Monday, 16 April 2012

(10.00 am)

THE CHAIRMAN: Good morning, everybody. Welcome back to Banbridge. The conclusion of the opening address in Adam's case was circulated on Friday afternoon and then a further copy of some additions were sent yesterday evening and hard copies have been made available this morning.

As a result of that, Ms Anyadike-Danes will present that address this morning and she will finish by lunchtime. That means inevitably that she will not go through the paper which has been circulated line by line; instead she will highlight various issues to which she particularly wants to draw attention and it's possible to do that because it has been circulated in advance and it will go on the inquiry website later on today.

The other point about finishing by lunchtime is that this will allow witnesses, particularly this week's witnesses, some time to consider the content of the opening with their lawyers before they come to give evidence. This is effectively what Mr Fortune asked for on 27 March on behalf of Dr Savage. Mr Fortune, should we be calling your client "professor" or "doctor"?

MR FORTUNE: Professor Savage.

THE CHAIRMAN: Thank you very much. We will then start, having concluded the opening by lunchtime, we will then be in a position to start the oral evidence tomorrow.

In that context, could I remind the lawyers for the various parties that, under our hearing procedures at paragraph 6.3, they are required to give inquiry counsel at least 72 hours' notice of topics, issues or lines of questioning which they want to be raised with each witness.

We have received some notes along these lines, but comparatively few. This procedure is in place to help us plan and time the questioning and therefore adhere to our witness schedule as best we can. I'm laying down that marker now because if it isn't followed, it'll make the hearings more difficult. And if it is not followed, I may draw an inference -- and counsel may draw an inference -- that you don't have any particular lines of questioning which you want to be raised. Beyond that, ladies and gentlemen, any outstanding issues can be raised at the end of the openings and I invite Ms Anyadike-Danes to present the conclusion of the opening, which was started on 26 and 27 March.

Opening by MS ANYADIKE-DANES (continued)

MS ANYADIKE-DANES: Thank you very much, Mr Chairman. Good morning, everybody. You have the opening, sir.

You will see from the table of contents that where we were last time is I was going through the selection of issues to be addressed through the oral hearing. I had got as far as the conclusion of the preoperative stage. What was to follow then is the perioperative stage, which is the stage during which Adam would have been in theatre, the operating theatre, and then the issues to be addressed in the immediate post-operative stage, which takes us through to PICU and to the brainstem tests. And then the period following his death.

So those are the three issues, areas, that still have to be addressed. I should also say that you have three schedules; they should have been provided, accompanying the opening. Two of those deal with the position of the experts. As you know, that was also one of the reasons why I did not continue last time because it required an analysis of the experts' positions and their reports weren't all finally in. We now have them, and so what you should have is a schedule which is a summary of the points prior to the experts' meeting, and then a longer schedule of a summary of points after the experts' meeting.

I have to say, those are schedules that have been compiled by the legal team, so it's not that the experts

themselves have approved those schedules; it is our take on the essential issues that they have made. I will go through -- not literally go through it -- but I will take you to it in a little more detail towards the end of the opening. But I just want to be sure that you have that.

You will appreciate there were some changes made to the opening that was delivered on Monday and Tuesday of 26 and 27 March. The reason for that is the purpose of this opening is not really like an opening in litigation; the purpose of it is to communicate to the chairman and to the public, for that matter, the evidence that the investigation has to date acquired and to set out, therefore, the basis upon which we still need to obtain further evidence in order for the chairman to be in a position to make his determination, rulings and, ultimately, his recommendations.

So if there is information, as indeed was the case, that came to the inquiry after the opening was delivered, which calls into question something that had previously been in the opening, then obviously we have to change that, or if there is further information that we should have put in to put matters in a better context or make sure that matters were put more broadly, where that's appropriate, then obviously we have to deal with

that. I just want to take you to two issues and draw your attention to them. All of them have been underlined. Obviously, I'm not going to go through everything, but there are two which are worth noting.

The first appears on page 28, paragraph 81. That deals with the question of the experience and expertise of the anaesthetists. You may remember that when I first delivered the opening, we were in possession of information in relation to transplant surgeons prior to Adam's surgery, which enabled us to make comparisons as to people's relative experience.

But we didn't have that information in relation to the anaesthetists. We had it, but not that would enable us to know who had what information prior to his surgery. We now have that and so you will see that we've been able to provide you with the information of those anaesthetists who had been involved in paediatric renal transplant prior to Adam's. If you look on page 29 you will see who they are. This is information from the DLS. I'm not in a position to vouch for its accuracy, but I hope that it is since they have provided it. There is an unidentified anaesthetic team who had been involved in a renal paediatric transplant on 7 October 1993 and then in 27 September 1995, Dr Peter Crean was involved. He was, of course, a

consultant in paediatric anaesthesia and intensive care. His name comes up in the list of persons. Then on 17 October, literally just before Adam's transplant surgery, he again was involved with a Dr David Hill, who's a senior registrar, and David Hill also has a role other than that for the purposes of Adam's case. And you can look him up on the list of persons involved.

So there we are. That seems to be the extent of the anaesthetic experience that was available prior to Adam's transplant. Then if you go to page 42, the other change that's worth drawing to your attention. It's something that Professor Savage's counsel was good enough to draw my attention to. It all relates to the paediatric fluid balance tables. His client had produced a table which provided his accurate figures and we also subsequently had reports from Dr Coulthard and Dr Haynes and Professor Gross, but Dr Coulthard in particular had somewhat changed figures, and so they are all reflected in an updated paediatric fluid table and we can see that from the comparison table. So it's there. I have referenced where it is. You can see that from the footnote, so I don't propose to go into exactly how they changed it at this stage, but simply to flag up that we now have that.

So then, any other changes like those are all

underlined and you can see them for yourselves.

If I then go to the perioperative stage. As I said, that commences with Adam being anaesthetised at 07.00 on Monday the 27th, and ends with his transfer to PICU, which was roughly at about noon. We have some schedules to assist you with exactly what was going on and what the evidence says was going on, if I can put it that way. That's in his chronology of events and we have, obviously, the reports of the experts that deal with that period and, of course, all the witnesses, their statements and notes and records. The identity of those who were specifically involved in that period are in the list of persons and that describes exactly how they were involved.

We have analysed his condition, Adam's condition, at the start of the period by reference to two charts that we have compiled and reference has already been made to them. The first is his perioperative fluid balance, and that distills the information on and the calculations by the clinicians and the experts and that's the chart, one of the charts, I was just talking about. You will appreciate, Mr Chairman, that the purpose of all of that is -- at least the purpose of the comparative one is to provide a comparative analysis of his fluid balance at the start of his transplant

surgery. It does other things as well. Obviously, it goes on and talks about what was happening throughout the surgery, but an important part is to try and get a fix on Adam's condition as he went into the surgery and the assumptions that the experts and the clinicians have made about his surface area, about his fluid losses and about the effect of dialysis, both on his serum sodium level and also on his fluid balance. It is all to try and set it out so that one can make appropriate comparisons and see where they differ and the reasons why they differ, for that matter.

If we then go to his condition and the risk factors presurgery. The second chart is Adam's pre-surgical state and that's a chart that the legal team provided and you have already seen it. It sets out certain pre-admission details as well as summarising his condition going into surgery according to a variety of factors. I'm not going to pull these charts up because I already did that previously, you'll have seen them, and, in any event, they are referenced in the footnote and you can pull them up and see them. I'm also very conscious of the time, so you'll forgive me if I don't go through all those compiled documents in quite the detail I might otherwise have done.

There is also the timeline of main events, which is

a very, very long timeline. That takes you from as early as would appear to be appropriate, right up until past this period -- actually right up until his death -- and I took you through that timeline before and identified how it had been put together and the significance of the colour scheme used, particularly those factors that were highlighted in red, the acute factors, and we also provided a summary of that to try and indicate the extent to which Adam was relatively free of significant factors. You will have seen that as well.

The view of Adam's mother of his condition is set out in her first inquiry witness statement. She is very clear:

"Adam had been ill -- "

And you can see that from the charts that I have referred to and the timelines:

"-- all that summer and he was now back on top form. He was really well at that point, but I was told that I wouldn't know when another kidney would come up. This was a really good match."

Doctor Savage also considered that Adam was fit and well going into his transplant surgery, and you can see that from his correspondence with Adam's GP.

Such a view seems to have been generally accepted,

actually, by everyone treating him at the time. It's reflected in the coroner's letter, which he said when he was briefing Dr John Alexander, to provide an expert anaesthetist report. He said:

"I understand the child was healthy and considered to be an ideal candidate for transplant surgery. No complications were anticipated."

And that view is also echoed by Dr Coulthard during the experts' meetings in Newcastle. He says:

"If you put all the evidence together as to what condition he was in when he went to theatre, everything else [other than his CVP reading] points to him being in a relatively good condition."

And Dr Taylor, initially, would appear to have provided a slight discordant note because he states in his PSNI interview under caution that:

"[Adam was] in good health. However, his chronic status of congenital nephritic [sic] syndrome did not make him a perfect candidate."

He was pressed about that because that particular syndrome had not previously been associated with Adam. He resiled from it and states in his inquiry witness statement in May of last year that his diagnosis -- that is Adam's diagnosis -- was:

"... 'bilateral dysplastic kidneys with large cyst'

as diagnosed by Dr Savage and 'reflux nephropathy' by Dr O'Connor, not as I suggested."

So the precise implications of what that means about what he considered Adam's condition to be, if you remove the chronic status and the congenital nephrotic syndrome, is not entirely clear, but I'm sure that we can pursue that with Dr Taylor.

There remains, of course, as of yet, unresolved issues raised by Professor Kirkham in her reports as to whether Adam nonetheless arrived for his surgery with risk factors for the development of chronic venous sinus thrombosis. And if you have read the transcripts of the meetings of the experts and also the reports, you will know what she considered those risk factors to be. The first was the administration of erythropoietin. And then there was: anemia, at least in part secondary to iron deficiency; polyuric and intermittently at risk of dehydration; and ligation of the left internal jugular vein with the CVP catheter in the other side of his neck. Those, she considered, were the risk factors.

And she also considered that they were present in Adam when he arrived for his transplant surgery and she considered he developed an additional risk factor for chronic venous sinus thrombosis when methylprednisolone was administered in the operating theatre as the

immunosuppressant drug. So those are her issues about Adam's condition, if I can put it that way.

Alternatively, Professor Kirkham also considered that Adam may have arrived at the operating theatre for his transplant surgery with a compromised ability to deal with the cerebral oedema that he subsequently developed. She refers in her reports to the compensatory mechanisms in the brain of increase in venous drainage and, two, increase in the reabsorption of central spinal fluid -- that's CSF.

I have provided two diagrams and, although I'm not going to go through all the material that's provided, some of these are actually quite helpful to understand what's going on. If I can pull up, please, 300-088-186. That's not going to pull up, okay. That's unfortunate. I would ask you, please, to look at that diagram in the footnotes because it explains in a way that's to be readily appreciated what the contents within the skull are and how they may or may not be affected by pressures. Ah, here we are.

There's the intracranial contents. In figure 1A we see the central spinal fluid. Then you see where the brain is and you can see the space that exists between those, and you see the arterial supply coming in from the left-hand side, on the right-hand, exiting venous,

and then if you look at the contents during raised intracranial pressure, there you can see that the central spinal fluid has been -- the pressure pushes that down so far as is possible, but you also see how the brain swells and once everything has been pressed out that it can be -- if I can put it in those layman's terms -- there's nowhere else to go and if the brain is still swelling, you can see what's happening right at the top, you can see the flattening of the brain against the skull.

When we come to talk about the evidence that Dr Squier saw, and when she talks about the flattening of the dura and so forth. You can appreciate how that happens and how that assists them in interpreting quite how much pressure may or may not have been exerted.

Professor Kirkham also produced a diagram with both of her reports. That shows the Monroe-Kellie Principle. That's also a diagram that's worth pulling up because it helps understand what she's talking about. That's 300-092-192. There we are. So you can see that she has got the same intracranial components of brain, blood -- both arterial and venous -- and the central spinal fluid. She has the normal arrangement, then "compensated", "normal", and then "decompensated" with an increase in intracranial pressure.

This is to try and explain what the brain does when it comes under pressure and, of course, the brain's intention -- if one can attribute an intention in that way -- is to try and survive. Those are its mechanisms. So she was using that to demonstrate that if the volume of one of these components increases, there is a cerebral oedema leading to increased volume of the brain, there is some reserve capacity related to the reduction of venous blood by compression and/or drainage into the jugular veins and, two, reduction of cerebrospinal fluid volume by increased absorption into the subarachnoid space of the brain around the spinal cord. That point where she talks about drainage into the jugular veins, you can begin to see the significance of that if there is any compromise of venous drainage. So that's a diagram to try and explain the basis upon which Professor Kirkham says the brain responds to pressure.

So she considered it a possibility that the efficacy of those compensatory mechanisms in Adam's brain were likely to have been reduced by reduced jugular venous drainage due to a combination of, one, the possible ligation of Adam's left internal jugular vein -- as noted by Dr Armour in her report and autopsy -- and the position of the central venous line catheter in the

right jugular vein. And as we go on -- and you can look and see from the comparative schedule that I referred you to right at the beginning of the experts' positions -- you can see the extent to which there is or is not agreement with her about the effect of any kind of compromise to the venous drainage.

So she states in her preliminary report that such a combination would have reduced the opportunity for compensating for increasing cerebral oedema by drainage of blood into the jugular veins and she reiterates that in her final report. She also expresses the view in her final report that such a compromising effect was possibly exacerbated by Adam's position during surgery, which was head down and turned slightly to one side. As you'll have appreciated, Mr Chairman, whether Adam had any risk factors going in to his transplant surgery, and if he did, whether they played any part in the development of his fatal cerebral oedema, has been and continues to be a matter of considerable debate amongst the inquiry's experts. His condition going into transplant surgery and its significance are issues that will require to be explored in the oral hearing.

If we then move on to the responsibilities of the members of the transplant team. Professor Savage accepted that the responsibility for getting Adam to the

operating theatre in an appropriate condition for his transplant surgery rested to a large extent with him. As you are aware, Mr Chairman, the anaesthetic team for Adam's transplant are comprised, at the outset, of Dr Taylor, a consultant paediatric anaesthetist, and Dr Terence Montague, who assisted him. He had started as a senior registrar in anaesthesia at the Children's Hospital in November 1995, so he was quite new there. And Dr Taylor has accepted that, in large part, the responsibility for Adam's well-being during this perioperative stage -- so if we can put it this way: Dr Savage is really responsible for that preoperative stage and making sure that Adam comes through that stage in a fit as state as possible for his surgery. Once we get to the perioperative stage, Dr Savage is accepting in large part the responsibility for Adam's well-being during that stage with the anaesthetic team generally and with him as consultant in particular. And the extent to which the assistant anaesthetist assisting and working under the supervision of Dr Taylor had an obligation to intervene so as to advise on and help to correct mistakes, if any, made by Dr Taylor during Adam's surgery is a matter that's going to be considered during the oral hearing. In other words, whether there was any kind of active role that

the assistant anaesthetist would have. That's a matter to be considered.

The inquiry's expert Dr Haynes has described the nature of the responsibility. He says that:

"The consultant anaesthetists would be responsible for assessing the preoperative condition of the patient, including liaising with referring clinicians [paediatric nephrology in this case] and this would include ensuring that appropriate fluid management took place in the hours leading up to the operation, the appropriate investigations had taken place, that the results were obtained and noted and the impact of previous surgical procedures -- for example, the central line insertion -- would be assessed. The consultant anaesthetist would decide on the conduct of anaesthesia, including fluid and electrolytes administered. He or she would either carry out the (see p95 para320, Adam Opening) epidural catheter insertion, urinary catheter insertion ...(see p95 para320, Adam Opening)... on the consultant anaesthetist to appraise the surgeon of any difficulties encountered ...(see p95 para320, Adam Opening)... and an alternative strategy, for example, surgery cutdown agreed.

"If present, a trainee anaesthetist would assist the consultant anaesthetist with the role as described above

within his or her capabilities, with the consultant being responsible for the actions of the trainee."

And the trainee is really anybody of less than consultant grade.

So if you recall, from the table of paediatric renal transplants, Dr Taylor and the other lead members of the transplant team, Dr Savage, Mr Keane, together with the inquiry's experts, have all set out what they consider should have been the level of involvement of the medical and nursing personnel in the various phases of the transplant process. I'm not going to go through all of that now. I took you to an example of those last time and you have them there. They have all indicated the various levels of priority who they think should have been involved at any given phase of the surgery.

Dr Taylor has provided a number of inquiry witness statements in addition to his evidence to the coroner and his PSNI statement under caution in which he sets out how he went about discharging that responsibility. In addition, his conduct over the period of 26 November 1995 until Adam failed to wake from his transplant surgery at about noon on 27 November has been commented upon and criticised by Dr Sumner as an expert for the Coroner and PSNI and the inquiry's experts, Dr Coulthard, Professor Gross and Dr Haynes, in numerous

reports, and I'm not going to refer to them all here.

Nevertheless, there remain outstanding matters concerning the way in which Dr Taylor sought to discharge his responsibilities to Adam during the perioperative stage and the possible consequences of his conduct. They are matters that we will consider during the oral hearing.

So if we go to the preparation of the operating theatre and equipment. Dr Taylor acknowledges that the preparation of the theatre is largely a matter for the anaesthetic team, assisted by the medical technical officer. He states in his deposition that he was familiar with all of the anaesthetic equipment used and it was checked prior to the start of its use. In his inquiry witness statement, he confirms that the equipment was, in fact, checked on 27 November prior to the start. He makes the following comments:

"Checking the equipment involved. Checking the pipes were securely plugged in ...(see p96 para324(i) Adam Opening)... and so on and, in particular, patient monitors were in working order, airway equipment, drugs and resuscitation equipment."

He also says Dr Montague was with him when he made those routine checks and that neither the checks nor the results were recorded because they were routine checks.

Messrs McLaughlin and Wilson provided a report to the coroner as part of the inquest into Adam's death dealing with the equipment. They, in that report, indicate that:

"All cylinders were removed from the Lamtec and five pins were discovered to be loose and could be removed."

And they go to talk about the significance of that and how serious they regarded that to be. It's not clear when that happened or whether that was the condition of the equipment at the time of Dr Taylor's inspection and, even if it was the condition of the equipment, whether that's the sort of thing that could or should have been noted by him when he checked it. The report also states that the anaesthetist using the machine is also expected to sign a log before commencing the list, but this does not happen on most occasions. Then they say a reason for this omission should be requested.

It's not entirely clear whether Dr Taylor did sign the log as he was expected to do or whether the kind of checks that he said he carried out as routine checks required a signing of the log. We just don't know and it's something we're going to pursue during the oral hearing.

I should just say that it also has governance

implications. The main starting point for the perioperative stage is, of course, the anaesthetising of Adam, and according to Dr Montague's inquiry witness statement the, anaesthetic room was not used to anaesthetise Adam. He was brought directly into the operating theatre with his mother to be anaesthetised there. I showed you a plan last time and I'm not going to take you to that now, but it is referenced here and you will be able to see it yourselves, exactly where the operating theatre used for Adam and the adjacent anaesthetic room are, and you'll be able to see that. So you'll appreciate what Dr Montague may or may not have been able to see from where he was, bearing in mind that Debra Slavin, Adam's mother, and Dr Taylor are in the operating theatre with Adam.

So Dr Montague claims that he was in the anaesthetic room preparing drugs and equipment when Adam was brought into the theatre. Adam's recorded as having been brought in crying, and Dr Taylor says that he anaesthetised him in the presence of his mother. Dr Montague goes to say that he doesn't actually recall who else was in the operating theatre, but he does state:

"Normally, one of the theatre nurses helps the anaesthetist and I don't recall which nurses were

there."

Mr Chairman, that's going to be an issue, as you know. There is an issue as to how many nurses were available in the operating theatre and whether any of them was an anaesthetic nurse. Adam's mother states in her inquiry witness statement that the theatre staff was present when she arrived with Adam and while she concedes she doesn't know whether there were any nurses specifically assisting Dr Taylor anaesthetising Adam, she is clear there were nurses in the room. Dr Montague claims that he didn't go into the operating theatre until Adam was asleep as he thought it would be less upsetting for him if there were fewer strangers about. But he does state:

"Dr Taylor didn't need me for the induction of anaesthesia."

So there will be an issue as to who was exactly in the operating theatre helping or assisting Dr Taylor with anaesthetising Adam.

The anaesthetic record shows anaesthesia commencing at 07.00 with the intravenous administration of those drugs and his mother states in her inquiry witness statement that:

"Adam spoke directly to Dr Taylor saying that he wanted to be anaesthetised by the butterfly and not the

mask."

And, in fact, Dr Taylor confirms in his deposition to the Coroner that's that is exactly how he was anaesthetised: through a 25G butterfly needle in his right antecubital fossa.

No criticism appears to be made of the conduct of Adam's anaesthetic by the inquiry's expert. He describes it in his report as "satisfactory". As part of the arrangements to provide Adam with appropriate pain relief during the transplant surgery, Dr Montague also cited an epidural once Adam was anaesthetised. The purpose of that was also to assist with Adam's post-operative pain management. It seems that Adam's mother was unaware that an epidural would be administered. When she first learned of it, when Dr Savage updated her on his way to perform his other duties, she states that she was unhappy about it as Adam had experienced considerable pain last time an epidural had been used. So it may well be that there will be an issue as to exactly the fulsomeness of the information that was given to Adam's mother.

A number of things then happened prior to surgery and they are recorded in the chronology that I referred to earlier. A cannula was inserted into a vein in Adam's left hand and Dr Taylor started an infusion of

500 ml of number 18 solution, which he recorded as being fluids as per Dr Savage.

The fluid calculations that Dr Taylor made and the principles which he applied in relation to the replacement of the fluid deficit in the first hour -- which he considered it to be -- and addressing the ongoing renal losses associated with Adam's native kidneys are discussed later on. They're also obviously going to be an important part of the oral hearing.

Secondly, there was arterial access gained with a fine catheter into the right artery to continue to monitor arterial blood pressure. Dr Savage appreciated at the outset that there was an opportunity to check Adam's electrolytes. As soon as that happened -- in fact, very early on -- he wrote a letter to Dr Murnaghan and he stated:

"I understand that venous access was readily achieved in theatre and therefore it would have been possible to check the electrolyte picture at that stage."

And that matter was further addressed by Dr Savage in his witness statement to the inquiry. He said:

"I made it clear to Dr Taylor that it was important that his sodium and electrolytes were checked immediately prior to theatre."

We know that we have received a subsequent witness statement, but in any event, I'm simply reciting what the position was at the time and people's thoughts of it.

Mr Keane's own view as stated in his inquiry witness statement is:

"I cannot explain why Adam's electrolytes were not checked when the central line was inserted. He should have had his electrolytes checked once the central or arterial lines were inserted."

Dr Taylor, in his PSNI statement under caution, sets out his view that the checking of the electrolytes was not a priority and, when asked whether it was accurate to say it was not a priority, he agreed but added an element of explanation namely:

"We had knowledge that his sodium didn't vary."

In other words, not only was it not a priority, but it really didn't matter because his sodium levels were fairly constant. He addressed that matter in his witness statement to the inquiry when he stated:

"When I commenced Adam's anaesthetic at around 7 on 27 November, I appear to have been preoccupied with the anaesthetic procedures -- endotracheal intubation, the insertion of a peripheral intravenous line, arterial line and central line and epidural -- and omitted

sending a blood sample for electrolyte analysis to the laboratory, as I should have done. I accept that I should have sent the electrolyte sample before starting the operation. I should also have sent other samples as necessary and used the results to adjust the rate and type of intravenous fluids."

That is an acceptance that has come very recently, on 1 February of this year, and it raises its own queries. But it should be noted that from the correspondence from the DLS, it would have been necessary to use the main laboratory for electrolyte testing for anything that was required to be tested before 9 o'clock because the children's laboratory didn't open until then. That will require some investigation as to what the implications of that are for the turnaround times and so forth.

Dr Haynes reiterates in his report the view that he expressed right at the outset that a sample of Adam's blood should have been sent off to the laboratory for assay as soon as he was anaesthetised, as well as a sample being retained for testing with the blood gas analyser for a speedy result. In other words, that would give you an almost instantaneous result and he goes on to say:

"This would have been a priority."

So quite why Dr Taylor was able to think it wasn't a priority is something obviously that will be explored.

A triple lumen central venous catheter was inserted into the right subclavian vein and the legal team has provided a photo of one of those. I'm not going to take you to it now, but it's there, you'll be able to see it. We have also provided a diagrammatic representation of marks found on Adam's body, as compiled by Dr Haynes. I am going to take you to that: it's at 300-090-189.

There we are. That is something that I had wanted to show you previously, but we weren't able to get it up. That is to try and put on a diagram all the marks that Dr Armour says she identified at autopsy. And if you look at box 4, up there to the right, you will see:

"Needle puncture mark in left upper chest in region of subclavian vein."

That's where that went in. It's also necessary to refer to a chest X-ray that was taken of Adam post-operatively, which clearly shows the catheter tip turning away from the heart and up towards Adam's neck. You can see that; it is there available for you. I'm not going to pull it up now.

Dr Taylor states in his deposition that:

"A central venous catheter was placed without undue difficulty."

However, it should be noted, firstly, that that's not the view of absolutely everybody and he even comments that a central venous line was attempted on three occasions in the left subclavian, once in the left internal jugular and then, successfully, in the right subclavian. So the extent to which it was a central -- a central venous line was placed in Adam without difficulty is a matter that is not consistently approached by Dr Taylor.

It should be noted that Dr John Wilson, the chief medical technical officer at that time for anaesthetics, theatres and intensive care at The Royal Group explains in his statement how the CVP transducer is connected and calibrated and he explains how to check the reading for accuracy and how to deal with anomalies, including re-zeroing and replacing the transducer. He claims both operations can be performed quickly, with the latter taking about a minute. And that is relevant to what is available to be done if you thought your equipment was not functioning as it ought to.

So if I move now to the insertion of an urinary catheter, which is also something to be done at an early stage -- or can be done at an early stage -- in addition to the failure to have Adam's electrolytes measured once he was anaesthetised and arterial access was gained,

there was also a failure to insert a catheter so that Adam's urine output could be monitored and measured during surgery. The inquiry's experts on surgery have provided diagrams of three urinary catheters in their joint report and those three catheters, which are the urethral, suprapubic and ureteric. 300-037-055.

There you are. The one, in fact, that was inserted in Adam is a suprapubic. He also had a ureteric, which is the one below, and you can see the purpose of the one below is actually not to drain out urine for monitoring it in any way, but really to protect that join. The first is the issue whether or not a urethral catheter, which would be a method of collecting urine and monitoring output, should have been inserted.

Dr Haynes has included insertion of an urinary catheter, one of those, as a task for the anaesthetic team, and Dr Taylor states in his inquiry witness statement that he believes Adam's bladder was not catheterised at the outset so as to permit it to be as full as possible. He says:

"I suspect it was as a result of discussions with the surgeons, although I cannot remember. A catheter would have provided me with information on urine output and the surgeon with an empty bladder. Without it, there is no information on urine output, but the surgeon

has a full bladder."

Those matters of communication between the two respective teams is something to be pursued. Mr Keane is quite clear in his inquiry witness statement. He says:

"It was my decision not to catheterise. I believe it was a correct decision. I decided to allow the bladder to distend naturally."

The insertion of a catheter for the monitoring of urine output during transplant surgery is discussed by Dr Haynes and he says:

"Adam produced significant volumes of urine and his urinary output should have been monitored when possible during the operation and a urinary catheter should have been inserted following induction of anaesthesia prior to commencing surgery."

And he cites some guidelines in support of that. Those guidelines indicate all patients have bladder catheters inserted prior to surgery. Those guidelines are not guidelines from the Royal, they're simply referred to by Dr Haynes for the purpose of supporting his position that it's something that really ought to have happened. He goes on it give his reasons:

"It was known that Adam's native kidneys produced large volumes of poor quality urine and measurement of

urine production during the initial part of the operation while his native kidneys were still perfused would have guided fluid therapy."

And he expands on that and he says that the fact that Adam's previous extensive surgeries meant that his transplant surgery prior to the re-implantation of the transplanted ureter might be:

"... lengthy and involved significant blood loss ...(p102 para 345 Adam Opening)... the anaesthetist needed to know as best he could the volume of urine produced, especially in a patient such as Adam where urinary losses because of the underlying disease may not reflect his circulatory state. This is done by noting urine volume drained from the bladder catheter."

Mr Koffman, who was the expert for the PSNI, he says that the bladder should be -- should have been left on free drainage if you have a polyuric patient, which is obviously what Adam was. Dr Haynes claims that Mr Koffman is considering the monitoring of urine from the surgical perspective of ascertaining the function of the engrafted donor kidney and not from the perspective of the anaesthetist. He needs to consider the patient's condition during the initial phase of a transplant operation, remembering that the condition of the patient is the primary responsibility of the anaesthetist.

Messrs Forsythe and Rigg express very similar views to those of Dr Haynes:

"A urethral catheter [that's the first one, figure 2A] will always be placed at the beginning of the operation, unless it is not technically possible."

Mr Keane was asked whether it was technically possible to insert that and he said that it was, but when he was pressed about why one wasn't inserted, he then went on to say in a subsequent inquiry witness statement:

"Adam's ureter was very small and, in my opinion, urethral catheterisation was unnecessary. I wanted the bladder full."

Messrs Forsythe and Rigg go on to address that requirement for the distension of the bladder in their report. They also comment on a statement by Professor Alexander who was an expert for the Coroner, who states:

"During renal transplantation, the urinary bladder is allowed to fill so that it is easy to identify when it is time to transplant the ureter into the bladder. This is normal practice."

And they say:

"This is not and has not been the normal practice of either of us or the units in which we have worked. If

an urethral catheter has been placed, then, as noted above [in their report], it may be clamped during the first part of the surgical procedure to allow the bladder to distend. However, this is a controlled situation rather than leaving the bladder to fill in an uncontrolled way when one is not sure of the urinary output of that individual."

And they deal with Mr Keane's claim that Adam's urethra was very small in their joint report of November last year:

"Adam's urethra was very small because he was young. We are not aware of any reason why his urethra would have been smaller than usual."

So there are a number of issues that arise from that: whether or not a urethral catheter should have been inserted at the outset and the significance, if any, of it not having been done; whether Mr Keane's requirement for the lack of a catheter at the outset so that Adam's urine output might be used as a means of distending his bladder was appropriate in the circumstances; what type of discussion, if any, should there have been between the anesthetic and surgical teams over the insertion of the urethral catheter at the outset; whose requirements, as between the anaesthetic and surgical teams, should have prevailed in the

circumstances of Adam's transplant surgery; and the significance of the size of Adam's ureter for an insertion of an urethral catheter prior to the start of the transplant surgery, including whether his ureter was small for his age and size.

So if I move then to monitoring Adam. And before I deal with the issues raised in the monitoring of Adam, it may be helpful to have some appreciation of the arrangement of a typical operating theatre during an operation. We have provided some photographs and we can, I hope, go through these fairly quickly, just to give you some appreciation of what's goes on in this relatively confined space. 300-046-064. That's a general view of an operating theatre, showing the renal transplant in progress. The object of doing that is to show you how close all those people are to each other. In this case one is talking about a child, Adam, 4 years, 20 kilos, 103 centimetres, I believe, long.

Then if we can pull up 300-047-065. None of these photographs have anything to do with Adam's actual surgery, I should say. You can see again -- look at the heads of those involved, how close they all are. The circulating nurse or the runner, as she's sometimes called, is in the foreground. Then if we go to

300-048-066. There they are again. Not the same team. And the scrub nurse is to the right, you see her there, sterilised, in contra distinction to the runner. And the last one, 300-049-067. There you can see the scrub nurse is there to the left.

Interestingly, in that one, you can see the strong operating lights that are used, you can really see them there as they shine down. I will refer later on in relation to the conduct of the transplant surgery to the effect of those operating lights on the temperature of the donor kidney prior to its anastomosis.

So moving to the anaesthetic assistance for Dr Taylor. Dr Taylor accepts in his inquiry witness statement that the monitoring of Adam throughout the transplant surgery was the responsibility of the anaesthetic team and that he had the lead role in the monitoring of vital signs and blood fluid management. And as you know, there is an unresolved issue about whether Dr Taylor had the benefit of an assistant anaesthetist for the duration of Adam's transplant surgery, and that's an issue which includes when exactly Dr Montague left the operating theatre and whether, and if so when and by whom, he was replaced. And it's far from clear from the statements of various witnesses when Dr Montague actually left the operating theatre.

Dr Montague himself states in his PSNI statement that he was there at the start, but then he was sent home by Dr Taylor. That's because he had been on call all night, and he believes that was prior to 9.32. The significance of 9.32 is that is when they receive the serum sodium level taken by the blood gas analyser and it shows Adam's serum sodium level was 123 millimoles.

Dr Montague states in his inquiry witness statement, his first one, that his 24-hour shift was due to end at 9 am of the Monday of Adam's operation and that he would have been free to go home. He goes on to state that at the time he left the surgery, it had started but the donor kidney had not been transplanted. And in his inquiry witness statement after that, he states that he can't recall whether he was still in the operating theatre when the third bag of Solution No. 18 was erected, which happened about 8.43, and one can tell that from the anaesthetic record:

"But I think I am likely to have left around 8.30 when the anaesthetic registrars would have started their normal day."

And Dr O'Connor states in her inquiry witness statement that she arrived at work at approximately 9 o'clock that morning. She then states in her subsequent inquiry witness statement Dr Taylor and

Dr Montague were the anaesthetists that she saw in the operating theatre and regarded as the anaesthetic team.

Obviously, there were timing issues of exactly when there was a handover between Professor Savage and Dr O'Connor, but here she is saying that Dr Montague was present when she arrived in the operating theatre, but she cannot recall if he was present for the whole procedure or if there were any other anaesthetists.

Dr Taylor is unable to clarify matters at all in his inquiry witness statement, apart from anything else, because it wasn't until 16 May last year, after the publication of Dr Montague's PSNI statement, that he actually disclosed that Dr Montague was replaced by an as yet unidentified trainee anaesthetist. He states in that statement that surgery had just commenced when he let Dr Montague go. It's not entirely clear what he means by "surgery had just commenced". If he means "knife to skin", that's about 8 o'clock. If he means something more substantial than that in terms of the actual transplant aspect of the surgery, then obviously that's much later on.

He goes on to state in his inquiry witness statement that he would accept that Dr Montague went home around the expected changeover time of 9 am, so he would accept it, but he does not specifically recall it. And the

significance of all of that, Mr Chairman, is that Dr Taylor accepts that he did leave the operating theatre from time to time. So if there wasn't an assistant anaesthetist after Dr Montague left, then that would leave the responsibility of monitoring Adam during that period to the medical technical officer, Mr Shaw, and the as yet unidentified anaesthetic nurse.

Monitoring issues. The inquiry's expert Dr Haynes explains in his report that the purpose of the anaesthetic team monitoring Adam was really a means of them ensuring adequate depth of anaesthesia and maintaining stability of respiratory and cardiovascular systems, and all the time that Dr Taylor as a consultant retained responsibility for Adam, which was until he handed over Adam's care to paediatric intensive care or, as the case may be, high dependency care or the ward staff.

The monitoring of Adam was carried out, so far as we can assess it, by four principal means. Firstly, there was the continuous monitoring of Adam's vital signs, namely his ECG, blood temperature, pressure, heart rate, blood pressure, including his central venous pressure. Then there were periodic checks and tests including the measurements of his blood loss by weighing swabs and towels and noting the administration of fluids

and medication as shown on his anaesthetic record and the blood swab count. There were other checks and tests, including the blood gas analysis to check his haemoglobin and haematocrit levels. Fourthly, there was continuous visual observation, which Dr Taylor refers to on a number of occasions during his PSNI statement under caution, and he attaches significance to this. He says:

"When continuously reassessing Adam's fluid replacement, we used all the information available from the anaesthetic monitors as well as visualising the impact on the surgical field. But there would have been a watchful [by that he means anaesthetic] eye at the surgical field and the monitors constantly, so I would have been aware of everything that happened."

And then yet again:

"So we anaesthetists must position ourselves in a place as well as looking at our technology to actually see what's happening in real time with the patient's blood ..."

And then there's a typographical error in the transcript of his interview:

"... doesn't [sic] be lost as maybe you can see in the swab count ..."

And then it's, in a slightly incomprehensible manner, that he says -- it's just a typographical error,

I'm sure, but I think you can get the sense of it:

"Visualising the impact in the surgical field relates to blood loss and the colour of blood."

And then, finally, the general look at his veins. Are his veins dilated or shrunken? Does the wound look moist or dehydrated? All this is an important element of the monitoring that Dr Taylor says was happening for Adam during his transplant surgery.

We have compiled schedules and charts of the results of the recordings made during the perioperative period, and that's largely in relation to the first three that I just mentioned to you. They show Adam's vital signs, the drugs administered, temperature and central venous pressure, fluid administered and lost, oxygen saturation and end tidal carbon dioxide, serum sodium and haemoglobin levels. I have shown you those charts last time, so I'm not going to go through them again, although obviously you can look at them yourselves to familiarise yourself with the information they display.

There are a number of issues which arise in respect of the perioperative monitoring of Adam during his surgery, and they are going to be considered during the oral hearing and, to assist, we have compiled a schedule of them. It's a schedule of issues arising from perioperative monitoring. Let's put that up quickly.

306-015-120.

There we are. You can see the structure of it. We have the issue down the left-hand side, then you have the members of the transplant team, particularly the consultant members involved in this. You have Dr Taylor and Mr Keane. Then you have the inquiry's experts that are particularly involved, Dr Coulthard, Professor Gross and Dr Haynes. And then you have the other experts, who may or may not have made a comment on it.

It works through, in a summary fashion, the principal issues in relation to perioperative monitoring. First is the checking of serum electrolytes prior to Adam being taken to the operating theatre. Secondly is the turnaround of serum electrolyte laboratory results. Third is the failure to insert a urinary catheter after anaesthetic. Fourth, the accuracy of CVP monitoring. Fifth, the subsequent blood testing by the blood gas analyser. Sixth, whether there was a regular monitoring and review and regulation of Adam's fluid intake to keep up with his losses. Seventh, visual observations. Eighth, the significance of Adam being swollen, puffy and/or bloated after surgery. And the ninth, compliance with the 1990 guidelines for renal transplantation in small children, which is a protocol that was in operation at that time.

Beside each of those, I have set out in further columns any comments made on those issues by those persons. As I say, I'm not going to go through it. That's how it works.

I have to say that that is a schedule that we have compiled. I'm not saying that the persons involved have confirmed that they accept all of that, but that information is taken from either their witness statements or from a report. We hope we have done it in a balanced way.

Then the administration of fluids in response to Adam's condition. As you know, Mr Chairman, the appropriateness or otherwise of the intravenous fluids that Adam received during surgery is one of the key areas of investigation by the inquiry and that's reflected by the terms of reference because it specifically says, "Especially in relation to the management of fluid balance and the choice and administration of intravenous fluids in each case."

So we are charged with that. And the legal team has therefore gone to some length to investigate that issue. We've already made reference to the fluid management comparison table and Dr Taylor states in his first witness statement that the preoperative fluid calculations were based on the following factors. And

he lists them as:

"Replace fluid deficit, mainly dilute urine. Provide fluid management requirements each hour in theatre. Replace any blood loss. Further fluid management would depend on BP, heart rate, CVP and organ perfusion. The need to ensure that Adam's blood volume was certainly not deficient, but with careful monitoring was actually increased in order to adequately perfuse the new adult size donor kidney."

So his calculations were based bearing that in mind. The issues related to Adam's fluid management can therefore be considered in relation to Adam's pre-surgical condition, including whether Adam was in deficit prior to surgery and the effect of dialysis on fluid and serum sodium balance. Adam's maintenance requirements, including factoring in his urine or anticipated urine output. Adam's blood loss during surgery. I pause there. The reason I say "anticipated" is, of course, it wasn't being measured, so some sort of assumption was going to be made as to what it is. Then Adam's blood loss during surgery, whether the fluids chosen were appropriate in terms of their sodium and glucose content and the volume of fluids administered and the reason for doing so.

Then if we go through those items, Adam's

pre-surgical fluids. As I say, we've gone through this in some detail because, to some extent, it does lie at the heart of the fluid management element of Adam's surgical time, if I can put it that way. So at the time of Adam's transplant, he was receiving three bolus feeds of 300 ml each, during the day and 1200 ml of Nutrison over 8 hours every night as his feeds through his gastrostomy tube. Dr Cartmill prescribed two amounts of 500 ml of IV fluids of Solution No. 18 to run at a rate of 75 ml an hour, which she described as maintenance.

As 2200 hours, when fluids were actually started, 180 ml of clear fluids were to be administered through his gastrostomy tube and Dr Savage has said that the "clear fluids" administered were in fact Dioralyte. This was in addition to his IV fluids which were now reduced to 200 ml an hour. However, the IV cannula tissued at about 01.42 and Dr O'Neill therefore prescribed an increase in Adam's gastrostomy fluids to 200 ml. So he simply added the 20 to the 180.

That uncertainty is a lack of clarity over whether the cannula was reinserted at 5 am. The nursing note indicates it was, but Catherine Murphy queries whether that actually happened, and we can see that in the PSNI statement, and it is an issue to be pursued in the oral hearing because it goes to the decisions that were made

at that time.

The inquiry's experts and Professor Savage, stated that Dioralyte contains 57 to 60 millimoles of sodium. However, Dr Taylor in his deposition to the coroner stated that Dioralyte was equal to Solution No. 18 and has stated that it contains only 35 millimoles of sodium, though he states elsewhere that it contains 60 millimoles of sodium. This is also an issue to be pursued during the oral hearing.

Adam's overnight fluid balance sheet shows that he received a total of 952 ml of Dioralyte and 18 ml of Solution No. 18. And his feeds were stopped at 05.00 because of pre-surgical fasting, and from 05.00 until his transfer to surgery for anaesthetic preparation at 07.00, he received no fluids, so the records show. Those are his fluids.

We move on to the effect of dialysis on fluid balance and plasma sodium. There is an issue as to the effect of dialysis on fluid balance and serum sodium, particularly whether it's possible to fix one or other of either a fluid imbalance or a sodium imbalance. Dr Coulthard has stated that in his experience, peritoneal dialysis tends to buffer the impact of variations in fluid status that would otherwise result in children becoming either dehydrated or fluid overloaded and the

dialysis would remove less fluid overnight if a child was dehydrated and more if they're overhydrated. He states that because of dialysis, Adam's overall fluid balance was unlikely to have been significantly perturbed by the events in the few hours prior to his transplant. Likewise, he states that peritoneal dialysis tends to correct any imbalances that may exist in the plasma sodium because the dialysate contains sodium at normal plasma concentrations. In Adam's case, that would be 122 millimoles. Dr Coulthard says that sodium diffuse down its concentration gradient from fluid to plasma if the plasma sodium is low or from plasma to the fluid if they are hyponatraemic. Thus he states that the plasma sodium in the morning after an overnight dialysis session is almost guaranteed to be normal if the child starts off with a near normal value.

Adam received 8 cycles rather than his usual 15, but Dr Coulthard doesn't think that that would have made a substantial difference to his fluid balance, although it may have reduced the change the dialysis had on the sodium balance. It might have had that effect.

Dr Savage, in his most recent statement to the inquiry, has stated that peritoneal dialysis tends to normalise both plasma sodium concentration and fluid balance status. In his earlier inquiry statement, he states

that:

"The effect of receiving 952 ml of clear fluid after admission rather than the usual 1.5 litres of Nutrison feed and a small volume of IV fluids meant that Adam was in relative deficit of 500 ml compared to previous days. He would therefore have been less well hydrated than usual and it is possible that this may have resulted in some degree of haemoconcentration, which would have the possible effect of increasing his serum sodium concentration. In normal circumstances, this deficit would have been addressed by replacing the deficit by extending his tube field at 200 ml per hour over 2 to 3 hours."

Then when one deals with the 8 rather than the 15 cycles of peritoneal dialysis, Dr Savage says in his witness statement that:

"Furthermore Adam was having a short period of dialysis and some tube and IV fluids overnight and, again, I thought it would be wise to check that his electrolytes had remained in the normal range."

Dr Taylor agrees it was usual for Adam's electrolytes to remain stable following dialysis for 24 hours, so that his dialysis did not lead to deranged electrolytes.

Well, the issue on the effect of Adam's sodium

levels of his 8 cycles of peritoneal dialysis as opposed to his usual 15 cycles is something that will be addressed further in the oral hearing, both in terms of its effect on his fluid balance and also in terms of its effect on his serum sodium levels.

I move now to fluid deficit. The fact that Adam received less fluid overnight than his usual 1200 ml and the fact that he received no fluids between 5 am and 7 am has raised an issue as to whether Adam was in deficit of fluid or was dehydrated on his arrival to surgery at 7 am, and if so, what degree of deficit was it. Dr Taylor stated that he believed that Adam was in fluid deficit and therefore planned the administration of fluid in the early part of the surgery to replace that deficit and he judged this deficit to be between 300 ml and 500 ml and stated that there was some evidence to suggest that Adam may have been dehydrated prior to surgery. In the witness statement he says:

"A total of 970 ml had been given over 6 hours. I calculated that he should have received 1200 ml over these 6 hours and therefore he had not had to receive in excess of 200 ml an hour to provide for this planned fluid administration."

In addition to believing there was a deficit, Dr Taylor also considered that there was an urgency to

replace this deficit so Adam did not become dehydrated or suffer from low blood circulation prior to transplant and that:

"[He] wished to ensure that no potential deficit remained as we began the process of increasing Adam's circulating blood volume in preparation for his kidney transplant."

That's his view. Professor Savage agrees that the fact that Adam received 952 ml of Dioralyte plus a small amount of IV fluids rather than his usual 1.5 litres of Nutrison feed meant that Adam would have been less well hydrated than normal and he stated that the deficit was important to address so as to provide a good intravascular volume prior to the removal of the vascular clamps and therefore addressing deficit over 1 to 2 hours would seem to be reasonable. And in his inquiry witness statement of September of last year, he states:

"The amount of fluid deficit that I believed was required to be corrected by IV infusion during Adam's surgery was approximately 500 ml. This was based on the fact that he normally received 1500 ml gastrostomy feeds overnight, but on the night in question he only received 970 ml."

However, in his most recent statement to the inquiry

on 20 March he states he estimated Adam was 300 ml to 500 ml in deficit.

Dr Alexander, at the inquest, agreed. He was the anaesthetic expert engaged by the Coroner. He agreed that there was a fluid deficit between that period of 5 am to 7 am. So those are the clinicians and the experts of the Coroner.

Dr Coulthard disagrees that Adam was in fluid deficit before surgery and asserts that he would have arrived in theatre at approximately normal salt and water balance. He believes Adam arrived in theatre somewhere between being in precise water balance and between about 300 ml overloaded and that he would certainly exclude him having been water deficient.

Professor Gross agrees that it was unlikely that Adam was dehydrated prior to surgery, pointing to the fact that Dr Taylor was able to place a right subclavian access at his first attempt. So there are clearly issues there as to exactly what the status, the fluid status, of Adam was going into his surgery so far as one can work it out at this remove, given the information available.

Urine output. There is a significant disagreement between the witnesses and the inquiry's experts as to the level of Adam's urine output, which is a crucial

issue for you, Mr Chairman, as it is one of the major factors taken into account when clinicians are calculating the rate of fluid administration. And of particular significance is the position of Dr Taylor, which has altered since the beginning of the inquiry's investigations.

Prior to January this year, Dr Taylor appears to have made the assumption that Adam would pass around 200 ml per hour of dilute urine. This was despite the note on 9 November 1995 in his medical notes by Dr O'Connor. She made a note in the medical notes, "PU++" -- that is "passes urine plus plus -- "how much, query, 1 to 2 litres", ie she was querying whether he passed 1 to 2 litres per day. Dr Taylor was proceeding on the basis that he was passing 200 ml per hour. Dr Savage's position is that Adam passed 1.5 litres of urine a day, and that he planned with Dr Taylor that Adam should receive intravenous fluid at 75 ml an hour after his tube feeds. Dr Taylor also believed that Adam could tolerate large quantities of Solution No. 18 as, according to him, he had received 300 ml in one hour in a previous operation on 18 October 1995. And he states in his PSNI interview under caution that this showed Adam was not a normal child because normal children couldn't cope with 300 ml over an hour. Adam was

exceptional, and then he goes on to state that Adam's body operated like a hole in a bucket and that he had to get that bucket filled up. In addition, he stated that his knowledge of Adam and his kidney disease were such that he considered that 200 ml an hour to be a minimum loss and that he may well have been unlimited and that no one had established his maximum output. As a result, it seems that Dr Taylor did not believe that Adam could retain free water and could not suffer from dilutional hyponatraemia. That was the position at the time. And for that matter, some time afterwards.

THE CHAIRMAN: Sorry, Ms Anyadike-Danes, if you pause there. If Dr Savage is right or Professor Savage is right that he had planned with Dr Taylor that Adam should receive only 75 ml an hour, then there would have to be for some reason for Dr Taylor to depart from what Professor Savage says was the agreed plan.

MS ANYADIKE-DANES: Well, I'm sure those are matters that we're going to pursue.

THE CHAIRMAN: Okay.

MS ANYADIKE-DANES: Dr Taylor [sic], absolutely crucially, disagrees with Dr Taylor's assumption, and he describes it as "without foundation".

He states that:

"Dysplastic kidneys in end-stage failure will have

a relatively fixed urine output as regulation of individual renal functions such as urine concentration or water reabsorption will have failed by that stage."

And he therefore believes that prior to his surgery in November 1995, Adam produced about 1.5 litres per day of urine, which equates to somewhere between 60 to 65 ml an hour, and that this was near both his maximum and minimum volume capacity. In effect, his kidneys were always working flat out. Therefore, if he was administered more than the rate he was able to excrete, he would simply retain the rest in his body.

As highlighted by his most recent witness statement, Dr Taylor has since reflected on and recognised that Adam did have a fixed urine output of around 70-80 ml per hour and admitted that, based on his incorrect assumption, he administered Solution No. 18 to Adam at a rate in excess of his ability to excrete it, particularly in the first hour of anaesthesia. He has yet to accept that Adam suffered from dilutional hyponatraemia and Dr Coulthard has commented that the fluid regime would have been inappropriate even if Adam could have excreted it at the rate previously assumed by Dr Taylor.

Adam's renal output was not measured during his surgery -- we all know that -- until a suprapubic

catheter was inserted by Mr Keane later in the operation at around 10.30. It's not entirely clear.

There is a result of 49 ml for urine output from the surgery and Dr Taylor considers his measurement begins only after the insertion of the catheter. Sorry, that that measurement for the 49 ml commences only after insertion of the catheter.

Mr Keane seems to suggest that there was urine produced during the surgery:

"In Adam's case, we allowed the bladder to distend naturally and not measured his urine output [sic], but depended on his CVP measurements, which is the parameter of most value to a surgeon."

In contrast, Dr Coulthard, in fact, believes that Adam probably produced the noted 49 ml at the beginning of the procedure and that his general condition during anaesthesia after the first period resulted in his very vulnerable kidney function slowing or actually stopping during the rest of the procedure. Whether and how much urine Adam produced during the course of the surgery is an issue to be addressed at the oral hearing.

THE CHAIRMAN: If we pause there and give our stenographer the break, which I mentioned at the previous hearing, and we'll resume at 11.40.

(11.25 am)

(A short break)

(11.46 am)

MS ANYADIKE-DANES: I wonder if I may just correct one of those errors that you make inadvertently. It relates to paragraph 387. What I should have said was:

"Crucially, Dr Coulthard disagrees with this assumption, describing it as 'without foundation'."

In fact, I think what I said was, "Crucially, Dr Taylor disagrees". I obviously didn't mean that.

THE CHAIRMAN: Which wouldn't have made any sense.

MS ANYADIKE-DANES: No, it wouldn't have made any sense at all, and it was helpfully pointed out to me and I'm grateful for that. Maybe the ultimate record of it can show the correct form.

So Mr Chairman, just before the break I was about to start on choice of fluids.

THE CHAIRMAN: You're starting at paragraph 390.

MS ANYADIKE-DANES: That is an important paragraph to be starting with. Before one discusses the choice of fluids, it's important to address the meaning of the term "free water". It is used by several of the inquiry's experts, most notably and most commonly by Dr Coulthard and Professor Gross. Dr Coulthard explains the term in this way:

"If you give a solution, which is less strong than

normal saline, you can calculate it as if you had given a volume of normal saline and the rest of it as pure water, whereas in reality you may have given it in different combinations. So for example, one litre of fifth normal saline is the equivalent of 200 ml of normal saline and 800 ml -- four-fifths of it -- as water."

That turns out, insofar as Dr Coulthard is concerned, to be an important concept in the whole issue of fluid management of Adam and the extent to which he was overhydrated. So Dr Coulthard has taken the inquiry's comparative fluid balance table and calculated the amount of free water given to Adam based on each of the contributors' fluid calculations. So he's also gone and looked at each of the clinicians' or experts', as the case may be, own fluid balance table and he has taken those figures and reworked them to extract the free water component.

The purpose of that is, not wishing to steal his thunder -- and I'm sure he will address it himself when he gives evidence -- but it is the free water element of it that is the diluting aspect of it. That's what is important: how much of that that was in Adam, how much of that could be calculated to be in Adam. The issue of free water and its significance for Adam's fluid

management in the development of his hyponatraemia is obviously something that's going to be addressed during the oral hearing.

Dr Coulthard's recalculations -- I'm not going to take you to them, they're referred to in the footnotes and you'll be able to get access to them, but you can see the principle of what he has done and, obviously, we're going to take him through that in the oral hearing.

If I go on to choice of fluids. Adam had received a total of 1500 ml of Solution No. 18 during his transplant surgery. I had mentioned before what Solution No. 18 is. The remainder of the part that's not sodium and not glucose is free water. That means it contains one fifth of the sodium and chloride ions that are found in an isotonic solution, ie 0.9 per cent sodium chloride. And an isotonic solution, such as Hartmann's solution, contains approximately the same number of sodium and chloride ions that are in human blood and I went through that in the general opening.

So since Solution No. 18 contains one fifth of the sodium content of normal saline, Professor Gross comments that:

"Given that Adam received a total of 1500 ml of Solution No. 18 during his transplant surgery, this was

equivalent to him receiving 300 ml of normal saline and 1200 ml of free water as the diluting agent."

As I also mentioned in my general opening, the Alert No. 22 has directed hospitals across the UK to remove Solution No. 18 from stock and general use in areas that treat children and this is an issue in Adam's care as to whether it was the appropriate fluid to be administered as a maintenance fluid, as a replacement fluid for any deficit Adam may have had, or at all, and those issues are to be pursued in the oral hearing, both in relation to the position as it was 1995 -- what people would have understood and what was the practice in 1995 -- and now.

Dr Taylor has stated that Solution No. 18 was the standard IV maintenance fluid in paediatric practice and that it was used widely for replacement fluid in dehydration. He has also said that he would use it for maintenance in healthy infants and children undergoing surgery. In addition, Dr Taylor has stated that because of Adam's inability to concentrate urine, he produced very dilute urine with a low concentration of sodium. In assessing this, he relied on urine biochemistry results for almost four years prior to Adam's transplant surgery, which showed his urine to have a sodium content of 29 to 52 millimoles, and he has since estimated the

concentration of Adam's urine as 30 to 40 millimoles.

Professor Gross and Dr Haynes consider that Adam's urine concentration, similarly, to be about 30 and 40 millimoles respectively. He therefore chose Solution No. 18 with its sodium content of 30 millimoles as the fluid which most closely represented the fluids lost.

Dr Coulthard has commented that because Adam's renal function would have changed over time, particularly with him starting dialysis in 1994, previous urinary sodium measurements had no relevance to the situation that pertained at the time of his death and he estimated Adam's urinary sodium content to be about 75 millimoles. As mentioned previously, Dr Taylor also believed that Adam's urine sodium content resembled the sodium concentration of his night feeds and Dioralyte, although Dr Savage and the inquiry's experts disagree with that. In addition, Dr Taylor states that he used Solution No. 18 because of its glucose content and the need to provide sufficient sugar for Adam's metabolic requirements and to prevent hypoglycaemia.

Adam also received other solution, so that wasn't the only fluid he received. He received 1000 ml of human plasma protein fraction -- which you'll see in his notes very often as "HPPF" -- and 500 ml of packed blood cells to replace blood loss during surgery. HPPF

contains 130 to 150 mmol of sodium and is accepted as having a similar electrolyte profile to blood, and he also received 500 ml of Hartmann's solution, which is a sodium content of around 130 ml, which is also similar to that of blood.

Dr Taylor has accepted that there were other intravenous solutions available in the Children's Hospital in November 1995: there was 5 per cent glucose, 10 per cent glucose, 0.9 per cent sodium chloride -- which is normal saline -- and Hartmann's solution. The first two solutions contain no sodium chloride at all -- which is why Dr Taylor said he didn't use them -- and the latter two are both balanced salt solutions. Dr Taylor said that had he used them instead of Solution No. 18, then Adam would have had a dangerously low blood sugar at the end of his surgery. So that's the decision that he made and Dr Haynes comments that hyponatraemia is the inevitable consequence of the administration of Solution No. 18 in significant volumes. Dr Coulthard states that his default replacement fluid -- not maintenance, replacement fluid -- would be 0.5 per cent dextrose saline rather than the 0.18 per cent dextrose saline used with Adam, although it would not be unreasonable to use the latter to replace only the insensible and urine losses.

However, he states that to use this fluid to replace Adam's deficit or to increase Adam's circulating volume to perfuse the transplant was just simply wrong. He also states that half normal saline, 0.45 per cent, and normal saline, 0.9 per cent, are both routinely available on general paediatric wards with glucose contents of 4 or 5 per cent.

Those are the fluids. The rate is another issue to be considered, and Dr Taylor had decided that Adam required 600 ml in the first hour of his transplant surgery to address what he had calculated was Adam's fluid deficit of approximately 400 ml and also Adam's maintenance requirements. That's an important point to grasp. He was trying to compensate for a deficit that he thought Adam had, but also Adam's fluid needed to be maintained and so there were two things going on. He therefore administered 500 ml of Solution No. 18 during the first 30 minutes of surgery and a second bag of 500 ml was started thereafter. Dr Taylor has accepted that Adam received approximately 700 ml of Solution No. 18 in the first hour of his transplant surgery.

In his deposition, Dr Taylor states that the rate that Solution No. 18 was administered at was calculated to restore the deficit and supply maintenance of 150 ml per hour in view of his polyuria and insensible losses,

as there's a large area of the abdominal cavity that's exposed. In his first statement to the inquiry, he describes Adam's fluid maintenance requirements as 200 ml an hour -- which is something that he repeated in his PSNI interview -- and he explained that his assessment of 200 ml for the maintenance rate was based on Adam's overnight maintenance rate of 200 ml an hour.

He therefore administered 500 ml of Solution No. 18 to Adam during the first half hour of surgery and a second bag of 500 ml was started afterwards. So there is an issue as to the appropriateness of Dr Taylor's rate of administration. So quite apart from the type of fluids he selected, quite apart from the amount of fluids he selected, there is an issue as to the rate of administration which is to be addressed during the oral hearing.

Several of the experts believe that the rate of administration led to an acute fall in Adam's serum sodium level, which was dangerous. Professor Gross states that there is a significant difference between acute hyponatraemia and chronic hyponatraemia. And Dr Coulthard agrees that the quantity of low sodium concentration infused into Adam was simply vast and dramatically fast in a very short period of time. He believes that an absolutely critical element of

management is about how quickly or how slowly you allow the sodium to fall, and that letting the sodium fall quickly leads to cerebral oedema and brain death. And he contextualises that by refer to be to the literature of three children who died having been administered free water rates of between 3 and 7 ml per hour. In contrast, Adam received 31.6 ml. If you compare that, they had 3 to 7 ml per kilo hourly and, in contrast, Adam received 31.6 ml per kilo of free water. He stated that:

"There are no compensatory mechanisms in the body that can come into play anywhere quickly enough to prevent brain swelling in the face of such an inappropriate and massive -- in the context of administration of fluid."

So Dr Taylor's explained that he wanted to give Adam fluids to make him hypervolemic -- that is to increase his circulating blood volume -- and to increase Adam's blood pressure, as that was vital to allow perfusion of the vital organs and the donor kidney. The fluid that he gave to do that was the HPPF, and Dr Taylor has commented that his fluid management of Adam was going according to his presurgery plan up to about 9 o'clock when Adam's blood loss became problematic.

That brings me on to the next point, which is blood

loss. There is an issue and some disagreement, particularly between Dr Taylor and Mr Keane, as to the volume of blood Adam lost during the surgery. That is a matter that will be pursued during the oral hearing.

Dr Taylor states in his deposition to the coroner that there was substantial ongoing blood loss from the surgery and he stated that the haemoglobin fell from 10.5 to an estimated 6.1 during the surgery, which confirms significant blood loss, and that there was 328 ml of blood loss in the swabs, which started of light but increased in size. There was 500 ml of blood in the suction bottle and an unknown amount in the towels and drapes, which he estimates to be greater than 300 ml.

So Dr Taylor has several estimates for the total blood loss, including 1,128, 1,211, 1,211, 1,411, depending on which statement you're looking at.

Mr Keane disagrees. He states:

"There was no major bleeding in Adam's case as no more than two units were used to replace blood loss. In addition, the blood loss of 1200CCs was not all blood, but contained approximately 600 ml of urine -- which is another issue about how much urine people think was produced by Adam during surgery -- peritoneal dialysis fluid and slushed ice used to cool the kidney

until the vascular anastomoses were complete.

He also states that Adam received between 250 and 350 ml of blood, not 500 ml as stated by Dr Taylor. Dr Haynes has examined the records and the statement of Dr Taylor and Mr Keane and he suggests that the blood loss was somewhere in between 528 and 1,128 ml, and most probably 750 to 1,000 ml, although he concedes that this remains an estimate little better than an informed guess and it may be an issue for record keeping that one is making a guess as to the extent of blood loss.

If I move then to CVP. Central venous pressure is a measure of the pressure of blood in one of the main veins draining into the heart and offers a guide to the amount of blood returning to the heart and the ability of the heart to pump that blood out of the arterial system. It's affected by various events including whether or not the circulation needs more fluid in it for the heart to pump blood effectively or the opposite, whether the circulation is overloaded, so putting a strain on the heart. And Dr Haynes has commented that a continuous display of central venous pressure would be required in a patient such as Adam.

We have provided a photograph of a monitor to indicate a continuous display. It's worth a quick look at that. 300-036-054. There we are. This is not the

actual monitor that was used in Adam's case, and it may not even be -- and probably isn't -- the particular model. But it is being provided for illustrative purposes so that you can see the sort of continuous trace that would have been available to anybody wanting to see what was happening to a range of values, and you can see the second one there, CVP.

We have also provided a diagram to explain that CVP waveform because, if you look at it, it's a very particular shape. Let's have a look at 300-035-053. There you are. That's the typical trace. I'm not going to go through what all those highs and lows mean on the trace. It's there for you to look at. What you will have seen in the papers and in the statements as to whether there was a waveform or a trace -- that's the sort of typical waveform or trace one is looking for -- and one is looking for differences in that and why we are seeing those differences.

So the CVP recording was commenced at just prior to 8 o'clock with a reading of 17 and it rose to -- these measurements are in mercury. It's also possible to measure them in water, but these are in mercury. It rose to over 20, according to the trace, by 9 in the morning and reached 30 at about 10. And you can see that from the monitor printouts of his surgery.

If we just look very quickly at that so you see what I'm talking about. 094-192-908.

Maybe it's not going to come up. Anyway, you will have that in your papers and you can see that trace. There is also a trace from the monitor printout of when he was in paediatric intensive care and the intensive care unit daily record sheet is there. It shows that Adam's central venous pressure fell to about 11 on his transfer to paediatric intensive care at about noon, and it doesn't appear to go beyond about 14 all the time he was there on 27 November.

A word of caution about these printouts. They don't show the real time CVP readings. That would literally have been spooling out in real time. What they show is a compressed version which produces a graph of the average CVP readings, and that's what's capable of producing from 7 o'clock in the morning to 12 noon or 11 o'clock or whenever they stop into essentially a one-page sheet. Dr Taylor stated in his deposition to the coroner that there were both cardiac and respiratory patterns to the waveform, confirming correct intravascular placement.

THE CHAIRMAN: If you just pause. I'm conscious of the promise that we've made to everyone to finish this by lunch. But what you have done in the next, I think,

four pages of this opening from paragraph 418 to paragraph 430 is to set out the positions of Dr Taylor and various inquiry experts --

MS ANYADIKE-DANES: Yes.

THE CHAIRMAN: -- about CVP, including what was discussed at the second experts' meeting on 9 March; isn't that right?

MS ANYADIKE-DANES: Yes. Not just about the CVP levels, but also, importantly, about whether there was or there wasn't a waveform.

THE CHAIRMAN: Yes, and then you bring those to a head at paragraph 431.

MS ANYADIKE-DANES: Yes.

THE CHAIRMAN: Perhaps you'd move to 431. As I said at the start, a lot of the people here today have this in front of them, and those who don't will be able to look at the full opening on the inquiry website later on today. So would it help to go forward to 431?

MS ANYADIKE-DANES: Yes, Mr Chairman.

So as a result of the various statements of the actual clinicians, which is largely Dr Taylor, but the comments on those that are in reports from Dr Coulthard, Professor Gross, Dr Haynes and also, for that matter, Mr Forsythe and Mr Rigg, who are all inquiry experts. They have all looked at the contemporaneous information,

they have looked at Dr Taylor's statements and produced their own comments in their reports. And as a result of all of that, one can distill the issues in relation to CVP that we really need to address at the oral hearing.

They are: what the CVP catheter was measuring over the course of Adam's transplant surgery. The whole CVP issue is a very important issue for two reasons. One, it's something that guides the anaesthetist in his role in managing the fluid management of Adam. Secondly, it's something that the surgeons are very keen to know, but you will recall that earlier Mr Keane said it's actually one of the most important values for the surgeon to know is what the CVP is. The surgeons are acutely conscious of blood loss as it's very important to them, as it is to the anaesthetists. So the CVP is a very important value, and that's why a certain amount of time has been spent trying to understand what people at the time knew about it, thought about it and did about it. So what the CVP catheter was actually measuring over the course of Adam's surgery is an important issue to be determined.

The use that can properly be made of the CVP readings during the course of Adam's transplant surgery is another issue. That monitor was producing certain values. They were interpreted in a certain way by

Dr Taylor. There will be an issue as to whether or not he was entitled to interpret them in that way.

Then whether he should have continued on with the CVP. He expresses his views as to what he thought those values were actually measuring and how accurate a representation he thought they were of Adam's central venous pressure. They were certainly measuring something, something at the top of the catheter, but what relevance that had or how that compared with what Adam's central venous pressure actually was is the big issue for him. And he expressed the view that he didn't think that it was correctly measuring that, and so there is an issue as to the extent to which he should have simply carried on without having any accurate measurement of Adam's central venous pressure.

What he, in fact, ended up using it for is for relative change, but he didn't know, on his own evidence, what Adam's central venous pressure actually was. And he had various reasons why he didn't know that.

Then fourthly, whether Dr Taylor should have relied upon or otherwise reacted to the CVP readings that he received. In other words, should he even have used them for relative change? Were they even appropriate for that? And what should he have done about it? When he

expressed the view that he didn't think it was measuring Adam's central venous pressure, then what else could he have done -- what else could anybody have done -- to ensure that there was some accurate way of understanding Adam's central venous pressure? And that, of course, will go into another issue, which I raise later on, which is the quality of the communication between the two teams in that operating theatre during the course of Adam's surgery.

So Dr Taylor has also stated in his deposition to the coroner that there was a sudden increase in CVP to 28 when the table was raised 5 to 6 inches for surgical reasons. We are not entirely sure why the table was raised for surgical reasons, who requested it and what consideration anybody should have given as to its possible implications, so that's one of the things that we will consider. It may be that there's a fairly standard answer for that. But in any event, we will explore who took that decision and what they should have had in mind when they asked for it to happen.

Mr Keane has absolutely no recollection of being made aware of any problems with the CVP although, as I've just said, he does state that the central venous pressure was the most important parameter I would rely on:

"I would want his CVP to be 10 to 12 when the clamps came off."

He also claims not to have been aware that the CVP was recorded as 17 at the start of surgery, and he expresses a view that such a value could be attributed to misplacement, kinking of the line or overhydration and states that:

"If [he] had been aware of the 17, I would have asked the anaesthetist to ensure the CVP reading was truly 17. It is normal to subtract 5 from the reading in a ventilated patient. If it was truly 17, then seek medical input from Savage. I would have checked the position, the flow in the line and, if this was a true reading, restricted Adam's fluids and considered giving him a diuretic."

And there is therefore an issue to be addressed at the oral hearing as to whether Mr Keane could or should have known Adam's CVP was registering at levels of 17, over 20 and as high as 30 at any time.

Dr O'Connor, who's the other nephrologist who replaced Professor Savage and came into the operating theatre from time to time, claims that she discussed the CVP with Dr Taylor as she had noted a high reading of 30 perioperatively -- that's in this period we are talking about. He informed her that the reading had been 17

at the time of the insertion of the line and that as this was clinically unlikely in a child who had received overnight dialysis, he had presumed the reading to be inaccurate. Dr O'Connor formed the view that:

"Due to the high initial CVP, the accuracy of the recordings was uncertain. I assumed that Adam may have had one of his external jugular veins tied off as this was common practice in the insertion of central venous lines in the Royal in 1995."

And she expands on that a little bit in her statement of September 2011:

"I noted that the CVP reading was 30 and expressed my concern about this to Dr Taylor. He informed me that the CVP line had been difficult to insert."

Which you will recall some of his earlier statements about that insertion:

"And that the recording had been 17 at the time of the insertion of the line as this was clinically unlikely in a child who had received overnight dialysis and who had received his full and normal quota of fluids. I understood that he presumed the reading to be inaccurate as the line could be malpositioned."

Whether Dr O'Connor dealt appropriately with the issue of the CVP reading being high and whether she said or should have said something about this to Mr Keane or

Dr Taylor or to both of them, that's a matter that will be pursued at the oral hearing.

We'll move to the blood gas result of 09.32. Dr Taylor sent a blood sample to be analysed at the blood gas machine, which is quite close to the paediatric intensive care. In fact, you can see where it is from the photographs that I referred to in the general opening. He gives his reason for doing so in his statement of September last year, which was to assess Adam's pH, pO2 and haematocrit. He received the results of the blood gas analysis at 09.32, which shows a haematocrit of 18 per cent and a sodium level of 123 mmol/L. And it that sodium level that has focused a lot of attention, but latterly so too has the haematocrit.

Dr Taylor states in his statement of October that he'd been told that the blood gas machine did not produce reliable results for serum electrolytes, mainly because of the dilutional effects of adding liquid heparin to the syringe, which would tend to produce artefactually low electrolyte concentrations. What he means is that adding liquid heparin is something that was done to flush through the line and what he's really saying is that the presence of even traces of that heparin in the line could lead to an incorrect serum

sodium value.

The inquiry obtained a witness statement from David Wheeler from Instrumentation Laboratories. They're the manufacturers of the blood gas analyser that was used in Adam's case and he states that although they don't recommend sodium heparin for use as an anticoagulant -- that's actually what it is and why that's why they use it to flush it through -- because doing so will increase sodium levels by 1 to 3 millimoles, even in the presence of the correct proportion of heparin and blood. So there you see the significance: according to him, it increases the serum sodium level.

Dr Haynes disagrees with Dr Taylor. He states in his report of August last year that the measurement should have been believed and steps taken to correct the abnormality as well as any cerebral oedema that may have ensued as a result. And he also states that he would have considered ceasing immediately the administration of any intravenous fluid containing less than 131 millimoles and would have given a dose of 0.5 grams per kilo of mannitol. Ultimately, you know that mannitol was prescribed to Adam, but much later on. In addition, he says that he would have considered administering hypertonic saline solution -- typically as a 3 per cent

solution -- and he was of the view that frequent blood samples would have been required to monitor the corrective progress. That's what he thinks should have happened once they got the result back at 09.32.

Dr Coulthard calculates in his report that the plasma sodium reading of 123 millimoles measured then likely to be correct and he states in his report -- one of his early reports in December 2010 -- that it should have initiated an urgent serum sodium measurement from the hospital laboratory. He reiterates that in one of his recent reports from February this year.

So the following issues, we think, will need to be addressed at the oral hearing: whether Dr Taylor had been told that the serum sodium result from the blood gas analyser should not be relied upon and, if so, in what circumstances. That is possibly also an issue for governance. Irrespective of what he had been told, whether the blood gas sodium result should have been relied upon by him and the other members of the transplant team and for what purpose. And how Dr Taylor and the other members of the transplant team should have reacted to that result in terms of their treatment and management of Adam during this perioperative stage.

If I move finally, on the monitoring side, to the physical appearance. At the end of the transplant

surgery, Dr Taylor states that he noted that Adam's face, hands and feet were swollen when the sterile towels were removed. Professor Gross has suggested that Adam may have been fluid overloaded to such degree that he manifested oedema of the skin as a sign of increased extracellular fluid. And Dr Haynes, when he saw the photographs that were taken of Adam, he commented that, in his opinion, they showed very marked swelling of Adam's head and arms, so Adam's appearance and the significance of it is something to be considered at the oral hearing.

If I move now into the domain of the surgeons, which is the conduct of the transplant surgery. The surgical team was Mr Keane as consultant urologist and Mr Brown as a consultant paediatric surgeon to assist him. Mr Keane has set out the steps in transplant surgery in his inquiry witness statement as to what he would have done, and the order of those turns out to be quite interesting for the purposes of timing. First was the incision, identification and exposure of the vessels which are going to be used and the approach. So he would have started with an incision in Adam.

Then, isolating the vessels in preparation for clamping. Then he would have moved to cleaning and preparing the donor kidney, the vascular and ureteric

anastomoses and wound closure.

If we then go to timing of the surgery. It is not entirely clear, Mr Chairman, when the actual transplant surgery -- ie knife to skin -- commenced. That time is not recorded in Adam's medical notes and records and it really only appears by way of statements from those involved, primarily Mr Keane. He states in his deposition to the coroner the fact that he has a number of differing views on it. If we start with his deposition to the coroner on 18 June, he says the operation started at 7.30. Then he's asked questions during the inquest and he says: well, the operation would have started between 7.15 and 8 am. And then in his inquiry witness statement, when he's specifically asked so we can bring some clarity to it, "Knife to skin; when it did it start?", he says it started at approximately 7.15. And then when he was pressed to explain the basis of how he arrived at that time, he said in his witness statement of September 2011:

"Having reflected on this and considering the evidence, it would now appear that the surgery started at around 8 am."

The position on timing is made even less clear because he goes on in that September statement, when he deals with the times in relation to the steps in the

procedure, as he states that between approximately 7 and 8 am, he would have scrubbed and prepared the kidney and then he states that the surgery started at approximately 8 am:

"I made an incision into the right iliac fossa and opened the peritoneum."

But it all depends whether he is following the order he originally stated or not, and so that is an issue to be clarified during the oral hearing.

Condition of the kidney and the ischaemic time. The significance of the preparation time is its contribution to what has previously been referred to as the warm ischaemic time. Mr Keane describes in his statement of September 2011 what he did by way of preparing the donor kidney and states it would have taken several minutes. And he sets it all out: excising the fats, cleaning the artery and the vein, joining the two arteries on a single patch. As you'll recall from the form, there were two arteries on a single patch. In fact, we'll come to that in a minute.

We have provided some photographs. I know that time is pressing, but it may just help you understand the sort of time that might be involved in some of these processes. 300-041-059. That's what it comes in, "Human kidney for transplant".

Then if we go to 300-042-060. Within that box, that's how it's been preserved. If we move on to 300-043-061. There you see it being taken -- I have to say none of this is anything to do with Adam's own kidney or own transplant surgery.

THE CHAIRMAN: I think we should just make the general point that I think there are no photographs at all which are going to be produced which relate to Adam. These are all illustrations?

MS ANYADIKE-DANES: There are photographs of Adam's brain and as soon as we got to a photograph of Adam, I will say that. But until then ... Then if we go to 300-044-062. That is a picture of the surgeon preparing the donor kidney for transplant, cleaning and testing it. At 300-045-063 -- in fact, on that one you can actually see that that kidney actually has two arteries and he's working on those. There are various ways of deal with the fact if you have a kidney with two arteries and that's something that I think that not only Mr Keane, but also the inquiry's experts will address, different ways of dealing with it. That one has two.

Mr Keane states that the kidney -- this is how he addresses warm ischaemic time, and this is important:

"The kidney is kept in swabs, wrapped in slushed ice during the preparation and returned to the ice-water

solution at the end of the preparation."

You'll have seen in the photographs someone working on one:

"I cannot state the time of the vascular anastomoses, but the kidney is kept wrapped in ice-soaked swabs during the time taken to perform the anastomoses ...(reading to the words)... arterial clamp was seconds as there was no need to reapply them."

So in his view, the warm ischaemic time is seconds. Messrs Forsythe and Rigg describe the process in their report and they explain that the donor kidney is in a sterile bowl containing ice and cold fluid whilst the surgeon is working on it. They acknowledge that the time for the surgeon to inspect, clean and trim and separate the vessels varies and will be longer when there is a complex anatomy or there is damage to repair. They state that, typically, the preparation time takes 20 to 30 minutes to do that and it's recognised good practice to do this before the patient is anaesthetised in case the kidney is unusable and the transplant cannot proceed. In case they find it's damaged or there's some other anatomical defect with it, they won't have put, unnecessarily, a patient under anaesthesia.

As you know, the UK transplant form shows that the kidney had two arteries. In fact, perhaps we'd better

look at it since there might be some -- I wonder if we can pull it up. 058-009-027. Yes. You can see up there:

"Two arteries. Number of arterial patches, 1. Number of arteries on patches, 3. Number of veins [can't entirely see it, it looks like 1]. Branches tied, 1."

Then there's a whole long list of things to which 1 is added and right down at the bottom, "Other, please specify".

It's pretty difficult to make out. We are, in fact, getting Adam's original medical notes and records into Banbridge for the start of the evidence and hopefully the original will be easier to work out. But in any event, the DLS has provided correspondence to the inquiry to say that what that says is:

"Query, third artery tied off plus cut-off patch."

And they have deciphered that with the assistance of Miss Donaghy, who was actually the transplant coordinator. She, it would appear, completed some part of the form, although she wouldn't have completed that side of the form because that's the side that comes from the donor end.

The inquiry's experts have been asked to address that and their response is: that doesn't change the

facts of our report, but it does re-emphasise the need for the surgeon to have been involved in the decision to accept the kidney and the need to inspect the kidney and to do the bench work before the patient was anaesthetised. The likely effect of those features of the donor kidney on its preparation time is something that will be addressed during the oral hearing.

I just want to whizz through a few photographs which are important to continue to understand this aspect of warm ischaemic time. 300-050-068. Apologies for the squeamish. That is a donor kidney about to be transplanted. You see it's very pale. Then if we look at 300-051-069. There it is held in a swab by -- it's being sutured in place.

Then if we look at 300-052-070. You can see it better. It's being held in a swab there as they're working to suture it in place. Then if we look at 300-053-071, if you recall how pale it was before, there you see it pinker at one end. That's the pinking up that you will see in the papers. And that is what happens, as I understand it, as the blood begins to flow into the kidney.

Messrs Forsythe and Rigg address in their joint report this whole issue of the warm ischaemic time and, more to the point, how Mr Keane categorises it. They

say:

"The first period of warm ischaemic time occurs at the time of organ retrieval ...(reading to the words)... circulation of the kidney stops until the kidneys are cooled by ...(reading to the words)... zero minutes for Adam's donor."

So we don't have to worry about warm ischaemic time at the donor end:

"The second warm ischaemic time starts from when the kidney is removed from the cold and finishes when the recipient blood is perfused into the kidney."

That's what you see happening there. They go on to deal with the anastomosis time -- which they state is the same thing as the second warm ischaemic time -- and they address in particular the extent to which the donor kidney may become warmed up during anastomosis. And that's important. They say:

"It begins when the kidney is removed from the cold and ends when the recipient's blood is perfused into the kidney. During this time, the assistant surgeon holds the kidney [which you'll have seen] in a manner which facilitates the operating surgeon in performing the anastomoses, which is the ...(reading to the words)... direct contact with both the recipient and also the gloved hands of the surgeon. These two forms of

contact, the ambient temperature and the energy of the strong operating lights [which is something that I mentioned before when I showed you the photograph of the operating theatre] mean that the kidney gradually warms, rising to a core temperature above 10 centigrade at approximately 20 minutes."

And in their joint report, Messrs Forsythe and Rigg state:

"The anastomosis time will usually be under 30 to 40 minutes ...(reading to the words)... 60 minutes would be exceptional and be due to intraoperative technical difficulties."

Their view echoes that of Mr Koffman. You'll recall he was the surgeon expert for the PSNI:

"Anastomosis times may vary from approximately 20 minutes to 60 minutes in the case of a difficult anastomosis."

And Messrs Forsythe and Rigg go on to say that two hours of warm ischaemic time is very likely to cause irrevocable damage to the kidney. In fact, if one looks at the UK transplant form, it records the donor kidney as having been removed from the ice in Belfast at 8.30 in the morning and perfused with Adam's blood at 10.30 in the morning. That's recorded on the form itself, which, according to Messrs Forsythe and Rigg, means that

the warm ischaemic time of the donor kidney, or the anastomosis time, was two hours. And the length of that warm ischaemic time or anastomosis time is something that is going to be pursued in the oral hearing, as will the question of what effect, if any, it is likely to have had on the donor kidney at or after its transplantation.

If we move now to surgical approach, once all the cleaning and preparation work has been done, we go to the surgical approach. The actual method of anastomosis used by Mr Keane was to join the renal vein of the donor kidney to Adam's external iliac vein and the two renal arteries of the donor kidney on a common patch to Adam's iliac artery. Messrs Forsythe and Rigg have provided a diagrammatic representation of what was happening and I wonder if we can see that. 203-004-083.

There we are. So there you can see exactly what it is that Mr Keane says he did in terms of the arteries and veins that were available for use. As you can see, the external iliac artery that Mr Keane used is a considerably narrower vessel than either the common iliac artery or the aorta, and similarly the external iliac vein that he used is considerably narrower than either the inferior vena cava. And he explains in his witness statement:

"I considered using the aorta common iliac, but it was my judgment that Adam's iliac vessels were satisfactory in calibre. No surgical complication occurred. I considered the common iliac and vena cava, but my judgment was that the external, iliac vein was suitable. No surgical complication occurred."

Mr Koffman considered Mr Keane's approach in his report. He says:

"... the major decision would have been about whether to anastomise the transplant renal vessels (artery and vein) to the iliac vessels, as in adults, or because of Adam's small size, to choose larger blood vessels such as the aorta and vena cava for those anastomoses ...(reading to the words)... chose to use iliac vessels and, although this is not the approach I would use normally for a four year-old, 20 kilos, it is used by some surgeons carrying out paediatric transplants. Therefore, I would not criticise the use of this approach."

And he goes on to state:

"There were considerable difficulties experienced during this operation, chiefly because of the previous surgery, but also partly because of Adam's age and weight, and it is impossible to ascertain from the operation note whether the anastomoses were performed in

a technically sound way."

And the significance of the anastomoses is explained and he says:

"The likelihood is that the kidney was viable at the time of the implantation in Adam, but there was subsequent thrombosis of the artery or the vein either due to technical factors or due to low blood flow secondary to acute tubular necrosis or due to some hypercoaguable."

And finally, he says in a letter that he provided to the inquiry:

"I cannot be certain that there was not a technical error in the performance of the arterial or venous anastomoses or in the positioning of the kidney before closure."

If I pause there to explain the significance of all of this. Adam is a four year-old boy, 20 kilos. He is having transplanted into him, effectively, an adult kidney. So he has a four year-old boy 20 kilos sized vessels to be anastomosed onto an adult kidney, effectively. And the issue is: if you do the normal like-for-like, are you going to provide sufficiently large dimension vessels to allow an adequate flow of blood to support the survival of the graft of that kidney? That's what this is all about. And the

question is if you're dealing with a small child, should you use the child's larger vessels to enable an adequate supply of blood to the transplanted kidney?

Messrs Forsythe and Rigg take a different view in their joint report and agree with Mr Koffman that they would not have performed the anastomoses in the way that Mr Keane did and they disagree that it was nonetheless an acceptable method in view of Adam's size and the effectively adult-sized donor kidney. This is what they say:

"Children under five years of age or under 20 kilos do require special consideration in terms of surgical approach. The surgical approach would usually be an extraperitoneal approach in the right iliac fossa with a view to using the common iliac artery or the aorta, the main artery of the abdomen, for the arterial anastomoses and the common iliac vein or inferior vena cava -- the larger veins -- for the venous anastomoses. In a young child aged 5 years of age, it is unacceptable to use the external iliac artery. This would significantly increase the chance of renal artery thrombosis and loss of the kidney. Conventional practice both in 1995 and now would be to use the larger common iliac artery or aorta."

Just before where they had referred to the approach,

what they're really saying is: if you were to do this method that they say, just as Mr Koffman said, it requires a different approach. You can't go in the same way and choose to hook it up in the way you would with adult surgery and try this alternative method with a child. If you're doing this, you have a different approach to how you conduct the surgery.

Then they go on to say that:

"Mr Keane's reference to Adam's iliac vessels being of satisfactory calibre is inappropriate as a normal calibre external iliac artery is not suitable to use in a five year-old child."

In other words, that he may have had perfectly acceptable normal calibre, his artery is just too small. That is effectively what they're saying. None of the experts have stated that the infarction of the kidney contributed to Adam's death. That's important to note. But Professor Gross states in his report as far back as January 2011:

"The malfunctioning transplant in itself did not contribute to Adam's hyponatraemia since it was the renal failure of his native kidneys that presented excretion of major amounts of free water. However, if the transplant functioned well, it is likely that it would have begun to excrete free water, which could

have reduced the degree of hyponatraemia in Adam."

So there are issues to be addressed in the oral hearing as to the way in which the anastomosis was carried out, the adequacy or the justification for the method and any possible consequences for the viability of the donor kidney and generally.

If I move now to something I've mentioned before, which is the communication between the anaesthetic and surgical teams. That is a very important issue to be addressed in the oral hearing in terms of the adequacy of communication between the anaesthetic and surgical teams. And a number of experts identify its importance for successful procedure. But a real query has been raised by some of the experts as to whether the two teams communicated appropriately with each other over the course of transplant surgery and, if they did not do so, then what effect that had. If one looks at Dr Haynes, he says:

"Communication between surgeon and anaesthetist, especially with regard to the volume of blood loss during the operation, does not appear to have been good. While certainly the anaesthetists and surgeon had different views as to what blood loss was, my overall impression is that there appears to be a failure of senior clinicians involved in Adam's transplant

operation to work effectively as a team. Reading and re-reading the various witness statements does not reassure me that surgeon and anaesthetist were working effectively together as a team, communicating well with each other."

They are not the only ones to comment on that. But in any event, that is going to be an issue that will be explored in the oral hearing.

If one moves now to the role of the nephrologist during the surgery. That is an issue that we also want to consider during the oral hearings. Dr Savage states that it was his habit to observe the procedure intermittently and to be close at hand. He states that he would have changed into theatre scrubs, but would not have been gowned as an observer. He also states that he left "around 9 o'clock" to undertake some duties at the university.

Dr O'Connor states that Adam's surgery was in progress when she arrived that morning and made herself available to attend to Adam's post-operative care. She was present in theatre towards the end of the operation and also that she went into theatre on several occasions as she was keen to know how quickly the operation was progressing.

Pausing there. A principal reason for that is that

the nephrologist is usually there when the immunosuppressant drugs are being given so the nephrologist needs to what stage they have reached in the operation, quite apart from any other reason they might be there.

Dr Coulthard considered all of that in his report to the inquiry and he describes consultant paediatric nephrologists as the main medical carers for children with end-stage renal failure. He says that the consultant paediatric nephrologist should visit the operating theatre intermittently during the child's transplantation, when it's practicable, but it doesn't constitute a formal part of the paediatric nephrologist's role. Then he went on to say it's more a social aspect of providing holistic care to these children and their families.

Well, that will be pursued as exactly what the role is. You will recall that they all produced that form where they ascribe various roles to various clinicians and the role of the nephrologist is also addressed in the various stages and phases of the transplant surgery. So if I move now to the end of the transplant surgery and the issues that arise.

Just as it's a little bit difficult to work out precisely when the surgery commenced, knife to skin,

because it is not recorded, it's also not quite so clear-cut to work out exactly when it ended. That is when the transplant surgery itself ended because that's not recorded either. What we do have is the anaesthetic record ends at 11 with Dr Taylor administering drugs to reverse the neuromuscular blockade and Adam's medical notes record that he was admitted to paediatric intensive care at 12.05. But we are dependent upon the statements of the clinicians who were directly involved for the actual time that Mr Keane left the operating theatre and the actual time of the end of the surgery.

There is no reference in Mr Keane's deposition and evidence to the coroner to him not staying until the end of the transplant surgery or of Mr Brown being involved in any particular task in relation to the surgery. But Mr Keane states in his inquiry witness statement of 2005 that he left 10 minutes prior to the end of anaesthesia to attend an emergency, leaving Mr Brown to close the wound. Mr Brown has provided a report to the coroner or did provide a report to the coroner, but it makes no reference to him closing the wound or to Mr Keane leaving before the end of the transplant surgery. Indeed, he refers to it in less than categorical terms in his PSNI statement. He says:

"It would appear to be the case that Mr Keane left

myself to sew up the wound. I don't have any recollection of the end of the operation or the anaesthetist trying to bring Adam round."

Subsequently, Mr Keane puts the time that he left the operating theatre at approximately 10.30. And he claims that, at that stage:

"There was pulsatile flow in the artery, the ureter had been connected successfully and the kidney was well perfused."

Earlier in his deposition to the coroner, he says at the end of the procedure it was obvious that the kidney was not perfusing as well as it had done. Obviously an issue there.

The views of the other witnesses are not entirely consistent on the condition of the donor kidney. So Dr O'Connor, just going through them quickly, has recorded in Adam's medical notes and records that the kidney looked bluish at the end of theatre. Staff Nurse Popplestone was in the operating theatre as a scrub nurse and she says in her PSNI statement that she recalls the surgeons discussing possible discolouration of the kidney at the time of the transplant, but then she says the concern appears to have subsided as the operation progressed.

Then Mr Brown says:

"From what I can remember, the kidney turned pink in colour when it was transplanted and blood was put through it. As far as I can remember, the kidney remained pink in colour."

Mr Taylor comments in his deposition for the Coroner that the kidney, at around 10 am, was not looking good and not producing urine. Mr Keane says in his inquiry witness statement:

"A minute or so after the completion of the vascular anastomoses, a few drops of urine were produced."

Mr Brown has never been of that view. In his statement to the coroner, he says:

"The perfusion of the kidney was satisfactory, though at no stage did it produce any urine."

And he has reiterated that to the PSNI.

Then it seems that the pressure for Mr Keane to leave -- so why he didn't stay to the end and close himself -- was that he had received a phone call from the Belfast City Hospital about a patient who was undergoing -- and this may prove significant -- a percutaneous nephrolithotomy was bleeding heavily in the operating theatre and they needed help urgently.

However, Miss Donaghy, the transplant coordinator, says in her PSNI statement, that when she went in to the operating theatre, having spoken to Staff Nurse

Clingham, who told her that Adam might be brainstem dead and was still in the operating theatre, she describes the mood as very sombre and believes that the surgeons were still at the table although she didn't know what stage they were at or what time it was. Staff Nurse Clingham says she doesn't recall any conversations in respect of the progress. Miss Donaghy then goes on in a further statement for the PSNI in which she is very clear. She says:

"I can only say that I remember Patrick Keane, surgeon, being at the table. There was another surgeon, however I do not recall who it was. There were other staff present in the operating theatre. However, I do not recall who they were. I remember when I was in the theatre wondering why they were all continuing on with the procedure if the child was supposed to be brainstem dead. However, I would not be able to say what part of the procedure they were at."

She has made a witness statement for the inquiry in much the same vein. For example, the one in September was that:

"[She remembers] two surgeons standing at opposite sides of the operating theatre. There was an anaesthetist and a nursing staff in theatre."

The narrative of actually what happened is something

to be explored during the oral hearing, as is the issue of the condition of the donor kidney, particularly in view of the report of Professor Berry for the coroner. He states that:

"The transplant kidney was infarcted [dead]. The extent of the change suggested that this occurred at or before the time of transplantation."

Professor Risdon, who was engaged as an expert for the PSNI, states:

"In my opinion, the transplant kidney must have suffered significant ischaemic damage prior to its insertion for this degree of ischaemic damage to be apparent at post-mortem."

Messrs Forsythe and Rigg state, in their view, that:

"... thrombosis of the kidney happened soon after implantation due to poor positioning of the kidney, the use of the smaller external iliac artery inflow or due to a surgical technical problem."

And they deal with what those surgical technical problems might be. One of them is the positioning of the kidney before closure. I should say it is only, so far as we're aware, Professor Berry and Professor Risdon who have actually looked at histological slides of the kidney to form a view as to what the extent of cellular change had been and therefore to try and work back as to

what its condition may or may not have been at or around the time it was being transplanted.

The issue of the positioning of the transplanted kidney and closure of the wound, including the fact that Mr Brown had never previously been involved in a paediatric or adult, for that matter, renal transplant and was left to do it is something that's going to be considered further during the oral hearing.

If we go back to the information we have, it would seem that the skin closure occurred at about 11 and over a further 30 to 40 minutes, Adam was prepared for transfer to paediatric intensive care and unsuccessful attempts were made to wake him.

The theatre log of the other operating theatre shows that Mr Brown was involved in a surgery that started at 12.15 and finished at 12.50 with Dr Campbell as the anaesthetist and, during that period, at about 11.30, blood was taken from Adam for laboratory testing and the results of that were received at 1 o'clock, roughly, showing his serum sodium levels had fallen further to 19 millimoles.

The turnaround time on that sample is obviously something that will be pursued because it was taken at 11.30 and was back at 1 o'clock.

If we go to record keeping. Dr Taylor is very clear

when he gave his report to the coroner -- Dr Alexander is very clear that:

"Dr Taylor is to be commended on the detailed notes and records he kept throughout the anaesthesia."

Messrs Forsythe and Rigg in their report say that it was brief and the key points were there. Then they go on to identify further information that should have been included to produce what they regard as a complete record, and they list those out. I'm not going to go through them all, but essentially it's confirmation of the extraperitoneal approach and whether the peritoneum had been breached. Further detail or a diagram to the reference to the arteries, inclusion of the time at the beginning and end of anastomoses and, ideally, the cold ischaemic time and better comments on the perfusion of the kidney and the post-operative management plan.

Miss Ramsay is also an expert for the inquiry on nursing. She is looked at the perioperative record of nurses kept and she notes that Adam arrived in the operating theatre with no care plan. Nevertheless, she concludes that the operating theatre nursing records were of an acceptable standard. The absence of a formal care plan will be addressed during the oral hearing, as will the fact that the anaesthetic record was neither completed nor signed, and she says that it was "poor

practice to fail to sign records" -- "she" being Ms Ramsay.

Two final sections really then in this phase. Keeping Adam's family informed. Adam's mother sets out in her witness statement that she left Adam in the operating theatre with Dr Taylor. She believes, at about 6.45, and waited in Musgrave Ward with her sister. That time differs slightly from the anaesthetic record and others. She goes on to say that she was notified of Adam's progress on two occasions: at 9.30 by Dr Savage, who was leaving for other duties; and at 10.30 by Dr O'Connor. And she's pretty clear about the times. She says that:

"Dr Savage and Dr O'Connor were very good at keeping me informed of what they understood was happening in theatre. At 9.30, I was told that things were progressing well and that Mr Brown was assisting Mr Keane."

You know her views on that. They have already been rehearsed earlier:

"Some time after 10, I was told that the operation was taking longer than expected because of Adam's previous surgery and because of his weight. At around 12, I was told that Adam was out of theatre."

And she goes on to state that she was completely

unaware, and therefore by inference uninformed of the dangers of fluid mismanagement until after Adam's death. She goes on in her witness statement also to say that it was not until 9.30 that she learned that Adam had received an epidural and she wasn't happy because he had been in a lot of pain before when he had received one and she didn't want that again. She reiterates that Dr Savage told her that all was well and, in the same witness statement, she states that she was told that Adam's bladder was enlarged and that, after the transplant, she would need to catheterise him several times a day. It seems she was told nothing about his low serum sodium measurement at 9.32.

Dr O'Connor doesn't actually recall talking to Adam's mother. Dr Savage does not believe he was in the operating theatre at 9.32 or that he was aware of the serum sodium value of 123. He thinks he left when he handed over to Dr O'Connor at about 9 o'clock. That's an issue to be pursued in the oral hearing, whether either of the nephrologists knew about the low serum sodium level at 9.32 and whether, even if they had, it was the sort of information that should have been passed on to Adam's mother and to what end. And generally, the extent to which she was being kept adequately informed of Adam's condition.

Finally in this phase, the response to Adam's failure to wake. Dr O'Connor was present in the theatre towards the end of Adam's operation and she says that she was aware that Dr Taylor discovered Adam to have fixed and dilated pupils. Dr Hill states in his Inquiry witnesss statement I mentioned him previously as somebody who had been part of an anaesthetic team with Dr Peter Crean in carrying out a paediatric transplant prior to Adam's. He says in his inquiry witness statement:

"In or around that time, I was assisting Dr Rosalie Campbell in the adjacent theatre."

If you pull up the site plan that I have referred to earlier in the general opening, you'll be able to see the proximity between those two theatres. He states:

"At some point during the course of their theatre list, Dr Campbell left to assist Dr Taylor because a patient, which I now understand to be Adam Strain, was slow to wake up."

The theatre log records Dr Campbell's attendance in that adjacent theatre throughout both the morning and afternoon list, so it appears she was there, but she says though that she does not recall entering the theatre during Adam's transplant and she has no recollection of being asked for or of offering advice. Obviously, that is something to be pursued at the oral

hearing.

Then, Mr Chairman, there's the next issue. I know the time. I will do my best. There's the treatment following surgery. This whole section is called "The immediate post-operative stage", and the treatment following surgery is essentially what was done when they realised that Adam was slow to wake up. If I move through that quickly, you will see that essentially Dr O'Connor had noted that he was puffy, his CVP measurement was 11 -- of water, not mercury -- and he had no recorded output from the transplanted kidney. She also queried two causes for his neurological abnormalities. She thought he might have coned due to cerebral oedema and that he had had high fluid intake and possible abnormal cerebral venous drainage. Her immediate plan was to give mannitol to decrease any possible cerebral oedema and to restrict his fluid intake.

She agreed with Dr Taylor's management of his hyperventilation. She urgently requested urea and electrolyte profiles and a neurological opinion. Dr Haynes says what he would have done and he says mannitol rather than hypertonic saline as a first line therapy. He describes why and he says that he would have been more likely to have administered mannitol as

initial therapy if he suspected the presence of cerebral oedema in a patient, and the urgency is to reduce the potential injury to brain cells.

Then there's communication with Adam's mother. That is obviously an important area of investigation for the inquiry, and who should have been informing the mother as to what had happened. There is an issue as to whether the surgeons should have been part of the clinicians who spoke to the mother.

As it happens, none of the surgeons were present for any of the discussions with Adam's mother. Mr Keane says that he had left at that stage, having been called away to his emergency. However, he does say that he would have spoken to Adam's family in accordance with his customary practice and that, in his absence, he expected Mr Brown to speak to Adam's family.

Now, Mr Brown says that when he was asked why he didn't do that, he said, "This is not a paediatric surgical operation but a transplant. As I have emphasised, my role was a technical one of acting as assistant to the surgeon. I did not take any responsibility either before or after the operation."

Well, that's his position. Dr Coulthard deals with speaking to Adam's mother in his report. He says he would have expected the anaesthetist to join the

anaesthetist [sic] as the patient's general management and support would be his primary responsibility at the time:

"... but in most cases I think the surgeon would usually join the discussion as well."

So there will be an issue as to who should have spoken and why people made the assumptions that they did about speaking to Adam's mother.

If we go quickly to the CT scan, a lot of that is covered in the discussions between the experts, but it's simply just to record that there was one, and to compare how the initial description of it compares with Dr Anslow, who's the expert brought in by Dr Squier, the inquiry expert. I won't go through it now, you'll see it in his medical notes and records. But the important thing to note is that Dr Anslow thinks that the swelling, rather than being generalised, was more severe in the posterior fossa. That is a point of significance for Professor Kirkham and you'll have seen the way that features in her report.

I will move very, very quickly to the X-rays. There was an issue. The X-rays -- in fact, there were two of them: one at 1.20 and one at 8.30. They were there because they had detected a pulmonary oedema. As you know, we haven't been able to track the X-ray that

should have been taken of Adam on the 26th. In fact, we don't know that one was, but in any event we haven't seen it so we can't compare between the before and after.

But one can look at these two X-rays and there is a difference of view amongst the experts and the clinicians as to exactly what can be seen on these X-rays. I think everybody is clear that you can see where the CVP catheter is going. Dr Landes, the inquiry's expert, has examined the X-rays and she says that the lungs are clear in both photographs and she doesn't consider that there was any oedema. That's something that the clinicians had thought was present. If one reads her report, she gives her reasons for how it is that sometimes oedema is mistaken.

Then the DLS have provided a witness statement from Dr Louise Sweeney. She is a consultant paediatric radiologist at the Children's Hospital. She states that there had been an increase in the heart size and a deterioration in the appearance of the lungs due to an increase in pulmonary oedema in both lungs. So obviously there's a difference between the inquiry's experts and Dr Louise Sweeney, and appropriate interpretation of those two X-rays is something to be considered at the oral hearing.

Possible venous obstruction is an important issue; it assumed importance for not only the -- well, I can't say the clinicians at the time, but certainly for Dr Armour on the autopsy report and for the experts thereafter. She says in her autopsy report:

"Another factor to be considered in this case is cerebral perfusion. The autopsy revealed ligation of the left internal jugular vein. The catheter tip of the CVP was situated on the right side. This would mean that the cerebral perfusion would be less than that in a normal child. This would exacerbate the effects of the cerebral oedema and should also be considered a factor in the cause of death."

And I think I have taken you to what Dr Sumner made of that in his evidence to the Coroner.

THE CHAIRMAN: Yes.

MS ANYADIKE-DANES: Dr Haynes takes the issue further. He says:

"The central venous cannulation in small children frequently leads to thrombosis in proximity to a cannula with subsequent obstruction of veins and this leads me to suspect that there may have been some narrowing of Adam's great veins caused by previous central line insertion."

That whole issue as to what extent there was any

compromise to the venous drainage from Adam's brain is something that's going to be pursued. Dr O'Connor sets out her analysis of the post-operative period.

THE CHAIRMAN: We have that at paragraph 525.

MS ANYADIKE-DANES: Yes, so I'm not going to go into that. If I move on to the neurological observation and brainstem deaths. That was carried out by Dr David Webb. He explains that he had found evidence for osmotic disequilibrium syndrome that was thought to occur because of shifts of urea concentration between blood and brain and was associated with brain swelling. But then he provided the inquiry with a statement in August of last year, and he expresses a different view:

"I'm fairly sure that no one informed me that the sodium level was so low because if I had been aware of the low sodium, I would have considered hyponatraemia to be the likely cause of the fluid shift."

There is one issue to be addressed there that came out during the experts' meeting of 9 March. There was a discussion about the appropriate protocol with brainstem testing and Dr Haynes said with reference to Adam's sodium level that he would have expected to see more active steps taken to bring Adam's sodium within normal range. That is before the brainstem test was

found to be positive in the sense that there was no brain activity. And Professor Kirkham agreed that you'd certainly want to have a normal metabolic range. That's obviously something to be considered. Nobody has suggested that it made any difference, but if one is looking at lessons learned and protocols and procedures, it may be something that we need to consider.

Then the period following Adam's death. Much of that is taken up with the discussion of what the mother was told and the autopsy.

THE CHAIRMAN: And the change that we have since the last hearing is that we have now circulated a report from Professor Lucas, who has given a report on how well the autopsy was performed by Dr Armour.

MS ANYADIKE-DANES: Yes. I can deal with that. There is actually -- if you'll bear with me, Mr Chairman, there's not very much more to go, and I think people would like, if it can be done, to finish now rather than come back.

THE CHAIRMAN: Absolutely, yes.

MS ANYADIKE-DANES: If we go straight to Dr Armour's report on autopsy. Leaving aside the witness statements and so forth and her evidence to the Coroner, we do actually have two documents from Dr Armour. We have the notes that she made, which presumably were going to inform her report, and we have her report on autopsy. There are

differences between those two and I hope to highlight those very briefly as we go through.

She appears to have removed Adam's heart, weighed it, recorded its weight as 120 grams and noted the organ was taken for transplant. It appears that the heart itself was not examined, although the pericardial sac and aorta were described as normal. Dr Armour did not carry out, so far as we understand, an examination of the heart and its surrounding vessels and there was no comment from her on the weight of the heart.

Dr Sweeney has referred to an increase in heart size and I think Professor Kirkham does also. She refers to that between the taking of the chest X-ray at 13.20 and that at 21.30, but it's not known how the size of Adam's heart compared with that of a normal 4 year-old boy, ie one of 20 kilos in weight and 104 centimetres in height. There is simply no comment on it.

It should also be noted that, as you have said, Mr Chairman, the inquiry did engage Professor Lucas. He is a consultant histopathologist. He was engaged in relation to the autopsy and its performance. He came to the view in his preliminary report that in the context of current practice in London, this removal would not take place -- "this removal" meaning the removal of the heart -- would not take place in a case that would be

regarded as high profile. The unexpected post-operative death of a young child in hospital he regards as high profile.

We are clarifying with Professor Lucas what may or may not have happened in 1995 to the extent that he's aware of it. So the issue of what should have been done about Adam's heart is something that will be considered. We don't now know what is to be made of its weight, if anything.

If I go now to the conduct of the autopsy, which is the last section in this, and provision of the report on autopsy. As you know, Mr Chairman, the inquiry has instructed Dr Wayney Squier -- she's a consultant neuropathologist at the John Radcliffe Hospital -- to provide an expert neuropathological opinion from the histological slides that she made from tissue blocks taken by Dr Armour of Adam's brain. And throughout the inquiry's investigation, the issue of whether a thorough and accurate post-mortem was carried out into Adam's death has risen in importance, particularly in the light of the recent discussions amongst the inquiry's experts as to the cause of Adam's death.

So the inquiry sought advice from Dr Squier regarding some of the issues that have arisen regarding the autopsy. She has assisted with the

neuropathological issues and, in general terms, with issue of autopsy practice. Since then, we've briefed, or the inquiry has, Professor Sebastian Lucas. He is a professor of clinical histopathology and a consultant histopathologist at Guy's and Tommy's, and he provided a preliminary report.

The issues that have arisen regarding the autopsy that was carried out by Dr Armour and which are matters that will be pursued in the oral hearing and, in some cases, from a governance perspective, are these: whether Dr Armour had the requisite experience as a trainee forensic pathologist for Adam's autopsy and/or whether she should have been supervised by a consultant pathologist. Professor Lucas has found Dr Armour's autopsy to have been performed competently and was internally consistent. He stated that he would regularly review coronial autopsy reports and he would grade Dr Armour's as good and it addressed the central issue and produced a coherent answer.

That's not a view entirely shared by Dr Squier, who states in her report of January this year:

"It is impossible to answer the question of whether the suture was causing venous obstruction from the description given. Dr Armour writes that there was no congestion or obstruction of the jugular veins but that

the left internal jugular vein was ligated. These statements are not consistent with one another."

Whether there was ligation of the left internal jugular vein, as I have explained previously -- so I don't propose to explain it again -- is an issue. Suffice it to say that there is disagreement between the trust and Dr Armour as to whether there actually was a suture present. And if you look back in the earlier parts, you will see that one of the changes that was made was when we received some information to indicate that there were actually X-rays of the neck that showed that jugular vein to be patent. You will see it as you go through it; it's highlighted and underlined in red, as are all the other changes.

Professor Lucas has stated that the autopsy description of the ligature apparently found in Adam's left neck was sub-optimal since it was not then and has not since become clear whether or not there really was a ligature that obstructed the venous outflow of the left internal jugular vein. He stated:

"This lack of clarity is an important criticism of the autopsy and report."

And Dr Squier agrees that Dr Armour's report is unclear on this matter and her report is inconsistent when addressing the question of whether the suture was

causing venous obstruction, and she states that Dr Armour could have made further investigations to see how long the suture had been present, including sampling for histology.

You will recall that when Dr Armour gave evidence to the Coroner, she said that that ligature had been there for some time. So really what Dr Squier is getting at here is: what is the investigation that was carried out to enable Dr Armour to give that evidence to the Coroner?

Another issue is whether the donor kidney was infarcted. Dr Armour examined histological slides with the internal organs under a microscope, which allegedly revealed complete infarction of the transplanted kidney and she sent Professor Berry histological slides of a number of different parts of Adam's organs, and he noted that there was unexplained cellular change in the hepatocytes scattered throughout his liver, but he did not know the significance of it. He concluded that the transplanted kidney was infarcted, dead, at or about the time of the transplant.

Professor Lucas has criticised Dr Armour for failing to pursue the issue of the cellular change in the liver and her omission to carry out any histopathological investigation of why the transplanted kidney had

infarcted. There are also differences between her contemporaneous notes, which is a point I was just mentioning, and the final autopsy report. Dr Armour made notes in order to assist her and would necessarily have to be -- sorry, to assist her in the provision of her report. Those notes would necessarily have to be made before she could write a report. The report would take some time because she had to wait for the brain to be fixed. Until it's fixed, you can't make the histological slides from which to conduct your examination.

THE CHAIRMAN: And you have set out there what the inconsistencies are.

MS ANYADIKE-DANES: Yes. They are inconsistencies in -- well, the notes themselves have their own inconsistencies to the brain weight. That may just be a simple transcription error or something. But the very important thing is that although she's recorded the fresh, ie unfixed brain weight in her notes, there is no record in the autopsy of the unfixed brain weight; all you have is the fixed brain weight, and that is considerably heavier than that.

Then there's the lungs. She did weigh the lungs, left and right are different weights, and she regarded them as both being moderately oedematous, but that is

not recorded in her report on autopsy and she can't explain why it wasn't.

I have said something about the fixed weight. The fixed weight was in fact noted at 1,680 grams. The difficulty there is, of course, is that without an accurate -- assuming without an accurate unfixed brain weight, one is left to try and back calculate it from the fixed brain weight. That is an issue as to whether or not the weights that she -- what she ascribed to the unfixed brain weight is accurate and, if it's not accurate, how does she come to write it and then how it compares at all with the fixed brain weight and, if you can't use the unfixed brain weight at all, how do you try and get a handle on what the unfixed brain weight was. All of that, of course, is extremely important because what we're really dealing with here is cerebral oedema, so the swelling of the brain. That's why it's all so important.

The appropriateness of the description of the brain in the report on autopsy and in Dr Armour's evidence -- she describes the brain as:

"Grossly swollen with loss of sulci and uncal swelling."

In her evidence to the Coroner, she says:

"There was massive cerebral oedema and I have never

come across anything of a similar degree."

When Dr Squier wrote her report, she doesn't describe it in those terms. She says:

"The external appearances of the brain at the vertex showed mild swelling with compression of the sulci but the shape of the gyri is relatively well preserved. At the base of the brain the cerebellar tonsils are haemorrhagic and appear damaged ... In some slices gyri are flattened and sulci compressed, in others the gyri are better preserved. Pictures of the cerebellum show this to be extremely swollen. No spaces are seen between the folds of the cerebellar cortex."

So that's quite important. She has a different picture of the definition that still was in the brain at the time. I haven't pulled them up for you, but she provided photographs which show you an impression for comparison purposes of a grossly swollen brain and one that wasn't. Given the time, I'm not going to take you to them now, but they are there for you to see, I encourage you to look at them. There are also pictures of Adam's brain and you'll be able to make comparisons and perhaps appreciate better the debate between Dr Squier and Professor Kirkham about that.

Then finally -- almost finally -- there's the involvement of Dr Mirakhur. Dr Armour says that she

sought a second opinion on the brain and sent material to Dr Mirakhur. She was a consultant neuropathologist at the Royal. Unfortunately, there's no record of her having done that. Dr Armour is pretty adamant that not only did she do that and receive a report from her, but the views of Dr Mirakhur are what she reflected in the report on autopsy. Dr Mirakhur doesn't know anything about that, denies all knowledge of it, having seen any slides, knowing anything about Adam and certainly of having seen the report on autopsy in order to confirm whether or not she agreed with how the brain is being described there.

Dr Squier says:

"In a case such as this where the cause of death was thought to have been in the brain and was potentially the result of a hospital procedure, surgery and anaesthesia, best practice would have been to ask a neuropathologist to undertake a formal and complete brain examination. This is particularly important as Dr Armour was not at the time fully qualified as a consultant pathologist. I am surprised her report was not countersigned by a consultant supervisor."

Then there's the involvement of Dr O'Hara and the Doctors Bharucha, and I think I touched on the fact that unfortunately we don't have -- Dr O'Hara is since

deceased so he can't assist us. But it all comes about from a note that the Coroner made, which I took you to before, which refers to Dr Armour showing slides to Dr O'Hara and a Dr Bharucha and they being of the view that there was clear evidence of hypoxia. That, of course, is an issue because nobody else seems to have -- well, certainly Dr Armour did not record there being any hypoxia. Quite the reverse. She says there was no evidence of terminal hypoxia.

The basis upon which she formed a different view from Dr O'Hara and Dr Bharucha is not known and that is a matter to be pursued. There's also a small matter to be pursued as to who the actual Dr Bharuchas are. There are two Dr Bharuchas, married to each other. One is a Dr Chitra Bharucha. She's a histopathologist, I believe.

THE CHAIRMAN: Haematologist?

MS ANYADIKE-DANES: Haematologist, I beg your pardon. And then there's a Dr Hoshang Bharucha, and he's the pathologist. We've had witness statements from both of them and they don't remember anything, have no knowledge, don't concede they were involved in any way. But nonetheless there stands the note of the Coroner, so that will be also investigated.

Dr Squier considered that Adam's case was complex

and that specialist assistance should have been sought formally and reports of those specialists included signed reports within the final pathology report. Then whether the lungs were oedematous, I have been through that. And one knows now, with hindsight, looking at those X-rays, the difference of views that exist between Dr Landes and Dr Sweeney.

It's not clear whether Dr Armour herself examined the X-rays or whether she simply relied upon the description in Adam's medical notes and records. It's also not clear whether she examined the CT scan. You'll be aware, Mr Chairman, that the experts for the inquiry considered that it was necessary in a case such as this to have specific expert assistance with both the X-ray and the CT scan. So if she didn't seek that, the basis on which she felt competent to do so will be a matter that will be progressed in the oral hearing.

I have mentioned a bit about that there was no examination of the heart and I have referred to whether she should have asked for expert opinion on the CT scan. There is another matter to do with the conduct of the autopsy itself. It was conducted on hospital site and Dr Squier has stated that:

"Where there is a question regarding the conduct of the treating clinician, it would today be most unusual

for the autopsy to be performed in the same hospital. It would be normal for the body to be removed to another hospital so that there can be no question of conflict of interest."

Well, there will be an issue to be pursued as to whether that would have been the position in 1995 and what in fact the protocols were, or the guidance was, for Northern Ireland about that. That is a matter that will also be viewed from a governance perspective.

Leading on from that is an issue as to Dr Taylor and Dr Savage. They were both present during the autopsy and, interestingly enough, one of the criticisms that Professor Lucas makes of Dr Armour is that she simply included too much, what he calls, non-pathology information, so all her views as to what effect there might have been on Adam's cerebral venous drainage. Those were all areas where Professor Lucas feels that she moved away from her role as a pathologist. And whether or not the effect of Dr Taylor or any of the clinicians being there or any of her discussions that she had with the clinicians -- those are all matters that will be discussed.

Finally, in this section, there is the reason for Dr Armour's letter of 8 December 1995 to Professor Jack Crane. Professor Jack Crane, of course, was then and

still is the state pathologist, and she copied that letter to the Medical Protection Society and the British Medical Association and also to George Murnaghan, who was the hospital administrator, and to the Coroner. I will just read it out:

"I am willing to attend any meeting about this case, including a meeting with clinicians, administrative staff, HM Coroner, and whoever else wishes to attend. As I was the pathologist who carried out the autopsy, I feel my opinion on the case is relevant to such a meeting and, as such, the case could be discussed in full."

That's a letter sent on 8 December 1995. Autopsy carried out on 29 November 1995, report on autopsy some time in the third week of April 1996. So this is well before she actually produced her report and there will be an issue as to the circumstances in which she was writing such a letter and why.

Then the "final final" is the whole question of the cause of Adam's cerebral oedema and death. Of course, you all know what the verdict on inquest was. And you will note, Mr Chairman, the debate which one sees at paragraph 545 amongst the experts about the role of dilutional hyponatraemia and any other causes or contributing factors. I set them out, all the ones that

have so far been mentioned. I just want to take you to two documents that we prepared and I mentioned right at the beginning. The first, if we pull it up, is 306-016-130.

This is a schedule. As I said before, this is the legal team's work, so I hope we've been fair to everybody to try and represent their views, but they're not to be held to it. This is the summary of key points, as we are understood them to be, going into the expert meetings on 22 February of this year. Basically, we have across the top the experts and then we have, down the left-hand side, starting with Professor Kirkham, the issues that we think had arisen. If you go through them, developmental delay and so forth.

Developmental delay is the first one. Then there's the literature. There's quite a long debate about the literature and to what extent it forms the basis for various people's views. Then there are the risk factors for chronic venous thrombosis and we go through what those risk factors were: erythropoietin, polyuria, intermittent dehydration, ligation, anaemia, and so forth.

Then there's venous sinus thrombosis itself. Then there is the effect of the reduced jugular venous

drainage. Then there's PRES; Adam's presentation during surgery, which is an important area; the blood pressure and potential seizures; arguments on brain death caused by dilutional hyponatraemia is quite a lengthy section.

So that was everybody's views, so far as we could summarise them, in order to assist with what is a considerable volume of material going into those meetings.

Then if we pull up 306-017-146. These are the legal team's views on what the experts say in relation to the key points following those meetings. As you know, there were two and you can read the transcripts blow-by-blow on 22 February and 9 March. And thereafter, there was an absolute slew of reports from all of them, really. What we have tried to do is to try and go through all of that and try and extract their points in relation to the same issues as were in the first schedule that I have shown you, which is to try and help you do a sort of before and after to see to what extent anybody's changed their view and, if so, on what basis. So I will not go through it all because it goes through exactly those same points, but that's the idea. It's a much lengthier document because since then they've had a lot more to say, but in any event that's the purpose of that.

I had said before that we would try and address the

differences amongst the experts. In fact, it was one of the reasons why the matter was adjourned. This is our attempt to do it. To put it all into the opening would take a huge amount of time and it is hoped that this provides an easier means to try and access what the experts were saying and why and its significance.

So Mr Chairman, I'm late and I'm sorry.

THE CHAIRMAN: Thank you very much indeed. I'm very grateful to Ms Anyadike-Danes for that exceptionally comprehensive analysis of the issues which we'll be looking at during the next four weeks. As I've indicated, there are to be various discussions, I think, about how we will move forward and there are some of the lawyers representing the interested parties who wanted some time with their clients this afternoon in light of the opening, subject to one issue, which I need to deal with, I want to deal with separately without everybody being present, and that's about the representation of one interested party and issues developed about that, but I don't need everybody to be present for that.

Apart from that, is there anything anybody needs to raise or wants to raise before we stop for today and resume at 10 o'clock tomorrow with Professor Savage? Good. You've had a chance to put your hands up. Let me break for a few minutes and see if we can deal with one

issue on representation of a witness after a few minutes' break.

(1.30 pm)

(The hearing adjourned until 10.00 am the following day)

I N D E X