

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Developed in Collaboration With the American College of Surgeons,
American Society of Anesthesiologists, American Society of
Echocardiography, American Society of Nuclear Cardiology, Society for
Cardiovascular Angiography and Interventions, and Society of
Cardiovascular Anesthesiologists

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Citation

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<http://content.onlinejacc.org/article.aspx?articleID=1893784>

) and *Circulation* (

<http://circ.ahajournals.org/content/early/2014/07/31/CIR.000000000000106.full.pdf+html?sid=97577506-c63c-4a3d-abdd-778248a4b36a>

)

The full-text guidelines are also available on the following Web sites:

ACC (www.cardiosource.org) and AHA (

americanheart.org)



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

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Applying Classification of Recommendations and Levels of Evidence

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT		CLASS I <i>Benefit >>> Risk</i> Procedure/Treatment SHOULD be performed/ administered	CLASS IIa <i>Benefit >> Risk</i> <i>Additional studies with focused objectives needed</i> IT IS REASONABLE to per- form procedure/administer treatment	CLASS IIb <i>Benefit ≥ Risk</i> <i>Additional studies with broad objectives needed; additional registry data would be helpful</i> Procedure/Treatment MAY BE CONSIDERED	CLASS III <i>No Benefit</i> or CLASS III Harm <table><thead><tr><th></th><th>Procedure/ Test</th><th>Treatment</th></tr></thead><tbody><tr><td>COR III: No benefit</td><td>Not Helpful</td><td>No Proven Benefit</td></tr><tr><td>COR III: Harm</td><td>Excess Cost w/o Benefit or Harmful</td><td>Harmful to Patients</td></tr></tbody></table>		Procedure/ Test	Treatment	COR III: No benefit	Not Helpful	No Proven Benefit	COR III: Harm	Excess Cost w/o Benefit or Harmful	Harmful to Patients
		Procedure/ Test	Treatment											
	COR III: No benefit	Not Helpful	No Proven Benefit											
	COR III: Harm	Excess Cost w/o Benefit or Harmful	Harmful to Patients											
	LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is useful/effective■ Sufficient evidence from multiple randomized trials or meta-analyses	<ul style="list-style-type: none">■ Recommendation in favor of treatment or procedure being useful/effective■ Some conflicting evidence from multiple randomized trials or meta-analyses	<ul style="list-style-type: none">■ Recommendation’s usefulness/efficacy less well established■ Greater conflicting evidence from multiple randomized trials or meta-analyses	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is not useful/effective and may be harmful■ Sufficient evidence from multiple randomized trials or meta-analyses									
LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is useful/effective■ Evidence from single randomized trial or nonrandomized studies	<ul style="list-style-type: none">■ Recommendation in favor of treatment or procedure being useful/effective■ Some conflicting evidence from single randomized trial or nonrandomized studies	<ul style="list-style-type: none">■ Recommendation’s usefulness/efficacy less well established■ Greater conflicting evidence from single randomized trial or nonrandomized studies	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is not useful/effective and may be harmful■ Evidence from single randomized trial or nonrandomized studies										
LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is useful/effective■ Only expert opinion, case studies, or standard of care	<ul style="list-style-type: none">■ Recommendation in favor of treatment or procedure being useful/effective■ Only diverging expert opinion, case studies, or standard of care	<ul style="list-style-type: none">■ Recommendation’s usefulness/efficacy less well established■ Only diverging expert opinion, case studies, or standard of care	<ul style="list-style-type: none">■ Recommendation that procedure or treatment is not useful/effective and may be harmful■ Only expert opinion, case studies, or standard of care										
Suggested phrases for writing recommendations	should is recommended is indicated is useful/effective/beneficial	is reasonable can be useful/effective/beneficial is probably recommended or indicated	may/might be considered may/might be reasonable usefulness/effectiveness is unknown/unclear/uncertain or not well established	COR III: No Benefit is not recommended is not indicated should not be performed/ administered/ other is not useful/ beneficial/ effective	COR III: Harm potentially harmful causes harm associated with excess morbidity/mortality should not be performed/ administered/ other									
Comparative effectiveness phrases†	treatment/strategy A is recommended/indicated in preference to treatment B treatment A should be chosen over treatment B	treatment/strategy A is probably recommended/indicated in preference to treatment B it is reasonable to choose treatment A over treatment B												

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

†For comparative effectiveness recommendations (Class I and IIa; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Clinical Risk Factors



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Clinical Risk Factors

Valvular Heart Disease

Recommendations	COR	LOE
It is recommended that patients with clinically suspected moderate or greater degrees of valvular stenosis or regurgitation undergo preoperative echocardiography if there has been either 1) no prior echocardiography within 1 year or 2) a significant change in clinical status or physical examination since last evaluation.	I	C
For adults who meet standard indications for valvular intervention (replacement and repair) on the basis of symptoms and severity of stenosis or regurgitation, valvular intervention before elective noncardiac surgery is effective in reducing perioperative risk.	I	C



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Clinical Risk Factors

Aortic Stenosis

Recommendation	COR	LOE
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe AS.	IIa	B

Mitral Stenosis

Recommendation	COR	LOE
Elevated-risk elective noncardiac surgery using appropriate intraoperative and postoperative hemodynamic monitoring may be reasonable in asymptomatic patients with severe mitral stenosis if valve morphology is not favorable for percutaneous mitral balloon commissurotomy.	IIb	C



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Clinical Risk Factors

Aortic and Mitral Regurgitation

Recommendations	COR	LOE
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe MR.	Ila	C
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe AR and a normal LVEF.	Ila	C



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Clinical Risk Factors

Cardiovascular Implantable Electronic Devices

Recommendation	COR	LOE
Before elective surgery in a patient with a CIED, the surgical/procedure team and clinician following the CIED should communicate in advance to plan perioperative management of the CIED.	I	C



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Clinical Risk Factors

Pulmonary Vascular Disease

Recommendations	COR	LOE
Chronic pulmonary vascular targeted therapy (i.e., phosphodiesterase type 5 inhibitors, soluble guanylate cyclase stimulators, endothelin receptor antagonists, and prostanoids) should be continued unless contraindicated or not tolerated in patients with pulmonary hypertension who are undergoing noncardiac surgery.	I	C
Unless the risks of delay outweigh the potential benefits, preoperative evaluation by a pulmonary hypertension specialist before noncardiac surgery can be beneficial for patients with pulmonary hypertension, particularly for those with features of increased perioperative risk.*	IIa	C

*Features of increased perioperative risk in patients with pulmonary hypertension include: 1) diagnosis of Group 1 pulmonary hypertension (i.e., pulmonary arterial hypertension), 2) other forms of pulmonary hypertension associated with high pulmonary pressures (pulmonary artery systolic pressures >70 mm Hg) and/or moderate or greater RV dilatation and/or dysfunction and/or pulmonary vascular resistance >3 Wood units, and 3) World Health Organization/New York Heart Association class III or IV symptoms attributable to pulmonary hypertension.



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Calculation of Risk to Predict Perioperative Cardiac Morbidity



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Calculation of Risk to Predict Perioperative Cardiac Morbidity

Multivariate Risk Indices

Recommendations	COR	LOE
A validated risk-prediction tool can be useful in predicting the risk of perioperative MACE in patients undergoing noncardiac surgery.	IIa	B
For patients with a low risk of perioperative MACE, further testing is not recommended before the planned operation.	III: No Benefit	B



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Duke Activity Status Index

Activity	Weight
Can you...	
1. take care of yourself, that is, eating, dressing, bathing, or using the toilet?	2.75
2. walk indoors, such as around your house?	1.75
3. walk a block or 2 on level ground?	2.75
4. climb a flight of stairs or walk up a hill?	5.50
5. run a short distance?	8.00
6. do light work around the house like dusting or washing dishes?	2.70
7. do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries?	3.50
8. do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8.00
9. do yardwork like raking leaves, weeding, or pushing a power mower?	4.50
10. have sexual relations?	5.25
11. participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	6.00
12. participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7.50

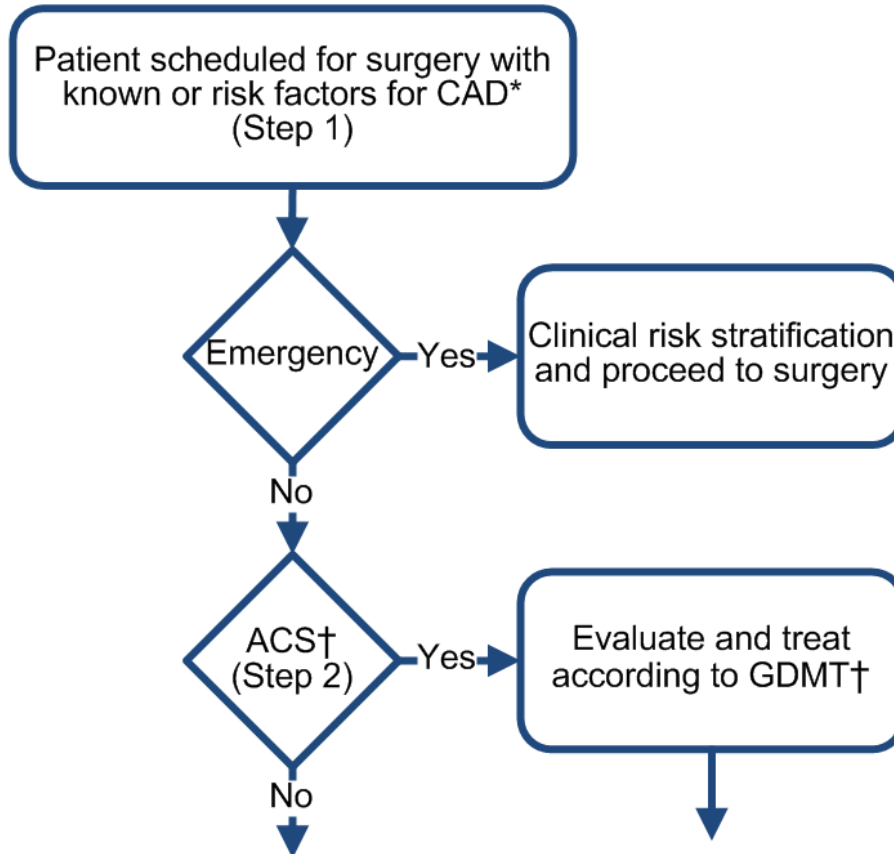


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Stepwise Approach to Perioperative Cardiac Assessment for CAD



Colors correspond to the Classes of Recommendations in Table 1.

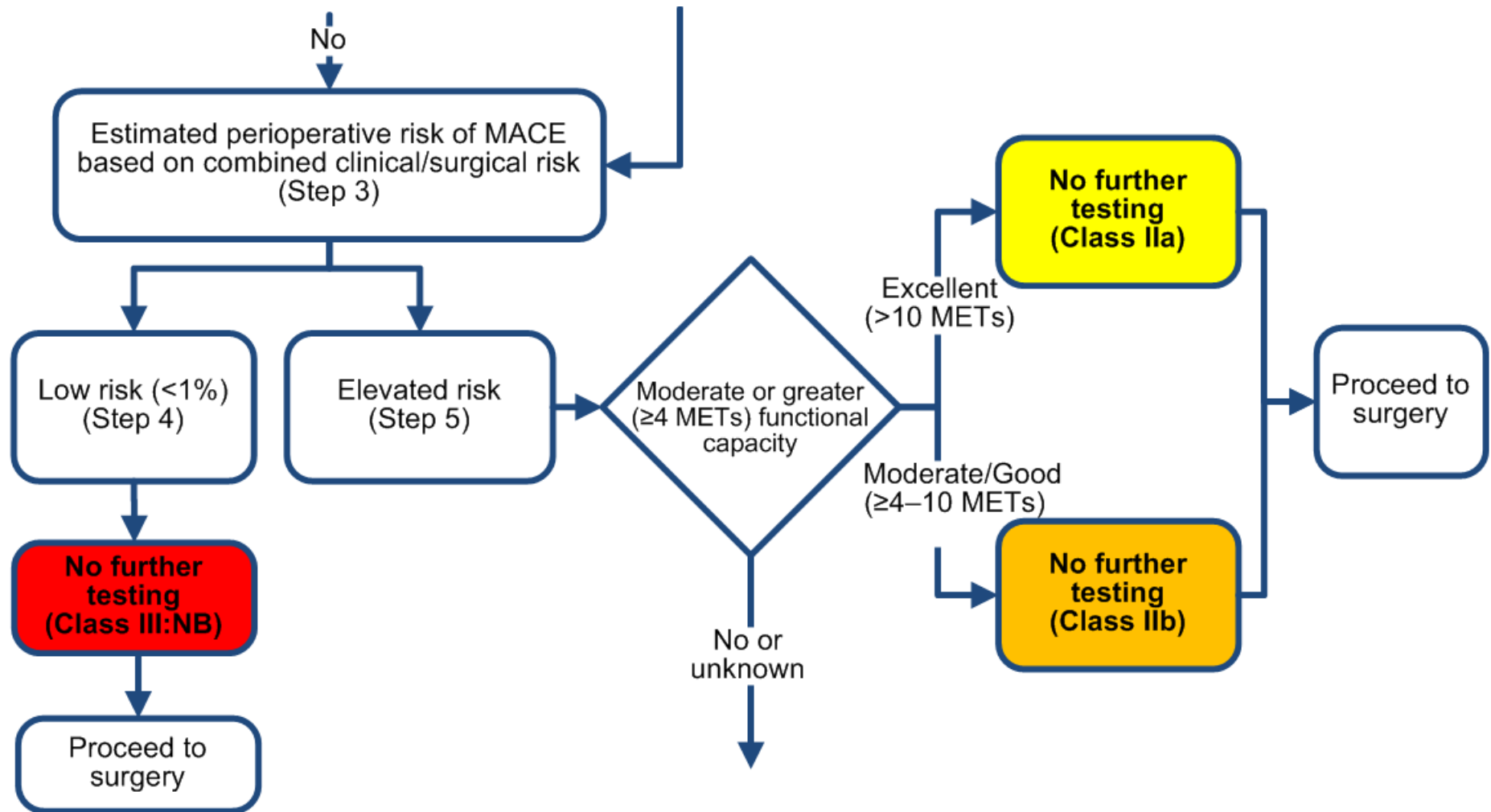
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Stepwise Approach to Perioperative Cardiac Assessment for CAD (cont'd)



Colors correspond to the Classes of Recommendations in Table 1.

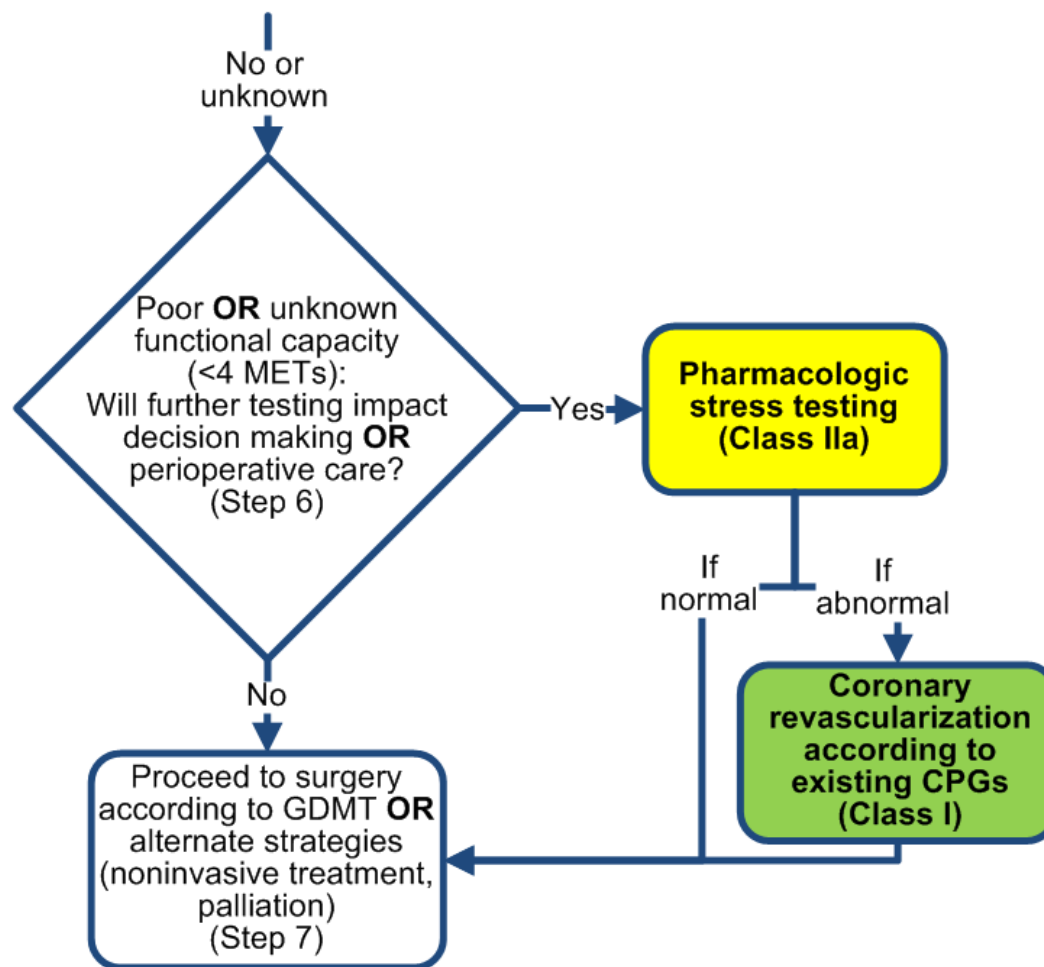
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Stepwise Approach to Perioperative Cardiac Assessment for CAD (cont'd)



Colors correspond to the Classes of Recommendations in Table 1.



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Stepwise Approach to Perioperative Cardiac Assessment for

Step 1: In patients scheduled for surgery with risk factors for or known CAD, determine the urgency of surgery. If emergent, then determine the clinical risk factors that may influence perioperative management and proceed to surgery with appropriate monitoring and management strategies based upon the clinical assessment.

Step 2: If the surgery is urgent or elective, determine if the patient has an ACS. If yes, then refer patient for cardiology evaluation and management according to GDMT according to the UA/NSTEMI and STEMI CPGs.

Step 3: If the patient has risk factors for stable CAD, then estimate the perioperative risk of MACE on the basis of the combined clinical/surgical risk. This estimate can use the American College of Surgeons NSQIP risk calculator (<http://www.surgicalriskcalculator.com>) or incorporate the RCRI with an estimation of surgical risk. For example, a patient undergoing very low-risk surgery (e.g., ophthalmologic surgery), even with multiple risk factors, would have a low risk of MACE, whereas a patient undergoing major vascular surgery with few risk factors would have an elevated risk of MACE.

Step 4: If the patient has a low risk of MACE (<1%), then no further testing is needed and the patient may proceed to surgery.



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Stepwise Approach to Perioperative Cardiac Assessment for

CAD (cont'd)

Step 5: If the patient is at elevated risk of MACE, then determine functional capacity using an objective measure or scale such as the DASI. If the patient has good or excellent functional capacity (≥ 4 METs), then proceed to surgery without further evaluation.

Step 6: If the patient has poor (< 4 METs) or unknown functional capacity, then the clinician should consult with the patient and perioperative team to determine if further testing will impact patient decision-making (e.g., decision to perform original surgery or willingness to undergo CABG or PCI depending on the results of the test) or perioperative care. If yes, then pharmacologic stress testing is appropriate. In those patients with unknown functional capacity, exercise stress testing may be reasonable to perform. If the stress test is abnormal, consider coronary angiography and revascularization depending up the extent of the abnormal test. The patient can then proceed to surgery with GDMT or consider alternate strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation. If the test is normal, proceed to surgery according to GDMT.

Step 7: If testing will not impact decision making or care, then proceed to surgery according to GDMT or consider alternate strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation.



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Supplemental Preoperative Evaluation



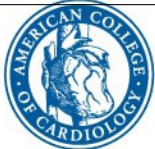
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Supplemental Preoperative Evaluation

The 12-Lead ECG

Recommendations	COR	LOE
Preoperative resting 12-lead ECG is reasonable for patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease, except for those undergoing low-risk.	IIa	B
Preoperative resting 12-lead ECG may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery.	IIb	B
Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures.	III: No Benefit	B



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Supplemental Preoperative Evaluation

Assessment of LV Function

Recommendations	COR	LOE
It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function.	IIa	C
It is reasonable for patients with HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function.	IIa	C
Reassessment of LV function in clinically stable patients with previously documented LV dysfunction may be considered if there has been no assessment within a year.	IIb	C
Routine preoperative evaluation of LV function is not recommended.	III: No Benefit	B



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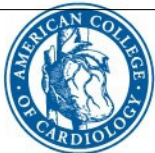


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Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardial Ischemia and Functional Capacity

Recommendations	COR	LOE
For patients with elevated risk and excellent (>10 METs) functional capacity, it is reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIa	B
For patients with elevated risk and unknown functional capacity, it may be reasonable to perform exercise testing to assess for functional capacity if it will change management.	IIb	B
For patients with elevated risk and moderate to good (≥ 4 METs to 10 METs) functional capacity, it may be reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIb	B



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Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardial Ischemia and Functional Capacity (cont'd)

Recommendations	COR	LOE
For patients with elevated risk and poor (<4 METs) or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia if it will change management.	IIb	C
Routine screening with noninvasive stress testing is not useful for patients at low risk for noncardiac surgery.	III: No Benefit	B



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Supplemental Preoperative Evaluation

Cardiopulmonary Exercise Testing

Recommendation	COR	LOE
Cardiopulmonary exercise testing may be considered for patients undergoing elevated risk procedures in whom functional capacity is unknown.	IIb	B



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Supplemental Preoperative Evaluation

Noninvasive Pharmacological Stress Testing Before Noncardiac Surgery

Recommendations	COR	LOE
It is reasonable for patients who are at an elevated risk for noncardiac surgery and have poor functional capacity (<4 METs) to undergo noninvasive pharmacological stress testing (either DSE or pharmacological stress MPI) if it will change management.	IIa	B
Routine screening with noninvasive stress testing is not useful for patients undergoing low-risk noncardiac surgery.	III: No Benefit	B



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Supplemental Preoperative Evaluation

Preoperative Coronary Angiography

Recommendation	COR	LOE
Routine preoperative coronary angiography is not recommended.	III: No Benefit	C



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Perioperative Therapy



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Perioperative Therapy

Coronary Revascularization Prior to Noncardiac Surgery

Recommendations	COR	LOE
Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing CPGs.	I	C
It is not recommended that routine coronary revascularization be performed before noncardiac surgery exclusively to reduce perioperative cardiac events.	III: No Benefit	B



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Perioperative Therapy

Timing of Elective Noncardiac Surgery in Patients With Previous PCI

Recommendations	COR	LOE
Elective noncardiac surgery should be delayed 14 days after balloon angioplasty...	I	C
...and 30 days after BMS implantation	I	B
Elective noncardiac surgery should optimally be delayed 365 days after DES implantation.	I	B
In patients in whom noncardiac surgery is required, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy can be useful.	IIa	C



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Perioperative Therapy

Timing of Elective Noncardiac Surgery in Patients With Previous PCI (cont'd)

Recommendations	COR	LOE
Elective noncardiac surgery after DES implantation may be considered after 180 days if the risk of further delay is greater than the expected risks of ischemia and stent thrombosis.	IIb*	B
Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 12 months after DES implantation in patients in whom DAPT will need to be discontinued perioperatively.	III: Harm	B
Elective noncardiac surgery should not be performed within 14 days of balloon angioplasty in patients in whom aspirin will need to be discontinued perioperatively. <small>*Because of new evidence, this is a new recommendation since the publication of 2011 ACC/AHA/SCCT Guideline for the Management of Patients With Acute Coronary Syndromes.</small>	III: Harm	C



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Perioperative Therapy

Perioperative Beta-Blocker Therapy

Recommendations	COR	LOE
Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically.	I	B ^{SR}
It is reasonable for the management of beta blockers after surgery to be guided by clinical circumstances, independent of when the agent was started.	IIa	B ^{SR}
In patients with intermediate- or high-risk myocardial ischemia noted in preoperative risk stratification tests, it may be reasonable to begin perioperative beta blockers.	IIb	C ^{SR}
In patients with 3 or more RCRI risk factors (e.g., diabetes mellitus, HF, CAD, renal insufficiency, cerebrovascular accident), it may be reasonable to begin beta blockers before surgery.	IIb	B ^{SR}

These recommendations have been designated with a Class I or II designation, indicating the rigor of support from the ERC's systematic review. See the ERC systematic review report, "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" for the complete evidence review on perioperative beta-blocker therapy.



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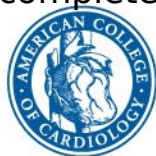


Perioperative Therapy

Perioperative Beta-Blocker Therapy (cont'd)

Recommendations	COR	LOE
In patients with a compelling long-term indication for beta-blocker therapy but no other RCRI risk factors, initiating beta blockers in the perioperative setting as an approach to reduce perioperative risk is of uncertain benefit.	IIb	BSR
In patients in whom beta-blocker therapy is initiated, it may be reasonable to begin perioperative beta blockers long enough in advance to assess safety and tolerability, preferably more than 1 day before surgery.	IIb	BSR
Beta-blocker therapy should not be started on the day of surgery.	III: Harm	BSR

These recommendations have been designated with a SR to emphasize the rigor of support from the ERC's systematic review. See the ERC systematic review report, "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" for the complete evidence review on perioperative beta-blocker therapy.



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Perioperative Therapy

Perioperative Statin Therapy

Recommendations	COR	LOE
Statins should be continued in patients currently taking statins and scheduled for noncardiac surgery.	I	B
Perioperative initiation of statin use is reasonable in patients undergoing vascular surgery.	IIa	B
Perioperative initiation of statins may be considered in patients with clinical indications according to GDMT who are undergoing elevated-risk procedures.	IIb	C

Alpha-2 Agonists

Recommendation	COR	LOE
Alpha-2 agonists for prevention of cardiac events are not recommended in patients who are undergoing noncardiac surgery.	III: No Benefit	B



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Perioperative Therapy

Angiotensin-Converting Enzyme Inhibitors

Recommendations	COR	LOE
Continuation of ACE inhibitors or angiotensin-receptor ARBs perioperatively is reasonable.	IIa	B
If ACE inhibitors or ARBs are held before surgery, it is reasonable to restart as soon as clinically feasible postoperatively.	IIa	C



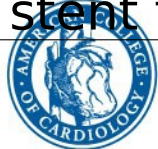
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Perioperative Therapy

Antiplatelet Agents

Recommendations	COR	LOE
In patients undergoing urgent noncardiac surgery during the first 4 to 6 weeks after BMS or DES implantation, DAPT should be continued unless the relative risk of bleeding outweighs the benefit of the prevention of stent thrombosis.	I	C
In patients who have received coronary stents and must undergo surgical procedures that mandate the discontinuation of P2Y ₁₂ platelet receptor-inhibitor therapy, it is recommended that aspirin be continued if possible and the P2Y ₁₂ platelet receptor-inhibitor be restarted as soon as possible after surgery.	I	C
Management of the perioperative antiplatelet therapy should be determined by a consensus of the surgeon, anesthesiologist, cardiologist, and patient, who should weigh the relative risk of bleeding versus prevention of stent thrombosis.	I	C



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Perioperative Therapy

Antiplatelet Agents (cont'd)

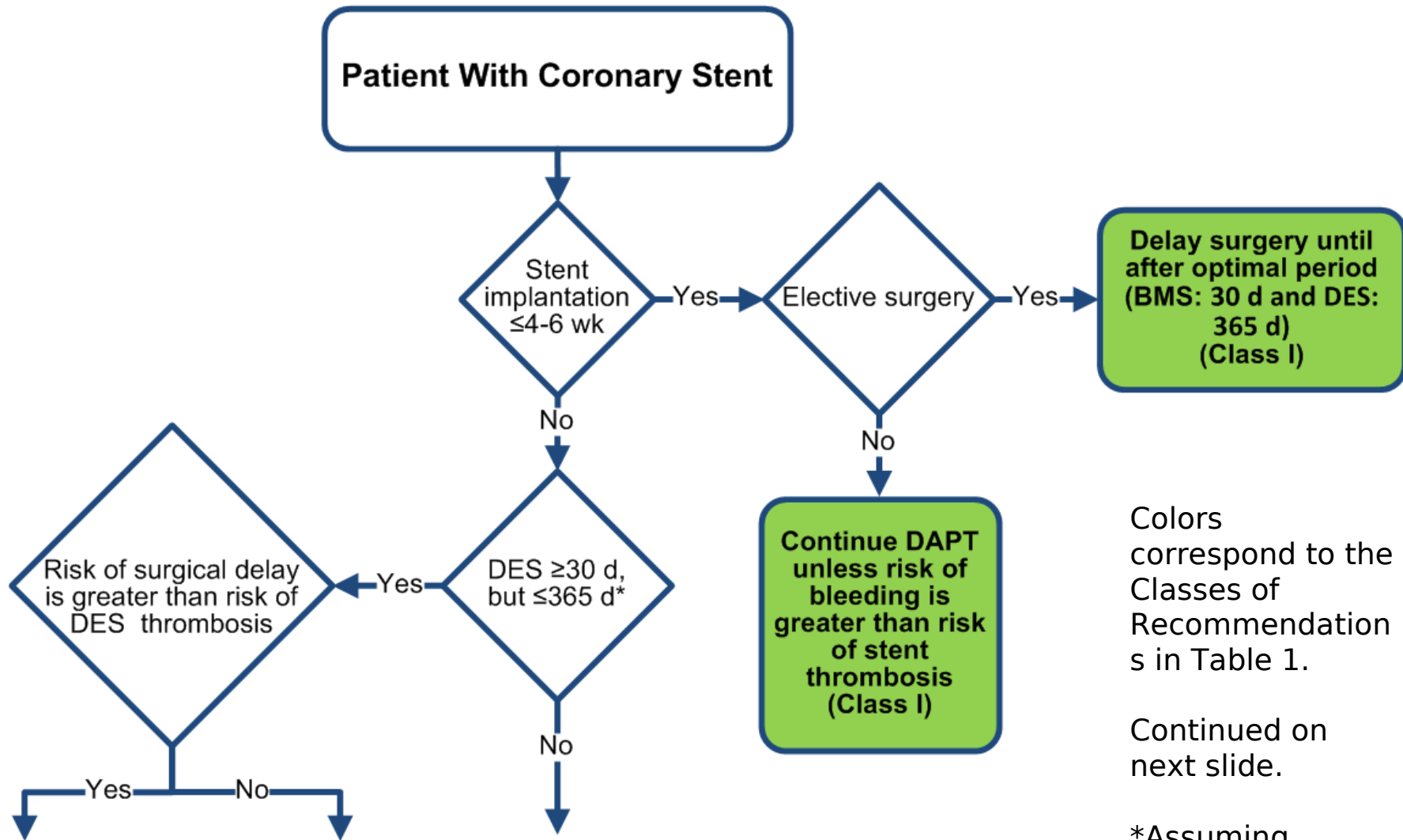
Recommendations	COR	LOE
In patients undergoing nonemergency/nonurgent noncardiac surgery who have not had previous coronary stenting, it may be reasonable to continue aspirin when the risk of potential increased cardiac events outweighs the risk of increased bleeding.	IIb	B
Initiation or continuation of aspirin is not beneficial in patients undergoing elective noncardiac noncarotid surgery who have not had previous coronary stenting,...	III: No Benefit	B
...unless the risk of ischemic events outweighs the risk of surgical bleeding.		C



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Proposed Algorithm for Antiplatelet Management in Patients with PCI and Noncardiac Surgery



Colors correspond to the Classes of Recommendations in Table 1.

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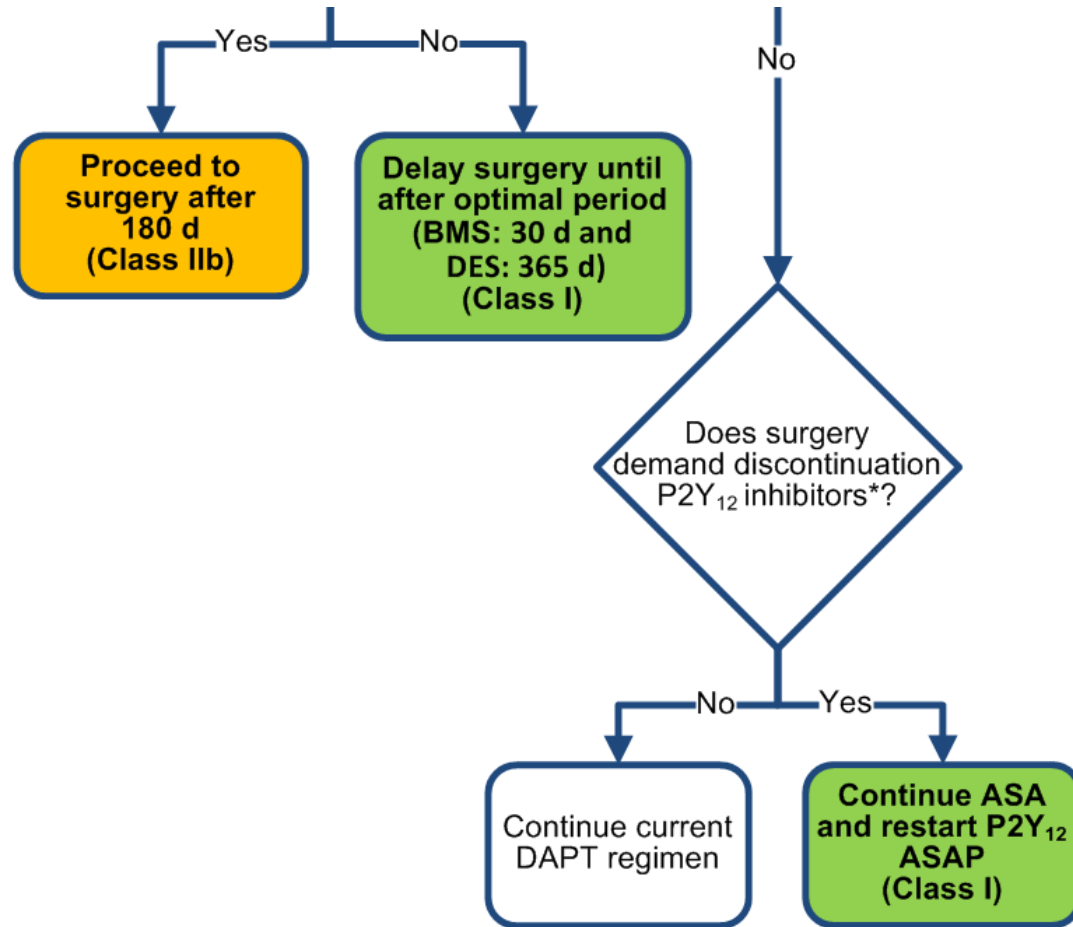
*Assuming patient is currently on DAPT.

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Proposed Algorithm for Antiplatelet Management in Patients with PCI and Noncardiac Surgery (cont'd)



Colors correspond to the Classes of Recommendations in Table 1.

*Assuming patient is currently on DAPT.



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Perioperative Therapy

Perioperative Management of Patients With CIEDs

Recommendation

COR

LOE

Patients with ICDs who have preoperative reprogramming to inactivate tachytherapy should be on cardiac monitoring continuously during the entire period of inactivation, and external defibrillation equipment should be readily available. Systems should be in place to ensure that ICDs are reprogrammed to active therapy before discontinuation of cardiac monitoring and discharge from the facility.

I

C



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Anesthetic Consideration and Intraoperative Management



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Anesthetic Consideration and Intraoperative Management

Volatile General Anesthesia versus Total Intravenous Anesthesia

Recommendation	COR	LOE
Use of either a volatile anesthetic agent or total intravenous anesthesia is reasonable for patients undergoing noncardiac surgery, and the choice is determined by factors other than the prevention of myocardial ischemia and MI.	IIa	A



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Anesthetic Consideration and Intraoperative Management

Perioperative Pain Management

Recommendations	COR	LOE
Neuraxial anesthesia for <i>postoperative</i> pain relief can be effective in patients undergoing abdominal aortic surgery to decrease the incidence of perioperative MI.	IIa	B
Perioperative epidural analgesia may be considered to decrease the incidence of <i>preoperative</i> cardiac events in patients with a hip fracture.	IIb	B



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Anesthetic Consideration and Intraoperative Management

Prophylactic Perioperative Nitroglycerin

Recommendation	COR	LOE
Prophylactic intravenous nitroglycerin is not effective in reducing myocardial ischemia in patients undergoing noncardiac surgery.	III: No Benefit	B



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Anesthetic Consideration and Intraoperative Management

Intraoperative Monitoring Techniques

Recommendations	COR	LOE
The emergency use of perioperative TEE is reasonable in patients with hemodynamic instability undergoing noncardiac surgery to determine the cause of hemodynamic instability when it persists despite attempted corrective therapy, if expertise is readily available.	IIa	C
The routine use of intraoperative TEE during noncardiac surgery to screen for cardiac abnormalities or to monitor for myocardial ischemia is not recommended in patients without risk factors or procedural risks for significant hemodynamic, pulmonary, or neurologic compromise.	III: No Benefit	C



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Anesthetic Consideration and Intraoperative Management

Maintenance of Body Temperature

Recommendation	COR	LOE
Maintenance of normothermia may be reasonable to reduce perioperative cardiac events in patients undergoing noncardiac surgery.	IIb	B



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Anesthetic Consideration and Intraoperative Management

Hemodynamic Assist Devices

Recommendation	COR	LOE
Use of hemodynamic assist devices may be considered when urgent or emergency noncardiac surgery is required in the setting of acute severe cardiac dysfunction (i.e., acute MI, cardiogenic shock) that cannot be corrected before surgery.	IIb	C



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Anesthetic Consideration and Intraoperative Management

Perioperative Use of Pulmonary Artery Catheters

Recommendations	COR	LOE
The use of pulmonary artery catheterization may be considered when underlying medical conditions that significantly affect hemodynamics (i.e., HF, severe valvular disease, combined shock states) cannot be corrected before surgery.	IIb	C
Routine use of pulmonary artery catheterization in patients, even those with elevated risk, is not recommended.	III: No Benefit	A



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Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Perioperative Surveillance



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Perioperative Surveillance

Surveillance and Management for Perioperative MI

Recommendations	COR	LOE
Measurement of troponin levels is recommended in the setting of signs or symptoms suggestive of myocardial ischemia or MI.	I	A
Obtaining an ECG is recommended in the setting of signs or symptoms suggestive of myocardial ischemia, MI, or arrhythmia.	I	B
The usefulness of postoperative screening with troponin levels in patients at high risk for perioperative MI, but without signs or symptoms suggestive of myocardial ischemia or MI, is uncertain in the absence of established risks and benefits of a defined management strategy.	IIb	B



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Perioperative Surveillance

Surveillance and Management for Perioperative MI (cont'd)

Recommendations	COR	LOE
The usefulness of postoperative screening with ECGs in patients at high risk for perioperative MI, but without signs or symptoms suggestive of myocardial ischemia, MI, or arrhythmia, is uncertain in the absence of established risks and benefits of a defined management strategy.	IIb	B
Routine postoperative screening with troponin levels in unselected patients without signs or symptoms suggestive of myocardial ischemia or MI is not useful for guiding perioperative management.	III: No Benefit	B



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