Perioperative Myocardial Ischemia

To Everything There Is a Season

Because perioperative myocardial infarction has an important adverse effect on outcome after both cardiac and noncardiac surgery, it has been a subject of intense interest among anesthesiologists, cardiologists, and surgeons. As with most scientific questions, our understanding of factors affecting the incidence of perioperative myocardial ischemia and infarction has advanced in small steps, as incremental information is slowly deposited on the stalagmite of preexisting knowledge. Every so often, however, a methodological breakthrough has catalyzed a more rapid advance.

The First Breakthrough

The first major breakthrough in perioperative risk assessment was the development of methods for the prospective study and sophisticated biostatistical analysis of patients who might be at risk for perioperative cardiac complications.1 These methods allowed clinical research to move beyond the era of retrospective post hoc analyses that were limited by the quality of information that might (or might not) have been recorded by physicians during routine patient care. By gathering comprehensive, prospective data on large numbers of patients and analyzing those data with newly available statistical techniques, the risks of perioperative complications could be estimated for patients undergoing both cardiac and noncardiac surgery.2–5

Although routine data from the history, physical examination, and basic laboratory tests can segregate some patients into very-high- or very-low-risk groups, a substantial portion of patients may remain in a less well-defined middle-risk group. In such patients, especially if they are undergoing noncardiac surgery, additional preoperative diagnostic testing would be potentially desirable.

The Second Breakthrough

Fitness for surgery, and especially for noncardiac surgery, was traditionally determined in part preoperatively by assessing the functional capacity of the patient. This assessment could be guided by crude or more refined series of structured questions or by routine exercise testing.

Preoperative evaluation became substantially more sophisticated, however, with the availability of newer techniques, such as dipyridamole–thallium scintigraphy,9–11 ambulatory ischemia monitoring,12,13 and stress echocardiography.14 Despite some conflicting data,11 each of these techniques has shown promise for stratifying risk, especially in patients undergoing noncardiac surgery. Of note is that the incremental benefit of these tests is primarily in middle-risk patients, with data to suggest that the history, physical examination, and more basic laboratory tests are sufficient for identifying very-high- and very-low-risk patients.9,12

The same techniques for continuous ischemia monitoring that can be used for preoperative evaluation can also be used for intraoperative and postoperative evaluation.15 In addition, transesophageal echocardiography and, more recently, transesophageal echocardiography,17 can assess intraoperative myocardial function, and by extrapolation, myocardial ischemia.

As a result of these improvements in preoperative risk stratification and perioperative diagnostic testing, we are more able than ever to identify high-risk patients and to monitor them in exquisite detail to detect the earliest sign of possible abnormalities. We also know that detectable postoperative ischemia is a clinically important and statistically significant prelude to major postoperative cardiac events.13,15 Intraoperative ischemia is also associated with postoperative cardiac events, but the correlation is not as strong as it is for preoperative or postoperative ischemia.13,15

Where Next: The Third Breakthrough?

In my opinion, we have already made great strides in risk stratification and in the early detection of abnormalities that may auger major complications. Although future research may allow us to “fine-tune” preoperative clinical assessment, preoperative diagnostic testing, or intraoperative and postoperative monitoring, the important question now is whether we can alter natural history.

The randomized control trial as described in a recent editorial in this journal18 is the standard mechanism for assessing the efficacy of interventions. While not a new breakthrough per se, it is a methodological advance that

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331
has had a profound effect on other clinical fields. The
dearth of randomized trials in the perioperative manage-
ment of patients at risk for myocardial ischemia explains
much of the uncertainty regarding optimal practice.

The postoperative period is a time when substantial
myocardial ischemia may occur\textsuperscript{12,15,16,19} and when early in-
tervention may be helpful. Potential approaches to reduce
such ischemia include cardiac medications to decrease
heart rate, control hypertension, or dilate the coronary
arteries. In this issue of ANESTHESIOLOGY Mango and
colleagues\textsuperscript{19} remind us that more effective postoperative
anesthesia can also reduce myocardial ischemia.

It is my hope that the current study by Mango and
colleagues will usher in a new era, during which the meth-
odology of randomized trials is repeatedly applied to
common questions in perioperative management. Even if
I could be accused of bias because of my planned future
collaborations with Mango and his colleagues on trials
in this field, I believe that the logic of this conclusion is
self-evident.

Randomized trials are usually limited by the availability
of patients, the frequency with which the outcome of
interest occurs, and how soon the outcome occurs. It is
paradoxical that the methodology of randomized trials has
not been applied sooner to perioperative management of
patients with cardiac disease, since patients are plentiful,
cardiac complications remain more frequent than we
would like, and the complications occur fairly soon after
surgery.

In taking this next step, it is imperative that we not be
satisfied with reductions in intermediate outcomes, such
as monitor-detected ischemia, but rather focus on the
clinically important outcomes of myocardial infarction,
perioperative death, and long-term outcome. Prior car-
diac research has emphasized the fallacy of reliance on
intermediate outcomes: in the Cardiac Arrhythmia
Suppression Trial Study,\textsuperscript{20} a reduction in ventricular ar-
hythmias in postmyocardial infarction patients by certain
medications was associated with a surprising increase in
mortality.

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Methods are now available to enable research in peri-
operative management of the patient with cardiac disease
to make a great leap forward. If cardiologists can perform
large, multicenter, randomized trials of thrombolysis for
patients with acute myocardial infarctions, and if oncol-
ologists can perform similar studies in patients with mali-
gancies, it should be possible to apply these same methods
to address common issues in perioperative management.
Based on prior experience in other fields, many traditional
assumptions may be challenged or disproved by such rig-
orous evaluation.

Even the randomized trial is not the final step for eval-
uating diagnostic and therapeutic strategies in the 1990s.
Given the limitations in financial resources, it will also be
necessary to demonstrate that any effective interventions
are also cost-effective.\textsuperscript{21} The assessment of cost-effective-
ness is especially important in perioperative management,
because technologies such as dipyridamole–thallium scin-
tigraphy, transesophageal echocardiography, continuous
ischemia monitoring, and pulmonary artery catheterization
are expensive, and the numbers of patients who are
potential candidates for them are immense. Thus, even if interventions with medications or new technologies can
be shown to be safe and beneficial, their cost effectiveness
must be determined before they can be recommended for
routine patient care.

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