Neutral Citation Number: [2019] EWHC 283 (QB)

Case No: HQ17C00168

IN THE HIGH COURT OF JUSTICE
QUEEN'S BENCH DIVISION

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 15/02/2019

Before:

MR JUSTICE STEWART

- -

Between:

MR IAN MARSHALL (WIDOWER AND ADMINISTRATOR OF THE ESTATE OF DOREEN JOAN MARSHALL, DECEASED, AND ON BEHALF OF HER DEPENDANTS)	**Claimant**
- and –	
DOCTOR MARIO SCHEMBRI	**Defendant**

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Mr Stephen Cottrell (instructed by **Irwin Mitchell LLP**) for the **Claimant**
Ms Farah Mauladad (instructed by **Hill Dickinson LLP**) for the **Defendant**

Hearing date: 23rd, 24th,25th, 28th and 29th January 2019

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Approved Judgment

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

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MR JUSTICE STEWART

Mr Justice Stewart:

Introduction

1. The Claimant is the husband of Doreen Marshall ("the deceased") who died on 26th April 2014. The time of death was declared at 09:37 hours. The Defendant is a General Practitioner. It is admitted that the Defendant breached his duty of care to the deceased. It is denied that that breach of duty of care caused the deceased's death. Subject to causation, and therefore to liability, damages have been agreed between the parties. Thus, the sole issue for the court is causation.

2. On 25th April 2014 the deceased attended at Shoebury Health Centre, Shoeburyness. It was about 4 p.m. Her presenting symptoms were chest pain and breathlessness. The deceased had a known history of pulmonary embolism ("PE") from 2008. The admitted negligence is that the Defendant should have referred the deceased directly to Southend Hospital. He did not do so and the deceased returned home. She suffered a cardiac arrest at about 8.30 a.m the following morning. The paramedics attended but were unable to resuscitate her.

3. As the Defendant stated at the outset of its skeleton argument, this is a tragic case exacerbated by the admitted breach of duty.

The witnesses

4. I have heard evidence from the following witnesses. Their written evidence was as follows:

- witness statements of Mr Ian Marshall, the claimant, dated 9th September 2017 and 8th October 2018.
- report of Professor Duncan Empey, Respiratory Physician, dated March 2018.
- report of Doctor Keith Gomez, Haematologist, dated 27th February 2018.
- report of Professor Peter Davies, Respiratory Physician, dated 3rd May 2018.
- report of Professor Charles Hay, Haematologist, dated May 2018.

5. There are also Part 35 responses from Professor Empey. These are dated 26th September 2018.

6. Professor Empey and Doctor Gomez are the experts relied upon by the Claimant. Professor Davies and Professor Hay are the experts relied upon by the Defendant.

7. There is a joint statement of all four experts. This is dated 31st August 2018.

8. The central issue between the parties is that the Claimant's case is that the deceased would have survived had she been referred by the Defendant to Southend Hospital. The Defendant's case is that the deceased would have died in any event.

Terminology

9. PE has been described in the literature as "one manifestation of venous thromboembolism, the other being deep vein thrombosis ("DVT"). "Pulmonary embolism occurs when a DVT breaks free, passes through the right side of the heart, and lodges in the pulmonary arteries". Elsewhere, it has been said that PE "is a condition in which one or more emboli, usually arising from a thrombus (blood clot) formed in the veins (or, rarely, in the right heart), are lodged in and obstruct the pulmonary arterial system."

10. Relevant treatment for PE, for the purposes of this case, is as follows:

    i) Anticoagulation: it is common ground that had the deceased attended hospital on 25th April 2014, a diagnosis of PE would have been made and she would have received anticoagulation treatment, namely low molecular weight heparin ("heparin").

    ii) Thrombolysis: this is described as "clot-busting" treatment. The relevant drug used at Southend would have been alteplase. As the description implies, thrombolysis works by dissolving or removing already formed clots. However, it should only be used where indicated and where the benefits of treatment outweigh the risks, primarily risks of bleeding.

Mr Marshall's evidence

11. Having very briefly set out some preliminary explanation of the issues in this case, I now summarise Mr Marshall's evidence. I shall limit it to what is relevant to the issues of causation. What he says forms an important backdrop to the disputes between the experts.

12. Mr Marshall retired in April 2008, aged 63. His wife, the deceased, retired in October 2007, aged 58. In 2008 they were visiting friends in Edinburgh when the deceased developed a PE and was admitted to Edinburgh Royal Infirmary. She underwent thrombolysis and was prescribed warfarin for six months. She returned home and was treated by Southend Hospital. After the warfarin was stopped she was advised to wear TED stockings and to take Clexane for journeys lasting for more than two hours in any transport, and if she was involved in air travel. This she did. Otherwise the deceased was generally well.

13. It is important that I set out Mr Marshall's recollection in his witness statements as to the progress of the Edinburgh incident. The detail is in his supplementary witness statement. This supplementary witness statement was after the joint statement of the medical experts. Mr Marshall said that the intention of that statement was to "provide more detail of the events of August 2008 in Edinburgh and 25th and 26th April 2014, so far as I can remember."

14. In relation to the Edinburgh incident he said:

> "2…on the way up that year my wife felt a little bit unwell, it was just as we were outside Edinburgh. When we got to our friends' place she asked to go to the bathroom and collapsed on

> the floor. It was in the afternoon sometime, I think it was 4 p.m. The paramedics came very quickly and we explained to them that nothing like this had happened before. They did the necessary observations like putting the machine on her arm but everything looked normal. They advised her to just rest.
>
> 3. Later that evening at around 10 p.m. when we got into bed, she didn't get in. She said that she felt herself "going". We called an ambulance again and they came quickly and this time they took her to Edinburgh hospital. It all happened so quickly once we arrived within an hour they knew what was up, although I had no idea. They decided to keep her in and she went onto a specialist ward. They told me that it was best I go home and get some sleep, so I did."

15. In the week prior to 25th April 2014 Mr Marshall and his wife had been gardening together. Mr Marshall went to the tip. When he returned at about 12.30 p.m, on 25th April 2014 the deceased said she was not feeling right. She complained that she could not get to the top of the stairs without becoming breathless and that she had a nagging pain in the left side of her chest. She was a bit tearful and clearly worried. Mr Marshall telephoned the GP Surgery straightaway to make an appointment. He was given an appointment with the Defendant at 3.45 p.m. The deceased became a bit tearful again whilst she was in the Defendant's surgery. She explained to the Defendant that she was concerned, given her medical history. The Defendant examined the deceased and concluded that the most probable cause of her illness and pain was a strained muscle affecting her hiatus hernia. The Marshalls were both reassured by this.

16. Mr and Mrs Marshall returned home and the deceased took some ibuprofen as advised and rested for the remainder of the day. On the way home they took their time as they had done on the way to the health centre, because the deceased was a little breathless and she had pain on the right side of her chest. Mr Marshall does not remember his wife complaining of pain during the rest of the evening. He took that to mean that the ibuprofen had worked. Apart from making a sandwich tea, the deceased rested at home.

17. Normally the couple went to bed at about 10 p.m, however that evening the deceased went to bed at about 8.30 p.m. She was breathless and slower on the stairs then she would normally be. As Mr Marshall said in paragraph 10 of his second statement: "we put it down to what Doctor Schembri had said." Mr Marshall went up to bed at about 10 p.m. Before that he went up to check if his wife needed a drink, but she had a glass of water by the bed. He thinks that the television was off in the bedroom and she was a bit sleepy.

18. Mr Marshall does not remember getting up in the night and does not remember his wife being up because, he says, he would have woken up too. Both of them were good sleepers at the time and tended not to have to get up in the night.

19. The next morning the couple woke at about 7.30 a.m. Mr Marshall switched on the television and went downstairs to make coffee. This was the normal routine. He returned upstairs with coffee for his wife. They chatted a bit about a wedding

they were due to attend later that afternoon. That was the wedding of Mr Marshall's brother's grandson. Mrs Marshall then went to the bathroom which is just along the corridor from their bedroom, no more than half a minute away[1]. She then called his name and sounded frightened. He ran in and found her sitting on the toilet in distress. She was struggling to breathe and was leaning on the wash basin next to the toilet. He said her colour was bad and her face was distorted. She was not conscious but she was still breathing. She collapsed.

20. Mr Marshall ran downstairs to call 999. He was advised to try to lay his wife on the floor on her side. He says he must have opened his front door and porch door because, after going back upstairs and trying and failing to lay his wife down, he started to go back downstairs again but the paramedics were already climbing the stairs. They asked for her name and then Mr Marshall went back downstairs and waited. There were four paramedics and two ambulances. Mr Marshall called his son who arrived at about 8.45 a.m. He was at the bottom of the stairs when the paramedics told him that Mrs Marshall had passed away at 9.37 a.m. In the meantime, they had been trying to resuscitate her.

Ambulance records of morning of 26th April 2014

21. The records are not detailed. They show:

> "08:29:18 – phone ring
>
> Pick up 08:29:19 …
>
> 08:30:08 the caller is with the patient
>
> 08:30:09 the patient is a 64-year-old female, who is unconscious and breathing.
>
> 08:30:29 the caller is with the patient … her breathing is not completely normal…
>
> 08:31:18 on scene…
>
> 09:29:03 … witnessed cardiac arrest … whilst on phone to crew…"

22. It appears from this that what in fact happened was that the Claimant collapsed and was in a state of cardiogenic shock from very shortly before Mr Marshall rang at 08:29:18. This would have been the time it took him to get about 20 feet to the bathroom and then telephone. It is not entirely clear when she went into cardiac arrest. It appears to have been a matter of a few minutes after she collapsed.

[1] Mr Marshall briefly gave oral evidence. The only point he made was that the distance from the bedroom to the bathroom was somewhat less than the width of the courtroom. He estimated about 20 feet.

Initial treatment had the deceased gone to hospital

23. All the experts agree that the deceased probably developed her DVT in the right calf during the 7 days before 22nd April 2014. Had the Defendant referred the deceased to Southend Hospital at about 4 p.m, and she had arrived at the Accident and Emergency Department at about 5 p.m., she would then have to have been triaged. The Defendant's experts say that this would have happened by 6 p.m. Professor Empey says that, given her presenting symptoms and the various significant past history of a massive PE in 2008, triage would have been prompt, by 5.30 p.m. This is especially so if the deceased had been brought in by ambulance.

24. Professor Empey, relying upon the fact that Mr Marshall says that his wife, although able to walk slowly, was significantly troubled by her symptoms of breathlessness and chest pain, and in view of her past history, said that at triage she would have been classed as "urgent". The Defendant's experts say that since the deceased was well enough to make her own way, some 200 yards, to the health centre with her husband, she was not critically ill and would have been deemed semi-urgent.

25. These timeline disputes lead to a half-hour difference in the experts' opinion as to when the deceased would have been seen by a doctor. Professor Empey says that she would have been seen quickly, by 6 p.m. The Defendant's experts say that it would have been by 6.30 p.m.

26. The 2012 Clinical Guideline from NICE provides what is known as "a Wells score". The Defendant's experts say that, based on the deceased's symptoms and past history, the Wells score would have been at least 4.5 and possibly higher. The Claimant's experts say, "the score would have been at least 4.5 and might well have been 7.5." In any event all the expert doctors agree that the score would have been at least 4.5. This would have put the deceased in the category of "PE likely." It is therefore agreed that she would have been urgently investigated for PE[2].

27. Once the deceased had seen a doctor she would have been investigated by means of a "D-dimer, a chest x-ray and CT pulmonary angiography (CTPA)." It is further agreed that the D-dimer would have been elevated, chest x-ray would have been normal and CTPA would have shown PE[3].

28. As to when the D-dimer test would have been available, the Claimant's experts say that this would have been by 7 p.m. The Defendant's experts suggest that the test results would have been available within an hour of seeing the doctor. They therefore estimate 8 p.m. as a more likely timing. Nevertheless, all experts agree that the elevated D-dimer results would have led to anticoagulation using heparin. They say that heparin would have been administered between 8 p.m. and 9 p.m.

[2] For this reason, the possible difference in opinion in the Wells score is not of importance.
[3] All doctors agree that as regards to CTPA (i) whether it would have been performed out of hours or scheduled for the following day depends on the local arrangements; however (ii) this should not have delayed starting heparin anticoagulation and is therefore not material.

29. The end result of the expert opinion summarised in the preceding paragraphs is that, according to the Claimant's case, heparin would have been administered by about 7.30 p.m; according to the Defendant's case it would have been administered by 9 p.m.

30. Although there was considerable evidence given on those differences, the deceased would have been prescribed heparin by 9 p.m at the latest. The heparin would have had time to take effect preventing future clotting. This would have been by about midnight, at the latest.

Heparin - causation

31. I now turn to the administration of heparin and the case on causation in that regard.

32. The Claimant's pleaded case on this point is:

> "11…the deceased would have been given anticoagulation treatment so that the massive pulmonary embolism that caused her death would have been avoided."

33. The Defendant's experts and Doctor Gomez, the Claimant's Haematologist, all agreed that the initiation of therapeutic anticoagulation in the 24 hours prior to the time of the massive PE which caused the deceased's death would not, on the balance of probabilities, have prevented the fatal arrest. Professor Empey disagreed. In a joint statement he said[4]

> "8… from the probable time of DM's admission, suspected diagnosis, and the administration of heparin as per NICE Guidelines 2012 (probably by 19:30) until her collapse at 08:00 the next morning, around 12 hours would have elapsed. We know from the post mortem findings that DM had a clot in a leg vein (DVT), which was the origin of earlier smaller emboli causing her symptoms. As there were 12 hours overnight without anticoagulant treatment, on the balance of probabilities, some more clot was laid down in the leg vein. This resulted in a larger clot and the greater potential for a massive, fatal, pulmonary embolism to occur. The pulmonary embolism which occurred in the morning would almost certainly still have occurred but, on the balance of probabilities, it would have been sub-massive, or even smaller, thus significantly increasing DM's chances of survival."

34. Although:

i) The experts agree that the deceased would have been given heparin at hospital.

[4] In the joint statement Professor Hay is referred to as CH, Doctor Gomez KG, Professor Davies PD and Professor Empey DE. The deceased is referred to as DM.

ii) Such treatment, when it takes effect[5], would have prevented the formation of new clot.

iii) Preventing the formation of a new clot decreases the chances of development of massive PE and therefore increases prospects of survival.

- Nevertheless, upon consideration of the medical evidence as it now is, the Claimant does not now submit that heparin alone would probably have prevented the death. It is important to note, however, that the Claimant still submits that anticoagulation would have had a beneficial effect and that it is relevant to consideration of the case as a whole.

35. Professsor Empey said in his Report that heparin "… on the balance of probabilities, would have prevented additional clot forming in the deep veins of the leg, and even if further embolism had occurred in the morning, it would have been significantly smaller than the massive one which caused her demise."

36. In oral evidence Professor Empey said he modified his opinion slightly in the joint statement paragraph 8 (see above). He said he still thought that heparin would have made new clot less likely. The deceased had had PE over several days. He thought that the pattern would have continued. If heparin had been given then, after a few hours, fresh clot would not have been laid down.

37. Professor Empey also said that once a patient is admitted to hospital with PE, it is very, very unusual if the patient dies. However, he accepted that, with the deceased's history of previous PE and the fact of her death, it was difficult to be dogmatic about the effect heparin would have had.

38. He said, when pressed, that it was 50/50 whether heparin alone would have prevented her death. His previous opinions in writing were pointed out to him and he said it was very difficult and that, medically, there was little between 50% and 51%.

39. As to heparin having an effect to stop the size of the clot in the leg increasing, Professor Davies agreed this. However, he said that, given that the clot had been forming already for a number of days, it would probably still have been about 95% of the size it eventually was. I accept this as the best realistic estimate.

Causation issues in the case

40. Paragraph 11 of the Particulars of Claim continued, in relation to causation:

> "Although unlikely after anticoagulation treatment, if a massive or a sub-massive pulmonary embolism did occur whilst in hospital, thrombolysis and full supportive treatment would have been available and on a balance of probabilities she would have survived."

41. Therefore, the central questions for the court to determine now are:

[5] See later as to timing.

i) Has the Claimant proven on the balance of probabilities that there were progressive pulmonary emboli during the night of 25/26 April 2014?

ii) If so:

a) would progressive pulmonary emboli have been picked up on monitoring had she been in hospital?

b) if so, would thrombolysis have been prescribed and with what effect?

iii) If, the answer to (i) and/or (ii) is negative, had the deceased been in hospital, would thrombolysis have saved her? In other words, had there not been progressive pulmonary emboli, can the Claimant prove that thrombolysis would have saved her had she gone into cardiogenic shock or arrested in hospital?

iv) If the answer to (i)-(iii) are negative in that the Claimant cannot prove a specific train of events or mechanism which would absent the Defendant's negligence, have saved her. Looking at the evidence as a whole, is it nevertheless more likely than not that the Claimant would have survived had she been referred to Southend Hospital?

42. In summary the disputes at the outset of the trial were:

i) The Claimant:

The deceased was probably deteriorating during the night in that she was progressively forming emboli. Had she been in hospital being monitored, the trend of monitoring would have shown substantial fall in blood pressure, rise in heart rate and reduction in oxygen saturation. This would have led to the administration of alteplase at some stage during the night and this would have saved her.

ii) The Defendant:

• The deceased was not forming new emboli during the night. She formed a new large embolism from the DVT which started in her calf just before she collapsed in the bathroom. By that time, had the deceased been in hospital she would still have died.

• Even if the Claimant is correct as to the course of the illness, had the deceased been in hospital (a) she would not have been given alteplase during the night, (b) even if she had, it would probably not have saved her.

iii) The Claimant said that even if the Defendant was correct that the deceased probably formed only one new large embolism, had the deceased been in hospital, she would have been given alteplase and CPR and that would, even at that late stage probably have saved her life. This was disputed by the Defendant.

43. As the trial continued and the medical evidence was refined, the submissions were somewhat modified as I shall demonstrate below.

Question 1. Has the Claimant proven that there were continuing pulmonary emboli during the night of 25/26 April 2014?

44. All doctors accepted that the deceased was haemodynamically stable at the time she would have arrived at hospital. As it turned out she was definitely haemodynamically unstable when she collapsed in the bathroom the next morning. The first question was whether the Claimant can prove that she probably became unstable overnight.

45. Professor Empey earlier said that if the clot in the calf was still giving off emboli, then that would have led to deterioration overnight and, had she been monitored in hospital, that would have raised the question of treatment by thrombolysis. The heparin would have stopped new clot. On post-mortem there was some clot left in the calf. The clot in the leg which led to the death may in fact have been forming new clot which progressively broke off with increasing obstruction of the arteries.

46. The suggestion that there were increasing pulmonary emboli during the night was challenged on the basis that the deceased would have had symptoms of chest pain and breathlessness. Nothing was recorded, even in the hour or so between the deceased waking up and making her way to the bathroom where she collapsed. Professor Empey disagreed with this for these reasons:

i) Chest pain is not a necessary symptom. In any event, she may have had some in the morning but not mentioned it. This, despite the fact that she had complained of chest pain the night before.

ii) If a person is haemodynamically unstable, this instability is based on very low systolic blood pressure – something of which a person is not aware[6].

iii) In his report Professor Empey had said: "Patients with such massive emboli have a large amount of clot in the pulmonary arteries causing the blood flow through the lungs to be virtually obliterated. This causes breathlessness and collapse and the diagnosis is confirmed if the systolic blood pressure is below 90 mmHg." He said in evidence that there would not necessarily have been breathlessness at rest (i.e. while the deceased was in bed) even if she was in fact haemodynamically unstable. He added that breathlessness is a subjective symptom and that there is not a linear relationship between what is happening to the body and how the person perceives it.

iv) Professor Empey did not consider the fact that the deceased had a number of symptoms prior to her 2008 admission to hospital in Edinburgh to be of relevance.

v) In short, from what we know from Mr Marshall of the deceased's actual presentation overnight and on her last morning, Professor Empey said there was nothing consistent or inconsistent with her being haemodynamically unstable prior to her collapse.

[6] The deceased's systolic had been measured at 132 by the Defendant on the afternoon of 25th April 2014.

47. It is to be recalled that in the joint statement at paragraph 8, Professor Empey's opinion was that the clot in the calf increased in size (unrestrained by heparin) and that this, resulted in a larger clot and the greater potential for a massive, fatal PE to occur.

48. Further, in his earlier report, Professor Empey had said: "As Mrs Marshall's symptoms were unchanged overnight and her collapse occurred only after she had gone to the bathroom on the morning of 26 April 2014, it is unlikely that she had pulmonary emboli during the night."

49. Professor Empey accepted at first that he did not now agree with this earlier opinion, on the basis that new small pulmonary emboli may have developed but without causing any symptoms until just prior to collapse. That was a feasible course of events, alternative to that in his earlier statement.

50. Professor Empey was further cross-examined on his opinion that the deceased probably became haemodynamically unstable during the night. Two further sections in the joint statement were referred to. These were:

i) In answer to a question as to whether even with heparin the clot would have embolised and caused a massive pulmonary embolism, Professor Empey had written at paragraph 9 (g):

> "It is likely that an embolism would have occurred but, on the balance of probabilities, it would have been significantly smaller if 12 hours of anticoagulant had been administered."

In an earlier response he had said that "part of the clot was old and part fresh. On the balance of probabilities, both parts embolised causing the demise of DM."

ii) In answer to the question at paragraph 14 (c) "what would her condition overnight probably have been?" both Professor Empey and Doctor Gomez responded "on the balance of probabilities her clinical course would have been similar to the previous case and she would have manifested signs of haemodynamic instability during the night. Being able to speak with her husband when lying in bed in the morning, and walked to a nearby bathroom, does not rule out clinically significant changes in oxygen saturation and/or blood pressure having occurred while sleeping during the night."

51. Professor Empey conceded that the last response was not consistent either with his Report or with the earlier responses he made in the joint statement. He then accepted that he could not say whether it was more likely that the deceased had progressive pulmonary emboli during the night, rather than one big clot (larger because of the lack of heparin) which embolised shortly before the deceased collapsed the following morning.

52. In relation to the relevance of the Edinburgh incident, as referred to in his response at paragraph 14 (c) of the joint statement, Professor Empey said that when the deceased arrived at Edinburgh she was very unwell. The presentation in Edinburgh was very different because the deceased had collapsed and had

urinary incontinence but this was not significant in that she, by that stage, already had a massive PE. He said that in a patient like this lady it is likely that she would fit a similar pattern in how her pathology developed, even though the signs and symptoms differed. The underlying disease may well be similar in pattern. That does not necessary replicate itself in her presentation of symptoms and in how they affected her. However, Professor Empey accepted that he could not say how the pathology in Edinburgh occurred. At one stage he said that we know the deceased had a massive PE in 2008 which was treated and was not fatal; we know that in 2014 she had a massive PE which was fatal. Anything more was speculative.

53. Professor Empey added that on reading the Edinburgh notes, the symptoms resulting from the PE were not too clear. She may have been having pulmonary emboli and then there were symptomatic emboli and lots of them; therefore it is possible that she had embolic episodes on a number of occasions in the car and in the ambulance; enough emboli to cause haemodynamic instability.[7]

54. Professor Davies agreed with Professor Hay in the joint statement as to the deceased's probable condition overnight. They both said:

> "Given that the following morning she had a normal conversation with her husband and was making her own way around the house, we would say that she was probably stable and not particularly unwell overnight."

Professor Davies said that the comment about the deceased making her own way around the house related to the evening before. However, he added in the joint statement, with reference to the morning, that the deceased "walked to the toilet with no apparent difficulties."

55. It was put to Professor Davies that the post mortem showed that the deceased's lungs had an obvious "occlusion of both left and right pulmonary arteries by a massive pulmonary emboli. These extended down numerous lower order branches but no frank pulmonary infarction had developed." It was suggested that there being more than one pulmonary embolism and the nature of the distribution of the pulmonary emboli were indicative of more than one clot entering the lungs and therefore progressive development of emboli overnight prior to death. Professor Davies suggested that the post-mortem report was consistent with one clot which entered the lung and fragmented. He agreed that the deceased had had symptoms of pulmonary embolism for some days and that she was haemodynamically stable at the time when she would have entered the hospital. His view was that she had had symptoms consistent with small pulmonary emboli which had caused her some three days pain and then some breathlessness, though not breathlessness at rest. His opinion was that there was probably a large number of emboli breaking off and lodging in the lung. Then there was a period of stability until the clot in the leg embolised, entered the lung and broke into several fragments. This happened very quickly. His opinion was

[7] In the Edinburgh notes it says that there was no calf swelling but Professor Empey said this was not very significant. Doctors would often just have a quick look in the circumstances of the deceased's admission to hospital in Edinburgh.

based upon the fact that there was no evidence of any worsening symptomatology from the afternoon of 25th April until the next morning. Also, there was no infarction and therefore earlier emboli were probably so small as to cause no damage to the lungs.

56. Professor Davies accepted that once a person has PE and it is not treated, things are only likely to go in one direction. However, he said the timing of this was unknown. The forming of emboli is somewhat random. It can be more or less continuous with very small emboli followed by a big one. There can be stops and re-starts in the formation of emboli. Therefore, the fact that she had had small emboli forming over a few days and causing her some symptomatology was no indication that that continued, in the absence of any evidence that her symptoms worsened.[8]

57. Before turning to the evidence of the haematologists, I will set out the evidence which is available from the Edinburgh records. I have already previously recorded Mr Marshall's recollection of those events. Unfortunately, the Edinburgh records are not full. The most illuminating one is the discharge summary. This shows attendance at 2:55. This may be 22:55 so as to fit in with Mr Marshall's evidence. It is also likely that a digit is missing since the 24-hour clock would have been used. The notes show:

> "A 58-year-old lady collapsed x4. Normally fit and well. Drove up from Southend overnight Monday to Tuesday. Got out of car walking along, felt chest tightness, palpitations, hot and sweaty and light headed leading to collapse, witnessed by husband. LOC approx. 1-2 minutes. Urinary incontinence. No seizure like activity.
>
> Three further episodes including one in ambulance with similar presentation and symptoms.
>
> Now SOB+ generally feels unwell. No pleuritic chest pain, cough or haemoptysis. No calf pain or swellings."

Those are the clinical notes of the treating doctor.

58. Doctor Gomez made the point that the evidence we have so as to determine what the course of progression (if any) of the PE was on the morning of 26th April 2014, is of poor quality. It comes from two sources, namely the Edinburgh evidence as to what happened 6 years earlier and the symptomatology as described by Mr Marshall on both occasions.

59. Based on the thesis that what happened in Edinburgh was a better guide to what happened during the early hours of 26th April 2014, and that the course of the

[8] Professor Davies suggested that had there been further emboli during the night, the deceased would have awakened with chest pain. However, the records of her admission at Edinburgh indicated that she had no chest pain (though there was reference to chest tightness). The pain caused by PE is inflammatory and may take some hours to develop after the initial insult. [See below].

underlying pathology was liable to be similar on both occasions, Doctor Gomez said:

• In the joint statement (with Professor Empey) "we would consider the previous presentation with the same disease in 2008 when she fulfilled the criteria for thrombolysis in Edinburgh. There had been no new medical conditions that would have had an effect on her condition … on the balance of probabilities her clinical course would have been similar to the previous occasion and she would have manifested signs of haemodynamic instability during the night."

• In Edinburgh the deceased had had symptoms of PE just outside Edinburgh and collapsed soon after they arrived in the friends' house. At that stage she had a massive PE but her heart rallied such that, when the ambulance arrived, her blood pressure appeared normal and PE was not then suspected.

• Nevertheless, the die was cast. Some 6 hours later she collapsed again and went in and out of consciousness three times, once in the ambulance. At this stage she was in cardiogenic shock.

60. Doctor Gomez's thesis was that in the intervening period after the first collapse until the second collapse some 6 hours later, the deceased would have been having symptoms. This is despite the fact that there is no evidence that she complained of them.

61. Professor Hay considered the evidence as to Edinburgh and said that he believed it illustrated that it was more likely that massive PE was caused on both occasions by reason of episodic embolisation. In his opinion Mrs Marshall was unwell in the car on the outskirts of Edinburgh, she had one episode where she felt faint and tightness in the chest and then fainted. Her blood pressure recovered. Later she had the other episode and felt herself going. This time she was in cardiogenic shock. He said this illustrated different one-off events rather than slow deterioration.

62. There was a lot of further evidence and submissions in relation to symptomatology on the morning of 26th April 2014, despite the deceased not having complained of anything.

63. As to the morning of 26th April 2014, I have already summarised the opinions of Professor Empey and Professor Davies. Doctor Gomez's opinion as to the progressive build-up of emboli overnight was premised on the fact that in the morning she had symptoms but did not report them. Breathlessness and chest pain are subjective symptoms.

64. There were numerous submissions as to the likelihood of the deceased reporting any symptoms of pain or shortness of breath at rest in the morning. On the one hand, she may have been asked by her husband (or not). Even if he did ask, it would not be comparable with more focused questions which would be asked by hospital staff. Also, it can be said that she had been reassured by the GP the previous evening. On the other hand, she had had a previous near fatal experience because of PE, she was clearly worried about going to the GP and Mr Marshall was aware on walking home from the GP that his wife was a little breathless and

had pain on the right side of her chest. Further, he was aware she was breathless and slower on the stairs when she went up to bed at about 8.30 p.m on 25th April 2014.

65. It is in this context that I turn to Professor Hay's evidence. He accepted that it was possible that the deceased had some PE during the night but unlikely that they were such as to cause any cardiogenic shock. If she had had small PE during the night they would not have been sufficient to cause collapse. He said it was not possible to say whether she had had small PE during the night. If there had been small PE, when she awakened she would not have been breathless at rest. It all depended on the size of the PE. Also, chest pain tends not to be immediate unless there is a large PE. Small PE would not cause a significant drop in blood pressure. If the PE were progressive, hypoxia would increase and the next stage would be shortness of breath at rest.

66. From the above evidence I draw the following conclusions on the balance of probabilities:

i) the evidence at Edinburgh does not assist in relation to the dispute as to whether there were progressive PE occurring during the night on 25th/26th April 2014. This is because it is not possible to say that there was progressive substantial embolism in the period from Mrs Marshall's first collapse in the friends' home until her second collapse. There may or may not have been. There is a lack of evidence that she did complain of chest pain or breathlessness between her first and second collapse in Edinburgh.

ii) It is not possible to say whether the deceased had an accumulation of small PE during the night of 25th/26th April 2014. She may or may not have done. There is nothing to indicate one way or the other.

iii) Even if the deceased did have further PEs during that night it cannot be proven that they were large enough to have caused a significant drop in blood pressure. If she had any symptoms she may have slept through them and felt symptom free on awakening. If there had been a substantial accumulation of PEs then she probably would have had shortness of breath when resting. She sat up, chatted and drank coffee with her husband prior to her final collapse. They were discussing attending a wedding later in the afternoon. Although symptoms are subjective, I conclude that had they have been substantial she would in those circumstances have probably mentioned them to her husband.

67. I now turn to the relevant section of the post-mortem report. This states:

> "The chest wall including the ribs, sternum and cervical spine was intact and the pleural cavities merely moist. … The lungs themselves … were subject to pulmonary oedema but most obvious was an occlusion of both left and right pulmonary arteries by massive pulmonary emboli. These extended down numerous lower order branches but no frank pulmonary infarction had developed …"

68. Doctor Gomez's view was that the fact that the PE extended to numerous branches showed the process and logically suggested a build-up. Professor Hay said that the post-mortem report was not very detailed. Emboli break up to some extent going through the turbulence of the heart. Often post-mortem reports say that there are coils. Almost by definition you do not get one clot on a post-mortem, as the clot breaks up and goes down both lungs. That is normal and it is very unusual for a clot to go down one lung only. His (and Professor Davies') thesis was that this was a ribbon clot which started in the calf and extended up the venous system. It was one large clot. Most of the emboli probably came from the thigh or pelvis because it is above knee clot that is more likely to embolise. Doctor Gomez disagreed. He says that once there is a clot and emboli it is much more likely that emboli are not necessarily from the main clot. Clotting occurs once a blood vessel is damaged. He accepted that the clot could have broken up on CPR. However, he did not think that the clot could go up the venous system and fragment in such a way as to show emboli extending into numerous branches in the lungs.

69. I am of the opinion that the post-mortem report does not particularly assist. This was Professor Hay's view. It does not provide evidence to say whether there is a build-up of PEs or one large embolism which caused her collapse. It is consistent with both. Both haematologists agreed that the fact there was no frank pulmonary infarction also did not really assist.

70. Therefore, my conclusion is that, for the above reasons, the Claimant has not proven on the balance of probabilities that there were continuing emboli forming during the night. This is also consistent with Professor Empey's initial view in his report though, of course, he substantially amended that in one part of the joint statement and in his oral evidence.

71. I now turn to question 2. Before that I will deal with the Guidelines for treating with thrombolysis and the hospital monitoring of the deceased which would have occurred.

Treating with thrombolysis - Guidelines

72. Two sets of Guidelines were referred to in evidence. The first is the NICE Guidelines "Venous Thromboembolic Diseases: Diagnosis, Management and Thrombophilia Testing". These were published on 27th June 2012. The second were the Southend Guidelines headed "Pulmonary Embolism in Adults Investigation and Treatment." These were ratified by the Clinical Governance Group (medicine) on 25th June 2013.

73. In the NICE Guidelines is the following:

> "*Pulmonary embolism*
>
> 1.2.7 consider pharmacological systemic thrombolytic therapy for patients with PE and haemodynamic instability …
>
> 1.2.8 do not offer pharmacological systemic thrombolytic therapy to patients with PE and haemodynamic stability with or

without right ventricular dysfunction…if patients develop haemodynamic instability, refer to recommendation 1.2.7…"[9]

The NICE definition of haemodynamically stable PE is:

"When a patient has PE and a normal blood pressure. The haemodynamically stable patient sub-group includes patients with what was previously called normotensive, non-massive, or sub-massive PE. Patients with haemodynamically stable PE, with or without right ventricular dysfunction, may be considered separately by clinicians. See also pulmonary embolism."

74. In the Southend Guidelines is the following:

"**Haemodynamically unstable PE**

This patient group was previously called massive PE; it is defined by:

• systolic BP < 90mmHg or,

• a pressure drop of ≥ 40 mmHg for > than 15 minutes), if not, caused by arrhythmia, hypovolaemia or sepsis.

About 5-10 % of patients present in this high-risk group with a risk of early death >15%; they may be too unstable to be sent for investigations as recommended above, if possible a CTPA should be performed within the hour.

15.2 Haemodynamically stable PE

This includes the groups that were previously called normotensive, non-massive or sub-massive…

16 Thrombolytic treatment for PE

Recommendations

1. Consider systemic thrombolytic therapy for patients with PE and haemodynamic instability.

2. Do not offer systemic thrombolytic therapy to patients with PE and haemodynamic stability…"

75. Professor Empey was questioned about the letter of claim which included a statement: "if she was just to have a sub-massive PE it (i.e. thrombolysis) may still have been considered and given." It was put to him that the effect of the

[9] Paragraph 1.2.8 was not added to the NICE Guidelines until 2015. However, Professor Hay said it was in accordance with medical practice in 2014. In any event the Southend Guidelines in force in April 2014 were to the same effect. See para 16.2 of those Guidelines set out below.

NICE and Southend Guidelines was that thrombolysis should not be considered unless there is a massive/haemodynamically unstable PE.

76. Professor Empey agreed that a systolic BP of less than 90 was internationally accepted as the threshold of haemodynamically unstable PE. Nevertheless, he said that whether to prescribe thrombolysis was ultimately a clinical decision. If somebody had a sub-massive PE and the haemodynamic changes had not reached 90 but were heading that way, and there were other signs e.g. raised pulse and reduced oxygen saturation – i.e if everything was heading in the wrong direction - a clinician could probably consider thrombolysis before the threshold of 90 was reached. In short, clinicians would not follow rigidly the Guidelines. They would take account of other clinical data.

77. Doctor Gomez said that as a person's condition becomes more severe, and if there are continuing emboli, then there will be more breathing difficulties and the diastolic blood pressure would fall. A person can have breathing difficulties and chest pain, then they go away and come back. If there are developing pulmonary emboli however, the trajectory of the blood pressure is downwards and the heart rate upwards. That would be the overall trend.

78. On all these points there was no substantial disagreement. Professor Hay agreed that, in relation to the Guidelines, there would be a bit of "fuzziness around the edges". In other words, if somebody was approaching the threshold then a treating clinician would step in and prescribe thrombolysis. Essentially, he and Doctor Gomez agreed that the trend would have to be clear and the threshold in the Guidelines, if not actually reached, would have to be almost reached. My impression, and the expression used when speaking to the doctors was that a patient would have to reach the threshold limits or as near as really did not make much difference.

Hospital monitoring of the deceased which would have occurred

79. All doctors agreed that, had she gone to hospital, the deceased would have been admitted to an Acute Medical Unit or to a High Dependency Unit (HDU). Had it been an HDU it would have been Level 1, not Level 3. Professor Empey said the difference between Level 3 HDU and an Acute Medical Ward is that there are usually fewer beds in the HDU and generally greater staffing levels for monitoring.

80. All doctors agreed also that oxygen levels and heart rate would be continuously monitored. The Defendant's doctors had said in writing that blood pressure monitoring, although important, would be on a four-hourly basis[10].

81. Professor Empey was of the opinion that continuous monitoring of heart rate and oxygen, with nurses reacting to any significant change by way of an alarm system, would not have been sufficient. He said that changes in blood pressure, especially with the 15 minutes criterion for distinguishing between massive and sub-massive

[10] In the joint statements they suggested all monitoring would be on a four-hourly basis. This was in error. Professor Davies accepted that he should have made it clear that monitoring continuously of oxygen levels and heart rate would have been continuous.

PE, would have led to at least hourly blood pressure monitoring. He said that blood pressure can go down without the pulse going up and that blood pressure and oxygen levels are not directly related. They can go down together. It is not possible to infer a blood pressure drop from something else e.g. the oxygen level dropping to a point where the alarm was triggered.

82. Professor Empey's opinion was that the diagnosis of PE and the deceased's past history of near fatal massive pulmonary embolism would have ensured that she was given oxygen and that her blood pressure would have been measured every thirty minutes (or at least every hour), or more frequently if the heart rate and/or oxygen saturation deteriorated.

83. There was also a dispute as to what the deceased's oxygen saturation would have been on admission to hospital. The Defendant's doctors said in the joint statement that this was unknown "but may well have been normal." Professor Davies was asked about this in cross examination and he said that he should have made it clear that he meant "probably normal".

84. Professor Empey said that given the presence of significant breathlessness the oxygen saturation would have been 92% or significantly lower. Normal oxygen saturation is more than 96%. 92% or lower indicates significant gas exchange problems such as occur with PE resulting in hypoxia. He said this level is a sign that something very serious is going on. As stated, Professor Empey based this assessment on the history of breathlessness. It was pointed out to him, from the Claimant's statement, that there was breathlessness only on exertion. He said that breathlessness is subjective and if the Claimant reported breathlessness, then he believed that her oxygen level was 92% or lower. On the other hand, he accepted that the Claimant may have been acutely aware of the problems of breathlessness as a result of her previous PE episode in 2008. This may have made her more likely to complain of breathlessness than the average person.

85. In the joint statement Professor Hay and Professor Davies said that the oxygen saturation at presentation was unknown but may well have been normal. Later in response 13(b) they said "given that she was able to make her own way 200 yards to the surgery and the following morning have a normal conversation with her husband, I would say, on the balance of probabilities … she probably had a normal blood pressure and probably had no hypoxia." Professor Davies in oral evidence said that the deceased could have had normal saturation and still been breathless on exertion. He added that on balance there is no evidence to suppose that her oxygen was anything other than normal; just because she was breathless on exertion did not mean to say that her oxygen saturation would have been low. Similarly, Professor Hay said at rest the oxygen level may be completely normal and there is some degree of desaturation when the patient exercises.

86. Looking at the evidence overall, although this is a difficult point, I am not persuaded on the balance of probabilities that the deceased was hypoxic at the time when she would have been initially assessed at hospital.

87. As the evidence progressed there became a broad measure of agreement between the doctors that blood pressure monitoring would have been at least about every hour. This is what Professor Davies accepted. Professor Hay thought perhaps it

would be every one to two hours. On the balance of probabilities, having regard to the evidence as a whole, I find the blood pressure monitoring at Southend would have been about every hour.

Question 2 (a). Would progressive pulmonary emboli have been picked up on monitoring had the deceased been in hospital? (b) if so, would thrombolysis have been prescribed and with what effect?

88. In the light of my findings in relation to question 1, the Claimant cannot prove that on the balance of probabilities there were progressive pulmonary emboli overnight and in the early hours of the morning. Therefore, strictly this question does not arise. However, it needs to be addressed as it has relevance in relation to Question 4.

89. On the evidence:

a) had there been progressive pulmonary emboli they would have been picked up on monitoring and a downward trend would have been noticed.

b) However, thrombolysis would not, on the balance of probabilities, have been prescribed overnight. In the joint statement at question 14 (c), Professor Empey and Doctor Gomez said that the deceased would probably have manifested signs of haemodynamic instability during the night. In oral evidence Doctor Gomez said that as the thromboses progressed, signs and symptoms indicating the severity would have easily been picked up and would likely have led to thrombolysis at some point during the early hours of 26th April. He subsequently said that he did not know when in the early hours the deceased probably would have been given alteplase. Finally, and crucially, his evidence was that he could not say on the balance of probabilities that if the deceased had been having small PE during the night such that her condition was deteriorating and her systolic blood pressure had a downward trend, that it would have reached either of the criteria, or even very close to the criteria, for the administration of alteplase. He said it was a reasonable point that, on the Southend Guidelines, if the blood pressure had not dropped to, or very near to, threshold, the deceased would not have been given alteplase.

Question 3. Had the deceased been in hospital would thrombolysis have saved her?

90. This question needs to be considered in conjunction with the medical literature. Although I will review all the literature, I will not at this stage draw conclusions from overall mortality of patients with PE who are treated in hospital. I will deal with that more fully in answering question 4.

Anticoagulation

91. Barritt[11]: this is the first relevant study and dates from 1960. It is the basis of the evidence for the efficacy of administering heparin. In fact, in that study there were no deaths from PE in the patients given heparin. From that study it is considered unethical not to give heparin to patients with suspected PE.

92. Kearon[12]: This is a review paper which says that in patients with PE treated with anticoagulant alone, resolution of PE is negligible after two hours and is only about 10% after 24 hours.

93. ESC Guidelines[13]: At paragraph 5.3 of the Guidelines it states that thrombolytic treatment of acute PE restores pulmonary perfusion more rapidly than anticoagulation with UFH (unfractionated heparin) alone. The early resolution of pulmonary obstruction leads to a prompt reduction in pulmonary artery pressure and resistance, with a concomitant improvement in RV (right ventricular) function.

94. Restoration of pulmonary perfusion is not, ultimately, what matters. What matters is life or death.

Thrombolysis – general efficacy

95. Wan and others [14]. This paper is a 2004 meta-analysis which concludes, as reflected in the abstract,:

> "Thrombolytic therapy compared with heparin was associated with a significant reduction in recurrent pulmonary embolism or death in trials that also enrolled patients with major (haemodynamically unstable) pulmonary embolism…but not in trials that excluded these patients…"

Overall outcomes of patients with PE

96. Kopcke and others[15]. The conclusion drawn by the authors[16] was that the proportion of deaths caused by PE appears to be considerably lower than the widely published rate. The paper shows that in a hospital survey of 2007 and 2008 there were over 186,000 adult in-patient admissions and 2583 in-patient deaths. Of these deaths, five had a pre-mortem diagnosis of DVT or PE. Therefore, these five are the only ones who may have been treated for PE but did not survive. The authors pointed out that: "many hospital patients who die from pulmonary embolism have other severe life-threatening conditions." The deceased did not have any such conditions. Professor Empey conjectured that if, say, 450 of those patients had PE then five deaths would be a very small percentage. He said that in any event, a very small percentage of those treated in hospital die. The central

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[11] Anticoagulant drugs in the treatment of pulmonary embolism. A controlled trial. Lancet 1960; 1: 1309-1312.
[12] Natural history of venous thromboembolism. Circulation 2003; 107; I-22-I-30.
[13] 2014 ESC Guidelines on the Diagnosis and Management of Acute Pulmonary Embolism. European Heart Journal [2014] 35, 3033-3080.
[14] Thrombolysis compared with heparin for the initial treatment of pulmonary embolism. American Heart Association 2004; 110:744-749.
[15] JR Soc Med [2011]:104:327-331.
[16] They included Professor Hay.

problem with the paper is that we do not know the denominator, i.e the overall figure of those treated for PE in the hospital. Having considered all the expert evidence, the only conclusion which can be drawn is what Professor Hay agreed, namely that it looks as though it is only a very small percentage of people treated for PE that did in fact die.

97. Goldhaber and others[17]. This study concerned 101 patients aged 18 years or more who presented with signs of PE. PE was then confirmed. 24 hours after treatment with alteplase, patients had an absolute improvement in pulmonary perfusion of 14.6% compared to 1.5% improvement among those treated with heparin alone.

98. Doctor Gomez said that a 15% improvement is a really good outcome. He explained: "let's say you have five pulmonary arteries and one of them is blocked. You are measuring overall perfusion so then you have a 20 per cent reduction in perfusion, you have one-fifth gone. Thrombolysis effectively opens that artery; the best you can achieve is a 20 per cent improvement, yes. Here we have achieved 15 per cent."

99. Two points have to be addressed in relation to Goldhaber:

i) it deals with pulmonary perfusion, not life and death.

ii) the 15% improvement referred to in the text is 24 hours after administration of alteplase.

In relation to (i) i.e. pulmonary perfusion, it is accepted that this does not translate into the difference between life and death. What it does show is how alteplase works i.e. how it treats the clotting. In relation to (ii), the study estimated right-ventricular end diastolic area by planimetry from echocardiogram at baseline and three hours after the administration of alteplase. Figure 1 is a graph[18] which, according to Doctor Gomez, demonstrates that, three hours after the administration of alteplase, there had been a significant decrease in pressure, in circumstances where PE is responsible for increase in pressure. The measurement at three hours did not mean there would not have been improvement at one hour. He said that alteplase was very likely to be effective in less than three hours. This is why alteplase can be given in cardiac arrest; it can have an effect even then.

100. It was put to Doctor Gomez that these results were in haemodynamically stable patients, reference being made to table 1 - base line characteristics. This showed, for the patients given alteplase, that the mean blood pressure was 128/77. He said that this was a mean and that the pressure could have been dropping. Further he said: (a) that unless the patients deteriorated they would not have been prescribed alteplase (at least nowadays)[19], (b) in any event, the study shows that the alteplase breaks down the thrombus, whether the patient is haemodynamically stable or not.

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[17] Alteplase versus heparin in acute pulmonary embolism: randomised trial assessing right ventricular function and pulmonary perfusion. Lancet 1993: 341: 507-11.
[18] Right ventricular end-diastolic area (RVEDA) (cm^2) over time.
[19] I note that the paper in fact says that the patients were randomized when they were haemodynamically stable.

101. Doctor Gomez was of the opinion that the study assisted in showing that, if alteplase had been given three hours prior to death, the deceased would have survived.[20] Further, the deceased just had PE. Otherwise she was healthy. She had nothing wrong with her heart or blood.

102. Professor Hay made a number of qualifications as to what can be drawn from Goldhaber. He agreed that typically nowadays alteplase is given by way of a 50mg bolus at the onset, followed by two hours infusion[21]. Although he said it was difficult to be certain, he said that had Mrs Marshall developed shock and massive PE sometime in the night with enough time for alteplase to work, then it may well have been lifesaving.

103. Casazza and others[22]. This paper is a study of 1716 patients with confirmed acute PE in 47 Italian hospitals. It shows:

i) Of the 1716 patients, 11.7% i.e. 201 patients were haemodynamically unstable at presentation /diagnosis (abstract and table 3).

ii) table 3 further shows:

a) of those who were haemodynamically stable at presentation/diagnosis, death from PE was 1.4%.

b) of those who were haemodynamically unstable at presentation/diagnosis, death from PE was 23.3%.

iii) In unstable patients all-cause death[23] occurred in 62.7% of those with cardiac arrest at presentation, in 36.4% of those in cardiogenic shock and in 17% of those with isolated hypotension.

iv) A thrombolytic agent was administered to 185 patients (NB: this was fewer than those who were haemodynamically unstable on presentation/diagnosis). Doctor Gomez says the Italians follow the European standards definition of unstable and use of thrombolysis. It is, therefore, highly probable that all-or practically all-those who received alteplase were unstable on presentation/diagnosis, though some may have become so later.

v) 15 of the 47 deaths from PE in unstable patients died in 24 hours (32%) – see figure 2.

vi) 43% of the patients in the study were over 75 years old. "Age over 75, immobilisation lasting for more than three days before index PE and haemodynamic impairment were independent predictors for in-hospital

[20] He also said that there would be a beneficial effect in the period up to three hours. The study states: "most of the rt-PA patients' decease in right-ventricular end diastolic area occurred during the first three h."
[21] The patients in Goldhaber did not receive the initial bolus.
[22] Clinical features and short-term outcomes of patients with acute pulmonary embolism. The Italian Pulmonary Embolism Registry. Thrombosis research 130 [2012] 845-852.
[23] Not just death from PE.

deaths." (The deceased, when she would have presented at hospital, would not have fallen into any of those higher risk categories).

104. I will return shortly to the Casazza paper in relation to survival rate of people in cardiogenic shock or with cardiac arrest, and on question 4. Again, a number of points can be made about the statistics. Nevertheless, broadly speaking, had alteplase been prescribed, say, 3 hours earlier then 8.30 a.m, Mrs Marshall would probably have survived.[24]

105. That said, I have already found that it cannot be shown, on the balance of probabilities, that Mrs Marshall would have reached the threshold for prescription of alteplase at any stage prior to her going into cardiogenic shock.

Administration of thrombolysis in cardiogenic shock or with cardiac arrest

106. Returning to the Casazza paper on this point, the Claimant submitted:

a) Mrs Marshall would have had a more favourable outcome than the overall figure in the paper as she was not in a higher risk category and she was not unstable on presentation.

b) Even absent point (a) Mrs Marshall had a 64% chance of survival once she was in cardiogenic shock.[25]

c) In the light of point (a) she probably would have survived in hospital if she went into cardiac arrest.

107. Sekhri and others[26]. This paper says that early diagnosis is the key in the management of PE. It cites a 1994 paper on decision making in the surgical treatment of massive PE for the proposition that the interval from the onset of symptoms to death is relatively short. From that paper it is said that in patients with massive PE, 50% die within thirty minutes, 70% die within one hour and more than 85% die within six hours of the onset of symptoms.

108. In dealing with this, Professor Empey accepted it, but said that if a person was in hospital and treated then the risk of death would be very different.[27] His opinion was that the risk of developing massive PE in hospital was very low because of (a) having heparin which could reduce the size of the clot and (b) early thrombolysis. In addition to this, Mrs Marshall would have been constantly monitored as someone with suspected PE. Further, she did not have other risk factors for mortality such as being very elderly or having co-morbidity.

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[24] Only Professor Davies gave evidence seriously doubting this conclusion. However, in fairness to him, he said he had not really considered this point and was going off general impression and was open to correction.
[25] And 77% if haemodynamically unstable (i.e. including those meeting the threshold for alteplase though not in cardiogenic shock or with cardiac arrest).
[26] Arch Med Sci [2012]; 8,6:957-969.
[27] It may also be that the definition of a massive PE in the 1994 paper was different from that now adopted in Guidelines, namely haemodynamically unstable such that thrombolysis should be considered. There was evidence that doctors may use the term massive PE when describing its size and effect.

109. In any event, the actual findings in Table 1 in the Sekhri paper deal with in-hospital mortality according to the degree of haemodynamic compromise in 1001 patients with acute PE. It shows:

a) the mortality of 102 patients in cardiogenic shock (as defined) was 24.5%.

b) the mortality of 176 patients requiring CPR (cardio pulmonary resuscitation) was 64.7%. Professor Davies accepted that this group would include elderly people and others who had other pathology such as ischemic heart disease.

110. Sekhri also points out that, as a significant number of deaths occur within a few hours of the onset of symptoms, initial supportive treatment has a major role in the management of patients with massive PE. Professor Davies accepted that such support would include oxygen, electrolyte and fluid balance and preparedness to administer thrombolysis.

111. Sekhri (page 964) says: "thrombolytic therapy causes rapid lysis of clot," though it does not say how rapid. Nevertheless, in relation to the patients who survive cardiogenic shock (75.5%), and those who survived despite requiring CPR (35.3%), the intervention which would have saved them would have been thrombolysis. This led Doctor Gomez to say that the papers show that if a person is in cardiogenic shock, thrombolysis would probably work so as to save them. If they had progressed to cardiac arrest so as to require CPR, it probably would not. In both cases some of those who died in the study may not have had the advantage of being in a hospital. In the deceased's case it was relevant that she had responded well to thrombolysis when she was treated in Edinburgh.

112. It is to be recalled that there is a broad similarity of the figures in Sekhri and Casazza. Thus in Casazza 64% of these in cardiogenic shock survived and 37% of those in cardiac arrest survived. In the Claimant's favour:

a) These figures include people who were in cardiogenic shock or with arrest on presentation at hospital.

b) 43% of those in the Casazza study were over 75. The deceased was not in that category. Nor was she suffering from co-morbidity.

113. Why should the deceased not be in the 64%-75% who survived cardiogenic shock in these two papers? One unknown factor is how long the surviving patients were in cardiogenic shock. The evidence before me was that the duration of such shock is very variable[28]. Further, although precise timing is not available, alteplase takes time to work. Although there are case reports purportedly showing it working very rapidly[29], these cannot be relied upon as being of general application.

114. The Defendant submits that it would not have worked because Mrs Marshall was in cardiogenic shock for only a couple of minutes or so. This is in fact what

[28] Professor Davies said it was 'as long as a piece of string'. I return to this point on Question 4 below.
[29] See below.

happened. What we do not know is what the duration of cardiogenic shock would have been had Mrs Marshall spent the night in hospital. Her clot would probably have been about 5% smaller. Perhaps the embolus would have been more than 5% smaller, and she would have been monitored throughout. Depending on where and how she went into cardiogenic shock, she would have had almost instantaneous treatment from trained staff on the ward and the crash team would have arrived very quickly. There is also the fact that she survived after a period of about one-hour cardiogenic shock in Edinburgh.

115. Looking at the evidence on cardiogenic shock in isolation, I find that:

i) The Claimant cannot prove on the balance of probabilities that the deceased would have been in the 64-75% who would have survived; she may or may not have been.

ii) Nevertheless, her chances of survival would have been significantly increased had she been in hospital overnight and at the time she became haemodynamically unstable.

116. As to the position with cardiac arrest, the Claimant submits that, because of the fact that she was relatively young and had no comorbidity, she probably would have survived with high quality CPR in hospital, and therefore have been in the group of 35% (Sekhri) – 37% (Casazza) who do not die. In my judgment, whilst this is a possibility, it is less likely than her chances of surviving cardiogenic shock – itself not a probability.

117. Two other papers were relied upon by the Claimant. These were Kurkciyan and others[30] and Laher and others[31]. The Kurkciyan Paper is a retrospective study. Only the abstract was put in evidence. Professor Empey said that the only conclusion he drew from the papers was that cardiac arrest following PE was associated with high mortality but that some people survived. The papers show high mortality. In Kurkciyan 90% of such patients died (19/21), albeit that 81% had circulation re-established with thrombolysis, compared to 43% who were not treated with thrombolysis. Laher is a case study of a man who received alteplase when he had arrested and who was receiving high quality CPR. The alteplase in his case worked quickly despite the authors noting "…outcomes after cardiac arrest following PE are generally dismal." Laher refers to other papers evidencing that cardiac arrest following PE has an associated mortality of 70% within the first hour of presentation and an overall mortality of up to 95%. Approximately 90% of episodes of cardiac arrests occur within one-two hours after the onset of symptoms of PE. In considering other literature, the Laher paper said that overall there is a lack of good data supporting the use of thrombolysis in CPR, though major societal bodies have recommended its use when PE is either known or suspected as the cause of cardiac arrest. A meta-analysis which included patients with PE as a cause of cardiac arrest concluded that fibrinolytic therapy was associated with an increase in return of spontaneous circulation, survival to hospital discharge and better long term neurological outcomes.

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[30] Arch Intern Med [2000] May 22; 160 (10): 1529-135
[31] Hindawi Case Reports in Emergency Medicine Volume 2018 Article ID 8076808.

118. In Wu and others[32] there is a case report of a 70-year-old man with sudden cardiac arrest who failed to return to spontaneous circulation after a 100 minute CPR. Then a rescue thrombolytic alteplase saved his life since he was highly suspected to have PE. Approximately two minutes after the alteplase infusion, stable continuous circulation was achieved. This paper demonstrates the possible effects of alteplase in one case. Professor Davies said that it was an exceptional case. I accept that it was probably exceptional. That may well be the reason it was reported. The same goes for Laher, the other case study.

119. Professor Empey's opinion was that if a patient is in hospital and suddenly develops a massive PE leading to cardiac arrest then there is a chance, on balance a probability, of survival, because of the speed of CPR and the fact that the quality of resuscitation will be better. He says he believes that those who do survive the cardiac arrest following a massive PE are those who are in hospital.

120. Whilst it is very likely to be the case that most of those who do survive cardiac arrest following a massive PE are those who are in hospital, I cannot find on the literature that there is a probability of survival following an arrest in hospital. Had the arrest occurred in hospital it was common ground in the joint statement that the deceased would probably have been given alteplase and that CPR would probably have continued for 90 minutes. Professor Hay said that the 90 minutes in the Southend policy was a theoretical construct for alteplase to have a chance of working. Although Professor Empey believed that the deceased would have survived cardiac arrest had she been in hospital, and although I accept that her chance of survival would have been better, I cannot find that she probably would have survived.

Criticism of the medical experts

121. Before I consider question 4, I wish to comment on some criticisms made of the experts. Both parties asked questions exploring whether the medical experts had approached the issues perhaps with something less than complete independence.

122. In Professor Empey's case there was the fact of the inconsistencies and change of opinion in his report, the joint statement and his oral evidence concerning whether it was more likely that the deceased was continuing to form PE overnight, thereby leading to an accumulation of PE which led to her demise, or whether the clot in the leg became detached shortly prior to death.

123. Professor Davies conceded a number of points. For example:

i) in his Report at paragraph 7.3.2 he said: "any intervention carried out after 17:00 hours to 19:00 hours on the 25th April 2014, on the balance of probability, would not have affected the final outcome." He was asked why he did not consider alteplase. His reply was that thrombolytic therapy was not indicated.

[32] Good neurological recovery after rescue thrombolysis of presumed pulmonary embolism despite 100 minutes of CPR. J Thoracic Dis.2014; 6(12): E289-E293.

ii) Professor Davies' response was similar in respect of his statement at paragraph 5.12 of his Report that "nothing could probably have prevented the clot from suddenly dislodging and travelling through the venous system…". Again, he said that alteplase was never indicated in this lady whether hypothetically or in fact.

iii) In answer to the question in the joint statement what the diagnosis should have been on attendance at the A&E department, Professor Davies said he "suspected small to medium pulmonary embolism." He accepted that the actual diagnosis would be pulmonary embolism. He said he was emphasising that there was nothing big causing haemodynamic problems.

iv) In the joint statement when asked what was the probable cause of the deceased's symptoms when she attended the appointment with the Defendant he replied, "on the balance of probabilities, and with the wisdom of hindsight, her symptoms were caused by pulmonary embolism." He was asked about the words "with the wisdom of hindsight". He said he used that expression because we are now sure of the diagnosis because of what happened later. He accepted that the words add nothing to the diagnosis.

v) In respect of the question in the joint statement on the Wells score (question 5), Professor Davies said that it would be "at least 4.5 and possibly higher, i.e. at least moderate risk of PE." He accepted that the words "moderate risk" were a hang-over of a previous text.

124. Professor Davies also accepted that looking at some of the above responses an independent observer might think that he was "playing things down".

125. Having considered all these matters, I do not accept that any of the experts were less than independent in their evidence.

Question 4. On the evidence as a whole, is it more likely than not that the Claimant would have survived had she been referred to Southend Hospital?

126. I was taken to the case of *Vaile v London Borough of Havering*[33]. The circumstances of this case are that a special needs child X assaulted a teacher causing her injury. The Court of Appeal reversed the first instance decision and found that the Defendant had failed in its duty to provide the Claimant with a safe system at work. As to causation, the Defendant submitted that the Claimant could not show what, if anything, might have been done which could have prevented the assault. The Court of Appeal, relying upon *Drake v Harbour*[34] said at paragraph 32:

> "It may be difficult for Mrs Vaile to show precisely what she or the school could have done to avoid the incident if she had been appropriately instructed in suitable techniques for dealing with ASD children but the probability is that, if proper care had been

[33] [2011] EWCA Civ 246
[34] [2018] EWCA Civ 25

> taken over the relevant three year period, she would not have met the injury she did."

127. In the case of *KA v East Midlands Ambulance Service NHS*[35] Mitting J referred to the case of *Wright*[36]. In *KA* at paragraph 51 the learned judge said that if a defendant is found to be in breach of duty and to have caused injury seeks to avoid the consequences of those findings by showing that the injury would in any event have occurred, then the Defendant must prove it. The Claimant in the present case accepts that the finding there was that causation had been made out. However, reliance is placed on what was said by Mitting J at paragraph 51 a little earlier, as being useful dicta. He said:

> "… the Claimants have proved all that they need to prove to establish their case. To require them in addition to assume the burden not merely of proving a negative, but a negative based on contingencies which are, at the outset of forensic enquiry, unknowable, is unreasonable and unjust."

128. I find the authorities of limited assistance here. As is accepted, the Claimant has the burden of proving causation.[37] Yet the Claimant needs to prove no more than that Mrs Marshall would have probably have survived had she been admitted to hospital. The Claimant does not need to prove the precise mechanism by which her survival would have been achieved.

129. There has been very detailed evidence from four experts dealing with the probabilities of what did happen and what would have happened, absent the negligence. I must deal with causation on the facts of the case and analysis of the expert evidence in conjunction with the medical literature.

130. In the Claimant's final submissions it was stated:

> "26. There are many individual possible factual scenarios (some of which may in fact amount to probabilities on the evidence within the overall hypothetical scenario of Mrs Marshall's admission to hospital on the evening of 25th April 2014. These include[38]…
>
> 27. On several of these scenarios the Claimant would have been treated with thrombolytic therapy in the form of alteplase that would have been effective.
>
> 28. The Claimant need not 'choose' from one of these competing counterfactual scenarios in order to make out causation."

131. The submission then deals with the defendant's case that Mrs Marshall presented as normotensive with a diagnosis of PE and went onto develop a massive PE.

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[35] [2015] EWHC 3930 (QB)
[36] [2013] QB 312
[37] See Bolitho v City and Hackney Health Authority [1998] AC 232 at 239f-g
[38] They were then set out. I have re-modelled them below to take account of my findings so far.

132. I have made a number of findings of the balance of probabilities. Some, though not all, of these are "close calls", often based on trying to assess the hypothetical situation of the deceased having been admitted to an acute medical ward.

133. The first is that Mrs Marshall would not have responded to heparin treatment alone in terms of her life being saved. However, heparin would have restricted the size of the clot to perhaps 95% of its eventual size. There would therefore have been less fresh clot to embolise. If the size of the embolus had been slightly smaller, that might have had an effect on the course of events. The smaller the PE, the more likely it is that deterioration (e.g. from cardiogenic shock to cardiac arrest) might be slower. Thrombolysis would also have had to deal probably with a slightly smaller embolus. There is a possibility that the embolus may not therefore have completely cut off the blood flow.

134. The second is the matter of assessment of RV function. Professor Hay said that on admission an ECG would have been done. On balance it would not have found RV dysfunction. This was based on table II in the Sekhri paper. The table shows that by averaging data from three other papers, the percentage of normotensive patients with acute PE who have RV dysfunction was 34%[39]. The Claimant said it is difficult to extrapolate from this table since Mrs Marshall died and therefore would more likely have had RV dysfunction. The text of the Sekhri paper shows that in patients with normal blood pressure and no signs of cardiogenic shock on presentation, RV dysfunction provides indirect evidence of severe pulmonary artery obstruction and impending haemodynamic failure. Further, Professor Hay's opinion was based on the premise that the deceased did not deteriorate until the next morning and therefore would not have had RV dysfunction on initial presentation had she gone to hospital. Looking at Sekhri, and the fact that I have found that the Claimant cannot prove that there was probably any significant deterioration until the next morning, the probabilities are that Mrs Marshall would not have had RV dysfunction on initial presentation. If that is correct, then I accept Professor Hay's further evidence that, unless the hospital had been monitoring her ECG continuously, they would not have picked up any RV dysfunction. However, these findings need to be elaborated upon in this way:

a) It is a possibility that there was significant deterioration whilst the deceased was asleep. It is therefore a possibility also that she had RV dysfunction on initial presentation.

b) If she did have RV dysfunction on initial presentation, that would have been picked up on an ECG. If she had developed RV dysfunction during the night then it is also a possibility (not a probability) that in Southend Hospital there would have been continuous ECG monitoring which would have picked up the deterioration. There is no evidence one way or the other on this.

c) Therefore, it is possible that the deceased had RV dysfunction at the time when she would have presented at hospital and/or that she had a

[39] Professor Hay worked it out as 29%, but it appears he made an arithmetical error.

deterioration leading to RV dysfunction later that evening/the next morning and that, if so, it might have been detected.

d) If either of those possible events had been the case, it must not be forgotten that according to Sekhri, RV dysfunction provides indirect evidence of severe pulmonary artery obstruction and impending haemodynamic failure. This would have been significant in terms of monitoring/potential treatments.

135. The third is that, although a difficult decision, I have found that the Claimant cannot prove on the balance of probabilities that Mrs Marshall would have been found to be hypoxic on arrival at hospital. If she had been, there was the evidence from Professor Empey that this is a sign that something very serious was going on.

136. The fourth is that it is a possibility that there was a gradual build-up of PE in the lungs which would have led to hypoxia and/or haemodynamic instability being detected much earlier than when the deceased collapsed. If so, she may well have been given alteplase in time for it to work and so avoid the death.

137. The fifth is that, although small PE accumulating during the night would not, according to Professor Hay, have caused significant drop in blood pressure, if there had been something more than that and blood pressure had dropped significantly though not to the alteplase threshold, the deceased would have been very carefully monitored and alteplase would have been probably available at the bedside.

138. The sixth is that the Claimant cannot show that the deceased would have been probably in the cohort of those who would have survived cardiogenic shock or cardiac arrest. Nevertheless, she would have had a possibility of surviving the latter and a greater possibility of surviving the former. Further, in relation to the length of cardiogenic shock, Doctor Gomez said that would be influenced by the supporting treatment given in hospital, namely the supportive care, the oxygen monitor, the blood pressure support and the expert nursing care. He said that earlier supportive measures are a very important part of the treatment. This has to be seen in the context also that the deceased recovered in Edinburgh, despite being in cardiogenic shock, when that shock lasted for something in the region of an hour.

139. All these possibilities set out in closing submissions have been individually assessed on the evidence. There cannot be an inference, much less a finding, merely on the basis that a number of possibilities amount to a probability that death would have been avoided. That said, this concentration on each possible stage of what would have happened where much is uncertain and difficult to resolve, must be considered against some important overall evidence.

140. Overall most people do not die of PE when they are in hospital. The deceased was not very elderly and had no comorbidity. In addition, Professor Empey said that his experience and that of many of his colleagues is that once a patient is admitted to hospital, properly assessed and given the appropriate treatment: heparin, oxygen, monitoring and other observations they do not die. It is very,

very unusual. Similarly, Doctor Gomez said that he would have fully expected the deceased to survive because of the package of care that would be given to her.

141. The Claimant's case was that despite the statistics in the literature, to find for the Defendant, the court would need to accept the scenario that Mrs Marshall, having initially presented as normotensive with a diagnosis of PE, would have gone on to develop a massive PE whose onset and progress would have been so sudden as to be undetectable and irreversible. In other words that what did happen would have probably happened in any event. It was said that such counterfactual scenario is not described anywhere in the literature adduced at trial. Also, that it is statistically unlikely and based on the factual fallacy that the embolus or emboli would have been as big – or almost as big – as the embolus or emboli that did in fact embolise at home in the absence of treatment.

142. As to this submission:

a) There is nothing unlikely about a large embolus forming from a large clot.

b) The clot itself would have been, had heparin been prescribed, 95% approximately of the size that it was on the morning of 26th April 2014.

c) According to Professor Hay, and I accept, most of the clot would have embolised.

d) While fresh clot is more likely to embolise than old clot, none of the clot was very old. It had all formed within a week to ten days. Probably, according to Professor Hay, most of the clot that was above the knee had embolised, there being no clot in the thigh and pelvis.[40]

e) Therefore, I do not find it necessarily fallacious that the embolus which embolised at home was as big, or almost as big, as what would have embolised in hospital.

f) The fact that this is not described anywhere in the literature adduced at trial does not assist the Claimant. The literature does not deal with this question. Yet Professor Hay said that is absolutely typical that a person can get up, move about and have a massive PE and die on the toilet.

g) Nevertheless, for the Claimant to fail, looking at the case overall it needs to be at least equally likely that the deceased would have died in any event, not for death to have been just a possibility.

143. The Claimant also submits that the court must be careful to avoid deciding matters on the basis that what would have happened to Mrs Marshall, had she been referred to hospital, should be by reference to what did in fact happen to her at home. At home she was untreated, unmonitored and did not have the attention and assistance she would have received in hospital. This is a valid point.

[40] According to Professor Hay below knee DVT is much less ready to embolise. Most PE come from clot above the knee.

144. This overall evidence, much of which has already been set out, can be summarised as follows:

i) The expert evidence:

a) Professor Empey said that it was his experience, and the experience of many of his colleagues in general medicine and chest medicine, that once a patient is admitted to hospital, properly assessed and given the appropriate treatment, they do not die. He said it was "very, very, very unusual". He went on to say that he had had only one patient under his care who actually died, in spite of completely standard treatment, having come into hospital with a pulmonary embolism. Even that was 8 days after they were initially admitted.

b) Doctor Gomez said that when he first looked at the case, his overriding impression was that if this lady had turned up in his hospital or indeed any hospital in the UK, haemodynamically stable, with a PE in the evening, he would have been extremely disappointed if she had died the next morning. He would fully expect her to have survived because of the package of care given to her.

c) As stated above, Professor Hay said that it is absolutely typical that when a person has a massive PE they may die on the toilet. He said it was one of the things that you learn as a medical student. This may well be so, but it tells us little about the risk of death from a massive PE if a patient is admitted to hospital. Indeed, it would be seen from the statistical evidence, to which I now turn, that that absolutely typical event does not appear to translate into many deaths in hospital.

ii) The evidence in the literature

(a) Casazza: 1716 patients with confirmed acute PE presenting at 47 different hospitals in Italy were considered. The overall death rate from PE was as low as 3.9%. Of those who were haemodynamically stable at presentation only 1.4% died. Mrs Marshall was haemodynamically stable at presentation on the agreed evidence. It may be said that she may have become haemodynamically unstable faster than a number of people in the Casazza study. However, for the reasons given in paragraph 40(iv) above, this is unlikely. In any event, even of those who were haemodynamically unstable at presentation only 23.3% died. Further, as already noted, Mrs Marshall did not have a number of the risk factors for in hospital death such as being aged over 75[41], immobilisation lasting more than three days before index PE and haemodynamic impairment[42].

[41] 43% of the patients in the Casazza study were over 75 years old.
[42] In this study on presentation.

(b) Sekhri: table 1 deals with in-hospital mortality according to the degree of haemodynamic compromise in 1001 patients with acute PE. It shows:

• RV dysfunction, no arterial hypotension 8.1%

• Arterial hypotension 15.2%

• Cardiogenic shock 24.5%

• CPR 64.8%

It is not clear at which stage the patients referred to presented with these four stages of deterioration i.e. whether they came to hospital with them, or whether they developed them in hospital. I have already found that, on the probabilities, Mrs Marshall would not have had RV dysfunction or arterial hypotension at the time she would have arrived at hospital, or for a substantial number of hours thereafter. Further, even at home she did not go into cardiogenic shock or require CPR until about 8.30 a.m. the following morning. On that basis she was probably in a sub-group with a better outcome statistically than those with RV dysfunction who had a mortality rate of 8.1%. If this is correct then her chances of survival would have been well over 90% statistically had she gone to hospital.

(c) Kopcke: I have reviewed this paper above. I have accepted that there are a number of variables in it, but it is a proper conclusion to draw that only a very small percentage of people treated in hospital for PE do in fact die.

145. Thus the expert medical evidence to which I have referred and the statistical evidence demonstrate that at the time when Mrs Marshall should have presented at hospital, anybody rating her chances of survival would have put them at being very high. Tragically, she did in fact die out of hospital. In the situation which occurred, detailed analysis of such evidence as we have cannot lead the court to find that by such and such a mechanism, or at any particular stage, the course of events would probably have been different. This is overwhelmingly because of a large number of unknowns.

146. The court, in looking at the evidence as a whole, must take a common sense and pragmatic approach to that evidence, in circumstances where it is equivocal. The court must also be wary of relying on the statistical evidence in the literature which has a number of variables. Had the statistical evidence, in conjunction with the expert evidence, have led to the conclusion that Mrs Marshall's chances of dying would have been assessed on presentation as only slightly better than 50-50, I would have found for the Defendant. However, the above evidence of Professor Empey and Doctor Gomez, in conjunction with the medical literature,

drives me to the conclusion that on the clear balance of probabilities she would have survived.

147. For those reasons I find for the Claimant on the issue of causation.