Mortality associated with anaesthesia at Zimbabwean teaching hospitals

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Objective. To determine and analyse peri-operative mortality with particular emphasis on avoidable factors, in the hope that this information will lead to an improvement in standards.

Design. Review of all anaesthetic-associated deaths (AADs) during the year 1992. All available records were scrutinised and further information was obtained from mortality meetings and confidential discussions.

Setting. Harare Central and Parirenyatwa hospitals, which are referral centres.

Patients. Out of 34 553 subjects presenting for surgical procedures, there were 89 deaths between 1 January and 31 December 1992.

Main outcome measures. Incidence of AAD, avoidable mortality rate (AMR) and classification of avoidable surgical, anaesthetic and administrative factors.

Main results. The incidence of AAD per 1 000 anaesthetics was 2.58. (AAD was defined as death within 24 hours of anaesthesia or failure of a patient, who was previously conscious, to regain consciousness.) There were avoidable factors in 45 (51%) of the deaths. The overall AMR was 1.34 per 1 000 operations (death classified as avoidable if mismanagement contributed to mortality). The AMR (surgical), AMR (anaesthetic) and AMR (administrative) were 0.80, 0.33 and 0.21 respectively. Scoring in each category of avoidability was done proportionately, with a maximum of one point per death awarded where there were avoidable factors). The commonest avoidable factors (in order of frequency) were uncontrolled haemorrhage, poor postoperative management, poor pre-operative management and anastomotic dehiscence.

Conclusions. This audit reveals that there were avoidable factors in 51% of peri-operative deaths. It should be possible to reduce the mortality rate by developing preventive measures.

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Medical care in Zimbabwe is coming under increasing scrutiny and a commission of enquiry into the conduct of the Health Professions Council was recently constituted.[1] Formal audit of peri-operative mortality in Zimbabwe has not been reported, despite a surge of studies throughout the world (the most recent and ambitious being the National Confidential Enquiry into Peri-operative Deaths (NCEPOD) from the UK, published in 1992[2]). Although regular mortality meetings have been held by the Department of Anaesthetics at the University of Zimbabwe for about 25 years, these were initially anecdotal. This first contemporary surveillance study was undertaken to examine mortality after surgery and anaesthesia, in the hope that clinical practice might be improved.

Cases and methods

A review of peri-operative deaths was undertaken at the Harare teaching hospitals from 1 January to 31 December 1992. These hospitals are Harare Central Hospital (1 087 beds) and Parirenyatwa Hospital (1 031 operational beds). Both are serviced by a single Division of Anaesthetics, but have separate surgical firms. The Division of Anaesthetics in 1992 was composed of (on average) 9 consultants, 10 registrars, 15 senior house officers (SHOs) and 12 nurse anaesthetists. The surgical services (including obstetrics and gynaecology) were provided by firms composed of a consultant, registrar, SHO and pre-registration house officer(s).

Definitions

Anaesthetic-associated death (AAD) was defined as the death of a patient during or within 24 hours of anaesthesia, or failure of a patient, who was previously conscious, to regain consciousness after anaesthesia. A 24-hour period after anaesthesia has been used in a number of mortality studies in different parts of the world.[3-6] In this study, the 24-hour period was chosen primarily to facilitate accuracy of data. In Zimbabwe it is established practice for all deaths within 24 hours of surgery/anaesthesia to be given a police docket and to undergo mandatory autopsy. The consequent additional record-keeping greatly improves the chances of tracing such cases.

The avoidable mortality rate (AMR) is the number of avoidable deaths per 1 000 operations. Death was classified as avoidable where mismanagement was considered to have contributed (partially or wholly) to mortality. Avoidable factors were subdivided into three groups — surgical, anaesthetic and administrative. One point per death was awarded where there were avoidable factors, and a group, e.g. surgical, scored one point if none of the other two groups was culpable. If two groups were involved, each scored half a point. (A situation where all three groups were involved in one death did not arise.)

Sources of data

Theatre registers were used to count the numbers and types of operations and anaesthetics. Details of the peri-operative deaths were obtained from these theatre registers, plus postmortem reports and, wherever possible, the case notes.

Decisions on causes of death and avoidability

All available clinical information was scrutinised. Wherever possible the surgeons and anaesthetists involved were given the opportunity to state their opinions — either at mortality meetings or in confidential discussion. In the few cases where this option was declined/evaded, or where a person had left the service, a senior specialist was asked to arbitrate — in a sincere effort to avoid bias. In 2 cases the opinion of a consultant pathologist was obtained.

Results

During the 12-month period, 34 553 surgical procedures were performed, of which 19 834 were done under general anaesthesia. There were 89 AADs as defined, giving a mortality rate of 2.58 per 1 000 operations. There were avoidable factors in 45 cases, giving an AMR of 1.34 per 1 000. With regard to the nature of surgery, 56 of the 89 deaths (62.9%) were major emergency cases. The relative contributions of surgical, anaesthetic and administrative factors to AMR are shown in Table I. The age and sex distribution of the peri-operative deaths are reflected in Fig. 1.

Table I. Mortality rates

Class of operation	No. of operations	No. of deaths	AAD per 1 000 anaes.	No. of avoidable deaths	AMR per 1 000	AMR surg.	AMR anaes.	AMR admin.
Major	11 346	84	7.40	44	3.88	2.29	0.97	0.62
						(26.0)	(11.0)	(7.0)
Minor	23 207	5	0.22	1	0.04	0.04	0	0
						(1.0)	(0)	(0)
Totals	33 553	89	2.58	45	1.34	0.80	0.33	0.21
						(27.0)	(11.0)	(7.0)

* Figures in parentheses are the points scored.
AAD = anaesthetic-associated death; AMR = avoidable mortality rate.

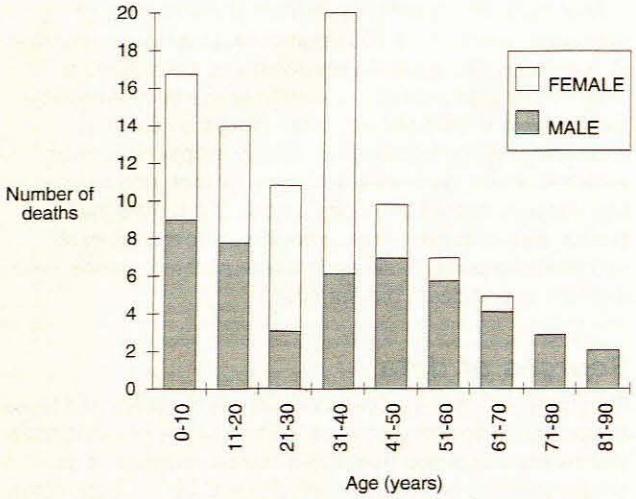

Fig. 1. Age and sex distribution of total peri-operative deaths.

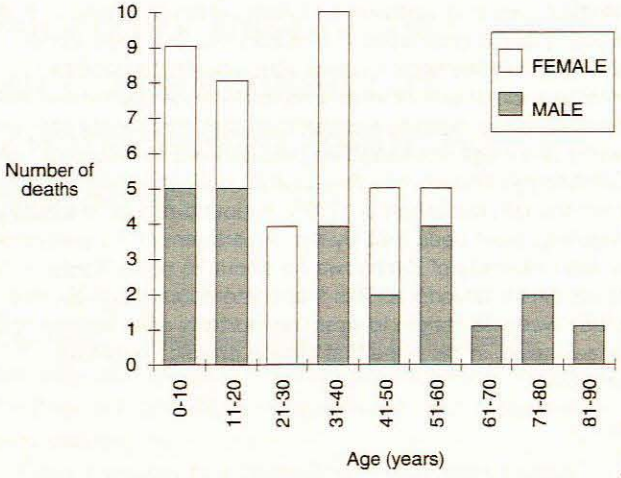

Fig. 2. Age and sex distribution of peri-operative deaths with avoidable factors.

Causes of death

These are shown in Table II. In 75 of the 89 cases autopsy was performed. Significant additional information was revealed by postmortem examination in 12 cases. Fifty-nine deaths (66%) were emergency cases.

Table II. Causes of death

Clinical cause of death	Total (*N* = 89)	Unavoidable (*N* = 44)	Avoidable (*N* = 45)
Abdominal/pelvic sepsis*	28	15	13
Haemorrhage†	24	8	16
Respiratory failure (excluding aspiration)	9	3	6
Head injury/space-occupying lesion/CVA	9	7	2
Malignancy	6	6	0
Cardiac failure	3	2	1
Aspiration	2	0	2
Eclampsia	2	0	2
Pulmonary embolism	2	2	0
Other	4	1	3

CVA = cerebrovascular accident.
* 5 cases of anastomotic dehiscence.
† In 2 cases, the haemorrhage caused death by mechanical effect rather than by hypovolaemia.

Avoidable factors

Table III shows the avoidable factors in 45 deaths; Fig. 2 reflects the age and sex distribution of these cases.

Surgical. Failure to secure haemostasis was by far the most common problem (16 out of 31 cases). The result was usually hypovolaemic shock, but in 2 cases the major insult was mechanical: (*i*) haemothorax causing lung collapse; (*ii*) mediastinal haemorrhage causing cardiac tamponade.

Out of 22 cases of severe haemorrhage leading to hypovolaemic shock/coagulopathy, the haemorrhage was considered truly uncontrollable in 7 cases. In the remaining 15 cases, there were three categories of avoidability: (*i*) massive intra-operative haemorrhage due to inadequate surgical skill (4 cases); (*ii*) slower bleeding that continued into the postoperative period and was inadequately managed (9 cases); (*iii*) coagulopathy which could have been avoided by heeding pre-operative laboratory investigations or by prompt surgical intervention (2 cases).

Table III. Avoidable factors in 45 'avoidable deaths'

Avoidable factors	No. of patients affected
Surgical	
Haemorrhage	16
Anastomotic dehiscence	5
Other trauma	4
Poor pre-operative management/delay	4
Poor postoperative management	2
Anaesthetic	
Respiratory failures	
Failure in airway management	1
Failure in ventilation management	4
Poor postoperative management	6
Poor intra-operative management	2
Poor pre-operative management	1
Administrative	
Insufficient nursing staff/low standard nursing care	3
Equipment failure	3
Lack of high-care unit/ICU	2

The highest incidence of avoidable failure to control haemorrhage occurred in urology (7) and obstetrics (6). Ranked after haemorrhage (in nearly equal proportions) were anastomotic failure (5), 'other trauma' (4) and delayed treatment/poor pre-operative management (4).

The 4 cases of 'other trauma' were: (*i*) inadvertent ligature of porta hepatis; (*ii*) clamping of pulmonary artery; (*iii*) lung collapse following bronchoscopy; and (*iv*) accidental pleural wound causing tension pneumothorax.

Table IV shows that junior surgeons were *not* responsible for more avoidable surgical factors than consultants.

Table IV. Grade of surgeon

	SHO	Registrar	Consultant	Totals
Deaths with no avoidable surgical factors	0	30	29	59
Deaths contributed to by avoidable surgical factors	1	12	17	30

Anaesthetic. Table V shows the breakdown of anaesthetic technique. All cases of avoidable anaesthetic factors were associated with general anaesthesia. The distribution of anaesthetic technique was similar between the various grades of anaesthetic personnel, but general anaesthesia was used much more frequently than regional blocks were.

Table V. AAD classified by type of surgery and anaesthesia

	Elective cases		Emergency cases	
	No avoidable anaesthetic factors	Avoidable anaesthetic factors	No avoidable anaesthetic factors	Avoidable anaesthetic factors
General anaesthesia	24	4	48	10
Regional anaesthesia	2	0	0	0
Local anaesthetic infiltration/ sedation	0	0	1	0
	—	—	—	—
Totals	26	4	49	10

The most common avoidable anaesthetic factor was failure of postoperative care (6 cases). In all cases, the junior anaesthetist (SHO or registrar) did not appreciate the gravity of the situation, and failed to provide invasive monitoring, consider admission to the intensive care unit (ICU) or summon the consultant anaesthetist on call. Four of these patients had septic shock, one had multiple trauma and one eclampsia. The second most common anaesthetic factor contributing to death was failure to control respiration (5 deaths). There were four instances of avoidable failure of pulmonary ventilation: once with a nurse anaesthetist, the remainder with SHOs. In 3 of these cases, cardiac/ respiratory arrest occurred in the recovery ward just after termination of anaesthesia, possibly as a consequence of inadequate reversal of muscle relaxant. Two of these patients were resuscitated, but suffered hypoxic brain damage/brain death. In the 4th case, it seems that inadequate monitoring and improper use of a ventilator resulted in death of the patient on the operating table before surgery could be started.

The only avoidable case of failure to control the *airway* was a failed intubation — of a 125 kg woman requiring emergency caesarean section. The patient aspirated and all efforts of the anaesthetist (SHO) to ventilate the patient failed. The consultant anaesthetist on call was contacted only after the failure to intubate, and the patient died on the operating table. As shown in Table VI, junior anaesthetists (particularly SHOs) experienced the highest incidence of avoidable anaesthetic factors.

Table VI. Grade of anaesthetist

	Nurse	SHO	Registrar	Consultant	Total
Deaths with no avoidable anaesthetic factors	2	12	32	29	75
Deaths contributed to by avoidable anaesthetic factors	1	8	3	2	14

Administrative. A low standard of nursing care (perhaps due to shortage of staff) contributed to 3 deaths. The small number of ICU beds (5 for each hospital) and the absence of a high-dependency unit (HDU) at Harare Central Hospital contributed to 2 deaths. The 'equipment failures' included 2 cases of cardiopulmonary bypass pump problems causing massive haemolysis. In the 3rd case, a non-functioning elevator and absence of a light in the alternative elevator both delayed transfer to ICU and impaired management of a patient who developed a tension pneumothorax following a pneumonectomy.

Discussion

The avoidable mortality rates found in this study are higher than those reported by the UK Confidential Enquiry into Peri-operative Deaths (CEPOD),[7] even though the outcome period of CEPOD was 30 days. To highlight certain issues, some comparisons between this study and NCEPOD are made. It must be emphasised that this study should be considered selective within the context of Zimbabwe. A survey of private practice might reveal quite different figures. Equally, audit of district hospitals could show further differences: anaesthetic services at many of these are provided by a qualified nurse anaesthetist or only an informally trained anaesthetist; furthermore the surgeons may be unspecialised or inexperienced.

The population

The majority of patients are relatively young — 69.7% were younger than 41 years at death (Fig. 1). This is in marked contrast to the NCEPOD report where a much greater proportion were elderly (31.5% older than 80 years).

Within the age range 11 - 40 years, 13 (46.4%) of the 28 *female* deaths were due to obstetric complications. There were avoidable factors in 9 of these 13 obstetric deaths, the commonest factor being failure to control haemorrhage (6 cases). Avoidable factors in the two deaths due to eclampsia were: (*i*) case 1 — administrative, ICU bed not available; (*ii*) case 2 — failure of postoperative care, apportioned to both surgical and anaesthetic staff.

It is notable that out of the total 45 'avoidable deaths' the number of obstetric cases was 10. Since the published Harare Hospital maternal mortality report for 1987[8] there has been a 2.75-fold rise in maternal deaths (V. Iliff, Department of Obstetrics and Gynaecology, University of Zimbabwe — personal communication).

It should also be emphasised that a large proportion of the patients who died (65.2%) were from the working population (often defined as 16 - 64 years). There were avoidable factors in 50.0% of these deaths and measures to improve outcome for this group are obviously of great socio-economic importance (Figs 1 and 2).

Reporting

The 'required' reporting of all deaths within 24 hours of surgery ensured a high yield of data. Nevertheless, zealous follow-up revealed 12 cases where a death certificate was written and autopsy therefor avoided in defiance of the

standard practice. Postmortem examination was also omitted in 2 of the 3 patients who failed to regain consciousness after anaesthesia. In 22 instances (24.7%), the case notes could not be found for review. This compares favourably with NCEPOD where under-reporting was a noted problem.

Lack of certain data

Like NCEPOD, this study suffers from a lack of data on denominators. For example, there were 28 cases of abdominal/pelvic sepsis associated with peri-operative death, but out of how many such cases? What is the overall survival rate in such cases and how is this affected by delay in treatment and by admission to ICU?

Avoidable factors

While some degree of subjectivity is inevitable in decisions on mismanagement, a concerted effort was made to eliminate bias through discussion with many experts. Failure to secure surgical haemostasis is a major problem which needs to be addressed. Junior surgeons need to call their consultants both more frequently and earlier. Surveillance after some operations requires drastic improvement, e.g. prostatectomy, operative delivery where the uterus is poorly contracted.

The problem of failure to control respiration could be improved by provision and use of more monitoring equipment. In 1992, pulse oximetry and capnography were not routinely available in the Harare teaching hospitals. Each hospital had one peripheral nerve stimulator which every anaesthetist could obtain on request. It is notable that a peripheral nerve stimulator was not used in any of the 3 cases where respiratory/cardiac arrest occurred in the recovery ward just after termination of anaesthesia. In common with the NCEPOD finding, it seems that SHO anaesthetists ought to have more supervision by senior anaesthetists.

No doubt the shortage of ICU and HDU beds contributes to many more peri-operative deaths than indicated by this study — if a longer postoperative period is considered.

It is probable that all these factors are accentuated at peripheral hospitals. Comparison of this study with mortality data from neighbouring countries is fraught with difficulties, e.g. differences in population, peri-operative time period, study design and methodology. However, for interest, the AAD and AMR (anaesthesia) from this study and others in South Africa[5,6] and Zambia[9] are summarised in Table VII. It is interesting that the figure of 0.33 for AMR (anaesthesia) in this study is identical to the rate at Groote Schuur Hospital (GSH)[5] for a 9-year period between 1956 and 1966. However, the GSH rate decreased considerably to 0.07 for the 5-year period from 1983 to 1987 — apparently as a result of improvements in knowledge, drug supply, training and monitoring.[6]

In conclusion, the finding that 51% of peri-operative deaths at the Harare teaching hospitals were avoidable demands efforts to tackle the avoidable factors. It is hoped that this form of audit will be continued and that future reports will demonstrate improvement, i.e. a progressive decrease in mortality.

Table VII. Mortality rates in central/southern Africa

Country, hospitals	Years studied	Outcome period	AAD per 1 000 anaes.	AMR (anaes.) per 1 000
South Africa GSH, Cape Town	1956 - 1960 and 1963 - 1966	24 h	2.33	0.33
South Africa GSH, Cape Town	1983 - 1987	24 h	1.27	0.07
Zambia UTH, Lusaka	1989	6 d	7.55	0.52
Zimbabwe Harare teaching hospitals	1992	24 h	2.58	0.33

UTH = University Teaching Hospital.

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