

ISSUES ARISING FROM PERI-OPERATIVE MONITORING

27th November 1995

ISSUE	MEMBERS OF TRANSPLANT TEAM		INQUIRY'S EXPERTS			OTHER EXPERTS
	Dr. Taylor	Mr. Keane	Dr. Coulthard	Professor Gross	Dr. Haynes	
1. Checking of serum electrolytes prior to Adam being taken to the operating theatre.	Dr. Taylor states that his failure to collect a blood sample for biochemical analysis at the commencement of surgery was the result of being too preoccupied with other duties ¹	<p><i>"Given the time that has passed I am unable to recall any specific details of the operation"</i>²</p> <p><i>"I would have expected that Adam's electrolyte levels would have been checked either just before or just after the operation started"</i>³</p> <p><i>"He should have had his electrolytes checked once the</i></p>	<p><i>"The test was of most importance to Dr. Taylor himself...because its relevance was to make any adjustments, if necessary, to Adam's management...he had a double reason to take responsibility himself for taking and sending off the blood sample; he had been asked and had agreed to do so, and he was the person who would act upon the results"</i>⁵</p>	<p><i>"After Dr. Taylor had placed a right subclavian access successfully-which was just before the induction of anaesthesia-someone could have obtained blood from that access and sent this blood to the lab for stat measurement, usually having a turnaround time of 10-30 min"</i>⁶</p> <p><i>"Since preoperative measurements were not done the anaesthiologist had to work with assumptions rather than fact as far as electrolytes and blood sugar are concerned"</i>⁷</p>	<p><i>"There was an intention that he should have his serum electrolytes checked early in the morning prior to being taken to the operating theatre, this was not done, which was not unreasonable given that he [Adam] was probably scared and it might have been difficult to get a blood sample from him".</i>⁸</p> <p><i>"Dr. Taylor should at the very least have carried out a point of care testing using the blood gas analyser as soon as he had secure</i></p>	Mr. Koffman: <i>"The sodium and potassium should have been repeated prior to start of surgery"</i> ¹⁰

¹ Ref: WS-008/6 p.3² Ref: WS-006/1 p.2³ Ref: 093-010-030 & WS-006-02 p.13

TABLE

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	Dr. Taylor	Mr. Keane	Dr. Coulthard	Professor Gross	Dr. Haynes	
		<i>central or arterial lines were inserted"</i> ⁴			<i>vascular access following induction of anaesthesia (knowing that it may not be as accurate as a formal laboratory test but any serious abnormality would have become evident quickly) and also sending part of that for laboratory analysis, and at regular hourly intervals thereafter using blood from an arterial line. He did not give adequate consideration to Adam's electrolyte status"</i> ⁹	
2. Turnaround of serum electrolyte laboratory	Dr. Taylor states that he did not ask a nurse to attend to take blood samples	Mr. Keane cannot recall anything in relation to	<i>"In my experience (from the mid 1970s), it would be very rare to wait more than an hour to obtain electrolyte assay</i>	<i>"if there were technical difficulties obtaining blood in Adam during the pre-operative period this is no reason by itself why</i>	<i>"In 1995 as now, a turnaround time of no more than 60 minutes for an emergency sample is taken to the result</i>	

⁵ Ref: 200-007-128

⁶ Ref: 201-004-114

⁷ Ref: 201-004-128

⁸ Ref: 307-008-165

¹⁰ Mr. Koffman, Ref: 094-007-032

⁴ Ref: WS-006/2 p.13

⁹ Ref: 204-013-394, 204-004-149-150, 204-004-162, & 204-002-024-025

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results.	down to the lab, that the portering service <i>"could be variable"</i> , that no pneumatic tube system was available at the time, and that no arrangements had been made pre-operatively for the transportation of samples to the lab during the operation ¹¹	laboratory results ¹²	<i>results from specimens sent urgently sent to a laboratory, and typically they would be completed within about ½ hour"</i> ¹³	<i>the measurement of serum sodium should have been cancelled... someone could have obtained blood from that access and sent this blood to the lab for stat measurement usually having a turnaround time of 10-30 min"</i> ¹⁴	<i>being made available"</i> ¹⁵	
3. Failure to insert urinary catheter after anaesthetic.	<i>"There is no record of the reason why his bladder was not catheterised. It may have been to permit the bladder to be as full as possible in</i>	<i>"Monitoring of urine during a transplant procedure is never done"</i> ¹⁷ <i>"It was my</i>	<i>"Adam had a high native urine output, which could have fallen briskly during anaesthetic if his blood pressure fell. It was necessary to catheterise</i>	<i>"It would have been desirable to have a bladder catheter in place because this would have permitted to determine Adam's fluid balance during the operation more precisely.</i>	<i>"It would have been helpful if a urinary catheter had been inserted as soon as Adam was anaesthetised to give an index of urine volume that was being produced.</i>	

¹¹ Ref: WS-008/3 p.32

¹² Ref: WS-006/3 p.25

¹³ Ref: 200-012-186

¹⁴ Ref: 201-004-114

¹⁵ Ref: 204-002-026

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	<i>relation to the operation"</i> ¹⁶	<i>decision not to catheterise and I believe was the correct decision"</i> ¹⁸	<i>Adam and monitor his hourly output"</i> ¹⁹	<i>However a bladder catheter would not have been strictly necessary"</i> ²⁰	<i>If it wasn't done for a good reason, a brief comment in the medical notes should have been made in my opinion".</i> ²¹	
4. Accuracy of CVP monitoring.	<i>"The computerised records indicated that Adam's central venous pressure... had risen... after 2 hours of surgery. ...We concluded that the tip had curved upward into the neck vessels as confirmed by compression. Therefore, as indicated in my statement... we accepted the 17mmHg as a marker to look for a relative change</i>	<i>"I was not made aware of any problems during the operation in relation to blood pressure or central venous pressure... I have no recollection of being made aware of any problems with the CVP"</i> ²⁴	<i>"I agree entirely with Simon's [Haynes] speculation that CVP as high as Adam had at the onset of surgery, or had recorded at the onset of surgery, is not at all compatible with what we think his physical state was at the time. To me it seems... that there is a problem, there is an error"</i> ²⁵ . <i>"It appears to me that Adam's printed out</i>	<i>"It is not fully explained why Dr. Taylor did not accept these readings as correct or why he failed to undertake appropriate steps to clarify what the correct CVP was such as pulling back the catheter"</i> ²⁷ <i>"The significance of the CVP measurements during the operation was that they indicated an elevated or an at least high normal intravascular</i>	<i>"The values documented were not representative of his true central venous pressure and that they were of no real guidance and it should have been recognised that they could not possibly have been correct in the circumstance"</i> ²⁹ <i>"There never was a proper venous wave form during the operation obtained through that</i>	

¹⁷ Ref: 011-013-093 & WS-006/2

¹⁶ Ref: WS-008/3 p.1(a)

¹⁸ Ref: WS-006/3 p.13

¹⁹ Ref: 200-002-042

²⁰ Ref: 201-006-175

²¹ Ref: 307-008-166

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	<p><i>rather than an absolute measure”²²</i></p> <p><i>“There were both cardiac and respiratory patterns to the waveform confirming correct intravascular placement. However from the pressure reading, I concluded that the tip of the line was not in close relation to the heart (later confirmed by ex-ray). I, therefore, used the initial reading (17mmHg) as a baseline”²³</i></p>		<p><i>CVP rose from a starting value of over 20 at or about 7:50 am... to reach about 30 by 8:30 am, and to stay at or above that level for most of the rest of the operation. I cannot understand why this was not regarded as a danger signal to indicate fluid overload”²⁶.</i></p>	<p><i>volume in Adam- but not volume reduction as Dr. Taylor assumed. The implications for Adam's fluid management should have been to proceed sparingly and replace no more than the losses which occurred. Instead rather large amounts (of hypotonic fluids) were given to fill up assumed deficits which did not exist”²⁸</i></p>	<p><i>central venous line”³⁰</i></p>	

²⁴ Ref: 090-010-030 & WS-006/2 p.13

²⁵ Ref: 307-008-182

²⁷ Ref: 200-004-125

²⁹ Ref: 307-008-180

²² Ref: WS-008/1 p.5

²³ Ref: 011-014-099

²⁶ Ref: 200-002-055

²⁸ Ref: 201-004-137

³⁰ Ref: 307-008-181

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5. Subsequent blood testing by Blood Gas Analyser	<p><i>"It was not highlighted as a particular problem because we would send a sample to the Royal Biochemistry Laboratory for accurate U&E tests"</i>³¹</p> <p><i>"The technicians tried to give us as much information as they could at the time but we were told by the labs not to rely on these tests [blood gases]"</i>³²</p>	<p><i>"I had no discussion with Dr. Taylor on fluid management during this procedure. I do not discuss fluid management, other than blood loss, when a consultant anaesthetist is involved in a case"</i>³³</p>	<p><i>"The reason(s) why Dr. Taylor failed to send any blood specimen to the biochemistry laboratory throughout the entire operation remain(s) unexplained"</i>³⁴</p>	<p><i>"Sodium measurements obtained on blood gas machines are less reliable than measurements obtained by the central chemistry facility"</i>³⁵</p>	<p><i>"It is the anaesthetist's responsibility and duty to ensure that these values remain within acceptable limits throughout the period of the transplant"</i>³⁶</p> <p><i>"Dr. Taylor should have acted upon the 9.32am sodium result of 123 mmol/L to correct it as it was an abnormally low result, even if he regarded it as less accurate than a formal laboratory assay"</i>³⁷. Should have ceased IV fluids less than 131mmol/L sodium immediately, given Mannitol and then calculate how much</p>	

³¹ Ref: WS-008/2 p.40

³² Ref: 093-038-255 & WS-008/2 p.40

³³ Ref: WS-006/2 p.14

³⁴ Ref: 200-012-177

³⁵ Ref: 201-004-105

³⁶ Ref: 204-004-150

³⁷ Ref: 204-013-394, & 204-004-149

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					<i>hypertonic saline to give pending confirmation of test result³⁸. Should have minimised any cerebral oedema which may have ensued from the abnormality e.g. head in neutral position held slightly up³⁹.</i>	
6. Whether there was regular monitoring, review and regulation of Adam's fluid intake to keep up with his fluid losses.	Dr. Taylor states that there was such regular monitoring etc., and that "we were administering fluids to Adam with the express purpose of increasing his blood volume to ensure that the donor kidney (with a long ischaemic time) would have sufficient preload and be given the best possible chance of working" ⁴⁰	<i>"In Adam's case we allowed the bladder to distend naturally and not measure his urine output"⁴¹</i> <i>"I had no discussion with Dr. Taylor on fluid management during this procedure. I do not discuss fluid management,</i>	<i>"For someone undertaking an anaesthetic on a child who they believe to have an extra-ordinarily high output of excessively dilute urine, whose fluid administration strategy was based on these assumptions being true, it appears that he did not monitor the obvious and simple parameter of the urine output (let alone confirm that its sodium concentration was as</i>	<i>"This expert (Gross) is convinced that appropriate fluid management would have been successful in preventing hyponatraemia"⁴⁴</i>	<i>"During the transplant operation there was a need for a significant volume of intravenous fluid replacement to be given to him to compensate for blood loss, insensible fluid loss, urine production and vasodilatation... it would have been prudent to have measured the sodium concentration in his blood as soon as possible after anaesthesia and then at regular intervals – hourly if</i>	Dr. Sumner: "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

³⁸ Ref: 204-004-159 & 204-002-034

³⁹ Ref: 204-002-033-034

⁴⁰ Ref: WS-008/1 p.7

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		<i>other than blood loss, when a consultant anaesthetist is involved in a case</i> " ⁴²	<i>low as he presumed)</i> " ⁴³		<i>stable, more frequently if rapid volume replacement was needed</i> " ⁴⁵	<i>and plasma)</i> " ⁴⁶
7. Visual Observations	<i>"When continuously re-assessing Adam's fluid replacement we used all the information available from the anaesthetic monitors as well as visualising the impact on the surgical field"</i> ⁴⁷				<i>"It is customary to keep the head visible during an anaesthetic whenever possible, and to examine it, including looking at the pupils, at intervals during a long operation"</i> ⁴⁸	
8. Significance of Adam being 'swollen', 'puffy' and	Dr. Taylor states that he first noticed that Adam's face, hands and feet were	Mr. Keane was not present at the end of the surgery,		<i>"Perhaps Adam was fluid overloaded to such a degree that he manifested edema of the skin as a sign</i>	<i>"I can only comment on the appearance of his body as informed by the descriptions provided in</i>	

⁴¹ Ref: WS-006-2 p.10

⁴⁴ Ref: 201-004-112

⁴² Ref: WS-006/2 p.14

⁴³ Ref: 200-005-093

⁴⁵ Ref: 204-002-032

⁴⁶ Dr. Sumner, Ref: 011-011-053

⁴⁷ Ref: 093-038-128

⁴⁸ Ref: 204-004-170

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'bloated' at the end of the surgery	swollen when the sterile towels were removed at the end of the operation ⁴⁹	having been called away to an emergency at the Belfast City Hospital ⁵⁰		<i>of increased extracellular fluid..."⁵¹</i>	<i>the various witness statement. The photographs sent to me (093-005-008-13) show very marked swelling of Adam's head and arms"⁵²</i>	
9. Compliance with 1990 RBHSC Guidelines for Renal Transplantation in Small Children.	Dr. Taylor states that these Guidelines governed Adam's renal transplant operation ⁵³	Mr. Keane states that no protocols or guidelines governed Adam's renal transplant operation ⁵⁴	<p>Did not comply with 1990 guidelines on use of intra-operative fluids which stated:</p> <p>(i) blood (likely whole blood rather than packed cells); or</p> <p>(ii) PPF (solution containing proteins and sodium at concentrations similar to plasma); or</p> <p>(iii) N/2 saline (half</p>	<i>"The 1990 Guidelines were complied with in relation to Adam"⁵⁷</i>	<i>"Protocols (and guidelines) for specific circumstances e.g. renal transplantation in children, are generally prepared by individual institutions... in 1995 the facility to access guidelines such as these... would be on paper and less instantly to hand"⁵⁸</i>	

⁴⁹ Ref: WS-008/2 p.45

⁵⁰ Ref: WS-006/2 p.6

⁵¹ Ref: 201-004-143

⁵² Ref: 204-006-333

⁵³ Ref: WS-008/2 p.48

⁵⁴ Ref: WS-006/2 p.17

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			<p>normal saline, 0.45% with a sodium concentration of 77mmol/L)⁵⁵</p> <p>In his later report Dr. Coulthard further states that the "<i>checklist</i>" was in line with the Guidelines⁵⁶</p>			

⁵⁷ Ref: 201-006-177

⁵⁸ Ref: 204-002-020

⁵⁵ Ref: 200-004-086

⁵⁶ Ref: 200-007-129