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INVITED COMMENTARY

Perioperative medicine and mortality after elective and emergency surgery

Kjetil Søreide, David A. Story and Bernhard Walder

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This Invited Commentary accompanies the following original article:

Jawad M, Baigi A, Oldner A, *et al*. Swedish surgical outcome study (SweSOS). An observational study on 30-day and 1-year mortality after surgery. *Eur J Anaesthesiol* 2016; **33**:317–325.

In this issue of the *European Journal of Anaesthesiology*, Jawad *et al.*[1] present an exceptional study on mortality up to 1 year after perioperative care in Sweden. The findings that age, American Society of Anesthesiologists (ASA) status and comorbidities and nonelective surgery are strongly associated with postoperative mortality are consistent with studies from the United States,[2] and Australia and New Zealand.[3] This study is a further piece in the puzzle of how better perioperative care and patient safety management may improve outcomes for patients undergoing elective or emergency surgery. Three observations in this study need a comment: first, high standards of in-hospital perioperative management probably improve short-term survival, but not long-term outcomes if compared with standardised mortality rates; second, high standards of in-hospital perioperative management are probably only partly dependent on ICU bed availability and third, perioperative mortality reporting is important for quality assurance of care, but mortality has limitations as a sole outcome measure and other patient-relevant outcomes may have an as yet unappreciated role in assessment.

Scandinavia, survival and mortality

The current SweSOS study[1] echoes the finding that Scandinavian countries have lower in-hospital 30-day mortalities than other high-income countries with similar health budgets.[4] Indeed, a recent Danish randomised trial, the InCare Trial, was stopped prematurely because of lower than expected postoperative mortality in the target population,[5] reflecting that Scandinavian outcomes are better than elsewhere. There are several possible attributes of Scandinavian health systems that might be responsible for improved perioperative survival. First, Scandinavian hospitals may have better perioperative management with multidisciplinary teams working in a consistent and coherent manner applying sound care protocols – including aspects of ‘Enhanced Recovery After Surgery’ – providing an integrated process of care from the decision to operate until the patient has recovered from surgery.[6] Second, Scandinavian hospitals may have a higher degree of standardisation or care bundles to decrease perioperative (drug) errors[7] and healthcare-associated infections.[8] Third, Scandinavian healthcare systems may have structures and procedures that decrease fatal postoperative complications (‘failure to rescue’), a major contributor to short-term mortality.[9] Fourth, Scandinavian countries may have a higher nurse-to-patient ratio and the nurses may have a higher education degree, which is associated with decreased mortality.[10] And finally, the Scandinavian countries (as do Australia) have government-based, nationwide, health insurance coverage that may reduce the effect of social class and undiagnosed or undertreated surgical and comorbid diseases compared with other countries. There is, however, limited evidence for these hypotheses and further investigation of causes of lower in-hospital mortality in Scandinavian countries is warranted.

The observed long-term mortality may reflect both the underlying disease and its course. But of greatest importance are age and comorbidity, both strongly associated with long-term deterioration due to frailty in the elderly, and both strongly associated with short and long-term

From the Department of Gastrointestinal Surgery, Stavanger University Hospital, Stavanger, Norway (KS), Department of Clinical Medicine, University of Bergen, Bergen, Norway (KS), Anaesthesia, Perioperative and Pain Medicine Unit, Melbourne Medical School, University of Melbourne, Australia (DAS), and Division of Anaesthesiology, Geneva University Hospitals, Geneva, Switzerland (BW)

Correspondence to Professor Bernhard Walder, Division of Anaesthesiology, Geneva University Hospitals, Rue Gabrielle-Perret-Gentil 4, CH-1211 Geneva 14, Switzerland
E-mail: bernhard.walder@hcuge.ch

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mortality after surgery.[11,12] Frailty is a lack of resilience to stressors to physiological systems. Although there might be survival of the initial insult, the challenge to the body and organ systems may reveal previously unrecognised organ failure or trigger new physiological weakness. Muscle wasting, cardiac failure, deterioration of lung function and kidney failure may lead the frail and the elderly into a negative spiral possibly ending in death in the postoperative period after hospital discharge.[13] For this reason, long-term postoperative mortality studies should include an estimate of frailty, but at present there is no pragmatic or predictive frailty scale for surgical patients.[12] Finally, limitations of medical treatment orders for the frail and the elderly may influence mortality as an outcome measure. We suspect, furthermore, that current standards of perioperative care fail to provide adequate access to high-quality postoperative in-hospital rehabilitation and ambulatory postdischarge care, with a negative impact on long-term mortality.[14]

ICU, intermediate care, high-dependency unit, postanaesthesia care unit and critical care

The Swedish Surgical Outcome Study[1] observed a low requirement for ICU; this observation was associated with a low 30-day in-hospital mortality.[4] Vaster-Andersen *et al.*[5] made the same observation in the Danish In Care Trial study. The same relationship was observed in hospitalised patients with sudden clinical deterioration – the number of ICU beds available and the hospital mortality were not associated.[15]

However, postanaesthesia care unit (PACU) structures with physician-driven intermediate care (IMC) facilities as mentioned by the authors,[1] or independent postoperative IMC units, may be an important structural element for high-quality perioperative management. In one study, the introduction of intermediate care structures decreased both 30-day in-hospital mortality and unplanned ICU admissions.[16] Furthermore, intermediate care structures may allow increased perioperative flows for high-risk patients, including cardiac surgery.[17] The rate of high-risk patients with preexisting comorbidities is increasing in high-income countries and is related to demographic changes.[3,11] Adaptations of postoperative surveillance management are imperative, but may not need expensive ICU beds. Identification of index markers that trigger a priority for a higher level of care, IMC or ICU level, are needed. Early warning scores and medical emergency teams have been proposed in several studies without clearly showing a reduction in mortality and there have been several pitfalls in the implementation of this care bundle.[18,19]

Any given ICU admission rate depends on the way it is defined. For instance, Jawad *et al.*[1] reported that 6.6% of patients stayed more than 12 h in the PACU; these patients can be seen as ‘critical care’ admissions. In Australia and New Zealand, and elsewhere, many of those individuals would be high-dependency patients usually recorded as ICU admissions. Combining the ICU and long-stay PACU patients gives a 10.2% critical care admission rate for a reasonably young (median age 57 years) healthy (69% ASA I + II) group.[1] This critical care admission rate exceeds that of an Australian study of older (median 78 years) and sicker (32% ASA I + II) surgical patients with a 9.2% critical care admission rate.[3] Depending on how one defines long PACU stay, the Swedish patients had a low ICU admission rate but a high critical care admission rate.

Limitations of perioperative weighted mortality

Postoperative mortality data reporting has limitations and is clearly associated with the case-mix and discharge policy,[20] which justifies questioning whether mortality rates are true indicators of perioperative performance. It has been argued that mortality can only be used as a measure of quality when it is applied to one specific frequently performed perioperative procedure with a high mortality.[21] Thus, in daily practice and when investigating general populations of rather healthy patients undergoing elective surgery, mortality may not be a suitable endpoint to investigate.

Nonetheless, investigating outcomes using standardised mortality ratios, as in the SweSOS study, may provide useful and unexpected information. The use of standardised mortality ratios may decrease the impact of case-mix, the observed mortality ratio of a study cohort compared with that of a similar general population. Another approach to decrease the impact of case-mix is the reporting of observed-to-expected mortalities, based on prediction models. The expected postoperative mortality may be estimated with available prediction models, such as the surgical mortality probability model.[22] However, this simple 9-point scale model based on ASA score, emergency status and surgical risk class may not adjust precisely for all risk factors of postoperative mortality.

A supplementary bias can arise from limiting the reporting of in-hospital mortality to just 30 days. This discharge bias can be reduced by extending reporting to 30-day mortality after discharge, or alternatively include 60 and perhaps 90-day mortality as suggested in some studies.[23,24]

It is evident that isolated postoperative mortality reporting is insufficient to estimate perioperative performance. Candidate outcome measures to improve the estimation of the quality of perioperative management are disability-free survival after surgery,[25] and health-related quality of life.[26] But also for these outcomes, potential biases have to be considered and relevant differences have to be defined.[27]

Perspectives

The current SweSOS study[1] has yielded interesting data and unanswered questions regarding postoperative mortality in the current one-country, short-period, point-prevalence study. It is evident that international collaboration is required to provide more robust, in-depth analysis of the reported outcomes and the factors that underpin them.[28] Only if and when we arrive at larger numbers, with clear descriptors of care pathways and adjusted case-mix reports, can we start to discern what actually contributes to the difference in outcomes. Then, when we have learned the lessons, we can disseminate our new knowledge to improve perioperative care across Europe and beyond.

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