Annals of the Royal College of Surgeons of England (1989) *vol.* 71

Perioperative mortality in Zambia

A J HEYWOOD MA FRCSEd*
Lecturer
I H WILSON MB FFARCS
Lecturer
J R SINCLAIR MB FFARCS*
Lecturer
Department of Surgery, University Teaching Hospital, Lusaka, Zambia

Key words: DEVELOPING WORLD; AUDIT; PERIOPERATIVE MORTALITY; AVOIDABILITY; SURGERY; ANAESTHESIA; ADMINISTRATION; AVOIDABLE MORTALITY RATE

Summary

An audit of 10 592 consecutive operations performed during 7 months in a central African teaching hospital is presented. Eighty deaths occurred within 6 days of operation, an overall mortality rate (OMR) of 7.55 per 1000 operations. Deaths are classified as avoidable or unavoidable. Avoidable deaths are those for which there was evidence of mismanagement of a type and degree sufficient to account for the death. There were 35 avoidable deaths, an avoidable mortality rate (AMR) of 3.3 per 1000 operations. Avoidable factors which contributed to death are classified as surgical, anaesthetic, and administrative.

Surgery and anaesthesia at this hospital are described, and possible means of decreasing avoidable mortality discussed. The value of combined anaesthetic and surgical audit is emphasised.

Introduction

The importance of medical audit is established, and there have been several recent studies of perioperative deaths in Britain and their association with surgery or anaesthesia *(1–4)*. Most recently the Confidential Enquiry into Perioperative Deaths (CEPOD) examined surgery and anaesthesia together *(5)*.

Unable to find similar reports from central Africa, we studied perioperative deaths at our hospital in order to identify and quantify causes, and determine whether avoidable factors exist.

Methods

THE HOSPITAL

The study was made at the University Teaching Hospital (UTH), Lusaka, Zambia, during the period May to November 1987. UTH has 1500 beds, serves the Lusaka region (population 1 million), and admits patients referred from elsewhere in Zambia (population 8 million). All major surgical specialties are represented, except for neurological and cardiac surgery, and virtually all non-obstetric/gynaecological emergencies are managed by general surgeons.

SURGICAL AND ANAESTHETIC STAFF

There are five general surgical and four obstetric and gynaecological firms, each comprising consultant, senior registrar or registrar, one or two preregistration house officers, and sometimes a senior house officer.

Anaesthetic services largely depend upon clinical officer anaesthetists (COAs). COAs undergo 3 years' basic training and a period of general clinical duties. Those selected receive 1 year of anaesthetic training to become qualified COAs, and later may become more senior principal COAs. During the study the anaesthetic department comprised one consultant, two senior registrars, one senior house officer, three principal COAs, 12 qualified COAs, and eight student COAs.

DATA COLLECTION

Demographic data were obtained from the last national census *(6)*, and for the surgical population of UTH by examining theatre records for 1000 consecutive operations in May 1987.

The same theatre records were used to count types and numbers of operations performed, and the grades of anaesthetist and surgeon for different classes of operation (major, minor, elective, emergency).

Theatre records for the whole 7 months were used to obtain denominator figures for the perioperative deaths.

Files of all patients dying between induction of anaesthesia and the 6th postoperative day (the day of operation being day 1) were traced soon after death via mortuary records. The notes were examined by two of the authors (anaesthetist and surgeon), and the following classifications and decisions made:

1 The operation was classed as major or minor and

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* Present appointments:

A J Heywood is now Locum Registrar in Plastic Surgery at Bangour General Hospital, West Lothian

J R Sinclair is now Senior Registrar in Anaesthesia at the Bristol Royal Infirmary, Bristol

Correspondence to: A J Heywood, Department of Plastic Surgery, Bangour General Hospital, West Lothian EG52 6LR

emergency or elective. Emergencies were those performed as soon as possible after the decision to operate was taken; all others were elective.

2 Cause of death was decided according to clinical information. Points requiring clarification were discussed in confidence with the surgeon and anaesthetist involved, and with the consultant in charge of the case.

3 Death was classified as avoidable where there was evidence of mismanagement of a type and degree sufficient to account for the death, and otherwise, or where the cause of death was unknown, as unavoidable. Totally avoidable and probably avoidable deaths were grouped together as avoidable.

4 Instances of mismanagement contributing to avoidable deaths were classified into three groups of avoidable factors: surgical, anaesthetic, and administrative. The administrative group included cases where death was due to deficiencies in equipment, supplies, staffing, or laboratory and other services. Avoidable factors in each group were classified according to what form they took (eg poor preoperative management, poor airway management).

The numbers of all deaths, avoidable deaths, and operations, were used to arrive at expressions of overall mortality rate (OMR) and avoidable mortality rate (AMR). AMR was subdivided into AMR for each of the groups surgical, anaesthetic, and administrative, by the following means. For each death, the types of avoidable factor were noted. Where surgical factors alone were involved, one surgical death was counted. Where two types of factor were involved (eg one or more surgical factor and one or more anaesthetic factor), they were given equal weighting and each type of factor was considered to have caused half a death (there were no cases where all three types of factor were involved).

Results

POPULATIONS AND NUMBERS OF DEATHS

Figure 1 illustrates the age and sex distributions of the general and surgical populations, and of the 80 patients who died. Thirty-five deaths were avoidable; 16 totally and 19 probably.

OPERATIONS AND SPECIALTY

The spectrum of operations matched that in a paper from this hospital *(7)*; the majority were for acute infections, trauma, small lumps, and abdominal, obstetric, and gynaecological emergencies. Among the 80 patients who died, the commonest operations were laparotomy (40), burr holes (10), caesarian section (6), and wound treatment (5).

During the study 10 592 operations were performed, 47% by general surgeons, and 40% by obstetric and gynaecological surgeons. Approximately 74% of operations were emergencies, of which 57% were performed by general surgeons and 43% by obstetric and gynaecological surgeons.

GRADE OF SURGEON

In the sample of 1000 operations, nearly all emergency operations were performed by surgeons below consultant grade, whereas many elective operations were performed by consultants. Among the cases of perioperative death, the grades of surgeon were: house officer 1, senior house officer 5, registrar 21, senior registrar 27, and consultant 26. Of the 80 operations, 64 were emergencies, of which 21 were performed by consultants and 21 by senior registrars, a much higher than normal proportion of senior operators. Out of 35 avoidable deaths, eight had operations by grades below senior registrar, but none were considered inappropriately junior for the procedure performed.

GRADE OF ANAESTHETIST

Table I shows that for both the sample of 1000 operations and for the 80 cases of perioperative death, a similar proportion of anaesthetics (approximately 80%)

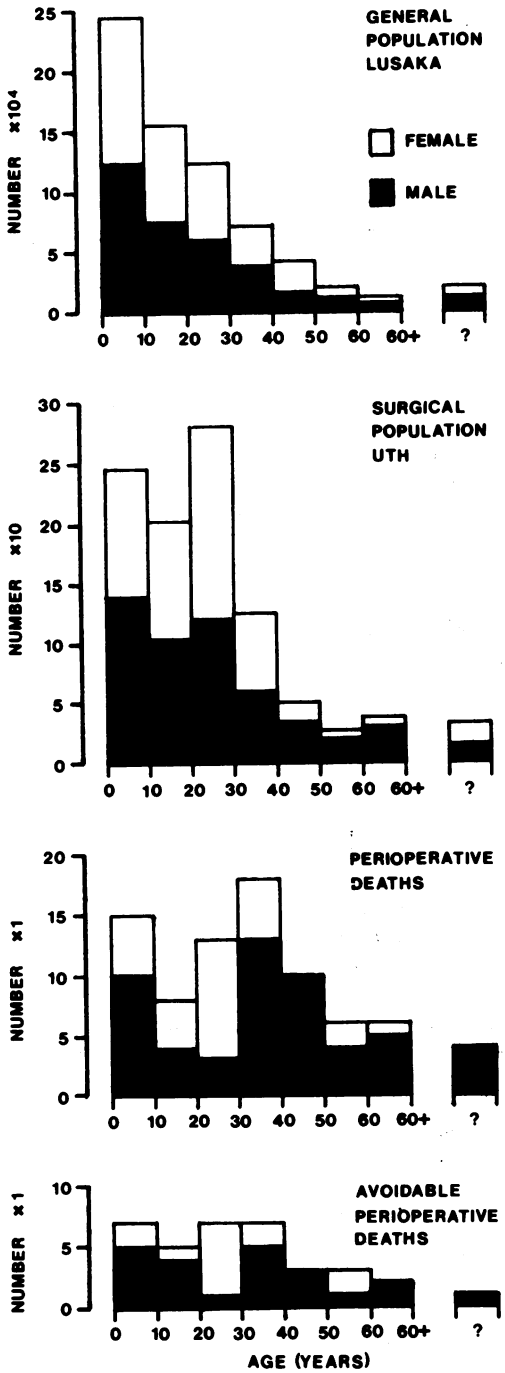

FIG. 1 Age and sex of general population, surgical population, and perioperative deaths.

TABLE I *Class of operation and grade of anaesthetist for a sample of 1000 operations and for 80 perioperative deaths*

	*Surgeon**	*Qualified COA*	*Principal COA*	*Senior House Officer*	*Consultant/ Senior Registrar*	*Totals*
1000 operations						
Emergency	48	606	5	4	7	670
Elective	8	89	107	39	87	330
Perioperative deaths						
Emergency	2	44	6	2	10	64
Elective	2	4	10	0	0	16

* Local anaesthetic

were administered by COAs. Out of the 64 emergencies, 10 anaesthetics were administered by a consultant or senior registrar, compared to 7 out of 670 anaesthetics for the emergencies in the sample of 1000 operations. For the cases in which avoidable anaesthetic factors contributed to death, the anaesthetists were all qualified COAs, except for two cases involving principal COAs.

CAUSE OF DEATH

Table II lists clinical causes of death. Six post-mortems were performed, one of which showed a cause of death not clinically apparent (pneumonia following laparotomy).

AVOIDABLE SURGICAL FACTORS (Table III)

Delayed treatment was due to failure to recognise urgency. Poor preoperative management usually involved failure to resuscitate acutely ill patients before surgery. This included failure to perform important investigations, to give any or sufficient intravenous fluids, and to monitor treatment and response by simple clinical measurements. In two elective cases, jaundiced patients were not given fluid therapy to protect renal function, and died of renal failure; these were considered failures both of surgical and anaesthetic management.

Poor postoperative management included failure to diagnose and treat a case of post-thyroidectomy bleeding, and failures in the management of 'medical' disease or complications (four respiratory complications, one case of diabetes and one case of meningitis).

TABLE II *Causes of death and numbers of avoidable and unavoidable deaths for each cause*

Clinical cause of death	*Unavoidable (n=45)*	*Avoidable (n=35)*
Abdominal/pelvic sepsis	8	4
Head injury	10	1
Haemorrhage	1	8
Bowel obstruction	4	5
Respiratory failure (excluding aspiration)	3	5
Soft tissue infections	6	0
Metabolic/renal/fluids/ electrolytes	1	5
Malignancy	5	0
Aspiration vomit/pus	0	5
Other*	7*	2

* Four unknown

AVOIDABLE ANAESTHETIC FACTORS (Table III)

Aspiration affected two patients undergoing caesarian section, two with bowel obstruction, and one with an abscess which ruptured into the pharynx, and in three of these was the sole avoidable factor. Poor care during recovery involved one of the patients who aspirated and another who was hypotensive during operation (the single instance of poor peroperative management) became hypoxic afterwards and had a cardiac arrest in recovery.

AVOIDABLE ADMINISTRATIVE FACTORS (Table III)

Eight patients died of haemorrhage when insufficient or no blood was available, and lack of blood contributed to two other deaths. On four occasions inability to contact senior staff contributed to deaths. Poor recovery facilities (lack of oxygen, suction, and monitoring equipment) were contributory in two deaths, and equipment failure (suction machine and laryngoscope batteries) in two others.

MORTALITY RATES (Table IV)

Eighty deaths out of 10 592 operations gave an OMR of 7.55 per 1000 operations, and 35 avoidable deaths gave an AMR of 3.3 per 1000. The highest OMR and AMR were associated with major emergencies. Surgical AMR was highest, anaesthetic lowest, and administrative intermediate.

TABLE III *Avoidable factors in 35 avoidable deaths*

Avoidable factors	*No. of patients affected**
Surgical	
Delayed treatment	11
Poor preoperative management	9
Poor postoperative management	7
Anaesthetic	
Poor airway management	5
Poor preoperative management	2
Poor care during recovery	2
Poor peroperative management	1
Administrative	
Insufficient or no blood	10
Poor communications	4
Poor recovery facilities	2
Equipment failure	2

* $n>35$ because some patients affected by more than one factor of the same or different types

TABLE IV *Mortality rates (per 1000 operations) by class of operation*

Class of operation	*No. of operations*	*No. of deaths*	*OMR*	*No. of avoidable deaths*	*AMR*	*AMR surg. (No.)*	*AMR anaesth. (No.)*	*AMR admin. (No.)*
Major emergency	1336	50	37.43	22	16.47	8.61 (11.5)	2.62 (3.5)	5.24 (7.0)
Minor emergency	6522	14	2.15	6	0.92	0.61 (4.0)	0.15 (1.0)	0.15 (1.0)
Major elective	1268	8	6.31	4	3.15	1.58 (2.0)	0.79 (1.0)	0.79 (1.0)
Minor elective	1466	8	5.46	3	2.05	2.05 (3.0)	0 (0)	0 (0)
Totals	10592	80	7.55	35	3.30	1.93 (20.5)	0.52 (5.5)	0.85 (9.0)

Discussion

Surgical and anaesthetic practice in the developing world differs markedly from that in developed countries. There are major differences in the age and general health of patients, spectrum of pathology and surgery, staffing levels, and availability of equipment and material supplies. As no published studies from similar environments exist, we have drawn comparisons and contrasts with Britain where these seem useful or interesting.

PATIENTS

Most patients are young, even when obstetric patients are excluded, and in good health apart from their surgical problems, although some suffer from poor nutrition. All populations contrast with Britain, where general and surgical populations have fewer children and more old people *(4,5)*. The most striking contrast is in the ages of patients dying in the perioperative period; in Britain most are over 60 years of age *(4,5)*, whereas in Lusaka 45% of all deaths and 54% of avoidable deaths were in patients under 30 years of age.

CAUSES OF DEATH

These were categorised so as to give the clearest indication of how patients died; some are described according to mechanism (eg haemorrhage, aspiration), and others according to pathology (eg head injury, malignancy). Most patients die of their primary surgical problem, and in contrast to Britain *(4,5)*, only two patients died as a result of chronic coexistent medical disease, both diabetics.

It is difficult to have post-mortem examinations carried out at UTH. In most cases we had no difficulty in assigning a cause of death on clinical grounds, and the limited value of post-mortem examination in this kind of study has been noted *(4)*.

Deaths from causes such as head injury and malignancy were mostly unavoidable and many of these patients would not have had operations in Britain because of diagnostic facilities such as computed tomography. Excluding them would lower OMR but leave AMR unchanged. Other causes, notably haemorrhage and aspiration, were mostly avoidable.

AVOIDABLE SURGICAL FACTORS

Delayed operations are frequent at UTH for 'administrative' reasons such as problems in running theatres, but apparently these did not cause any deaths. To blame surgeons for delays may appear to be retrospective wisdom, but in all such cases there was clear evidence of urgency which was not acted on.

Poor preoperative management, mostly poor resuscitation, was common, and the importance of this was emphasised in CEPOD.

The high proportion of senior operators suggests that in this respect the seriousness of patients' conditions was recognised. None of the avoidable group were operated on by too junior surgeons. In CEPOD this, and surgeons operating outside their specialty, were cited as problems. Neither can be considered problems at UTH, the latter because surgeons in central Africa are necessarily less specialised than in developed countries.

Most shortcomings affected patients admitted as surgical emergencies (average 42/day). One preregistration house officer has immediate responsibility for these patients, and for casualty and the wards at night. The next most senior surgeon is in theatre most of the time. In addition to this high workload, materials such as catheters and intravenous fluids are not always immediately at hand, although they can usually be found somewhere in the hospital. While awareness of and efforts to correct the problems described ought to improve surgical performance, beyond a certain point improved staffing and material supplies would be necessary. An unquantifiable element of avoidable surgical factors, therefore, is administrative and economic.

AVOIDABLE ANAESTHETIC FACTORS

Poor airway control and aspiration were due to failures to follow accepted clinical practice, and eradication of the problem would almost halve the anaesthetic AMR.

There was sometimes difficulty in apportioning responsibility between anaesthetists and surgeons. To what extent, for example, are COAs responsible for operations upon poorly resuscitated patients? When anaesthetists are not medically qualified, surgeons should surely accept more responsibility for all aspects of patient care. In recognition of this and because in some Zambian hospitals the surgeon may also be the anaesthetist, surgical training at UTH includes some training in anaesthesia. We were conscious of this in our assessment and feel that the bias it may have introduced in favour of anaesthetists is fair.

Likewise, poor care during recovery cannot be blamed entirely on anaesthetists. Elective operations often take place with more than one anaesthetist present, and there

is a recovery room with basic equipment and recovery nurses. The majority of operations, however, are emergencies, performed in a different theatre block, where the anaesthetist is usually alone, monitoring is purely by clinical observation, and recovery facilities are inadequate; patients recover in the theatre corridor, observed intermittently by a nurse who also has other duties. There is no monitoring equipment apart from a sphygmomanometer, no oxygen, and no suction. These problems are exacerbated by a large caseload and constant pressure to start the next case. Hence the two cases of poor care during recovery were partly administrative in origin.

We have not cited too junior anaesthetists as an avoidable anaesthetic factor. However, the facts that 22 avoidable deaths involved major emergencies, that this class of operation was associated with the highest anaesthetic AMR, and that all avoidable anaesthetic factors involved COAs, suggest that some improvement might accrue from more involvement of senior anaesthetists in major emergencies. This would also have the advantage that senior anaesthetists might insist on better preoperative resuscitation. Although a senior anaesthetist is always on call at home, making contact may be difficult.

An anaesthetic service at UTH provided solely by medically qualified anaesthetists would not be practical or desirable. District and rural hospitals are staffed by COAs, who receive much of their training in the teaching centre. The present complement of one consultant and two senior registrars could fairly be described as suboptimal, however. The avoidable anaesthetic deaths were largely due to lack of knowledge, and there is a need for more medically qualified anaesthetists to train and supervise COAs and provide support in clinical practice. The existence of an academic department, which better staffing levels would facilitate, might attract more Zambian medical graduates into the specialty.

With the reservation that three out of 35 avoidable deaths were solely due to anaesthesia, the standard of service provided by COAs can only be regarded as remarkably high.

AVOIDABLE ADMINISTRATIVE FACTORS

The extreme shortage of blood is a long-standing problem caused by lack of donors and far exceeds other administrative shortcomings.

Improvement in recovery facilities and equipment maintenance is straightforward, but may be subject to economic stringency. According to our data it is of high priority.

Communication difficulties are less straightforward, and telephones are partly outside hospital administrative control. Messengers, the other means of contact in and outside hospital, are also subject to problems, especially lack of transport and slowness. Knowing this may discourage attempts to contact senior colleagues.

Low staffing levels, alluded to with respect to surgery and anaesthesia, is surely best classed as administrative, but is of an underlying nature and could not be shown to be directly causative in any avoidable deaths. Nurses have not been considered at all in this study, but inadequate numbers may be suspected of having played a part in, for example, poor monitoring of resuscitation.

MORTALITY RATES

The differences between most aspects of surgery and anaesthesia in Zambia and Britain make comparisons of mortality rates unhelpful, and the most useful observation is probably that many of the same mistakes occur in two such diverse environments. It may be of interest to know, however, that our OMR is of similar magnitude to that in Britain *(4,5)*, and that, with regard to avoidability, deaths totally due to anaesthesia are between three times *(4)* and 40 times *(5)* as frequent at UTH as in Britain, whereas those partly due to anaesthesia are of similar frequency. For surgery, totally attributable deaths are about three times, and partly attributable deaths about five times, as frequent *(5)*.

Conclusions

Our most important finding is that 44% of deaths were avoidable and that most affected young patients. Attention to the avoidable factors described ought to reduce these deaths, and this should be monitored by regular audit meetings, preferably involving both surgeons and anaesthetists. These have recently started.

The expression AMR, implicit in the studies with which we have drawn comparisons, is offered as a simple index which directly addresses one of the main objectives of audit: measurement of performance to improve patient management.

The authors wish to thank all members of the surgical and anaesthetic department of UTH for their cooperation in the compilation of data, and the Department of Medical Illustration at Bangour General Hospital for help with illustrations.

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Received 28 February 1989