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**Northern Ireland Inquiry
into Hyponatraemia Deaths
Paediatrician's Expert Report
Re: Raychel Ferguson**

Introduction

I have been requested by the Inquiry Chairman, Mr John O'Hara, to give my expert opinion into the circumstances leading up to the death of Raychel Ferguson in June 2001.

I have been supplied with and studied the following documents:

1. Brief for paediatric expert from the enquiry with some specific questions.
2. Copies of all the hospital in-patient notes from both Altnagelvin Hospital, Londonderry and the Royal Belfast Hospital for Sick Children. All the papers relating to the Altnagelvin Hospital's own internal inquiry, and subsequently the Coroner's Inquest held in Belfast.
3. Witness statements for both the initial inquiry and the inquest from all the relevant members of staff.
4. Papers relating to the subsequent press coverage and the claims for malpractice.

My Credentials

I am a Consultant General Paediatrician in a small District General Hospital in England. I qualified in 1990 and took up my consultant post in 1992. My consultant post involves care of children presenting acutely with a wide variety of conditions and I have some experience of the conditions relating to this case. I also have some responsibility for children admitted to our ward under the surgical teams. As I took up my consultant post in 1992 I am familiar with the standards of practice current in 2001.

Scope of my Report

I have limited my comments to the events leading up to and immediately following Raychel's death and have studied all the documents relevant to this. I have not addressed the issues of whether the staff should have been aware of the potential problems of hyponatraemia given the previous death in Northern Ireland, nor have I addressed the

subsequent issues relating to media coverage and actions taken by senior management as a consequence of this death.

Background to the Case

Raychel was a previously well nine-year-old girl who was admitted to Altnagelvin Hospital on the 7th June 2001 with what appeared to be a fairly straight forward case of suspected appendicitis. A surgically uneventful appendicectomy was performed on the night of the 8th June 2001, and there were no unusual problems at the time.

Twenty-four hours after the operation she had a generalised seizure, and was found to be profoundly hyponatraemic. Her condition deteriorated rapidly, and in spite of resuscitation and intensive care, she was eventually declared brain dead after being transferred to the Royal Belfast Hospital for Sick Children.

I will not reiterate the details of the case that have already been supplied in many of the documents available to the inquiry. I will limit my comments to the questions specifically asked, and some general impressions about the management.

Response to specific questions (paediatrician's brief page 27 paragraph 133)

Paragraph a) *The question relates to the responsibilities of paediatric SHO, Dr Butler, when she prescribed intravenous fluids for Raychel on the morning of the 8th June.*

Response: from Dr Butler's witness statement, it appears that her only involvement with Raychel was the prescribing of intravenous fluids. She, it appears, was merely asked to continue the prescription that had already been started by someone else previously. She was therefore not required to make any changes to Raychel's fluid regime. She duly complied, and simply wrote up the standard fluid regime that was in use on that Ward at that time i.e. 0.18% Saline (also known as Solution No. 18), and this was what was administered. The infusion rate was not changed.

It is a very common situation on any children's' ward that a passing doctor will be asked by the nursing staff to write up routine prescriptions, either for intravenous fluids, analgesia, or antibiotics, and this is very common practice throughout the NHS. Although it could be argued that any doctor prescribing anything for any patient should first assess the situation and possibly examine them, in the real world this does not happen. Any doctor who was requested to do this, and then insisted on doing a detailed assessment would be perceived by the nursing staff as being overly cautious, and obstructive to the running of a busy ward. This does not mean that undue pressure is put on a doctor to do this. It is simply understood that in a straightforward situation, where everything appears to be going well and there are no decisions to be made, this prescription could be done by almost anybody with a medical qualification.

In this particular situation, Dr Butler was a paediatric SHO, while the patient was under the surgical team. On any children's ward, the paediatric doctors are the ones who are most likely to be present for most of the time. The surgical team will also have adult patients on other wards, and may be tied up operating, and therefore are often not immediately available. Therefore, as a means of running a ward efficiently and saving unnecessary delay, nurses will often ask the paediatric doctors to write up prescriptions for surgical patients. This is quite acceptable. If either the nurses did not ask the doctor, or the doctor refused, this would entail calling a surgical doctor who might be engaged

elsewhere, causing considerable delay to the writing of the prescription and possibly the patient going without the required fluids for a period of time.

Paragraph b) Dr Butler says in her witness statement that she would have recorded something in the notes if she had been asked to examine Raychel or if she had done so, and this is entirely reasonable. However, I would not expect every doctor who was asked to write up intravenous fluids to examine the patient unless a problem was mentioned.

Paragraph c) In my view Dr Butler's decision to continue the prescription of IV Solution No. 18 at the same rate was entirely reasonable.

In conclusion, my view is that Dr Butler's actions were entirely reasonable, and what would have been normal then and now for a paediatric SHO on a ward that contained both medical and surgical patients. I do not believe her actions were in any way culpable nor is she to be blamed for the events that led to Raychel's death.

Paragraph d) *The question relates to the nature of the communications that should generally take place between members of a surgical team and members of a paediatric team in this situation.*

Response: This will vary very much between hospitals, and indeed between different wards. Generally, on most children's wards, children who are admitted with a clearly surgical condition, such as appendicitis, have their care primarily under the surgical team. Apart from the situations described above, the surgeons would be responsible for making all the decisions, and discharge etc. The paediatric team in most hospitals are normally only asked to become involved by the surgeons if there is a significant problem. Again the threshold for calling the paediatricians would depend very much on local policy, and on the experience that the doctors involved have in dealing with children. Regarding the situation where a child is continuing to vomit more than twelve hours after surgery, I would not consider it obligatory for a paediatrician to be involved. If the child was clearly extremely unwell with sepsis, shock, or an abnormal conscious level, then I would consider it to be obligatory. However just vomiting would probably not qualify in this situation. Most surgical teams should be competent to assess the situation appropriately. Another situation where the paediatric team may be involved, as happened in this case, is when the surgical team are unavailable, and the only doctors immediately available are the paediatricians.

Paragraph e) *The question relates to what the paediatric team might reasonably have been expected to have been told by the surgical team.*

Response: Obviously this question only arises if the surgical team choose to contact them. Had they done so, then clearly they would be expected to have mentioned that she was continuing to vomit, and had not taken any fluids by mouth.

Paragraph f) *The question relates to the advice, investigations or treatment which a paediatrician would have been expected to direct if their attention had been brought to Raychel's case in the afternoon or evening of the 8th June.*

Response: In my view, by the evening of the 8th June with persistent vomiting, and with Raychel continuing to receive nearly all intravenous fluids and very little by mouth, an assessment of her blood electrolytes status would have been appropriate. At that time

she had had no seizures and her conscious level was normal, so there would have been no reason to address any concerns about her brain or neurological status.

Therefore the advice would have been to clinically assess Raychel for her hydration status both in terms of clinical signs of over or under hydration, and her urine output, and her observations i.e. temperature, pulse, respirations, blood pressure. Even if this examination had not revealed any major problems, then in my view it would have been advisable to take a blood test to check her urea and electrolytes. However it should be pointed out, as it was in several of the witness statements, that most hospitals at that time had a policy of checking blood electrolytes only when a child has been on intravenous fluids for twenty-four hours. In the early evening the twenty-four hour deadline had not been reached. However the continued vomiting I believe should have prompted an assessment before that time.

Paragraph g) *The question relates to the adequacy of the care provided to Raychel by Dr Johnston, paediatric SHO, who was called immediately to Raychel when she had her seizure in the early hours of the 8th June.*

- 1) *The question relates to whether the dosages of Diazepam prescribed were appropriate.*

Response: She was given 5mgs of Diazepam rectally immediately, and when she did not respond to this she was then given 10mgs of Diazepam (in the emulsion form known as Diazemuls) intravenously. There is a discrepancy with this latter dose: Nurse Noble in her witness statement says that Raychel was given 2mgs of Diazemuls. Dr Johnston in his statement, says 10mgs of Diazemuls were given and this is what is recorded on the drug chart written presumably in retrospect. I think it is much more likely that she was given 10mgs, and this would be an appropriate dose for a child her age and weight. This proved to be effective in the short term.

- 2) *The question relates to whether he ought to have placed Raychel on her side in the recovery position when he found her to be unresponsive.*

Response: I am not certain of the significance of the question. According to Nurse Noble's witness statement, when she found Raychel fitting she was already in the left lateral position. It is unclear whether she happened to be laying in that position when the fit started anyway, or whether someone had placed her in that position. Dr Johnston makes no comment about what position Raychel was in either in the case notes, or in his witness statement. As the positioning of a patient having a seizure is very well taught and understood by all members of medical teams, I would be very surprised if she was not placed in an appropriate position either by nursing or medical staff. This is so routine as to hardly be worth a mention in the case notes. A failure to place any fitting patient in the appropriate position could result in an airway obstruction. According to the observations done on Raychel during and after the fit, her oxygen saturations appeared to be satisfactory and therefore there does not appear to be any evidence of an airway obstruction, so I do not think this question is particularly relevant.

- 3) *The question relates to what should have been done at 03.15 when an electrolyte abnormality was suspected.*

Response: The obvious answer to this question is to check the blood electrolytes which is exactly what was done and this was appropriate action. The question may arise as to whether any action should have been taken while awaiting the result to come back from the laboratory, which apparently took about forty-five minutes. It is easy with hindsight to say that the fluids should have been restricted or changed to 0.9% Saline, but we must remember that the staff there at the time had absolutely no idea that the sodium was going to be so low, and had no reason to suspect hyponatraemia. There could have been a wide range of electrolyte abnormalities found, even possibly hypernatraemia i.e. a high blood sodium, and these would have resulted in the need for a very different course of action. I therefore do not think any criticism should be attached to Dr Johnston for not assuming that hyponatraemia was the problem in advance of the blood result.

Prompt action was taken when the very low sodium result was known, but unfortunately it seems that by this time it was probably too late for any change in treatment to make much difference. It was clearly appropriate to do a second blood test, as any result that is so abnormal could be the result of laboratory error. This did result in some delay in treatment but I think this was appropriate given the risks of taking action on a false result. A high sodium level might have indicated severe dehydration and the need for more fluid, the opposite of what was actually needed.

Paragraph h) *The question relates to the adequacy of the care provided to Raychel provided by the paediatric team after the fit.*

Response: When the low serum sodium was found the appropriate action to take was to confirm that it was a genuine result because it was so abnormal. The second blood test was taken and I think this was appropriate. There was then about half an hour's delay until the second blood test confirmed a very low serum sodium. The difference between 119mmol/L and 118mmol/L is insignificant and is within the limits of laboratory error. Therefore the result was effectively the same on both occasions. The appropriate steps were taken after the second confirmatory serum sodium result, and her fluids were restricted to half the original infusion rate, and changed to 0.9% Saline.

As she also had a low serum magnesium, and hypomagnesaemia is known to cause convulsions, I think it was appropriate to give her a single injection of magnesium. Even if this was not the cause, it would not have done any harm.

General Comments on the Care Raychel Received

Raychel's case up until she had the acute deterioration with the seizure, was entirely straightforward and there was nothing about her case that could possibly have indicated to the staff that such a catastrophic outcome was about to occur. All the staff would have dealt with many similar cases of children presenting with acute abdominal pain, with suspected appendicitis, and then going to theatre. The fact that the appendix did not turn

out to be inflamed is irrelevant as this frequently happens and is not the result of any diagnostic error. I am sure it was the right thing to do to remove her appendix if appendicitis was a serious possibility.

The main issue that appears to have been contentious at the internal inquiry and at the inquest, was the degree of post operative vomiting. Although with modern surgical techniques and anaesthetics, post operative vomiting is less of a problem than it used to be, it can still occur quite frequently. Some children seem to be much more susceptible to this than others and this is quite unpredictable. I therefore think it is entirely reasonable that all the staff involved attributed Raychel's vomiting to normal post-operative vomiting, and there would have been no reason for any of them to consider any more serious diagnosis until much later.

The issue of exactly how much she vomited has been discussed in the internal inquiry and the inquest and I have nothing new to add to this. It seems to hinge entirely on different individual's subjective impressions.

Regarding the issue of whether she should have had a naso-gastric tube inserted, I agree with the witnesses who stated that this was not routine practice at the time. Even now it is still not routine practice to insert a naso-gastric tube in every child who vomits post-operatively.

It should be pointed out that the insertion of a naso-gastric tube is a thoroughly unpleasant experience at any age but particularly for a child. It also carries risks, such as inadvertent placement in the airway, or bleeding from the oesophagus or stomach. Vomiting for whatever cause normally settles without the need to do this. The advantage of a naso-gastric tube is that it is possible to monitor the amount of gastric secretions that are being retained in the stomach and also reduce the amount of actual vomiting by aspirating the stomach regularly, but this has to be balanced against the risks and the discomfort. Anti-emetic medications were given appropriately, and in the absence of any signs of a bowel obstruction (i.e. distended abdomen, absent bowel sounds, green bile stained vomit), a naso-gastric tube would not have been obligatory.

Incidence of Hyponatraemia

It is clear from the witness statements from many of the people involved, that they had never before experienced a case of hyponatraemia. I would concur with that, and say that this devastating complication is exceedingly rare. Very many children would have been treated exactly the same way as Raychel, and would have maintained a normal or only marginally low serum sodium level with no adverse effects.

As in many areas of medicine, we do not understand why certain individuals seem to react differently to interventions and there may be many reasons for this. This is of course entirely unpredictable.

Cause of Cerebral Oedema

In Raychel's case, it seems that things deteriorated particularly rapidly when she had the seizure. Although this is speculative, I would guess that the seizure itself caused a

"vicious cycle" that hastened her deterioration. It is impossible to say how much of the vomiting that preceded the seizure was due to normal post operative vomiting and how much was due to increasing cerebral oedema. There were no clearly diagnostic signs of raised intracranial pressure until after the seizure (i.e. reduced conscious level, bradycardia and hypertension). Any seizure can result in increased swelling of the brain, as the cerebral metabolic activity increases, and the blood supply is unable to keep up with the demand. The brain cells need more oxygen at a time when it is relatively lacking in the blood supply, and hypoxic brain cells can swell rapidly. Normally this recovers extremely quickly, but if the brain had already started to become oedematous because of the hyponatraemia, the seizure would have rapidly made it worse. The seizure would also have worsened the inappropriate ADH secretion, which is with hindsight assumed to be part of the cause of Raychel's hyponatraemia. The seizure could therefore have been both an effect and a cause of her rapid deterioration. Once cerebral oedema progressed above a certain level, "coning" i.e. herniation of the brain stem through the foramen magnum at the base of the skull, would have occurred and the situation would have become irrecoverable.

Other Expert Views Required

A number of specialists from different disciplines have already given comments at both the internal inquiry and the inquest.

In my view, the other important experts to be consulted in this case are:

- 1) A paediatric anaesthetist, to comment on intra-operative and immediate post-operative fluid management
- 2) A chemical pathologist or clinical biochemist with paediatric expertise, to comment on the causative mechanisms of hyponatraemia and laboratory measurement issues
- 3) A general surgeon who operates on children (not a specialist paediatric surgeon) to comment on issues of clinical responsibility for surgical children on general children's wards
- 4) A paediatric and/or neuro-pathologist, to comment on the pathogenesis and the post-mortem findings.

Further matters to be addressed in Witness Statements

These are all referred to above. Generally the witness statements are complete and thorough. As mentioned in the brief, a statement is required from Dr Curran, but it seems unlikely that anything said by him would alter the conclusions.

Conclusion

Had Raychel's electrolytes been checked in the early evening on the 8th June, it is highly likely that a very low sodium level would have been discovered and intervention by reducing her fluid and changing it to 0.9% Saline may well have prevented the later deterioration and her death. However the indications for doing this were very marginal

and I believe in many well-run units, this would not have been done. I do not believe that the practice on the ward at the time was below the standard that one might have expected on any children's ward within the UK.

Implications of Post Operative Fluid Policy

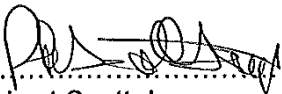
It is now clear that following this and other Northern Ireland cases the policy that was in place at the time for giving intravenous fluids to post operative children were presenting a risk. However it should be remembered that this risk was very small, and these cases are extremely rare. There are also some risks to using the alternative regime that is now in routine use i.e. 0.9% Saline or Hartmann's Solution.

I do not believe that any blame should be attributed to any of the members of staff for prescribing or administering 0.18% Saline in the first place, as this was quite clearly routine ward policy at the time. Indeed it was the policy on most children's wards in the UK at that time. It was not until 2007 that the National Patient Safety Authority issued an alert advising all areas treating children to stop using 0.18% saline. (1) As late as 2003 standard paediatric textbooks were still recommending 0.18% saline as a possible choice of standard IV fluid management. (2) Regarding the choice of IV fluid treatment in this case, it is important to remember that the clinicians concerned would have treated very many children, as indeed I did myself, with this fluid regime with no adverse effects whatsoever.

Declaration:

I declare that the above is my own true opinion having studied all the relevant documents supplied to me, given to the best of my knowledge and ability. I have no personal interest in supporting any particular point of view, I do not personally know any of the clinicians involved in this case and I have never worked in Northern Ireland.

Signed:


..... 14/02/11
Dr Robert Scott-Jupp

References:

1) National Patient Safety Authority (2007). Reducing the risk of hyponatraemia when administering intravenous infusions to children.
<http://www.nrls.npsa.nhs.uk/resources/?entryid45=59809> (Accessed 08/04/2011)

2) Nelson Textbook of Pediatrics (2004) 17th edition (Pub. Saunders) p. 242