As anaesthesiologists, we are constantly striving to improve the perioperative care of our patients. Over the past several decades, the specialty has been lauded for improving perioperative safety through efforts to improve intraoperative monitoring and management. Recent studies suggest that the risk of death directly from anaesthesia is of the order of 1 in 250,000 cases, although one author has questioned this value [1]. However, perioperative complications and death from those complications continue to occur at high rates. This lecture will demonstrate how care decisions made by anaesthesiologists may have an impact on outcome and that appropriate utilization of best evidence can aid decision making and lead to improved patient outcomes [2].

When assessing the causes of perioperative risk, there has been a focus on outcomes directly influenced by the anaesthesiologist. However, there is increasing evidence that factors that have the capacity to be altered by the anaesthesiologist, although not traditionally considered to be within the domain of the anaesthesiologist, can affect outcomes. For example, the historical notion has been that surgical site infections were thought to be unrelated to anaesthetic care. However, recent studies have suggested that activities potentially within the control of anaesthesiologists, e.g. maintenance of normothermia and appropriate timing of antibiotics, can influence overall patient outcomes. Additionally, complications traditionally thought to be a reflection of underlying patient disease, e.g. cardiac or pulmonary disease, can be reduced by treatment initiated or performed by the anaesthesiologist. As perioperative physicians, we should look for all opportunities to improve the care we give and apply best evidence to our perioperative decision making.

An underlying assumption in medical care is that treatment should be individualized for a given patient if optimal outcomes are desired. In the perioperative period, anaesthesiologists are presented with a multiplicity of options with regard to the choice of anaesthesia, monitors and drugs utilized to achieve the desired outcome. Whilst a large portion of our patients will do well if they receive a ‘standard’ anaesthetic (e.g. propofol, a muscle relaxant, an inhalational agent and narcotic) there is a basic assumption that obtaining a preoperative history, physical examination and appropriate laboratory testing will influence management choices resulting in better outcomes. The concept of establishing a baseline database to assess risk of disease and risk of developing complications can be incorporated within a decision paradigm (Figure 1). Using our understanding of clinical findings, prior experience, and the application of medical literature we can assess the probability of disease within certain confidence intervals. Within this paradigm, the clinician may decide that the probability of disease reaches a certain threshold that requires action. For patients with cardiovascular disease who are undergoing noncardiac surgery, these actions can include modification of medical management including initiation or continuation of beta-blockers and statins, treatment for unstable coronary symptoms, and coronary revascularization among other interventions [3].

![Figure 1](image-url)

*Figure 1- The influence of baseline knowledge and clinical assessment of extent of disease in making a decision. If the probability is above a threshold for action, then the action should be taken. If the probability of disease straddles the threshold for action, then a test may be indicated to determine the best action. Reproduced with permission from Reference 2.*
Therefore, risk assessment is a critical first step in the decision process. There are multiple examples of assessing risk and utilizing clinical and laboratory information to dictate subsequent care. A recent example is the use of the Revised Cardiac Risk Index (RCRI). The RCRI has been utilized in multiple studies to define a population at risk that was subsequently randomized to two different treatment regimens. For example, a modification of the RCRI was utilized in the Coronary Artery Revascularization Project (CARP) to determine who should undergo coronary angiography for potential randomization to medical versus revascularization therapy [4]. Similarly, the RCRI has been utilized to determine the potential benefit or risk of perioperative beta-blocker or statin therapy in several large-scale studies. This Bayesian approach to decision making is the basis for the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines on Perioperative Cardiovascular Evaluation and Management for Noncardiac Surgery [3].

Importantly, the clinical evaluation and integration of knowledge does not always lead to a clear decision for action. A key question is how to determine what the optimal management should be when the probability and extent of a disease is less precise and when the threshold for any action lies within the confidence intervals of the risk assessment. Testing can potentially have value in such situations since a negative test would lower the probability and obviate any need for action while a positive test would raise the probability above threshold and therefore lead to an initiation of the action.

Understanding the evidence

Randomized clinical trials (RCT) form the basis for determining the evidence supporting an action. Over the past several decades there has been a marked increase in the number and quality of RCTs focussing on the perioperative period. RCTs are designed to prove efficacy: determining whether an intervention works under ideal conditions. They have clearly defined patient inclusion/exclusion criteria and usually have strict protocols of care. While internal validity of these trials is very high, the trials’ external validity may be low. In contrast, effectiveness refers to how an intervention works under real-world conditions. In such situations, the intervention may behave identically or differently from the RCT.

In the patient with cardiovascular disease, examples of RCTs include the study of beta-blockers, statins, coronary revascularization, and thermal management. The recent series of studies of perioperative beta-blockade in noncardiac surgery help illustrate both the importance of how the baseline risks of the patient and the study protocol can influence effectiveness [5]. For example commencement of beta-blockade several weeks in advance of surgery has been shown to be efficacious in vascular surgery patients at very high risk [6]. However, subsequent studies questioned the finding in lower risk patients and in real world usage (i.e. effectiveness).

The POISE trial demonstrates the importance of study protocol and sample size with respect to the effectiveness of a drug [7]. As opposed to the small sample size in the DECREASE trials, the POISE investigators randomized a total of 8351 patients to controlled-release oral metoprolol succinate or placebo. The primary endpoint of cardiac death, non-fatal myocardial infarction or cardiac arrest was reduced in the metoprolol group compared to placebo (5.8% vs. 6.9%, hazard ratio 0.84, 95% CI 0.70-0.99, p=0.04), driven by a reduction of non-fatal myocardial infarctions, however, at the costs of an increased overall incidence of total mortality and stroke. One of the major conjectures with regard to the difference between the results in the POISE study and other trials is the differences in the protocol; metoprolol succinate, a long-acting beta-blocker, was used at much higher doses and was started the morning of surgery in contrast to lower doses titrated to effect and started weeks before surgery [8]. Additionally, the larger study size provides sufficient power to detect less common events such as perioperative stroke.

Cohort studies are also important from an evidence perspective. Because they can include a large number of patients, they can have sufficient sample size to determine the presence of rare associations. It is becoming increasingly common for Institutions to query their large anaesthesia information systems’ patient database to look at important questions. For example, investigators at the University of Michigan have evaluated predictors of early postoperative tracheal intubation [9]. One statistical method to obtain more robust information from large databases or cohorts is the use of propensity analysis. This approach was an important determinant in the studies demonstrating the potential harm identified with the use of aprotinin.
Another approach to studying effectiveness is the review of administrative datasets (e.g. Medicare claims data) to evaluate the effect of an intervention in clinical practice. For example, Lindenauer et al. retrospectively reviewed the records of 782,969 patients and determined who received beta-blocker treatment during the first two days in hospital [10]. The relationship between perioperative beta-blocker treatment and the risk of death varied directly with cardiac risk: among the 580,665 patients with a RCRI score of 0 or 1, treatment was associated with no benefit and possible harm, whereas among the patients with a score of 2, 3, or 4 or more, the adjusted odds ratios for death in the hospital were 0.88 (95 percent confidence interval, 0.80 to 0.98), 0.71 (95 percent confidence interval, 0.63 to 0.80), and 0.58 (95 percent confidence interval, 0.50 to 0.67), respectively.

Implementation to the individual patient

If an intervention is found to be effective or advocated in a guideline, should it always be implemented in every patient? Clearly, the answer is no since the patient of interest may not be similar to the original population studied or the processes of care and method of implementation may be different at the local institution compared with those conducting the original studies. As described above, patients have different levels of risk and, additionally, patients have a complex characteristic of diseases for which the best practice guidelines may actually be in direct conflict. Boyd and colleagues demonstrated that most clinical practice guidelines do not modify or discuss the applicability of their recommendations for older patients with multiple comorbidities [11]. They also demonstrated that adverse interactions between drugs and diseases could result. Applying best practices (which may be defined in guidelines) therefore requires an understanding of the applicability of the results and the risks and benefits in the individual patient. This is a further application of efficacy versus effectiveness and illustrates the importance of incorporating this information into guidelines and ensuring there are defined triggers for re-evaluating the evidence. For example, institution of new beta-blocker therapy the morning of surgery or in low-risk patients may actually cause more harm than good. Importantly, continuation of beta-blocker therapy or initiating therapy in the appropriate population with a well-defined protocol has been shown to benefit patients.

Patient preferences are an important component of the application of evidence to the individual patient. Specifically, different patients value or assign different weights to different outcomes and therefore the optimal decision for any given patient is sensitive to these values. Patient preferences can be assessed using willingness-to-pay, which has been applied to issues such as nausea and vomiting and choice of inpatient or outpatient care [12]. Another approach to assessing preferences is the use of standard gamble techniques, whereby the subject is offered a choice of a known outcome and offered a varying probabilities of a good outcome of morbidity/mortality. These techniques have frequently been applied to determine how subjects rate such outcomes as stroke, angina, etc [13].

A critical area in which patient preferences influence decision-making is in the area of preoperative cardiovascular testing in patients undergoing intermediate risk surgery with 1 or 2 risk factors. As outlined in the ACC/AHA guidelines, proceeding to the operating room with adequate heart rate control was assigned a class IIa recommendation while preoperative testing was assigned a class IIb recommendation [3]. In trying to determine the correct approach for the individual patient, a patient’s preference for surgery versus alternative management can drive the decision. For example, if the patient is determined to be high risk then they may choose to undergo a less invasive procedure or no surgery at all.

Summary

In summary, application of evidence-based practices in the perioperative period by anaesthesiologists should result in improvement in patient outcomes. In order to achieve this goal, the anaesthesiologist must understand the actual evidence with respect to the appropriate population and protocols and application of patient preferences.
Key Learning Points

• Improving perioperative outcomes depends upon the integration of best evidence into clinical practice.
• Application of evidence requires an understanding of the baseline assessment of risk in a given patient and the applicability of the available studies.
• Evidence based practice includes understanding the role of randomized clinical trials, cohorts studies and analysis of administrative data.
• Individualizing care includes understanding the importance of patient preferences.

References