civilian contractor for "Atlantic Telephone and Telegraphing"

("AT&T"). In 2000, whilst still in South Korea, the deceased met her future husband, David Robinson, who was stationed there with the US Air Force. The couple moved back to Florida in 2001 and then married on 7 August 2002.

12. On 30 July 2003 the couple had their first child, namely Daniel, and on 29 September 2006, their second child, Caitlin, was born. In January 2009, the young family moved to Alice Springs through Mr Robinson's employment with the Air Force. The deceased gained employment as a sales assistant at a local restaurant in Alice Springs and then around Christmas 2009, the deceased discovered she was pregnant.

13. In terms of her pregnancy history, the deceased was noted in the records held by the Joint Defence Force Medical Clinic, Alice Springs, as follows:

    13.1 First pregnancy – miscarriage at 16-20 weeks;

    13.2 Second pregnancy (2003) – C-section due to large sized baby (9 lbs.);

    13.3 Third pregnancy (2006) – C-section. Pregnancy deemed high risk due to complication by eclampsia and confinement to bed rest for one (1) month during the second trimester.

14. In March 2010 Ms Tran was diagnosed with gestational diabetes. This was treated per diet, rather than medication. It appears on the evidence that her pregnancy was for all intents and purposes normal.

<u>Events at Alice Springs Hospital</u>

15. On Friday 28 May 2010 Ms Tran attended the pre-anaesthetic clinic at Alice Springs for an assessment prior to her scheduled lower segment caesarean section. It appears that a caesarean was required because Ms Tran had undertaken two previous caesarean sections. On examination it was

recorded that there were "no significant findings" except that Ms Tran was of "small frame".

16. At 7.30am on Wednesday 2 June 2010, Ms Tran presented at the ASH. Shortly prior to 1.00pm she was transferred to the operating theatre. She had an intravenous infusion running via a cannula in her right hand and a urinary catheter in place. A spinal anaesthesia was administered and proceeded uneventfully. Her initial blood pressure reading, and heart rate, was stable. Her caesarean surgery began at 1.20pm.

17. At 1.30pm Ms Tran gave birth to her third child, namely Abigail, without incident. I received evidence that following the birth of a baby, the next step is the removal of the placenta. Normally after a birth the uterus contracts and spontaneously releases the placenta. The uterus is blood rich to supply the baby's needs via the placenta, and therefore when it contracts it constricts the feeding blood vessels to the placenta and terminates any bleeding. Sometimes however the placenta does not separate and this is what occurred in relation to Ms Tran.

18. When the uterus did not contract, Dr Megan Halliday (who was performing the caesarean) placed her hand into the uterus and using her fingertips, she attempted to find the plane of separation between the placenta and the uterine wall in order to commence the separation process. I heard evidence that this was in accordance with accepted practice.

19. During this process Dr Halliday gave evidence that she discovered a portion of the placenta, approximately 5cm in diameter, which would not separate easily from the uterine wall. I heard evidence that this is known as placenta accreta which is when the placenta attaches itself too deeply into the wall of the uterus. When this occurred Dr Halliday advised the senior anaesthetist involved in the caesarean, namely Dr Mahesh Ganji, that the uterus was not contracting well and she suspected placenta accreta.

20. Both doctors Ganji and Halliday stated that in their experience placenta accreta often results in excessive bleeding. As a result, Dr Ganji gave evidence that he telephoned the pathology section and requested more cross-matched blood. Dr Ganji stated that he requested cross-matched blood as he preferred to use such blood where possible, rather than o-negative (or un-cross-matched) blood which carries a higher risk of infection. At the time of the call to pathology it appears that there was no profuse bleeding.

21. Dr Halliday continued separating the placenta from the uterus in a piecemeal fashion. As she did this however the uterus began to bleed profusely. It appears that the removal process took a few minutes. At 1.40pm Ms Tran suffered a fall in blood pressure from the blood loss. Dr Ganji administered fluids and also a vasopressor called Metaraminol. I heard evidence that vasopressors constrict blood vessels to increase blood pressure and are the usual practice undertaken in such circumstances. Ms Tran immediately responded and her blood pressure rose.

22. I heard evidence that Dr Halliday then exteriorised, or "took out", the uterus from the peritoneal cavity, so that she could have a better view and access. Ms Tran was also given oxytocin which is a hormone that causes smooth muscle contraction. Dr Halliday stated that she gave this to assist the uterus to contract.

23. During this time attempts were also being made to estimate Ms Tran's blood loss. I heard evidence that estimating blood loss during such procedures can be very, very difficult. The blood goes onto sponges, suction bottles, drapes and the floor. Estimates are therefore based on such items, as well as visual estimates. It appears that whilst this is not a very reliable method, there is at present no better method. Via this process it was estimated that Ms Tran had lost about 1.5 to two litres of blood, however it was acknowledged by both doctors Halliday and Ganji that it was possible that there was greater blood loss.

24. Dr Halliday was being assisted by Dr Hnin Aung; who held the uterus in her hands and manually compressed it to help it contract so as to constrict the blood vessels and stop the bleeding. Dr Halliday gave evidence that at this time she considered the uterus was contracting well and the bleeding appeared to settle. Dr Halliday then began to suture the surgical wound. During this time, Dr Halliday stated that she noted that the inferior, or below, aspect of the lower uterine segment was "paper thin" and tearing through. As a result, Dr Halliday limited the number of sutures she made. During this time no blood came from the uterus. After finishing the suturing, the uterus was placed back into the peritoneal cavity and Dr Halliday considered it appeared to be well contracted and not bleeding. Dr Halliday then closed the abdomen, which took approximately 20-30 minutes. Surgery then concluded at 2.15pm.

25. Dr Halliday then conducted a vaginal examination. At this time she observed a "brisk flow of blood" which she considered was coming from the uterus. Dr Halliday expressed the blood clots and then began an external massage of the uterus, again in an attempt to simulate further contraction of the uterus. Dr Halliday stated that she also administered four Misoprostol tablets. I heard evidence that this is another smooth muscle contractor. Despite these interventions, the bleeding did not settle and it was realised that further steps needed to be taken. As a result, a bimanual compression of the uterus was undertaken and Dr Lakshmi was called to assist. During this process it was estimated that a further 800-1,000 mLs of blood was lost.

26. By this stage the total amount of blood estimated to have been lost was almost three litres. I heard evidence that given Ms Tran's size, this was almost certainly greater than 50% of her blood volume. As a result she was exhibiting signs of shock. At 2.20pm Ms Tran's blood pressure dropped for the second time from the blood loss. By this stage it was realised that Ms Tran was suffering a massive post-partum haemorrhage ("PPH").

27. I received evidence that that at least 10% of births at ASH are complicated by PPH. PPH is when the blood loss suffered by the patient is more than 500 mLs at delivery. Massive PPH is when the blood loss is more than 1,500 mLs. Material was tendered in evidence before me which showed that in 2010 there were at least eight cases, in addition to the case of Ms Tran, where there was massive PPH. As at July 2011 there had already been at least five cases of massive PPH.

28. Due to the amount of blood loss, contact was again made by Dr Ganji with pathology to determine the status of the earlier ordered cross-matched blood. Dr Ganji stated that he was told that the cross-matched blood was on its way. The ASH records show the blood arrived soon after and transfusion commenced at 2.25pm. Ms Tran was also placed under general anaesthetic at 2.30pm.

29. Dr Halliday gave evidence that in a further attempt to try and control the bleeding, she inserted what is known as a Bakri, or intra uterine, balloon. I heard evidence that this is a well-recognised technique for dealing with PPH and is a balloon that is inserted per the vagina and inflated with water, thus exerting pressure on the placental bed. This is the area where Dr Halliday considered the blood was coming from. Shortly after its insertion, Dr Halliday gave evidence that it appeared to her that the bleeding was slowing. This is when Dr Lakshmi arrived.

30. Dr Lakshmi gave evidence that when she arrived Ms Tran's blood pressure was about 110 and there was nothing that she saw upon entering the operating theatre that caused her any particular alarm. Dr Lakshmi conducted an ultra sound of the abdomen to see the positioning of the balloon and found that it had not been inserted as high as hoped. It was therefore deflated and pushed a little higher. There did not appear to be a great deal of bleeding at this time. Dr Halliday stated that at this point she advised Dr Lakshmi that she had seen two of the earlier inserted four

Misoprostol tablets had fallen out. Dr Halliday was therefore considering the administration of further tablets; however Dr Lakshmi suggested an injection of Prostaglandin F2 alpha ("PGF2α").

31. I heard evidence that PGF2α is a strong contractor of the uterine muscle used to control bleeding and is often the last step in medical management of massive PPH before surgical intervention. I received evidence from Dr Don Cave that PGF2α is 90% metabolised on first passage through the lungs, but that too large an amount can overload the lung metabolic pathways and allow the un-metabolised PGF2α into the systemic arterial system, resulting in cardiovascular effects.

32. Dr Halliday gave evidence that she agreed with Dr Lakshmi's suggestion of the PGF2α, at which point Dr Lakshmi prepared the injection and administered the drug. Dr Lakshmi gave evidence that she had used PGF2α previously and "knew" the guidelines for its preparation. I received these guidelines into evidence and they appeared quite detailed and complex. Unfortunately, whilst it does appear that Dr Lakshmi did know the guidelines for the "preparation" of the injection and appears to have prepared the injection correctly, she did not "administer" the drug correctly.

33. Dr Lakshmi injected the drug in such a way that instead of administering the drug in three separate doses of 1 mg, 10-15 minutes apart, to a maximum of 3 mgs (as per the guidelines). She in fact administered the PGF2α by way of two separate doses of 1.5 mgs only minutes apart from one another. By her own admission, this was "too high" a dose and something that Dr Lakshmi stated "I deeply regret".

34. According to the evidence, it also appears that the anaesthetist, Dr Ganji, was not advised of the intention to administer the PGF2α. As stated earlier, given the possible effects upon the heart and lungs, this appears to have been a serious oversight. Dr Ganji gave evidence that he was well aware of the risk associated with PGF2α upon the heart and the lungs and that he

would have "expected" to have been informed of its intended administration. There was also no discussion between doctors Halliday and Lakshmi of the amount of PGF2α to be administered, nor how.

35. At approximately 3.20pm, and within only a minute or two of the administration of the PGF2α, Ms Tran's blood pressure rose dramatically and she went into cardiac arrest. The anaesthetic team commenced cardio pulmonary resuscitation ("CPR") and to facilitate this, Ms Tran was placed into the supine (or face up) position. This position however made it difficult to monitor any continued blood loss. After approximately 25 minutes of CPR, Ms Tran's cardiac rhythm returned however she was on high doses of adrenaline and noradrenaline infusions to keep her heart rate and blood pressure. I heard evidence that the abdominal drain was checked and there appeared to be no bleeding, however bleeding continued from the vagina and it was more than before.

36. At 3.55pm Ms Tran suffered another episode of cardiovascular collapse which was recovered after a few minutes of CPR, but again she was on high doses of adrenaline and calcium. Because Ms Tran continued to bleed from her vagina, a decision was made to conduct a hysterectomy. At 4.05pm, Dr Lakshmi performed the hysterectomy, which was described as "uneventful" and "with little bleeding". The hysterectomy was completed at 4.50pm and at approximately 5.30pm Ms Tran was transferred to the Intensive Care Unit ("ICU") under the care of Dr Penny Stewart.

37. According to the statement of Dr Stewart (exhibit 11), which was accepted into evidence with the consent of all persons involved in this inquest, she had in fact attended at the operating theatre just prior to the commencement of the hysterectomy. Dr Stewart stated that when Ms Tran's abdomen was opened, she was "struck" by the fact that all Ms Tran's "tissues appeared to be white, even once circulation was restored". Dr Stewart stated that at paragraph 6 :

> "It appeared that Linda's blood vessels were tightly constricted. This appearance was worrying because it signified that, although blood pressure had been restored, blood flow to most of her organs had not been restored. Lack of blood flow in such circumstances always concerns me as it indicates a sick heart that is unable to pump blood effectively and also indicates that there will be tissue damage and organ damage because of the lack of blood flow. This can lead to multi-organ failure".

Dr Stewart went on at paragraph 7:

> "My concern was that Linda was already in multi-organ failure and signs of irreversible shock were present. From a heart point of view she was in gross pulmonary oedema (fluid on the lungs). From a kidney point of view she was passing no urine. From a liver point of view she needed recurrent boluses of calcium which implied she had citrate chelating the calcium. Citrate is present in the packed cells to stop the blood clotting. It is metabolised by the liver and Linda was acting like this metabolism was not occurring".

And further at paragraph 8:

> "I knew that we would need to place her on dialysis when she returned from theatre and given her degree of hyperkalaemia and acidosis this would need to be done quickly".

38. It appears clear from the evidence that by the time Ms Tran arrived at the ICU she had several serious conditions, all of which were life threatening, and all of which Dr Stewart and her ICU team attempted to deal with. Ms Tran had developed a pulmonary oedema and very difficult ventilation. ICU staff were unable to get oxygen saturations. Ms Tran's blood gases revealed adequate (but poor) oxygenation and severe metabolic acidosis. Within a relatively short period it was the opinion of Dr Stewart that Ms Tran's instability was because "of the degree of damage to her organs, not because of ongoing blood loss". Dr Stewart stated at paragraph 15, that:

> "I thought the reason she was deteriorating is that she had too much damage to her heart and organs from the lack of blood flow during her arrest".

39. Dr Stewart attempted to place Ms Tran on dialysis which, as indicated earlier, was something she had considered "needed to be done quickly". At paragraph 16 Dr Stewart stated:

> "We tried to place her on dialysis and her blood pressure dropped. I realised at this stage we could not stabilise her enough to place her on dialysis and that without dialysis she was going to die. This was a situation that had no management options".

40. Dr Stewart stated that it was agreed that "all other measures were futile" and as a result she went out to Ms Tran's husband and brought him to Ms Tran's bedside. At 6.45pm, Ms Tran passed away.

41. On Friday 4 June 2010, Dr Terence Sinton (Director of the Forensic Pathology Unit at the RDH) conducted an autopsy upon Ms Tran. Following his examination Dr Sinton expressed the opinion that the condition leading directly to Ms Tran's death was "Catastrophic Post-Partum Haemorrhage of undetermined cause" following a caesarean delivery.

Issues Considered

42. At the commencement of this inquest, counsel assisting submitted that the principal issues for my consideration were as follows:

    42.1 Whether I could find on the balance of probabilities what caused the catastrophic PPH described in the autopsy report as the cause of Ms Tran's death;

    42.2 Whether everything that could have been done to save Ms Tran's life, was done;

    42.3 Whether Ms Tran's death was avoidable;

    42.4 Whether I should make any recommendations to avoid such a death in future.

    I will now address each of the above issues in turn.

Can I find what caused the catastrophic post-partum haemorrhage which brought about Ms Tran's death?

43. In relation to this issue, I note that very shortly following Ms Tran's death the ASH commissioned an independent review to be conducted in relation to the circumstances surrounding Ms Tran's death. That review was conducted by Dr Don Cave, Obstetrician and Gynaecologist and Director of Perinatal Medicine at the Mater Women and Children's Hospital in Brisbane, Queensland, together with Dr Kym Osborne, Head of Women's Anaesthetic Department at the Women and Children's Hospital in Adelaide, South Australia. Both doctors gave very detailed and helpful reports following their review which were tendered into evidence as a bundle as exhibit 3.

44. In addition to his report, Dr Cave also gave evidence before me. Dr Osborne was not required by any of the parties involved and his report was simply tendered by consent into evidence. Dr Cave's evidence was extremely helpful in terms of the question of the cause of the massive (or catastrophic) PPH. Dr Cave stated during the course of his evidence that PPH is one of the well-recognised and true obstetric emergencies "contributing to a significant number of maternal deaths in morbidity and mortality reports in both the developed and developing world". He stated many times during the course of his evidence that it was "extremely serious" and I accept this evidence.

45. Dr Cave stated that the survival rates for massive PPH very much depended on the "cause" of the PPH. He gave evidence that "in the developing world" the prospects of survival were "reasonable" but that this was "not the case for all causes". Dr Cave gave evidence that in the case of Ms Tran, the cause of the massive PPH was the placenta accreta, i.e. the morbidly adhered portion of the placenta to the uterus. Dr Cave stated that in cases of placenta accreta which result in massive PPH the prospects of survival were "significantly inferior".

46. Dr Cave gave evidence that even in the very early stages when Ms Tran suffered her first loss in blood pressure at 1.40pm, and only 10 minutes after the birth of her child, Ms Tran's circumstances were "very serious" and she was "already showing signs of hypovolemic shock" as a result of having "lost a significant amount of blood volume". Dr Cave stated that by the time of Ms Tran's second significant drop in blood pressure at 2.20pm, Ms Tran's cardiovascular system had already been significantly compromised as a result of having been resuscitated from the first drop in blood pressure.

47. Dr Cave stated that in relation to the actions taken by Dr Halliday prior to the arrival of Dr Lakshmi, he considered them to have been "entirely reasonable" in the circumstances. Dr Cave stated that up until the point of the insertion of the Bakri balloon he considered that Dr Halliday (tp.70.5):

> " … my view is that this is an incredibly difficult obstetric situation to have to deal with. Placenta accreta is nasty. And it's difficult enough to deal with in the setting of knowing that that's what you're going to be dealing with before you start the procedure. Dr Halliday didn't have the benefit of knowing that through no fault of her own, through no one's fault really. Could she have anticipated this was a – that it was going to be a placenta accreta. Why I don't think so, placenta accretas do occur in association with some other obstetric events, like for example previous caesarean sections or placenta previa. But usually you would expect the placenta to be, under those circumstances, to be implanted over the caesarean section scar on the inside of the uterus. Now, there is an ultrasound report that's available or it was available for me to look at. It tells me that the uterus – the placenta was on the posterior uterine wall, that is, that uterine wall 7.7 centimetres I think it said or around about 7 centimetres from the – from the internal lines of the uterus. So, it wasn't a low implantation of the placenta and it was on the posterior wall. And I wouldn't – personally, I wouldn't have either anticipated that this was necessarily going to be a placenta accreta. And in fact, there was no indication from the ultrasound report that the radiologist or whoever reported on that ultrasound considered that this had any of the appearances or features of placenta previa – of a placenta accreta. So, I – I think that she – she went in anticipating to do a straight forward repeat elective caesarean section and – and was faced with this horrendous problem of actually dealing with a placenta accreta as a – as an unheralded event if you like. And I think that's an incredibly difficult thing to deal with. And it's

> difficult enough to deal with when you actually know you're going to be dealing with a placenta accreta".

48. In relation to the insertion of the Bakri balloon, Dr Cave stated that he considered this was "not unreasonable as a temporising measure". He stated that such balloons could be used for longer periods, "but not generally". Dr Cave considered such a step to have been reasonable, particularly whilst Dr Halliday waited for the arrival of her more senior colleague, Dr Lakshmi.

49. In relation to the arrival of Dr Lakshmi and her administration of the PGF2α, Dr Cave gave evidence that there were some significant risks associated with such a decision as the drug was "very potent" and a "smooth muscle everywhere" in the body, which therefore included the "cardiovascular system". Dr Cave stated that as a result of the PGF2α being substantially metabolised via the lungs, an overdose could have an impact on the cardiovascular system (transcript p.71.5):

> "Yeah, look yes, I mean an overdose – well, any dose I guess we would have to say. But an overdose certainly has the potential to not be completely metabolised by the lungs because of the – because of the amount that the lungs have to deal with in – you know, in that instant episode. And then it spills over into the circulation and has other affects".

50. Given the admission by Dr Lakshmi that she had administered too high a dose of the PGF2α, Dr Cave was asked his opinion as to whether there was any relationship between the administration of that dose and Ms Tran's subsequent cardiac arrest. In relation to this question, Dr Cave stated (transcript p.71.10):

> "It's – it's always tempting I think when – when there's an action and then a subsequent reaction to link this as cause and effect. And otherwise one had to postulate another reason for the catastrophic event which occurred in this case. And while one might consider that there's a possibility of another reason, my own view is that the two events were probably related".

He went on to state (transcript p.72.2):

> "I guess what I would say is it's more likely than not that the cardiac arrest occurred in association with her receiving Prostaglandin. Now, the distinction that I'm drawing between what you said and what I said is that I've omitted the two words 'excessive dose'. Because I – I believe that Prostaglandin is such a potent agent that it's possible to give a dose of that agent to someone whose metabolism has been – for want of a better term, altered already, simply because of the events that have occurred prior to the administration of that dose and that she may have reacted to the Prostaglandin partly – to – to a normal dose of Prostaglandin partly because of that".

51. During the course of the evidence before me an alternative cause for the cardiac arrest was suggested as amniotic fluid embolism ("AFE"). I note that this was first raised by Dr Lakshmi in her second statutory declaration (exhibit 9) and subsequent evidence. It was also discussed in the statutory declarations of Dr Ganji (exhibit 10) and Dr Stewart (exhibit 11). Some criticism was made by counsel for the family of the raising of this alternative and suggestion made that it was raised to get Dr Lakshmi "off the hook". I should state now that I do not accept such a suggestion. It is clear to me that doctors Halliday, Lakshmi, Ganji and Stewart are all doctors of many years' experience. It is therefore of no surprise that they would be considering all possible alternatives as to the cause of Ms Tran's death. This would be particularly so where all doctors gave evidence that they have undertaken many cases whilst at the ASH which have involved massive PPH and none have resulted in the death of a patient.

52. In relation to the possibility of AFE, I heard evidence that this occurs in about one in 8,000 to one in 80,000 births. Dr Stewart helpfully set out in her statement that AFE is caused by amniotic fluid, with particles of skin or hair from the baby, entering the mother's blood stream via the enlarged blood vessels in the uterus and travelling to her heart or lungs and causing an embolism, much like a clot would. Dr Stewart noted that whilst AFE was not detected in this case at autopsy, it was not detected at autopsy in 10% of cases. Dr Lakshmi stated during her evidence that she had "always thought

AFE strong possibility" as to a possible cause of Ms Tran's arrest and noted that the main features of AFE were "rapid deterioration despite resuscitation, cardiovascular collapse, hypoxia, hypothermia, disseminated intravascular coagulation ("DIC"), and pulmonary oedema and Linda had all these features". I also note that I heard evidence that AFE is a clinical diagnosis and that there is no "gold standard test".

53. In terms of this possible alternative, Dr Cave gave evidence that whilst he agreed AFE "was a possibility", it was his opinion that the cardiac arrest was "more likely" as a result of the PGF2α. Dr Cave stated (transcript p.73.10):

> "I mean it is my opinion that it was more likely to be the prostaglandin. And the reason I say that, is that with amniotic fluid embolism, I think it's generally agreed that the three major clinical features are an abrupt and rapidly evolving onset of – of the decreased blood pressure, decreased oxygen saturation of the blood and respiratory failure and an increase in what we call disseminated intravascular coagulation or clotting or otherwise known as DIC. With a – and now having said that that's not dissimilar to the features that you see that – that Linda demonstrated, the only difference really was that before she dropped her blood pressure dramatically after the prostaglandin F2 alpha was – was administered, she had a rapid and sudden rise in blood pressure. So it was reported to me that the first thing that happened was that her blood pressure escalated rapidly. And I think I alluded to it in my report somewhere that the anaesthetist actually said to me, 'I asked the surgeon or the obstetrician what they'd done to cause this rapid rise of blood pressure'. Now, that's – normally with AFE you'd see the hypotension and those other features developing first. So evidence of cardiogenic shock. In this case we saw them, but there was – at first there was a rapid rise in blood pressure, which I interpreted to be the effect of the prostaglandin rapidly acting on the vascular smooth muscle and elevating the blood pressure, because that's – that's the affect it will have initially".

54. On the basis of Dr Cave's evidence, I find that it was the placenta accreta that caused the massive PPH suffered by Ms Tran. This resulted in a serious and significant "insult" to Ms Tran's body. As a result, Ms Tran's cardiovascular system was already significantly compromised and was

attempting to compensate. Then when the PGF2α was administered, I find that it was administered incorrectly and at too high a dose. I do not consider it necessary for me to find whether it was an "overdose" or not, as I consider the evidence such that it is possible that it was the mere administration of the PGF2α that resulted in a further serious and significant insult to Ms Tran's system, which resulted in the cardiac arrest. I find that at that point the insults to Ms Tran's system had been so significant that she was unable to recover from them, resulting in her subsequent death.

Was everything that could have been done, actually done, in an attempt to save Ms Tran's life?

55. Whilst I have made those findings set out above, it does appear on the evidence that Ms Tran would have suffered a placenta accreta whether she gave birth to her child by caesarean or vaginal delivery and despite this there was nothing to indicate to the doctors in advance that this was the case. As Dr Cave put it in his evidence as follows (transcript p.77.3):

> " … this is an incredibly difficult obstetric situation to manage. It's difficult enough for us to manage where we've got all the facilities at our disposal to manage it. In the circumstances where we know what we're going to be dealing with before we – before we're faced with it. These people were – were facing this situation and it was a surprise to them not unreasonably, there was nothing in their performance prior to that that I would criticise. And I think they did their very best to try and retrieve this situation. It's an awful situation, much – you know, with all the experience that I have, I – none of us, I certainly don't like dealing with placenta accreta, even when I know that I've got all at my disposal to deal with it. Because a – all of our patients who have placenta accreta in this hospital end up in intensive care, all of them. And that's knowing that we're doing an elective procedure. And they all lose a substantial amount of blood and that's with some of the very best surgeons in the country operating on them".

I note that this is also in spite of the fact that Dr Cave works at the largest maternity hospital in the country.

56. In terms of Ms Tran's circumstances, an alternative available to the doctors whilst attempting to deal with the massive PPH was to conduct a hysterectomy. Dr Halliday was asked by counsel for the family why she did not discuss the possibility of a hysterectomy with Dr Lakshmi when she arrived. Dr Halliday gave evidence that she could not recall why. I note that in terms of the possibility of a hysterectomy, Dr Halliday had set out in her statement (exhibit 8) at paragraph 21 as follows:

> "Proceeding to a hysterectomy at this point would have been an alternative but it is not without risks. The uterus is close to the bladder and ureters (which are the tubes for draining urine from the kidneys to the bladder) and both bladder and ureters are vulnerable to injury during hysterectomy. If someone has lost a large amount of blood then they are also vulnerable to clotting problems (specifically disseminated intravascular coagulation, or "DIC"). Surgical control of bleeding can be extremely difficult in this situation due to small vessel bleeding".

57. In terms of the question of a hysterectomy, Dr Lakshmi also highlighted risks similar to those set out by Dr Halliday. In terms of the question when she arrived into the operating theatre, Dr Lakshmi set out in her statement (exhibit 9) at paragraph 9:

> "In my clinical judgement, I did not think it appropriate to do a hysterectomy at that time. There was only a trickle of blood and hysterectomy has its own risks in patients in this situation".

Dr Lakshmi went on:

> "In my view, because of the risks involved, hysterectomy is the last resort to control PPH. The number of peri partum hysterectomies for PPH has remarkably reduced over the years since the availability of Misoprostol and PGF2α, use of Bakri balloon and B Lynch suture".

At paragraph 10, Dr Lakshmi stated:

> "Peri partum hysterectomy has much higher risks than elective hysterectomies for gynaecological causes as the blood vessels of a pregnant woman are much larger; the hole field is more vascular,

there is more tendency for more blood loss and the risks are much more significant for morbidity and mortality".

58. During the course of the evidence it became clear that there had been no exchange of information between the surgical and anaesthetic teams as to what had already occurred in relation to Ms Tran when Dr Lakshmi arrived. On some occasions it was suggested that perhaps there was an obligation on others to provide such information, on other occasions it was suggested that perhaps there was an obligation for such information to have been sought. I do not consider it necessary for the purpose of these findings to determine who should have "provided" or "sought" such information. Whatever the case, it was not exchanged in a sufficient manner when Dr Lakshmi became involved.

59. This resulted in Dr Lakshmi being unaware that there had been two significant drops in Ms Tran's blood pressure and the administration of vasopressors. In these circumstances, Dr Lakshmi stated at paragraph 11 (and maintained during her oral evidence):

> "If I had known that Linda had been haemodynamically unstable, that she was already on vasopressors and that she had collapsed twice already, I would not have suggested further medical management. I would have recommended a hysterectomy, despite the risks since removing the uterus removes the source of bleeding".

60. During the course of questioning by counsel assisting, Dr Cave was asked whether he considered the hysterectomy should have been performed earlier. Dr Cave stated (transcript p.73.2):

> "Look, I think that the international literature would suggest that a surgical intervention earlier rather than later in these situations is likely to be associated with a better outcome. Having said that, we – the people that were dealing with this situation, I think were faced with an incredibly difficult – as I've said before, a surprise if you like. What we do in accreta in this hospital and we do quite a lot of them, we actually get gynaecological oncologists and surgeons familiar with the – with pelvic haemorrhage as well as the obstetricians and so on involved and we often plan it as a caesarean

hysterectomy, so that we are under much more control than these poor people were because they didn't have any pre-warning so to speak".

61. During the course of questioning by counsel for the family, Dr Cave was asked at what stage he considered it reasonable to have conducted a hysterectomy after it had been discovered that Ms Tran was suffering from a placenta accreta. Dr Cave stated (transcript p.78.3):

> " … given that she – given that she felt that she had the blood loss under control within 15 minutes of the baby being born, I think that's what we've – what other people have said and that's certainly the information that I gleaned from other medical people who were present at the time, then I wouldn't necessarily jump in and do a hysterectomy at that stage, because a postpartum hysterectomy is an incredibly difficult procedure to do. And I – I think that unless you're used to doing them relatively frequently, it's not one that I would undertake as a sort of semi-elective procedure. In other words, if I could – if I thought I could stop the haemorrhage some other way, I would try the other way first".

62. Counsel for the family then inquired whether it was reasonable at the stage of the administration of the PGF2α to have instead conducted a hysterectomy. Dr Cave answered (transcript p.79.8):

> " … my answer to that would be that in the context they would be making the decision of the context of their collective expertise and experience with managing this sort of postpartum haemorrhage secondary to placenta accreta and – and believed, at least I assumed they believed because that's the decision that they made, that it was safer for them to give her prostaglandin than to set out to do a hysterectomy at that stage".

63. Dr Cave was then asked by counsel for the Department of Health whether had the hysterectomy had been performed instead of the administration of the PGF2α, would Ms Tran's chances of survival have changed? Dr Cave stated (transcript p.80.7):

> "Look again, I think that's difficult to say because I think that you have to take – one has to take into account the – the experience and the frequency with which the primary operators have with doing peri

partum hysterectomies. They're difficult procedures to do, they're not – it's not like doing a straight forward elective hysterectomy on someone with a gynaecological reason to do it. And so I – I don't know that I can actually answer that properly. But what I could say to you, that if you gave me a straight forward elective gynaecological hysterectomy to do or a peri partum hysterectomy to do of this nature, then the likelihood is that the woman having the straight forward gynaecological hysterectomy would do better than the one having the peri partum hysterectomy".

64. In terms of the actions taken by the doctors to try and save Ms Tran's life, I do find that the doctors did their best to try to save her life. Appropriate measures were put in place each time Ms Tran's blood pressure dropped and when she suffered a cardiac arrest. There is no basis whatsoever for any criticism of the actions taken by any of the staff upon her admission to the ICU.

Was Ms Tran's death avoidable?

65. My findings above however, do not deal entirely with the question of whether Ms Tran's death was "avoidable". In relation to this question, I consider that there were two (2) identifiable areas of concern in this case:

65.1 The administration of the PGF2α; and

65.2 The communication between the surgical team and the anaesthetic team.

66. As stated above, it has been accepted by Dr Lakshmi that the dose she administered to Ms Tran in the amount administered was incorrect and that this was a mistake. I have already found that I consider it more likely than not that it was the administration of PGF2α that brought about Ms Tran's arrest at a time when her cardiovascular system was already significantly compromised. Counsel for the family strenuously submitted that I should find that Dr Lakshmi's actions constituted a significant departure from medical norms and that it constituted an act of negligence or unprofessional conduct.

67. In this regard, I note (as I did during the course of submissions) that I was impressed by the frankness of the witnesses in relation to their actions as contained in their written statements tendered before me. I was similarly impressed by their viva voce evidence. Their frankness has assisted this inquiry to understand all of the circumstances associated with Ms Tran's death. That is to their credit.

68. As I stated during the course of proceedings, I am not prepared to find that any of the conduct by the medical professionals in this case was unprofessional conduct.

69. I do find however that but for the admitted mistake by Dr Lakshmi in terms of the administration of PGF2α in a haemodynamically unstable patient at too high level a dosage, Ms Tran's death *may* have been preventable. I do not find it *would* have been prevented, as it is clear that the placenta accreta was significant and had led to massive bleeding, however I do consider it may have been preventable.

70. It is my opinion that the more significant mistake was the significant breakdown in communication between the two teams in and around the urgency of the situation and that this is more significant than, what I find to be, the accidental and mistaken overdose of the PGF2α.

71. Whether or not these mistakes were of such a nature as to be reckless or negligent, I am not prepared to find (nor am I required to so find for the purpose of these proceedings), but I do consider them to be significant and to have had an impact on the decisions made in relation to the care to be provided to Ms Tran. I do not however find that they were unprofessional. As I stated during the course of these proceedings, we do not operate in a perfect world and therefore we do have to accept that imperfections, and indeed mistakes, will occur from time to time.

Are there any recommendations that can, or should, be made to avoid such a death in future?

72. In terms of this question, I note that the reports of Doctors Cave and Osborne (exhibit 3) set out a number of recommendations as a result of their investigation and review. For completeness, I set these out in full:

72.1 "An agreed and documented protocol for the management of post-partum haemorrhage and other obstetric emergencies at ASH;

72.2 Management of post-partum haemorrhage is critical in the prevention of severe morbidity and mortality. Consideration by ASH should be given to the UK colleges (Royal College of Midwives (RCM) and the RCOG), recommendation that training of all birth attendants in the maintenance of post-partum haemorrhage should occur;

72.3 A flow chart should be freely available in the operating theatre and labour ward and clear dosage instructions should be available in the emergency box for the use of PGF2α, especially as this is a drug which is used infrequently and with which staff may not be completely familiar;

72.4 A laminated diagram showing how to insert a uterine compression suture should be available in the operating theatre;

72.5 A skills workshop in the management of this emergency and other well recognised obstetric emergencies, e.g. shoulder dystocia should be conducted every 6 months;

72.6 A process needs to be established when confronted with these situations whereby there is one designated person to communicate with the laboratory staff in an efficient time conserving manner. This will also apply to labour ward and the emergency department if the emergency is occurring in those locations;

72.7 Consideration needs to be given to review the timely provision of blood products from the laboratory. If this is found to be an issue it should be addressed. If relocation of the laboratory is not feasible then a process needs to be developed to address this problem;

72.8 Arrangements should be made to make more than one (1) unit of platelets available at any time;

72.9 Close formal links be established between ASH Senior Clinical Staff and a tertiary level hospital for readily available telephone and/or onsite advice;

72.10 Multidisciplinary hospital drills in the management of massive obstetric haemorrhage should occur involving members of the obstetric, anaesthetic, midwifery, theatre, laboratory and ancillary staff (e.g. orderlies) every twelve months in line with the NHMRC's National Guidance on Collaborative Maternity Care;

72.11 Multidisciplinary case review meeting with the Obstetric and Anaesthetic Departments (and other relevant departments) on a 6 monthly basis of cases that are relevant to both departments covering cases such as severe post-partum haemorrhage."

73. I note that the ASH has considered and addressed each and every one of these recommendations. That is very much to their credit. The statutory declaration of Mr Michele Melino, General Manager of ASH, was tendered as exhibit 12 and it sets out in detail the responses made by the ASH to such recommendations. I commend them for their proactive approach to the review. It is important and shows that the ASH has taken Ms Tran's death seriously, as they should.

74. Because of those changes however I do not consider it necessary to make any recommendations arising from this inquest other than to encourage the ASH in its endeavours.

75. I have no recommendations to make arising from this inquest.

Dated this 9th day of September 2011

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GREG CAVANAGH
TERRITORY CORONER