

Peri-operative mortality in the anaesthetic service at Tygerberg Hospital

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Abstract This study reports on the process of peer review of peri-operative mortality at Tygerberg Hospital. The peri-operative mortality rate for the past 3,5 years was 11,9/10 000. The departmental evaluation committee thought that 3,4/10 000 of these deaths were anaesthetic-related. In 2,3/10 000, the anaesthetic contributed to the death of the patient and in 10 cases (total case load = 94 945; i.e. 1,1/10 000) anaesthesia was responsible for the death of the patient. The majority of the peri-operative deaths (8,5/10 000) were caused by a combination of trauma and haemorrhagic shock.

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Continuous peer review and audits of anaesthetic services are essential and in this study we summarise the results of the review process dealing with peri-operative deaths over 3,5 years at Tygerberg Hospital. The aim of this ongoing study was to: (i) identify peri-operative deaths associated with anaesthesia; (ii) use the information to improve patient care; (iii) identify problems associated with the evaluation process and thereby improve the system of peer review.

Methods

From July 1987 the department instituted a peer review process in order to evaluate all peri-operative deaths (Fig. 1). *Peri-operative death* was defined as death occurring after the induction of general anaesthesia or the performance of a local procedure up to 24 hours after the anaesthetic was initiated. *Anaesthesia-related death* was defined as a death in which the anaesthetic technique could have contributed to the death but was not the sole cause of the death. An *anaesthetic death* was defined as death caused by the anaesthetic management. A senior consultant (H. du T.) evaluated and verified the information with regard to every peri-operative death and, if required, conducted a personal interview with the anaesthetist and collected the relevant post-mortem information. A preliminary report was compiled and the sequence of events leading to the death of the patient listed. The following questions were addressed in the preliminary report:

1. a) Was the pre-operative evaluation and identification of essential problems correct?
b) Was pre-operative resuscitation and risk management effective?
2. a) Was the anaesthetic technique appropriate?
b) Was the patient appropriately monitored?

- c) Did the anaesthetist recognise the problem when it initially presented?
- d) Did he or she then act effectively to contain or correct the risk recognised?
- e) Did the anaesthetist demonstrate insight into the problem?
3. Did the patient die intra- or postoperatively?
4. Was the death preventable?
5. Which organ (system) was the single most important element in the death of the patient?

Possible answers to questions 1 and 2 were 'good', 'poor' and 'uncertain'. The answer to question 4 was either 'yes', 'no' or 'uncertain'.

The preliminary summary was then discussed at the quarterly post-mortem meeting which all the specialist staff attend. A senior registrar represented the registrars and medical officers. The final decision was documented for storage on computer and, if required, the consultant discussed the case with the anaesthetist involved with particular reference to mistakes and/or substandard practice.

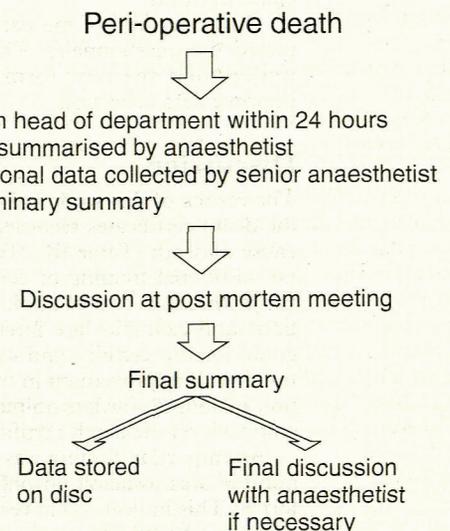


FIG. 1. System for evaluation of peri-operative deaths.

Results

During the period July 1987 - December 1990, 94 945 anaesthetics (general and local) were administered. There were 113 peri-operative deaths (11,9/10 000). Seventy-nine per cent of patients who died were male and 21% female with a mean age of 33,8 years and a range of 0,3 - 88 years. Twenty per cent were elective cases and 80% emergency cases. The percentage distribution ($N = 113$) between the 5 classes of the American Society of Anesthesiologists' pre-operative functional evaluation (ASA classification¹) were: ASA 1: 0,9%; ASA 2: 4,4%; ASA 3: 23,9%; ASA 4: 23,9%; ASA 5: 46,8%. Forty-five per cent of patients who died were classified as ASA 5E (E = emergency).

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Of the 113 deaths that took place within 24 hours of the initiation of an anaesthetic procedure, 81 or 8,5/10 000 were considered not to be anaesthesia-related (Fig. 2). The rest of the fatalities (32 cases or 3,4/10 000) were either anaesthesia-related or anaesthetic deaths. In 22 cases (2,3/10 000) it was decided that a combination of the patient's basic pathology, the surgical intervention and the anaesthetic were responsible for the death. These were therefore regarded as anaesthetic-related deaths. In 10 cases, i.e. 1,1/10 000, death was caused by the anaesthetic management and these were by definition regarded as anaesthetic deaths.

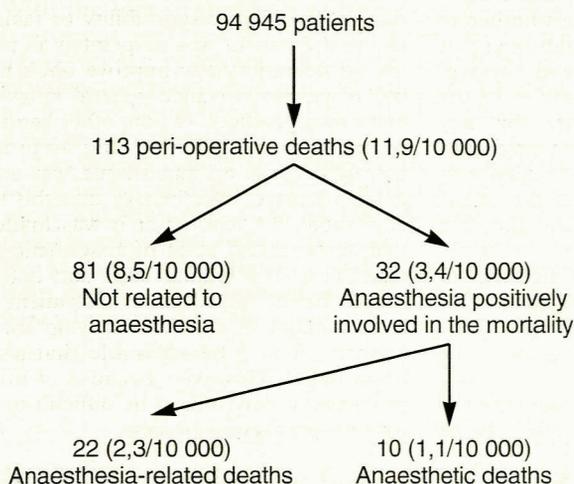


FIG. 2.

Results from the 3,5-year survey of peri-operative mortality. Incidences are related to the total surgical population.

Eight patients died in shock. Of these, 2 died of extensive postoperative bleeding. Four died of intra-operative haemorrhagic shock, diffuse intravascular coagulation, anaphylaxis, and relative hypoventilation (possibly due to increased dead space because of hypotension). Mismanagement of a MAST suit complicated 3 of these cases. Two patients died in septic shock. In both of these the management of the inotropic support was questionable and one patient had, in addition, unstable angina. Two patients died of respiratory complications, 1 because of an intubation problem and the other because of a tension pneumothorax.

Analysis of the peri-operative deaths related to anaesthesia revealed the following clinical errors: (i) pre-operative evaluation and/or resuscitation were inadequate in 49% of patients; (ii) the anaesthetic technique was considered inappropriate in 26% of cases; (iii) the anaesthetist failed to recognise or did not understand the presenting problem in 62% of cases; and (iv) having excluded the aforementioned errors, it was concluded that the anaesthetist failed to take appropriate corrective action in 30% of cases.

Both postoperative deaths from haemorrhage could have been prevented had the system been perfect. The bleeding in the recovery room could not be attended to immediately because all anaesthetic and surgical staff were dealing with life-threatening emergencies at the time. A full-time, after-hours recovery-room physician could possibly have solved the problem. Due to manpower shortage, a physician oversees the recovery room only during normal work-hours. A child who died in the ward should possibly have stayed in the recovery room for longer than the routine 2 hours.

One patient developed acute respiratory distress syndrome after aspiration of gastric content. This patient died on day 7 but, according to the definition of this study, is not included although clearly this death was the

result of anaesthesia. (If included, the incidence of anaesthetic death would be 1,15/10 000).

No equipment failure was responsible for anaesthetic mortality. Of all the peri-operative deaths, 97% were related to the cardiovascular system. The combination of trauma with subsequent cardiovascular dysfunction (usually haemorrhagic shock) proved to be a particularly lethal combination.

Discussion

Evaluation of peri-operative mortality has two basic components, i.e. data acquisition and data analysis. Given the fact that the data acquisition is probably the more important aspect of the exercise, it was decided to have a senior member of the department accept responsibility for this. Discussions at meetings were anonymous in order to ensure impartiality (as far as possible) and, although this peer review was done by anaesthetists from the same institution, it represents an unbiased, and sometimes overcritical, view of our practice. The aim of the exercise was not to compare our data with those of other institutions, although the published literature does indeed serve as a guide to peri-operative mortality.

The total peri-operative mortality rate in our institution compares favourably with published figures, which range from 4/10 000 to 22/10 000.²⁻⁶ However, only 2,3/10 000 of the deaths in our series were associated with anaesthesia and in each of these cases, the review panel could detect only subtle anaesthetic contributions. However, the study had the clearly defined aim of improving patient care, so the panel elected to classify even very minor anaesthetic indiscretions as possibly contributing to the death of the patient. In only 1,1/10 000 cases was the death caused by the anaesthetic or the system. Again this compares favourably with some of the published figures, which range from 1/10 000 to 2,2/10 000.²⁻⁶ However, it must be pointed out that the definitions, review processes and patient loads vary considerably between hospitals and that straight comparison is therefore probably unwise.

Our peer review process indicated that 22 - 32% of pre- and intra-operative evaluations, diagnoses, managements and insights into problems leading to case fatalities were either poor or uncertain. This suggested that certain conditions, such as trauma, shock and resuscitation during anaesthesia and sepsis, require additional attention.

Although the vast majority of monitoring problems were related to sophisticated monitoring devices, such as those that monitor cardiac output and its derived indices, it was felt that in an academic institution, all members of the department should be well versed in the use of these modalities. The minimum standards for patient monitoring, as summarised by the Harvard group,⁷ have been observed in this institution for a considerable number of years.

The ASA classification was not devised to serve as a predictor of mortality, but has indeed been shown to correlate with postoperative mortality.⁸ Deaths in the ASA groups 1 and 2 are therefore difficult to explain other than as the result of an anaesthetic or surgical mishap. These deaths, in our study, were associated with high-risk procedures in which the poor outcome could be explained in terms of definite physiological abnormality that resulted after a high-risk surgical intervention. The exceptions were the problems experienced with intubation and the undiagnosed pneumothorax.

A large number of patients who died (45%) were classified pre-operatively as ASA 5E by the anaesthetist. By definition these are patients who would have died irrespective of the surgical intervention. One can justifiably ask why these cases were operated on in an era

when financial resources are continually being eroded. In many patients, death occurred in spite of the administration of 40 units of blood, many hours in theatre and enormous costs. This is, however, not a simple matter as the majority of 5E cases were trauma victims. Furthermore, many of these patients were young and healthy before the incident. It is therefore unlikely that theoretical and statistical analysis of deaths will serve as sufficient reason for physicians not to try and save a life.

What is of greater concern to the department is whether the ASA 5E classification was applied correctly. The physician may (erroneously) think that such a classification could protect against litigation or departmental discipline. We therefore evaluated the number of class 5E patients *who did not die*. Analysis indicated that 40% of cases classified as 5E, did indeed survive. Misinterpretation and/or improper application of the ASA classification is apparent. Furthermore, this may simply reflect a lack of experience in the physician making the classifications. Given the high incidence of apparently wrong classifications, we elected not to exclude these cases from further analysis and they are therefore reflected in our figures.

It is gratifying to note that there was no incidence of equipment failure causing mortality of patients. This must be ascribed to the continual dedicated care of the well-motivated group of clinical technologists in the department.

Of the initial goals set by this ongoing study, the following have been implemented or are currently being investigated:

1. The number of lectures dealing with shock, emphasising septic and haemorrhagic shock, has been increased.
2. The total rotation time in the intensive care units has been increased to 5 months (average).
3. Although the ASA classification of pre-operative functional status is a useful modality, it certainly has limitations insofar as it is applied in practice. ASA class 5 is an especially questionable entity and we are currently considering omitting this from the anaesthetic record system or future analysis of data.
4. In future evaluations (questions 1 and 2 of our report system), performance will only be rated as 'good' or 'poor'. In this publication we were forced to group the 'uncertain' answers with the 'poor' scores. From a departmental point of view, 'uncertain' should be regarded as ineffective performance and although this approach may introduce bias, or at times reflect wrong decisions, it will be to the advantage of the evaluation of department function as it will reflect areas where improvement in standards can be attained. It should be kept in mind that this review process was not devised to punish those responsible but rather to improve patient care.
5. Because of the time lapse between the death of

the patient and the final evaluation, it is important that information should be stored in such a manner that final retrieval will allow for quick summary without re-evaluation. In order to do this, the cause of death will be classified into 1 of 4 possible groups: (i) patient factors; (ii) anaesthesia, i.e. clinical judgement and skill; (iii) system failure, i.e. organisation mishaps; and (iv) technical faults.

6. A method has been devised to record all deaths occurring up to 6 days after the anaesthetic procedure. It has been demonstrated that the yield, with reference to usable information, reaches a plateau after 6 days.⁹

In a study published in 1961, Dripps *et al.*¹⁰ stated that by 'avoiding responsibility or taking refuge in the fact that a patient was desperately ill prior to anaesthesia, an operation may improve one's mortality figures, but it will not advance general knowledge or change one's own practices. On the other hand, one should not resort to self-flagellation and assume responsibility merely because an anaesthetic was administered and death occurred.' We believe that this statement is still applicable, 30 years after it was made. It is essential that an organised audit of anaesthetic-related incidents take place on a regular basis and that the overall aim should be the improvement of patient care. Given the large number of patients receiving anaesthetics in this country, it may be advisable that a national survey be initiated. However, because of multiple logistical problems, it may indeed be difficult to establish such a national peer review process.

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REFERENCES

1. Derrington MC, Smith G. A review of studies of anaesthetic risk, morbidity and mortality. *Br J Anaesth* 1987; **59**: 815-833.
2. Tiret L, Halton F, Vouréh G. Complications associated with anaesthesia — a prospective survey in France. *Can Anaesth Soc J* 1986; **33**: 336-344.
3. Hovi-Viander M. Death associated with anaesthesia in Finland. *Br J Anaesth* 1980; **52**: 483-489.
4. Turnbull KW, Fancourt-Smith P, Banting GC. Death within 48 hours of anaesthesia at the Vancouver General Hospital. *Can Anaesth Soc J* 1980; **27**: 159-163.
5. Harrison GG. Death attributable to anaesthesia. *Br J Anaesth* 1978; **50**: 1041-1046.
6. Harrison GG. Deaths due to anaesthesia at Groote Schuur Hospital, Cape Town — 1956 - 1987. *S Afr Med J* 1990; **77**: 416-421.
7. Eichhorn JH, Cooper JB, Cullen DJ, Maier WR, Philip JA, Seaman RG. Standards for patient monitoring during anaesthesia at Harvard Medical School. *JAMA* 1986; **256**: 1017-1020.
8. Vacanti CJ, Van Houten RJ, Hill RC. A statistical analysis of the physical status to postoperative mortality in 68 386 cases. *Anesth Analg* 1970; **49**: 564-566.
9. Lunn JN, Mushin WW. *Mortality Associated with Anaesthesia*. London: Nuffield Provincial Hospital Trust, 1982.
10. Dripps RD, Lamont A, Eckenhoff JE. The role of anaesthesia in surgical mortality. *JAMA* 1961; **178**: 261-266.