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PERI-OPERATIVE MORBIDITY AND MORTALITY

Complications following anaesthesia and surgery are claimed to affect 10-20% of all patients undergoing anaesthesia [1, 2]. However, anaesthesia is considered safe because few serious peri-operative adverse outcomes such as coma or death are related directly to anaesthesia [3, 4]. Anaesthetic-related mortality in the past two decades is estimated to range from 0.05 to 10 per 10,000 administered anaesthetics [5-10]. The available knowledge on safety and quality of anaesthetic care includes insight into the effects of anaesthetic drugs and techniques and the anaesthesia practice. However, quantitative estimates of how the characteristics of anaesthesia practice affect peri-operative morbidity and mortality are limited. Anaesthesia management entails a broad range of factors related to characteristics of the hospital and anaesthetic department (operating room, pre-operative and postoperative care unit, medical ward and ICU), training and education, quality and quantity of physician and non-physician staff, availability and use of medical protocols, and standards for monitoring in the intra-operative and postoperative period. A few investigators have quantitatively studied the effect of the anaesthesia management on adverse peri-operative events [11-15]. The safety and quality of peri-operative care may be further improved by quantifying the risk of more factors related to anaesthesia management.

DEFINING PERI-OPERATIVE RISK

In clinical research literature, the definitions of anaesthesia's contribution to peri-operative risk now include 'anaesthesia-only', 'anaesthesia-contributory, and 'anaesthesia-related' (Table 1) [16].

TABLE 1. DEFINITIONS OF COMPLICATIONS INVOLVING ANAESTHESIA (FROM [16])**Anaesthesia-only complication:**

'Pure' or 'intrinsic' anaesthesia risk. Death or morbidity occurred despite the fact that the anaesthesiologist properly applied an approved technique, properly used well-maintained equipment, made reasonable attempts to acquire pertinent information, and used reasonable judgment based on current therapeutic and diagnostic standards and available resources.

Anaesthesia-contributory complication:

The anaesthesiologist used improper technique, mis-used equipment, disregarded important data, failed to seek appropriate data, displayed inadequate knowledge or exercised poor judgment, and this failure led to either death or morbidity.

Anaesthesia-related complication:

Anything adverse that manifest itself intra-operatively or postoperatively, or anything that is less likely to occur intra-operatively or postoperatively, based on decision or intervention in the purview of an anaesthesiologist (for example, new associations established by evidenced-based clinical studies related to administration of adrenergic blocking agents, statins, antibiotics, or long-acting neuromuscular blocking agents and control of blood glucose or body temperature).

Conceptually an equation describing total perioperative risk (T) may be constructed as $T = M + S + (A^C + A)$, where M is the medical risk, S is the surgical risk, and A and A^C are the anaesthesia-only and anaesthesia-contributory risks as defined in Table 1. When studies of peri-operative mortality from 2002 are compared with those from 1954, an order of magnitude reduction is found to have occurred in the T and A^C terms of the equation (Table 2). It is right for us to be proud of this accomplishment, but there is a very uncomfortable reality in these numbers. We have reached the point that additional reductions in anaesthesia risk ($A^C + A$) will help individual patients, and we should certainly strive for them, but they will not significantly lower total peri-operative risk, because $M > S > (A^C + A)$, as stressed by Roy & Calicotti [17].

TABLE 2. A COMPARISON OF TOTAL PERI-OPERATIVE RISK OF DEATH BETWEEN 1954 AND 2002, ADAPTED FROM [17].

T = M + S + (A^C + A) where risk is defined as: T = total perioperative, M = medical, S = surgical, A^C = anaesthesia-contributory, and A = anaesthesia-only.

Date	T	M	S	Ac
1954	1:75	1:95	1:420	1:1560
2002	1:500	-	-	1:13,000

If anaesthesia risk is a third order term, then by definition it is not as important or relevant as first and second order ones, especially to healthcare system managers and third-party payers. To significantly reduce peri-operative mortality and morbidity, the contributions from medical and surgical risk (M and S) must be reduced.

IMPACT OF ANAESTHESIA MANAGEMENT CHARACTERISTICS ON MORBIDITY AND MORTALITY

A number of studies of the effects of anaesthesia management on morbidity and mortality have been published. Arbous performed a case-control study to assess 24 h postoperative severe morbidity and mortality after all types of surgery in relation to anaesthesia management factors [18]. The aim was to assess which anaesthesia management factors are independent risk factors for peri-operative severe morbidity and mortality and are amenable for preventive measures. The study comprised 869,483 patients; 807 cases and 883 controls were analyzed. The incidence of 24 h postoperative death was 8.8 per 10,000 anaesthetics (95% CI 8.2–9.5). The incidence of coma was 0.5 per 10,000 (95% CI 0.3–0.6). Anaesthesia management factors that were significantly associated with a *decreased* risk were: equipment check with protocol and checklist (OR 0.64), documentation of the equipment check (OR 0.61), a directly available anaesthesiologist (OR 0.46), no change of anaesthesiologist during anaesthesia (OR 0.44), presence of a full-time working anaesthetic nurse (OR 0.41), two persons present at emergence (OR 0.69), reversal of anaesthesia (for muscle relaxants and the combination of muscle relaxants and opiates, OR 0.10 and 0.29, respectively), and postoperative pain medication as opposed to no pain medication, particularly if administered epidurally or intramuscularly (as opposed to intravenously).

The investigators chose to limit the matching of controls only to age and sex to prevent bias and also to allow them to examine all factors affecting mortality in a multivariate model. The possible flaw with this approach in the context of their study is that ASA physical status classification is such a powerful confounding factor that it could have undermined their multivariate model. Most (>90%) of the patients who died were ASA physical status III–V; fewer than 30% of the control patients were ASA physical status III–V. However, the study raises important issues. In particular, it is believed that separating anaesthetic from surgical death is a false distinction. The study highlights the contention that multiple aspects of peri-operative care and management may impact on postoperative outcome.

HOW CAN ANAESTHESIOLOGISTS HELP REDUCE PERI-OPERATIVE RISK?

There are difficulties in epidemiological research into mortality related to anaesthesia. Comparisons between studies may be invalidated by variation in sampling procedure, the definition of time of death, the peri-operative time period studied, and the patient and hospital populations encompassed. However, there does appear to be consensus that at least one-third to one-half of deaths are preventable, given existing medical knowledge and accepted anaesthetic practice [19]. Lunn & Devlin [10] suggested that at least 55% are 'avoidable'. Although conclusions from one study should not lead to wholesale changes in practice, the findings in the study by Arbous et al [18] support many plausible assumptions that improvements in anaesthetic management processes can positively influence patient outcomes.

In general, if the technique had been used properly, if standard procedures had been followed, and finally, if equipment had been provided with patient safety measures, many of the deaths may have been avoided. Lack of knowledge about equipment ought to be prevented by proper education. Having protocols and guidelines and using them is, in the authors' view, essential.

Over the next decade, we need to invest our time and resources to determining the right way to expand the scope of anesthetic practice - and then do it. Addressing overall peri-operative morbidity is a natural extension for us. Success depends on a concerted national effort that is well-organized, demonstrably effective and ultimately reasonably funded.

CONCLUSION

In conclusion, peri-operative mortality and morbidity are still substantial. Aetiologic insight into the role of anaesthetic management is limited and must be improved because certain aspects of anaesthetic management, which may be modified by preventive measures, continue to play a major role in adverse events.

KEY LEARNING POINTS

- Use equipment check lists
- Do not change anaesthesiologists during anaesthesia
- Ensure the immediate availability of other anaesthesiologists to provide help if needed, especially during emergence from anaesthesia
- Routinely use reversal agents after the use of muscle relaxants
- Use local anaesthetic agents alone or in combination with opioids postoperatively

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