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Review

Anesthesia related mortality? A national and international overview

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ABSTRACT

The anesthetic risk is estimated only to be a very small proportion of the total risk of the surgical procedures, but with an estimated 230 million anesthetic procedures taking place worldwide annually, anesthetic peri-operative mortality represents a small but relevant proportion of cases. Mortality, although death is a clearly definable end point, must often be regarded as a rather crude risk estimate because of its relative rarity. A comparison of death rates is feasible only when using the same criteria for the numerator, the time period under investigation, and the denominator. Herein lies the problem when interpreting data and studies reporting the incidence of mortality, even if based on the best available data, differ widely, possibly as a result of differences in the definitions used and sources studied.

This review gives an overview of the available data, their source and quality on perioperative anesthetic mortality.

Contents

1. Introduction

The mortality rate in patients undergoing non-cardiac surgery can be substantial [1]; and ranges between 0.5% and 1% (48 h) [2,3]; up to 4% (7 days) [4].

However, the available data are prone to misinterpretation and in some instances, was based on inaccurate data were the study outcome data showed large variations in perioperative mortality [4]. The current mortality rates of surgery in a 7-day period are likely to be in the range of 0.5–1.2% [5].

An analysis of nationwide German hospital discharge data found an inhospital mortality for elective cholecystectomies and herniotomies to be 0.4% and 0.13%.

Associated with higher perioperative mortality are age (less

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than 1 yr or greater than or equal to 65 yrs), ASA physical status, urgency and type of operation [6–10].

Parallel, improvements in anesthesia safety have made anesthesia-related deaths and severe outcome rare events [11–13]. The anesthetic risk is estimated only to be a very diminutive proportion of the total risk of the surgical procedures. With an estimated 230 million anesthetic procedures taking place worldwide annually [14] and with almost 10 million procedures in Germany alone (in 2009, www.gbe-bund.de), anesthetic peri-operative mortality and major complications represent a small but relevant proportion of cases.

Here, the clear definition of mortality generally stands in contrast to the more debatable definitions of morbidity.

Mortality is considered a vital estimate of risk associated with an aesthesia with an apparently precise definition. However, even a mortality rate must often be regarded as a rather crude risk estimate because of its relative rarity. Thus, a comparison of death rates is feasible only when using the same criteria for the numerator, the time period under investigation, and the denominator. Herein lies the problem when interpreting data:

Estimates of the incidence of mortality, even if based on the best available data, differ widely between different studies, possibly as a result of differences in the definitions used and sources studied [15]. A spectrum of time limits has been used for studies [11,12,16,17], together with the lack of defined populations as a denominator, different ranges of procedures and co-existing illness as well as the urgency of the surgical procedures often impedes exact calculations, even when the numerator is quite accurate. Together with varying definitions of the anesthetic contribution, this obviously impacts heavily on results.

The observed differences between the reported rates therefore come as little surprise.

The purpose of this article is to give an overview of the available data, their source and quality on perioperative anesthetic mortality.

2. Methods

The search period was from January 2000 to December 2015, only studies in German and English were included if they reported on a population of at least 3000 patients who underwent general anesthesia for surgery in a hospital setting and for which a full text version was available in concordance to the study by Bainbridge et al. [2] to reasonably estimate adverse events that occur at a rate of one in 1000 or less. The studies had to report on a period starting in 1995 or thereafter, or reporting of events including the year 1995.

Because the aim is to assess the outcome in unselected patients who underwent surgery, studies reporting exclusively on regional anesthesia or focusing on specific endpoints (for example myocardial ischemia) were excluded, as were studies relating to populations in developing countries. Studies had to report a number of anesthetic procedures as a denominator to determine the rate of anesthesia-related deaths. The search also included tangential electronic exploration of related articles (i.e. 'snowballing': using links to related references to search for additional articles).

A MEDLINE, Google Scholar and Cochrane Library search was performed to search for evaluating mortality and severe morbidity. Searched terms were mortality AND death AND severe incidents AND general anesthesia OR severe morbidity AND general anesthesia.

3. Results

A MEDLINE and Cochrane library search were performed to search for studies evaluating mortality and severe morbidity. The search identified a total of 60 studies, of which 37 were rejected, 9 were review articles, while 14 matched the set criteria.

3.1. Reporting

In a number of studies, reporting was voluntary [15,18–24], which coincides with a high probability of information bias and possible underreporting [15,18–22,24]. This may be minimized by using specific reporting systems to cross-check results to reduce the rate of missed events [11,15,18,19,23,25,26].

In the Australian reporting of death under anesthesia or deaths where anesthesia is thought to be a contributing factor, is mandatory in three states and a condition of employment in another (Tasmania), for the remainder reporting voluntary [27].

In one study reporting of adverse events by faculty, residents, and nurse anesthetists was mandatory [25]. Some of the other authors used databases [16,17,25,26,28], or International Classification of Disease (ICD) codes 9 [11] or 10 [12] to identify cases from death certificates. Others fall short to comment on the exact nature of reporting in their study [23].

One of the most important points is to ensure that the process of reporting and investigating the incident is non-punitive and/or even confidential. Studies have shown that anesthesiologists will comply with a system of self-reporting if the process is non-punitive and likely to result in tangible improvements in patient care [15,29,30]. In Australia, reports to the committees are confidential and legally protected; there is no risk of litigation [25–27].

In other studies [24], questionnaires were collected by mail in a double envelope or anonymous forms were used for communication to the research committee [18,19].

3.2. Review process, peer review

The peer review can also affect published anesthesia-related mortality rates through the accuracy of their judgments [15]. A peer review process will allow to define perioperative death to which human error has contributed, as well as the factors that have led to the fatal outcome. One measure to improve the reliability of the peer review process is the use of multiple reviewers which was shown to markedly increase consensus among reviewers [31–34].

It seems prudent to involve more than two reviewers in case analysis. This was the case in the majority of studies [11,15,16,18,21,22,25,26], whereas in the remaining studies [23,28] the authors did not follow the more stringent methods, had only two authors assessing the cases [17], or simply mentioned that review committees had been employed [24,27].

3.3. Definitions of anesthetic contribution to mortality

A medical 'error' might either human or system related. Nominal definitions for subcategorising these two types of errors may increase the objectivity of the process [30–32]. Lagasse et al. [15] define error based on the IOM definition as 'Failure of a planned action to be completed as intended' or 'use of a wrong plan to achieve an aim; the accumulation of errors results in accidents'. However, determining whether an anesthetic factor has caused or contributed to death remains an opinion only and therefore is always subjective (at least to some extent). Thus it is imperative that authors explain the system used to evaluate contributions of anesthesia.

A number of authors described definitions to determine the role of anesthesia in fatal outcomes [11,12,15–20,22–25,27].

The use of the modified criteria published by Edwards et al. [35] were also promoted [27], in which deaths in categories 1–3 can be considered 'anesthesia-related', while deaths in category 1 are