

**BRIEF FOR EXPERT ON PAEDIATRIC ANAESTHETICS
ADAM STRAIN**

Introduction

1. Adam Strain is one of 4 children who are the subject of a public inquiry being conducted by John O'Hara QC.
2. Adam was born on 4th August 1991. He died on 28th November 1995 in the Royal Belfast Hospital for Sick Children ("the Royal") following kidney transplant surgery. The Inquest into his death was conducted on 18th and 21st June 1996 by John Leckey the Coroner for Greater Belfast, who engaged as experts: (i) Dr. Edward Sumner then Consultant Paediatric Anaesthetist at Great Ormond Street Hospital for Sick Children ("Great Ormond Street"); (ii) Dr. John Alexander Consultant Anaesthetist at Belfast City Hospital; and (iii) Professor Peter Berry of the Department of Paediatric Pathology in St. Michael's Hospital, Bristol. The Inquest Verdict identified Cerebral Oedema as the cause of his death with Dilutional Hyponatraemia as a contributory factor.
3. The other 3 children are :

- (1) Claire Roberts was born on 10th January 1987. She was admitted to the Royal on 21st October 1996 with a history of malaise, vomiting and drowsiness and she died on 23rd October 1996. Her medical certificate recorded the cause of her death as Cerebral Oedema and Status Epilepticus. That certification was subsequently challenged after a television documentary into the deaths of Adam and 2 other children (Lucy Crawford and Raychel Ferguson).

The Inquest into Claire's death was carried out by John Leckey on 4th May 2006 who engaged as experts Dr. Robert Bingham (Consultant Paediatric Anaesthetist at Great Ormond Street) and Dr. Ian Maconochie (Consultant in Paediatric A&E Medicine at St Mary's, London). The Inquest Verdict found the cause of Claire's death to be Cerebral Oedema with Hyponatraemia as a contributory factor.

- (2) Raychel Ferguson was born on 4th February 1992. She was admitted to the Altnagelvin Area Hospital on 7th June 2001 with suspected appendicitis. An appendectomy was performed on 8th June 2001. She was transferred to the Royal on 9th June 2001 where brain stem tests were shown to be negative and she was pronounced dead on 10th June 2001. The Autopsy Report dated 11th June 2001 concluded that the cause of her death was Cerebral Oedema caused by Hyponatraemia.

The Inquest into Raychel's death was conducted on 5th February 2003 by John Leckey who once more engaged Dr. Edward Sumner as an expert. The Inquest Verdict found the cause of Raychel's death to be Cerebral Oedema with Acute Dilutional Hyponatraemia as a contributory factor. It also made findings that the Hyponatraemia was caused by a combination of inadequate electrolyte replacement following severe post-operative vomiting and water retention resulting from the secretion of anti-diuretic hormone (ADH).

- (3) Conor Mitchell was born on 12th October 1987 with cerebral palsy. He was admitted to A&E Craigavon Hospital on 8th May 2003 with signs of dehydration and for observation. He was transferred to the Royal on 9th May 2003 where brain stem tests were shown to be negative and he was pronounced dead on 12th May 2003.

The Inquest into Conor's death was conducted on 9th June 2004 by John Leckey, Coroner who again engaged Dr. Edward Sumner as an expert. Despite the Inquest, the precise cause of Conor's death remains unclear.

The clinical diagnosis of Dr. Janice Bothwell (Paediatric Consultant) at the Royal was brainstem dysfunction with Cerebral Oedema related to viral illness, over-rehydration/inappropriate fluid management and status epilepticus causing hypoxia. Dr. Brian Herron from the Department of Neuropathy, Institute of Pathology, Belfast performed the autopsy. He was unsure what 'sparked off' the seizure activity and the extent to which it contributed to the swelling of Conor's brain but he considered that the major hypernatraemia occurred after brainstem death and therefore probably played no part in the cause of the brain swelling. He concluded that the ultimate cause of death was Cerebral Oedema. Dr. Edward Sumner commented in his Report of November 2003 that Conor died of the acute effects of cerebral swelling which caused coning and brainstem death but he remained uncertain why. He noted that the volume of intravenous fluids was not excessive and the type appropriate but queried the initial rate of administration. That query was raised in his correspondence shortly after the Inquest Verdict. In that correspondence, Dr. Sumner described the fluid management regime as 'sub-optimal'.

The Inquest Verdict stated the cause of death to be Brainstem Failure with Cerebral Oedema, Hypoxia, Ischemia, Seizures and Infarction and Cerebral Palsy as contributing factors.

4. The impetus for this Inquiry was a UTV Live Insight documentary 'When Hospitals Kill' shown on 21st October 2004. The documentary primarily focused on the death of a toddler called Lucy Crawford (who was subsequently also found to have died in hospital in 2000 as a result of hyponatraemia) and what was presented as significant shortcomings of personnel at the Erne Hospital. In

effect, the programme alleged a cover-up and it criticized the hospital, the Trust and the Chief Medical Officer. The programme also referred to the deaths of Adam and Raychel in which hyponatraemia had similarly played a part. At that time, no connection was made between the deaths of Adam, Lucy and Raychel and the deaths of Claire and Conor.

Original Terms of Reference

5. The Inquiry was established under the Health and Personal Social Services (Northern Ireland) Order 1972, by virtue of the powers conferred on the Department by Article 54 and Schedule 8 and it continues pursuant to the Inquiries Act 2005.
6. The original Terms of Reference for the Inquiry as published by Angela Smith (then Minister with responsibility for the Department of Health, Social Services and Public Safety) on 1st November 2004 were to:

To hold an Inquiry into the events surrounding and following the deaths of Adam Strain, Lucy Crawford and Raychel Ferguson, with particular reference to:

- i. The care and treatment of Adam Strain, Lucy Crawford and Raychel Ferguson, especially in relation to the management of fluid balance and the choice and administration of intravenous fluids in each case.
- ii. The actions of the statutory authorities, other organisations and responsible individuals concerned in the procedures, investigations and events which followed the deaths of Adam Strain, Lucy Crawford and Raychel Ferguson.
- iii. The communications with, and explanations given to, the respective families and others by the relevant authorities.

In addition, Mr O'Hara will:

- (a) Report by 1 June 2005 or such other date as may be agreed with the Department, on the areas specifically identified above and, at his discretion, examine and report on any other relevant matters which arise in connection with the Inquiry.
- (b) Make such recommendations to the Department of Health, Social Services and Public Safety as he considers necessary and appropriate.

(Emphasis added)

Changes

7. There have been a number of significant changes in the Inquiry since 2005. Firstly there was the receipt of Revised Terms of Reference from the Minister following the wish of the Crawford family to have Lucy excluded from the Inquiry's work:
 1. The care and treatment of Adam Strain and Raychel Ferguson, especially in relation to the management of fluid balance and the choice and administration of intravenous fluids in each case.

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2. The actions of the statutory authorities, other organisations and responsible individuals concerned in the procedures, investigations and events which followed the deaths of Adam Strain and Raychel Ferguson.
3. The communications with and explanations given to the respective families and others by the relevant authorities.

In addition, Mr O'Hara will:

- (a) Report by 1 June 2005 or such date as may be agreed with the Department, on the areas specifically identified above and, at his discretion, examine and report on any other matters which arise in connection with the Inquiry.
 - (b) Make such recommendations to the Department of Health, Social services and Public Safety, as he considers necessary and appropriate.
8. Secondly, Claire and Conor were included into the Inquiry's work by the Chairman due to the cause of Claire's death and the apparent fluid mismanagement in Conor's case so soon after the implementation of Guidelines on Hyponatraemia stressing the importance of fluid management.
 9. The effect of the Revised Terms of Reference has been to exclude all explicit references to Lucy. The Chairman has interpreted the Revised Terms of Reference insofar as Lucy is concerned in the following way:

... the terms still permit and indeed require an investigation into the events which followed Lucy's death such as the failure to identify the correct cause of death and the alleged Sperrin Lakeland cover-up because they contributed, arguably, to the death of Raychel in Altnagelvin. This reflects the contention that had the circumstances of Lucy's death been identified correctly and had lessons been learned from the way in which fluids were administered to her, defective fluid management would not have occurred so soon afterwards (only 14 months later) in Altnagelvin, a hospital within the same Western Health and Social Services Board area.

10. Claire's case is being investigated according to precisely the same terms as those of Adam and Raychel. The investigation of Conor will address more limited issues in view of the fact that hyponatraemia was not thought to be a cause of his death (if anything he developed hypernatraemia). Similarly, the fluid mismanagement referred to by Dr. Sumner was not considered to have been a cause of his death. The Chairman has stated:

It is obviously a matter of concern if guidelines which have been introduced as a result of a previous death or deaths and which are aimed at avoiding similar events in the future, are not properly communicated to hospital staff and followed. It is relevant to the investigation to be conducted by the Inquiry whether and to what extent the guidelines had been disseminated and followed in the period since they were published. Another matter of interest is whether the fact that Connor was being treated on an adult ward rather than a children's ward made any difference to the way in which it appears that the guidelines may not have been followed.

Accordingly, the Inquiry will investigate the way in which the guidelines had been circulated by the Department, the way in which they had been made known to hospital staff and the steps, if any, which had been taken to ensure that they were being followed. While

this is an issue of general importance, it will be informed by an examination of the way in which the guidelines had been introduced and followed in Craigavon Area Hospital by May 2003.

Role of the Experts

11. The Role of the Experts to the Inquiry is set out in 'Protocol No.4: Experts', a copy of which is attached. There are 4 categories of expert assistance:
 - (i) Expert Advisers¹ appointed to assist the Inquiry in identifying, obtaining, interpreting and evaluating the evidence within their particular area of expertise, which Panel currently comprises the following:
 - (a) Consultant Paediatrician
 - (b) Consultant Paediatric Anaesthetist
 - (c) Paediatric Nurse, previously Consultant Nurse in Paediatric Intensive Care
 - (d) National Health Service Hospital Management
 - (ii) Experts engaged on a case-by-case basis as Expert Witnesses. In addition to your appointment as an expert on paediatric anaesthetics, the Inquiry has also appointed Expert Witnesses in Adam's case on Transplant Surgery, Paediatric Nephrology, Hyponatraemia and Paediatric Nursing² and is in the course of appointing an Expert Witness on hospital management and governance. The Experts are required to provide their Expert opinion in the form of a Report(s) incorporating an 'expert declaration' and attached to a Witness Statement. The Reports will be made public. The Expert Witnesses may be required to attend the oral hearings and present their views.
 - (iii) Experts to provide commissioned 'Background Papers'³
 - (iv) Experts appointed as Peer Reviewers⁴

Background to Adam

12. Adam Strain was born with cystic, dysplastic kidneys with associated problems with the drainage of his kidneys related to obstruction and vesico-ureteric reflux. He was referred to the Royal from the Ulster Hospital in Dundonald and

¹ Dr. Harvey Marcovitch (Paediatrics); Dr. Peter Booker (Paediatric Anaesthesia); Carol Williams (Paediatric Nursing); Grenville Kershaw (Health Service Management and Patient Safety)

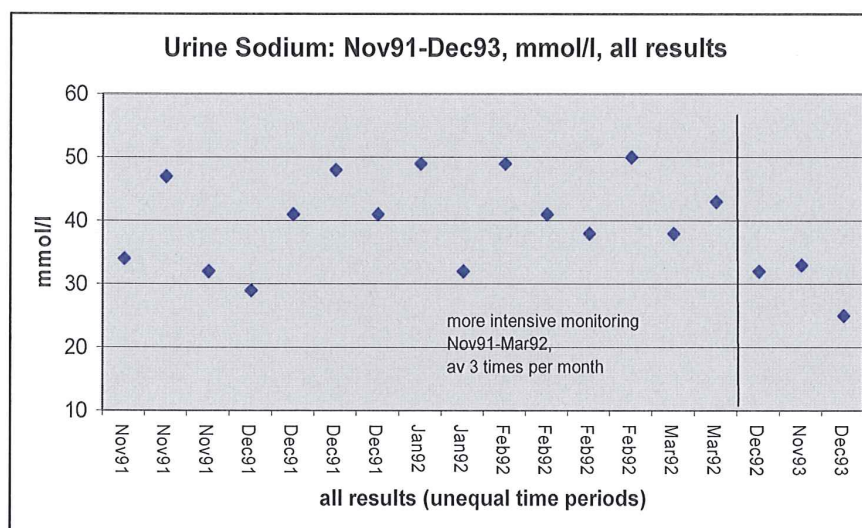
² Malcolm Coulthard (Paediatric Nephrology); Peter Gross (Hyponatraemia); Sally Ramsay (Paediatric Nursing); John Forsyth/Keith Rigg (Transplant Surgeons)

³ To date the Inquiry has sought 'Background papers' on: (i) Education & Training of Doctors; (ii) Education & Training of Nurses; (iii) Coroners; (iv) Adverse incidents and coding of deaths; (v) Statistics

⁴ Professor Allen Arieff at the University of California Medical School in San Francisco (Internal Medicine & Nephrology), Dr. Desmond Bohn of the Critical Care Unit at the Hospital for Sick Children in Toronto (Paediatric Anaesthesia), Ms. Sharon Kinney at the Intensive Care Unit and Clinical Quality and Safety Unit at the Royal Children's Hospital in Melbourne (Paediatric and Intensive Care Nursing)

came under the care of Dr. Maurice Savage (Consultant Paediatric Nephrologist)⁵ and Mr. Stephen Brown (Consultant Paediatric Surgeon).

13. Adam had multiple operations to his urinary tract, during which he was largely under the care of Mr. Stephen Brown... He had re-implantation of his ureters on 2 occasions and had nephrostomies performed during the early months of his life. On several occasions, he was critically ill and required care in PICU and a brief period of dialysis due to acute renal failure. In addition a fundoplication procedure was carried out in 1992 when Adam was less than a year old, to help prevent gastro-oesophageal reflux. Eventually he required all his nutrition through a gastrostomy tube and, in 1993, he had a cystoscopy and PEG gastrostomy. In October 1995, he had his PEG changed.⁶
14. Adam was subject to recurrent urinary tract infections and his renal function deteriorated to the point where he required dialysis for uraemia. His mother was trained in the home peritoneal dialysis technique so that he could be dialysed at home. His urine output was quite large but of poor quality and he was described as being polyuric. Biochemistry tests carried out when he was a few months old showed the sodium content of his urine to be 29 – 52 mmol/l.⁷
15. A graph of all Adam's recorded urine sodium results is shown below:⁸



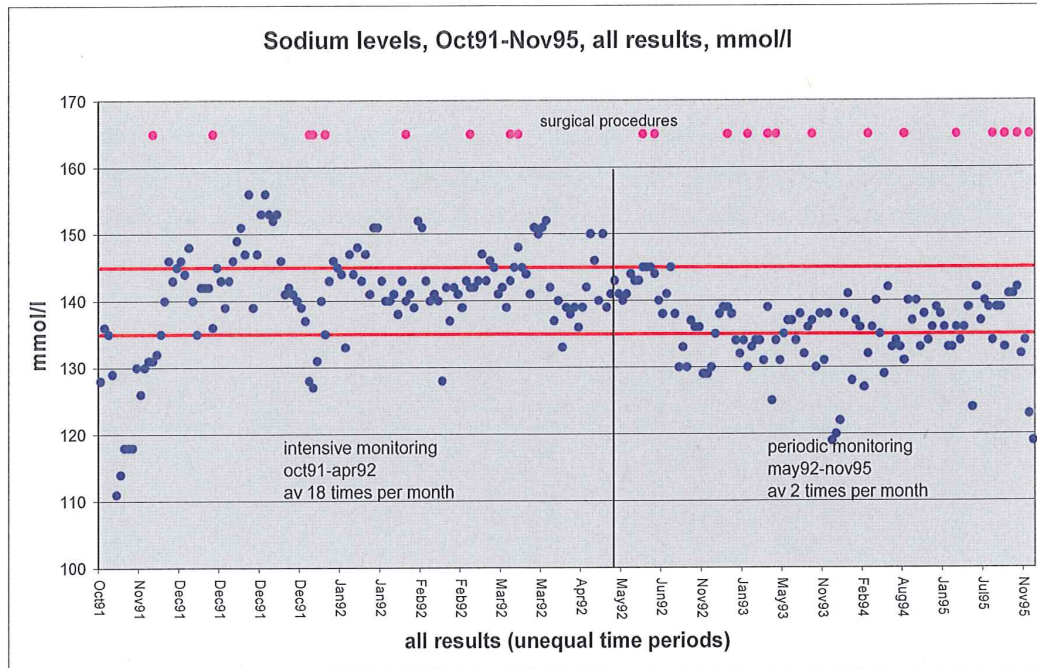
⁵ Now Professor Maurice Savage

⁶ A Schedule is attached showing all Adam's surgical procedures and their dates together with the surgeons and anaesthetists involved – see Tab 2

⁷ See Witness Statement to the Inquiry of Robert Taylor – see Tab 5d. See also biochemistry results in 1995 at: ref: 058-041-187-224 – see Tab 7k and 050-018-055 – see Tab 7c

⁸ The 2 graphs are taken from table compiled from Adam's medical notes and records. For ease of reference the parallel red lines indicate the normal range of 135-145mmol/l – see Tab 3

16. According to his nephrologist, Dr. Maurice Savage, Adam had a potential for hyponatraemia and he received sodium supplements in his feeds. A graph of all of his recorded blood sodium levels is shown below with 135-145mmol/l being the normal range:



17. The management of his serum sodium levels appears to have been largely carried out under the care of Messrs. Victor Boston and Stephen Brown, both Consultant Paediatric Surgeons. Despite that, his recorded sodium levels for 1995, the year of his transplant surgery, show one very low result of 124 mmol/l and a number below the normal range of 135-145 mmol/l. Furthermore, in Adam's first year of life his recorded sodium levels fell as low as 111 mmol/l, 114 mmol/l and 118 mmol/l. Thereafter there were numerous occasions when his recorded serum sodium levels fell below the normal range.
18. Adam was put on call for a kidney transplant once he was placed on dialysis. His tube feeds in the months prior to the transplantation surgery were slightly over 2 litres per day and he passed in excess of 1 litre of urine each day.
19. Adam received the offer of a reasonably matched kidney on 26th November 1995. The donor kidney had been removed from a heart-beating 16-year-old donor with normal renal function at 1.42am on 26th 1995. Transplant surgery was scheduled for 6.00am on 27th November 1995.

20. At 2300 on 26th November 1995, Adam's serum sodium was recorded as 134 mmol/l⁹ and Hb 10.5 gm/dl. As part of the preparation for his surgery, his feeds were changed although there remains an issue as to exactly what they were changed to. According to his charts, he was given 952 ml of 'clear fluid' to stop 2 hours before going into theatre. The nursing records do not state the nature of the 'clear fluids' given. Some witnesses have claimed that fluid was Dioralyte (containing 60 mmol of sodium chloride/L). However, Dr. Maurice Savage corrected his Deposition to delete 'Dioralyte' and substitute 'N/S Saline Dextrose'. In any event, it is thought that he received just over 1 litre of fluids. Apparently it was planned between Dr. Maurice Savage and Dr. Robert Taylor (Consultant Paediatric Anaesthetist) that Adam should receive intravenous fluid (75 ml/h) after the tube feeds were discontinued and have his blood chemistry checked before going to theatre. Those checks did not take place. Once again, there are different views as to why they did not. On one basis, it was because it proved difficult to achieve venous access, whilst on another it was because of the potential delay in receiving results back from the laboratory.
21. The main events surrounding Adam's transplant surgery are summarised in the following table:

Date	Event	Reference
26.11.1995	1.42am Donor kidney removed by Mr. Casey at Southern General Hospital, Glasgow	058-009-025 (Kidney Donor Information Form) – Tab 7i
	9.00pm Adam admitted to Musgrave Ward at the RBHSC for possible renal transplant	011-009-001 (Deposition of Ms. Strain 18 th June 1996) – Tab 7a
	9.30pm Pre-op investigations for possible renal transplant carried out by Dr. Cartmill (Surgical SHO); Nursing admission details taken by SN Murphy	058-035-144 (Extract from Medical Notes and Records) – Tab 7j 049-036-245 (Royal's Chronology of Care) – Tab 7b
	10.00pm Evaluation Nursing Report taken by SN Murphy	049-036-245 (Royal's Chronology of Care) – Tab 7b
	11.00pm i.v. fluids commenced prescribed by Dr. Larkin (Community SHO); Results of investigations recorded by Dr. O'Neill (SHO) as haemoglobin 10.5g/dl, sodium 134 mmol/l and urea 16.8 mmol/l; Dioralyte instead of Nutrison gastrostomy feeds on Dr. Taylor's (Consultant Paediatric Anaesthetist) advice	<ul style="list-style-type: none"> • 049-036-245 (Royal's Chronology of Care) – Tab 7b • 058-035-144 (Extract from Medical Notes and Records) – Tab 7j • 011-014 & 015 (Depositions of Drs. Savage and Taylor 21st June 1996) – Tab 4e & 4a
	11.30pm Medical history and clinical examination taken by Dr.	059-006-009 (Extract from Medical Notes and Records) – Tab 7m

⁹ No print out is available but some confusion arose as a result of an entry in the clinical notes of 'query' 139mmol/L

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Date	Event	Reference
	O'Neill (Senior House Officer): (i) temp. 36.4; (ii) pulse 97; (iii) blood pressure 108/56; (iv) weight 20.2kg	
27.11.1995	1.30am SN Murphy recorded i.v. fluids tissued and informed Dr. O'Neill	049-036-245 (Royal's Chronology of Care) – Tab 7b
	5.00am i.v. cannula reinserted(?) ¹⁰ Between 2300 and 0500 952ml of 'Dioralyte' given internally. PD cycles as normal (750 ml fluid volume 1.36% Dextrose solution – 8 cycles given before theatre). PD stopped at 0500 (?)	<ul style="list-style-type: none"> • 049-036-246 (Royal's Chronology of Care) – Tab 7b • 011-015 (Deposition of Dr. Savage 21st June 1996) – Tab 4a
	6.55am Adam arrival in theatre. Anaesthesia induced.	<ul style="list-style-type: none"> • 094-006-022 (theatre log) – Tab 7n
	7.00am Dextrose saline fluids (0.18% NaCl in 4% glucose) started i.v. by Dr. Taylor – 500 ml given up to 7.30am. Epidural inserted by Dr Montague. Arterial line inserted by Dr Taylor.	<ul style="list-style-type: none"> • 058-003-005 (Anaesthetic Record) – Tab 7f • 011-014 (Deposition of Dr. Taylor 21st June 1996) – Tab 4e
	0800 Central Venous Line inserted via right subclavian vein initial reading of 17 mmHg (normal 10-12 mmHg). Transplant surgery started by Mr. Keane (Consultant Urologist); further 500 ml of Dextrose saline fluids given up to 8.45am	<ul style="list-style-type: none"> • 011-014 (Transcript of Dr. Taylor 21st June 1996) – Tab 4e • 058-003-005 (Anaesthetic Record) – Tab 7f
	8.30am Donor kidney removed from ice; 400 ml HPPF given	<ul style="list-style-type: none"> • 058-009-027 (Kidney Donor Information Form) – Tab 7i • 058-003-005 (Anaesthetic Record) – Tab 7f
	8.45am Rate of Dextrose saline fluids slowed (500 ml given up to 1100) and 500 ml Hartmann's solution commenced	<ul style="list-style-type: none"> • 058-003-005 (Anaesthetic Record) – Tab 7f • 059-004-007 (Dr. Taylor's note to Mr. Brangam, Solicitor) – Tab 7l
	9.15am 400 colloid fluids (HPPF) given	<ul style="list-style-type: none"> • 058-003-005 (Anaesthetic Record) – Tab 7f
	9.32am Results of pH Blood Gases and Electrolytes received, showing sodium at 123 mmol/l ('normal' on the report being 135-145) and haematocrit at 18% (Adam's normal being 30%3);	<ul style="list-style-type: none"> • 058-003-003 (BGE Report) – Tab 7f • 058-003-005 (Anaesthetic Record) – Tab 7f

¹⁰ The Nursing Notes record "“Reinsertion of cannula @ 5am” (Ref: 057-014-019) – See Tab 7m, however Staff Nurse Catherine Murphy states “Although his patient notes say that he had his cannula re-inserted at 5.00am I have a vague memory of the doctor having difficulty in inserting this and Adam going to theatre without IV access being obtained.” (Ref: 093-007-024) – Tab 6c. Dr. Robert Taylor states “Difficult i.v. access. The paediatric registrar had attempted on several occasions to erect i.v. fluids to further prevent dehydration prior to surgery. This proved impossible and the child came to theatre without i.v. access.” (Ref: 011-014-099) – See Tab 4e.

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Date	Event	Reference
	250 ml packed red blood cells given	
	10.45am 200 ml colloid fluids (HPPF) and 250 ml packed red blood cells given	058-003-005 (Anaesthetic Record) – Tab 7f
	11.00am Skin closure; neostigmine and glycopyrolate administered by Dr. Taylor to reverse the neuromuscular blockade; blood loss recorded from swabs (328 ml), suction (500 ml) and other (300 ml)	<ul style="list-style-type: none"> • Ref:011-014 (Transcript of Dr. Taylor 21st June 1996); • 058-003-005 (Anaesthetic Record)
	11.55 noon Adam failed to wake, did not breathe and pupils fixed and dilated	011-014 (Deposition of Dr. Taylor 21 st June 1996) – Tab 4e
	12.05pm Adam transferred to PICU for ventilation of his lungs and assessment; puffy appearance with central venous pressure (CVP) approx. 30 mm Hg dropping to 11 mmHg; Mannitol 50 ml prescribed and reduction in fluids	<ul style="list-style-type: none"> • 058-005-013 (Drug record sheet) – Tab 7h • 058-005-014 (Extract from Medical Notes and Records recorded by Dr. O'Connor) • 094-006-022 (Theatre log) – Tab 7n
	12.15pm Adam's appearance bloated	011- 009 (Deposition of Ms. Strain 18 th June 1996) – Tab 7a 093-003 & 093-005 (PSNI witness statements of Adam's mother) – Tab 6a
	7.35pm First brain stem test carried out by Dr. Webb (Consultant Paediatric Neurologist)	058-004-009 (Brain Death Form) – Tab 7g
28.11. 1995	9.10am Second brain stem test carried out by Dr. Webb (Consultant Paediatric Neurologist)	058-004-009 (Brain Death Form) – Tab 7g
	9.15am Life pronounced extinct	011-010-011 (Report of Autopsy 29 th November 1995) – Tab 4c

22. A post-mortem was carried out on 29th November 1995 by Dr. Armour (Senior Registrar State Pathologist's Department) who reported the cause of Adam's death as: 1(a) cerebral oedema due to (b) dilutional hyponatraemia and impaired cerebral perfusion during renal transplant.

23. The Inquest that was subsequently conducted into Adam's death on 18th and 21st June 1996 recorded the Verdict that the cause of his death was:

1(A) Cerebral Oedema
due to

(B) Dilutional Hyponatraemia and impaired cerebral perfusion during renal transplant operation for chronic renal failure (congenital obstructive uropathy)

Findings:

The onset of cerebral oedema was caused by the acute onset of hyponatraemia from the excess administration of fluids containing only very small amounts of sodium and this was exacerbated by blood loss and possibly the overnight dialysis and the obstruction of the venous drainage to the head

24. The Coroner, Mr. John Leckey, was assisted in reaching that Verdict by Dr. Edward Sumner (Consultant Paediatric Anaesthetist) who was retained to prepare a Report on the circumstances of Adam's death. Dr. Sumner concluded in his Report dated 22nd January 1996:

I believe that on a balance of probabilities Adam's gross cerebral oedema was caused by the acute onset of hyponatraemia (see reference) from the excess administration of fluids containing only very small amounts of sodium (dextrose-saline and plasma). This state was exacerbated by the blood loss and possibly by the overnight dialysis.

A further exacerbating cause may have been the obstruction to the venous drainage of the head. If drugs such as antibiotics were administered through a venous line in a partially obstructed neck vein then it is possible that they could cause some cerebral damage as well.

(Emphasis added)

25. Dr. Sumner also gave evidence at Adam's Inquest and his Deposition of 18th June 1996 records him as having expressed the following views:

All the fluids given after dialysis may have been given to increase central venous pressure. It may have had the effect of causing the dilution of the sodium in the body. Fluid balance in paediatrics is a more controversial area with a variety of views. With kidney transplants one gives more fluids than in other operations [*"it is usual to be generous with fluids to maintain a CVP of 10-12 to optimise perfusion of the new kidney and to establish its urine-producing function"*¹¹]. When the new kidney is perfused it is vital that sufficient fluids are available. I got the impression that Dr. Taylor was not believing the CVP readings he was getting. I believe they were probably correct but high. I think I would have believed them. A high CVP can mean too much fluid has been administered¹² ... The low sodium was indicative of the hyponatraemia. Below 128 is a hyponatraemic state.

(Emphasis and parenthesis added)

26. Dr. Robert Taylor (Consultant Paediatric Anaesthetist) gave evidence at the Inquest. His Deposition of 21st June 1996 shows that he disagreed with Dr. Sumner's principal finding:

I cannot understand why a fluid regime employed successfully with Adam previously, led on this occasion to dilutional hyponatraemia ... I believe that the underlying cause of the cerebral oedema was hyponatraemia (not dilutional) during renal transplant operation.

...

¹¹ See Dr. Sumner's Report of 22nd January 1996 at ref:011-011-059 - See Tab 4g

¹² Dr. Sumner prepared his Report on the basis that Adam received 900mls of Dioralyte. See at ref: 011-011-055 - See Tab 4g. That figure was corrected in correspondence between the Coroner and Dr. Armour but it is not clear that the correspondence from Adam's mother referring to the lower figure was passed to Dr. Sumner. Dr. Armour thought that the difference between the two figures made no difference to her opinion on the cause of Adam's death: *"It is not just the volume of fluid he received but the type."* See at ref: 011-079-214 - See Tab 4c

Adam was the only child with polyuric renal failure I have anaesthetised for renal transplant. He needed a greater amount of fluid because of the nature of the operation [*"All the more important in this case is the need to avoid dehydration that will deprive the donor kidney of sufficient fluid to produce urine"*¹³]. I believe the fluids given were neither restrictive or excessive. The new kidney did not work leading to a re-assessment of the fluids given. This made us think we have underestimated fluid and we gave a fluid bolus at 9.32.

(Emphasis added)

27. The circumstances of the calculation of the fluids given to Adam and the actual amounts involved (bearing in mind his 'polyuric condition'¹⁴) are important issues for the Inquiry as they go to whether Adam's hyponatraemia might have been avoided by appropriate fluid management. Mr. Geoff Koffman (Consultant Surgeon at Guy's & St. Thomas Hospital and Great Ormond Street), was retained by the Police Service of Northern Ireland (PSNI)¹⁵ as an expert paediatric transplant surgeon and stated that: *"The sodium and potassium should have been repeated prior to start of surgery. The polyuric patient with poor renal function would pass large quantities of dilute urine and may have difficulty controlling the concentration of sodium and potassium in the blood"*.
28. However, the fundamental difference between Dr. Edward Sumner and Dr. Robert Taylor is over whether Adam's condition permitted him to suffer from 'dilutional hyponatraemia'. Dr. Taylor's underlying thesis was that Adam's condition and his performance under anaesthesia were known to him (but not to Dr. Sumner) and he was therefore able to state with confidence that Dr. Sumner was wrong in concluding that Adam developed 'dilutional hyponatraemia' as opposed to 'hyponatraemia'.
29. In addition, the papers received by the Inquiry indicate a possible clinical tension between the Anaesthetist Dr. Robert Taylor and the transplant Surgeon Mr. Patrick Keane over the extent of blood loss during the transplant surgery.
30. Furthermore, the papers disclose an issue as to the size of the operating theatre team and the role of the members of that team, including the number of Anaesthetists present during the surgery, and the presence and/or requirement of a dedicated Anaesthetic Nurse.

¹³ See Deposition at ref:011-014-100 – see Tab 4e

¹⁴ See letter dated 2nd March 1995 from Mr. Maurice Savage (Consultant Paediatric Nephrologist) to Dr. Scott (Adam's GP) explaining: *"The problem is he still needs about 2 litres a day because of his polyuric renal failure"* (057-072 – see Tab 7e).

¹⁵ The PSNI conducted an investigation into the deaths of all of the children over a period of about 2 years before deciding not to prosecute anyone in connection with their deaths

Requirements

31. The Inquiry team requires your assistance with the following matters, arising out of the material received to date and the guidance of the Inquiry's Expert Advisors:
- (i) The protocols (if any) that were generally available in 1995 (and now) governing or impacting upon the work or role of an anaesthetist before, during and after a transplant procedure
 - (ii) The level and type of anaesthetic experience that was warranted in the circumstances, including:
 - (a) The extent to which the anaesthetic management of Adam was complex (due to his previous surgery, age and weight)
 - (b) The level and type of experience of the anaesthetic team that were actually involved in Adam's operation
 - (iii) The equipment that was typically available in 1995 (and now) for a renal transplant procedure, including the equipment that would be used for taking bloods (including urea and electrolyte results), measuring pressures, etc
 - (iv) Whether the Royal Belfast Hospital for Sick Children had the facilities and resources, both in terms of clinical experience and technological services, to carry out such surgery in November 1995
 - (v) The significance for the anaesthetists (if any) of the fact that Adam had a past history of occasional hyponatraemia (with serum sodium results of below 120 mmol/L)
 - (vi) The information that the anaesthetists should have sought about Adam's medical condition (including type, volume and rate of fluid intake and urine output) and also his physical state before commencing the transplant procedure, and the reasons for them seeking it
 - (vii) The frequency of blood and electrolyte results that should have been sought including whether, as a matter of good practice, the anaesthetists should have sought up to date information on Adam's electrolyte levels prior to commencing the anaesthetic and the transplant procedure and, if so, the practical significance of not having such information prior to commencing the anaesthetic
 - (viii) The use of, and reliability of, the blood gas analysers that were available during transplant operations in 1995 (and now), including whether and how the administration of certain fluids or medications

(including Heparin) would impact upon the reliability and accuracy of such machines

- (ix) The typical arrangements in 1995 (and now) for getting out-of-hours laboratory results on blood tests and the typical turn around times for such results for transplant surgery
- (x) The typical size and composition of an anaesthetic team for a paediatric renal transplant in 1995 (and now) including during the periods:
 - (a) When anaesthesia is being induced
 - (b) Whilst the child is anaesthetised
 - (c) When the child is being awakened/reversed
- (xi) With reference to the periods at (a) to (c) above:
 - (a) The respective roles of the anaesthetic 'team'
 - (b) The number of anaesthetists required to be present and their respective roles
 - (c) The number of nurses required to be present
 - (d) Whether a medical technical officer and/or anaesthetic nurse would be expected to be present
 - (e) Whether the number of persons present could/would change over the course of a procedure
 - (f) The role of the anaesthetist in charge in deciding the number and the composition of the operating team
- (xii) The significance for the anaesthetists (if any) of the fact that the donor kidney was perfused at 01:42am on 26th November 1995 and the transplant surgery was not scheduled to start until 07:00am on 27th November 1995
- (xiii) The relationship between the surgeons and the anaesthetists during transplant procedure in respect of the administration of fluids, including:
 - (a) How the surgeons and anaesthetists work as a team in the operating theatre
 - (b) How the surgeons and anaesthetists work as individuals in the operating theatre, in particular where the primary responsibility lies for ensuring that the appropriate balance is achieved between excessive venous filling which would be dangerous for Adam and under filling which would compromise the transplanted kidney
- (xiv) The patient undergoing the transplant surgery was unusual in that he had functional native kidneys, was normally polyuric, and had a tendency to be hyponatraemic. In the light of these facts, please explain:

- (a) Whether the anaesthetists need continuous measurements of blood pressure and central venous pressure throughout the procedure and afterwards, and if so why
 - (b) Whether there was a need for the anaesthetists to be aware of Adam's urine output and if so why and whether a urinary catheter should have been inserted immediately after induction of anaesthesia
 - (c) Whether there was a need for frequent checks of serum sodium during the procedure, including just after induction of anaesthesia and if so why
 - (d) What should have been done when at 0800 a central venous line was inserted via the right subclavian vein produced a reading of 17 mmHg
 - (e) What should have been done when at 0932, the serum sodium result of 123 mmol/L was received
 - (f) What fluids (content and volume) Adam should have received during and after the procedure, and why
- (xiv) The quality of record keeping and monitoring of fluids and electrolytes, including recording of dialysis cycles, that would be expected of an anaesthetist in 1995 (and now)
- (xv) The role (if any) of the anaesthetist in discussing with the patient's family the risk of death and adverse events from the transplant surgery, in particular:
- (a) The quality of the communication by the anaesthetist with Adam's family (particularly Adam's mother)
 - (b) The role of the anaesthetist in gaining consent from the paediatric patient's parents (both in 1995 and now)
 - (c) Any particular risks that were apparent in Adam's case that should have been explained by the anaesthetist to Adam's mother before the transplant surgery
 - (d) Whether (both in relation to 1995 and now) patients and their families are regularly informed of the identities of their surgical team, and if they are unhappy with a particular anaesthetist, whether alternatives are made available
 - (e) Whether there were any other options to immediate renal transplant surgery that should have discussed and/or recommended, such as:
 - delaying transplant surgery until Adam was older

- having Adam taken to a centre with greater experience of paediatric renal transplant
- having the transplant carried out by a more experienced team

(xvi) How anaesthetists would deal with lessons learned following an 'adverse incident' or 'near miss' in 1995 (and now)

32. To assist you we have attached an index of 'key documents' together with a 'core bundle' of the documents that would appear to be of especial significance. Please request any other documents that you consider relevant for the preparation of your Report

Conclusion

33. It is of fundamental importance that the Inquiry receives a clear reasoned opinion on these issues.
34. Your assistance on the Inquiry's requirements should be provided in the form of a fully referenced Expert's Report. In accordance with the Protocol on Experts, your Report will be peer reviewed.

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Tab.4 Selected Inquest Documents:

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- Dr. Maurice Savage (Ref: 011-015-109, Tab 4a)
- Mr. Patrick Keane (Ref: 011-013-093, Tab 4b)
- Dr. Alison Armour (Ref: 011-010-030, Tab 4c)
- Dr. John Alexander (Ref: 011-012-079, Tab 4d)
- Dr. Robert Taylor (Ref: 011-014-096, Tab 4e)

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- Professor Peter Berry (Ref: 011-007-20, Tab 4f)
- Dr. Edward Sumner (Ref: 011-011-042, Tab 4g)

Tab.5 Selected Inquiry Statements (initial):

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- Ms. Debra Slavin (Tab 5a)
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Tab.6 Selected PSNI Documents:

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- Ms. Debra Slavin (Ref: 093-003-003 and Ref: 093-005-007, Tab 6a)
- Dr. Maurice Savage (Ref: 093-006-014, Tab 6b)
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- Transcript of Dr. Robert Taylor's interview under caution (included in the statement of DS William Cross (Ref: 093-035, Tab 6q)

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- Medical opinion of Dr. Edward Sumner, including PSNI brief (Ref: 094-001-001 and Ref: 094-002-002, Tab 6r)

Other documents:

- Dr. John Burton's folder of documents (Ref: 094-013-053, Tab 6s)

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Volume 3

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