DEATH WITHIN 48 HOURS OF ANAESTHESIA AT THE VANCOUVER GENERAL HOSPITAL

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ABSTRACT

A formal review of all deaths within 48 hours of an anaesthetic is done at the Vancouver General Hospital. All cases are reviewed for significant contributory factors directly attributable to anaesthesia. This study presents the data of such a review of 195,232 anaesthetics administered between 1973 and 1977. The overall incidence of 2.2 deaths per 1000 anaesthetics compares favourably with other studies. The death classification system revealed a group of patients who were high risk and who could be classified as congenital heart disease, adult cardiacs with cardiopulmonary bypass, brain tumour or brain oedema, multiple injury, profound sepsis and major vascular catastrophes. Another group of patients were classified as possibly preventable deaths, as these patients had predictable respiratory and cardiac factors that could be anticipated and ameliorated. Careful attention to the essential principles of anaesthetic care such as careful preoperative assessment, adequate patient monitoring and access to the patient (e.g. intravenous, precordial stethoscopes), supportive recovery room and intensive care unit care and a continuing assessment and review of each anaesthetic-related death, have helped to decrease the number of deaths in this patient group.

The final assessment of patients who have had an anaesthetic should assure adequacy of respiratory function, tissue perfusion, central nervous system function and tissue oxygenation. Such an approach should result in a minimum of deaths within 48 hours of anaesthesia.

ADVANCES IN ANAESTHETIC TECHNIQUES have allowed the scope of surgical procedures to increase dramatically. The practicing anaesthetist is faced with a wider range of problems spanning the extremes of age. The primary role of the anaesthetist includes the traditional objectives of the provision of amnesia, analgesia, reflex control and relaxation with the addition of oxygenation and tissue perfusion. The anaesthetist must ensure the safety of the patient under his care. He must do his utmost to ensure the patient survives the anaesthetic and the postoperative period. The information yielded by a study of deaths associated with anaesthesia will provide the anaesthetist with data that review, support or question the techniques he uses. Such a review should form a part of every anaesthetist's self-appraisal system.

The Mortality Review Committee of the Department of Anaesthesia at the Vancouver General Hospital formally reviews every death occurring within 48 hours of an anaesthetic. Particular attention is paid to anaesthetic charts and any contributory role of anaesthesia in the circumstances of a patient's death.

The deaths are then classified in the following way¹:

1. *Inevitable* – the initial state of the patient precludes the likelihood of life saving treatment being successful.

2. *Fortuitous* – appropriate use of established techniques of medical care fail to be associated with recovery of the patient.

3. *Possibly preventable* – a judgement made with the benefit of hindsight and not necessarily implying blame.

4. *Unassessable* – used in the case where the chart and/or anaesthetic record are unreadable or where inadequate detail is available with which to judge the case.

The results of this review form the basis for a number of mortality rounds involving all members of the Department of Anaesthesia.

Vancouver General Hospital is an acute care (tertiary care) hospital of 1,500 beds. The data from 1973–1977 are reported here. There were 195,232 anaesthetics given during this period. Preoperative assessments suggest that 60 per cent of these anaesthetics were administered to patients who were ASA Class I; 25 per cent were ASA Class II; 13 per cent were ASA Class III; and two per cent were ASA Class IV and V. More than ten per cent of this anaesthetic case load were emergency procedures. A small number of anaesthetic related deaths have been excluded by not extending the period of audit past 48 hours.

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TABLE 1
DEATH CLASSIFICATION - MAJOR GROUPS

Group	Year				
	1973	1974	1975	1976	1977
Inevitable	39	46	39	31	40
Fortuitous	26	18	55	28	62
Possibly preventable	12	8	5	10	3
Unassessable	0	0	1	0	0
TOTAL	77	72	100	69	105

PATIENT STATUS - AGE & DEATHS

FIGURE 1 Patient status - age and deaths.

Other studies have used varying time limits ranging from 24 hours² to seven days³ which affect the comparability of these studies. The anaesthetics ranged from those for vaginal deliveries to those for cardiopulmonary bypass procedures. There were 423 deaths within 48 hours of an anaesthetic in this group of 195,232 (Table I). This is an incidence of 2.2 deaths per 1,000 anaesthetics and compares favourably with other studies.^{2,5}

The majority of deaths (135) occur in the *Inevitable* group of patients with the most significant age range being 50-69 years. Those patients under one month of age represented a large group (52) who died within 48 hours of an anaesthetic (Figure 1). The majority of patients were ASA Class III and IV (Figure 2), while emergency classification produced a shift to Class IV and V patients (Figure 3).

FIGURE 2 Patient status - (elective).

FIGURE 3 Patient status (emergency).

Closer inspection of the patients in the *Inevitable* group showed the majority of deaths occurred in those patients with congenital heart disease, adult cardiacs with cardiopulmonary bypass (CPB), brain tumour or brain oedema, multiple injury (including subdural, ruptured viscera), profound sepsis and major vascular catastrophies such as abdominal aortic aneurysms (Table II).

The review of the mechanisms of death in the possibly preventable group of patients revealed respiratory and cardiac factors which can often be predicted and avoided in the management of other patients (Table III).

DISCUSSION

Status of patient and urgency of operation

The usefulness of the ASA classification is reflected in the predictable distribution involving ASA III to V patient groups. The shift to an

TABLE II
INEVITABLE

Patient group	Year				
	1973	1974	1975	1976	1977
Congenital heart disease	12	6	8	8	3
Adult cardiac with CPB	4	4	5	4	9
Brain tumour/oedema	9	17	14	7	7
Multiple injury (incl. subdural, ruptured viscus)	11	7	4	6	3
Profund sepsis	2	5	2	1	6
Major vascular catastrophies (e.g. abd. aortic aneurysm)	2	1	4	1	5

TABLE III
POSSIBLY PREVENTABLE - MECHANISMS OF DEATH

	Year				
	1973	1974	1975	1976	1977
RESPIRATORY					
Aspiration	1	0	2	1	0
Pulmonary emboli	3	1	0	0	0
Pulmonary bleeder	1	0	0	0	0
Recovery room care	0	3	1	2	0
CARDIAC					
Bradyarrhythmia	1	0	1	0	0
Tachyarrhythmia	1	0	0	0	0
Cardiac arrest	1	0	0	1	3
Hypovolaemia/overload	1	2	1	3	0

emergency procedure was accompanied by a more severe assessment of patients with fewer deaths occurring in the lower (I to III) ASA groups. Resuscitative techniques have improved and sicker patients are being supported and brought to the operating rooms.

The expected high risk groups making up the *Inevitable* patient group continue to appear each year. Congenital heart disease, adult cardiacs, neurosurgical and multiple injury patients will continue to be a challenge in management at Vancouver General Hospital as they are in other centres.⁴ Careful preoperative assessment, adequate patient monitoring and access, supportive intensive care unit care and an awareness of the subgroups of high-risk patients should enable the anaesthetist to decrease the mortality associated with these procedures.

Mechanisms of death in the possibly preventable cases

Respiratory function can be compromised by aspiration, pulmonary emboli, unrecognized

bleeding and inadequate recovery room care. Current management should include an awareness of these problems and the use of such things as antacids, oxygenation, suction, high inspired oxygen tensions, to overcome the majority of these problems. Recovery room care must be adequate to prevent reoxygenation, reoxygenation, aspiration, unrecognized hypovolaemia, bradyarrhythmias associated with suctioning, drug-induced cardiac arrests (e.g. hyperkalaemia, hypokalaemia) respiratory acidosis and fluid overload from contributing to mortality. Factors such as these were found to be significant during the recovery room care of patients reviewed in this study (see Appendix).

Cardiac dysfunction may result from injudicious use of induction drugs. There were no cases of cardiac arrest precipitated by anaesthetic drug overdose. Respiratory dysfunction always preceded the cardiac changes. Inappropriate use of potassium (KCl) in an intravenous bolus provided one example of an avoidable bradyarrhythmia and death.

CONCLUSION

Continued assessment of all deaths within 48 hours of anaesthesia at Vancouver General Hospital has resulted in increased awareness of those patients particularly at risk. Increased attention to patient assessment, monitoring, physiology and postoperative care in the recovery room and intensive care unit is reflected in the decrease in deaths related to recovery room care from 1973 to 1977. Continued improvement in care must include improved preoperative patient management. Particular attention must be paid to the basic principles of anaesthesia, including careful preoperative assessment (beware of the patient in the Inevitable Group); adequate patient monitoring and access; supportive care in the recovery room and the intensive care unit; continuing assessment and review of each anaesthetic-related death.

No patient should be left in the recovery room until the adequacy of respiratory function, reversal of paralysis, tissue perfusion, central nervous system function and tissue oxygenation have been clinically substantiated as satisfactory. Such an approach should result in a minimum of deaths within 48 hours of anaesthesia.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. L. C. Jenkins for his continued support and encouragement.

APPENDIX

CASE EXAMPLES – POSSIBLY PREVENTABLE DEATHS

(1) *Vagal stimulation followed by cardiac asystole (85-09-23-1973)*

Patient was an 11-year-old boy. Received in the

recovery room with the trachea intubated, with head injury, coma, fractured ribs and a chest tube in the right side. Developed pulmonary oedema (over-hydration) and had bradycardia with tracheal suctioning, progressing to cardiac asystole. Left-sided pneumothorax relieved during resuscitation. No preoperative chest x-ray.

(2) *Unrecognized hypovolaemia (98-90-55-1976)*

Patient was a five-month-old child brought to the recovery room after an uneventful operative course (PA Banding). Patient was stable until turned on his side when the arterial line fell out and a large volume of blood was lost into the bed. Resuscitation appropriate and unsuccessful.

(3) *Recurarization (98-56-63-1976)*

Patient was a 91-year-old man who had uneventful lysis of adhesions for small bowel obstruction. Brought to recovery room with trachea intubated because reversal of muscle relaxant (pancuronium) was recognized as inadequate. He was weaned over two hours, extubated with "shallow" respiration, developed tachycardia and then had a respiratory arrest two hours later.

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RÉSUMÉ

Une révision en profondeur de tous les décès survenus en deça de 48 heures de l'anesthésie a été effectuée au Vancouver General Hospital. L'étude a spécialement porté sur les facteurs contributifs attribuables à l'anesthésie et fournit des données sur 195,232 anesthésies administrées entre 1973 et 1977 avec un taux de mortalité de 2.2 morts pour 1,000 anesthésie, taux qui se compare favorablement avec les statistiques obtenues dans d'autres milieux. Le système de classification des mortalités employé a révélé un groupe de malades à risque élevé comprenant maladies cardiaques congénitales, maladies cardiaques adultes avec circulation extra-corporelle, tumeurs ou oedèmes cérébraux, polytraumatismes, états septiques et catastrophes vasculaires majeures. Un autre groupe a été classé en mortalités évitables parce les malades qu'il constitue présentaient des paramètres respiratoires ou cardiaques qui pouvaient être anticipés et améliorés. Une attention soignée aux principes essentiels de l'anesthésie, comme l'évaluation pré-opératoire rigoureuse, un monitoring adéquat avec accès au malade, la disponibilité d'une salle de réveil et de soins intensifs, une évolution

surveillée, et la revision de toute mort anesthésique, a aidé à diminuer le taux de mortalité dans ce dernier groupe de malade.

La ligne de conduite proposée pour les patients qui ont subi une anesthésie devrait pouvoir assurer la compétence de la fonction respiratoire, de la perfusion tissulaire, du système nerveux central et l'oxygénation, et ainsi permettre de minimiser la mortalité des premières 48 heures post-anesthésiques.