Perioperative Medicine: Clinical Cases & Updates

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Why Pre-op evaluation?

- Risk assessment
- Improved outcomes
- Safety
- Prevention
## Applying Classification of Recommendations and Level of Evidence

<table>
<thead>
<tr>
<th>Class I</th>
<th>Class Ila</th>
<th>Class Iib</th>
<th>Class III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit &gt;&gt;&gt; Risk</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Benefit ≥ Risk</td>
<td>Risk ≥ Benefit</td>
</tr>
<tr>
<td>Procedure/Treatment <strong>SHOULD</strong> be performed/administered</td>
<td>Additional studies with focused objectives needed</td>
<td>Additional studies with broad objectives needed; Additional registry data would be helpful</td>
<td>No additional studies needed</td>
</tr>
<tr>
<td><strong>IT IS REASONABLE</strong> to perform procedure/administer treatment</td>
<td><strong>IT IS REASONABLE</strong> to perform procedure/administer treatment</td>
<td>Procedure/Treatment <strong>MAY BE CONSIDERED</strong></td>
<td>Procedure/Treatment should <strong>NOT</strong> be performed/administered <strong>SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL</strong></td>
</tr>
</tbody>
</table>

- **should** is recommended
  - **is** 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
- **is not** recommended
  - **is not** indicated
  - **is not** useful/effective/beneficial
  - may be harmful
**Applying Classification of Recommendations and Level of Evidence**

<table>
<thead>
<tr>
<th>Class I</th>
<th>Class Ila</th>
<th>Class IIb</th>
<th>Class III</th>
</tr>
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<tr>
<td>Benefit &gt;&gt;&gt; Risk</td>
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**Level A**  
*Multiple (3-5) population risk strata evaluated*  
*General consistency of direction and magnitude of effect*

**Level B**  
*Limited (2-3) population risk strata evaluated*

**Level C**  
*Very limited (1-2) population risk strata evaluated*
Case #1:
Focus: Cardiac Risk assessment
You were consulted for pre-op “clearance”.

The patient is an 80 year old male, diabetic, with no previous cardiac history. Patient fell and broke his hip. Patient lives in an apartment in a second floor and uses stairs daily. Patient lives alone and does his own shopping.

P/E is unremarkable except for Rt hip pain. EKG shows non-specific ST-T changes. Orthopedics team wants to operate next morning.

What are you going to recommend from cardiac point of view??

A. Cardiac stress test.

B. Cardiac catheterization

C. Echocardiogram

D. No cardiac testing and proceed to surgery.


Thinking process:

Patient conditions: Clinical Risk Predictors

Procedure risk
(Surgery specific risk)

Patient’s functional status
(self reported exercise capacity)
Clinical Predictors of Increased Perioperative Cardiovascular Risk
(Myocardial Infarction, Heart Failure, Death)

- **Active Cardiac Conditions (used to be called Major Clinical Predictors)**
  - Unstable coronary syndromes
  - Acute or recent myocardial infarction (within 4-6 weeks) with evidence of important ischemic risk by clinical symptoms or noninvasive study
  - Unstable or severe angina (Canadian class III or IV)
  - Decompensated heart failure
  - Significant arrhythmias
    - High-grade atrioventricular block
    - Symptomatic ventricular arrhythmias in the presence of underlying heart disease
    - Supraventricular arrhythmias with uncontrolled ventricular rate
  - Severe valvular disease

- **Clinical Risk Factors (used to be called Intermediate risk factors)**
  - Mild angina pectoris (Canadian class I or II)
  - Previous myocardial infarction by history or pathological Q waves
  - Compensated or prior heart failure
  - Diabetes mellitus (particularly insulin-dependent)
  - Renal insufficiency
  - History of CVA
Functional Capacity

1 MET
Can you take care of yourself?

4 METs
Climb a flight of stairs or walk up a hill?
Eat, dress, or use the toilet?
Walk on level ground at 4 mph or 6.4 km per h?
Walk indoors around the house?
Run a short distance?
Walk a block or two on level ground at 2 to 3 mph or 3.2 to 4.8 km per h?
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?

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

Greater than 10 METs
Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?

MET indicates metabolic equivalent. Adapted from the Duke Activity Status Index\textsuperscript{20} and AHA Exercise Standards
Cardiac Risk* Stratification for Noncardiac Surgical Procedures

**Major Vascular Surgery (old: High (Reported cardiac risk often greater than 5%))**
- Emergent major operations, particularly in the elderly
- Aortic and other major vascular surgery
- Peripheral vascular surgery
- Anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss

**Intermediate Risk Operations (Old: Intermediate (Reported cardiac risk generally less than 5%))**
- Carotid endarterectomy
- Head and neck surgery
- Intraperitoneal and intrathoracic surgery
- Orthopedic surgery
- Prostate surgery
- Endovascular aortic aneurysm repair by stent or coil

**Low Risk Operations (Old: Low (Reported cardiac risk generally less than 1%))**
- Endoscopic procedures
- Superficial procedure
- Cataract surgery
- Breast surgery
Recommended approach to cardiac evaluation and care prior to noncardiac surgery

Step 1: Need for emergency noncardiac surgery?
- Yes (Class I, LOE C) → Operating room → Perioperative surveillance and postoperative risk stratification and risk factor management
- No

Step 2: Active cardiac conditions
- Yes (Class I, LOE B) → Evaluate and treat per ACC/AHA guidelines → Consider operating room
- No

Step 3: Low-risk surgery
- Yes (Class I, LOE B) → Proceed with planned surgery
- No

Step 4: Functional capacity ≥1 to 4 METs without symptoms
- Yes (Class IIa, LOE B) → Proceed with planned surgery
- No or unknown
  - 3 or more clinical risk factors† → Vascular surgery
    - Class IIa, LOE B
      - Consider testing if it will change management†
  - 1–2 clinical risk factors† → Intermediate-risk surgery
    - Proceed with planned surgery with heart rate control‡ (Class IIa, LOE B) or consider noninvasive testing (Class IIb, LOE B) if it will change management
  - No clinical risk factors† → Intermediate-risk surgery
    - Vascular surgery
    - Proceed with planned surgery
  - Class I, LOE B

† Noninvasive testing may be considered before surgery in specific patients with risk factors if it will change management.
‡ Clinical risk factors include ischemic heart disease, compensated or prior heart failure, diabetes mellitus, renal insufficiency, and cerebrovascular disease.
‡ Consider perioperative beta-blockade for populations in which this has been shown to reduce cardiac morbidity/mortality.

LOE = level of evidence; MET = metabolic equivalent
MedCalc: Perioperative Cardiac Evaluation

Guidelines for Perioperative Cardiovascular Evaluation for Noncardiac Surgery
American College of Cardiology / American Heart Association


Pocket Guideline: requires Adobe Acrobat Reader

Need for cardiac surgery?

- Emergency surgery
- Urgent or elective surgery

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Created: Saturday, July 14, 2001
Last Modified: Sunday, December 11, 2005
Case #2:

Focus: Previous PCI or stents
A 60 year old male is interested in an elective cholecystectomy. He had PCI with bare metal placed 2 months ago and is asking your input about when he can proceed with elective surgery.

You will advise him that the safe period to have an elective surgery after bare metal stent was placed is:

- A: 2 weeks
- B: 4-6 weeks
- C: 6 months
- D: 1 Year
Debating the Risks of Drug-Eluting Stents
Risks Associated with Drug-Eluting Stents and Bare-Metal Stents.

Ingrowth of tissue may cause bare-metal stents to become obstructed, resulting in the need for a second procedure. Drug-eluting stents inhibit this process, but uncovered struts may be prone to thrombosis after the discontinuation of antiplatelet therapy.
Proposed approach to management of patients with prior PCI

Previous PCI

- Balloon angioplasty
  - Time since PCI:
    - < 14 days: Delay for elective or nonurgent surgery
    - > 14 days: Proceed to the operating room with aspirin

- Bare-metal stent
  - Time since PCI:
    - > 30–45 days: Proceed to the operating room with aspirin
    - < 30–45 days: Delay for elective or nonurgent surgery

- Drug-eluting stent
  - Time since PCI:
    - < 365 days: Delay for elective or nonurgent surgery
    - > 365 days: Proceed to the operating room with aspirin

www.sciencedirect.com/science/journal/07351097
Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery

The Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC) and endorsed by the European Society of Anaesthesiology (ESA)
Case #3:

Focus: Previous PCI or stents & urgent surgery
A 75-year-old woman presents with a hip fracture. Her medical history is remarkable for coronary artery disease. Two months previously she had a non-ST-segment elevation myocardial infarction and had a drug-eluting stent (DES) placed. She has a history of type 2 diabetes, hypertension, and hyperlipidemia.

Current medications:
- Aspirin, 81 mg/d
- Clopidogrel, 75 mg/d
- Atorvastatin, 20 mg/d
- Metformin, 1000 mg twice daily
- Enalapril, 40 mg/d
- Hydrochlorothiazide, 25 mg/d

Which one of the following would be the most appropriate recommendation to the surgeon about this patient's antiplatelet therapy before hip fracture repair?

- a. Do not interrupt aspirin or clopidogrel therapy before surgery
- b. Stop both clopidogrel and aspirin therapy for 5 days before surgery
- c. Stop both clopidogrel and aspirin therapy for 5 days before surgery and bridge with low-molecular-weight heparin (LMWH)
- d. Stop clopidogrel therapy for 5 days before surgery but do not interrupt aspirin therapy
- e. Delay surgery until the 1-year anniversary of stent placement.

The American College of Chest Physicians Evidence-Based Clinical Practice Guidelines also address this issue in the section on the perioperative management of antithrombotic therapy.

These guidelines recommend that patients with a DES who require surgery within 12 months of stent placement continue aspirin and clopidogrel therapy in the perioperative period. Additionally, patients with a BMS who require surgery within 6 weeks of stent placement should also continue aspirin and clopidogrel therapy in the perioperative period.

Clinical Pearl:
Most operations (except neurosurgery) can be performed in patients who have recent coronary artery stents and who are receiving dual antiplatelet therapy without increasing mortality.

Case #4:

Focus:
Hypertension at time of surgery
A 50 year old female presented to surgery suite for an elective cholecystectomy. Anesthesia staff call Medicine service for a recommendation regarding her surgery because her BP was found to be 170/100. She has no symptoms. She takes HCTZ and Amlodipine and her outpatient BP has been around 130-150/ 70-90. Her exam is unremarkable.

What will you recommend?

A: Delay surgery.

B: Give Clonidine sublingual and recheck BP.

C: Give Hydralazine IV and recheck BP.

D: Proceed with surgery with intraoperative control of BP.
Hypertension at time of surgery:

- 180/110 or higher?
- End organ damage?
- Urgent surgery?
Q: Does elevated blood pressure at the time of surgery increase perioperative cardiac risk?

BP > 180/110 mm Hg

ACC/AHA and JNC 7 recommend delaying surgery

- Verify outpatient BP control
- Confirm reading:
  - Appropriate cuff size
  - Calibrated instrument
  - Trained reader
- Carefully assess for target-organ damage:
  - Left ventricular hypertrophy
  - Congestive heart failure
  - Coronary artery disease
  - Chronic renal failure

Elective surgery

BP < 180/110 mm Hg

Proceed with surgery

BP > 180/110 mm Hg

Target-organ damage

- Present
- Absent

May proceed with surgery

Delay surgery and optimize treatment

Emergency surgery

Proceed with surgery

1. Arterial line with BP monitoring
2. Intraoperative electrocardiographic monitoring
3. Close perioperative monitoring in intensive care unit setting
4. Administer anti-ischemic therapy such as beta-blockers
5. Consider spinal or epidural anesthesia
6. Avoid > 20% increase or decrease in BP from preoperative levels
7. Obtain postoperative electrocardiogram and troponin levels

BP = blood pressure; ACC = American College of Cardiology; AHA = American Heart Association; JNC 7 = Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure

Case #5:

Focus: Perioperative Pulmonary Risk Modification
A 62-year-old man presents for an evaluation before an open cholecystectomy for acute cholecystitis under general anesthesia.

He has a history of chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea and is actively smoking. He has no history of coronary artery disease. His functional capacity is about 4 to 5 metabolic equivalents.

His inhalers include ipratropium, salmeterol, and albuterol, as needed. He uses continuous positive airway pressure at night. Pulmonary function testing 1 year previously revealed a forced expiratory volume in 1 second of 60% of predicted.

Oxygen saturation, 91% while breathing room air. Lungs: prolonged expiration phase, otherwise clear Unremarkable findings on remainder of examination.

Which one of the following strategies will most effectively reduce this patient's risk of postoperative pulmonary complications?

A. Smoking cessation

B. Postoperative incentive spirometry

C. Switching to a laparoscopic surgical technique

D. Postoperative nasogastric decompression

E. Preoperative oral corticosteroid therapy.

**Strength of evidence for strategies to reduce risk of postoperative pulmonary complications**

<table>
<thead>
<tr>
<th>Supported by good evidence</th>
<th>Postoperative lung expansion modalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported by fair evidence</td>
<td>Selective postoperative nasogastric tube use</td>
</tr>
<tr>
<td></td>
<td>Short-acting neuromuscular blockade</td>
</tr>
<tr>
<td>Balance of benefit and harm</td>
<td>Laparoscopic (vs open) operation†</td>
</tr>
<tr>
<td>too close to justify</td>
<td>Routine total parenteral or enteral nutrition</td>
</tr>
<tr>
<td>recommendation</td>
<td>Right heart catheterization</td>
</tr>
<tr>
<td>At least fair evidence that</td>
<td>Intraoperative neuraxial blockade</td>
</tr>
<tr>
<td>strategy does not</td>
<td>Postoperative epidural analgesia‡</td>
</tr>
<tr>
<td>reduce risk or harm</td>
<td>Smoking cessation</td>
</tr>
<tr>
<td>outweighs benefit</td>
<td></td>
</tr>
</tbody>
</table>

*Adapted from the systematic review by Lawrence et al*¹ for the 2006 American College of Physicians guideline.

†More recent data provide fair evidence to support this risk factor
‡More recent data provide good evidence to support this risk factor
In 2006, Lawrence et al published a systematic review of strategies to reduce pulmonary complications after noncardiothoracic surgery for the American College of Physicians. In this review, the authors reported the strength of the evidence for specific interventions to reduce the risk of postoperative pulmonary complications. The best evidence exists for lung-expansion therapy (eg, incentive spirometry, deep breathing exercises, and continuous positive airway pressure) for reducing pulmonary risk after abdominal surgery.

Clinical Pearl: Lung-expansion modalities (eg, postoperative incentive spirometry) are most effective for reducing the risk of post-operative pulmonary complications in high-risk patients.

Case #6:

Focus: Sleep Apnea in perioperative period
A 55 year old morbidly obese male patient presents with his wife for pre-op evaluation before an elective inguinal hernia repair under general anesthesia. His wife said that he snores loud and wakes up several times a night. Patient admits to morning headache and daytime sleepiness. Patient wants to proceed to surgery ASAP.

Meds: HCTZ, Lisinopril

Exam reveals obese male but otherwise unremarkable.

Review of recent labs: Hb 15, WBC 10, Na 140, K 4, CO2 30, Glucose random 180
What will you recommend regarding your concern for sleep apnea?

A: Patient may proceed with surgery but will need postoperative sleep study.
B: Surgery should be delayed for evaluation of sleep apnea.
C: Patient may proceed with surgery with instructions to anesthesia to deliver continuous Oxygen per nasal canula.
D: Patient should proceed with surgery with advice to lose weight after surgery and reassess by his PCP.
For surgical patients deemed to be at high risk for OSA, and for whom surgery cannot be delayed for diagnostic tests and OSA treatment, the best course is to proceed with surgery but assume the patient has moderate to severe OSA.
Factors to keep in mind in the evaluation for obstructive sleep apnea (OSA)

Factors that reduce upper airway size or predispose to upper airway collapse

Obesity
Male gender
Menopausal status
Hard-tissue craniofacial abnormalities (retrognathia, micrognathia, brachycephaly)
Soft-tissue craniofacial abnormalities (large uvula, enlarged tonsils, macroglossia, long soft palate)
Alcohol or sedative use (aggravates underlying OSA)

Symptoms and complaints that may be suggestive of OSA

Snoring
Sleepiness
Physically restless sleep
Night sweats
Morning dry mouth or sore throat

Personality change
Morning confusion
Intellectual impairment
Impotence
Morning headaches
### STOP-BANG questionnaire*

**STOP**

- **S** (snore)  
  Do you *snore* loudly (louder than talking or loud enough to be heard through closed doors)?  
  Yes/No

- **T** (tired)  
  Do you often feel *tired*, fatigued, or sleepy during daytime?  
  Yes/No

- **O** (observed)  
  Has anyone *observed* you stop breathing during sleep?  
  Yes/No

- **P** (blood pressure)  
  Do you have or are you being treated for high blood *pressure*?  
  Yes/No

**BANG**

- **B** (body mass index [BMI])  
  *BMI* > 35 kg/m²?  
  Yes/No

- **A** (age)  
  *Age* > 50 years?  
  Yes/No

- **N** (neck)  
  *Neck circumference* > 40 cm?  
  Yes/No

- **G** (gender)  
  *Gender* male?  
  Yes/No

---

*Yes to ≥ 3 questions = high risk of obstructive sleep apnea  
Yes to < 3 questions = low risk of obstructive sleep apnea*
Q: Should we routinely screen for hypercapnia in sleep apnea patients before elective noncardiac surgery?

A: Yes. Obesity hypoventilation syndrome (OHS) is often undiagnosed and greatly increases perioperative risk. Therefore, we recommend trying to detect OHS in a timely manner. Treatment should begin without delay to avoid adverse perioperative outcomes, which can include acute-on-chronic respiratory failure requiring intensive-care monitoring and invasive mechanical ventilation, or death.
What can be done before elective surgery regarding OSA and hypercapnia?

- Serum venous bicarbonate level
- ABG
- PFT and CXR
- Sleep study
- CPAP or BiPAP

Practical points:

- Keep OSA in mind when doing pre-op evaluation.
- Use STOP-BANG tool to identify patients at risk.
- Use preoperative screening tools in history, physical and labs.
- Realize the serious perioperative complications for undiagnosed or untreated OSA.
- When in doubt and surgery cannot be delayed, proceed as if the patient has OSA.
Case #7:

Focus: Stroke & perioperative period
A 60 year old male is being evaluated for an elective gallbladder surgery due to recurrent attacks. He had a recent ischemic stroke. Surgery would like a recommendation on how soon he can proceed with surgery.

From a stroke point of view, what is the minimum period you will recommend after stroke and before surgery?

- A. 2 weeks after stroke
- B. 1 month after stroke
- C. 3 months after stroke
- D. 6 months after stroke
- E. 1 year after stroke
Concise Review for Clinicians

The Preoperative Cerebrovascular Consultation: Common Cerebrovascular Questions Before General or Cardiac Surgery

DAVID J. BLACKER, FRACP; KELLY D. FLEMMING, MD; MICHAEL J. LINK, MD; AND ROBERT D. BROWN, JR, MD, MPH

Table 1. Perioperative Ischemic Stroke Risk Rates for Specific Surgeries and Clinical Conditions*

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Stroke risk (%)</th>
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</thead>
<tbody>
<tr>
<td>General surgery$^5$</td>
<td>0.2</td>
</tr>
<tr>
<td>General surgery with$^6$ or without carotid bruit</td>
<td>0.5</td>
</tr>
<tr>
<td>General surgery after prior stroke$^7$</td>
<td>2.9</td>
</tr>
<tr>
<td>General surgery with carotid stenosis and bruit or prior symptoms$^8$</td>
<td>3.6</td>
</tr>
<tr>
<td>CABG retrospective studies$^1$</td>
<td>1.4</td>
</tr>
<tr>
<td>CABG prospective studies$^1$</td>
<td>2.0</td>
</tr>
<tr>
<td>CABG surgery after prior stroke or TIA$^1$</td>
<td>8.5</td>
</tr>
<tr>
<td>CABG surgery + valve surgery$^1$</td>
<td>4.2-13.0</td>
</tr>
<tr>
<td>CABG surgery + unilateral &gt;50% carotid stenosis$^1$</td>
<td>3.0</td>
</tr>
<tr>
<td>CABG surgery + bilateral &gt;50% carotid stenosis$^1$</td>
<td>5.0</td>
</tr>
<tr>
<td>CABG surgery + carotid occlusion$^1$</td>
<td>7.0</td>
</tr>
<tr>
<td>Surgery with symptomatic vertebrobasilar stenosis$^2$</td>
<td>6.0</td>
</tr>
</tbody>
</table>

*CABG = coronary artery bypass graft; TIA = transient ischemic attack.

How long should general surgery under anesthesia be delayed after a stroke?

Promptly examine all stroke patients, and defer nonessential surgery until the evaluation is complete.

Treat symptomatic carotid stenosis with CEA or CAS before the patient undergoes general or cardiac surgery.

Allow at least 1 month to elapse between a moderately large ischemic stroke (greater than one third the distribution of the middle cerebral artery) and surgery.
Case #8:

Focus:
Steroids & perioperative period
A 56-year-old man with rheumatoid arthritis needs a preoperative assessment before a scheduled total knee replacement. His only other medical problem is hypertension. His medications include prednisone, 5 mg/d; atenolol, 50 mg/d; hydrochlorothiazide, 25 mg/d; and omeprazole, 20 mg/d.

On physical examination, his pulse rate is 70/min and his blood pressure is 142/80 mm Hg. He has facial plethora and central obesity. His heart and lungs are normal on examination.

What is the most appropriate regimen for perioperative management of his corticosteroid therapy?

A. Hydrocortisone, 50 mg intravenously every 8 hours for 3 doses; followed by hydrocortisone, 25 mg intravenously every 8 hours for 3 doses; then resume usual outpatient regimen

B. Hydrocortisone, 100 mg intravenously every 8 hours for 3 doses; then hydrocortisone, 50 mg intravenously every 8 hours for 3 doses; then hydrocortisone, 25 mg intravenously every 8 hours for 3 doses; then resume usual outpatient regimen

C. Prednisone, 10 mg on the day of surgery and the first postoperative day; then resume usual dose of prednisone

D. Prednisone, 5 mg on the day of surgery; prednisone, 10 mg on the first postoperative day; then resume usual outpatient regimen

E. Stop steroids since it delays wound healing

**Perioperative Stress Dose Corticosteroid Therapy**

Major surgeries (cardiothoracic, oncologic, or major abdominal surgeries)
- Start hydrocortisone, 100 mg intravenously every 8 h for 3 doses
- Then 50 mg for 3 doses
- Then 25 mg for 3 doses
- Then resume usual outpatient dose in uncomplicated patients

Moderate surgeries (orthopedic, urologic, otolaryngologic)
- Start hydrocortisone, 50 mg intravenously every 8 h for 3 doses
- Then 25 mg for 3 doses
- Then resume usual outpatient dose in uncomplicated patients

Minor procedures (cataract surgery, other outpatient procedures)
- Usual dose on the day of surgery
- Double the first postoperative dose

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Supplementation</th>
</tr>
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<tbody>
<tr>
<td><strong>Superficial</strong> procedure: local anesthesia less than 1 h (ie, dental work, skin biopsy)</td>
<td>Continue normal daily dose</td>
</tr>
<tr>
<td><strong>Minor</strong> surgery (ie, inguinal hernia repair)</td>
<td><strong>25 mg HC</strong> or 5 mg MP IV on DOS</td>
</tr>
<tr>
<td><strong>Moderate</strong> surgery (ie, total joint replacement, open cholecystectomy, segmental colon resection, lower extremity revascularization, abdominal hysterectomy)</td>
<td><strong>50-75 mg HC</strong> or 10-15 mg MP IV on DOS Taper quickly over 1-2 days to usual dose</td>
</tr>
<tr>
<td><strong>Major</strong> surgery (ie, cardiothoracic surgery, pancreaticoduodenectomy, esophagogastrectomy, total proctocolectomy)</td>
<td><strong>100-150 mg HC</strong> or 20-30 mg MP IV on DOS Taper quickly over 2-3 days to usual dose</td>
</tr>
</tbody>
</table>

Semin Arthritis Rheum 2007; 36:278-286
Case #9:

Focus:
Beta Blockers & perioperative period
A 75 year old female will undergo removal of hardware from an infected hip prosthesis tomorrow. She has a history of diabetes and a remote stroke, but no current cardiovascular symptoms. Focusing on decreasing her overall perioperative mortality and decreasing her risk of another stroke, you will:

A. Definitely start β-blocker

B. Probably start β-blocker

C. Probably avoid β-blocker

D. Definitely avoid β-blocker
Story of B blockers....
B Blockers studies in periop period:


- Auerbach AD, Goldman L. Beta-blockers and reduction of cardiac events in noncardiac surgery. JAMA. 2002; 287:1435-44.


Vague recommendation back in late 90s:

**Clear Opportunities for Safety Improvement**

The following 11 patient safety practices were the most highly rated (of the 79 practices reviewed in detail in the full report and ranked in the Executive Summary Addendum, AHRQ Publication No. 01-E057b) in terms of strength of the evidence supporting more widespread implementation. Practices appear in descending order, with the most highly rated practices listed first. Because of the imprecision of the ratings, the editors did not further divide the practices, nor indicate where there were ties.

- Appropriate use of prophylaxis to prevent venous thromboembolism in patients at risk;
- Use of perioperative beta-blockers in appropriate patients to prevent perioperative morbidity and mortality;
- Use of maximum sterile barriers while placing central intravenous catheters to prevent infections;
- Appropriate use of antibiotic prophylaxis in surgical patients to prevent perioperative infections;
- Asking that patients recall and restate what they have been told during the informed consent process;
- Continuous aspiration of subglottic secretions (CASS) to prevent ventilator-associated pneumonia;
- Use of pressure relieving bedding materials to prevent pressure ulcers;
- Use of real-time ultrasound guidance during central line insertion to prevent complications;
- Patient self-management for warfarin (Coumadin™) to achieve appropriate outpatient anticoagulation and prevent complications;
- Appropriate provision of nutrition, with a particular emphasis on early enteral nutrition in critically ill and surgical patients; and
- Use of antibiotic-impregnated central venous catheters to prevent catheter-related infections.
Are we harming patients?

- Dr. Lindenauer (lead author of 7/28/05, NEJM study) compared outcomes in more than 660,000 noncardiac surgery patients, roughly 20 percent of whom had received perioperative beta-blockers.

- The retrospective study was based on records from 329 hospitals between the years 2000 and 2001. It found that beta-blockers cut the risk of premature death by nearly 40 percent in patients with four or more risk factors for cardiovascular trouble (as defined by the revised cardiac risk index, or RCRI) going into the operating room. Mortality was reduced in 29 percent of individuals with an RCRI of three, and in 12 percent of those with an RCRI of two.

- But the benefit tailed off in healthier patients, and the drugs had no preventive effect in patients with one or no cardiac risk factors. Indeed, those in the lowest-risk group appeared to have increased odds of dying in the hospital if they took the drugs.
Mortality among patients who received beta-blockers before major noncardiac surgery

<table>
<thead>
<tr>
<th>Patient risk score</th>
<th>Odds ratio of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.43</td>
</tr>
<tr>
<td>1</td>
<td>1.13</td>
</tr>
<tr>
<td>2</td>
<td>0.90</td>
</tr>
<tr>
<td>3</td>
<td>0.71</td>
</tr>
<tr>
<td>4 and greater</td>
<td>0.57</td>
</tr>
</tbody>
</table>

The NEW ENGLAND JOURNAL OF MEDICINE

ORIGINAL ARTICLE

Perioperative Beta-Blocker Therapy and Mortality after Major Noncardiac Surgery

Peter K. Lindenauer, M.D., Penelope Pekow, Ph.D., Kaijun Wang, M.S., Dheeresh K. Mamidi, M.B., B.S., M.P.H., Benjamin Gutierrez, Ph.D., and Evan M. Benjamin, M.D.
BACKGROUND
Despite limited evidence from randomized trials, perioperative treatment with beta-blockers is now widely advocated. We assessed the use of perioperative beta-blockers and their association with in-hospital mortality in routine clinical practice.

METHODS
We conducted a retrospective cohort study of patients 18 years of age or older who underwent major noncardiac surgery in 2000 and 2001 at 329 hospitals throughout the United States. We used propensity-score matching to adjust for differences between patients who received perioperative beta-blockers and those who did not receive such therapy and compared in-hospital mortality using multivariable logistic modeling.

RESULTS
Of 782,969 patients, 663,635 (85 percent) had no recorded contraindications to beta-blockers, 122,338 of whom (18 percent) received such treatment during the first two hospital days, including 14 percent of patients with a Revised Cardiac Risk Index (RCRI) score of 0 and 44 percent with a score of 4 or higher. The relationship between perioperative beta-blocker treatment and the risk of death varied directly with cardiac risk; among the 580,665 patients with an RCRI score of 0 or 1, treatment was associated with no benefit and possible harm, whereas among the patients with an RCRI score of 2, 3, or 4 or more, the adjusted odds ratios for death in the hospital were 0.88 (95 percent confidence interval, 0.80 to 0.98), 0.71 (95 percent confidence interval, 0.63 to 0.80), and 0.58 (95 percent confidence interval, 0.50 to 0.67), respectively.

CONCLUSIONS
Perioperative beta-blocker therapy is associated with a reduced risk of in-hospital death among high-risk, but not low-risk, patients undergoing major noncardiac surgery. Patient safety may be enhanced by increasing the use of beta-blockers in high-risk patients.
Although evidence from randomized trials remains limited, the treatment of surgical patients with beta-blockers has been championed by clinicians and policymakers for its potential to enhance patient safety. In this large observational study, the perioperative administration of beta-blockers was associated with clear and clinically significant reductions in mortality among the 2 percent of surgical patients at highest risk (those with an RCRI score of 3 or greater) and appeared to be beneficial in the 10 percent of patients with an RCRI score of 2, but was of no benefit — and was possibly harmful — among patients in the lowest risk categories (those with an RCRI score of 0 or 1). Our observation that only a minority of patients at highest risk received beta-blockers underscores the Agency for Healthcare Research and Quality’s statement that perioperative use of beta-blockade represents a clear opportunity for safety improvement.
“Still give beta-blockers, but carefully look at which of the risk index criteria patients have.”

–Amir Jaffer, MD
Cleveland Clinic

“These are not drugs that should be given to every patient undergoing major noncardiac surgery.”

–Peter K. Lindenauer, MD
Baystate Medical Center
POISE Trial

Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial

POISE Study Group*

Summary
Background Trials of β blockers in patients undergoing non-cardiac surgery have reported conflicting results. This randomised controlled trial, done in 190 hospitals in 23 countries, was designed to investigate the effects of perioperative β blockers.

Methods We randomly assigned 8351 patients with, or at risk of, atherosclerotic disease who were undergoing non-cardiac surgery to receive extended-release metoprolol succinate (n=4174) or placebo (n=4177), by a computerised randomisation phone service. Study treatment was started 2–4 h before surgery and continued for 30 days. Patients, health-care providers, data collectors, and outcome adjudicators were masked to treatment allocation. The primary endpoint was a composite of cardiovascular death, non-fatal myocardial infarction, and non-fatal cardiac arrest. Analyses were by intention to treat. This trial is registered with ClinicalTrials.gov, number NCT00182039.
POISE: Treatment Protocol

2-4 h
1st dose
Metoprolol
100 mg XL*

OR

0-6 h
2nd dose
Metoprolol
100 mg XL*

12 h
3rd & daily dose
Metoprolol
200 mg XL^*

* Study drug held for SBP < 100 or HR < 50
^ Daily dose reduced to 100 mg if persistent bradycardia or hypotension
POISE: Results

<table>
<thead>
<tr>
<th>CV Death, Cardiac Arrest, Nonfatal MI</th>
<th>Placebo</th>
<th>Metoprolol XL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.9%</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

| Total Mortality                     | 2.3%    | 3.1%          |

Metoprolol XL:
Reduced cardiac events (mostly nonfatal MI)

but
Increased risk of stroke & total mortality

For every 15 patients who participated in POISE, one had a cardiovascular death, non-fatal myocardial infarction, non-fatal cardiac arrest, or non-fatal stroke at 30-day follow-up. In view of the large numbers of individuals undergoing surgery and the high risk of cardiovascular complications, more large trials are needed urgently. The results of this trial suggest that the addition of perioperative extended-release metoprolol has potential benefits and risks. Patients who would place three times more value on avoiding a perioperative stroke than on avoiding a myocardial infarction, or who are unwilling to accept a probable increase in mortality, are unlikely to want perioperative extended-release metoprolol. Current perioperative guidelines that recommend β-blocker therapy to patients undergoing non-cardiac surgery should reconsider their recommendations in light of these findings.
POISE was the largest study of perioperative beta-blockers and demonstrated that extended release Metoprolol reduced the risk of MI but at the expense of increased stroke and overall mortality.

DECREASE IV:

- 1,066 intermediate-cardiac risk patients were randomized to receive bisoprolol, fluvastatin, combination treatment, or combination placebo control.

- Bisoprolol was initiated up to 30 days prior to surgery, and the 2.5-mg daily starting dosage was titrated according to the patient’s heart rate to achieve a target rate of 50 to 70 beats per minute.

- Fluvastatin was also started up to 30 days prior to surgery.

- Patients who received bisoprolol (with or without fluvastatin) had a significant reduction in the 30-day incidence of cardiac death and nonfatal MI compared with those who did not receive bisoprolol (2.1% vs 6.0%; HR = 0.34 [95% CI, 0.17–0.67]; P = .002). Fluvastatin was associated with a favorable trend on this end point, but statistical significance was not achieved (P = .17).

- There was no difference among treatment groups in the incidence of stroke (4 strokes in the 533 patients who received bisoprolol vs 3 strokes in the 533 patients who did not), which further suggests that the increased stroke rate seen with beta-blockade in POISE may have been due to dosage, timing of initiation, or both.

ACC/AHA Practice Guidelines

ACC/AHA 2006 Guideline Update on Perioperative Cardiovascular Evaluation for Noncardiac Surgery: Focused Update on Perioperative Beta-Blocker Therapy


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, and Society for Vascular Medicine and Biology

Practice Guideline: Focused Update

2009 ACCF/AHA Focused Update on Perioperative Beta Blockade

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

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 Society for Vascular Surgery

Circulation  November 24, 2009
<table>
<thead>
<tr>
<th>2007 Perioperative Guideline Recommendations</th>
<th>2009 Perioperative Focused Update Recommendations</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers to treat angina, symptomatic arrhythmias, hypertension, or other ACC/AHA Class I guideline indications. <em>(Level of Evidence: C)</em></td>
<td>1. Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers for treatment of conditions with ACCF/AHA Class I guideline indications for the drugs. <em>(Level of Evidence: C)</em></td>
<td>2007 recommendation remains current in 2009 update with revised wording.</td>
</tr>
<tr>
<td>2. Beta blockers should be given to patients undergoing vascular surgery who are at high cardiac risk owing to the finding of ischemia on preoperative testing. <em>(Level of Evidence: B)</em></td>
<td>Deleted/combined recommendation (class of recommendation changed from I to IIa for patients with cardiac ischemia on preoperative testing).</td>
<td></td>
</tr>
<tr>
<td>2007 Perioperative Guideline Recommendations</td>
<td>2009 Perioperative Focused Update Recommendations</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Class IIA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Beta blockers are probably recommended for patients undergoing vascular surgery in whom preoperative assessment identifies coronary heart disease. <em>(Level of Evidence: B)</em></td>
<td>1. <strong>Beta blockers titrated to heart rate and blood pressure</strong> are probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing. ⁴,⁵ <em>(Level of Evidence: B)</em></td>
<td>Modified/combined recommendation (wording revised and class of recommendation changed from I to IIA for patients with cardiac ischemia on preoperative testing).</td>
</tr>
<tr>
<td>2. Beta blockers are probably recommended for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor.* <em>(Level of Evidence: B)</em></td>
<td>2. <strong>Beta blockers titrated to heart rate and blood pressure</strong> are reasonable for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor.* <em>(Level of Evidence: C)</em></td>
<td>Modified recommendation (level of evidence changed from B to C).</td>
</tr>
<tr>
<td>3. Beta blockers are probably recommended for patients in whom preoperative assessment identifies coronary heart disease or high cardiac risk, as defined by the presence of more than 1 clinical risk factor,* who are undergoing intermediate-risk or vascular surgery. <em>(Level of Evidence: B)</em></td>
<td>3. <strong>Beta blockers titrated to heart rate and blood pressure</strong> are reasonable for patients in whom preoperative assessment identifies coronary artery disease or high cardiac risk, as defined by the presence of more than 1 clinical risk factor,* who are undergoing intermediate-risk surgery.⁶ <em>(Level of Evidence: B)</em></td>
<td>2007 recommendation remains current in 2009 update with revised wording.</td>
</tr>
<tr>
<td>2007 Perioperative Guideline Recommendations</td>
<td>2009 Perioperative Focused Update Recommendations Class IIb</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>1. The usefulness of beta blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery, in whom preoperative assessment identifies a single clinical risk factor.* (Level of Evidence: C)</td>
<td>1. The usefulness of beta blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease.* (Level of Evidence: C)</td>
<td>2007 recommendation remains current in 2009 update with revised wording.</td>
</tr>
<tr>
<td>2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta blockers. (Level of Evidence: B)</td>
<td>2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors* who are not currently taking beta blockers. (Level of Evidence: B)</td>
<td>2007 recommendation remains current in 2009 update.</td>
</tr>
</tbody>
</table>

**Class III**

<table>
<thead>
<tr>
<th>2007 Perioperative Guideline Recommendations</th>
<th>2009 Perioperative Focused Update Recommendations Class IIb</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)</td>
<td>1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)</td>
<td>2007 recommendation remains current in 2009 update.</td>
</tr>
<tr>
<td>2. Routine administration of high-dose beta blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta blockers who are undergoing noncardiac surgery.* (Level of Evidence: B)</td>
<td></td>
<td>New recommendation</td>
</tr>
</tbody>
</table>

*Clinical risk factors include history of ischemic heart disease, history of compensated or prior heart failure, history of cerebrovascular disease, diabetes mellitus, and renal insufficiency (defined in the Revised Cardiac Risk Index as a preoperative serum creatinine of >2 mg/dL)."
### Recommendations on β-blockers

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-Blockers are recommended in patients who have known IHD or myocardial ischaemia according to pre-operative stress testing</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>β-Blockers are recommended in patients scheduled for high-risk surgery</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Continuation of β-blockers is recommended in patients previously treated with β-blockers because of IHD, arrhythmias, or hypertension</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>β-Blockers should be considered for patients scheduled for intermediate-risk surgery</td>
<td>IIA</td>
<td>B</td>
</tr>
<tr>
<td>Continuation in patients previously treated with β-blockers because of chronic heart failure with systolic dysfunction should be considered</td>
<td>IIA</td>
<td>C</td>
</tr>
<tr>
<td>β-Blockers may be considered in patients scheduled for low-risk surgery with risk factor(s)</td>
<td>IIB</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative high-dose β-blockers without titration are not recommended</td>
<td>III</td>
<td>A</td>
</tr>
<tr>
<td>β-Blockers are not recommended in patients scheduled for low-risk surgery without risk factors</td>
<td>III</td>
<td>B</td>
</tr>
</tbody>
</table>

*"Treatment should be initiated optimally between 30 days and at least 1 week before surgery. Target: heart rate 60–70 beats/min, systolic blood pressure > 100 mmHg.*

*Class of recommendation.*

*Level of evidence.*

*IHD = ischaemic heart disease.*
The experts debate: Perioperative beta-blockade for noncardiac surgery—proven safe or not?
Program and Abstracts of the
7th Annual
Perioperative Medicine
Summit 2012
Using Evidence to Improve Quality,
Safety and Patient Outcomes

March 15-17, 2012
The Eden Roc Hotel
Miami Beach, Florida

http://periopmedicine.org/
Ample time for beta-blocker titration is key to stroke avoidance

**FIGURE 2.** Relationship between timing of beta-blocker initiation (relative to surgery) and stroke incidence in controlled trials of perioperative beta-blockade. The lower incidence of stroke among patients on titrated chronic beta-blocker therapy suggests that ample time for titration may be necessary to achieve an optimal, stable hemodynamic condition.
FIGURE 1. Pooled analysis of trials of perioperative beta-blockade shows no significant increase in perioperative stroke among studies using bisoprolol\textsuperscript{3,16,17} or atenolol,\textsuperscript{2} but pooled analysis of studies using metoprolol\textsuperscript{4,5,14,15} shows a significant excess of stroke driven largely by results from POISE.\textsuperscript{14} See text and References list for expansion of study abbreviations.
The reality of excess stroke with perioperative beta-blockers is consistent across all the trials. It does not mean that we cannot find another way to give beta-blockers safely, but if we want to establish safety, we need a large trial that unequivocally demonstrates safety, as opposed to simply using observational data, retrospective cohorts, or comparisons between two nonrandomized trials. Until we have large data sets, it is very difficult to say that we can give beta-blockers safely.

P. J. DEVEREAUX, MD, PhD
Associate Professor and Joint Member in Departments of Clinical Epidemiology & Biostatistics and Medicine (Cardiology), McMaster University, Hamilton, ON, Canada
Perioperative β-Blockers for Cardiac Risk Reduction
Time for Clarity
Contributing factors?

- Patient selection
- Timing of B Blockers
- Dosing of B Blockers
- Titration of B blockers
- What is goal? Reduction in MI, cardiac death, stroke, all cause mortality
Advice: Start early and titrate dose; continue chronic beta-blockade

My advice is as follows:

• If a patient is on chronic beta-blocker therapy, do not stop it perioperatively. We have seen devastating outcomes in the Netherlands when patients had their beta-blockers stopped immediately before surgery. Consider adjusting the dose, but do not stop it entirely. If a beta-blocker is on board and the patient develops hypotension or bradycardia during surgery, treat the symptoms and check for sepsis.

• In a patient not on a beta-blocker, consider adding one if the patient is at intermediate or high risk of a cardiac event, but start at a low dosage (i.e., 2.5 mg/day for bisoprolol and 25 mg/day for metoprolol). Treatment ideally should be started 30 days preoperatively; in the Netherlands, we have the chance to start well in advance of surgery so we can titrate the dose according to hemodynamics.

• If a beta-blocker is not started because of insufficient time for titration, do not add one to treat tachycardia that develops during surgery, since tachycardia may represent a response to normal defense mechanisms.
Case #10:
Focus:
Perioperative thromboembolic disease prevention
A 62-year-old woman with chronic renal insufficiency is evaluated the day after total hip replacement surgery for recommendations regarding prophylaxis for deep venous thrombosis (DVT).

She has recently begun walking again. While she was in surgery, graduated compression stockings were used for DVT prophylaxis. The patient is overweight (body mass index 35 kg/m$^2$) and has a creatinine level of 3.5 mg/dL.

Given that the patient has recently become ambulatory, which one of the following is the best approach to DVT prophylaxis?

A. Unfractionated heparin, 5000 U SC q 8 hours until hospital discharge

B. Fondaparinux, 2.5 mg/d SC for 10 days

C. Enoxaparin, 30 mg/d SC for 10 day

D. Warfarin with a target INR of 2.0 to 3.0 for 4 weeks

E. Dalteparin, 5000 U/d subcutaneously for 4 weeks
Patients who have hip or knee replacement or hip fracture surgery are at very high risk of developing venous thromboembolism in the perioperative period. Without prophylaxis, 40% to 60% of these patients will develop DVT.

The American College of Chest Physicians guidelines on prevention of venous thromboembolism, updated in 2008, recommend the use of LMWH (in a high-risk dose), fondaparinux, or adjusted-dose warfarin (INR, 2.0-3.0) for DVT prophylaxis in patients undergoing hip replacement surgery. The guidelines specifically advise against the use of aspirin, low-dose unfractionated heparin, compression stockings, or venous foot pumps as the sole method of DVT prophylaxis in this high-risk group of patients. The duration of thromboprophylaxis should be extended beyond 10 days and up to 35 days after surgery.

The use of LMWHs and fondaparinux can be difficult in patients with renal insufficiency because renal clearance is the primary mode of elimination.

**Clinical Pearls:**

Thromboprophylaxis should be extended beyond 10 days and up to 35 days after total hip or knee replacement surgery or hip fracture repair.

2. Avoid LMWHs and fondaparinux in patients with a creatinine clearance rate of less than 30 mL/ min.

Executive Summary*
American College of Chest Physicians
Evidence-Based Clinical Practice Guidelines
(8th Edition)

The Perioperative Management of Antithrombotic Therapy*
American College of Chest Physicians
Evidence-Based Clinical Practice Guidelines
(8th Edition)
3.5.3.1. For patients undergoing total hip replacement, total knee replacement, or hip fracture surgery, we recommend thromboprophylaxis with one of the recommended options for at least 10 days (Grade 1A).

3.5.3.2. For patients undergoing total hip replacement, we recommend that thromboprophylaxis be extended beyond 10 days and up to 35 days after surgery (Grade 1A). The recommended options for extended thromboprophylaxis in total hip replacement include LMWH (Grade 1A), a VKA (Grade 1B), or fondaparinux (Grade 1C).

3.5.3.3. For patients undergoing total knee replacement, we suggest that thromboprophylaxis be extended beyond 10 days and up to 35 days after surgery (Grade 2B). The recommended options for extended thromboprophylaxis in total knee replacement include LMWH (Grade 1C), a VKA (Grade 1C), or fondaparinux (Grade 1C).

3.5.3.4. For patients undergoing hip fracture surgery, we recommend that thromboprophylaxis be extended beyond 10 days and up to 35 days after surgery (Grade 1A). The recommended options for extended thromboprophylaxis in hip fracture surgery include fondaparinux (Grade 1A), LMWH (Grade 1C), or a VKA (Grade 1C).
Prevention of venous thromboembolism after surgery

KEY POINTS

Effective October 1, 2009, the Centers for Medicare and Medicaid Services is refusing to reimburse for hospital treatment of a primary diagnosis of deep vein thrombosis or pulmonary embolism following recent (within 30 days) hip or knee replacement surgery.
### Recommendations for thromboprophylaxis in orthopedic surgery from the latest ACCP guidelines

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Recommended options (grade*)</th>
<th>Duration of prophylaxis (grade*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hip replacement</td>
<td>LMWH, VKA†, or fondaparinux (1A for all)</td>
<td>10–35 days (1A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(typical patient, 28–30 days)</td>
</tr>
<tr>
<td>Hip fracture surgery</td>
<td>Fondaparinux (1A), LMWH (1B), VKA† (1B), or low-dose UFH (1B)</td>
<td>10–35 days (1A)</td>
</tr>
<tr>
<td>Total knee replacement</td>
<td>LMWH (1A), VKA† (1A), fondaparinux (1A), or intermittent pneumatic compression (1B)</td>
<td>10–35 days (2B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(typical patient, 10–14 days)</td>
</tr>
<tr>
<td>Arthroscopic knee surgery</td>
<td>In patients without risk factors, routine prophylaxis not recommended (2B)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In patients with risk factors or a complicated procedure, LMWH (1B)</td>
<td></td>
</tr>
<tr>
<td>Spine surgery</td>
<td>In patients without risk factors, routine prophylaxis not recommended (2C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In patients with risk factors, postoperative low-dose UFH (1B), postoperative LMWH (1B),</td>
<td></td>
</tr>
<tr>
<td></td>
<td>intermittent pneumatic compression (1B), or graduated compression stockings (2B)</td>
<td></td>
</tr>
</tbody>
</table>

*Guide to recommendation grades in the ACCP guidelines:

- **1A** = strong recommendation; high-quality evidence
- **1B** = strong recommendation; moderate-quality evidence
- **1C** = strong recommendation; low-quality or very-low-quality evidence
- **2B** = weak recommendation; moderate-quality evidence
- **2C** = weak recommendation; low-quality or very-low-quality evidence

†Dosed to an international normalized ratio of 2.0–3.0

ACCP = American College of Chest Physicians; LMWH = low-molecular-weight
Case #11:

**Focus:**
Preoperative Assessment in chronic liver disease patients
45 year old male with Hepatitis C and liver cirrhosis presents for pre-operative evaluation prior to an open cholecystectomy and hernia repair. His liver disease has caused him definite functional limitations. He has ascitis.

His labs are: Bilirubin: 2mg/ dL, Creatinine: 2mg/ dL, INR: 2.
He is in a compensated status and follows with GI in a regular basis.

What will you advise the patient regarding his surgery?

A. Patient may proceed with surgery.
B. Patient will need abdomen US and LFTs before a decision is made.
C. Patient may proceed with surgery as long as anesthesia is aware of his liver disease and adjust medications.
D. Patient should be advised that he has a mortality probability of 25% within 30 days of surgery and close to 50% in a year postoperatively.
Perioperative considerations for patients with liver disease

**FIGURE 1.** Natural history of chronic liver disease.

Chronic liver disease → Compensated cirrhosis → Decompensated cirrhosis → Death

Development of complications:
- Variceal hemorrhage
- Ascites
- Encephalopathy
- Jaundice

**TABLE 1**
Factors independently predictive of complications and mortality in cirrhotic patients undergoing surgery*

<table>
<thead>
<tr>
<th>Predictors of complications</th>
<th>Predictors of mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child-Pugh class B or C</td>
<td>Male gender</td>
</tr>
<tr>
<td>Ascites</td>
<td>Child-Pugh class B or C</td>
</tr>
<tr>
<td>Etiology of cirrhosis other than primary biliary cirrhosis</td>
<td>Etiology of cirrhosis other than primary biliary cirrhosis</td>
</tr>
<tr>
<td>Elevated creatinine</td>
<td>Ascites</td>
</tr>
<tr>
<td>Preoperative infection</td>
<td>Preoperative infection</td>
</tr>
<tr>
<td>COPD</td>
<td>Respiratory surgery</td>
</tr>
<tr>
<td>Preoperative upper GI bleeding</td>
<td>ASA physical status of 4–5</td>
</tr>
<tr>
<td>Invasiveness of surgical procedure</td>
<td></td>
</tr>
<tr>
<td>Intraoperative hypotension</td>
<td></td>
</tr>
</tbody>
</table>

* Debate continues on the optimal approach to managing these patients before surgery.
Model of End Stage Liver Disease (MELD) scores predict postoperative mortality in cirrhotics

- MELD Score calculation provides an objective scoring system for postoperative mortality in cirrhotic patients that can guide preoperative decision making:
Case #12:

**Focus:**
**Preoperative management of anemia**
42 year old female patient with large fibroids is undergoing evaluation for hysterectomy due to menorrhagia.
Her past medical history includes arthritis, HTN and sleep apnea.
Her lab results are consistent with microcytic anemia (Hb-7.9 gm/dl) and normal creatinine.
Her surgery is 3 weeks away

What do you recommend regarding her anemia?

A. PO iron
B. IV iron
C. Epo with Iron
D. Preoperative Blood Transfusion
Morbidity and mortality risk associated with red blood cell and blood-component transfusion in isolated coronary artery bypass grafting

Objective: Our objective was to quantify incremental risk associated with transfusion of packed red blood cells and other blood components on morbidity after coronary artery bypass grafting. Design: The study design was an observational cohort study. Setting: This investigation took place at a large tertiary care referral center. Patients: A total of 11,963 patients who underwent isolated coronary artery bypass from January 1, 1995, through July 1, 2002. Interventions: None. Measurements and Main Results: Among the 11,963 patients who underwent isolated coronary artery bypass grafting, 5,814 (48.6%) were transfused. Risk-adjusted probability of developing in-hospital mortality and morbidity as a function of red blood cell and blood-component transfusion was modeled using logistic regression. Transfusion of red blood cells was associated with a risk-adjusted increased risk for every postoperative morbid event: mortality (odds ratio [OR], 1.77; 95% confidence interval [CI], 1.67–1.87; p < .0001), renal failure (OR, 2.06; 95% CI, 1.87–2.27; p < .0001), prolonged ventilatory support (OR, 1.79; 95% CI, 1.72–1.86; p < .0001), serious infection (OR, 1.76; 95% CI, 1.68–1.84; p < .0001), cardiac complications (OR, 1.55; 95% CI, 1.47–1.63; p < .0001), and neurologic events (OR, 1.37; 95% CI, 1.30–1.44; p < .0001).

Conclusions: Perioperative red blood cell transfusion is the single factor most reliably associated with increased risk of postoperative morbid events after isolated coronary artery bypass grafting. Each unit of red cells transfused is associated with incrementally increased risk for adverse outcome. (Crit Care Med 2006; 34:1608–1616)

Key Words: blood cells; hemoglobin; complications; cardiopulmonary bypass; cardiovascular disease; mortality
Risks of perioperative anemia:

- **Preoperative Hb concentration <8 g/dL is associated with a 16-fold increase in mortality**
  

- **Increased risk of death**
  

- **Increased risk of cardiac events**
  

- **Increased risk of pneumonia**
  

- **Increased post-op delirium**
  
Anemia is a potent multiplier of morbidity and mortality risk, including in the perioperative setting.

The Joint Commission plans to implement a performance measure on blood management in the near future.

While the safety of the blood supply has improved markedly from the standpoint of infection transmission, other risks from transfusion persist, including transfusion-related acute lung injury and emerging infections.

The preoperative evaluation should elicit a history of bleeding tendencies, previous transfusions, and symptoms of anemia. Medications should be reviewed with an eye toward those that may need to be stopped to avoid a predisposition to bleeding (e.g., antiplatelets, anticoagulants).

Use of ESAs minimizes the need for blood transfusion in patients undergoing orthopedic and other surgeries, but they raise the risk of thromboembolism in the absence of prophylactic anticoagulation.
How to manage anemia perioperatively?

- Key is to identify prior to surgery (Key performance measure)
- Identify cause and correct
- Use Iron if needed (Oral or IV)
- Evaluate for Erythropoiesis-stimulating agent.
- Limit blood transfusions.
**Preoperative anemia protocol for patients undergoing major joint replacement**

- Patient seen at least 6–8 weeks before planned elective hip or knee replacement surgery.
  - If hemoglobin at orthopedic office < 13 g/dL, anemia panel requested
    (anemia panel: iron, ferritin, total iron-binding capacity, vitamin B₁₂, RBC folate).

**Hemoglobin between 10 and 13 g/dL**

- **Macrocytic anemia** (MCV > 100 fl)
  - or
  - **Microcytic anemia** (MCV < 80 fl)
    - Treat B₁₂ or folate deficiency if found
    - or
    - Refer for hematology work-up

- **Normocytic anemia** (MCV 80–100 fl)
  - Patient is referred for epoetin alfa injections and oral iron (ferrous sulfate 325 mg tid).
  - Epoetin alfa (600 U/kg subcutaneously) given as 4 injections (approximately 21, 14, and 7 days before surgery, and on day of surgery).
  - Lab tests on days of epoetin alfa injection:
    - Hemoglobin and reticulocyte count at each visit
    - Labs sent to designated IMPACT Center staff or nurse practitioner
    - Nonresponders: refer to hematology department

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* Exclusion criteria: Predonation of blood; hemoglobin < 10 g/dL; iron-deficiency anemia; recent gastrointestinal bleed (< 3 months); uncontrolled hypertension (systolic > 180 and diastolic > 100 mm Hg); seizure disorder; blood dyscrasias; known history of thromboembolism; contraindication to pharmacologic VTE prophylaxis

RBC = red blood cell; MCV = mean corpuscular volume; VTE = venous thromboembolism

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**FIGURE 2.** Cleveland Clinic’s anemia protocol for patients undergoing major joint replacement surgery. Management starts with an assessment of hemoglobin 6 to 8 weeks before the planned procedure. Decision points are based on red blood cell indices.
Picture of an amputation in the operating theatre of old Saint Thomas Hospital, London, around 1775
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