

REPORT TO THE INQUIRY INTO HYPONATRAEMIA RELATED DEATHS

ON

RAYCHEL FERGUSON

Date of Birth
09/02/1992

Date of Death
10/06/2001

REPORT PREPARED BY:

Dr W St. C Forbes MA MB FRCR
Consultant Neuroradiologist

DATE OF REPORT:

08/12/2011

Raychel Ferguson

PREAMBLE

Raychel was born on 4 February 1992. She was admitted to the Altnagevin Area Hospital on 7 June 2001 with suspected appendicitis. An appendicectomy was performed on 8 June 2001. She was transferred to the Royal Belfast Hospital for Sick Children ("RBHSC") on 9 June 2001 where brain stem tests were shown to be negative and she was pronounced dead on 10 June 2001. The Autopsy Report dated 11 June 2001 concluded that the cause of her death was cerebral oedema caused by hyponatraemia.

INSTRUCTION

I have been instructed by the Inquiry Team as an expert for the specific purpose of addressing a number of issues raised by the Inquiry's Advisors with regard to the CT scans which were conducted by Dr Cyril Charles Morrison (Consultant Radiologist) in relation to Raychel's brain.

MY QUALIFICATIONS FOR ACTING AS AN EXPERT

I, Wellesley St. Clair Forbes, am a fully registered Medical Practitioner (GMC No. 01360875) recently retired from full-time practice as a Consultant Neuroradiologist. I was employed by the Salford Royal Hospitals NHS Foundation Trust and the Manchester University Children's Hospitals NHS Foundation Trust and hold the qualifications of M.A., M.B., B.Ch., D.M.R.D. and F.R.C.R. I was also employed as a Lecturer (part-time) in the department of Diagnostic Radiology at the University of Manchester. I was appointed to my NHS post in 1978 and in the field of neuroradiology I have a special interest in paediatric neuroradiology

DOCUMENTATION

For the purposes of this report I have been provided with hard copies of the two CT scans reported by Dr Morrison and the following discrete documents:

- Request to radiologist for initial scan
- Clinical notes recording Dr Morrison's findings on each scan (poor quality copy)
- Note documenting initial findings
- Clinical note recording request for and reason for second CT scan
- Typed report on enhanced scan
- Dr Morrison's report to Mrs Brown (Risk Management Co-Ordinator, Altnagevin Hospital)
- Dr Morrison's statement to this Inquiry

Having considered the films and the aforementioned documents the Inquiry Team requires me to provide advice on the following matters:

- a) What can be seen on the first scan and understood from it?

- b) The adequacy of Dr Morrison's report on the first CT scan
- c) The reasons given for carrying out a second scan (enhanced) and whether they were reasonable
- d) The technical differences, if any, between the first scan and the second scan
- e) What can be seen on the second scan and understood from it?
- f) The adequacy of Dr Morrison's report on the second scan
- g) Whether any further steps were necessary from a radiological perspective after each scan was conducted

REVIEW OF RAYCHEL FERGUSON'S CT HEAD SCANS

i) **FIRST EXAMINATION 09/06/2001 – ALTNAGELVIN HOSPITAL**

The examination was commenced at 06:03 hours concluding at 06:06 hours.

Technique: A plain, i.e. non-contrast examination was performed with 3mm interval axial sections through the posterior fossa (back of brain) followed by 5 & 10mm interval sections through the cerebral hemispheres.

The copy images are of satisfactory quality for diagnostic purposes.

Findings:

- i) There is ill-defined diffuse low density throughout the white matter of both cerebral hemispheres, more particularly in the frontal and temporal regions with evidence of severe brain swelling. The lateral ventricles are slit-like, the 3rd ventricle effaced and the 4th ventricle is small in size. The basal cisterns and cortical sulci are effaced. There is no midline shift.
- ii) The meninges of the basal cisterns and posterior fossa and the vascular structures of the Circle of Willis show apparent high density.
- iii) The brain stem appears to be enlarged.
- iv) There is no evidence of an extra axial, i.e. subdural or extradural collection.

ii) **09/06/2001**

The examination was commenced at 08:29 hours and concluded at 08:35 hours.

The examination was performed following intravenous injection of 50ml of Niopam 300, a non-ionic contrast medium.

Technique: A plain, i.e. non-contrast examination was performed with 3mm interval axial sections through the posterior fossa (back of brain) followed by 5 & 10mm interval sections through the cerebral hemispheres.

The copy images are of satisfactory quality for diagnostic purposes.

Findings:

This examination shows essentially unchanged appearances. There is no abnormal enhancement within the brain parenchyma or extra-axially. The examination shows no new abnormal findings.

MY COMMENTS ON THE CT HEAD SCANS

- i) The CT head scans show evidence of severe brain swelling with evidence of presumed herniation of the cerebral contents through the tentorium (the opening between the cerebral hemispheres and the posterior fossa) as evidenced by the apparent enlargement of the brain stem and the low density change in the temporal lobes particularly.
- ii) The brain scans show no evidence of a focal mass lesion excluding the presence of an intracerebral or extra-axial, i.e. subdural abscess.
- iii) The hyperdensity of the basal structures is a secondary effect caused by the generalised reduction in the brain density as a consequence of the diffuse brain swelling caused by the cerebral oedema. The hyperdensity represents an alteration in the normal densities of the basal structures simulating either a subarachnoid haemorrhage or basal meningitis or meningeal thickening.

RESPONSE TO INQUIRY TEAM'S MATTERS:

- a) *What can be seen on the first scan and understood from it?*

Please see review of CT scans

- b) *The adequacy of Dr Morrison's report on the first CT scan*

In a letter to Therese Brown, Risk Management Co-ordinator, Altnagelvin Hospital, dated 6 December 2001 (012-005-096), Dr Morrison states that he was requested to perform an emergency computerized axial tomographic examination of this patient's (Raychel Ferguson) head at approximately 5:30am on 9 June 2001. The diagnostic imaging request included in the bundle of documents provided by the Inquiry Team for the purpose of this report is a request for a chest x-ray and not the request for the CT head scan. I therefore cannot comment on the written information that would have been provided to Dr Morrison prior to undertaking and reporting on the CT scan. However it would seem likely that the deceased's clinical condition would have been

made available to Dr Morrison at the time of the telephone request for the urgent CT scan and he would also have been made aware of Raychel's clinical condition by Dr Nesbitt, Consultant Anaesthetist, who was present during the examination. Dr Morrison's written report (020-015-026) on the emergency CT head scan should therefore be read in that context. Dr Morrison reports:

"Emergency CT of head.
There is evidence of a subarachnoid haemorrhage with raised intracranial pressure. No focal abnormality demonstrated".

Dr Morrison's written report correctly draws attention to the raised intracranial pressure but erroneously considers the presence of a subarachnoid haemorrhage. CT scans demonstrating severe brain swelling are not infrequently mis-diagnosed as a subarachnoid haemorrhage by inexperienced radiologists in training or general consultant radiologists who have had a limited involvement in acute neurological illness in cases of severe brain swelling. The brain swelling which manifests as diffuse low density "highlights" the otherwise normal structures of the skull base. In some cases there may also be hyperaemia of the basal meninges producing appearances which simulate a subarachnoid haemorrhage. Dr Morrison cannot therefore be criticized for suggesting the presence of a subarachnoid haemorrhage. He correctly sought a second opinion from a consultant Neuroradiologist (Dr McKinstry), at the Royal Victoria Hospital regarding the findings of the CT head scan (012-005-096). He comments that Dr McKinstry felt that the apparent subarachnoid haemorrhage was simply secondary to reduced brain density (cerebral oedema) causing apparent meningeal enhancement.

c) *The reasons given for carrying out a second scan (enhanced) and whether they were reasonable*

Dr Morrison in a note timed at 08:30am (020-015-026) notes that the deceased was re-scanned at the request of the neurosurgical unit at the Royal Victoria Hospital to repeat the scan to rule out a subdural empyema. In his Witness Statement he states he queried the request as there was no evidence of fluid on the initial scan. The neurosurgeons' main concern would have been to exclude a treatable cause for the severe brain swelling. A subdural empyema may not be apparent on a plain, i.e unenhanced CT scan, may present as severe brain swelling and raised intracranial pressure and requires a contrast enhanced scan for demonstrating its presence. A contrast enhanced scan would also provide information regarding the presence of meningitis or meningo-encephalitis which could not be diagnosed by lumbar puncture given the risks of performing lumbar puncture in the presence of severe raised intracranial pressure.

I would therefore consider that the reasons for carrying out a second enhanced scan were reasonable.

d) *The technical differences, if any, between the first scan and the second scan*

The only technical difference between the two examinations was the administration of

intravenous contrast media for the second examination. The examinations were otherwise identical and of similar diagnostic quality.

- e) *What can be seen on the second scan and understood from it?*

Please see section on review of CT scan.

- f) *The adequacy of Dr Morrison's report on the second scan*

Dr Morrison's handwritten report timed at 08:30am (020-015-026) states:

"CT of head.

An enhanced scan was performed. No evidence of a subdural empyema".

His subsequent typed report (020-026-055) is a composite of the two CT head scans performed on the deceased and states the following:

"Unenhanced and enhanced scans were performed.

Hyperdensity is noted in relation to the meninges and there is loss of definition of the basal cisterns in keeping with raised intracranial pressure.

The grey white matter differentiates and is preserved.

Following contrast injection there is no interval change.

In particular, as requested a subdural empyema has been excluded.

I have discussed this case with Dr Steven McKinstry, who feels that appearances are more in keeping with cerebral oedema which is highlighting the meninges and normal structures.

A subarachnoid haemorrhage is therefore unlikely".

Dr Morrison has correctly interpreted the neurosurgeons request for performing the CT scan and has, albeit briefly, reported the scan adequately.

- g) *Whether any further steps were necessary from a radiological perspective after each scan was conducted*

I do not consider that from a radiological perspective there were any further steps to be taken after each scan was performed. By inference from his report on the first CT scan, Dr Morrison probably considered that a subarachnoid haemorrhage may be the cause for the cerebral oedema and raised intracranial pressure. For reasons stated above, this would not be considered negligent for a radiologist inexperienced in interpreting paediatric CT brain scans in the setting of an acute neurological emergency. The reporting radiologist should always look for any information which could indicate a likely cause for the brain swelling. Unfortunately the cause of the cerebral oedema and raised intracranial pressure is often not apparent on an unenhanced or enhanced CT brain scan. Specifically with regard to hyponatraemia induced cerebral oedema there are no radiological features to indicate the presence of hyponatraemia which is caused by a biochemical/metabolic upset. There were therefore no further steps that could have been taken from a radiological perspective

Raychel Ferguson

after each scan was conducted in order to demonstrate the underlying abnormality which was biochemical and not structural in origin.

STATEMENT OF TRUTH

"I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer".



**Dr W St C Forbes MA MB FRCR
Consultant Neuroradiologist**

Date of Report: 8 December 2011