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Does hospital mortality rate reflect quality of care on a surgical unit?

D P O'Leary MCh FRCSI
Senior Registrar in Surgery

E Cosford
Clinical Audit Facilitator

R H Hardwick MD FRCS
Registrar in Surgery

A J S Knox MS FRCS
Consultant Surgeon

Departments of Surgery and Clinical Audit, Royal Devon and Exeter Hospital, Exeter

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All deaths occurring in 1 year in the surgical unit of a district general hospital were analysed to determine to what extent crude mortality rates reflect the quality of care. There were 166 deaths, 70% of patients were aged 75 years and older, and 87.3% were emergency admissions. Almost one-half (46.4%) of the deaths were inevitable. This high proportion of inevitable deaths means that crude hospital mortality rates are a poor indicator of the quality of surgical care. Factors such as the nature of the catchment area served, the proportion of emergency *versus* elective admissions, the numbers of complex operations performed and the availability of convalescent or hospice facilities are a greater influence on surgical mortality rates than variations in the standard of surgical care. The use of crude hospital mortality rates to compare the quality of care given by surgical units should be discontinued as it is unreliable and misleading.

Mortality rates are a useful endpoint by which to describe the likely outcome for specific diseases or treatment. Increasingly, however, mortality rates are being used to compare the results from different surgical units treating a wide range of conditions *(1,2)*. Such comparisons assume that overall mortality rates reflect accurately the quality and safety of surgical care in these units. This study was designed to test this assumption in a general surgical unit in the United Kingdom.

Setting

The Royal Devon and Exeter Hospital lies in the centre of its own district and provides surgical care for a population of 320 000. The department of surgery includes six general surgeons, one transplant surgeon and two urologists. In addition to the district general hospital there are four 'cottage' hospitals undertaking mainly minor and intermediate surgery, and a private hospital undertaking all types of surgery. Surgery from these centres is not included in this study. There are good facilities for the terminally ill in local community hospitals, a Marie Curie home and hospiscare unit on site. Patients who died in these units are not included in this study.

Correspondence to: Mr A J S Knox MS FRCS, Consultant Surgeon, Royal Devon and Exeter Hospital, Barrack Road, Exeter EX2 5DW

Methods

Patients who died in hospital under the care of the department of surgery between 1 July 1993 and 30 June 1994 were identified from the hospital's patient administration system, ward records and mortuary records. Clinical notes were reviewed. A proforma was completed including demographic details, diagnosis, fitness as indicated by American Society of Anesthesiologists (ASA) grade and POSSUM score (physiological and operative severity score for the enumeration of mortality and morbidity) *(3,4)*, treatment instituted, whether treatment was withdrawn and reason for death. Care was taken to determine the main circumstance leading to death rather than the terminal event. Each death was then classified as either 'inevitable' (group 1) or 'not inevitable' (group 2) by careful study of the clinical notes and the objective data. No attempt was made to match our classification of deaths with mortality rates previously reported for ASA or POSSUM scores. When there was any difficulty in assigning a death to one or other group, group 2 'not inevitable' was always chosen. Each case was reviewed twice (the second reviewer had not been involved in the care of any of the patients who died) to ensure uniformity of approach to classification. Deaths in

each group were compared using χ^2 tests with Yates' correction as appropriate. Details of the classification are as follows:

Group 1. Inevitable deaths regardless of the quality of surgical care. This group included (a) patients with known incurable disease who were admitted for terminal care, and (b) deaths which in retrospect were clearly inevitable, eg patients found to have advanced metastatic malignancy, extensive intestinal infarction, patients presenting with multi-organ failure, as well as patients unwilling or unfit to undergo life-saving surgery for lesser illnesses.

Group 2. 'Not inevitable'. This group comprises not only those deaths which were unexpected, but also includes all deaths from conditions which are normally associated with significant mortality such as faecal peritonitis and ruptured aortic aneurysm. High ASA grades (4 and 5) did not exclude patients from this group if they underwent surgery. We did not seek to determine whether any deaths were avoidable as such opinions would have been open to observer bias. However, this group includes all the deaths which may have been related to the quality of surgical care.

Results

In all, 10 938 patients were admitted to the surgical unit between 1 July 1993 and 30 June 1994. Of these, 2437 were day cases and 8501 inpatients. There were 166 deaths (overall hospital mortality rate 1.52%; 1.95% of inpatients). Patients who died had a median age of 79 years (range 20–104 years) compared with 62 years (range 0–105 years) for all admissions. Emergencies accounted for 37% of all admissions but 87.3% of deaths. Mortality rate was 0.31% for elective admissions and 3.6% for emergency admissions. Of patients who died, 39.2% had undergone an emergency operation, 19.9% an elective operation and 41% no operation. Of the deaths, 51.2% had an ASA grade of 4 or 5. There was significant comorbidity among those who died (Table I).

Classification of deaths

Among the 166 deaths, 77 (46.4%) were inevitable (group 1). Of these, 12 patients were admitted for terminal care. There were 89 deaths (53.6%) classified as not inevitable (group 2). In group 1, 35.1% of patients had had operations and most of these were emergencies (22/27). In group 2, 79.8% of patients had had an operation. The majority of patients who died after elective surgery were in this group. Disseminated cancer, cardiac causes and end-stage peripheral or intestinal vascular disease were the most common causes of death (Table II). Advanced malignancy accounted for, or was associated with 44.2% of inevitable deaths (group 1) compared with 11.2% of deaths in group 2. Active treatment was withdrawn at some stage in 74% of deaths in group 1, but in only 14.6% of those in group 2. Of 166 deaths, 130 or 78.3% of the total, were either inevitable or occurred in patients over 80 years of age or in patients with ASA grades of >3. Of the remaining 36 deaths, two-thirds were emergency admissions and operation was undertaken in 83.3%. Myocardial infarction was the most common cause of death in this subgroup.

Table I. Presentation and physical fitness of patients who died

	Group 1	*Group 2*	*All deaths*
Number	77	89	166
Admission			
Elective	3	18+	21
Emergency	74	71	145
Median age (range) in years	79 (20–96)	78 (26–104)	79 (20–104)
Median (range) POSS phys score	32 (16–51)	28 (13–64)	30 (13–64)
Median (range) POSS op sev score	16 (6–27)	19 (9–37)	17 (6–37)
Cardiac*	25 (32.55%)	17 (19.1%)	42 (25.3%)
Respiratory*	23 (29.9%)	22 (24.7%)	45 (27.2%)
Uraemic†	22 (28.6%)	19 (22.1%)	41 (25.3%)
ASA 2 and 3	24 (31.2%)	57 (64.0%)‡	81 (48.8%)
4 and 5	53 (68.8%)	32 (36.0%)‡	85 (51.2%)

Group 1: inevitable deaths. Group 2: not inevitable
POSS phys = POSSUM physiological score
POSS op sev = POSSUM operative severity score
* POSSUM scores of ≥ 4, POSSUM score = 8
‡ $P<0.01$ *versus* group 1

Elective admissions

Among the 21 people who died after elective admission (0.31% of elective admissions), the age range was 40–93 years. Eight (31.1%) had significant cardiac comorbidity, 5 (23.8%) had significant respiratory disease and 5

Table II. Management and causes of death

	Group 1 (n=77)	*Group 2 (n=89)*	*All deaths (n=166)*
Operation			
Elective	5 (6.5)	28 (31.5)	33 (19.9)
Emergency	22 (28.6)	43 (48.3)*	65 (39.2)
No operation	50 (64.9)	18 (20.2)	68 (41.0)
Cause of death			
Cardiac	4 (5.2)	25 (28.1)*	29 (17.5)
Respiratory	2 (2.6)	5 (5.6)	7 (4.2)
Sepsis	11 (14.3)	13 (14.6)	24 (14.5)
Neurological	0 (0.0)	5 (5.6)	5 (3.0)
Ischaemia	14 (18.2)	5 (5.6)†	19 (11.4)
Bleeding	2 (2.6)	8 (9.0)	10 (6.0)
Cancer	27 (35.1)	1 (1.1)*	28 (16.9)
Other + cancer	7 (9.1)	9 (10.1)	16 (9.6)
Other	10 (13.0)	18 (20.2)	28 (16.9)

Figures in brackets are percentages
*$P<0.001$ *versus* group 1; † $P<0.05$

Table III. Elective admissions: causes of non-inevitable postoperative deaths

Cause of death	*n*
Cardiac	5
Pneumonia	1
Pulmonary embolism	1
Anastomotic leak	1
Laparoscopic perforation	1
Cerebrovascular accident	3
Bleeding	3
Intestinal infarction	1
Endoscopic perforation of oesophageal carcinoma	1
TURP*	1

*Age 92 years, no specific cause of death identified

(23.8%) were uraemic. Three (14.3%) were ASA 4. Of the 21 deaths, 18 had undergone an operation. There were 18 deaths (85.7%) in group 2, including seven deaths from technical complications of surgery. The cause of death after elective admissions are recorded in Table III.

Discussion

Mortality rates are being used increasingly to compare outcome between individual surgeons, surgical units or hospitals, and to construct league tables of the quality of surgical care *(1,5)*. However, in this unit almost one-half of all deaths were inevitable and unrelated to the quality of surgical care. Inevitable deaths will be higher in hospitals with fewer 'terminal care' beds in the district. Such use of crude hospital mortality rates to measure and compare the quality of surgical care on different units ignores important factors *(2,6)*, including the nature of the catchment area, the proportion of emergency *versus* elective admissions, the numbers of complex operations performed (eg in a tertiary referral centre *versus* DGH) and the availability of convalescence or hospice facilities. Each of these is likely to influence overall mortality rates and the proportion of inevitable/non-inevitable deaths. We propose that variations in these parameters are a major contributor to differences in mortality rate between surgical units.

In agreement with national results, the great majority of deaths on this unit occurred among elderly patients admitted as emergencies *(7)*. Many were unfit, with significant cardiac, respiratory or renal comorbidity and high ASA grades. Standard physiological and operative scoring systems confirmed that those in whom death was inevitable were more ill as a group than those in whom death rates might reflect the quality of surgical care. However, there was considerable overlap between the groups. Such fitness assessments do not take account of the nature of the presenting surgical pathology, which in many emergency cases only becomes apparent at operation. Several patients presenting with carcinomatosis, extensive intestinal infarction or gross faecal peritonitis had reasonable fitness assessments although death was inevitable. In other instances death was inevitable because patients declined emergency operations or surgeons decided against them on account of great age or poor quality of life. This disparity between measurable physiological fitness and true prognosis in surgical patients complements previous observations in patients with non-surgical conditions. *(8)*.

A high proportion of all surgical deaths is inevitable, largely because of the nature of the surgical pathology at presentation. The proportion of inevitable deaths is likely to vary between units. These observations invalidate the use of crude mortality rates as the basis for league tables whose aim is to compare the quality of care in different surgical units.

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