

A 2-Year Audit of Perioperative Mortality in Malaysian Hospitals

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Summary

An audit of all perioperative deaths within seven days of surgery in 14 major public hospitals is presented. This study is part of a quality assurance programme examining the surgical and anaesthetic practices in these hospitals. During the study period from July 1992 till June 1994, 211,354 surgeries were performed and 715 deaths were reported out of which 699 were available for analysis. The data was obtained by confidential enquiry using predetermined questionnaires filled by participating surgeons and anaesthetists and analysed by a group of peers. The overall crude mortality rate was 0.34% and the majority of the deaths occurred in severely ill patients in whom the clinical management was satisfactory. Polytrauma including head, intra-abdominal and skeletal trauma accounted for 253 of the deaths (36.19%). The other causes were bowel obstruction with sepsis, burns, ischaemic limbs, congenital malformations in neonates and pregnancy-related hemorrhage. 62.52% of the deaths occurred within two days of surgery and 85.87% were related to emergency procedures. The review identified some shortfalls in perioperative care and these were lack of adequate critical care facilities, lack of supervision, unnecessary surgery in the moribund and inadequate preoperative optimisation. The results of the study have been forwarded to all participating hospitals for implementation of remedial measures.

Key Words: Audit, Perioperative mortality, Surgery, Anaesthesia

Introduction

Few countries have studied perioperative mortality on a national scale. One such study was the National Confidential Enquiry into Perioperative Deaths (NCE-POD)^{2,3,5,9}, established in 1988 in the United Kingdom. The recommendations published in this report were made available to health-care providers to identify areas for improvement. Such studies also helped establish standards and criteria, which could be used by health-care purchasers and providers. The advantage of establishing a national study is the creation of a large database, which would give a clearer picture of the pattern of problems encountered in the perioperative care of patients. It was with this intention that the Perioperative Mortality Review (POMR) was initiated

in July 1992 by the Ministry of Health as part of its Quality Assurance Programme in Health Services.

The main objective of the POMR was to evaluate the quality in the delivery of care in surgical-related disciplines. The specific objectives of this study were to identify aspects of surgical and anaesthetic care involved in perioperative care, including diagnosis, assessment and resuscitation, technical skills and appropriate procedures. In addition the study was to look into logistic and infrastructure support for operative services such as availability of blood and blood components, radioimaging and availability of operating rooms. The risk factors identified with perioperative deaths would allow the organisation to put in remedial measures.

Methodology

Perioperative mortality was defined as any death occurring within seven days of a surgical procedure under general anaesthesia or major regional anaesthesia. The study covered fourteen major hospitals in the country. All surgical disciplines were included except cardiothoracic surgery. The period of study was from July 1992 till June 1994.

Specific questionnaires for surgery, anaesthesia and obstetrics were made available to all participating hospitals. Apart from collecting data on patient profile, the questionnaires were designed to obtain information on the nature of surgery, perioperative status, status and experience of the surgeon and the anaesthetist, intraoperative and postoperative factors which could have contributed to the mortality. The ASA classification (Appendix A) was used to stratify risk factors associated with surgery and anaesthesia.

To categorise deaths, a standard grading system was used (Appendix B). This categorisation was basically to indicate whether the death was unavoidable or possibly preventable and was assigned after review by assessors and discussion by the committee.

Completed questionnaires were received and was reviewed by the POMR Committee comprising of a group of practicing anaesthetists, surgeons and obstetricians from various hospitals in the country including the National University of Malaysia. Confidentiality and anonymity was assured by the removal of all identification data of patients and hospital before peer review.

In addition to this, demographic data was collected from hospital record offices of patients who had died within seven days following surgery. This demographic data was collected by the records office of the hospital and passed on to the POMR secretariat and the Information and Documentation Unit (IDS) of the Ministry of Health. This parallel reporting system served as a check on the actual number of perioperative cases and the deaths reported.

Results

During the two-year study period, 211,354 surgeries were done and 715 deaths were reported, giving a crude mortality rate of 0.34% or about 340 deaths for 100,000 surgical procedures. Out of the 715 deaths, 699 questionnaires were returned. Of these, 442 reports were received from surgeons, 482 from anaesthetists and 212 from both. 16 reports contained insufficient data for detailed analysis.

Calendar days following surgery (Table I)

Most of the deaths occurred in the immediate postoperative period, 27.32% (191 out of 699) occurring on the day of surgery, 19.03% on the first day, and 17% on the second day. The death rates declined with time.

Place of perioperative death

The majority of the deaths (62.25%) occurred in the intensive care or high dependency units with a smaller number (28.96%) occurring in the surgical wards.

Nature of operation

Most of the deaths occurred after emergency surgery (85%, or 614 out of 715); whereas elective surgery

Table I
Deaths by postoperative days

Postoperative day	Number of deaths	Percentage of deaths
0	191	27.32
1	133	19.03
2	113	16.17
3	64	9.16
4	64	9.16
5	60	8.58
6	40	5.72
7	34	4.86
Total	699*	100.00

* Data was available only for 699 cases

accounted for 15%. The ratio of emergency surgery deaths to elective surgery deaths is 7:1.

Age distribution

The age distribution of deaths is shown in Table II and it showed that the proportion of deaths for the age group

Table II
Deaths by age distribution

Age in year	Number of deaths	Percentage of deaths
0	191	27.32
Neonate	62	8.69
Infant	20	2.80
1-12	37	5.19
13-29	141	19.78
30-49	185	25.95
50-79	228	31.98
80 and above	40	5.61
Total	713*	100.00

* Age was not available for 2 cases

Table III
Death by ASA grading (see Appendix A)

ASA Class	Number	Percentage
1	31	4.4
2	84	11.8
3	139	19.6
4	306	43.1
5	160	21.1
Total	710*	100.0

* Data not available for 5 patients

13-49 years was 45.83%, or 326 out of 713 deaths. The proportion of deaths in the age group 50 and above was 268 or 37.59% and among infants and neonates 82 or 11.49%.

ASA grading

Most of the deaths (83.8% or 605 out of 710 were categorised preoperatively as ASA category 3, 4 and 5 with a peak at ASA 4 category. 160 deaths (21.1%) were categorised as ASA 5, where death was imminent within 24 hours (see Table III).

Death category (Appendix B)

The perioperative care was satisfactory in the vast majority and death was classified as inevitable in 71%. 48 deaths (6.6%) took place in patients who were expected to make uneventful recovery (see Table IV). The main surgical factors contributing to deaths include inadequate preoperative assessment and optimisation, inappropriate operative procedures, and failure to recognise postoperative complications (see Table V). The anaesthetic factors contributing to the deaths were related to inadequate preoperative assessment and optimisation of cases, inadequate management of intraoperative problems including techniques and inadequate postoperative monitoring (see Table VI). Inadequate numbers of intensive care and high dependency beds was also a factor.

Table IV
Deaths classified by death category (see Appendix B)

Death category	Number	Percentage
1	27	3.7
2	49	6.8
3	48	6.6
4	505	71.0
5	48	6.6
6	38	5.3
Total	715	100.0

Table V
Surgical factors (Category 3 deaths)
contributing to death

Surgical Factors	Number	Percentage
A. Preoperative		
Inadequate assessment	39	13.6
Inadequate optimisation	38	13.2
Delay in surgery	25	9.0
Inadequate facilities	13	4.5
Lack of supervision	5	2.0
B. Intraoperative		
Inappropriate procedure	41	14.3
Inadequate skills	19	7.0
Lack of supervision	11	4.2
Inadequate facilities	0	0
C. Postoperative		
Failure to recognise complication	34	12.0
Inappropriate management	23	8.0
Inadequate facilities	22	8.0
Inadequate monitoring	17	6.0
Total	286	100.0

Surgical diagnosis

The ten most common surgical diagnosis associated with mortality is given in Table VII. Head injuries accounted for 25% of them (135 out of 541) and intra-abdominal trauma 16.3%. Large bowel pathology was diagnosed in 11.3% of the cases reported.

Table VI
Anaesthetic factors (Category 1 and 2
deaths) contributing to deaths

Anaesthetic Factors	Category 1	Category 2
A. Preoperative		
Inadequate assessment	2	14
Inadequate optimization	2	13
Lack of supervision	2	4
Weakness of organizing system	2	0
B. Intraoperative		
Inadequate management of complications	10	2
Inappropriate technique	7	3
Lack of skill	5	0
Inappropriate drug administration	4	1
Poor reversal	3	0
Adverse drug reaction	1	0
Inappropriate fluid management	0	2
C. Post-operative		
Inadequate monitoring	7	25
Shortage of ICU/HDU beds	2	9
Inappropriate management in HDU/ICU	0	2

Grade of surgeons and anaesthetists

Table VIII gives the categories of doctors involved in the surgical and anaesthetic teams. In 64.5% of the cases the surgical team were specialists and in 28% of the cases the anaesthetists were specialists.

Table VII
Leading surgical diagnoses
associated with deaths

Diagnosis	Number	Percentage
Head injury	135	25.0
Intra-abdominal injury	88	16.3
Large bowel pathology	61	11.2
Peptic ulcer complication	51	9.4
Obstetric/Gynecology	45	8.3
Limb sepsis	37	6.8
Congenital Gut Malformation	35	6.5
Peritonitis	34	6.3
Spontaneous brain bleed/ tumour	28	5.2
Burns	27	5.0
Total	541	100.0

Table VIII
Grade of Surgeons and Anaesthetists

Diagnosis	Number	Percentage
M.O. < 6 months	67 (10.5%)	6 (1%)
M.O. > 6 months	347 (51.5%)	168 (24.5%)
Registrar	60 (9%)	60 (9%)
Specialist	150 (22%)	318 (45.5%)
Consultant	40 (6%)	136 (19%)
Medical Assistant	7 (1%)	not applicable

Associated medical conditions

The most common associated medical conditions are given in Table IX. These include systemic sepsis, ischaemic heart disease, hypertension and diabetes

Table IX
Associated pre-existing medical illnesses

Pre-existing medical illness	No. of patients	Percentage
Systemic sepsis	154	21.6%
Ischaemic heart disease	89	12.7%
Diabetes mellitus	63	9%
Hypertension	56	8%
Coagulopathy	46	6.4%
Chronic obstructive airway disease	43	6.0%
Renal failure	37	5.2%

mellitus. Several of the cases had more than one pre-existing medical illness.

Discussion

Peer group review of perioperative management was the basis of the national POMR study initiated in 1992 in Malaysia by the Ministry of Health. Mortality is easily defined end point in surgical outcomes and has formed the starting point for many audit studies in anaesthesia and surgery^{1,2,3}. Perioperative mortality is a sentinel event and may be less sensitive than morbidity in assessing surgical and anaesthetic quality⁴, but nevertheless forms a useful starting point to analyse the process of care. The method chosen in this study was the use of standardised predetermined questionnaires to collect and analyse data on total perioperative mortality.

The crude death rate calculated at 0.34% or 340 deaths per 100,000 procedures is lower than the UK figures given by CEPOD² and NCEPOD⁵. The lower incidence could be due the differing definitions of perioperative mortalities; the POMR study adopting a 7-day period after surgery and the CEPOD, and NCEPOD a 30-day cut off point. Under reporting was another problem in this study coupled with poor record

keeping, documentation and difficulties in record retrieval in many of the hospitals. A total of 715 deaths were reported but because of a lack of sufficient data in some, 699 were available for analysis for most of the variables considered in the study. In some of the earlier studies on preoperative mortality done by Beecher¹⁶ in 1948, their operative death rates taken for the entire hospital stay was 1331 per 100,000 procedures. A later study done by Tikkanen¹⁸ in 1986 which also considered perioperative mortality for the whole hospital stay indicated an overall mortality of 175 per 100,000 surgeries. The CEPOD² report which calculated operative mortality for 30 days had 700 deaths per 100,000 procedures.

62.52% (437 out of 699) of the deaths occurred within the first 48 hours of surgery (Table II) i.e. the second postoperative day. This highlights the fact that most patients were seriously ill at the time of admission and had major physiological derangements at time of surgery and the immediate postoperative period. Operative mortality for high-risk procedures varies from 4-5% in colorectal surgery for the elderly⁶ to around 50% for ruptured intra-abdominal aortic aneurysm⁷. Many of our cases which died required intensive monitoring and life support and the majority in fact were managed in critical care areas. In Table III, it is noted that 28.96% of the deaths occurred in the general wards where there is often lack of adequate monitoring and support facilities for critically ill patients. Operating teams at present have acquired much knowledge and skills and are capable of handling difficult and complex problems. However, they are disadvantaged by the shortage of intensive care and high dependency beds in many of the participating hospitals⁸. This certainly contributed to perioperative deaths, a finding which is shared in the NCEPOD reports³.

In terms of age our study recorded that more than 45% of the deaths were in patients in the 2nd to the 5th decade of life in contrast to NCEPOD where more than 70% of the deaths were in patients aged 70 or more. The differences could be attributed to the different causes of death. In the UK study, the main causes was due to sepsis, complications following large bowel surgery and limb ischemia, all of which tends to occur in the older age groups. In the POMR study, polytrau-

ma including head injuries was the major contributor which tends to occur in the younger patients. Road trauma is the main cause of death in the 8-40-age groups²² in Malaysia and the main cause of hospitalisation among males aged 20 to 40²³. There was also high mortality in surgery for neonates. 9% of the deaths were from this category although they contributed to only 0.6% of the total operations. In summary, in terms of age, operative mortality was highest among the neonates and the group aged 20 years to 50 years.

85% (614 out of 699 deaths) of the POMR study were classified as emergency surgery (a ratio of 7:1 when compared to elective surgery) which is much higher than the NCEPOD 1992⁹ study where there were equal numbers of elective and emergency surgery deaths. A one-month survey conducted among the 14 participating hospitals indicated that 65% of the surgical workload consisted of emergencies and more than half of them were done outside office hours⁸. A look at Table IX reveals that severe head injuries, intra abdominal injuries, large bowel surgery, and conditions leading to advanced sepsis were major contributors to emergency surgeries. These emergency conditions are also brought about by patients seeking treatment late and delay in referrals from peripheral centres.

In terms of severity of illness, more than 60% occurred in seriously ill patients who were classified as ASA 3 and 4 (see Appendix A). These patients were compromised with pre-existing medical problems. More than one-fifth of the deaths occurred in patients in ASA 5 category where they were moribund and were expected to die within 24 hours, even without having subjected to surgery. These surgeries may sometimes be judged unnecessary or unjustified, often because the patients have advanced disease, were elderly or in poor general condition. Inexperience and poor judgment may have contributed to this. The NCEPOD recommendations² were that patients who were terminally ill should be allowed to die without subjecting them to unkind surgery. In terms of risk stratification the ASA classification²³ correlates fairly well with the overall surgical mortality although it was not meant to be used as an estimate of "operative risk"¹². In one study¹³ involving more than 68,000 elective cases, there was a clear trend in increasing mortality with increasing ASA grades. In that study the incidence of mortality was

0.08% for ASA 1 patients increasing to 9.4% to those in ASA 4. There is however sufficient inconsistency to place reliance on the ASA rating as the sole indicator of patient's condition^{10,11}. The rating does not take into account the extent and complexity of surgical procedures and there is an additional bias when the rating is done after a perioperative death. Several studies have examined risk factors of operative mortality using multivariate statistical models^{14,15}. Independent predictors include advanced age (>70 years), male gender, emergency procedures, major surgery, ASA grading, intraoperative complications, opioid techniques and the number of anaesthetics given. 16.2% or 115 of deaths occurred in patients categorised as ASA 1 or 2. A substantial number of these patients were trauma patients in particular head trauma who were young and apart from the primary injury had no physiological derangement⁸. There is also a possibility of a misinterpretation of the ASA classification by the individual reporter not taking into account systemic problems caused by the surgical pathology.

Majority of the deaths were inevitable and management was fairly satisfactory. There were some areas of deficiencies in both anaesthetic and surgical practices in about 20% of the deaths. The deficiencies are highlighted in Table VII and VIII, which include inadequate assessment and optimisation of patients, as a result of undue haste in getting the case to the operating room. Inappropriate procedures and failure to recognise post-operative complications were the more significant factors among the deficiencies.

6.6% of the deaths were categorised as class V where the patients were expected to make uneventful recoveries but died unexpectedly. Most of these cases had causes of death diagnosed as pulmonary embolism, myocardial infarction or cerebrovascular accidents and few were confirmed at post-mortems. Deep vein thrombosis (DVT) prophylaxis which is beneficial for high-risk patients²⁴ appears not to have found favour among the surgeons in the participating hospitals. None of the category 5 patients had been on DVT prophylaxis although there is evidence of benefit in certain patients^{25,26}.

Of the ten leading diagnostic categories, polytrauma accounted for 34% of the deaths and it involved mostly

younger patients. Head injury alone accounted for 18% of the deaths. This was followed by intra-abdominal sepsis and large bowel obstruction. Surgery for upper gastrointestinal hemorrhage accounted for 9.4% of deaths and limb sepsis a further 6.8%. In a study by O. Brien and colleagues¹⁹ the mortality rate for primary amputation for all causes for patients above 80 years is around 25% in the immediate postoperative period and 33% at about 6 months. Intra-abdominal injury accounted for 88 deaths (16.3%). The most common injuries were splenic and hepatic injuries. The mortality following hepatic injury is quite high and in some studies is as high as 34%²⁰. Pregnancy related causes constituted 7.9% of the overall mortalities and post partum hysterectomies were noted in 19 out of 41 obstetric operative deaths. Pelvic haemorrhage and post partum haemorrhage were the commoner indications for operative intervention. Post partum haemorrhage is the leading cause maternal mortalities in Malaysia²¹. The other causes are obstetric pulmonary embolism and complications resulting from pregnancy induced hypertension²⁴. It was noted in both reports^{21,24} that inadequate fluid resuscitation following post-partum haemorrhage is a major risk factor. Sub-optimal care in obstetric deaths included inadequate preoperative resuscitation, inappropriate procedure and lack of skill.

The lack of a reliable denominator for specific procedures in this review (with the exception of Caesarian sections) has made it difficult to calculate procedure specific mortality rates, which would have been more meaningful and can be used for comparison.

Conclusions

This large scale study, which the first of its kind in this region has helped to identify several remediable problems and also highlight certain characteristics of Malaysian perioperative deaths. A patient with a high risk for perioperative mortality would be a male who has sustained severe trauma after a motor vehicle accident, between 20-50 years of age, is of ASA IV and has the operation done as an emergency outside office hours. Additional factors would be the lack of intensive care and high dependency facilities. Death would commonly occur within 48 hours of surgery.

The POMR committee made some recommendations in the light of this study and among them were:

- a. The reorganisation of operating rooms to give priority and resources for emergency surgery.
- b. Hospitals to increase the number of intensive care and high dependency beds to cater for ill patients during the perioperative period.
- c. The development of departmental protocols and guidelines for management of ill patients in particular emergencies.
- d. All surgical and anaesthetic departments to have regular mortality and morbidity meetings.
- e. The development of appropriate computerised documentation for surgical procedures.

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Appendix A

American Society of Anesthesiologists classification of medical status (ASA classification)

Grade 1: A patient who has no organic disease or in whom the disease is localised and causes no systemic disturbance.

Grade 2: A patient exhibiting slight to moderate systemic disturbance which may or may not be associated with the surgical complaint and which

interferes only moderately with the patients normal activities.

Grade 3: A patient exhibiting severe systemic disturbance which may or may not be associated with the surgical complaint and which seriously interferes with the patient's normal activities.

Grade 4: A patient exhibiting extreme systemic disturbance which may or may not be associated with the surgical, complaint which seriously interferes with the patients normal activities and which has already become a threat to life.

Grade 5: A patient who is moribund before operation, whose preoperative condition is such that he is expected to die within 24 hours even if he or she is not submitted for surgery.

Appendix B - Classification of Perioperative Deaths

Category 1: Anaesthesia is the main contributory factor leading to perioperative death.

Category 2: Perioperative death is due to both surgical and anaesthetic factors.

Category 3: Perioperative death is mainly due to surgical factor/technique.

Category 4: Perioperative death occurring in a high-risk patient in whom the management was satisfactory.

Category 5: Unexpected perioperative deaths e.g. pulmonary embolism or myocardial infarction where the patient was expected to make a full recovery.

Category 6: Cause of death cannot be ascertained either due to insufficient data or otherwise.

References

1. Buck N, Devlin HB, Lunn J.N. Confidential Enquiry into Perioperative Deaths. London: Nuffield Provincial Hospitals Trust and Kings' Fund, 1987.
2. National Confidential Enquiry into Perioperative Deaths (NCEPOD) 1989. Published by NCEPOD, 35-43 Lincoln Inns Fields, London WC2A 3PN.
3. National Confidential Enquiry into Perioperative deaths (NCEPOD) 1992/93.
4. Blumberg MS. Risk adjusted health care outcomes; A methodologic review. Medical care review 1986; 43: 351-53.
5. National Confidential Enquiry into Perioperative deaths (NCEPOD) 1991/92.
6. Adloff M; et al. Colorectal cancer in patients over the age of 80 years; Ann. Chir 1993; 47(6): 492-96.
7. Katz DJ, Stanley JC. Operative mortality rates for intact and ruptured abdominal aortic aneurysms; A 11 year study in Michigan State: J of Vascular Surgery. 1994 May; 19(5): 804-15.
8. Perioperative mortality review. A two year report July 1992 - June 1994. Published by Ministry of Health Malaysia.
9. National Confidential Enquiry into Perioperative deaths (NCEPOD) 1990.
10. Tiret L, Desmont JM, Hatton F. Complications associated with anaesthesia; a prospective survey in France. Can Jour. Anaesthesia 1986; 33: 336-44.
11. Hines R, Barash PG, et al. Complications occurring in the post anaesthesia unit: a survey. Anaesthesia and Analgesia; 1992; 74: 503-9.
12. Keats AS. The ASA classification of physical status - a recapitulation. Editorial Anaesthesiology 1978; 49: 233-36.
13. Vacant CJ, Van Housen RJ, Hill RC. A statistical concept of the relationship of physical status to post operative mortality in 68,000 cases. Anaesthesia and Analgesia 1970; 49:564-66.
14. Cohen MM, Duncan PG,. Does anaesthesia contribute to operative mortality?. JAMA 1988; 260: 2859-63.
15. Pedersen T, Elison K, Hendersen E. A prospective study of mortality associated with anaesthesia and surgery, risk indicators of mortality in a hospital. Acta Anesthesiology Scand. 1990; 34: 176-82.
16. Beecher HK, Todd DP, - Study of deaths associated with anaesthesia and surgery. Ann. of Surgery; 1954; 140: 2-34.
17. Harrison GC. Death due to anaesthesia at Groot Shurr hospital; Cape Town. 1956-87. S. African Med. J. 1990; 77: 412-15.
18. Tikkanen J et al. Deaths associated with anaesthesia and surgery in Finland. Acta Anaesthesia Scand. 1955; 39: 262-67.
19. O Brien TS, Lamont PM. et al. Limb surgery in the octogenarian; is limb salvage surgery worthwhile? Ann. R. Coll. of Surg. 1993; 75(6): 445-7.
20. Menegaux F, Langlois P. Severe blunt Trauma of the liver; study of mortality factors. J. of Trauma 1993; 35(6); 865-9.
21. Report on Confidential Enquiries into Maternal deaths in Malaysia 1993. Published by Ministry of Health Malaysia.
22. Ministry of Health Malaysia - Statistics from the Information and Documentation Unit - 1993.
23. Royal Malaysian Police - Statistics of road traffic accidents - 1992-1993.
24. Report on Confidential Enquiries into Maternal deaths in Malaysia 1992. Published by Ministry of Health Malaysia.
25. Paiement G, Wessinger J, Haris W. Survey of prophylaxis against venous thrombosis in adults undergoing hip surgery. Clin Orthop 1987; 223: 188-93.
26. Kakkar VV, Corrigan TP, Fossard DP. Prevention of fatal postoperative pulmonary embolism by low doses of heparin. Lancet 1975; 2: 45-51.