



EDUCATIONAL OBJECTIVE: Readers will interpret the latest guidelines when evaluating patients for cardiovascular risk before noncardiac surgery

STEVEN L. COHN, MD, FACP, SFHM

Medical Director, UHealth Preoperative Assessment Center; Director, UMH Medical Consultation Service; Professor of Clinical Medicine, University of Miami Miller School of Medicine, Miami, FL

Updated guidelines on cardiovascular evaluation before noncardiac surgery: A view from the trenches

ABSTRACT

In August 2014, the American College of Cardiology and American Heart Association updated their guidelines on cardiovascular evaluation and care before noncardiac surgery and simultaneously published a systematic review of perioperative use of beta-blockers. The update reinforces many previous recommendations and provides new evidence and expert opinion that is useful to the perioperative team.

KEY POINTS

Like earlier guidelines, the update recommends preoperative cardiac testing only when the results may influence the patient's management.

Preoperative intervention is rarely necessary just to get the patient through surgery, unless it is otherwise indicated independent of the need for surgery.

The update proposes a modified algorithm for preoperative risk assessment and management and suggests using a new calculator of surgical risk.

The report also updates information on the timing of surgery after percutaneous coronary intervention, as well as on antiplatelet therapy, other medical therapy, and biomarkers.

GUIDELINES JOINTLY ISSUED by the American College of Cardiology and American Heart Association (ACC/AHA)¹ provide a framework for evaluating and managing perioperative cardiac risk in noncardiac surgery. An overriding theme in successive documents from these organizations through the years has been that preoperative intervention, coronary artery bypass grafting, or percutaneous coronary intervention is rarely necessary just to get the patient through surgery, unless it is otherwise indicated independent of the need for surgery.

See related commentary, page 752

This article highlights some of the key recommendations in the 2014 updates to these guidelines,¹⁻³ how they differ from previous guidelines,⁴ and the ongoing challenges and unresolved issues facing physicians involved in perioperative care.

Of note, while these guidelines were being updated, Erasmus University⁵ expressed concern about the scientific integrity of some of the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography (DECREASE) trials. As a result, the evidence review committee included these trials in its analysis but not in a systematic review of beta-blockers.² These trials were not included in the clinical practice guideline supplements and tables but were cited in the text if relevant.

The European Society of Cardiology and European Society of Anesthesiology⁶ revised their guidelines concurrently with but independently of the ACC/AHA, and although they discussed and aligned some recommendations,

many differences remain between the two sets of guidelines. Readers should consult the full guidelines for more detailed information.¹

■ THE ROLE OF THE PREOPERATIVE CARDIAC EVALUATION

The purpose of preoperative medical evaluation is not to “get medical clearance” but rather to evaluate the patient’s medical status and risk of complications. The process includes:

- Identifying risk factors and assessing their severity and stability
- Establishing a clinical risk profile for informed and shared decision-making
- Recommending needed changes in management, further testing, or specialty consultation.

The updated guidelines emphasize the importance of communication among the perioperative team and with the patient. They reiterate the focus on appropriateness of care and cost containment—one should order a test only if the result may change the patient’s management.

■ HOW URGENT IS SURGERY? HOW RISKY?

The new guidelines classify the urgency of surgery as follows:

- Emergency (necessary within 6 hours)
- Urgent (necessary within 6–24 hours)
- Time-sensitive (can delay 1–6 weeks)
- Elective (can delay up to 1 year).

Surgical risk is now classified as either low (< 1% risk of major adverse cardiac events) or elevated (≥ 1%) on the basis of surgical and patient characteristics. Previous schemas included an intermediate-risk category. Low-risk procedures include endoscopic procedures, superficial procedures, cataract surgery, breast surgery, and ambulatory surgery. Elevated-risk procedures include vascular surgery, intraperitoneal and intrathoracic surgery, head and neck surgery, orthopedic surgery, and prostate surgery.

Risk calculators and biomarkers

To estimate the perioperative risk of major adverse cardiac events, the guidelines suggest incorporating the Revised Cardiac Risk Index (RCRI)⁷ with an estimation of surgical risk or using a newer surgical risk calculator derived from a database of the American College of Surgeons’ National Surgical Quality Improve-

ment Project (ACS NSQIP).

The RCRI is based on six risk factors, each worth 1 point:

- High-risk surgery
- Ischemic heart disease
- Heart failure
- Stroke or transient ischemic attack
- Diabetes requiring insulin
- Renal insufficiency (serum creatinine > 2.0 mg/dL).⁷

MICA. The Myocardial Infarction or Cardiac Arrest (MICA) calculator⁸ has a narrower focus and was validated in only one center.

ACS NSQIP. The recommended newer ACS NSQIP surgical risk calculator⁹ provides an estimate of procedure-specific risk based on Current Procedural Terminology code and includes 21 patient-specific variables to predict death, major adverse cardiac events, and eight other outcomes. While more comprehensive, this risk calculator has yet to be validated outside of the ACS NSQIP database.

Reconstructed RCRI. The RCRI has been externally validated, but it underestimates risk in major vascular surgery and was outperformed by the MICA calculator. Although not discussed in the new guidelines, a recently published “reconstructed RCRI,”¹⁰ in which a serum creatinine level greater than 2 mg/dL in the original RCRI is replaced by a glomerular filtration rate less than 30 mL/min and diabetes is eliminated, may outperform the standard RCRI. A patient with either an RCRI score or a reconstructed RCRI score of 0 or 1 would be considered to be at low risk, whereas patients with two or more risk factors would have an elevated risk.

Cardiac biomarkers, primarily B-type natriuretic peptide (BNP) and N-terminal (NT) proBNP, are independent predictors of cardiac risk, and their addition to preoperative risk indices may provide incremental predictive value. However, how to use these biomarkers and whether any treatment aimed at them will reduce risk is unclear, and the new guidelines did not recommend their routine use.

■ CLINICAL RISK FACTORS

Coronary artery disease

Ischemic symptoms, a history of myocardial infarction, and elevated cardiac biomarkers are individually associated with perioperative

The purpose is not to ‘get clearance’ but to evaluate the patient’s medical status and risk of complications

risk of morbidity and death. The risk is modified by how long ago the infarction occurred, whether the patient underwent coronary revascularization, and if so, what type (bypass grafting or percutaneous coronary intervention). A patient with acute coronary syndrome (currently or in the recent past) is at higher risk, and should have elective surgery delayed and be referred for cardiac evaluation and management according to guidelines.

Heart failure

In terms of posing a risk for major adverse cardiac events, heart failure is at least equal to coronary artery disease, and is possibly worse. Its impact depends on its stability, its symptoms, and the patient’s left ventricular function. Symptomatic decompensated heart failure and depressed left ventricular function (ejection fraction < 30% or 40%) confer higher risk than asymptomatic heart failure and preserved left ventricular function. However, evidence is limited with respect to asymptomatic left ventricular dysfunction and diastolic dysfunction. Patients with stable heart failure treated according to guidelines may have better perioperative outcomes.

Valvular heart disease

Significant valvular heart disease is associated with increased risk of postoperative cardiac complications. This risk depends on the type and severity of the valvular lesion and type of noncardiac surgery, but can be minimized by clinical and echocardiographic assessment, choosing appropriate anesthesia, and closer perioperative monitoring. Aortic and mitral stenosis are associated with greater risk of perioperative adverse cardiac events than regurgitant valvular disease.

Echocardiography is recommended in patients suspected of having moderate to severe stenotic or regurgitant lesions if it has not been done within the past year or if the patient’s clinical condition has worsened.

If indicated, valvular intervention can reduce perioperative risk in these patients. Even if the planned noncardiac surgery is high-risk, it may be reasonable to proceed with it (using appropriate perioperative hemodynamic monitoring, which is not specified but typically would be with an arterial line, central line, and possibly a pulmonary arterial catheter) in

patients who have asymptomatic severe aortic or mitral regurgitation or aortic stenosis. Surgery may also be reasonable in patients with asymptomatic severe mitral stenosis who are not candidates for repair.

Arrhythmias

Cardiac arrhythmias and conduction defects are often seen in the perioperative period, but there is only limited evidence as to how they affect surgical risk. In addition to their hemodynamic effects, certain arrhythmias (atrial fibrillation, ventricular tachycardia) often indicate underlying structural heart disease, which requires further evaluation before surgery.

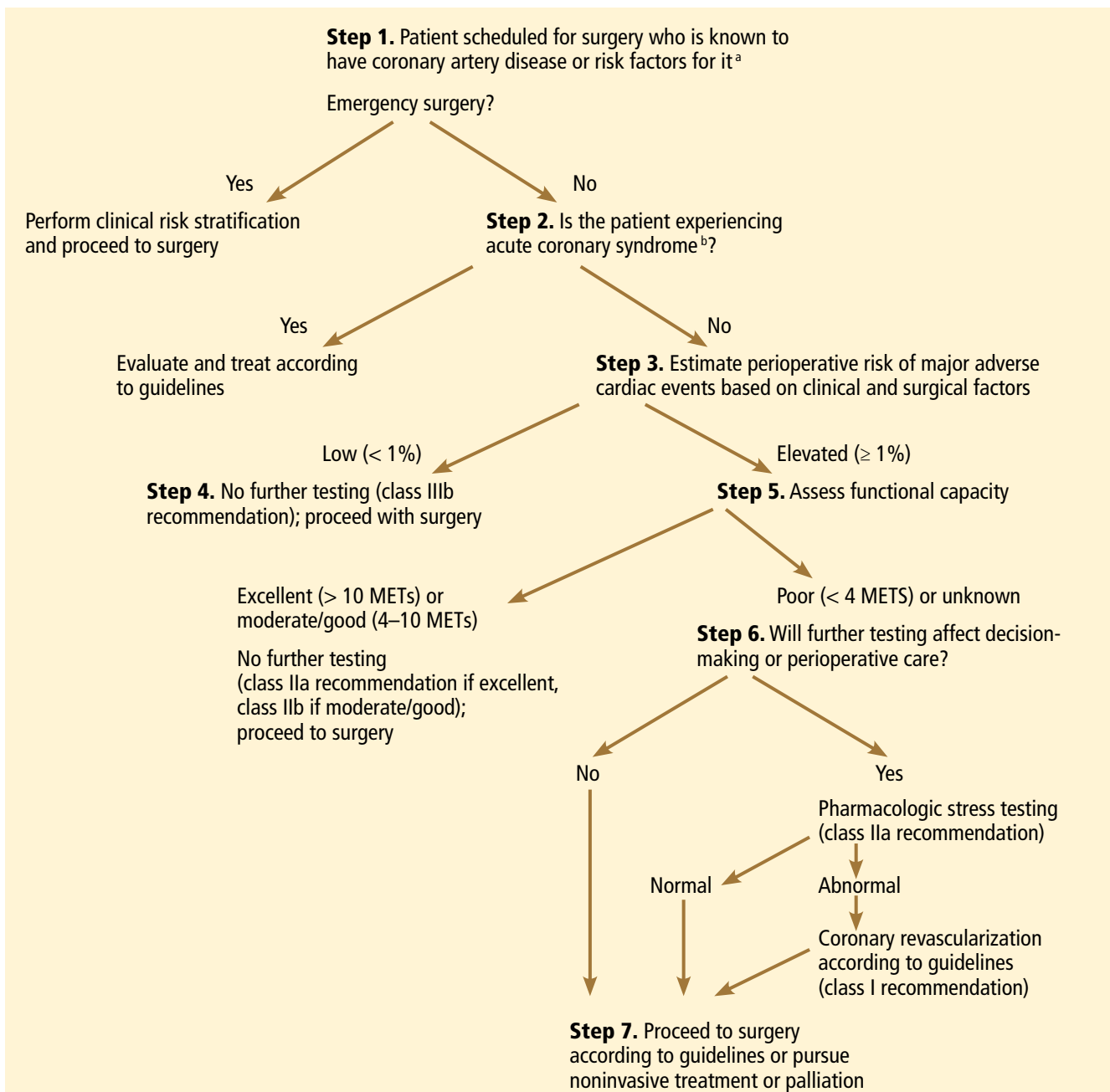
The new guidelines refer the reader to previously published clinical practice guidelines for atrial fibrillation,¹¹ supraventricular arrhythmias,¹² and device-based therapy.¹³

■ ALGORITHM FOR PREOPERATIVE CARDIAC ASSESSMENT

The new algorithm for evaluating a patient who is known to have coronary artery disease or risk factors for it has seven steps (FIGURE 1).^{1,11,12,14-17} It differs from the previous algorithm in several details:

- Instead of listing the four active cardiac conditions for which elective surgery should be delayed while the patient is being evaluated and treated (unstable coronary syndrome, decompensated heart failure, significant arrhythmias, severe valvular heart disease), the new version specifically asks about acute coronary syndrome and recommends cardiac evaluation and treatment according to guidelines. A footnote directs readers to other clinical practice guidelines for symptomatic heart failure,¹⁴ valvular heart disease,¹⁵ and arrhythmias.^{11,12}
- Instead of asking if the procedure is low-risk, the guidelines recommend estimating risk of major adverse cardiac events on the basis of combined clinical and surgical risk and define only two categories: low or elevated. Patients at low risk proceed to surgery with no further testing, as in the earlier algorithm.
- “Excellent” exercise capacity (> 10 metabolic equivalents of task [METs]) is separated from “moderate/good” (4–10 METs), presumably to indicate a stronger recommendation, but patients in both categories proceed to surgery as before.

One should order a test only if the result may change the patient’s management



^aSee sections 2.2, 2.4, and 2.5 in reference 1 for recommendations for patients with symptomatic heart failure,¹⁴ valvular heart disease,¹⁵ or arrhythmias.^{11,12}
^bSee American College of Cardiology/American Heart Association guidelines on unstable angina,¹⁶ non-ST-elevation myocardial infarction,¹⁶ and ST-elevation myocardial infarction.¹⁷

FIGURE 1. Stepwise approach to perioperative assessment for coronary artery disease

ADAPTED FROM FLEISHER LA, FLEISCHMANN KE, AUERBACH AD, ET AL. 2014 ACC/AHA GUIDELINE ON PERIOPERATIVE CARDIOVASCULAR EVALUATION AND MANAGEMENT OF PATIENTS UNDERGOING NONCARDIAC SURGERY: A REPORT OF THE AMERICAN COLLEGE OF CARDIOLOGY/AMERICAN HEART ASSOCIATION TASK FORCE ON PRACTICE GUIDELINES. J AM COLL CARDIOL 2014; JUL 29. PII: S0735-1097(14)05536-3. DOI: 10.1016/j.jacc.2014.07.944. [EPUB AHEAD OF PRINT]. ACCESSED OCTOBER 30, 2014. PROMOTIONAL AND COMMERCIAL USE OF THE MATERIAL IN PRINT, DIGITAL, OR MOBILE DEVICE FORMAT IS PROHIBITED WITHOUT THE PERMISSION FROM THE PUBLISHER LIPPINCOTT WILLIAMS & WILKINS. PLEASE CONTACT JOURNAL PERMISSIONS@LWW.COM FOR FURTHER INFORMATION.

• If the patient cannot exercise to at least 4 METs, the new algorithm asks whether further testing will affect decision-making or perioperative care (an addition to the previous al-

gorithm). This entails discussing with the patient and perioperative team whether the original surgery will be performed and whether the patient is willing to undergo revascular-

ization if indicated. If so, pharmacologic stress testing is recommended. Previously, this decision also included the number of RCRI factors as well as the type of surgery (vascular or non-vascular).

- If testing will not affect the decision or if the stress test is normal, in addition to recommending proceeding to surgery according to guidelines the new algorithm also lists an option for alternative strategies, including palliation.
- If the stress test is abnormal, especially with left main disease, it recommends coronary revascularization according to the 2011 clinical practice guidelines.^{18,19}

■ TESTING FOR LEFT VENTRICULAR DYSFUNCTION OR ISCHEMIA

In patients with dyspnea of unexplained cause or worsening dyspnea, assessment of left ventricular function is reasonable, but this is not part of a routine preoperative evaluation.

Pharmacologic stress testing is reasonable for patients at elevated risk with poor functional capacity if the results will change their management, but it is not useful for patients undergoing low-risk surgery. Although dobutamine stress echocardiography may be slightly superior to pharmacologic myocardial perfusion imaging, there are no head-to-head randomized controlled trials, and the guidelines suggest considering local expertise in deciding which test to use.

The presence of moderate to large areas of ischemia (reversible perfusion defects or new wall-motion abnormalities) is associated with risk of perioperative myocardial infarction or death, whereas evidence of an old infarction is associated with long-term but not short-term risk. The negative predictive value of these tests in predicting postoperative cardiac events is high (> 90%), but the positive predictive value is low.

■ CORONARY REVASCULARIZATION

Coronary artery bypass grafting and percutaneous coronary intervention

The guidelines recommend coronary revascularization before noncardiac surgery only when it is indicated anyway, on the basis of existing clinical practice guidelines.

Whether performing percutaneous coronary intervention before surgery will reduce perioperative cardiac complications is uncertain, and coronary revascularization should not be routinely performed solely to reduce perioperative cardiac events. The only two randomized controlled trials, Coronary Artery Revascularization Prophylaxis (CARP)²⁰ and DECREASE V²¹ evaluating prophylactic coronary revascularization before noncardiac surgery found no difference in either short-term or long-term outcomes, although subgroup analysis found a survival benefit in patients with left main disease who underwent bypass grafting. Preoperative percutaneous coronary intervention should be limited to patients with left main disease in whom comorbidities preclude bypass surgery and those with unstable coronary disease who may benefit from early invasive management.

The urgency and timing of the noncardiac surgery needs to be taken into account if percutaneous coronary intervention is being considered because of the need for antiplatelet therapy after the procedure, and the potential risks of bleeding and stent thrombosis. If the planned surgery is deemed time-sensitive, then balloon angioplasty or bare-metal stenting is preferred over placement of a drug-eluting stent.

The new guidelines continue to recommend that elective noncardiac surgery be delayed at least 14 days after balloon angioplasty, 30 days after bare-metal stent implantation, and ideally 365 days after drug-eluting stent placement, and reiterate that it is potentially harmful to perform elective surgery within these time frames without any antiplatelet therapy. However, a new class IIb recommendation (benefit \geq risk) states that “elective noncardiac surgery after [drug-eluting stent] implantation may be considered after 180 days if the risk of further delay is greater than the expected risks of ischemia and stent thrombosis.”

This is an important addition to the guidelines because we are often faced with patients needing to undergo surgery in the 6 to 12 months after placement of a drug-eluting stent. Based on previous guidelines, whether it was safe to proceed in this setting created controversy among the perioperative team caring for the patient, and surgery was often delayed

Classes of recommendations:
I: 'should'
IIa: 'reasonable'
IIb: 'may consider'
III: 'do not'

unnecessarily. Recent studies^{22,23} suggest that the newer drug-eluting stents may require a shorter duration of dual antiplatelet therapy, at least in the nonsurgical setting.

■ MEDICAL THERAPY

Antiplatelet therapy: Stop or continue?

The risk of perioperative bleeding if antiplatelet drugs are continued must be weighed against the risk of stent thrombosis and ischemia if they are stopped before the recommended duration of therapy. Ideally, some antiplatelet therapy should be continued perioperatively in these situations, but the guidelines recommend that a consensus decision among the treating physicians should be made regarding the relative risks of surgery and discontinuation or continuation of antiplatelet therapy. Whenever possible, aspirin should be continued in these patients.

Although the Perioperative Ischemic Evaluation (POISE)-2 trial²⁴ found that perioperative aspirin use was not associated with lower rates of postoperative myocardial infarction or death, it increased bleeding. Patients with stents who had not completed the recommended duration of antiplatelet therapy were excluded from the trial. Additionally, only 5% of the study patients had undergone percutaneous coronary intervention.

According to the guidelines and package inserts, if antiplatelet agents need to be discontinued before surgery, aspirin can be stopped 3 to 7 days before, clopidogrel and ticagrelor 5 days before, and prasugrel 7 days before. In patients without stents, it may be reasonable to continue aspirin perioperatively if the risk of cardiac events outweighs the risk of bleeding, but starting aspirin is not beneficial for patients undergoing elective noncardiac noncarotid surgery unless the risk of ischemic events outweighs the risk of bleeding.

Beta-blockers

In view of the issue of scientific integrity of the DECREASE trials, a separately commissioned systematic review² of perioperative beta-blocker therapy was performed. This review suggested that giving beta-blockers before surgery was associated with fewer postoperative cardiac events, primarily ischemia and nonfatal myocardial infarction, but few data sup-

ported their use to reduce postoperative mortality. Beta-blocker use was associated with adverse outcomes that included bradycardia and stroke. These findings were similar with the inclusion or exclusion of the DECREASE trials in question or of the POISE trial.²⁵

In addition to recommending continuing beta-blockers in patients already on them (class I—the highest recommendation), the guidelines say that it may be reasonable to start them in patients with intermediate- or high-risk ischemia on stress tests as well as in patients with three or more RCRI risk factors (class IIb). In the absence of these indications, initiating beta-blockers preoperatively to reduce risk even in patients with long-term indications is of uncertain benefit. They also recommended starting beta-blockers more than 1 day preoperatively, preferably at least 2 to 7 days before, and note that it was harmful to start them on the day of surgery, particularly at high doses, and with long-acting formulations.

Additionally, there is evidence of differences in outcome within the class of beta-blockers, with the more cardioselective drugs bisoprolol and atenolol being associated with more favorable outcomes than metoprolol in observational studies.

Statins

Multiple observational trials have reported that statins are associated with decreased perioperative morbidity and mortality. Limited evidence from three randomized controlled trials (including two from the discredited DECREASE group) suggests that there is a benefit in patients undergoing vascular surgery, but it is unclear for nonvascular surgery.^{26–30}

The ACC/AHA guidelines again give a class I recommendation to continue statin therapy perioperatively in patients already taking statins and undergoing noncardiac surgery, as there is some evidence that statin withdrawal is associated with increased risk. The guidelines comment that starting statin therapy perioperatively is reasonable for patients undergoing vascular surgery (class IIa) and may be considered in patients with other clinical guideline indications who are undergoing elevated-risk surgery (class IIb).

RCRI factors:
High-risk surgery
Ischemic heart disease
Heart failure
Stroke or TIA
Diabetes requiring insulin
Creatinine > 2.0 mg/dL

The mechanism of this benefit is unclear and may relate to the pleotropic as well as the lipid-lowering effects of the statins. Statins may also have beneficial effects in reducing the incidence of acute kidney injury and postoperative atrial fibrillation.

Whether a particular statin, dose, or time of initiation before surgery affects risk is also unknown at this time. The European guidelines⁶ recommend starting a longer-acting statin ideally at least 2 weeks before surgery for maximal plaque-stabilizing effects.

The risk of statin-induced myopathy, rhabdomyolysis, and hepatic injury appears to be minimal.

Other medications

Of note, the new guidelines do not recommend starting alpha-2 agonists for preventing cardiac events in patients undergoing noncardiac surgery. Despite previous evidence from smaller studies suggesting a benefit, the POISE-2 trial³¹ demonstrated that perioperative use of clonidine did not reduce cardiac events and was associated with a significant increase in hypotension and nonfatal cardiac arrest. However, clonidine should be continued in patients already taking it.

A somewhat surprising recommendation is that it is reasonable to continue angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs), and if they are held before surgery, to restart them as soon as possible postoperatively (class IIa). The guidelines note reports of increased hypotension associated with induction of anesthesia in patients taking these drugs but also note that there was no change in important postoperative cardiac and other outcomes. Although evidence of harm if these drugs are temporarily discontinued before surgery is sparse, the guidelines advocate continuing them in patients with heart failure or hypertension.

ANESTHESIA AND INTRAOPERATIVE MANAGEMENT

The classes of anesthesia include local, regional (nerve block or neuraxial), monitored anesthesia care (ie, intravenous sedation), and general (volatile agent, total intravenous, or a combination). The guideline committee found no evidence to support the use of neur-

axial over general anesthesia, volatile over total intravenous anesthesia, or monitored anesthesia care over general anesthesia. Neuraxial anesthesia for postoperative pain relief in patients undergoing abdominal aortic surgery did reduce the incidence of myocardial infarction.

The guidelines do not recommend routinely using intraoperative transesophageal echocardiography during noncardiac surgery to screen for cardiac abnormalities or to monitor for myocardial ischemia in patients without risk factors or procedural risks for significant hemodynamic, pulmonary, or neurologic compromise. Only in emergency settings do they deem perioperative transesophageal echocardiography reasonable to determine the cause of hemodynamic instability when it persists despite attempted corrective therapy.

Maintenance of normothermia is reasonable, as studies evaluating hypothermia or use of warmed air did not find a lower rate of cardiac events.^{32,33}

POSTOPERATIVE SURVEILLANCE

In observational studies, elevated troponin levels, and even detectable levels within the normal range, have been associated with adverse outcomes and predict mortality after noncardiac surgery—the higher the level, the higher the mortality rate.³⁴ Elevated troponins have many potential causes, both cardiac and noncardiac.

An entity termed *myocardial injury after noncardiac surgery* (MINS)³⁵ was described as prognostically relevant myocardial injury with a troponin T level higher than 0.03 ng/mL in the absence of a nonischemic etiology but not requiring the presence of ischemic features. Patients who had MINS had a higher 30-day mortality rate (9.8% vs 1.1%) and were also at higher risk of nonfatal cardiac arrest, heart failure, and stroke compared with patients who did not.

The guidelines recommend obtaining an electrocardiogram and troponin levels if there are signs or symptoms suggesting myocardial ischemia or infarction. However, despite the association between troponin and mortality, the guidelines state that “the usefulness of postoperative screening with troponin levels (and

Heart failure is at least equal to coronary artery disease in terms of risk

electrocardiograms) in patients at high risk for perioperative myocardial infarction, but without signs or symptoms suggestive of myocardial ischemia or infarction, is uncertain in the absence of established risks and benefits of a defined management strategy.” They also recommend against routinely measuring postoperative troponins in unselected patients without signs or symptoms suggestive of myocardial ischemia or infarction, stating it is not useful for guiding perioperative management.

Although there was a suggestion that patients in the POISE trial³⁶ who suffered postoperative myocardial infarction had better outcomes if they had received aspirin and statins, and another study³⁷ showed that intensification of cardiac therapy in patients with elevated postoperative troponin levels after vascular surgery led to better 1-year outcomes, there are no randomized controlled trials at this time to support any specific plan or intervention.

■ IMPACT ON CLINICAL PRACTICE: A PERIOPERATIVE HOSPITALIST’S VIEW

Regarding testing

Although the updated guidelines provide some novel concepts in risk stratification, the new algorithm still leaves many patients in a gray zone with respect to noninvasive testing. Patients with heart failure, valvular heart disease, and arrhythmias appear to be somewhat disconnected from the algorithm in this version, and management according to clinical practice guidelines is recommended.

Patients with acute coronary syndrome remain embedded in the algorithm, with recommendations for cardiology evaluation and management according to standard guidelines before proceeding to elective surgery.

The concept of a combined risk based on clinical factors along with the surgical procedure is important, and an alternative to the RCRI factors is offered. However, while this new NSQIP surgical risk calculator is more comprehensive, it may be too time-consuming for routine clinical use and still needs to be externally validated.

The concept of shared decision-making and team communication is stressed, but the physician may still have difficulty deciding when further testing may influence manage-

ment. The guidelines remain somewhat vague, and many physicians may be uncomfortable and will continue to look for further guidance in this area.

Without more specific recommendations, this uncertainty may result in more stress tests being ordered—often inappropriately, as they rarely change management. Future prospective studies using biomarkers in conjunction with risk calculators may shed some light on this decision.

The new perioperative guidelines incorporate other ACC/AHA guidelines for valvular heart disease¹⁵ and heart failure.¹⁴ Some of their recommendations, in my opinion, may lead to excessive testing (eg, repeat echocardiograms) that will not change perioperative management.

Regarding revascularization

The ACC/AHA guidelines continue to emphasize the important concept that coronary revascularization is rarely indicated just to get the patient through surgery.

The new guidelines give physicians some leeway in allowing patients with drug-eluting stents to undergo surgery after 6 rather than 12 months of dual antiplatelet therapy if they believe that delaying surgery would place the patient at more risk than that of stent thrombosis. There is evidence in the nonsurgical setting that the newer stents currently being used may require no more than 6 months of therapy. In my opinion it was never clear that there was a statistically significant benefit in delaying surgery more than 6 months after placement of a drug-eluting stent, so this is a welcome addition.

Regarding beta-blockers

The systematic review of beta-blockers reinforces the importance of continuing them preoperatively while downgrading recommendations for their prophylactic use in patients who are not at increased risk.

Although the debate continues, there is no doubt that beta-blockers are associated with a decrease in myocardial ischemia and infarction but an increase in bradycardia and hypotension. They probably are associated with some increased risk of stroke, although this may be related to the specific beta-blocker used as well as the time of initiation before

There is only limited evidence as to how arrhythmias affect surgical risk

surgery. Evidence of a possible effect on mortality depends on whether the DECREASE and POISE trials are included or excluded in the analysis.

In the absence of new large-scale randomized controlled trials, we are forced to rely on observational trials and expert opinion in the meantime. I think that if a beta-blocker is to be started preoperatively, it should be done at least 1 week before surgery, and a more cardioselective beta-blocker should be used.

Regarding other drugs and tests

I agree with the recommendation to continue ACE inhibitors and ARBs preoperatively in patients with heart failure and poorly controlled hypertension. Although somewhat contrary to current practice, continuance of these drugs has not been associated with an increase in myocardial infarction or death despite concern about intraoperative hypotension.

Data from randomized controlled trials of perioperative statins are limited, but the information from observational studies is favorable, and I see little downside to initiating statins preoperatively in patients who otherwise have indications for their use, particularly if undergoing vascular or other high-risk noncardiac surgery. It is not known whether the specific drug, dose, or timing of initiation of statins influences outcome.

Although multiple studies of biomarkers suggest that there is an association with outcome, there are no randomized controlled trials or specific interventions shown to improve outcome.

Some of the recommended interventions have included various cardiac medications, stress testing, possible coronary angiography, and revascularization, which are not without risk. In the absence of data and following the directive to “first do no harm,” the ACC/AHA has been appropriately cautious in not recommending them for routine use at this time.

The updated guidelines have summarized the new evidence in perioperative cardiac evaluation and management. Many of their recommendations were reinforced by this information and remain essentially unchanged. Several new recommendations will lead to changes in management going forward. Unfortunately, we lack the evidence to answer many questions that arise in routine practice and are therefore forced to rely on expert opinion and our clinical judgment in these cases. The ACC/AHA guidelines do provide a framework for our evaluation and management and help keep clinicians up-to-date with the latest evidence. ■

REFERENCES

1. **Flisher LA, Fleischmann KE, Auerbach AD, et al.** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014; Jul 29. pii: S0735-1097(14)05536-3. doi: 10.1016/j.jacc.2014.07.944. [Epub ahead of print].
2. **Wijesundera DN, Duncan D, Nkonde-Price C, et al.** Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014; Jul 29. pii: S0735-1097(14)05528-4. doi: 10.1016/j.jacc.2014.07.939. [Epub ahead of print].
3. **Flisher LA, Fleischmann KE, Auerbach AD, et al.** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014; Jul 29. pii: S0735-1097(14)05537-5. doi: 10.1016/j.jacc.2014.07.945. [Epub ahead of print].
4. **Flisher LA, Beckman JA, Brown KA, et al.** ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery. *J Am Coll Cardiol* 2007; 50:e159–e242.
5. **Erasmus MC Follow-up Investigation Committee.** Report on the 2012 follow-up investigation of possible breaches of academic integrity. September 30, 2012. <http://cardiobrief.files.wordpress.com/2012/10/integrity-report-2012-10-english-translation.pdf>. Accessed October 30, 2014.
6. **Anderson JL, Antman EM, Harold JG, et al.** Clinical practice guidelines on perioperative cardiovascular evaluation: collaborative efforts among the ACC, AHA, and ESC. *J Am Coll Cardiol* 2014 Jul 29. pii: S0735-1097(14)05527-2. doi: 10.1016/j.jacc.2014.07.938. [Epub ahead of print].
7. **Lee TH, Marcantonio ER, Mangione CM, et al.** Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation* 1999; 100:1043–1049.
8. **Gupta PK, Gupta H, Sundaram A, et al.** Development and validation of a risk calculator for prediction of cardiac risk after surgery. *Circulation* 2011; 124:381–387.
9. **Bilimoria KY, Liu Y, Paruch JL, et al.** Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg* 2013; 217:833–842. e1-3.
10. **Davis C, Tait G, Carroll J, Wijesundera DN, Beattie WS.** The Revised Cardiac Risk Index in the new millennium: a single-centre prospective cohort re-evaluation of the original variables in 9,519 consecutive elective surgical patients. *Can J Anaesth* 2013; 60:855–863.
11. **January CT, Wann LS, Alpert JS, et al.** 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol* 2014; e-pub before print. doi:10.1016/j.

- jacc.2014.03.022.
12. **Aliot EM, Alpert JS, Calkins H, et al.** ACC/AHA/ESC guidelines for the management of patients with supraventricular arrhythmias. <http://www.escardio.org/guidelines-surveys/esc-guidelines/GuidelinesDocuments/guidelines-SVA-FT.pdf>. Accessed October 30, 2014.
 13. **Crossley GH, Poole JE, Rozner MA, et al.** The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management. Developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). *Heart Rhythm* 2011; 8:1114–1154.
 14. **Yancy CW, Jessup M, Bozkurt B, et al.** 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2013; 62:e147–e239.
 15. **Nishimura RA, Otto CM, Bonow RO, et al.** 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014; 63:e57–e185
 16. **Jneid H, Anderson JL, Wright RS, et al.** 2012 ACCF/AHA focused update of the guideline for the management of patients with unstable angina/non-ST-elevation myocardial infarction (updating the 2007 guideline and replacing the 2011 focused update): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2012; 60:645–681.
 17. **O’Gara PT, Kushner FG, Ascheim DD, et al.** 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2013; 61:e78–e140.
 18. **Hillis LD, Smith PK, Anderson JL, et al.** 2011 ACCF/AHA guideline for coronary artery bypass graft surgery: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Developed in collaboration with the American Association for Thoracic Surgery, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2011; 58:e123–e210.
 19. **Levine GN, Bates ER, Blankenship JC, et al.** 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. *J Am Coll Cardiol* 2011; 58:e44–e122.
 20. **McFalls EO, Ward HB, Krupski WC, et al.** Prophylactic coronary artery revascularization for elective vascular surgery: study design. Veterans Affairs Cooperative Study Group on Coronary Artery Revascularization Prophylaxis for Elective Vascular Surgery. *Control Clin Trials* 1999; 20:297–308.
 21. **Schouten O, van Kuijk JP, Flu WJ, et al.** Long-term outcome of prophylactic coronary revascularization in cardiac high-risk patients undergoing major vascular surgery (from the randomized DECREASE-V Pilot Study). *Am J Cardiol* 2009; 103:897–901.
 22. **Wijesundera DN, Wijesundera HC, Yun L, et al.** risk of elective major noncardiac surgery after coronary stent insertion: a population-based study. *Circulation* 2012; 126:1355–1362.
 23. **Hawn MT, Graham LA, Richman JS, et al.** Risk of major adverse cardiac events following noncardiac surgery in patients with coronary stents. *JAMA* 2013; 310:1462–1472.
 24. **Devereaux PJ, Mrkobrada M, Sessler DI, et al.** Aspirin in patients undergoing noncardiac surgery. *N Engl J Med* 2014; 370:1494–1503.
 25. **Group PS, Devereaux PJ, Yang H, et al.** Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial. *Lancet* 2008; 371:1839–1847.
 26. **Lindenauer PK, Pekow P, Wang K, et al.** Lipid-lowering therapy and in-hospital mortality following major noncardiac surgery. *JAMA* 2004; 291:2092–2099.
 27. **Kennedy J, Quan H, Buchan AM, et al.** Statins are associated with better outcomes after carotid endarterectomy in symptomatic patients. *Stroke* 2005; 36:2072–2076.
 28. **Raju MG, Pachika A, Punnam SR, et al.** Statin therapy in the reduction of cardiovascular events in patients undergoing intermediate-risk noncardiac, nonvascular surgery. *Clin Cardiol* 2013; 36:456–461.
 29. **Desai H, Aronow WS, Ahn C, et al.** Incidence of perioperative myocardial infarction and of 2-year mortality in 577 elderly patients undergoing noncardiac vascular surgery treated with and without statins. *Arch Gerontol Geriatr* 2010; 51:149–151.
 30. **Durazzo AES, Machado FS, Ikeoka DT, et al.** Reduction in cardiovascular events after vascular surgery with atorvastatin: a randomized trial. *J Vasc Surg* 2004; 39:967–975.
 31. **Devereaux PJ, Sessler DI, Leslie K, et al.** Clonidine in patients undergoing noncardiac surgery. *N Engl J Med* 2014; 370:1504–1513.
 32. **Nguyen HP, Zaroff JG, Bayman EO, et al.** Perioperative hypothermia (33 degrees C) does not increase the occurrence of cardiovascular events in patients undergoing cerebral aneurysm surgery: findings from the Intraoperative Hypothermia for Aneurysm Surgery Trial. *Anesthesiology* 2010; 113:327–342.
 33. **Frank SM, Fleisher LA, Breslow MJ, et al.** Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events. A randomized clinical trial. *JAMA* 1997; 277:1127–1134.
 34. **Vascular Events In Noncardiac Surgery Patients Cohort Evaluation Study I, Devereaux PJ, Chan MT, Alonso-Coello P, et al.** Association between postoperative troponin levels and 30-day mortality among patients undergoing noncardiac surgery. *JAMA* 2012; 307:2295–2304.
 35. **Botto F, Alonso-Coello P, Chan MT, et al.** Myocardial injury after noncardiac surgery: a large, international, prospective cohort study establishing diagnostic criteria, characteristics, predictors, and 30-day outcomes. *Anesthesiology* 2014; 120:564–578.
 36. **Devereaux PJ, Xavier D, Pogue J, et al.** Characteristics and short-term prognosis of perioperative myocardial infarction in patients undergoing noncardiac surgery: a cohort study. *Ann Intern Med* 2011; 154:523–528.
 37. **Foucrier A, Rodseth R, Aissaoui M, Ibanes C, et al.** The long-term impact of early cardiovascular therapy intensification for postoperative troponin elevation after major vascular surgery. *Anesth Analg* 2014; 119:1053–1063.

ADDRESS: Steven L. Cohn, MD, University of Miami Miller School of Medicine, 1120 NW 14th St – CRB 1140, Miami, FL 33136; e-mail: scohn@med.miami.edu