Perioperative Medicine AHD

Case # 1

A 48 yo male has been admitted with an ankle fracture suffered during a soccer game. Ortho has consulted you for medical clearance prior to surgery. You review his chart to find he has a PMH of HTN and HLD and is on lisinopril and atorvastatin. Labs including a renal panel and CBC on admission are normal.

Can you clear a patient for surgery?
We can estimate risk of major adverse cardiac events and engage in shared decision making with patient. We cannot "clear" patients for surgery.

Describe the focused history and exam you will obtain
History and exam will focus on signs / symptoms of active cardiac conditions, functional status, and elements of RCRI.

- Coronary artery disease - exertional chest pain, anginal equivalents, dyspnea
- Arrythmia - palpitations, dyspnea
- Valvular heart disease - murmur, dyspnea
- Heart failure - PND, orthopnea, rales, extra heart sounds, edema, JVD
- Functional status - >= 4 METs
    - Study that 2014 ACC/AHA guideline uses to support use of functional status in algorithm defines "poor exercise tolerance" as inability to walk 4 blocks or climb 2 flights of stairs.
    - Reilly, Dominic F., et al. "Self-reported exercise tolerance and the risk of serious perioperative complications." Archives of internal medicine 159.18 (1999): 2185-2192.

This patient has "good" exercise tolerance and no symptoms consistent with an active cardiac condition

How do you advise the patient and your surgical colleagues?
This patient has a < 1% risk of MACE and you do not recommend any additional cardiac testing prior to surgery.

What do you consider to be a low or high risk of MACE? Compare with other group members.

- 2014 ACC/AHA definitions: low risk if < 1%, otherwise "elevated" risk
- Best to avoid use of "low" "Intermediate" "high" when discussing with patients and consultants, people have dramatically different definitions of these terms.

Taher T, Khan NA, Devereaux PJ, Fisher BW, Ghali WA, McAlister FA. Assessment and reporting of perioperative cardiac risk by Canadian general internists: art or science? J Gen Intern Med 2002;17:933-6.

What risk factors for major adverse cardiac events do you think are missing from the RCRI?
Point here is that the algorithm and RCRI are not comprehensive tools.

- Recency of acute coronary syndrome
    - A study using discharge summaries demonstrated that the postoperative MI rate decreased substantially as the length of time from MI to operation increased (0 to 30 days - 32.8%; 31 to 60 days - 18.7%; 61 to 90 days - 8.4%; and 91 to 180 days - 5.9%),
    - Livhits M, Ko CY, Leonardi MJ, et al. Risk of surgery following recent myocardial infarction. Ann Surg. 2011;253:857–64.
- Severely depressed left ventricular ejection fraction (< 30%)
    - "Survival after surgery for those with a LVEF ≤ 29% is significantly worse than for those with a LVEF>29%"
    - Kazmers A, Cerqueira MD, Zierler RE. Perioperative and late outcome in patients with left ventricular ejection fraction of 35% or less who require major vascular surgery. J Vasc Surg. 1988;8:307–15.
- Cardiomyopathy (restrictive, peripartum, etc.)

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- Severe valvular heart disease
- Pulmonary hypertension
- Adult congenital heart disease
- Duration of anesthesia and procedure

Case #2

A 63 yo male has been admitted with a fracture of the humerus after he slipped on icy steps. Ortho has consulted you for medical clearance prior to surgery. You review his chart to find he has a PMH of HTN, HLD, type II DM, and CKD. He is a current smoker and has a 50 pack year history of smoking. His meds Include valsartan, atorvastatin, and insulin. The patient walks 6 blocks from his bus stop to his office building in the mornings and goes up 2 flights of stairs to get to his office. His review of systems is negative.

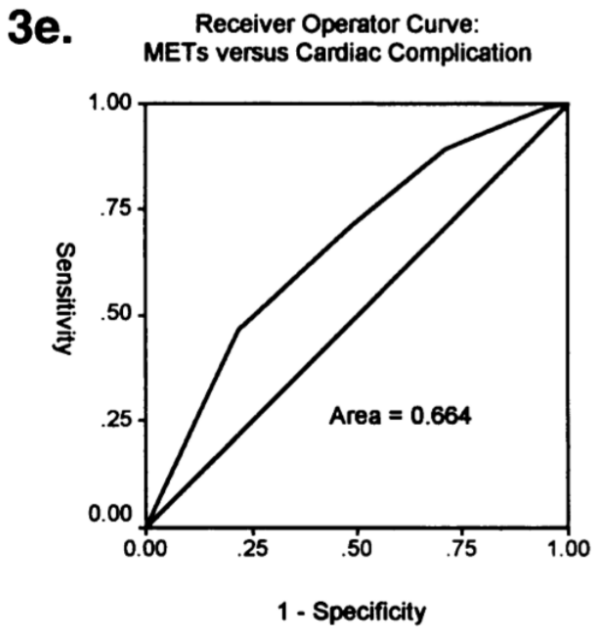
Vitals and exam are unremarkable except for bruising over high left proximal arm and ROM limited by pain. Labs show a creatinine at baseline of 2.1.

How do you advise the patient and the surgical teams?

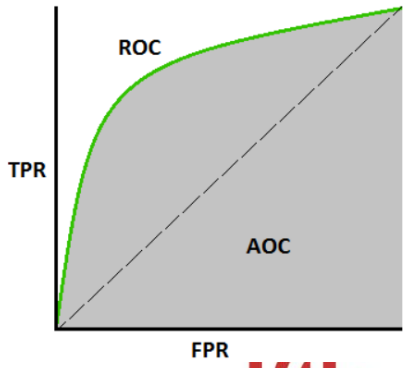
Risk of MACE of MACE is 6.6%, but functional capacity suggests there are no active cardiac conditions that should be investigated. Recommend proceeding with surgery without an additional testing.

From 2014 ACC/AHA guideline: CLASS IIb - For patients with elevated risk and moderate to good (>=4METs to 10 METs) functional capacity, it may be reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery (Level of Evidence: B).

As we discussed, the Canadian Cardiovascular Society guideline does not recommend subjective functional status assessment as part of perioperative cardiac risk assessment. In the study referenced below, METs were estimated for nearly 6000 inpatients who were admitted for elective, noncardiac surgery. Receiver operator characteristic curves were constructed to graphically demonstrate the sensitivity and specificity of METs for cardiac complications and death. Does this study support the conclusion of the ACC/AHA guideline or the CCS guideline?



A receiver operator curve plots sensitivity (or true positive rate) vs. 1 - specificity (or false positive rate). In our case, it is a graphical demonstration of how well subjectively assessed METs can distinguish between patients who will have cardiac complications and those who won't. An IDEAL test will have a higher TPR and lower FPR, so a better ROC curve would look like this:



In other words, an IDEAL test has an AUC (area under curve) that approaches 1. A test that cannot distinguish between the two groups would have an AUC of 0.5. This study is cited by the CCS guideline in support of their conclusion.

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Wiklund RA, Stein HD, Rosenbaum SH. Activities of daily living and cardiovascular complications following elective, noncardiac surgery. Yale JBiol Med 2001;74:75-87.

A subsequent study published in 2018 (referenced below) concluded that subjectively assessed preoperative functional capacity had no significant adjusted association death or major post-operative complications, whereas scores on the Duke Activity Status Index DID have an adjusted association with those outcomes. Take a look at the DASI. Is it practical? Do you think the next ACC/AHA guideline will change its recommendation with respect to functional status assessment?
Evidence favors using DASI score over less formal subjective assessments.

Wijeysundera, Duminda N., et al. "Assessment of functional capacity before major non-cardiac surgery: an international, prospective cohort study." The Lancet 391.10140 (2018): 2631-2640.

Would you recommend obtaining an ECG in this patient prior to surgery?
Per 2014 ACC/AHA guideline:

- "Reasonable" to get pre-op ECG in patient with known CAD, arrhythmia, or know atherosclerotic disease
- "May be considered" except if risk of MACE Is low
- Advise against routine ECG if risk of MACE is low

This patient uses 15 units of glargine nightly and 5 units of Humalog with meals. Will you adjust his insulin prior to surgery?
General principle: hold prandial insulin, reduce long-acting to 1/2 to 2/3s of normal dose.

Case #3
A 67 yo male with a PMH significant for HTN, type II DM, and ischemic stroke 4 years ago has been admitted for repair of an AAA. He is non-ambulatory and lives with his wife who is his caretaker. He has a 63 pack year history of smoking (quit after stroke). He is on amlodipine, Insulin, aspirin, atorvastatin, and fiber supplements. Cardiopulmonary ROS is negative.

Vitals are normal. Patient is non-ambulatory. Labs on admission are unremarkable.

General surgery has consulted medicine for clearance prior to proceeding with AAA repair. What do you discuss with the patient and the surgical team?

- RCRI predicts a high risk of MACE
- Cannot assess functional status
- Further risk stratification can be performed with a stress test

As you advised, a pharmacologic stress test is performed and is positive with regions of inducible ischemia. Will revascularization reduce this patient's risk of MACE?

Let's take a look at the CARP trial (Coronary-Artery Revascularization before Elective Major Vascular Surgery)

Clinical question: In patients with stable CAD undergoing major elective vascular surgery, is there a mortality benefit in preoperative coronary artery revascularization?

Methods: 510 patients scheduled for elective vascular surgery (without left main disease, LVEF < 20%, or severe aortic stenosis) were randomized to either preoperative revascularization (PCI or CABG) vs. no revascularization.

Results: After a median of 2.7 years, there was no difference in the primary outcome of long-term mortality (22% vs. 23% P=0.92). In addition, there was no difference in 30-day postoperative outcomes such as death, MI, stroke, reoperation and LOS.

So will revascularization reduce this patient's risk of MACE?

- Revascularization is warranted if there are OTHER indications for it other than just surgery
- Evidence suggests that in the absence of other indications, revascularization does not lower risk of MACE
- Ultimately whether this patient proceeds to left heart cath would require a discussion with cardiology and depends on the ischemic regions on the stress test

<u>ACC/AHA guideline on perioperative CV evaluation and management of patients undergoing noncardiac surgery (2014, adapted)</u>

- Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing clinical practice guidelines (Class I, level C)
- It is not recommended that routine coronary revascularization be performed before noncardiac surgery exclusively to reduce perioperative CV events (Class III, level B)

Case #4

A 61-year-old man is seen for preoperative evaluation before left total hip arthroplasty scheduled in 2 weeks. In addition to chronic left hip pain, his medical history is notable for CAD s/p PCI 5 months ago. TTE at the time revealed a normal LVEF and no structural heart disease. His physical activity is extremely limited due to hip pain, but he denies angina, dyspnea, palpitations, and syncope.

PMHx: CAD, HTN, HLD, OA
Rx: aspirin, clopidogrel, carvedilol, atorvastatin, and Lisinopril
PE: BP of 126/76, pulse of 64. Cardiopulmonary exam is normal.

Surgery has asked if this patient can stop his dual antiplatelet therapy prior to surgery. What do you advise?

- Inadequate information presented so far. Essentials to make this decision are:
  - Why was PCI performed (ACS vs stable ischemic heart disease)?
  - When was PCI performed?
  - What sort of stent was placed?

This patient had a DES stent placed in LAD 5 months ago for an NSTEMI

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Since this patient received stent for ACS, would recommend at least 12 months of uninterrupted DAPT. Would recommend delaying elective surgery.

What if the stent had been placed for chronic angina that was not adequately responding to medical therapy?

> 6 months of DAPT "would be reasonable"

Case #5

Below are some indications for anticoagulation. These patients' thrombotic risk can range from low to high. Try to give some examples of each risk category.

	Mechanical valves	Atrial fibrillation	VTE
High			
Intermediate			
Low			

The table below is from a 2015 JACC review article. Afib risk stratification has since been updated in a 2017 "Expert consensus" statement below

TABLE 1 Risk Stratification for Perioperative Thromboembolism as Suggested by ACCP

	Indication for Anticoagulation		
Risk Group	**Mechanical Heart Valve**	**Atrial Fibrillation**	**VTE**
High*	• Mitral valve prosthesis • Cage-ball or tilting disc aortic valve prosthesis • CVA/TIA <6 months prior	• $CHADS_2$ score 5 or 6 • CVA/TIA <3 months prior • Rheumatic valvular heart disease	• VTE <3 months prior • Severe thrombophilia†
Moderate	• Bileaflet aortic valve and other risk factors‡	• $CHADS_2$ score 3 or 4	• VTE 3-12 months prior • Nonsevere thrombophilia§ • Recurrent VTE • Active cancer
Low	• Bileaflet aortic valve *without* other risk factors	• $CHADS_2$ score 2 or less without prior CVA/TIA	• VTE >12 months prior without other risk factors

2 Assess patient thrombotic risk definitions:

Low:

CHA_2DS_2-VASc 1-4 (annualized stroke risk <5%), no prior TE

Moderate:

CHA_2DS_2-VASc 5-6 (annualized stroke risk 5-10%) or prior TE more than 3 months previously

High:

CHA_2DS_2-VASc 7+ (annualized stroke risk >10%) or prior TE within 3 months

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Case #5
A 68-year-old male is seen for preoperative evaluation prior to repair of an abdominal aortic aneurysm in 2 weeks. He has been in good health. He exercises on an elliptical for 30 minutes daily. He denies angina, dyspnea, palpitations, and syncope.

PMHx: atrial fibrillation, HTN
Meds: warfarin, amlodipine, atorvastatin, multivitamin

PE: BP 124/72, pulse is 60. Cardiovascular examination reveals a irregular rhythm, normal s1/s2.
INR from 3 days ago is within therapeutic range
ECG 2 months prior revealed atrial fibrillation with no other abnormalities
TTE 2 months prior revealed normal left ventricular function

What do you do with this patient's anticoagulation?

- Emphasis is on procedural bleeding vs. thrombosis risk
- Key decisions
    - What is procedural bleeding risk?
    - What is risk of thrombosis if anticoagulation is held?
    - If anti-coagulation is to be held, when should it be held?
    - Should patient be bridged while oral anticoagulant is held?

- CHA2DS2-VASc score of 2 for this patient, so low thrombotic risk
- AAA repair at high bleeding risk
- <u>Interrupt anticoagulation</u>

Will bridging be necessary? No

Same case, but patient has a prosthetic mitral valve. What do you do?
Interrupt anti-coagulation, bridge

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Case #6

How might initiation of beta-blockers affect perioperative risk of MACE?

Reduction of myocardial oxygen demand may reduce MI. Beta-blockers may also reduce incidence of post-operative arrhythmias.

What do you think are the risks of perioperative beta-blockers?

Open discussion, but hopefully some mention of: Hypotension and bradycardia with subsequent hypoperfusion and stroke.

Let's take a look at the POISE trial:

Clinical question: In patients undergoing non-cardiac surgery, does the use of perioperative beta-blockers reduce the risk of CV events or death?

Methods: ~8,400 patients > 45 yo undergoing non-cardiac surgery but at elevated risk for MACE were randomized to initiation of beta-blockers or placebo several hours prior to surgery (initial dose 100 mg metoprolol succinate).

Results:

Primary Outcomes

Composite of CV death, non-fatal MI, and non-fatal cardiac arrest at 30 days

5.8% vs. 6.9% (HR 0.84; 95% CI 0.70-0.99; P=0.0399)

Secondary Outcomes

CV death

1.8% vs. 1.4% (HR 1.30; 95% CI 0.92-1.83; P=0.1368)

Non-fatal MI

3.6% vs. 5.1% (HR 0.70; 95% CI 0.57-0.86; P=0.0008)

Non-fatal cardiac arrest

0.5% in both groups (p=NS)

Any MI

4.2% vs. 5.7% (HR 0.73; 95% CI 0.60-0.89; P=0.0017)

Death

3.1% vs. 2.3% (HR 1.33; 95% CI 1.03-1.74; P=0.0317)

Stroke

1.0% vs. 0.5% (HR 2.17; 95% CI 1.26-3.74; P=0.0053)

EBM tips:

- Hazard ratios: Hazard ratio represents the instantaneous event rate, which means the probability that an individual would experience an event
- Confidence interval: the range of values that is likely to include the true population value. If the confidence interval includes 1, then the hazard ratio is not significant.

Summarize the results above

Although metoprolol reduced the risk of perioperative MI among patients undergoing non-cardiac surgery, metoprolol was also associated with a higher rate of mortality and strokes.

Conclusion of the authors: "Our post-hoc multivariate analyses suggest that clinically significant hypotension, bradycardia, and stroke explain how β blockers increased the risk of death in this trial."

POISE Study Group. "Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial." The Lancet 371.9627 (2008): 1839-1847.

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A 58 year old female with a PMH significant for HTN, HLD, type II DM, tobacco use, and CKD is seen for preoperative evaluation prior to a planned hysterectomy in 2 weeks. She is employed as a postal carrier and ambulates 6 miles a day along her route. Cardiopulmonary ROS is negative.

Meds: Lisinopril, amlodipine, glargine, lispro, and atorvastatin

Vitals and labs are normal.
Lab work from last week reveals a baseline serum creatinine of 2.5.

What is you're assessment of his cardiac risk? Is any additional testing needed?

- Calculate RCRI score: 3 points = Class III (1 point for high-risk surgical procedure: intraperitoneal; 1 point for preoperative treatment with insulin, 1 point for preoperative serum creatinine >2.0) = 11% Risk of MACE
- Displays good functional capacity (able to complete >4 METs)
- Recommend proceeding to surgery without other cardiac testing.

Should we start a beta-blocker for this patient prior to surgery to reduce his risk of myocardial Infarction?
"It may be reasonable." ACC/AHA recommendations with respect to beta-blockers:

- In patients with 3 or more RCRI risk factors (e.g., diabetes mellitus, HF, CAD, renal insufficiency, cerebrovascular accident), it may be reasonable to begin beta blockers before surgery (class IIb LOE: B)

- In patients with a compelling long-term indication for beta-blocker therapy but no other RCRI risk factors, initiating beta blockers in the perioperative setting as an approach to reduce perioperative risk is of uncertain benefit (class IIb LOE: B)

- In patients in whom beta-blocker therapy is initiated, it may be reasonable to begin perioperative beta blockers long enough in advance to assess safety and tolerability, preferably more than 1 day before surgery (class IIb LOE: B)

- <u>Beta-blocker therapy should not be started on the day of surgery. (Class III, harmful; Level of Evidence: B)</u>

The 2014 ACC/AHA guideline also makes a Class IIa LOE: B recommendation that "It is reasonable for the management of beta blockers after surgery to be guided by clinical circumstances, independent of when the agent was started." What does this recommendation mean?

Hemodynamics must take priority in the perioperative period regardless of when beta-blockers were started. While they may protect against MIs, we must first avoid the harm that hypotension, bradycardia, and hypoperfusion can cause.

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