Cite this article as: BMJ, doi:10.1136/bmj.37985.371343.EE (published 27 January 2004)

Papers

Should surgeons take a break after an intraoperative death? Attitude survey and outcome evaluation

Antony R Goldstone, Christopher J Callaghan, Jon Mackay, Susan Charman, Samer A M Nashef

Abstract

Objectives To investigate attitudes of cardiac surgeons and anaesthetists towards working immediately after an intraoperative death and to establish whether an intraoperative death affects the outcome of subsequent surgery.
Design Questionnaire on attitudes to working after an intraoperative death and matched cohort study.
Setting UK adult cardiac surgery centres and regional cardiothoracic surgical centre.
Participants 371 consultant cardiac surgeons and anaesthetists in the United Kingdom were asked to complete a questionnaire, and seven surgeons from one centre who continued to operate after intraoperative death.
Main outcome measures Outcome for 233 patients operated on by a surgeon who had experienced an intraoperative death within the preceding 48 hours compared with outcome of 932 matched controls. Hospital mortality and length of stay as a surrogate for hospital morbidity.
Results The questionnaire response rate was 76%. Around a quarter of surgeons and anaesthetists thought they should stop work after an intraoperative death and most wanted guidelines on this subject. Overall, there was no increased mortality in patients operated on in the 48 hours after an intraoperative death. However, mortality was higher if the preceding intraoperative death was in an emergency or high risk case. Survivors operated on within 48 hours after an intraoperative death had longer stay in intensive care (odds ratio 1.64, 95% confidence interval 1.08 to 2.52, P = 0.02) and longer stay in hospital (relative change 1.15, 1.03 to 1.24, P = 0.02).
Conclusion Mortality is not increased in operations performed in the immediate aftermath of an intraoperative death, but survivors have longer stays in intensive care and on the hospital ward.

Introduction

A survey of Welsh consultant orthopaedic surgeons highlighted the lack of consensus about working after an intraoperative death.[1] The survey arose after an inquiry was conducted into the intraoperative deaths of two patients on the same elective surgical list. Expert witnesses advised that after an intraoperative death surgeons should cease operating that day. Sheriff Albert Sheehan recommended that the Scottish Royal Colleges and the Scottish Intercollegiate Guidelines Network consider whether guidelines or advice were needed.[2] As yet, no guidelines have been produced (personal communication, Royal College of Surgeons of Edinburgh and Scottish Intercollegiate Guidelines Network).

In the Welsh study only one of the 16 orthopaedic surgeons who had experienced a patient's intraoperative death decided to cancel further operations that day.[1] Given the differences between cardiac and non-cardiac surgery, Briffa has suggested that cardiac surgeons may behave differently.[3] Many anaesthetists feel that intraoperative death affects them equally, if not more so.[4]

We explored and compared the attitudes of cardiac surgeons and anaesthetists to working after an intraoperative death. We also sought to determine whether an intraoperative death has an adverse effect on subsequent operations by the same surgeon.

Methods

Questionnaire study

We compiled a database of UK adult cardiac surgery centres using the National Adult Cardiac Surgical Database.[5] Hospitals were telephoned and asked to supply the names of all consultant cardiac surgeons (n = 198) and anaesthetists (n = 288). An anonymous postal questionnaire was designed to establish information about experiences of intraoperative deaths, factors influencing the decision to stop working after an intraoperative death, and opinions on proposed guidelines for working after an intraoperative death.

Outcome study

Papworth Hospital prospectively collects data on patient demographics, risk profile, operation details, and outcome in a dedicated database. All patients are stratified for risk with the Parsonnet[6] and EuroSCORE[7] models. There were 81 intraoperative deaths in five years during operations carried out by all seven surgeons. Whenever a surgeon had an intraoperative death, we identified all operations carried out by that surgeon within 48 hours after the death (233 cases) and matched them with four control patients by surgeon, year, and type and priority of surgery (932 controls).

Analysis

We summarised patients' demographics and preoperative and intraoperative data using means (SD) or medians (interquartile range) if the data were skewed. To assess whether the groups (cases and controls) were balanced in these measures, we entered each one separately into a conditional logistic regression model and assessed significance by the likelihood ratio test. Bypass time, cross clamp time, and preoperative creatinine were log transformed before analysis. As we could not find suitable transformation for EuroSCORE or Parsonnet we categorised these data (EuroSCORE 0-2, 3-5, ≥ 6; Parsonnet 0-4, 5-9, 10-14, 15-19, ≥ 20) before analysis.

Conditional logistic regression was also used to compare the mortality in the cases and the controls. The results are expressed as odds ratios (95% confidence intervals). Significance was assessed with the likelihood ratio test. To assess whether the odds ratios between subgroups were different, we entered an interaction term into the model and tested it using the likelihood ratio test.

We categorised stay in intensive care into two groups (≤ 1 day or >1 day) and used conditional logistics regression to determine if there was a difference between cases and controls. Results are expressed as odds ratio (95% confidence intervals) for prolonged stay. We log transformed hospital stay and used linear regression, allowing for clustering on the matching set, to determine if there was a difference between cases and controls. Significance was determined by the Wald test. Results are expressed as a relative (cases *v* controls) change in hospital stay (95% confidence intervals).

Results

Questionnaire

In total, 371 (76%) consultants returned completed questionnaires, reflecting 3463 consultant years of experience (table 1). They reported an estimated 3672 intraoperative deaths, and 70% experienced an intraoperative death at least annually. The anaesthetists had been consultants longer than the surgeons (P = 0.02). More surgeons (53%) than anaesthetists (22%) had stopped working for the rest of the day after an intraoperative death (P < 0.01), though factors influencing the decision to stop were similar in both groups, with fatigue being the most important consideration. Similar proportions of surgeons (27%) and anaesthetists (26%) thought they should stop working after an intraoperative death. Most surgeons and anaesthetists wanted guidelines (54/27/19% and 52/23/24% for/against/neither, respectively). Both groups agreed that guidelines should differentiate between elective and emergency cases, and likely versus unexpected deaths. Anaesthetists were more likely to want guidelines to cover junior medical staff and other operating theatre staff. Only 29% of surgeons and anaesthetists believed that an intraoperative death adversely affected their subsequent ability to work.

Outcome study

Preoperative assessment of risk was missing in only six cardiac patients. There was no difference in case mix, age, sex, EuroSCORE, or Parsonnet score between cases and controls (table 2). Mortality and results are shown in table 3. Overall there was no difference (P = 0.83) in mortality between the cases (7.7%) performed after unselected intraoperative deaths and controls (7.9%).

Cases after an intraoperative death during emergency surgery had a higher mortality than their controls (odds ratio 1.34, 95% confidence interval 0.66 to 2.70), whereas those cases after an intraoperative death during elective surgery had a lower mortality than their own controls (0.69, 0.29 to 1.95). The difference in these odds ratios was not significant (P = 0.29). Similarly there was a higher mortality in cases after intraoperative death during high risk surgery compared with those after low risk surgery (1.22 *v* 0.67), but again this difference was not significant (P = 0.41).

Data on total hospital stay and intensive care unit stay were available for 1135 and 1110 patients, respectively. The median number of days (interquartile range) in intensive care unit was 0.85 (0.64-1.4) and 0.82 (0.16-1.1) for the cases and controls, respectively. Of the cases, 72 (32%) patients stayed more than a day in the intensive care unit whereas 248 (28%) of the control patients had a prolonged stay (1.8, 1.2 to 2.7; P = 0.003). Among survivors only, the odds ratio for prolonged intensive care unit stay was 1.6 (1.1 to 2.5, P = 0.02). The median (interquartile range) hospital stay (days) among the cases and controls was 8.8 (6.0-14) and 8.8 (5.9-14), respectively (P = 0.08). However, the surviving patients operated within 48 hours of an intraoperative death also had significantly longer hospital stays (P = 0.02; relative change 1.15, 1.03 to 1.24) than their matched controls.

Table 1 Summary of responses to questionnaire on intraoperative deaths sent to all UK consultant cardiac surgeons and anaesthetists. Figures are numbers (percentages) unless stated otherwise*

	Surgeons	Anaesthetists	P value†
Responses	154 (78)	217 (76)	0.63
Mean years since appointment	8.6	10.5	0.02
Intraoperative deaths/consultant/year	0.95	1.01	
Never encountered intraoperative death	20/140 (14)	11/205 (5)	<0.01
Stopped working after intraoperative death	71/153 (53)	44/203 (22)	<0.01
Factors influencing decision to stop working after intraoperative death			
Fatigue	137/148 (93)	193/206 (94)	0.88
Emotion	119/150 (79)	159/205 (78)	0.92
Medicolegal concerns	97/144 (67)	144/201 (72)	0.38
Advice of surgeons	134/147 (91)	173/202 (86)	0.21
Advice of anaesthetists	130/146 (89)	188/203 (93)	0.26
Advice of managers	80/145 (55)	129/204 (63)	0.15
Reports in literature	97/144 (67)	146/201 (73)	0.28
Guidelines should:			
Differentiate between elective and emergency cases	79/119 (66)	105/186 (56)	0.10
Differentiate between likely and unexpected intraoperative deaths	87/119 (73)	139/186 (75)	0.80
Apply to all surgical specialties	88/119 (74)	141/185 (76)	0.80
Guidelines on continuing to work after an intraoperative death should apply to:			
Consultant surgeons	98/143 (69)	138/192 (72)	0.64
Junior surgical staff	70/139 (50)	133/191 (70)	<0.01
Consultant anaesthetists	89/141 (63)	135/193 (70)	0.21
Junior anaesthetic staff	59/137 (43)	133/190 (70)	<0.01
Perfusionists	52/137 (38)	107/191 (56)	<0.01
Nursing staff/operating department practitioners	61/139 (44)	111/192 (58)	0.02

*Denominators for percentages represent non-blank responses.
†P<0.05 considered to be significant. Proportions compared with Pearson's χ^2 test and time since appointment was compared with Student's *t* test.

Discussion

Most consultant cardiac surgeons and anaesthetists are in favour of guidelines but want to continue operating after an intraoperative death, particularly when the death occurs in high risk or emergency cases. As Briffa suspected,[3] a higher proportion of cardiac surgeons than orthopaedic surgeons have stopped working for the rest of the day after an intraoperative death.

Mortality and morbidity

It has been assumed that an intraoperative death adversely affects a doctor's ability to work, but we were unable to identify prior work on this subject. We believe that our study is the first investigation of the outcome of operations performed after an intraoperative death. Overall cardiac surgical mortality at

Table 2 Profile of patients operated within 48 hours of an intraoperative death (cases) and matched controls

	Intraoperative deaths (n=81)	Cases (n=233)	Controls (n=932)	P value*
Mean (SD) age (years)	65 (13)	66 (9)	64 (11)	0.08
Proportion of men (%)	62	75	76	0.50
Median (IQR) bypass time (mins)	158 (100-242)	83 (63-109)	77 (59-101)	0.17
Median (IQR) cross clamp time (mins)	81 (45-133)	46 (36-65)	44 (34-61)	0.15
Mean (SD) height (m)	1.69 (0.12)	1.69 (0.10)	1.71 (0.10)	0.19
Mean (SD) weight (kg)	77 (15)	77 (13)	79 (13)	0.21
Mean (SD) blood pressure (mm Hg)	129 (39)/71 (22)	135 (23)/74 (13)	134 (21)/74 (13)	0.27
Median (IQR) serum creatinine (μmol/l)	109 (96-150)	108 (96-123)	106 (96-119)	0.60
Mean (SD) haemoglobin (g/l)	120 (25)	130 (15)	130 (15)	0.37
Median (IQR) EuroSCORE	8 (5-11)	4 (2-6)	4 (2-6)	0.26
Median (IQR) Parsonnet	22 (10-38)	8 (3-16)	8 (3-15)	0.21

IQR=interquartile range.
*P values refer to cases *v* controls.

Table 3 Mortality in patients operated within 48 hours of intraoperative death compared with matched controls

	Mortality			
Case group	**No (%) of cases**	**No (%) of controls**	**Odds ratio (95% CI)**	**P value**
Primary analysis				
Within 48 hours of:				
All intraoperative deaths	18/233 (7.7)	73/932 (7.9)	1.06 (0.60 to 1.90)	0.83
Intraoperative death during elective surgery	5/85 (5.9)	29/340 (8.5)	0.69 (0.24 to 1.95)	0.29
Intraoperative death during emergency surgery	13/148 (8.8)	43/592 (7.3)	1.34 (0.66 to 2.70)	
Subgroup analyses				
Within 24 hours of all intraoperative deaths	8/132 (6.1)	52/528 (9.8)	0.56 (0.24 to 1.29)	0.17
Within 12 hours of all intraoperative deaths	5/60 (8.3)	22/240 (9.2)	1.03 (0.36 to 2.99)	0.95
Cardiac surgery only, within 48 hours of:				
All intraoperative deaths	14/183 (7.7)	59/732 (8.1)	1.02 (0.53 to 1.95)	0.95
Intraoperative death during low risk surgery (EuroSCORE <6)	3/55 (5.5)	19/220 (8.6)	0.67 (0.18 to 2.39)	0.41
Intraoperative death during high risk surgery (EuroSCORE ≥6)	11/128 (8.6)	40/512 (7.8)	1.22 (0.57 to 2.60)	

Papworth Hospital is currently 3.18% and 1.42% after elective surgery. Mortality in this study was high in all groups. This is because of clusters of high risk and emergency cases. Many intraoperative deaths occur during emergency surgery, and subsequent operations by the same surgeon may fall within the 24-72 hour on-call period and are therefore more likely also to be high risk or emergency operations.

We have shown that mortality is no higher in operations performed in the immediate aftermath of an intraoperative death. However, lengths of stay in intensive care and in hospital, as a surrogate for morbidity, seem to be adversely affected in patients operated on after an intraoperative death. This finding suggests that surgical performance may indeed be affected by intraoperative death and supports the recommendation that surgeons should not operate in the immediate aftermath of intraoperative death. The impact of introducing such a policy on cost and throughput must be assessed. Both surgeons and anaesthetists would welcome guidance in this issue.

Which type of intraoperative death affects subsequent outcome?

Our questionnaire revealed a commonly held view that an unexpected intraoperative death in a low risk or elective operation should be taken as a stronger indication to "down tools" for a period than intraoperative death in a high risk or emergency operation.[8] Our findings suggest the opposite: all indicators are that performance is more adversely affected by an intraoperative death during high risk or emergency surgery. This is a consistent but perplexing finding that is worth exploring further.

There are two possible reasons for an adverse effect on surgical performance after intraoperative death: the team is psychologically and emotionally upset and the team is physically tired. It can be argued that the former is more likely after death during elective or low risk surgery and the latter is truer after death during emergency, high risk surgery. Our study indicates that surgeons may be more affected by the latter. Another explanation could be that death during elective or low risk surgery, by its unexpected nature, leads to re-evaluation of safety measures, extreme caution, and circumspection in subsequent operations. Such effects are less likely after a high risk or emergency operation in which death may have been a more expected outcome.

Limitations

It would be difficult to carry out a randomised trial in which patients would have to give informed consent to be operated by a surgeon who has just "lost" a patient. Our study is limited by its design, but we have attempted to minimise bias as much as possible by matching on five important variables. There was clearly no difference in the mortality over all surgery, and our subgroup analyses had limited power to detect clinically important differences. Odds ratios comparing outcome after death during elective surgery with death during emergency surgery should be treated with caution as the confidence intervals are wide. Intraoperative death is fortunately rare in all surgical specialties, and cardiac surgery is probably more likely to show an effect than others.

Guidelines

There was a clear desire among surgeons and anaesthetists that any guidelines should differentiate between elective and emergency cases, and likely versus unexpected deaths, although our study shows that the effect on outcome after these cases may

What is already known on this topic

There is a lack of consensus about whether a surgical team should continue working after an intraoperative death

Anaesthetists, and others, feel this issue affects them equally

There is currently no evidence to suggest an adverse outcome if a surgeon continues operating after an intraoperative death

What the study adds

Most cardiac surgeons and anaesthetists do not believe that intraoperative death adversely affects their performance, but would welcome guidelines

Intraoperative death adversely affects morbidity in patients operated by the same surgeon in the subsequent 48 hours, and this effect is more pronounced after a death during emergency or high risk surgery than otherwise

not be as predicted. Additionally, it would be difficult to design guidelines to take into account all the variables surrounding the individual doctor and the case involved. These factors have to be balanced against the possible medicolegal sequelae of poor outcomes of subsequent operations after an intraoperative death. With increasing public scrutiny of doctors' decisions, guidelines about working after an intraoperative death may serve to protect doctors as well as patients.

The difficult question of whether surgeons should continue to operate in the immediate aftermath of intraoperative death is a clinical governance issue. We believe that clinical governance should be as evidence based as the medicine it seeks to govern.

We are grateful to all the consultant surgeons at Papworth Hospital who allowed us to study data on their patients.

Contributors: ARG designed the study, cowrote the paper, and conducted the literature search. CJC conducted the literature search and assisted in data collection. JM supported the data collection. SC conducted the analyses. SAMN proposed the original idea, cowrote the paper, and is the guarantor.

Funding: None.

Competing interests: None declared.

Ethical approval: Not required.

1 Smith IC, Jones MW. Surgeons' attitudes to intraoperative death: questionnaire survey. *BMJ* 2001;322:896-7.
2 Sheehan AV. *Fatal accidents and sudden deaths inquiry*. Falkirk: Sheriff Court House, 26 January 1999.
3 Briffa N. Surgeons' attitudes to intraoperative death. Cardiac surgeons might have different attitudes. *BMJ* 2001;323:341-2.
4 Seinfert BC. Anaesthetic departments need action plans to deal with such catastrophes. *BMJ* 2001;323:341-2.
5 *National adult cardiac surgical database 1998*. London: Society of Cardiothoracic Surgeons of Great Britain and Ireland, May 1999.
6 Parsonnet V, Dean D, Bernstein AD. A method of uniform stratification of risk for evaluating the results of surgery in acquired heart disease. *Circulation* 1989;79(suppl I):I3-12.
7 Nashef SAM, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R and the EuroSCORE study group. European system for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg* 1999;16:9-13.
8 White SM. Death on the table. *Anaesthesia* 2003;58:515-9.

(Accepted 3 December 2003)

doi 10.1136/bmj.37985.371343.EE

MRC Cancer Cell Unit, University of Cambridge, Cambridge CB2 2XZ
Antony R Goldstone *clinical research fellow*

Department of Surgery, University of Cambridge, Cambridge CB2 2QQ
Christopher J Callaghan *honorary clinical fellow*

Papworth Hospital, Cambridge CB3 8RE
Jon Mackay *consultant anaesthetist*
Samer A M Nashef *consultant surgeon*

MRC Biostatistics Unit, Institute of Public Health, Cambridge CB2 2SR
Susan Charman *medical statistician*

Correspondence to: Samer Nashef sam.nashef@papworth.nhs.uk