STATE CORONER'S COURT

OF NEW SOUTH WALES

Inquest:	**Inquest into the death of Tama GALIERE**
Hearing dates:	**16-20 and 24 January 2012; 18 & 19 September 2013**
Date of findings:	**9 May 2014**
Place of findings:	**State Coroner's Court, Glebe**
Findings of:	**Deputy State Coroner H.C.B. Dillon**
Catchwords:	**CORONIAL LAW – Cause and manner of death** – Hospital death -- Whether procedure for inserting central line was appropriate given the diagnosis – Whether procedure carried out in appropriate manner – Whether line secured in appropriate fashion – How line migrated inwards causing heart damage – What has been done to mitigate chances of recurrence

File number:	**1027/08**
Representation:	Sgts S. Korneluk and G. Lolis (Coronial Advocates) Mr M. Williams SC instructed by Ms A Walsh, Maurice Blackburn, Lawyers (for family of Tama Galiere) Mr R. Weinstein SC instructed by Ms Voukidis (for Sydney Children's Hospital Specialty Network and Sydney Children's Hospital) Mr G. Gregg instructed by Mr Tsausidis, Avant Law (Drs Isert, Crawford, Katf & Reddie) Ms L Alexander, Nurses Association (RN Conaghan, Militar, Shaw, Lee and Crosby)
Findings:	I find that Tama Galiere died on 25 June 2008 at the Sydney Children's Hospital, Randwick and that, on the balance of probabilities, this was due to focal ventricular myocarditis and myonecrosis resulting from the migration of a 'Peripherally Inserted Central Catheter' (or 'PICC line') into the right ventricle of his heart in the course of treatment with antibiotics for a periorbital infection of his left eye.

REASONS FOR DECISION

Introduction

1. Tama Galiere was only 10 months old when he died on 25 June 2008 at the Children's Hospital in Randwick while receiving intravenous antibiotic treatment via a central line for a severe infection of his left eye. This has been an inquest into his death and, in particular, into the circumstances in which his death came about.

2. The inquest commenced in 2012 but was adjourned for a long period when the coroner, the late Deputy State Coroner Scott Mitchell, became gravely ill. Unfortunately he was unable to return to work and I took over the case from Deputy State Coroner Mitchell in 2013.

3. Sudden and unexpected deaths, or deaths from unknown causes, or the deaths of particularly vulnerable members of our society, are investigated by coroners. Coronial investigations signify that this is a society that in principle and at law respects human life and values the lives of each individual person, young or old, rich or poor, sick or well, without distinction.

4. There are a number of reasons for doing so: to identify the causes of deaths and how they came about; to address the concerns of relatives and friends about those deaths; and to learn such lessons as these deaths may be able to teach us so that we can reduce the risk for others in future.

5. The coroner's role is that of investigator and fact-finder. Inquests are not criminal or civil trials in which two or more parties face off in adversarial proceedings and in which a judgment is entered for one side or the other. The coroner's function is to follow the evidence in an attempt to identify a deceased person, when and where that person died, the physical cause of death and how that death came about.

6. A number of complex technical medical issues arise in this case but at its heart there is a sad and tragic human story. Before proceeding to consider the evidence, it important to consider Tama and his family.

Tama's Family background:

7. Tama was his parents' second child. Mr. Pierre Galiere, a chef by profession, was born in France and Ms. Karamia Wheaton, a graphic designer, comes from New Zealand. They met in London and moved to Australia in 2006. His older sister, Pearl, was about two years older. Since Tama's death, two other children have joined the family -- Ludo and Tia. His parents and his GP, Dr Peter Vo, have described Tama as a little boy who was well and healthy except for a persistent or recurrent inflammation of the tissues in the region of his left eye from which he had suffered since the age of about 7 months and for which he was

under treatment at the time of his death. There was no sign of any respiratory or cardio-respiratory issues that might explain his death.

8. Tama's mother described him as a happy, contented and laughing boy and his photographs certainly suggest as much. His death – so unexpected -- has been a tremendous blow to his parents and to those others, such as his grandmother, who loved him.

The Issues

9. Tama's case raises a number of questions:

- Why was the PICC line procedure adopted?
- How was it carried out?
- Was it carried out appropriately?
- How did a length of line migrate into Tama's right ventricle?
- Should the line have been secured by suture?
- What has been done to prevent a recurrence?

The background

10. Tama was initially treated with topical medications for his infected eye. This treatment, unfortunately, was unsuccessful in eradicating the root cause of the infection. He was admitted to hospital from 19 to 21 February and again from 10 to 20 June, 2008 for antibiotic and steroid anti-inflammatory therapy.

11. According to Dr. Matthew Orde, a specialist pathologist and the author of the autopsy report, '… the antibiotic therapy would have been more likely to have proved successful if administered intravenously but, unfortunately, securing peripheral intravenous access proved somewhat difficult'. So alternatives were needed.

12. During his second admission to hospital, a central line extending from the left groin into the central vein and entering the right side of the heart was employed but, towards the end of Tama's stay in hospital, this expedient failed when the central line became dislodged. Nevertheless, by that stage Tama appeared to be recovering and he was discharged on 20 June. Sadly, the infection promptly reappeared and Tama was once again admitted to the Children's Hospital on 21 June 2008 with a diagnosis of periorbital cellulitis[1].

13. As there were difficulties inserting a new central line similar to that which had posed problems during the earlier admission, a 'Peripherally Inserted Central Catheter' ('PICC

[1] Inflammation and infection of the eyelid and skin around the eye.

line') was inserted under general anaesthetic on 23 June. The particular line chosen was an Arrow brand 3 Fr. PICC. The catheter carried a manufacturer's warning:

> "! WARNING Do not place the catheter into or allow it to remain in the right atrium or the right ventricle. Failure to follow these instructions can result in severe patient injury or death. Read instructions."

Why was the PICC line procedure adopted?

14. The insertion of a PICC line was indicated because, during his earlier admission in June 2008, Tama had pulled out the femoral line that been inserted as a conduit for intravenous antibiotics. In general terms, PICC lines have a number of advantages over other forms of intravenous lines, especially for patients with chronic illnesses. The advantages include a reduced risk of infection and other complications. PICC lines can remain in situ longer than conventional central line catheters and are more versatile than conventional catheters.

15. The most common complications of using PICC lines are (a) migration of the line; (b) thrombosis; (c) blockage of the line itself and (d) infection. Nevertheless, while any procedure of this nature carries potential risk, the risks associated with PICC lines are generally regarded as being low. PICC lines are also pain-free when inserted. In my view, the decision to insert a PICC line was appropriate and reasonable.

How was the procedure for inserting the PICC line carried out?

16. In Tama's case, the PICC line was inserted under general anaesthetic. Drs Peter Isert and Matthew Crawford, both consultant anaesthetists, conducted the procedure. Before inserting the line, Dr Isert measured out a length of line to be inserted with a tape measure. This was estimated by measuring the distance from the entry point to the heart following the route that the line would follow. With Dr Crawford supervising, the line was inserted by Dr Isert at the right cubital fossa (elbow)with a guide wire inside it to maintain its stiffness within the vein along which it was travelling. The target for the tip of the catheter line was high in the right atrium of the heart (near the junction with the Superior Vena Cava).

17. While the line was inserted, an electrocardiogram (ECG) was taken. At a certain point, when the line had been inserted 20 cms, ventricular ectopic beats (VEBs) were recorded on the ECG. This indicated that the tip of the line had entered the right ventricle of the heart and touched the wall of the ventricle. Dr Isert withdrew the line five centimetres and the VEBs stopped. This indicated that the tip had been withdrawn from the right ventricle.

18. Both he and Dr Crawford then checked the placement of the tip with an image intensifier (a portable x-ray machine) and were satisfied that it was in the correct position. This is confirmed by the post-insertion x-ray taken on 23 June. At that time, there was no coiling of the line in the heart. Dr Isert then secured the line at the insertion point with a dressing and removed the guide wire.

Was the procedure carried out appropriately?

19. Dr. Crawford gave evidence that, in the course of insertion, the tip of a PICC line should usually be advanced beyond the point where it is proposed to be rested and then retracted so as to minimise the possibility of loops and other redundancies in the line and to enhance the prospect of accurate final placement at the target. A line can be retracted easily but it cannot easily be extended so that it may be prudent to overshoot the mark and then pull back.

20. In describing this as the general practice of most proceduralists, Dr. Crawford was supported by Dr Isert and Dr Christie. Two independent experts, Dr Michael Dobbie, an anaesthetist with significant paediatric experience inserting lines, and Dr Ken MacLean, a paediatrician, agreed that overshooting was a widespread practice although they did not regard it as the preferred option. Dr Dobbie gave evidence that although overshooting into the right atrium or even the right ventricle is quite common in practice, it is preferable to avoid those chambers and practical, too, if one proceeds, as he customarily does, with a degree of visual guidance provided by an image intensifier.

21. Dr. Crawford gave evidence that the manufacturer's warning not to enter the right ventricle should be qualified. In his experience, even if the tip were to be deliberately inserted into the right ventricle, no inflammation, trauma or necrosis need be expected provided that adequate care was exercised and provided that the invasion was momentary.

22. Of course, in Tama's case, the distances between significant landmarks were very much shorter than in, say, an adult and this left a much smaller margin for error.

23. Although the manner in which the procedure was carried may have conformed with what were regarded in 2008 as acceptable standards, it is almost trite to suggest that if there was no significant disadvantage in using an available but less risky method, it would have been preferable to do so.

24. That said, the post mortem evidence does not enable me to say whether or not the method used by Drs Isert and Crawford caused any damage to Tama's heart at the time the line was inserted and the tip entered his right ventricle.

25. Medicine has advanced in the last six years.The weight of expert opinion at the time of the inquest appears to be that the *deliberate* technique of entering the right ventricle ought not be practised and that accidental intrusion into the right ventricle should be avoided if possible, usually by the use of image intensification to view the progress and final positioning of the tip of the central line.

How did a length of line migrate into Tama's right ventricle?

26. Following the operation, Tama appears to have done quite well to begin with. There seem to have been no immediate complications that could be referred back to the insertion of the

line. This suggests that it was at least some little time before the line migrated into the right ventricle of his heart and coiled there.

27. How can this have happened? Migration of PICC lines seems to be quite common. According to Dr. Crawford, migration may occur as a result of stretching and flexing movements of the body but this will usually account for a migration of no more than 1.5 to 2 cms. Any migration of the tip beyond that will be limited by the length of line within the body and, in Tama's case, will have been influenced by whether any redundant length of line was inserted into his body at the time of the installation of the line or subsequently. Accordingly, it is necessary to consider whether the line was secured appropriately, and remained secure, at Tama's cubital fossa.

28. A number of possibilities were considered during the inquest:

i. The tip and an excess quantity of line was left in the right ventricle at the time of insertion

ii. A redundant length of line was left looped in Tama's arm at the completion of the procedure. It subsequently straightened out and migrated into the ventricle;

iii. Migration occurred at the time of resuscitation;

iv. Tama's movements, especially of his arms, caused or allowed the line to migrate;

v. The PICC line changed course intravenously due to change of posture;

vi. The dressing placed on Tama's arm to secure the line was removed and replaced subsequently, allowing the tip to migrate.

29. The first scenario is improbable. Drs Isert and Crawford knew that the tip of the line should not be positioned in the right ventricle. Their evidence and the objective evidence of the image taken at the conclusion of the operation demonstrates that the tip was not left in the ventricle.

30. It is also highly unlikely that a length of line was left looped within Tama's vein. The line was guided by a stiff wire. Tama was a baby with veins that were so small that there would have been insufficient room for a relatively inflexible line to loop in them accidentally. The stiffness of the wire itself would have prevented looping within the vein even if there was, in theory, sufficient room.

31. Although it appears unlikely, it is possible that the resuscitation effort caused the migration of the line. This is unlikely for a number of reasons. First, the post mortem investigation by the forensic pathologist, Dr Orde, suggests that the inflammation and irritation of the wall of Tama's heart (myocarditis) had taken some time to develop. Second, Tama's deterioration appears to be best explained by the irritation caused by the presence of the tip of the catheter (and its contents) too close to the ventricle wall. If that is so, what

caused the tip to move from its original position for a period long enough to cause the irritation and inflammation of the heart muscle? Or if it was not the catheter, what caused the myocarditis? Third, presuming that during the resuscitation process the catheter remained securely fastened in position, but Tama's arms were abducted, the evidence suggests that this would have led to a movement of no more than about 1.5-2 cm. This is inconsistent with the length of the redundancy found coiled in Tama's heart.

32. The fourth and fifth hypotheses are also theoretically possible but there is no evidence for either. As in the third scenario, the evidence that abduction of the arms would have led to internal movement of the line of only about 1.5-2 cms appears to rule out these two hypotheses.

33. The final hypothesis seems the most likely. After the PICC line was inserted, it was secured in place with an adhesive "sandwich" dressing. Evidence emerged during the inquest that the dressing applied by Dr Isert was almost certainly removed and replaced at a later stage. A photograph (Ex 22) showed Tama with an arm board taped to his arm with white tape. The uncontested evidence of Dr Isert is that he did not apply an arm board but that his practice was to place a small green gauze dressing on top of the sandwich dressing at the insertion point. He also gave evidence that his practice was to apply Transpore security tape at the distal and proximal ends of the sandwich dressing. The photograph shows that the Transpore tape had been removed at the distal end of the sandwich dressing. It is not clear whether the Transpore tape had also been removed from the proximal end.

34. If the catheter was left unsecured, even for a short interval, this seems the most likely time for it to have migrated.

35. Unfortunately, there are no records concerning the change to the dressing itself or the arm board. Despite enquiry, no evidence has emerged concerning who made the changes or when or what happened during those changes to the dressing. Given that management of dressings is generally a responsibility of ward staff it seems most likely that it was a person working on the ward who made the changes but we are unable to identify that person.

Should the line have been secured by sutures?

36. Whether or not the use of an adhesive sandwich dressing was an appropriate or preferable method of securing the PICC line was the cause of lively debate among the experts.

37. Drs Isert and Crawford, and Dr David Lord, a paediatric interventional radiologist, gave evidence that Dr Isert's method was preferable because it reduced the risks of blockage of the line (especially a very narrow gauge catheter such as was inserted in Tama's case) and infection. Their evidence was that the use of adhesive dressings was preferred and regarded as best practice at the Sydney Children's Hospital and in many children's hospitals. When Dr MacLean gave evidence, he also referred to securing the line with adhesive tape and stated that, given the type of catheter that was used, this "absolutely" an

appropriate way to fix the line in correct position. Dr Dobbie's view was that suturing is not necessary but that some means of securing the line, such as a "stat lock" (an adhesive fastener), is required.

38. Dr Levitt, on the other hand, considered that suturing a line in place is a more secure method and therefore to be preferred. Dr Levitt, while undoubtedly a very experienced and skilful anaesthetist who does some paediatric work, is not specialised in that field. His preference for suturing a line in position is because, while sutures are not necessarily a perfect anchors, dressings can become loose due to moisture and movement of the cubital fossa, and thus may permit movement of the catheter. He conceded, however, that an adhesive sandwich dressing may be appropriate in some circumstances and that the risk of occlusion of a line is greater when the line is of narrow gauge. He also very fairly conceded that lines secured by suture can move in some circumstances (usually out of the patient rather than inwards when, for example, the exterior part of the line catches on something).

39. There are obviously reasonable arguments both for and against the technique of securing a catheter line by suture. It appears to me that there is no black-and-white rule to be applied. The key point is that lines must be secured. In my view, Dr Isert took appropriate steps to secure the sandwich dressing with adhesive surgical tape that was approved and used by the Sydney Children's Hospital.

What measures did the hospital take after Tama's death?

40. Inquests are one means by which our society seeks to ensure that public institutions engage in a continual process of self-examination and improvement, especially when a person to whom they owe a duty of care dies.

41. Dr. Jonathon Taitz, then Assistant Director of Clinical Governance at the hospital, gave evidence before Deputy State Coroner Mitchell in 2012. He told the court that the hospital regarded the baby's death as a "catastrophe" and had since done a thorough review of its procedures.

42. This had resulted in the reassessment of the Sydney Children's Hospital Business Plan by a multi-disciplinary team. This was a consequence of a Root Cause Analysis investigation and report following Tama's death. That plan was later superseded by a Policy Directive of NSW Health entitled "Central Venous Access Device Insertion and Post Insertion Care" published on 22 September 2011. That policy directive applies not only in the Children's Hospital Network but in all NSW hospitals.

43. Dr Glen Farrow, Director of Clinical Governance for the Sydney Children's Hospital, himself a consultant paediatrician, produced comprehensive reports and gave evidence at the inquest concerning progress made in implementing changes and improvements introduced at the hospital since Tama's death:

- In direct response to Tama's death, the hospital reviewed its Central Venous Line policy and implemented a number of changes to protocols for the insertion and management of central venous catheters; for insertion and post-insertion care of Central Venous Access Devices (CVADs); and for the management of CVADs. A PICC line fact sheet for parents has been developed as has a PICC line daily checklist for ward staff. In 2013, the Sydney Children's Hospital Network issued new practice guidelines for CVADs;

- Image intensification is now used from the time the tip of a catheter is inserted into the thoracic area. A follow-up x-ray is taken in the recovery room to ensure the correct placement of the tip of the catheter;

- When technically possible, the image intensifier takes stills when the tip of a PICC line is placed in a child's arm and thoracic cavity;

- Two clinical nurse consultants, with vascular specialty, keep a PICC line list. They are specifically employed to check PICC lines daily and to record any migration of lines in or out. If this reveals any movement, an x-ray is performed. The nurses are trained to adjust lines and redress patients securely. A special section dealing with PICC lines is kept in the patient's notes and PICC line measurements are also recorded in the progress notes;

- The PICC line information is also recorded in clinical database;

- A pamphlet has been developed and is now in use concerning the consent to insertion of a PICC line.

44. These changes having been introduced by the hospital, recommendations from me appear to be superfluous.

Conclusion

45. The burden of sadness carried by the parents of children who die prematurely and unexpectedly is inestimable, especially where questions linger concerning the cause and circumstances of the child's death and any medical treatment he or she may have received. Such deaths defy the natural order and bring a sense of loss not only for a life ended but for a life not completed.

46. It would be presumptuous of a coroner to believe that he or she can "bring closure" to parents like Ms Wheaton and Mr Galiere. But, although it has taken too long to reach this point, I hope that they will accept from me that their concerns have been listened to and taken seriously by all involved in this inquest. I also hope also that they will accept my apology for the length of time it has taken to bring this inquest to a conclusion. And I hope that they will accept my very sincere and respectful condolences.

Findings

47. I find that Tama Galiere died on 25 June 2008 at the Sydney Children's Hospital, Randwick and that, on the balance of probabilities, this was due to focal ventricular myocarditis and myonecrosis resulting from the migration of a Peripherally Inserted Central Catheter' (or 'PICC line') into the right ventricle of his heart in the course of treatment with antibiotics for a periorbital infection of his left eye.

Magistrate Hugh Dillon
Deputy State Coroner for NSW