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Auditing perioperative mortality

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Summary

An audit of mortality following operation was performed over ten years classifying deaths into those that were 'expected' and 'unexpected'. 'Unexpected' deaths were defined as those in which, after careful consideration of the prevailing clinical circumstances at the time of operation, the probability of death following operation was felt to be low. This definition is a more helpful assessment of surgical performance than overall perioperative mortality as it highlights cases where improvements in surgical management might be achieved. In audits involving surgical mortality, the classification of deaths into 'expected' and 'unexpected' is recommended.

Introduction

The objectives of audit have been defined as 'education, planning, evaluation, research and anticipatory diplomacy' *(1)*. Hospital mortality is frequently used in evaluation of surgical management and in planning and educating for the future. However, since deaths which were likely to occur despite surgical intervention are included, overall perioperative mortality is not a true reflection of surgical performance. To provide a more sensitive means of assessing results, an audit of mortality following operation was carried out, classifying deaths into those that were 'expected' and 'unexpected'.

Patients and methods

Since 1973 clinical details of all deaths in the ward of the Professorial unit of the Royal Victoria Hospital have been recorded as they occured. Perioperative deaths were defined as those occuring during the same hospital admission as the patient had an operation. All perioperative deaths were reviewed for the period 1976 to 1986, deaths being further classified as expected or unexpected. Unexpected deaths were defined as those in which, after careful consideration of the prevailing clinical circumstances at the time of operation, the probability of death following operation was felt to be low. This group included all surgical complications and medical conditions which were not clinically manifest at the time of operation. Expected deaths were those in which it was felt there was a high risk of mortality following operation. Included in this category were surgical conditions such as generalised carcinomatosis, mesenteric vascular occlusion and patients moribund with peritonitis. Medical conditions apparent in a severe form at the time of surgery and from which the patient subsequently died, were also included.

The number of operations performed each year, classified as major, intermediate, or minor was obtained from theatre records. The operative mortality for each operation grouping and for expected and unexpected deaths was then calculated as a percentage for each year.

Patients were further classified by the interval from the last operation to death. The divisions were 'within 24 hours', 'from 24 hours to 7 days', 'from 7 to 30 days' and 'over 30 days'. The primary cause of death recorded on the death certificate, with postmortem confirmation where available, together with the incidence of expected and unexpected deaths were determined for each group.

Results

In the period under review 10141 operations (2176 major, 6989 intermediate and 976 minor) were performed in the unit and 125 patients died during the same admission as their operation was performed. Overall surgical mortality was therefore 1.23%, that of major, intermediate and minor procedures being 4.64%, 0.34% and 0% respectively. Yearly variations were slight with the exception of 1979/80 when overall mortality rose to 2.26% and that of major procedures to 9.9%.

Ninety six deaths were expected and 29 unexpected, the principle cause of death on the death certificate being shown in Table I. The percentage of unexpected deaths to total operations performed was 0.26%, the yearly

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TABLE I *The primary causes of 'expected' and 'unexpected' deaths*

Primary cause of death	*Expected number (n=96)*	*Unexpected number (n=29)*	
Carcinoma	43	0	
Bronchopneumonia	21	3	
Myocardial infarction } Congestive cardiac failure }	12	10	(All proven on ECG/X-ray)
Pulmonary embolus	0	7	(All proven at autopsy)
Generalised peritonitis	6	0	
Septic shock	5	2	(1 Postcholecystectomy) (1 ERCP sphincterotomy)
Mesenteric vascular occlusion	5	0	
Bleeding	0	3	(1 Orchidectomy) (1 ERCP sphincterotomy) (1 Angiodysplasia)
Peripheral vascular disease	3	0	
Perforated oesophagus	0	2	
Pancreatitis	0	1	(Post-ERCP)
Anastomotic leak	0	1	(Carcinoma oesophagus)
Ruptured aortic aneurysm	1	0	

TABLE II *Causes of death within the first seven days*

	Within 24 hours		*2nd to 7th day*	
	Expected (n)	*Unexpected* (n)	*Expected* (n)	*Unexpected* (n)
Myocardial infarction cardial failure	4	7	5	2
Bronchopneumonia	2	0	9	2
Septic shock	3	0	2	2
Generalised peritonitis	2	0	4	0
Mesenteric vascular occlusion	2	0	2	0
Pulmonary embolus	0	2	0	3
Carcinoma	0	0	5	0
Bleeding	0	1	0	2
Peripheral vascular disease	0	0	2	0
Perforation/ anastomotic leak of oesophagus	0	0	0	2
Aortic aneurysm	0	0	1	0

variation in unexpected deaths tending to mimic that of overall mortality (Fig. I).

In all, 25 autopsies were performed, 14 in the unexpected and 11 in the expected group.

Twenty three patients died within 24 hours of operation including three patients who died during operation. Ten of these deaths were unexpected. In all 23 cases the Coroner was informed. He requested postmortem examinations in 11 instances.

Between the second and seventh postoperative day, 43 deaths occured, 13 of which were unexpected (Table II).

Forty seven deaths occured between the eighth and thirtieth postoperative days, of which five were unexpected; 2 due to pulmonary embolus, and one each from myocardial infarction, haemorrhagic pancreatitis, and perforated oesophageal stricture. Of the 42 expected deaths 27 were directly attributed to carcinoma, 10 to

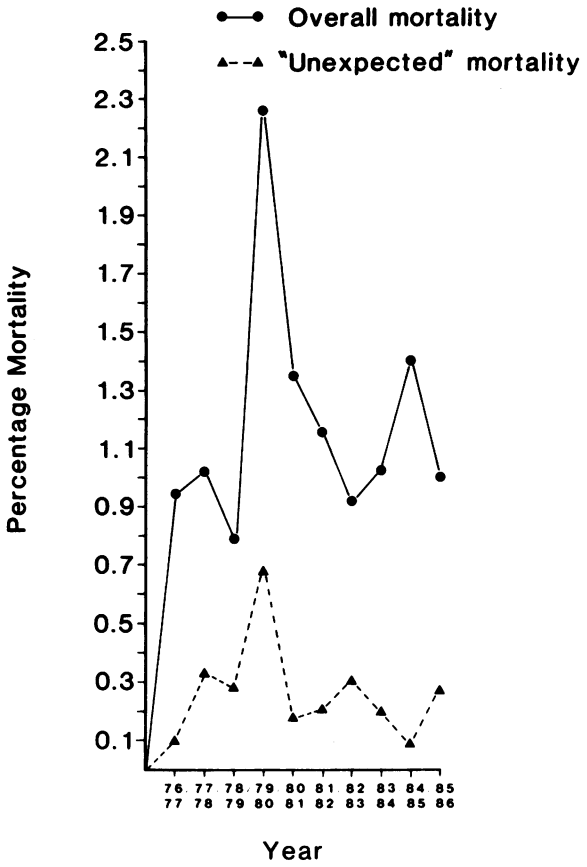

FIG. 1. Mortality as a percentage of operations performed each year.

bronchopneumonia, 3 to congestive cardiac failure and one each to peripheral vascular disease and superior mesenteric artery thrombosis.

Twelve patients died more than 30 days after their operation; 11 from carcinoma and one from bronchopneumonia. All the deaths were expected and no autopsies were performed.

Of the 125 deaths, carcinoma was present in 60 patients, being stated as the primary cause of death in 43. Bronchopneumonia was stated as the primary cause of death in 24 patients and congestive cardiac failure or myocardial infarction in 22. Pulmonary embolism accounted for 7 deaths and superior mesenteric vascular occlusion for 5.

Six patients died following a second operation during the same hospital admission.

Discussion

The overall perioperative mortality in our series was 1.4%, which is comparable to that of Gough *et al. (2)*. However, for highlighting possible improvements in operative and perioperative management, overall operative mortality proved unhelpful. Assessing mortality for major, intermediate and minor operations is better *(2)*, but many elective major operations carry little risk, whilst lesser procedures in severely ill patients may be associated with a significant mortality. Similarly, assessing mortality in elective and emergency operations may result in distorted analysis, since an elderly patient with severe cardiorespiratory disease undergoing an elective operation for cancer stands a greater risk of dying than a fit, young adult requiring emergency appendicectomy.

We therefore feel that to identify cases where poor surgical management contributed to death, due consideration of the prevailing clinical circumstances is essential. The definitions of expected and unexpected deaths

used in this study are similar, but not identical, to the 'viable' and 'non-viable' classification proposed by Seymour *et al (3)*. Seymour included all postoperative deaths due to medical complications, along with ruptured aneurysms and patients with moribund peritonitis as viable. However, in our study patients present *in extremis* from the medical or surgical condition of which they died were classified as expected deaths. We accept that the definitions of expected and unexpected deaths are not exact and that grey areas exist which are open to individual interpretation. Nevertheless, we feel that careful consideration of the clinical condition of each patient has allowed a more accurate assessment of surgical performance.

Applying our criteria, 76.8% of deaths were found to be expected and 23.2% unexpected. It is in the latter group that improvements may be made. Three patients died unexpectedly from bleeding. In one a ligature slipped following orchidectomy and another died following continued bleeding despite a right hemicolectomy for angiodysplasia of the colon. The third patient, considered too frail for open operation, bled following endoscopic sphincterotomy, despite attempted embolisation of the offending vessel. Lessons have been learnt from these patients and improvements in surgical technique may minimise such events in future.

Of the 10,141 operations performed, 7 patients died of proven pulmonary embolus. Three of these patients developed emboli despite having received prophylactic heparin, although in a further case heparin was only commenced postoperatively. Despite these cases prophylactic heparinisation has proved successful and the incidence of pulmonary embolus of 0.69/1000 operations is comparable with other reports *(1)*.

Endoscopic retrograde cholangiopancreatography alone was not associated with any mortality but four patients died following endoscopic sphincterotomy. One of these was due to uncontrollable bleeding which was unresponsive to embolisation. This indicates that embolisation is not always effective and that in significant bleeding following sphincterotomy, urgent surgery affords the only prospect of survival, even in the very frail patient. A further patient died from ascending cholangitis following impaction of a stone in the sphincterotomy site, emphasising the importance of urgent biliary drainage in such cases. The third patient died following perforation of the gallbladder despite the bile duct having been cleared of stones. The risk of sphincterotomy for diagnostic purposes was apparent when a fourth patient died from haemorrhagic pancreatitis. As a general rule we do not perform sphincterotomy in patients below the age of 65 years. This may be a further factor in the procedure mortality rate.

Auditing surgical mortality is amongst the most fundamental of surgical audits. The highlighting of areas where improved surgical management might reduce mortality is one of its most important functions. We conclude that for a sensitive assessment of surgical performance, careful consideration of the clinical condition of the patient at the time of operation is essential. This allows deaths to be classified as expected or unexpected, and examination of the latter group rapidly provides areas where improvements may be achieved.

References

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Assessor's Comments

There are two important issues raised by this paper, firstly perioperative death rates are now so low that large samples of surgical work are necessary if differences between surgeons and units are to be identified, hence the need for regional or even national, perioperative death rate surveillance. Secondly, a philosophical (and economic) question mark must be put onto 'expected deaths'. If the patients are expected to die postoperatively should any operation be performed? This is especially relevant to deaths from carcinomatosis. With modern imaging surely the extent of the disease and its inoperability can be judged prior to laparotomy? Then the patient and family could be spared the anguish of a operation? And resources saved for another patient with a more hopeful prognosis? Similarly the wisdom of late operation for intestinal vascular catastrophies and operations on 'moribund' patients must be questioned. These are contentious questions that will only be resolved when we obtain accurate national data on perioperative death rates and the events leading up to each of these deaths. We urgently need quality control and audit. These authors deserve full marks for a move in the right direction. Every surgical unit in the country should follow their lead.

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