Optimizing Perioperative Outcomes

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The past several decades have seen an intense interest in defining the impact of different perioperative practices on patient outcome. This has occurred within the general context of the movement towards evidence-based medicine, in which there is an emphasis on proven practices and technologies (both drugs and devices) and establishing guidelines for their use (1). Previously, many practices were propagated within the medical community based on historical beliefs without good support, and many have now been found to be of questionable value or even detrimental. Within the perioperative period, there has been a re-emphasis on performing randomized clinical trials, but first it is important to define the primary outcomes of interest that relate to the delivery of perioperative care by anesthesiologists.

Cause or Prevention

For the past 50 yr, there has been an emphasis on morbidity and mortality directly attributable to the anesthesia provider. Beginning with the Ruth Commission and Beecher and Todd's work on anesthetic mortality, complications were rated as directly or partly attributable to anesthesia (2,3). This practice remains the basis for the current morbidity and mortality approach. However, it is important to recognize that there are many practices within the scope of the anesthesia provider that may limit the detrimental effect of patient, disease, and surgical risk. For example, the administration of perioperative β-blockers in high-risk vascular patients can decrease morbidity and mortality from vascular surgery, although a perioperative myocardial infarction in these patients would not be considered primarily attributable to the anesthesiologist using traditional criteria (4,5). This lecture will attempt to approach the question of optimizing perioperative outcomes from this broader perspective.

Outcomes of Interest

Traditionally, 30-day mortality has been attributed to perioperative care and is used as the definition for most studies. With the development of ambulatory surgery, death within 30 days is an overestimate of the actual importance of the influence of surgery. Warner et al. (6) demonstrated that 30-day mortality and major morbidity after ambulatory surgery was lower than expected considering a similarly matched population of individuals. In some cases, 30-day mortality may actually underestimate the influence of the perioperative period. Mangano et al. (5) demonstrated that a short perioperative period of administration of β-blockers has an effect on 6-month survival. The optimal period of perioperative influence must therefore take into account the patient's disease and surgical risk.

Major nonfatal medical complications both in the hospital and within 30 days after surgery represent an additional outcome of interest. A listing of medical outcomes is shown in Table 1.

The major issue for medical morbidity is the definition of an adverse event. Definitions frequently vary between studies and sometimes make interpretation difficult. For example, the definition of myocardial infarction varies, particularly with the development of troponin as a more sensitive assay that detects smaller degrees of myocardial necrosis (7). An alternative approach by many investigators is to utilize length of stay as a surrogate or marker for increased complication rate.

More recently, patient-oriented outcomes have taken on greater importance. These include patient satisfaction, quality of recovery, and quality of life (8). The key issue with regard to these measures is the validity of the instruments and new instruments are constantly being developed.

There are numerous questions and studies related to perioperative outcomes and how best to yield the highest quality of care (Figure 1). This lecture will attempt to focus on several distinct areas as a means of identifying these best practices and identifying the methodology to approach the question. From an evidence-based perspective, randomized controlled trials represent the highest form of evidence (9). These trials form the basis of practice guidelines established by many specialty societies including the American Society of Anesthesiologists (10). In the absence of

Table 1. Outcomes of Interest

Death
Intraoperative
Immediate postoperative
30-day
Longer?
Major morbidity
MI
Pneumonia
CVA
PE
Minor morbidity
PONV
PDNV
Pain
Readmission
Etiology of admission
Costs
Hospital + Home
Medical + Non-medical
Patient satisfaction
Quality of recovery
Quality of life

MI = myocardial infarction; CVA = cerebrovascular accident; PE = pulmonary embolism; PONV = postoperative nausea and vomiting; PDNV = postdural nausea and vomiting.

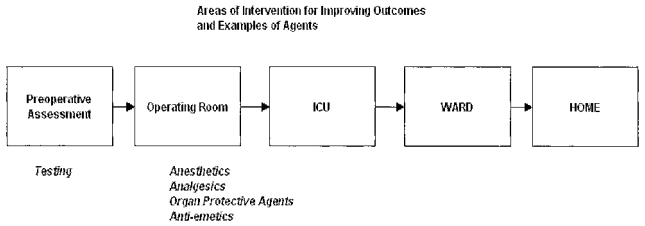

Figure 1. Identification of questions to address.

randomized controlled trials, case control and cohort studies also offer evidence, but the robustness of the conclusions is minimized by the absence of randomization. The Agency for Healthcare Research and Quality has recently commissioned a report that outlines those practices that have been found to improve patient safety (11). This lecture will focus on a group of interventions that are advocated in these guidelines or based on large-scale clinical trials.

Cardiovascular Disease

Preoperative cardiac testing and coronary revascularization has been suggested as a means of reducing perioperative cardiac morbidity for noncardiac surgery. There are no published randomized trials to address the value of preoperative testing before noncardiac surgery. Identification of subgroups of patients who warrant preoperative testing, according to the American Heart Association/American College of Cardiology, is based on results from cohort studies. Similarly, the value of preoperative coronary revascularization (either coronary artery bypass grafting or percutaneous coronary interventions) is based on nonrandomized cohort trials. The decision to perform testing and interventions has been further modified recently by randomized information on perioperative β-blockers. Figure 2 represents one proposed approach to the integration of preoperative testing and medical and surgical therapy to improve outcome in these patients (12).

The benefits of β-blocker in patients with coronary artery disease have been well documented for several decades. In the perioperative period, there was only scant evidence until recently that β-blockers were advantageous (13,14). Two recent randomized controlled trials of perioperative β-blockade have led to guidelines that suggest that perioperative administration will reduce cardiac morbidity particularly in the subgroup with a positive stress test undergoing major vascular surgery (4,5). Ideally, the β-blockers should be started a minimum of 7 days before noncardiac surgery and titrated to a heart rate of 60 bpm preoperatively and 70–80 bpm intra- and postoperatively. A key question with regard to many of these clinical trials is the ability to generalize beyond the immediate results. In this particular case, the questions remain: which specific groups of patients will benefit beyond those in the original clinical trial and how should the medication be administered to patients for whom seven days of preoperative titration is not practical? Figure 3 illustrates one approach to implementing β-blocker therapy based on the available evidence.

The use of pulmonary artery catheters represents another area in which guidelines have been developed. In 1993, one of the first guidelines was published by the ASA; it outlined six controlled studies of pulmonary artery catheters (15). The number of actual randomized clinical trials was even smaller. They defined the decision to use a pulmonary artery catheter based on patient disease, surgical risk, and location of care. Since publication of the trial, there have been two large-scale administrative database analyses, which have suggested that patients who have pulmonary artery catheters have either a similar or higher mortality than patients who do not, adjusting for the propensity to have a pulmonary artery catheter placed (16,17). Therefore, based on this and other work, new guidelines were developed (18). It is important to utilize pulmonary artery catheters appropriately so as to improve outcomes in those in whom it would benefit and not cause harm in those in whom there is no proven benefit.

Postoperative Nausea and Vomiting

For ambulatory surgery, postoperative nausea and vomiting represents one of the most significant causes

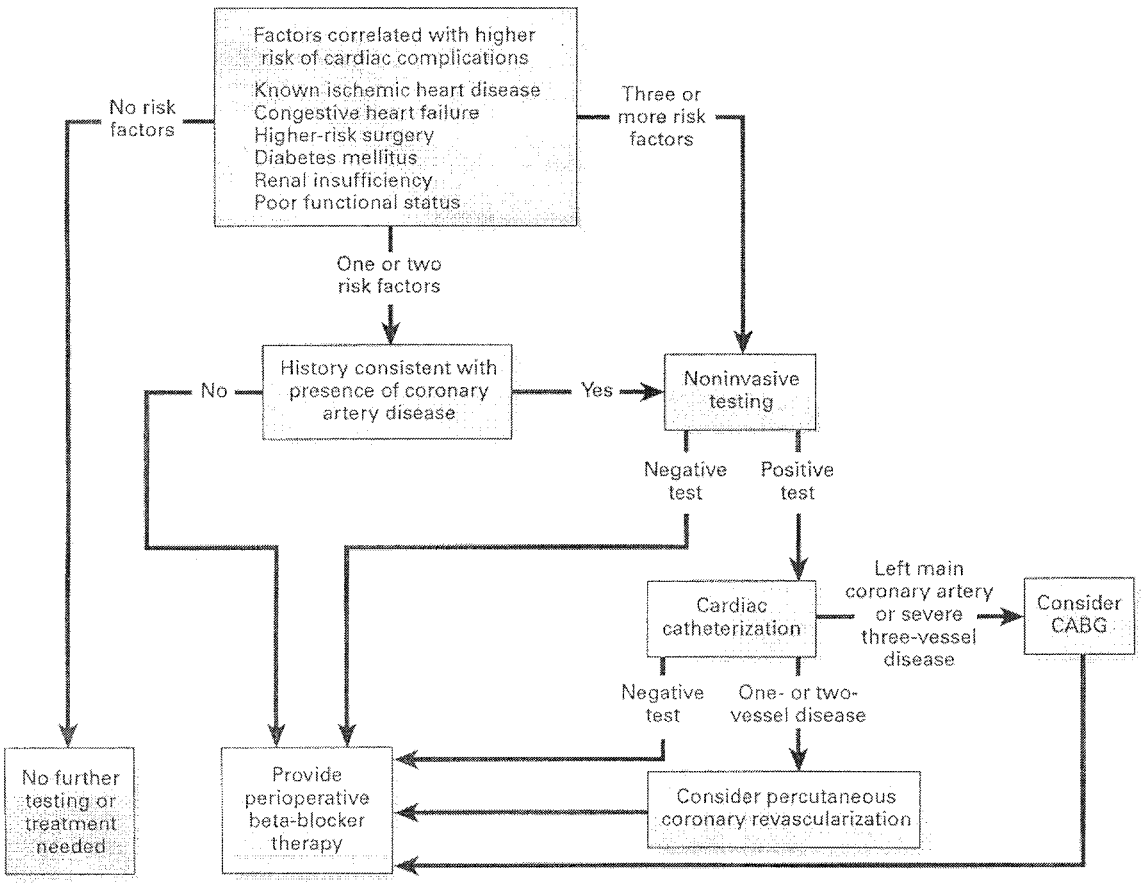

Figure 2. A proposed approach to the integration of preoperative testing and medical and surgical therapy in cardiovascular patients. Reproduced with permission from The New England Journal of Medicine (12).

of morbidity and delay in discharge (19). There have been numerous randomized clinical trials looking at those monotherapy and multimodal approaches. Several groups have performed meta-analyses to identify those strategies that are most efficacious in improving outcomes (20,21). Monotherapy has been shown to yield improved outcomes compared with placebo, but combination therapy is clearly the most efficacious. The issue is the added cost of combination therapy (i.e., its net cost effectiveness). In implementing a perioperative antiemetic program, it is, therefore, important to define high-risk subsets of patients in whom combination therapy might actually decrease or minimize cost from a total care perspective as well as increase patient satisfaction. Patients undergoing surgeries in whom the risk of postoperative nausea and vomiting is less might benefit from rescue therapy only or prophylactic monotherapy from a cost-effective perspective.

Perioperative Infections

As part of the Institute of Medicine Report on medical errors, iatrogenic infections are a major cause of complications, cost, and potential mortality. Prophylactic antibiotics have been shown to reduce infections. The timing of prophylactic antibiotics is critical with peak blood and tissue levels necessary before incision (22,23). It is also important to re-dose antibiotics at appropriate intervals. The anesthesiologist is a critical member of the team to insure that the antibiotics are given in an appropriate manner.

In addition to surgical site infection, blood stream infections from invasive central lines is another source of major morbidity related to infections (11). Barrier precautions during central line insertion have been shown to significantly reduce the rate of complications and should be utilized routinely as part of our insertion.

Postoperative Intensive Care Unit Care

As part of the continuum of perioperative medicine, it is important for anesthesiologists to continue to take an active role in the intensive care unit. Pronovost et al. (24) demonstrated markedly reduced mortality and length of intensive care unit stay in patients undergoing aortic surgery in those units in Maryland in which intensivists made daily rounds. Several other groups

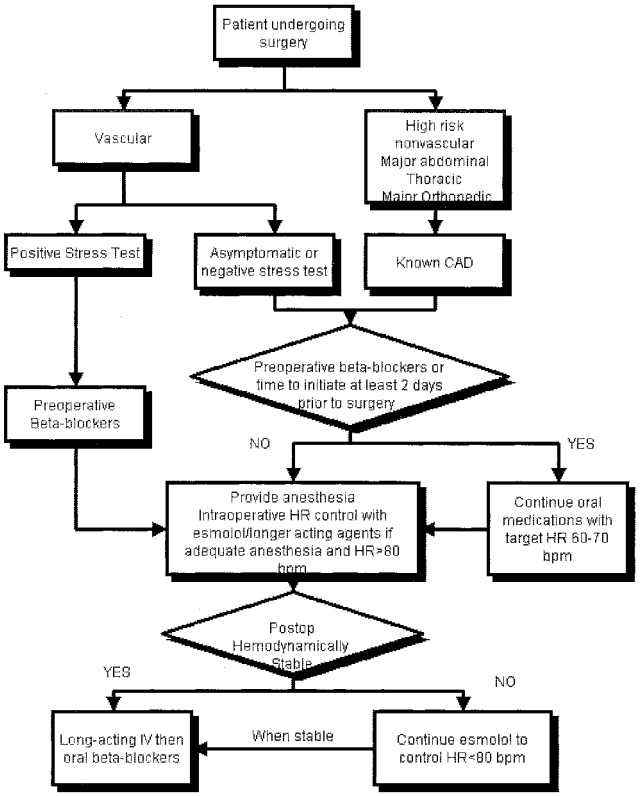

Figure 3. An approach to implementing β-blocker therapy based on the available evidence.

have demonstrated similar findings and this record is supported by a recent meta-analysis (25). Many health care quality groups have adopted this practice as a standard for providing care and have demanded intensivists from their health plans. Anesthesiologists especially must continue to take a leadership role in this area as part of our continuum of perioperative care.

Summary

There is a growing trend to perform randomized clinical trials and other studies to establish an evidentiary basis for many of our perioperative practices. It is important to understand which practices have strong evidence to support their continuation and guidelines represent one area in which the evidence is assimilated and recommendations proposed. It is now up to the specialty to help to adopt these recommendations into clinical practice to provide our patients with the highest level of care.

References

1. Fleisher LA, Mantha S, Roizen MF. Medical technology assessment: an overview. Anesth Analg 1998;87:1271–82.
2. Ruth HS. Anesthesia study commissions. JAMA 1945;127:514.
3. Beecher HK, Todd DP. A study of deaths associated with anesthesia and surgery. Ann Surg 1954;140:2–34.
4. Poldermans D, Boersma E, Bax JJ, et al. The effect of bisoprolol on perioperative mortality and myocardial infarction in high-risk patients undergoing vascular surgery. Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography Study Group. N Engl J Med 1999;341:1789–94.
5. Mangano DT, Layug EL, Wallace A, Tateo I. Effect of atenolol on mortality and cardiovascular morbidity after noncardiac surgery. Multicenter Study of Perioperative Ischemia Research Group. N Engl J Med 1996;335:1713–20.
6. Warner MA, Shields SE, Chute CG. Major morbidity and mortality within 1 month of ambulatory surgery and anesthesia. JAMA 1993;270:1437–41.
7. Mangano DT. Beyond CK-MB. Biochemical markers for perioperative myocardial infarction. Anesthesiology 1994;81:1317–20.
8. Wu CL, Naqibuddin M, Fleisher LA. Measurement of patient satisfaction as an outcome of regional anesthesia and analgesia: a systematic review. Reg Anesth Pain Med 2001;26:196–208.
9. Oxman AD, Sackett DL, Guyatt GH. Users' guides to the medical literature. I. How to get started The Evidence-Based Medicine Working Group. JAMA 1993;270:2093–5.
10. Arens JF. A practice parameters overview. Anesthesiology 1993; 78:229–30.
11. Shojania KG, Duncan BW, McDonald KM, Wachter RM. Safe but sound: patient safety meets evidence-based medicine. JAMA 2002;288:508–13.
12. Fleisher LA, Eagle KA. Clinical practice: lowering cardiac risk in noncardiac surgery. N Engl J Med 2001;345:1677–82.
13. Auerbach AD, Goldman L. Beta-blockers and reduction of cardiac events in noncardiac surgery: clinical applications. JAMA 2002;287:1445–7.
14. Auerbach AD, Goldman L. Beta-blockers and reduction of cardiac events in noncardiac surgery: scientific review. JAMA 2002; 287:1435–44.
15. American Society of Anesthesiologists Task Force on Pulmonary Artery Catheterization. Practice guidelines for pulmonary artery catheterization. Anesthesiology 1993;78:380–94.
16. Connors AF Jr, Speroff T, Dawson NV, et al. The effectiveness of right heart catheterization in the initial care of critically ill patients. SUPPORT Investigators. JAMA 1996;276:889–97.
17. Polanczyk CA, Rohde LE, Goldman L et al. Right heart catheterization and cardiac complications in patients undergoing noncardiac surgery: an observational study. JAMA 2001;286: 309–14.
18. Practice guidelines for pulmonary artery catheterization: Task Force on guidelines for pulmonary artery catheterization, 2002. Available at www.asahq.org/publicationsAndServices/pulmartery.pdf. Accessed January 8, 2003.
19. Gan TJ. Postoperative nausea and vomiting–can it be eliminated? JAMA 2002;287:1233–6.
20. Tramer MR. A rational approach to the control of postoperative nausea and vomiting: evidence from systematic reviews. Part I. Efficacy and harm of antiemetic interventions, and methodological issues. Acta Anaesthesiol Scand 2001;45:4–13.
21. Tramer MR. A rational approach to the control of postoperative nausea and vomiting: evidence from systematic reviews. Part II. Recommendations for prevention and treatment, and research agenda. Acta Anaesthesiol Scand 2001;45:14–9.
22. Wenzel RP. Preoperative antibiotic prophylaxis. N Engl J Med 1992;326:337–9.
23. Classen DC, Evans RS, Pestotnik SL, et al. The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. N Engl J Med 1992;326:281–6.
24. Pronovost PJ, Jenckes MW, Dorman T, et al. Organizational characteristics of intensive care units related to outcomes of abdominal aortic surgery. JAMA 1999;281:1310–7.
25. Pronovost PJ, Angus DC, Dorman T, et al. Physician staffing patterns and clinical outcomes in critically ill patients: a systematic review. JAMA 2002;288:2151–62.