Preoperative Risk Assessment

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Disclosures

- No financial or other material conflicts of interest
The 2014 ACC-AHA Guidelines for Perioperative Cardiovascular Evaluation (Noncardiac Surgery)


Circulation. published online August 1, 2014;
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539
Figure 1. Stepwise Approach to Perioperative Cardiac Assessment for CAD

- Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
- Emergency: Yes → Clinical risk stratification and proceed to surgery
- No ➔ ACS† (Step 2)
  - Yes → Evaluate and treat according to GDMT†
  - No ➔ Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
  - Low risk (<1%) (Step 4): No further testing (Class IIIb)
  - Elevated risk (Step 5): Proceed to surgery
  - Moderate or greater (≥4 METs) functional capacity (≥10 METs):
    - No or unknown ➔ Proceed to surgery
    - Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
      - Yes ➔ Pharmacologic stress testing (Class IIa)
      - No ➔ Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
      - If normal ➔ Proceed to surgery
      - If abnormal ➔ Coronary revascularization according to existing CPGs (Class I)

*See Sections 2.2, 2.4, and 2.5 for recommendations for patients with symptomatic HF, VHD, or arrhythmias.
†See UA/NSTEMI and STEMI CPGs (Table 2).

Colors correspond to the Classes of Recommendations in Table 1.
57 year old woman is scheduled to undergo a laparoscopic cholecystectomy tomorrow. She has a h/o IDDM-2, also taking metformin, with good glucose control, and a resting heart rate of 60bpm. She walks 1 mile daily without any problem. Which of the following is the best recommendation for her pre-operatively?

a) Proceed to surgery  
b) Begin beta-blockade, titrating to effect  
c) Order a cardiac stress test  
d) Consult cardiology for angiography
Why preoperative evaluation? NOT CLEARANCE

- **Assessment of perioperative risk**
  - Used to inform the decision to proceed or the choice of surgery
  - Includes the patient’s perspective

- **Determination of the need for management changes**
  - Change medical therapies
  - Perform further cardiovascular interventions
  - Recommendations about postoperative monitoring

- **Identification of cardiovascular conditions or risk factors requiring longer-term management**
Role of the Consultant

- Review available patient data, history and physical examination
- Determine if further testing is needed to define cardiovascular status
- Recommend treatment to improve medical condition

**PREOPERATIVE TESTING RECOMMENDED ONLY IF IT WILL CHANGE SURGICAL CARE OR PERIOPERATIVE MEDICAL THERAPY**
General Approach to the Patient-1

- History – unstable or severe angina, recent or past MI, decompensated HF, significant arrhythmias, severe vascular dz
- Comorbid Diseases – pulmonary, diabetes mellitus, renal impairment, hematologic disorders
- Medications – Rx, OTC, herbal, nutritional
- Social history – alcohol, tobacco, illicit drugs
General Approach to the Patient-2

- Functional capacity – measured in METs
- Physical Examination – general appearance, VS, lung and cardiac auscultation
- Ancillary Studies -  ECG may be indicated, blood chemistries and chest X-ray based on history and physical findings
(Un)necessary ancillary testing

- 9/10 patients undergo at least 1 unnecessary test

- Why do it?
  - Urban myth
  - Medical liability
  - Guideline distrust
  - Ignorance
• Coagulation studies
  o Mostly lab error; rarely predict bleeding risk
  o Check thorough history

• Pregnancy testing
  o Affects management in the proper population
  o Also obtain menstrual bleeding history

• ECG
  o History is better
  o Stratify risk; establish baseline
  o Not for asymptomatic patients and low-risk procedure

• CXR
  o History is better
  o Predictor, but doesn’t change management
Step 1: How urgent is the surgical procedure?

Steps 1 - 3:

Patient scheduled for surgery with known or risk factors for CAD* (Step 1)

Emergency Yes → Clinical risk stratification and proceed to surgery

No → ACS† (Step 2)

ACS† Yes → Evaluate and treat according to GDMT†

No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

MACE = major adverse cardiac event
MET = metabolic equivalent time
GDMT = guideline directed medical therapy
CPG = clinical practice guideline
- **EMERGENCY**
  - Extremely limited time for clinical evaluation
  - Life or limb is threatened if not in the OR within 6hrs
- **URGENT**
  - Time for limited evaluation
  - Life or limb is threatened if not in the OR 6-24hrs
- **TIME-SENSITIVE**
  - Delay of > 1-6wks to allow for E&M will negatively affect outcome
  - Most oncologic procedures
- **ELECTIVE**
  - Procedure can be delayed up to 1yr
Disease Specific Approaches

1. Coronary artery disease (CAD)
2. Decompensated heart failure
3. Cardiomyopathy
4. Valvular heart disease
5. Arrhythmias and conduction disorders
6. Cardiovascular implantable electronic devices
7. Pulmonary vascular disease
8. Adult congenital heart disease
Step 2: Does the patient have ACS?

Steps 1 - 3:

Patient scheduled for surgery with known or risk factors for CAD* (Step 1)

Emergency
Yes → Clinical risk stratification and proceed to surgery

No → ACS† (Step 2)

ACS† (Step 2)

Yes → Evaluate and treat according to GDMT†

No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

MACE = major adverse cardiac event
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Step 3: Perioperative risk assessment

Steps 1 - 3:

- Patient scheduled for surgery with known or risk factors for CAD\(^*\) (Step 1)
  - Emergency: Yes → Clinical risk stratification and proceed to surgery
  - No
    - ACS\(^\dagger\) (Step 2): Yes → Evaluate and treat according to GDMT\(^\dagger\)
    - No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

MACE = major adverse cardiac event
MET = metabolic equivalent time
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Type of Surgery

- MACE: major adverse cardiac event of death or MI

- Low surgical risk (< 1%)
  - Cataract surgery
  - Plastic surgery

- Elevated surgical risk (> 1%)
  - Peripheral vascular disease

NOTE: prior risk classifications included intermediate. Since recommendations are similar, intermediate and elevated are grouped together.
Revised Cardiac Risk Index (RCRI) Criteria

1. H/o ischemic heart disease
   - angina or CP relieved with NTG
   - remote MI (> 3 -6mos)
   - EKG: pathological Q waves
   - abnormal CST
   - abnormal cardiac cath
   - prior CABG or PCI
2. H/o compensated or prior HF
3. H/o cerebrovascular disease
4. Diabetes mellitus (insulin-dependent)
5. Renal insufficiency (SCr > 2mg/dL)
6. High-risk surgical procedure

0-1 RCRI = <1% mortality
2 RCRI = 2-7% mortality
3-4 RCRI = 9-18% mortality
>5 RCRI = >32% mortality

Revised Cardiac Risk Index for Pre-Operative Risk

Estimates risk of cardiac complications after surgery.

High-Risk Surgery
- Intraperitoneal
- Intrathoracic
- Suprainguinal vascular

History of ischemic heart disease
- History of MI
- History of positive exercise test
- Current chest pain considered due to myocardial ischemia
- Use of nitrate therapy
- ECG with pathological Q waves

History of congestive heart failure
- Pulmonary edema, bilateral rales or S3 gallop
- Paroxysmal nocturnal dyspnea
- CXR showing pulmonary vascular redistribution

History of cerebrovascular disease
- Prior TIA or stroke

Pre-operative treatment with insulin

Pre-operative creatinine >153 mmol/L

0 points
Class I Risk
0.4%
Risk of Major Cardiac Event (see below)

http://www.mdcalc.com/revised-cardiac-risk-index-for-pre-operative-risk/
ACS NSQIP MICA

- Includes adjusted odds ratios for different surgical sites
- Target complications:
  1. Cardiac arrest
     - "chaotic cardiac rhythm requiring initiation of basic or advanced life support"
  2. Myocardial infarction (≥ 1 of the following:)
     - Documented EKG findings of MI
     - ST elevation of ≥ 1mm in > 1 contiguous leads
     - New LBBB
     - New Q-wave in ≥ 2 contiguous leads
     - Troponin > 3xnml in setting of suspected ischemia

http://www.surgicalriskcalculator.com/miorcardiacarrest
ACS NSQIP Surgical Risk Calculator

- Calculates risk of:
  1. MACE
  2. Death
  3. PNA,
  4. VTE
  5. ARF
  6. Return to OR
  7. Unplanned intubation
  8. Discharge to rehab/nursing home,
  9. Surgical infection
  10. UTI
<table>
<thead>
<tr>
<th>RCRI</th>
<th>ACS NSQIP Calculator</th>
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<tr>
<td>Creatinine &gt; 2</td>
<td>ARF</td>
</tr>
<tr>
<td>H/o heart failure</td>
<td>H/o heart failure within 30 days</td>
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<tr>
<td>IDDM</td>
<td>DM</td>
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<tr>
<td>Thoracic, Intra-abdominal, or vascular</td>
<td>CPT code</td>
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<tr>
<td>H/o ischemic heart disease</td>
<td>Previous Cardiac event</td>
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<tr>
<td>H/o CVA or TIA</td>
<td>ASA status</td>
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<td>Age</td>
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<td>Sepsis</td>
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<td>Disseminated cancer</td>
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The American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) LOE and COR Table & Nomenclature

<table>
<thead>
<tr>
<th>LEVEL A</th>
<th>LEVEL B</th>
<th>LEVEL C</th>
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<tbody>
<tr>
<td>Multiple populations evaluated*</td>
<td>Limited populations evaluated</td>
<td>Very limited populations evaluated</td>
</tr>
<tr>
<td>Data derived from multiple randomized clinical trials or meta-analyses</td>
<td>Data derived from a single randomized trial or nonrandomized studies</td>
<td>Only consensus opinion of experts, case studies, or standard of care</td>
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**Suggested phrases for writing recommendations**
- should be recommended
- is indicated
- is useful/effective/beneficial

**Comparative effectiveness phrases**
- treatment/strategy A is recommended in preference to treatment B
- treatment A should be chosen over treatment B
- treatment/strategy A is probably recommended or indicated in preference to treatment B
- it is reasonable to choose treatment A over treatment B

**Cor III: No Benefit**
- Cor III: Not indicated
- Cor III: Not useful/effective
- Cor III: Harmful
correlated with excess morbidity/mortality should not be done

**Cor III: Harm**
- Cor III: Excess cost with benefit or harmful
- Cor III: Harmful to patients
Steps 4 and 5: Procedure-specific risk assessment

Steps 4 - 7:

- Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
  - Low risk (<1%) (Step 4)
  - Elevated risk (Step 5)
    - Moderate or greater (>4 METs) functional capacity
      - No further testing (Class IIa)
      - Excellent (>10 METs)
          - No further testing (Class IIb)
      - Moderate/Good (≥4–10 METs)
          - Proceed to surgery
  - Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
    - Yes
      - Pharmacologic stress testing (Class IIa)
        - If normal
        - If abnormal
          - Coronary revascularization according to existing CPGs (Class I)
    - No
      - Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

MACE = major adverse cardiac event
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CPG = clinical practice guideline
Step “5a”: Functional capacity determination

Steps 4 - 7:

- Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
  - Low risk (<1%) (Step 4)
    - No further testing (Class III/IIb)
      - Proceed to surgery
  - Elevated risk (Step 5)
    - Moderate or greater (≥4 METs) functional capacity
      - Excellent (>10 METs)
        - No further testing (Class IIa)
        - Proceed to surgery
      - Moderate/Good (≥4–10 METs)
        - No further testing (Class IIb)
      - No or unknown
        - Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
          - Yes
            - Pharmacologic stress testing (Class IIa)
              - If normal
              - If abnormal
                - Coronary revascularization according to existing CPGs (Class I)
          - No
            - Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

MACE = major adverse cardiac event
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Estimated Energy Requirements for Various Activities

1 MET  Can you . . .
Take care of yourself?
Eat, dress, or use the toilet?
Walk indoors around the house?
Walk a block or 2 on level ground at 2 to 3 mph (3.2 to 4.8 kph)?

4 METs  Do light work around the house like dusting or washing dishes?

4 METs  Can you . . .
Climb a flight of stairs or walk up a hill?
Walk on level ground at 4 mph (6.4 kph)?
Run a short distance?
Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?
Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?

Greater than 10 METs  Can you . . .
Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?
Step 6: Poor/unknown functional capacity

Steps 4 - 7:

MACE = major adverse cardiac event
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Stress Testing for Ischemia and Functional Status

Recommendations:
- Test of choice is exercise ECG testing
  - Provides estimate of functional capacity
  - Detects myocardial ischemia through ECG changes and hemodynamic response
Step 7: Surgery or alternative strategies

Steps 4 - 7:

- **MACE** = major adverse cardiac event
- **MET** = metabolic equivalent time
- **GDMT** = guideline directed medical therapy
- **CPG** = clinical practice guideline
57 year old woman is scheduled to undergo a laparoscopic cholecystectomy tomorrow. She has a h/o IDDM-2, also taking metformin, with good glucose control, and a resting heart rate of 60bpm. She walks 1 mile daily without any problem. Which of the following tests would be appropriate?

a) Resting ECG  
b) 2D transthoracic echocardiogram  
c) Cardiac stress test  
d) Coronary angiography  
e) None of the above
Supplemental Preoperative Evaluation

• Includes
  o ECG
  o Assessment of LV function
  o Exercise Stress Testing for Myocardial Ischemia and Functional Capacity
  o Pharmacological Stress Testing
    - Noninvasive
    - Radionuclide
    - DSE
  o Special Situations
Supplemental Preoperative Evaluation

- **Preop resting 12-lead EKG**
  - Known CHD, significant arrhythmia, PAD, cerebrovascular dz, structural HD, but not those undergoing low-risk surgery (IIa-B)
  - Considered for asymptomatic patients without CHD, but not low-risk (IIb-B)
  - Routine use in asymptomatic patients undergoing low-risk procedures (III-B)

- **Preop LV function assessment**
  - Dyspnea of unknown origin (IIa-C)
  - CHF with worsening dyspnea or other change in clinical status (IIa-C)
  - Clinically stable, previously noted LV dysfunction, >1yr since last echo (IIb-C)
  - Routine evaluation (III-B)
Preoperative stress testing recommendations

- Estimate peri-operative risk of MACE
  - Elevated (≥1%)
    - Functional capacity >10 METS
      - Proceed to surgery without stress testing (Class Ila)
    - Functional capacity 4-10 METS
      - Proceed to surgery without stress testing (Class IIb)
    - Functional capacity poor <4 METs /unknown
      - Pharmacological stress testing (Class Ila)
  - Low (<1%)
    - No role for pre-operative stress testing (Class III)
Exercise or Pharmacological Stress Test?

Choice of stress:
- Patient’s ability to exercise
- Baseline EKG (i.e. BBB or paced)

Choice of drug:
- Adenosine and Dipyridamole cause bronchospasm, transient AV block, hypotension, and are inhibited by xanthine use
- Dobutamine causes elevated BP and/or HR, increasing ischemia, and is inhibited by beta-blocker
- Regadenoson is contraindicated in high grade AV block or sinus node dysfunction
Pharmacological Stress Testing

- Noninvasive
  - **Reasonable (Class IIa)** for patients at elevated risk and have poor FC (either DSE or pharm stress MPI) (LOE=B)
  - **No Benefit (Class III)** for routine screening for patients undergoing low-risk noncardiac surgery (LOE=B)
Special Situations

1. If patient has a resting ECG that impairs diagnostic interpretation
   - LBBB
   - LV hypertrophy with “strain pattern”
   - Digitalis effect

2. Concomitant stress imaging with TTE or MPI may be appropriate

3. *Pharm stress MPI is suggested for LBBB*
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
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<tbody>
<tr>
<td><strong>The 12-lead ECG</strong></td>
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<tr>
<td>Preoperative testing 12-lead ECG is reasonable for patients with known coronary heart disease or other significant structural heart disease, except for low-risk surgery</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Preoperative testing 12-lead ECG may be considered for asymptomatic patients, except for low-risk surgery</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures</td>
<td>III: No Benefit</td>
<td>B</td>
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<tr>
<td><strong>Assessment of LV function</strong></td>
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<tr>
<td>It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function</td>
<td>IIa</td>
<td>C</td>
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<tr>
<td>It is reasonable for patients with HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Reassessment of LV function in clinically stable patients may be considered</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>Routine preoperative evaluation of LV function is not recommended</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
<tr>
<td><strong>Exercise stress testing for myocardial ischemia and functional capacity</strong></td>
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<tr>
<td>For patients with elevated risk and excellent functional capacity, it is reasonable to forgo further exercise testing and proceed to surgery</td>
<td>IIa</td>
<td>B</td>
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<tr>
<td>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</td>
<td>IIb</td>
<td>B</td>
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<tr>
<td>For patients with elevated risk and moderate to good functional capacity, it may be reasonable to forgo further exercise testing and proceed to surgery</td>
<td>IIb</td>
<td>B</td>
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<tr>
<td>For patients with elevated risk and poor or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia</td>
<td>IIb</td>
<td>C</td>
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<tr>
<td>Routine screening with noninvasive stress testing is not useful for low-risk noncardiac surgery</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
<tr>
<td><strong>Cardiopulmonary exercise testing</strong></td>
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<tr>
<td>Cardiopulmonary exercise testing may be considered for patients undergoing elevated risk procedures</td>
<td>IIb</td>
<td>B</td>
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<tr>
<td><strong>Noninvasive pharmacological stress testing before noncardiac surgery</strong></td>
<td></td>
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<tr>
<td>It is reasonable for patients at elevated risk for noncardiac surgery with poor functional capacity to undergo either DSE or MPI if it will change management</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Routine screening with noninvasive stress testing is not useful for low-risk noncardiac surgery</td>
<td>III: No Benefit</td>
<td>B</td>
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Coronary Revascularization Management

• **Class I:**
  1. Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing CPGs. (Appendix 3)
    - Unprotected Left Main Disease
    - 3 Vessel CAD with or without proximal LAD Disease
    - 2 Vessel Disease with Proximal LAD Disease
    - 1 Vessel Disease with Proximal LAD disease

• **Class III: No Benefit/Harm**
  1. It is not recommended that routine coronary revascularization be performed before noncardiac surgery to reduce perioperative cardiac events
Performing PCI before noncardiac surgery should be limited to:

1. Patients with Left Main disease who can’t get bypass surgery without undue risk
2. Patients with unstable CAD who are candidates for emergent or urgent revascularizations (NSTEMI, STEMI)

CARP Trial (Coronary Artery Revascularization Prophylaxis)
- Showed no difference in perioperative and long term cardiac outcomes with or without preoperative CABG or PCI in patients with CAD
- Exception: Left Main Disease, LVEF < 20%, Severe AS

Timing of Elective Non Cardiac Surgery after PCI

- **Class I:**
  1. Elective noncardiac surgery should be delayed:
     - 14 days after balloon angioplasty
     - 30 days after BMS implantation
  2. Elective noncardiac surgery should optimally be delayed:
     - 365 days after drug-eluting stent (DES) implantation

- **Class IIa**
  1. When 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.
Timing of Elective Non Cardiac Surgery after PCI

- **Class IIb***
  1. Elective noncardiac surgery after drug eluting stent implantation may be considered:
     - **After** 180 days if the risk of further delay is greater than risks of ischemia and stent thrombosis

- **Class III: No Benefit/Harm**
  1. Elective noncardiac surgery should not be performed:
     - Within **30 days** after BMS implantation if dual antiplatelet therapy needs to be discontinued
     - Within **12 months** after DES implantation if dual antiplatelet therapy needs to be discontinued
     - Within **14 days** of balloon angioplasty if aspirin needs to be discontinued
Choosing Appropriate PCI Intervention

- **Urgent Surgery**
  - Consider CABG combined with noncardiac surgery

- **Surgery 2-6 weeks with high bleeding risk**
  - Consider balloon angioplasty with provisional BMS

- **Surgery in 1-12 months**
  - Consider BMS and 4-6 weeks of ASA and P2Y12 inhibitor with continuation of ASA perioperatively

- **Surgery > 12 Months or low bleeding risk**
  - PCI and DES with prolonged aspirin and P2Y12 platelet receptor-inhibitor
Indications for Preoperative CABG

Class III-C (No Benefit, Not Indicated):
- Routine preoperative revascularization

Class I-B Indication:
- Significant LM disease
- Complex CAD
- 3-vessel disease
- 2-vessel disease with proximal LAD
- Survivor of sudden death

Class IIa-B Indication:
- 2-vessel disease without proximal LAD and extensive ischemia
- 1-vessel disease with proximal LAD
- 1-vessel disease with EF 35 - 50%

Class IIb-B Indication:
- 2-vessel disease without extensive ischemia
- 1-vessel disease without proximal LAD and EF<35%

If it will change management & elevated risk surgery, then:
Antiplatelet Agent Recommendations

• Class I
  1. **Urgent Non Cardiac Surgery 4-6 weeks after BMS or DES**
     - Continue DAPT unless RR of bleeding outweighs benefit of preventing stent thrombosis
  2. **Patient with coronary stent & surgical procedure mandates discontinuation of P2Y12 platelet receptor inhibitor**
     - Continue aspirin perioperatively, re-start P2Y12 platelet receptor inhibitor ASAP after surgery
  3. **Obtain a consensus between surgeon, anesthesiologist, cardiologist & patient to weigh RR of bleeding versus preventing stent thrombosis when deciding perioperative antiplatelet management**
• Class IIb

Non-emergent/Non-urgent, Non Cardiac surgery:
  - If patients have not had previous stenting, you may continue aspirin perioperatively when the risk of potential increased cardiac events outweighs the risk of bleeding
Antiplatelet Management Perioperatively

Patient With Coronary Stent

- Stent implantation ≤4-6 wk
  - Yes: Elective surgery
  - No: Risk of surgical delay is greater than risk of DES thrombosis

Risk of surgical delay is greater than risk of DES thrombosis

- Yes: DES ≥30 d, but ≤365 d
  - Yes: Delay surgery until after optimal period (BMS: 30 d and DES: 365 d) (Class I)
  - No: Continue DAPT unless risk of bleeding is greater than risk of stent thrombosis (Class I)

- No: Proceed to surgery after 180 d (Class IIb)

Does surgery demand discontinuation of P2Y₁₂ inhibitors?

- Yes: Continue current DAPT regimen
- No: Continue ASA and restart P2Y₁₂ inhibitors (Class I)
<table>
<thead>
<tr>
<th>Recommendations</th>
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<tbody>
<tr>
<td><strong>Coronary revascularization before noncardiac surgery</strong></td>
<td></td>
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<tr>
<td>Revascularization before noncardiac surgery is recommended when indicated by existing CPGs</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Coronary revascularization is not recommended before noncardiac surgery exclusively to reduce perioperative cardiac events</td>
<td>III: No Benefit</td>
<td>B</td>
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<tr>
<td><strong>Timing of elective noncardiac surgery in patients with previous PCI</strong></td>
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<tr>
<td>Noncardiac surgery should be delayed after PCI</td>
<td>I</td>
<td>C: 14 d after balloon angioplasty</td>
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<tr>
<td></td>
<td></td>
<td>B: 30 d after BMS implantation</td>
</tr>
<tr>
<td>Noncardiac surgery should be delayed 365 d after DES implantation</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>A consensus decision as to the relative risks of discontinuation or continuation of antiplatelet therapy can be useful</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Elective noncardiac surgery after DES implantation may be considered after 180 d</td>
<td>IIb*</td>
<td>B</td>
</tr>
<tr>
<td>Elective noncardiac surgery should not be performed in patients in whom DAPT will need to be discontinued perioperatively within 30 d after BMS implantation or within 12 mo after DES implantation</td>
<td>III: Harm</td>
<td>B</td>
</tr>
<tr>
<td>Elective noncardiac surgery should not be performed within 14 d of balloon angioplasty in patients in whom aspirin will need to be discontinued perioperatively</td>
<td>III: Harm</td>
<td>C</td>
</tr>
</tbody>
</table>
**Perioperative beta-blocker therapy**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Level</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue beta blockers in patients who are on beta blockers chronically</td>
<td>I</td>
<td>B SRT</td>
</tr>
<tr>
<td>Guide management of beta blockers after surgery by clinical circumstances</td>
<td>IIa</td>
<td>B SRT</td>
</tr>
<tr>
<td>In patients with intermediate- or high-risk preoperative tests, it may be reasonable to begin beta blockers</td>
<td>IIb</td>
<td>C SRT</td>
</tr>
<tr>
<td>In patients with $\geq 3$ RCRI factors, it may be reasonable to begin beta blockers before surgery</td>
<td>IIb</td>
<td>B SRT</td>
</tr>
<tr>
<td>Initiating beta blockers in the perioperative setting as an approach to reduce perioperative risk is of uncertain benefit in those with a long-term indication but no other RCRI risk factors</td>
<td>III: Harm</td>
<td>B SRT</td>
</tr>
<tr>
<td>It may be reasonable to begin perioperative beta blockers long enough in advance to assess safety and tolerability, preferably $\geq 1$ d before surgery</td>
<td>IIb</td>
<td>B SRT</td>
</tr>
<tr>
<td>Beta-blocker therapy should not be started on the d of surgery</td>
<td>III: Harm</td>
<td>B SRT</td>
</tr>
</tbody>
</table>

**Perioperative statin therapy**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Level</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue statins in patients currently taking statins</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative initiation of statin use is reasonable in patients undergoing vascular surgery</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative initiation of statins may be considered in patients with a clinical risk factor who are undergoing elevated-risk procedures</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

**Alpha-2 agonists**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Level</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-2 agonists are not recommended for prevention of cardiac events</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
</tbody>
</table>

**ACE inhibitors**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Level</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuation of ACE inhibitors or ARBs is reasonable perioperatively</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>If ACE inhibitors or ARBs are held before surgery, it is reasonable to restart as soon as clinically feasible postoperatively</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>
### Antiplatelet agents

| Continue DAPT in patients undergoing urgent noncardiac surgery during the first 4 to 6 wk after BMS or DES implantation, unless the risk of bleeding outweighs the benefit of stent thrombosis prevention | I | C |
| In patients with stents undergoing surgery that requires discontinuation P2Y₁₂ inhibitors, continue aspirin and restart the P2Y₁₂ platelet receptor–inhibitor as soon as possible after surgery | I | C |
| Management of perioperative antiplatelet therapy should be determined by consensus of treating clinicians and the patient | I | C |
| In patients undergoing nonemergency/nonurgent noncardiac surgery without prior coronary stenting, it may be reasonable to continue aspirin when the risk of 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 |

#### Perioperative management of patients with CIEDs

| Patients with ICDs should be on a cardiac monitor continuously during the entire period of inactivation, and external defibrillation equipment should be available. Ensure that ICDs are reprogrammed to active therapy | I | C |
Class III-B (Harm, Not Indicated):
- Do not initiate on day of surgery

If elevated risk surgery:
Class IIb-C Indication:
- Intermediate-high risk ischemia seen on preoperative testing

Class IIb-B Indication:
- ≥3 RCRI Criteria
- <3 RCRI with primary long-term indication (CAD, HF, HTN)
- Start >1 day preoperatively

Class IIa-B Recommendation:
- May be continued postoperatively if clinically safe (SBP>100, HR>55, no acute anemia or Hgb >10)

Class I-B Recommendation:
- May be safely continued if tolerated as chronic therapy
Perioperative Beta-Blocker & Mortality

Perioperative Beta-Blockers & Statins


Fig. 1. Incidence of perioperative mortality and myocardial infarction. Results are based on the number of clinical risk factors by the revised cardiac risk index (ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, insulin therapy for diabetes, preoperative serum creatinine > 2 mg/dl), statin and beta-blocker use.
If elevated risk surgery:

Class IIb-C Indication:
- Consider initiating if undergoing high risk procedure

Class IIa-B Indication:
- Initiate for vascular surgery

Class I-B Indication:
- Continue if chronically using

RCRI-based indication was discarded with DECREASE data
Indications for Perioperative Alpha-2 Agonist

Class III-B (No Benefit, Not Indicated)
- Insufficient data to recommend
- Benefit seen in those also taking beta-blocker


<table>
<thead>
<tr>
<th></th>
<th>Clonidine</th>
<th>Control</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periop ischemia</td>
<td>18/125 (14%)</td>
<td>20/65 (31%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Postop mortality (to 2 yrs)</td>
<td>19/125 (15%)</td>
<td>19/65 (29%)</td>
<td>0.035</td>
</tr>
</tbody>
</table>
Cardiac Risk Assessment Algorithm

**Steps 1 - 3:**
- Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
  - Emergency Yes → Clinical risk stratification and proceed to surgery
  - No → ACS† (Step 2)
  - Yes → Evaluate and treat according to GDMT†
  - No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

**Steps 4 - 7:**
- Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
  - Low risk (<1%) (Step 4)
  - Elevated risk (Step 5)
  - Moderate or greater (>24 METs) functional capacity
    - Excellent (>10 METs)
    - Moderate/Good (>8–10 METs)
    - Poor or unknown
      - Proceed to surgery
      - Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
        - Yes → Pharmacologic stress testing (Class IIa)
          - Normal → Proceed to surgery
          - Abnormal → Coronary revascularization according to existing CPGs (Class I)
        - No → Proceed to surgery OR alternate strategies (noninvasive treatment, palliation) (Step 7)

* MACE = major adverse cardiac event
† MET = metabolic equivalent time
‡ GDMT = guideline directed medical therapy
§ CPG = clinical practice guideline
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