

# Perioperative Cardiovascular Evaluation

Vincent Brinkman, MD  
 Division of Cardiovascular Medicine  
 The Ohio State University

# Guidelines

Journal of the American College of Cardiology  
 © 2007 by the American College of Cardiology Foundation and the American Heart Association, Inc.  
 Published by Elsevier Inc.

Vol. 49, No. 12, 2007  
 ISSN 0885-0666/332.00  
 doi:10.1016/j.jacc.2007.05.007

## ACC/AHA GUIDELINE

### ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

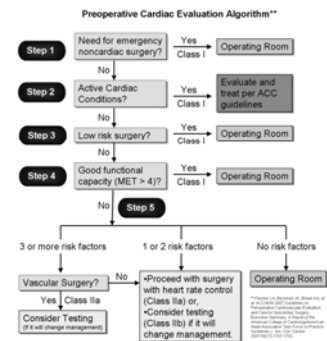
A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

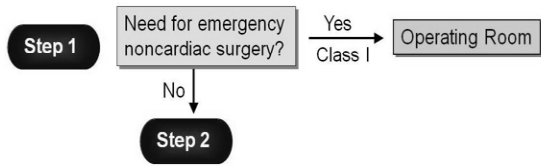
# Objectives

- Overview of current guidelines on preoperative evaluation.
- Explain the background behind these guidelines.
- Explain the general approach to preoperative cardiac assessment.

# ACC Guidelines

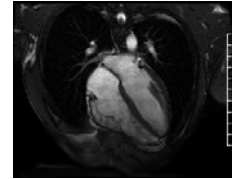


## ACC Perioperative Guidelines

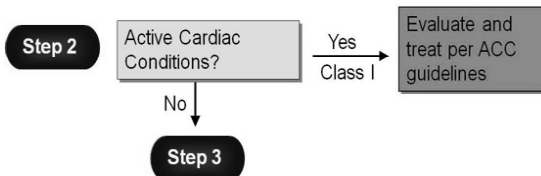


## Active Cardiac Conditions

- Unstable Angina
  - Or Recent Myocardial Infarction
- Decompensated heart failure
  - Class IV heart failure
- Unstable arrhythmias
  - Uncontrolled heart rate, heart block, Ventricular Tachycardia...
- Severe valve disease



## ACC Perioperative Guidelines

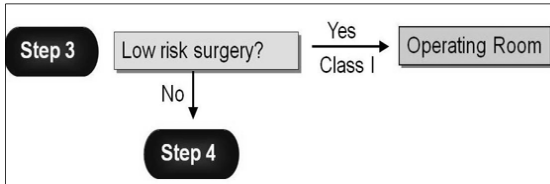


## Active Cardiac Conditions

- Treat these according to ACC guidelines
- Cardiology consultation
- In other words:

**Does this patient require further treatment of their cardiac condition in the absence of this surgery?**

## ACC Perioperative Guidelines



## Low Risk Surgery

Major Morbidity and Mortality Within 1 Month of Ambulatory Surgery and Anesthesia

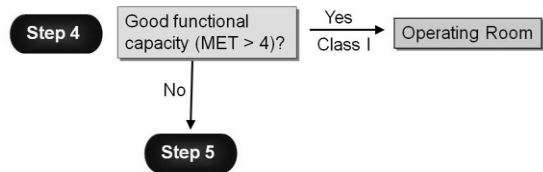
*Mark A. Warner, MD; Sondra E. Shields, MD; Christopher G. Chute, MD, DrPH*

- 45,000 Procedures
- 14 Myocardial Infarctions
  - 2 Cardiac Deaths
- 17.8 Myocardial Infarctions expected

## Risk of Surgery

Risk Stratification	Examples
Vascular <i>Risk more than 5%</i>	Aortic and other major peripheral vascular surgery
Intermediate Risk <i>Risk 1% to 5%</i>	Intraperitoneal or intrathoracic surgery Carotid endarterectomy Head and Neck Surgery Orthopedic surgery Prostate surgery
Low Risk <i>Risk less than 1%</i>	Endoscopic procedures Superficial procedures Cataract surgery Breast surgery Ambulatory surgery

## ACC Perioperative Guidelines



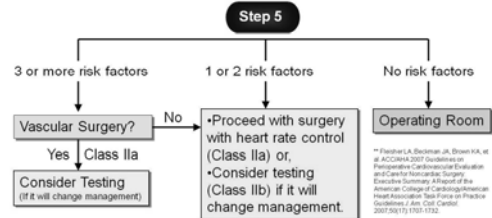
## Functional Capacity

- **Reliable way to determine cardiovascular risk of surgery.**
- **Can be determined with history**

1 MET	Getting Dressed Walking around the house
< 4 METs	Light house work
> 4 METs	Walk on level ground at 4 mph Climb 1-2 flights of stairs Heavy house work

*Based on the Duke Activity Status Index*

## ACC Perioperative Guidelines



## Functional Capacity

### Self-reported Exercise Tolerance and the Risk of Serious Perioperative Complications

*Dominic F. Reilly, MD, et al. Archives of Internal Medicine 1999*

- **600 patients undergoing “major” surgery.**
- **Poor functional tolerance defined as inability to climb 2 flights of stairs or walk 4 blocks.**
- **Serious complications inversely related to the number of blocks one could walk.**

## Risk Factors

- **History of ischemic heart disease**
- **Prior history of heart failure**
- **Diabetes**
- **Renal Insufficiency**
- **Cerebrovascular Disease**

*Based on the “Revised Cardiac Risk Index”*

Derivation and Prospective Validation of a Simple Index for Prediction of Cardiac Risk of Major Noncardiac Surgery; Thomas H. Lee, MD, et al., Circulation 1999

## Step Five

- No risk factors
  - ✓ Even among highest risk surgeries, absence of risk factors predicted a low incidence of events.

Class	Events/Patients, n/n	Event Rate (95% CI), %
I (0 risk factors)	2/488	0.4 (0.05–1.5)
II (1 risk factor)	5/567	0.9 (0.3–2.1)
III (2 risk factors)	17/258	6.6 (3.9–10.3)
IV (≥3 risk factors)	12/109	11.0 (5.8–18.4)
ROC curve area	0.806†	

Derivation and Prospective Validation of a Simple Index for Prediction of Cardiac Risk of Major Noncardiac Surgery; Thomas H. Lee, MD, et al., Circulation 1999

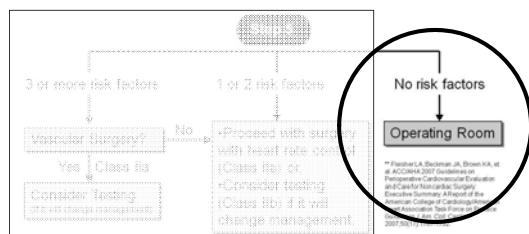
## Step Five

- 1-3 risk factors had increasing cardiac events during surgery.

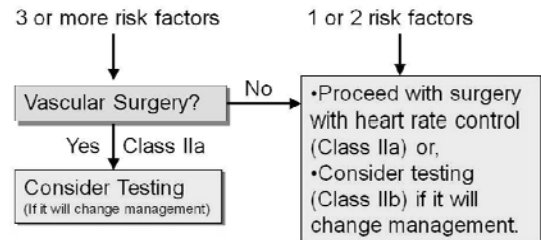
Class	Events/Patients, n/n	Event Rate (95% CI), %
I (0 risk factors)	2/488	0.4 (0.05–1.5)
II (1 risk factor)	5/567	0.9 (0.3–2.1)
III (2 risk factors)	17/258	6.6 (3.9–10.3)
IV (≥3 risk factors)	12/109	11.0 (5.8–18.4)
ROC curve area	0.806†	

Derivation and Prospective Validation of a Simple Index for Prediction of Cardiac Risk of Major Noncardiac Surgery; Thomas H. Lee, MD, et al., Circulation 1999

## Step Five



## Step Five



## Why Vascular Surgery?

- Highest cardiovascular risk
- Most studied in terms of cardiac risk
- High risk patient population
- Older patient population

## Intermediate Risk Patients

### Should Major Vascular Surgery Be Delayed Because of Preoperative Cardiac Testing in Intermediate-Risk Patients Receiving Beta-Blocker Therapy With Tight Heart Rate Control?

Don Poldermans, MD, PhD,\* Jeroen J. Bax, MD, PhD,† Olaf Schouten, MD,‡ Aleksandar N. Neskovic, MD, PhD,§ Bernard Paelinck, MD, PhD,|| Guido Rocci, MD, PhD,¶ Laura van Dorstmont, MD, PhD,‡ Anni E. S. Drazzo, MD, PhD,\*\*\* Louis L. M. van de Ven, MD, PhD,†† Marc R. H. M. van Sambeek, MD, PhD,‡ Miklos D. Kerai, MD, PhD,\* Eric Boersma, PhD,‡‡ for the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echo Study Group Rotterdam, Leiden, Schiedam, and Amsterdam, the Netherlands; Belgrade, Serbia and Montenegro; Antwerp, Belgium; Bologna, Italy; and São Paulo, Brazil

- 1,500 patients undergoing vascular surgery (700 intermediate risk).
- All patients received beta blockers with goal of heart rate less than 65 bpm.
- Patients randomized to stress testing or proceeding with surgery.
- If extensive ischemia found, patients underwent revascularization.

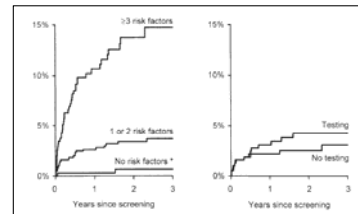
Should Major Vascular Surgery Be Delayed Because of Preoperative Cardiac Testing in Intermediate-Risk Patients Receiving Beta-Blocker Therapy With Tight Heart Rate Control? Don Poldermans, et al, JACC 2006

## Stress Tests

### Functional assessment

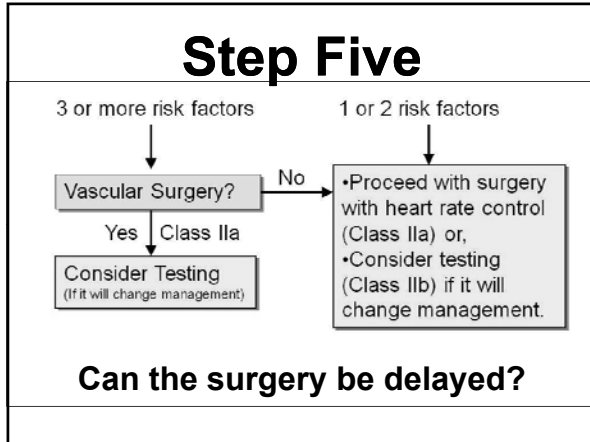
- Multiple studies show that risk of cardiac events increases as the extent of ischemia increases.
- Fixed defects (ie. Prior scar with no inducible ischemia) confer no additional increased risk.

## Intermediate Risk

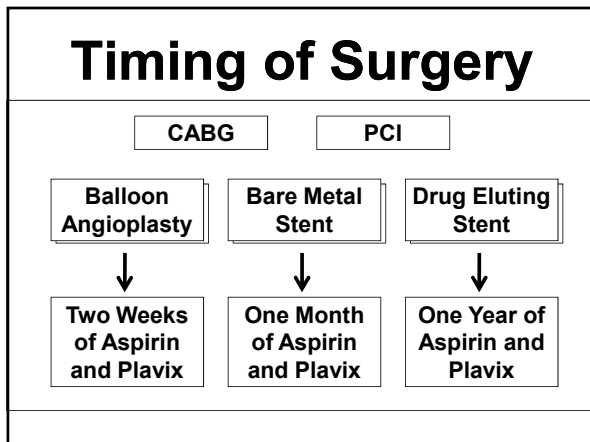


- No significant difference between stress testing and beta blocker treatment groups

Should Major Vascular Surgery Be Delayed Because of Preoperative Cardiac Testing in Intermediate-Risk Patients Receiving Beta-Blocker Therapy With Tight Heart Rate Control? Don Poldermans, et al, JACC 2006



# Does Revascularization Help?



## CARP Trial

- 510 patients with “stable,” significant CAD randomized to CABG or medical therapy before vascular surgery.
- No difference in survival.

No. at Risk	0	1	2	3	4	5	6
Revascularization	226	175	113	65	18	7	
No revascularization	229	172	108	55	17	12	

Figure 1. Long-Term Survival among Patients Assigned to Undergo Coronary-Artery Revascularization or No Coronary-Artery Revascularization before Elective Major Vascular Surgery. Kaplan-Meier estimates were used to generate survival curves, from the time of randomization, for all study patients.

Coronary-Artery Revascularization before Elective Major Vascular Surgery Edward O. McFall, M.D., Ph.D., et al., NEJM 2004

## Revascularization Before Surgery

- Does not appear to offer any significant benefit except in those patients that would require it independent of surgery.
- However, jury is still out . . .

### Class I Indications for Revascularization

- 3 vessel disease
- Left main disease or left main equivalent
- High risk unstable angina
- ST elevation MI

## Beta Blockers

- Controversial
  - ✓ Historically, studies have shown benefit in reducing mortality and cardiovascular events.
  - ✓ Wide variation in type, dose and timing of beta blockers in previous studies.
  - ✓ May not be class effect

## Medical Therapy

- Statins
- Aspirin
  - ✓ Probably does not need held for surgery.
  - ✓ May increase bleeding, but not mortality or severity of bleeding
- Plavix
  - ✓ Conflicting evidence
  - ✓ Some evidence that stopping 5 days before surgery may reduce risk of major bleeding events.

## POISE Trial

- 8351 patients with or at risk for CAD undergoing non-cardiac surgery.
- Randomized to metoprolol or placebo.
- Decreased incidence of myocardial infarctions, but increased stroke and mortality.
- Criticisms
  - Beta blockers started immediately before surgery
  - Single dosing (100mg of sustained release metoprolol).
    - No titration
  - Sepsis / hypotension / stroke

Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial, POISE Study Group, The Lancet 2008.

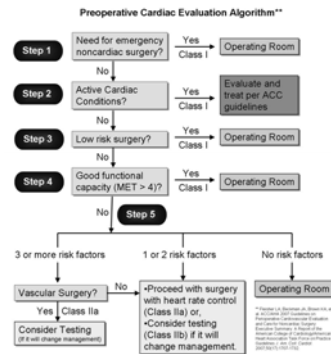


# POISE Trial

## Summary

- Beta blockers are not indicated for everyone undergoing surgery
- Dose titration and initiation prior to surgery may be necessary

# Summary



# Pre-op Beta Blockers

- Class I Indications:
  - ✓ Beta blockers should be continued in patients who are receiving beta blockers to treat angina, arrhythmias or hypertension.
- Class II Indications:
  - ✓ Beta blockers titrated to heart rate and blood pressure control are reasonable in high risk patients

# Preoperative Pulmonary Evaluation

Jennifer McCallister, MD  
 Assistant Professor  
 The Ohio State University Medical Center

## Objectives

- Review types of postoperative pulmonary complications (PPC)
- Describe risk factors for PPC
- Discuss strategies for risk factor assessment

## Importance of PPC

- Incidence 2-19% in non-thoracic surgery<sup>1</sup>
- Morbidity & mortality similar to cardiac complications<sup>2</sup>
- Better predict mortality<sup>3</sup>
- May double hospital length of stay<sup>4</sup>

1. Fisher et al, 2002. Am J Med;112(3):219.  
2. Smetana et al, 2006. Ann Int Med;144(8):581.  
3. Manku et al, 2003. Anesth Analg;96:583.  
4. Lawrence et al, 1995. J Gen Int Med;10(12):671.

## Types of post-op pulmonary complications (PPC)

- Atelectasis
- Pneumonia
- Respiratory failure/prolonged mechanical ventilation
- Exacerbation of chronic underlying pulmonary disease
- Death

## Preoperative Pulmonary Evaluation

- “Preoperative clearance”
  - ✓ Implied permission, all-or-none
- Identification of risk factors
  - ✓ Patient-related
  - ✓ Procedure-related
- Risk assessment
- Post-operative risk reduction or modification

Annals of Internal Medicine | CLINICAL GUIDELINES

**Preoperative Pulmonary Risk Stratification for Noncardiothoracic Surgery: Systematic Review for the American College of Physicians**

Gerald W. Smetana, MD; Valerie A. Lawrence, MD; and John E. Connell, PhD

Ann Intern Med 2006. 144:581-595.

## Health & Functional Status

- **American Society of Anesthesiologists (ASA) Classification of Preoperative Risk correlates with post-operative pulmonary complications<sup>1</sup>**
- **Functional dependence (ADLs)**
  - ✓ **Partial: OR 1.65 (1.36-2.01)**
  - ✓ **Total: OR 2.51 (1.99-3.15)**

1. Gerson et al, 1990. Am J Med;88:101.

## Age

Age (yr)	OR for post-op pulmonary complications (95% CI)
50-59	1.50 (1.31-1.71)
60-69	2.28 (1.86-2.80)
70-79	3.90 (2.70-5.65)
≥80	5.63 (4.63-6.85)

## ASA Classification

ASA class	Systemic Disease	Mortality (%)	PPC (%)
I	Healthy	<0.03	1.2
II	Mild/moderate	0.2	5.4
III	Severe, limits activity but not incapacitating	1.2	11.4
IV	Severe, incapacitating	8.0	10.9
V	Moribund	34	Not applicable

1. Gerson et al, 1990. Am J Med;88:101.

## Chronic Lung Disease

- OR for PPC 2.36 (1.90-2.93) in COPD
- Varies depending on severity of disease and evidence of active symptoms in some series
- NO LEVEL of lung function is an absolute contraindication to surgery

\*\*Lung resection a separate topic\*\*

## Other Factors

- CHF
  - ✓ OR 2.93
- Albumin < 3.5 g/dL
  - ✓ OR 2.53 in single study<sup>1</sup>

Arozullah et al, 2000, Ann Surg;232:242.

## Smoking

- Pooled OR for postoperative pulmonary complications 1.40 (CI 1.17-1.68)
- Risk greatest
  - ✓ ≥40 pack-yrs
  - ✓ smoking within 8 weeks prior to surgery
- Rates similar to nonsmokers with 6 months cessation

## Patient-Related Risk Factors

- Age > 60 yrs
- ASA Class > II
- Functional Dependence
- COPD
- CHF
- Albumin < 3.5 g/dL

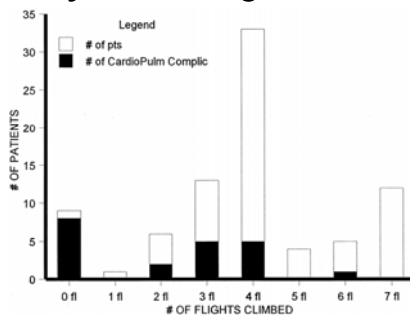
## Patient-Related Factors

- **Not significant**
  - ✓ Obesity
  - ✓ Asthma
  - ✓ Severity of COPD
- **Need more data**
  - ✓ OSA
  - ✓ Exercise Capacity

## Procedure-Related Risk Factors

- **Surgical Site**
  - ✓ Most important surgical factor
  - ✓ Inversely related to distance from diaphragm
- **Duration of Surgery**
  - ✓ 3 hours or longer
- **Anesthesia**
  - ✓ General anesthesia?
  - ✓ Long acting neuromuscular blockers

## Post-op complications and decreased ability to climb flights of stairs



Girish, M. et al. Chest 2001;120:1147-1151



## Risk Assessment

- **No universally accepted method**
- **ASA probably best**
- **Others--Arozullah Indices**
  - Postoperative Pneumonia Risk Index
  - Postoperative Respiratory Failure Index

1. Arozullah et al, 2001. Ann Int Med:135:847  
 2. Arozullah et al, 2000. Ann Surg:232(2):242

## Pulmonary Function Testing

- Not indicated in routine pre-operative evaluation
- Debate continues
  - ✓ COPD and Asthma
- No universally accepted ability to predict PPC
- No definitive lower limit for surgery
  - ✓ Lung resection surgery exception

## Pulmonary Function Testing

- No numbers predict risk
  - ✓ FEV1 <40% < 1.0 L often quoted
- Clinically useful?
  - ✓ Assess control in obstructive disease
  - ✓ Undiagnosed lung diseases
  - ✓ Differential diagnosis
- *Essential* in evaluation for lung resection

## Pulmonary Function Testing

- ACP 1990 Consensus statement recommends<sup>1</sup>
  - ✓ CABG or upper abdominal surgery
    - tobacco abuse or dyspnea
  - ✓ Head & Neck surgery
    - uncharacterized pulmonary disease
  - ✓ Lung resection
  - ✓ *NOT* routinely for abdominal surgery

ACP Position Paper Preoperative Pulmonary Function Testing, 1990. Ann Int Med; 112(10):793.

## Arterial Blood Gas

- Old data suggested pCO<sub>2</sub> > 45 mm Hg higher risk
- PaO<sub>2</sub> NOT predictive
- Helpful with diagnosis & post-operative management
- Less useful for risk stratification

## Chest X-Ray

- Everyone gets one
- No data to support this
- May be indicated
  - ✓ >50 years with symptoms of cardiac or pulmonary disease
  - ✓ known underlying cardiopulmonary disease

## Conclusions

- Post-operative pulmonary complications are common & important
- Pre-operative risk assessment depends on identification of patient specific risk factors
- Focus on modification of post-operative risk factors and risk reduction

## Post-Operative Risk Reduction

- Lung expansion maneuvers
- Early mobilization
- Aggressive pulmonary toilet
- Aggressive pain control
- Therapeutic bronchoscopy for secretions?
- Deep venous thrombosis prophylaxis

## Questions?