

Anaesthesia associated mortality in a district hospital in Zimbabwe: 1994 to 2001

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Abstract

Objective: To describe anaesthetic associated mortality in a district hospital in Zimbabwe.

Design: A retrospective descriptive study of anaesthesia associated mortality over an eight year period.

Setting: Murambinda Mission Hospital: a 120 bed rural district hospital in Zimbabwe.

Subjects: All patients who died within 24 hours of receiving an anaesthetic.

Main Outcome Measures: The overall mortality rate (OMR), being all deaths up to 24 hours after an anaesthetic. Avoidable anaesthetic mortality rate (AMR), are deaths in which correctable anaesthetic factors played a major role.

Results: An overall mortality rate (OMR) of 1:344 (2.9 deaths/1 000 anaesthetics) and avoidable mortality rate (AMR) for anaesthesia of 1:482 (2.1 deaths/1 000 anaesthetics) are reported. Factors under the control of the anaesthetist accounted for 72% of mortalities (AMR:OMR). All were emergency obstetric patients and had emergency surgery. The hospital maternal mortality rate of 360 per 100 000 and an operative obstetric mortality of 1:293 (3.4 deaths/1 000) are reported.

Conclusions: Most of the anaesthetic factors are preventable. These results, although very poor, are consistent with reports from hospitals in the region. By comparison, developed countries are at least 10 times better. Improving the provision, skills, support and profile of anaesthesia providers in the care of peri operative patients, would reduce anaesthesia-associated factors in peri operative mortality. A system of national audit data collection comparable to the CEPOD or Confidential Enquiry into Maternal Deaths is overdue in Zimbabwe.

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Introduction

Anaesthetic associated mortality statistics have not been reported before from a rural hospital in Zimbabwe. This report draws attention to issues related to the provision and quality of anaesthetic services in Zimbabwe. The Ministry of Health and Child Welfare has a health information system for data collection from health units. However, relevant data for anaesthetic services are difficult to extract from this. McKenzie has reported on anaesthetic mortality at the two tertiary hospitals of Harare Central and Parirenyatwa Hospitals¹ in Harare and on operative obstetric mortality at the Harare Central Hospital Maternity Unit.² Maternal mortality statistics have been collected and reported for many years,³ but again this has not included an analysis of the contribution of anaesthesia to the mortality in contrast to similar reports from the UK,⁴ Australia,⁵ the USA⁶ and now South Africa.⁷

In many countries the collection of anaesthesia associated morbidity and mortality data is now standard practise. The

study of risk assessment and quality improvement in anaesthesia has become an essential part of modern clinical practice.⁸⁻¹⁰ Highlighting preventable factors in a negative anaesthetic outcome has led to changes in provision, education and training and safety of anaesthesia.

Anaesthetic related deaths are uncommon, even in district hospitals in developing countries. Cases can be collected over a period of years from a single institution, as in this study, or as a large scale study involving many hospitals such as that of Fenton¹¹ and colleagues in Malawi. This can be done to highlight the contribution of anaesthesia to mortality. Another approach is to look at anaesthesia related morbidity on the grounds that it is more common than mortality.

Materials and Methods

Setting.

Murambinda Mission Hospital was established in 1968, as a small clinic providing only outpatient services and has

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grown since then to a 120 bed acting district hospital for the district of Buhera, in Manicaland Province, Zimbabwe. Since 1980 there have been two to three doctors at a time providing the entire medical service, each one an expatriate and staying for two to three years. It serves a population of 250 000.¹² The economy is predominantly subsistent farming. Buhera is one of the poorest districts in Zimbabwe. The nearest referral point was Mutare Provincial Hospital (about 200 km away) during this period.

The anaesthetic practice during this period.

1. The majority of general anaesthetics given involved ketamine. The doctor would give the ketamine anaesthetic intravenously before scrubbing and proceeding with the operation. A qualified general nurse then manually monitored blood pressure, pulse and respiration and maintained a chart. The patient would not be intubated but have oxygen by facemask. If anaesthetic top ups were required, the nurse monitoring the patient would draw up the dose under the direction of the doctor and administer half the loading dose intravenously. Atropine was always given to reduce secretions and 10 mg diazepam, but in Caesarean sections the latter was only given once the baby was delivered.
2. Sodium thiopentone was rarely used because that would make intubation mandatory. One of the nuns in the mission was a clinical officer; she was occasionally available to give general anaesthesia with intubation. General surgical cases were usually sent away to Mutare, the Provincial Hospital. Ether is not used in Zimbabwe.
3. For Caesarean sections no pre-medication was given. Occasionally magnesium trisilicate is given when available, but in general it is uncommon to give an antacid. Sodium citrate was not available.
4. Additional analgesics were given for long operations, usually pethidine 50 mg intramuscularly and 50 mg intravenously. No anti emetics were given, even if vomiting occurred.
5. Spinal anaesthetics would commence in the standard way with a pre-load of 1 000 mls Ringer's Lactate. The spinal anaesthetic would most usually be given in the sitting position. After half a minute, the patient was laid down with 15% lateral tilt and 15% anti-Trendelenburg, to prevent high spinal. Heavy bupivacaine was usually available. Ephedrine was rarely, if ever, used but was available. Blood pressure was measured before the spinal and after lying down, then every five minutes. Talking to the patient was considered very important as part of the monitoring. During this period no surgeon could speak Shona, the first language, so everyone spoke to the patient as a way of keeping aware of the state of alertness of the patient.
6. There was a core group of nurses who had expressed a willingness to monitor such patients. They would get instruction from the doctor and then watch a

colleague on the job. They would then be accompanied before they could monitor patients on their own. They would have no previous formal anaesthetic training before this.

7. If the baby was delivered requiring assistance then the doctor would have to unscrub and resuscitate. The nurse receiving the baby would not be trained in neonatal resuscitation.
8. Mishaps usually happened at the beginning or the end of an operation. If there was a conflict of interest between anaesthesia and surgery, the anaesthetic problem always took precedence. The surgeon would unscrub and take over management of the patient.

There was a nurse anaesthetic assistant from 1995 to 1997. He had trained on a six months course in the city of Bulawayo. Since 2001 there has been a nurse anaesthetist with the one year Diploma course from Harare

The Data Collection.

The theatre register for the years 1994 to 2001 at Murambinda Mission Hospital was examined and all deaths within 24 hours of an anaesthetic (table death) were extracted by one of the authors (MG). The histories were extracted and summarised. They were analysed and classified by the other author (FDM). An anaesthesia-associated death (AAD) is defined in Zimbabwe as one occurring within 24 hours of an anaesthetic. It does not imply anything more than a temporal relationship with the anaesthetic. All such deaths were reported as required by the Health Professions Council. Technically a *post mortem* examination is required. However, the process of obtaining one in the rural areas is difficult so that it is seldom done. For the overall mortality rate the numerator is the number of deaths within 24 hours of an anaesthetic over the study period. The denominator is the total number of anaesthetics given during the same period.

The deaths were further classified into avoidable (AMR) and non-avoidable mortality rate. An avoidable death does not mean that the anaesthetist caused it, only that there were factors in the anaesthetic, surgical or administrative domains that, with hindsight and "best practice", may have led to a different outcome. The anaesthetic attributable mortality rate (AAMR) refers to those deaths due to anaesthetic factors, also called the anaesthetic-AMR.

All the mortalities were obstetric patients. Obstetric data was further collected to set the data in the context of obstetric anaesthesia. This included the total obstetric deliveries and maternal deaths at the hospital.

Results

Seven patients died (range: zero to three deaths per year) within 24 hours of an anaesthetic during the eight year study period. All the patients had emergency surgery. A mean of 361 anaesthetics (range 297 to 336) was given each year, giving 120 anaesthetics per 100 000 of population. The Caesarean section rate was 9.6%.

Table 1: Deaths within 24 hours of an anaesthetic at Murambinda Mission Hospital 1994 to 2001.

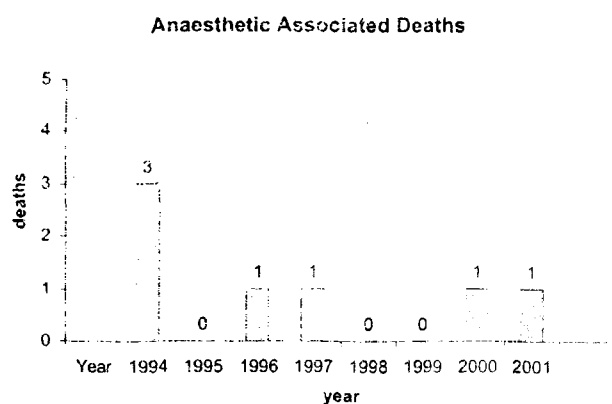
Case	Age	Diagnosis	Surgery	Anaesthetic	Mode of Death
1	33	Obstructed labour, Transverse lie	Caesarian section. Bled post operatively. Laparotomy for post partum Haemorrhage. Hysterectomy but continued to bleed.	Spinal for C/S. Ketamine for laparotomy	Post partum haemorrhagic shock.
2	37	Failure to progress	Caesarian section	Spinal	Cardiac arrest after spinal anaesthetic. Unsuccessful resuscitation. Live infant delivered.
3	21	Pregnancy induced hypertension	Caesarian section	Spinal	Convulsion post operatively followed by respiratory arrest. Resuscitated and transferred. Died in transport. Post mortem showed evidence of continued bleeding and placenta accreta.
4	25	Twin pregnancy. Normal vaginal delivery of first infant at home. Second infant delayed due to transverse lie and died in-utero. Internal podalic version done and followed by breech extraction. Post partum haemorrhage followed.	Laparotomy	Ketamine	At laparotomy uterine tear found and repaired but bleeding persistent. Died one hour post operatively.
5		Cephalo-pelvic disproportion (CPD)	Caesarian section	Spinal	Cardiac arrest on table after spinal anaesthetic.
6	30	Pregnancy induced hypertension	Caesarian section	Ketamine	Did not regain consciousness. Died five hours later.
7	20	Foetal distress, draining thick muconium	Caesarian section	Spinal	Cardiac arrest shortly after spinal anaesthetic. Live infant delivered. Unsuccessful resuscitation.

Individual cases per year have not been identified to preserve the confidentiality of the patients and doctors involved.

Table II: Anaesthetised, obstetric and patients' mortalities at MMH 1994 to 2001.

Years	Total General and Regional Anaesthetics	Total Obstetric Anaesthesia Cases (%)	Total Obstetric Deliveries	Anaesthesia Associated Deaths	% (AAD/Total Anaesthetics)	Total Hospital Deaths	% (Table Deaths/Hospital Deaths)
1994-2001	2410	2054 (85.2)	21,393	7	0.3	3034	0.23

Figure 1: Deaths each year of study.



Overall Mortality Rate (OMR).

Following an anaesthetic at MMH the overall mortality rate is 1:344 (7/2 410).

Avoidable Mortality Rate (AMR).

This refers to the anaesthetic, surgical or administrative factors that could be corrected. Such intervention may not have been foreseen at the time but with the benefit of hindsight remedial action can be identified to avoid such an outcome.

Anaesthetic AMR: 1:482.

Deaths in which anaesthesia may have been directly responsible: **Cases: 2,3,5,6 and 7.**

The anaesthetic factors relate principally to the management of hypotension during spinal anaesthesia. This requires aggressive management with possibly large volumes of fluid and use of ephedrine or adrenaline, left lateral tilt or complete lateral.

The use of ketamine in a hypertensive patient is strongly contra-indicated. Given that ketamine anaesthesia was the predominant form of general anaesthesia, if a spinal could not be done then the alternatives were very limited.

Surgical AMR: 1:2 410.

Surgical factors relate to one case (**Case 4**) of PPH where it appears that surgical haemostasis and haematological management of DIC may have made a difference.

Administrative AMR: 1:2 410.

Access to sufficient quantities of blood and blood products is a major problem in a district hospital in a rural area (**Case 1**).

Maternal Mortality Rate (MMR).

There was an average of 2 674 deliveries annually (range: 2 339 to 3 005). Over the same period there were 77 maternal deaths in hospital. The hospital MMR was 360 deaths per 100 000 (77/21, 393). The seven anaesthesia-associated deaths account for 9.1% of maternal deaths (7/77).

Total general vs regional anaesthetics given in all operations.

Table III: Type of anaesthesia given 1994 to 2001.

Anaesthetic	Number	Percent
General (Ketamine)	794	33%
Spinal	1 230	51%
Local infiltration	13	0.5%
Unspecified	373	15.5%
Total	2 410	100%

Hospital Deaths.

Anaesthesia associated deaths accounted for 0.23% (7/3 034) of the total hospital deaths from all causes. One patient had a *post mortem* examination.

Discussion

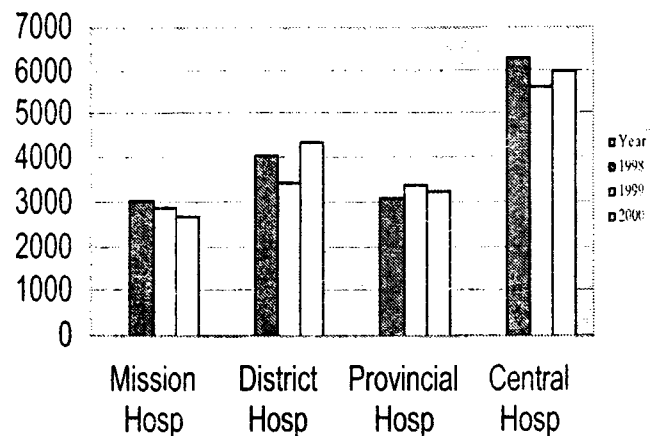
The majority of operations in rural hospitals in Zimbabwe are Caesarean sections, the lower the level of establishment the higher the proportion of Caesarean sections. Anaesthetic service provision does not take cognisance of the needs of the patient at this level. The anaesthetist at district level may be a:

1. Nurse anaesthetist with a one year diploma from Harare.
2. Nurse anaesthetic assistant with the six months training in Bulawayo.
3. Nurse with on-the-job training and no recognised qualification in the anaesthetic management of a patient.
4. There are a handful of doctors with formal training in anaesthesia practicing in the rural areas. All doctors, even with no knowledge of anaesthesia are considered the responsible authority in any anaesthetized patient. Most doctors feel comfortable with performing a spinal or give ketamine after basic training without the requirement for intubations. This pattern is repeated throughout most of Africa.¹³⁻¹⁵

There are 76 mission and district hospitals and seven provincial hospitals in Zimbabwe. Between them they perform 60% of all Caesarean sections in the country. Similar characteristics of rural district hospital practice have been reported from southern Africa.¹⁶

It seems, therefore, that the training and provision of anaesthesia providers at the district level is not a priority. Mortality figures represent an extreme end of a spectrum of morbidity that also needs addressing. The level of anaesthetic skills required need to take account of problems

Figure II: Caesarean sections in Zimbabwe: peripheral hospital vs central hospital.



that may be encountered fairly infrequently and dealing with problems with little or no back-up support. In a study from Malawi hypertension following anaesthesia was the commonest complication.¹⁷ Those patients resuscitated by the physician anaesthetist nearly all survived (4/5) while those resuscitated by the clinical officers nearly all died (9/10). There is a large skills gap between staff at the district hospital and the specialist physician anaesthetist. This can be addressed through the training and retention of large numbers of nurse and physician anaesthetists. Surgeon/anaesthetists will continue to be with us unless the number of trained anaesthetists available is adequate. At present the nurse anaesthetist training programme has produced between four and 10 candidates a year and the physician anaesthetist training course has produced between one and five anaesthetists every year for the last 10 years. This is not enough to meet service and future training requirements.

Regional is generally regarded as being safer than general anaesthesia in obstetric anaesthesia practice. However, under the circumstances of a single surgeon/anaesthetist, spinal or ketamine general anaesthesia as described above is widely practiced.¹⁸ Of the five cases where mortality was due to anaesthetic related factors, four patients had had a spinal. For spinal and epidural anaesthesia to be practised successfully fluid and vasoconstrictor drugs must be available and used aggressively.¹⁹ Skilled monitoring by a vigilant anaesthetist and adequate equipment are essential. The Zimbabwe Anaesthetic Association has published minimum standards for monitoring in anaesthesia practice for the country.²⁰ In addition, the ability to resort to general anaesthesia with the attendant intubation, ventilation and resuscitation skills is a requirement. The safety of spinal anaesthesia as described above is easy to improve through training. Patients who did not die but may have had a sub-optimal anaesthetic course will also reap the benefit. One patient had pregnancy-induced hypertension (PIH) but had a ketamine anaesthetic. The outcome was almost inevitable.

An avoidable mortality rate (AMR) of 1:482 (2.1/1 000 anaesthetics) is very high by world standards. However, it

is comparable with Malawi¹⁷ 1:504 (2.0/1 000) and Zambia²¹ 1:303 (3.3/1 000). The deaths reported here are all obstetric deaths (9.6% Caesarean section rate) and all had avoidable factors. In Australia the AMR is 1:67,000 (0.015/1 000).⁵

An additional observation is that the ratio between the anaesthesia AMR and OMR reflects the contribution of anaesthesia to overall anaesthetic risk. The table below shows that the AMR (2.1) accounts for nearly 72% of the OMR (2.9) of Murambinda Mission Hospital compared to about 10% for Australia. This suggests that much can be achieved by improving the anaesthetic service.

Table IV: Comparative statistics of OMR.

Institution	OMR	Death/1 000 anaesthetics	Year
Parirenyatwa and Harare Central Hospitals, Zimbabwe	1:377	2.7	1992
Harare Maternity Unit	1:447	2.2	1992-1994
Lilongwe Central Hospital, Malawi	1:215	4.7	2000
Two Central Hospitals in Malawi ¹¹	1:111	6.0	1998-2000
District Hospitals in Malawi ¹¹	1:77	13.6	1998-2000
University Teaching Hospital, Zambia	1:132	7.6	1987
University Hospital Kuala Lumpur, Malaysia ²²	1:1 240	0.8	1980-1992
Mortality Report: Australia and New Zealand College of Anaesthetists	1:5 744	0.17	1991-1993
Murambinda Mission Hospital	1:344	2.9	1994-2001

The definition of an anaesthetic associated death currently in use in Zimbabwe is archaic. With developments in anaesthesia and critical care medicine it is possible to postpone the diagnosis or prolong life beyond the 24 hour window. One widely accepted definition is "death during or following anaesthesia that may be attributable to an anaesthetic."²³ Current international practice is that a death up to 30 days and all deaths in hospital after an anaesthetic may be enumerated. This makes the data collection and the analysis more difficult, but the information is more accurate and relevant. Classification systems for analysing information have been published and one such widely accepted and used in Australia is presented in Table V.

Of the seven cases presented, probably only one was not directly related to the anaesthetic (Case 1.). At worst this patient would be a Class B 2. and at best a Class A 3. At a district hospital in a developing country, it is not possible to do the best that is possible; one can only do the best under the circumstances. The lack of availability of blood and blood products appears to be the determinant factor in this case.²⁴

Many countries have systems for collecting, analysing and publishing such data for the purpose of improving the quality of the delivery service by learning from mistakes. This process carries no punitive role.

In the United Kingdom, the CEPOD (Confidential Enquiry into Pre-operative Deaths) publishes a report

Table V: Classification of deaths by the Anaesthesia Mortality Committee of the Australia and New Zealand College of Anaesthetists (ANZAC) 1998.

Class A	Death attributable wholly or partly to anaesthesia.
1.	Where it is reasonably certain that the death was due to the anaesthetic or other factors under the control of the anaesthetist.
2.	Where there is some doubt about whether the death was entirely attributable to the anaesthetic or factors under the control of the anaesthetist.
3.	Where death was caused by both anaesthetics and surgical factors.
Class B	Deaths in which anaesthesia played no part.
1.	Death entirely referable to surgical factors.
2.	Inevitable deaths in which anaesthetic and surgical management were entirely satisfactory.
3.	Fortuitous death, i.e. not due to the indication for surgery and not due to surgical or anaesthetic factors. Death could not have been reasonably foreseen.
Class C	Unassessable deaths.
1.	Those that cannot be assessed despite considerable data.
2.	Those that cannot be assessed because of inadequate data.

annually whose recommendations the medical profession and the government take seriously.²⁵ Over a number of years many changes in pre-operative patient management initiated as a result of such reports have led to consistent improvements in patient care and outcomes.²⁶ In Australia it is a statutory requirement that such data is collected. With the present Health Information collection system, the infrastructure for collecting anaesthetic related information exists. The Medical and Dental Professions Council receives reports of all deaths within 24 hours of an anaesthetic as a legal requirement. These two services could be developed into a course of authoritative reports of pre operative mortality that could add weight to efforts to improve peri operative outcomes.

Conclusion

This is the first such report from a rural hospital in Zimbabwe. The anaesthesia associated mortality is very poor when compared with the highest standards of anaesthesia practice world wide, but comparable to similar settings in the region. Much needs and can be done to improve anaesthesia services in the rural areas. Obstetric anaesthesia is the major anaesthesia practice in the peripheral hospitals. In the best practice obstetric anaesthesia has a very low operative mortality. A greater effort is required to make adequate anaesthetic services available to the rural areas. A system of authoritative reports based on systematic national data collection would go a long way in giving energy to such an effort.

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