Brigham and Women's Hospital
Founding Member, Mass General Brigham

Current and Emerging Concepts for Preoperative Evaluation

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CONTINUING MEDICAL EDUCATION
DEPARTMENT OF MEDICINE

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Disclosures

- I have no financial disclosures

Learning Objectives

- Review the key perioperative guidelines
- Go through the major risk assessment tools
- Detail some perioperative considerations in specific patient populations
- Discuss important recent studies in perioperative medicine

Clinical Case

- 76-year-old male with severe COPD, on 3 L of home O_2 and chronic prednisone 7.5 mg daily, DMII on metformin, dyspnea with minimal exertion.
- No history of MI or CHF. His EKG is essentially normal.
- He has metastatic colon cancer, with a single metastasis to the brain causing left arm weakness
- You are seeing him in consultation prior to neurosurgery scheduled 48 h from now to resect the metastasis
- He underwent successful resection of a colon mass 3 years ago

Introduction

- The role of the clinician performing preoperative evaluation is **not** to provide medical "clearance" prior to surgery
- Instead, the clinician should:
  - Assess the patient's cardiac and other risks going into the procedure
  - Decide whether additional preoperative testing, such as a cardiac stress test, is needed
  - When indicated, recommend measures to reduce perioperative risk, such as beta blockers and statins
  - Assist the surgeon in deciding whether the benefits of the surgery outweigh the risks

The Current Periop Guidelines were Published in 2014

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association®

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Lee A. Fleisher, Kirsten E. Fleischmann, Andrew D. Auerbach, Susan A. Barnason, Joshua A. Beckman, Biykem Bozkurt, Victor G. Davila-Roman, Marie D. Gerhard-Herman, Thomas A. Holly, Garvan C. Kane, Joseph E. Marine, M. Timothy Nelson, Crystal C. Spencer, Annemarie Thompson, Henry H. Ting, Barry F. Uretsky and Duminda N. Wijeysundera

Circulation. published online August 1, 2014;
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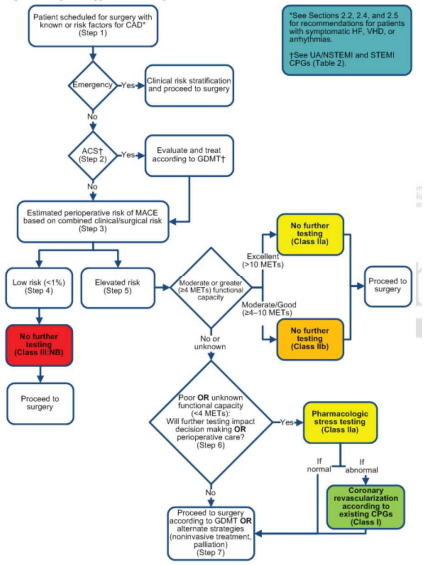
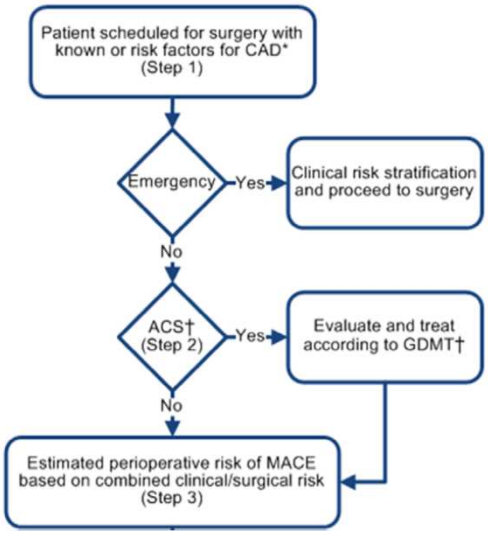
ACC/AHA 2014 Periop Guidelines

Figure 1. Stepwise Approach to Perioperative Cardiac Assessment for CAD



Source: Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management...Circulation. 2014 Dec 9;130(24):e278-333.

ACC/AHA 2014 Periop Guidelines



Source: Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management...Circulation. 2014 Dec 9;130(24):e278-333.

Risk Assessment in the 2014 Guidelines

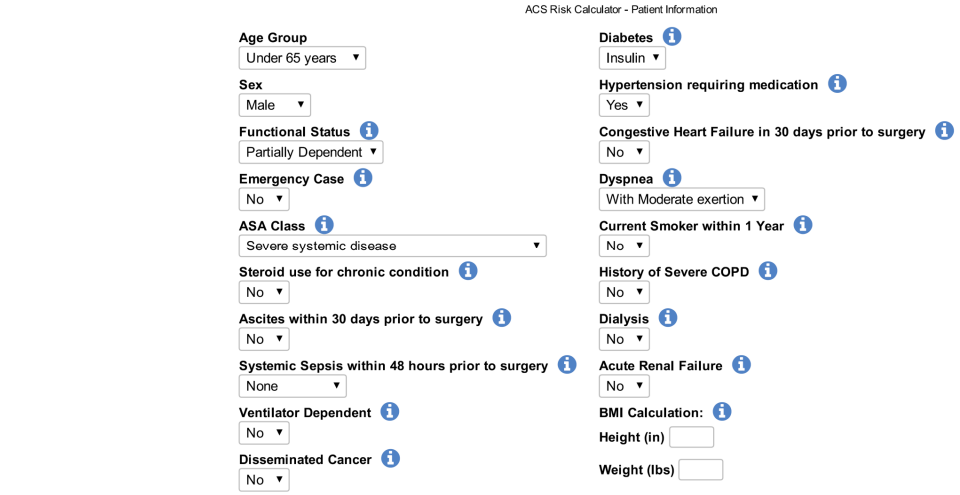
- For risk assessment, the 2014 guidelines recommend estimating the preoperative risk of a major adverse cardiac event (MACE), which here is defined as death or MI
- The risk of MACE is a function of both the risk associated with the procedure and the risk associated with the patient
- If there is a low risk of MACE, which is defined as < 1%, then one goes to surgery

Risk Assessment in the 2014 Guidelines

The guidelines suggest three ways to determine if the MACE risk is ≥ 1%:

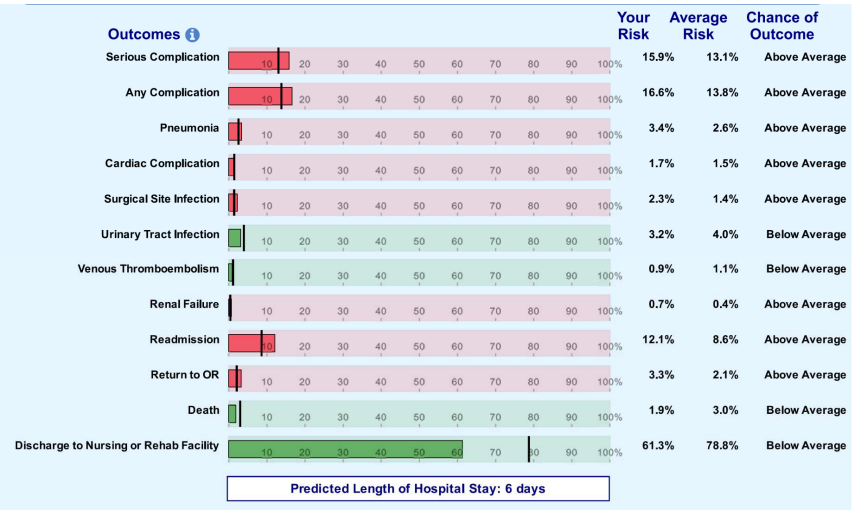
1. ACS NSQIP Surgical Risk Calculator (http://www.riskcalculator.facs.org/)
2. Perioperative Cardiac Risk Calculator (http://www.surgicalriskcalculator.com/miorcardiacarrest)
3. RCRI score (though one of the two options above is preferred because they outperform the RCRI score)

ACS NSQIP Surgical Risk Calculator



Source: Cohen ME, Ko CY, Bilimoria KY, et al. Optimizing ACS NSQIP modeling for evaluation of surgical quality and risk: .... Journal of the American College of Surgeons. Aug 2013;217(2):336-346.e331.

ACS NSQIP Surgical Risk Calculator



Source: Cohen ME, Ko CY, Bilimoria KY, et al. Optimizing ACS NSQIP modeling for evaluation of surgical quality and risk: .... Journal of the American College of Surgeons. Aug 2013;217(2):336-346.e331.

Perioperative Cardiac Risk Calculator

Estimate risk of perioperative myocardial infarction or cardiac arrest.

Age

Creatinine <1.5 mg/dL / 133 µmol/L

ASA Class ASA 1

ASA 1 = Normal healthy patient
ASA 2 = Patients with mild systemic disease
ASA 3 = Patients with severe systemic disease
ASA 4 = Patients with severe systemic disease that is a constant threat to life
ASA 5 = Moribund patients who are not expected to survive without the operation

Preoperative Function Totally Independent

Procedure Anorectal

Submit

Source: Gupta PK, Gupta H, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. Circulation. Jul 26 2011;124(4):381-387.

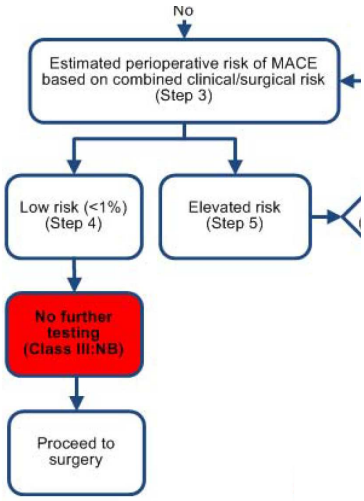
Revised Cardiac Risk Index

Risk Factor	Definition
1. High-risk type of surgery	**Intraperitoneal, intrathoracic, or suprainguinal vascular procedures**
2. Ischemic heart disease	**History of MI, positive stress test, current cardiac CP, nitrate usage, ECG with pathologic Q waves**
3. History of congestive heart failure	**History of CHF, pulmonary edema, or PND; rales or S3 on exam; chest x-ray with pulmonary edema**
4. History of cerebrovascular disease	**History of transient ischemic attack or stroke**
5. Insulin therapy for diabetes	
6. Preoperative serum creatinine > 2.0 mg/dL	

- "A patient with 0 or 1 [RCRI] predictor(s) of risk would have a low risk of MACE. Patients with ≥ 2 predictors of risk would have elevated risk."

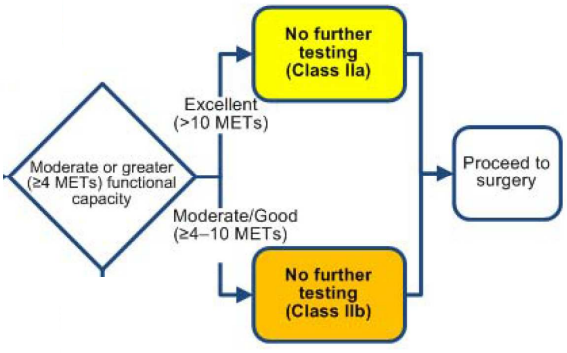
Sources: Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation.* Sep 7 1999;100(10):1043-1049.
Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management...Circulation. 2014 Dec 9;130(24):e278-333.

ACC/AHA 2014 Periop Guidelines



- Under the guidelines, if your risk of MACE is low (< 1%), then you go to surgery
- If you risk is elevated (≥ 1%), then you consider the patient's functional capacity

ACC/AHA 2014 Periop Guidelines



- If your functional capacity is ≥ 4 METs, then you proceed to surgery

Duke Activity Status Index

1. Take care of yourself by eating, dressing, bathing, toileting (2.75)
2. Walk indoors, such as around your house (1.75)
3. Walk a block or 2 on level ground (2.75)
4. Climb a flight of stairs or walk up hill (5.50)
5. Run a short distance (8.00)
6. Do light housework, such as dusting or washing dishes (2.70)
7. Do moderate housework, such as vacuuming, sweeping, or carrying groceries (3.50)
8. Do heavy housework, such as scrubbing floors or moving heavy furniture (8.00)
9. Do yard work, such as raking, weeding, or pushing a power mower (4.50)
10. Have sexual relations (5.25)
11. Moderate recreation, such as golf, bowling, dance, doubles tennis (6.00)
12. Strenuous sports, such as swimming, singles tennis, football, basketball (7.50)

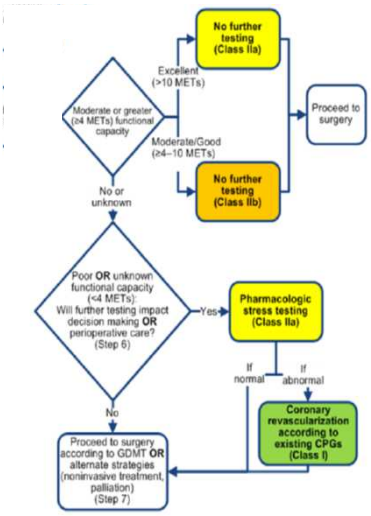
Source: Hlatky MA, et al. A brief self-administered questionnaire … (the Duke Activity Status Index). The American Journal of Cardiology. 1989;64(10):651-654.

Duke Activity Status Index

- Methods to use the DASI:
  - Online METs calculators based on DASI
    - E.g.: https://www.mdcalc.com/calc/3910/duke-activity-status-index-dasi
  - DASI scores > 34 are associated with a reduced risk of 30-d death or MI

Source: Wijeysundera, et al. Integration of the Duke Activity Status Index into preoperative risk evaluation …. Br J Anaesth. 2020;124(3):261-270.

ACC/AHA 2014 Periop Guidelines

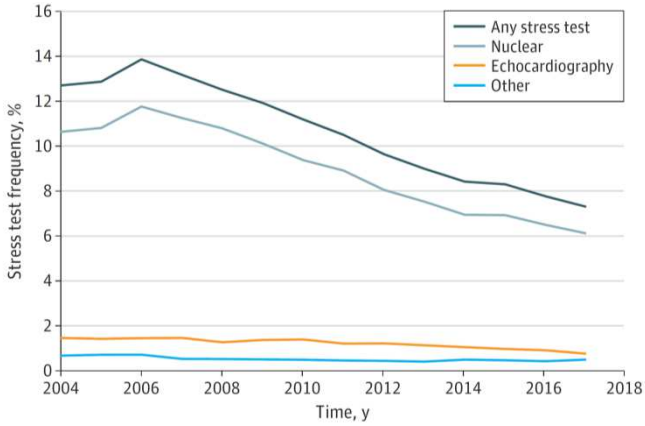


- If your functional capacity is < 4 METs, then consider pharmacologic stress testing, **if it will change management**

Preop Stress Tests Use is Declining

801,396 elective total hip or total knee arthroplasty patients

B Type of preoperative stress test performed 2004-2017



Year	RCRI, No./total No. (%) 0
2004	1636/3659 (44.7)
2005	2393/5268 (45.4)
2006	2323/4966 (46.8)
2007	2644/5414 (48.8)
2008	2763/5670 (48.7)
2009	2992/6003 (49.8)
2010	2865/5710 (50.2)
2011	3506/6980 (50.2)
2012	3315/6514 (50.9)
2013	2674/5414 (49.4)
2014	2843/5606 (50.7)
2015	2013/4117 (48.9)
2016	1790/3552 (50.4)
2017	1594/3032 (52.6)
Total	35 351/71 905 (49.2)

Source: Rubin DS et al. frequency and outcomes of preoperative stress testing in total hip and knee arthroplasty from 2004 to 2017. JAMA Cardiol. 2021 Jan 1;6(1):13-20.

The New York Times

PERSONAL HEALTH

Planning for Surgery? You Might Not Need All Those Tests Beforehand.

Cardiac stress tests, X-rays and other medical tests may not provide useful information before operations, and they could cause harm.

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Rachel Levit Ruiz

By Jane E. Brody

Nov. 15, 2021

Preoperative ECGs in the 2014 ACC/AHA Guidelines

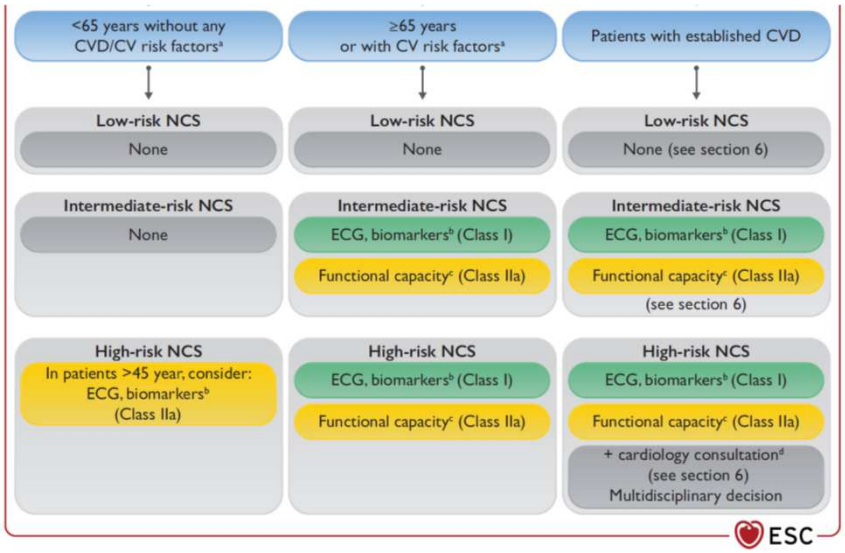
- Class IIa: Preop resting 12-lead ECG is reasonable for patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease, except for those undergoing low-risk surgery
- Class IIb: Preop resting 12-lead ECG may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery
- Class III: Routine preop resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures

Perioperative Troponin Measurements in High-Risk Patients without Symptoms

- 2014 ACC/AHA Guidelines: “The usefulness of postoperative screening with troponin levels in patients at high risk for perioperative MI but without signs or symptoms suggestive of myocardial ischemia or MI is uncertain”
- 2018 European Society of Anaesthesiology Guidelines: “We suggest considering assessment of cardiac troponins in high-risk patients, both before and 48 to 72 h after major surgery”

Source: Smilowitz NR, Berger JS. Perioperative Cardiovascular Risk Assessment and Management for Noncardiac Surgery: A Review. JAMA. 2020 Jul 21;324(3):279-290.

Perioperative Troponin Measurements in High-Risk Patients without Symptoms: 2022 ESC Guidelines



Source: Halvorsen S, et al. ESC Scientific Document Group. 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery. Eur Heart J. 2022 Oct 14;43(39):3826-3924.

Perioperative Troponin Measurements in High-Risk Patients without Symptoms

- Key question: will the troponin measurement change your management?
  - For example, will this information cause you to add an ASA or statin?
- A challenge: determining if the troponin elevation is a change from baseline
- May be useful should cardiac symptoms develop

Source: Smilowitz NR, Berger JS. Perioperative Cardiovascular Risk Assessment and Management for Noncardiac Surgery: A Review. JAMA. 2020 Jul 21;324(3):279-290.

Perioperative Beta Blockers: 2014 Guideline Recommendations

- Perioperative beta blockade appears to be of benefit in selected patients who are at elevated risk of perioperative cardiac events
- Per the ACC/AHA 2014 Periop Guidelines, there is one class I indication for perioperative beta-blocker use:
  - "Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically"
- What to do in patients who are not already on beta blockers is unsettled

Perioperative Beta Blockers: The POISE Trial

- The PeriOperative ISchemic Evaluation (POISE) Trial enrolled 8351 patients undergoing noncardiac surgery with at least one cardiac risk factor
- Patients were randomized to either placebo or controlled-release metoprolol (CR metoprolol) 100 mg orally 2 – 4 h before surgery, a postop dose of CR metoprolol based on heart rate and BP, and then 200 mg of CR metoprolol orally daily for the next 30 d
- The beta blocker arm had a lower rate of the primary outcome (30-day cardiac events): 5.8% in the beta blocker arm versus 6.9% in the placebo arm (P=0.04)
- However, the total mortality was higher in the CR metoprolol group (3.1%) than in the placebo group (2.3%) (P=0.03)
- The general view of this trial is that the dose of periop beta blockers given was too large, and so led to the increased stroke rate

Source: Poise Study Group. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial)…. *Lancet.* May 31 2008;371(9627):1839-1847.

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Giving high doses of beta blockers without dose titration to beta blocker naïve patients right before surgery increases mortality

ily for the next 30 d
cardiac events): 5
=0.04)
%) than in the placebo group (2.3%) (P=0.03)

Source: Poise Study Group. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial)…. *Lancet.* May 31 2008;371(9627):1839-1847.

Perioperative Beta Blockers: The POISE Trial

Unanswered questions:

- What if we gave moderate-dose beta blockers?
- What if we started beta blockers a week or even 30 days before surgery?

Source: Poise Study Group. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial)…. *Lancet.* May 31 2008;371(9627):1839-1847.

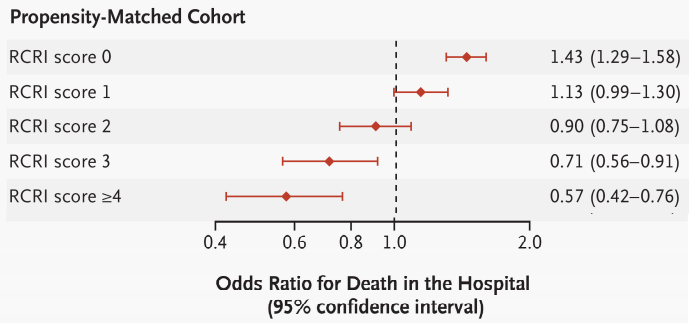
Perioperative Beta Blockers: Retrospective Data

- A large retrospective cohort study examining the benefits of periop beta blockers based on the cardiac risk of the patient
- Patients undergoing noncardiac surgery (mainly orthopedic and abdominal procedures) were included
- Patients receiving prophylactic periop beta blockers were compared with patients not receiving beta blockers
- This study is debated:
  - On the one hand, it was quite large (n=663,635)
  - On the other hand, it was retrospective, and based on the use of an administrative database. No charts were reviewed. Beta blockers started on hospital day 1 or 2 were considered prophylactic

Source: Lindenauer PK, et al. Perioperative beta-blocker therapy …. *New England Journal of Medicine.* Jul 28 2005;353(4):349-361.

Perioperative Beta Blockers: Retrospective Data

- Patients without cardiac risk factors who got periop beta blockers seemed to be harmed by them
- Patients with an RCRI of at least 2, and certainly with an RCRI of 3, appeared to benefit from beta blockers



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Perioperative Beta Blockers: Retrospective Data

- Patients without cardiac risk factors who got periop beta blockers seemed to be harmed by them
- Patients with an RCRI of at least 2, and certainly with an RCRI of 3, appeared to benefit from beta blockers

As the RCRI score goes up, the benefit from beta blockers increases. Beta blockers conferred a mortality benefit with an RCRI score ≥ 3.

Source: Lindenauer PK, et al. Perioperative beta-blocker therapy …. *New England Journal of Medicine.* Jul 28 2005;353(4):349-361.

Perioperative Beta Blockers: 2014 ACC/AHA Recommendations

- The 2014 AHA guidelines are offer mainly IIb recommendations about when to start periop beta blockers in those who are not on them
- In patients with an RCRI score of 3 or more, it may be reasonable to begin beta blockers prior to surgery (class IIb recommendation)
- "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"
- Beta-blocker therapy should not be started on the day of surgery (class III recommendation)

Perioperative Statins

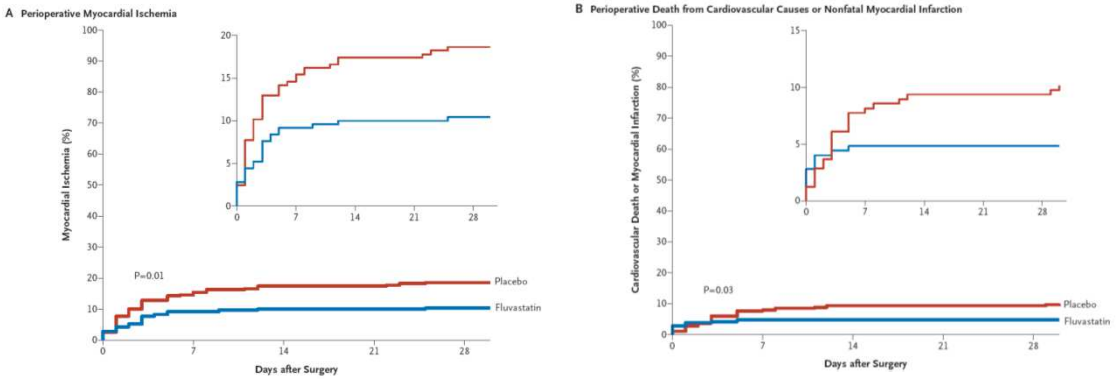
- The DECREASE-III trial enrolled 497 patients, age > 40, at elevated cardiac risk, scheduled to undergo noncardiac vascular surgery
- All patients had to be statin naïve
- All patients were on beta blockers
  - Patients who were already taking a beta blocker were continued on this beta blocker
  - Patients who were not on a beta blocker were started on one, and their dose was titrated based on their HR
- Patients were randomized to fluvastatin 80 mg daily or a placebo. This statin was started on average 37 days prior to surgery and continued for at least 30 days after surgery

Source: Schouten O, Boersma E, Hoeks SE, et al. Fluvastatin and perioperative events in patients undergoing vascular surgery. *NEJM.* Sep 3 2009;361(10):980-989.

Perioperative Statins

Perioperative Myocardial Ischemia: 10.8% in the statin arm vs. 19.0% in the placebo arm (P = 0.01)

Perioperative death from CV cause or MI: 4.8% in the statin arm vs. 10.1% in the placebo arm (P = 0.03)

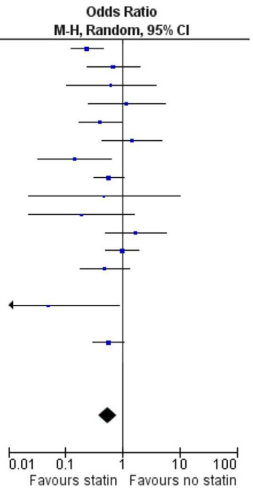


Source: Schouten O, Boersma E, Hoeks SE, et al. Fluvastatin and perioperative events in patients undergoing vascular surgery. *NEJM.* Sep 3 2009;361(10):980-989.

Perioperative Statins: Meta-Analysis

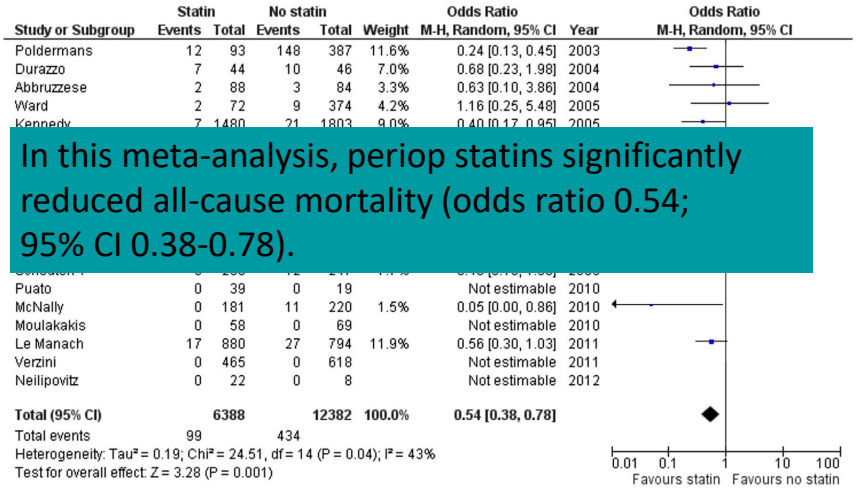
Study or Subgroup	Statin Events	Statin Total	No statin Events	No statin Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Poldermans	12	93	148	387	11.6%	0.24 [0.13, 0.45]	2003
Durazzo	7	44	10	46	7.0%	0.68 [0.23, 1.98]	2004
Abbruzzese	2	88	3	84	3.3%	0.63 [0.10, 3.86]	2004
Ward	2	72	9	374	4.2%	1.16 [0.25, 5.48]	2005
Kennedy	7	1480	21	1803	9.0%	0.40 [0.17, 0.95]	2005
O'Neil-Callahan	6	526	5	637	6.1%	1.46 [0.44, 4.81]	2005
McGirt	2	657	19	909	4.6%	0.14 [0.03, 0.62]	2005
Leurs	11	731	134	5161	11.9%	0.57 [0.31, 1.07]	2006
Gröschel	0	53	2	127	1.3%	0.47 [0.02, 9.94]	2006
Schouten 2	1	28	8	49	2.5%	0.19 [0.02, 1.61]	2006
Kor	9	85	4	62	5.9%	1.72 [0.50, 5.85]	2008
Schanzer	17	636	21	768	11.5%	0.98 [0.51, 1.87]	2008
Schouten 1	6	250	12	247	7.7%	0.48 [0.18, 1.30]	2009
Puato	0	39	0	19		Not estimable	2010
McNally	0	181	11	220	1.5%	0.05 [0.00, 0.86]	2010
Moulakakis	0	58	0	69		Not estimable	2010
Le Manach	17	880	27	794	11.9%	0.56 [0.30, 1.03]	2011
Verzini	0	465	0	618		Not estimable	2011
Neilipovitz	0	22	0	8		Not estimable	2012
Total (95% CI)		**6388**		**12382**	**100.0%**	**0.54 [0.38, 0.78]**	
Total events	99		434				

Heterogeneity: Tau² = 0.19; Chi² = 24.51, df = 14 (P = 0.04); I² = 43%
Test for overall effect: Z = 3.28 (P = 0.001)



Source: Antoniou GA, Hajibandeh S, Vallabhaneni SR, Brennan JA, Torella F. Meta-analysis of the effects of statins on perioperative outcomes in vascular and endovascular surgery. *Journal of Vascular Surgery*. Feb 2015;61(2):519-532 e511

Perioperative Statins: Meta-Analysis



In this meta-analysis, periop statins significantly reduced all-cause mortality (odds ratio 0.54; 95% CI 0.38-0.78).

Source: Antoniou GA, Hajibandeh S, Vallabhaneni SR, Brennan JA, Torella F. Meta-analysis of the effects of statins on perioperative outcomes in vascular and endovascular surgery. *Journal of Vascular Surgery*. Feb 2015;61(2):519-532 e511

Perioperative Statins: 2014 ACC/AHA Recommendations

- Statins should be continued in patients currently taking statins and scheduled for noncardiac surgery (class I)
- Perioperative initiation of statins is reasonable in patients undergoing vascular surgery (class IIa)
- Perioperative initiation of statins may be considered in patients with clinical indications according to GDMT who are undergoing elevated-risk procedures (class IIb)

Perioperative Aspirin

- The POISE 2 Trial was an that looked at the effect of perioperative ASA
- The trial enrolled 10,010 patients undergoing noncardiac surgery who were at risk for vascular complications
- Patient within the coronary stent critical periods were excluded
- The primary endpoint was death or nonfatal MI at 30 days
- The patients were stratified by whether they were already taking ASA (continuation group) or not (initiation group)

Source: Devereaux PJ, Mrkobrada M, Sessler DI, et al. Aspirin in patients undergoing noncardiac surgery. *NEJM*. Apr 17 2014;370(16):1494-1503.

Perioperative Aspirin

- There was no benefit to ASA in the primary outcome or any of the secondary outcomes
- The negative results were the same for the continuation group and the initiation group
- Taking ASA was associated with an increased risk of major bleeding

Source: Devereaux PJ, Mrkobrada M, Sessler DI, et al. Aspirin in patients undergoing noncardiac surgery. *NEJM*. Apr 17 2014;370(16):1494-1503.

Perioperative Aspirin

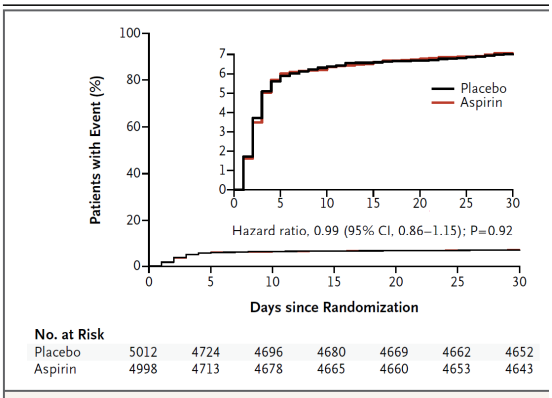


Figure 1. Kaplan–Meier Estimates of the Primary Composite Outcome of Death or Nonfatal Myocardial Infarction at 30 Days.
The inset shows the same data on an enlarged y axis.

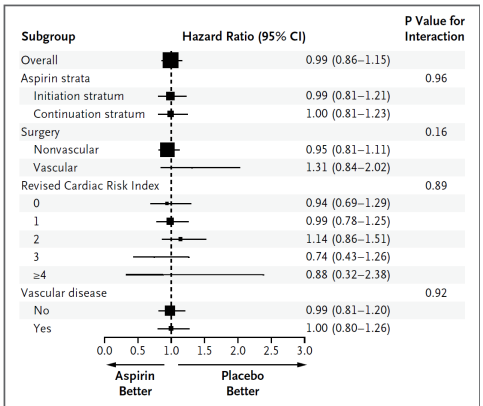
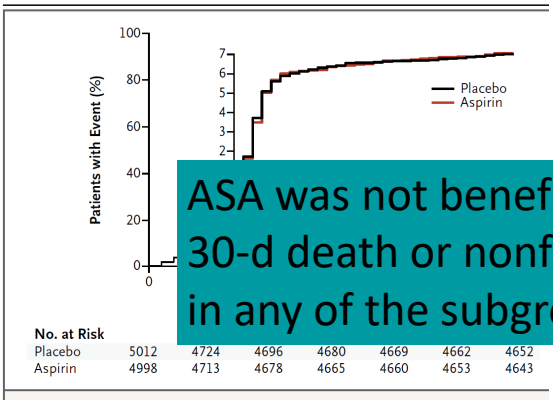


Figure 2. Subgroup Analyses of the Primary Outcome.
The primary composite outcome was death or nonfatal myocardial infarction at 30 days. The area of each square is proportional to the size of the corresponding subgroup. The Revised Cardiac Risk Index ranges from 0 to 6, with higher scores indicating greater risk.

Source: Devereaux PJ, Mrkobrada M, Sessler DI, et al. Aspirin in patients undergoing noncardiac surgery. *NEJM*. Apr 17 2014;370(16):1494-1503.

Perioperative Aspirin



ASA was not beneficial in reducing 30-d death or nonfatal MI overall or in any of the subgroups

Figure 1. Kaplan–Meier Estimates of the Primary Composite Outcome of Death or Nonfatal Myocardial Infarction at 30 Days.
The inset shows the same data on an enlarged y axis.

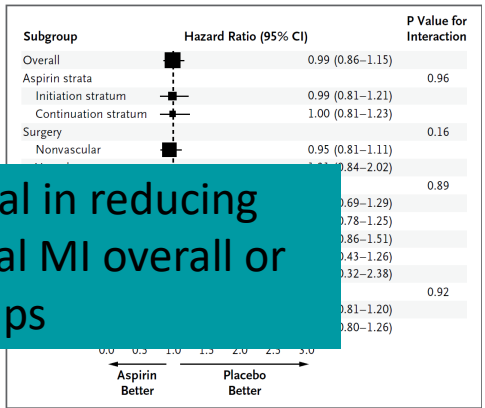


Figure 2. Subgroup Analyses of the Primary Outcome.
The primary composite outcome was death or nonfatal myocardial infarction at 30 days. The area of each square is proportional to the size of the corresponding subgroup. The Revised Cardiac Risk Index ranges from 0 to 6, with higher scores indicating greater risk.

Source: Devereaux PJ, Mrkobrada M, Sessler DI, et al. Aspirin in patients undergoing noncardiac surgery. *NEJM*. Apr 17 2014;370(16):1494-1503.

Should We Hold ACEI/ARB Periop?

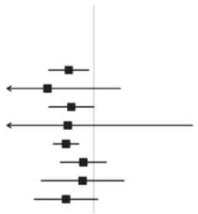
- Prospective cohort study of 14,687 patients (including 4,802 on ACEI or ARBs), ≥ 45 y.o., undergoing inpatient noncardiac surgery
- Primary endpoint was all-cause death, stroke, or myocardial injury after noncardiac surgery at 30 days postop
- 26% of patients had ACEI/ARB held in the 24 h prior to surgery

Source: Roshanov et al. Withholding versus Continuing Angiotensin-converting Enzyme Inhibitors …. Anesthesiology. Jan 2017;126(1):16-27.

Should We Hold ACEI/ARB Periop?

- Patient characteristics were similar in those in whom ACEI/ARB were held and those in whom they were continued
- The primary endpoint was lower in the held group (12.0%) compared to the continuation group (12.9%)
- But unable to analyze by subgroup (e.g., CHF)

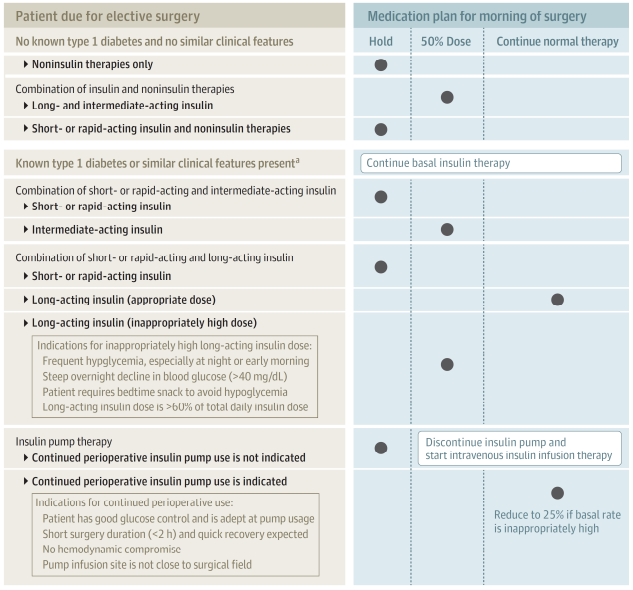
Medication withheld	Outcome	Events in withheld *vs.* continued	aRR (95% CI), p–value
ACEI/ARBs	Death, MINS, or stroke	150/1245 (12.0%) *vs.* 459/3557 (12.9%)	0.82 (0.70–0.96), 0.01
	Death	25/1245 (2.0%) *vs.* 74/3557 (2.1%)	0.69 (0.39–1.24), 0.21
	MINS	132/1245 (10.6%) *vs.* 399/3541 (11.3%)	0.84 (0.70–0.998), 0.048
	Stroke	8/1245 (0.6%) *vs.* 26/3557 (0.7%)	0.81 (0.30–2.2), 0.68
	Intraop. hypotension	290/1245 (23.3%) *vs.* 1017/3557 (28.6%)	0.80 (0.73–0.88), <0.001
	Postop. hypotension	242/1245 (19.4%) *vs.* 719/3557 (20.2%)	0.92 (0.77–1.10), 0.36
	MI (Exploratory)	57/1245 (4.6%) *vs.* 148/3557 (4.2%)	0.91 (0.66–1.27), 0.59
	Death, MI, or stroke (Exploratory)	78/1245 (6.3%) *vs.* 221/3557 (6.2%)	0.81 (0.62–1.03), 0.08



Source: Roshanov et al. Withholding versus Continuing Angiotensin-converting Enzyme Inhibitors …. Anesthesiology. Jan 2017;126(1):16-27.

Periop Management of Diabetes Medications

Figure. Suggested Administration of Insulin and Other Diabetes Medications on the Morning of Surgery



Source: Simha V, Shah P. Perioperative Glucose Control in Patients With Diabetes Undergoing Elective Surgery. *JAMA*. Jan 7 2019.

Bridging Anticoagulation

- The BRIDGE trial randomized 1884 patients with Afib on coumadin who were scheduled for an elective procedure to either bridging with LMWH (dalteparin) or placebo.
- Patients had to have at least 1 of the $CHADS_2$ risk factors.
- The mean $CHADS_2$ score was 2.3

Source: Douketis JD, Spyropoulos AC, Kaatz S, et al. Perioperative Bridging Anticoagulation in Patients with Atrial Fibrillation. *NEJM*. 2015;373(9):823-833.

Bridging Anticoagulation

Table 3. Study Outcomes.

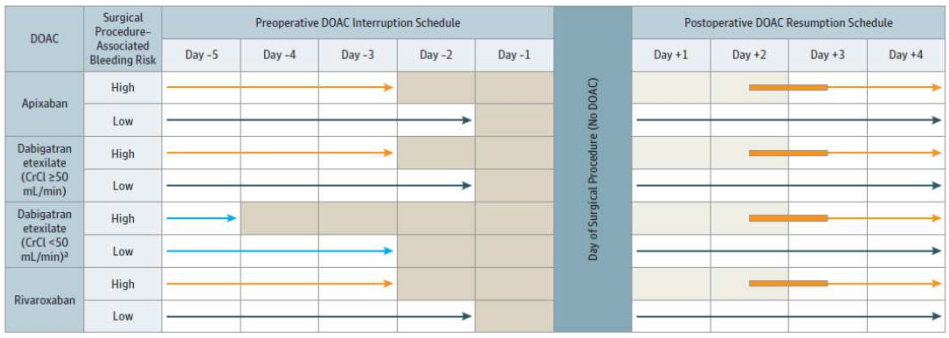
Outcome	No Bridging (N=918)	Bridging (N=895)	P Value
	number of patients (percent)		
Primary			
Arterial thromboembolism	4 (0.4)	3 (0.3)	0.01*, 0.73†
Stroke	2 (0.2)	3 (0.3)	
Transient ischemic attack	2 (0.2)	0	
Systemic embolism	0	0	
Major bleeding	12 (1.3)	29 (3.2)	0.005†
Secondary			
Death	5 (0.5)	4 (0.4)	0.88†
Myocardial infarction	7 (0.8)	14 (1.6)	0.10†
Deep-vein thrombosis	0	1 (0.1)	0.25†
Pulmonary embolism	0	1 (0.1)	0.25†
Minor bleeding	110 (12.0)	187 (20.9)	<0.001†

* P value for noninferiority.
† P value for superiority.

Source: Douketis JD, Spyropoulos AC, Kaatz S, et al. Perioperative Bridging Anticoagulation in Patients with Atrial Fibrillation. *NEJM*. 2015;373(9):823-833.

Bridging Anticoagulation with DOACS

Figure. Perioperative Direct Oral Anticoagulant (DOAC) Management Protocol



No DOAC was taken on certain days (shaded) and on the day of the elective surgery or procedure. The light blue arrows refer to an exception to the basic management, a subgroup of patients taking dabigatran with a creatinine clearance (CrCl) less than 50 ng/mL. The orange arrows refer to patients having a high-bleed-risk surgical procedure. Dark blue arrows refer to patients having a low-bleed-risk surgical procedure. The thickened orange part of arrows refer to flexibility in the timing of DOAC resumption after a procedure.

[a] Cancer diagnosed within 3 months or has been treated within 6 months or metastatic.

Source: Douketis JD, Spyropoulos AC, et al. Perioperative Management of Patients with Atrial Fibrillation Receiving a Direct Oral Anticoagulant. JAMA-IM. 2019 Nov 1;179(11):1469-1478.

Perioperative Pulmonary Complications

Table 1. The Seven ARISCAT Risk Predictors, β Regression Coefficients, and Points Assigned*

	β Regression Coefficients	Score
Age (yr)		
≤50	0	0
51–80	0.331	3
>80	1.619	16
Preoperative Spo_2		
≥96%	0	0
91–95%	0.802	8
≤90%	2.375	24
Respiratory infection in the last month		
No	0	0
Yes	1.698	17
Preoperative anemia (Hb ≤10 g/dl)		
No	0	0
Yes	1.105	11
Surgical incision		
Peripheral	0	0
Upper abdominal	1.480	15
Intrathoracic	2.431	24
Duration of surgery (h)		
<2	0	0
2–3	1.593	16
>3	2.268	23
Emergency procedure		
No	0	0
Yes	0.768	8

*Three levels of risk were indicated by the following cutoffs: <26 points, low risk; 26–44 points, moderate risk; and ≥45 points, high risk.

ARISCAT = Assess Respiratory Risk in Surgical Patients in Catalonia; Hb = hemoglobin; Spo_2 = arterial oxyhemoglobin saturation by pulse oximetry.

- Tested on 5,859 patients in 63 centers
- Respiratory complications were defined as:
  - Respiratory infection or failure
  - Bronchospasm
  - Atelectasis
  - Pleural effusion
  - Pneumothorax
  - Aspiration pneumonitis
- Score:
  - < 26 denotes a 3.4% risk
  - 26-45 denotes a 13.0% risk
  - >45 denotes a 38.0% risk

Source: Mazo V, Sabate S, et al. Prospective external validation of a predictive score for postoperative pulmonary complications. *Anesthesiology.* 2014;121(2):219-231.

Perioperative Pulmonary Risk Reduction Strategies: Lung Expansion

- In patients at elevated risk, such as those undergoing abdominal surgery, a lung expansion maneuver is appropriate, and is more effective than no intervention
- Options include incentive spirometry, lung expansion exercises, and continuous positive airway pressure
- There is no compelling evidence favoring one lung expansion intervention over another
- CPAP may be appropriate in patients who are unable to undergo either incentive spirometry or lung expansion exercises. CPAP is advisable in OSA patients.

Source: Lawrence VA, et al. Strategies to reduce postoperative pulmonary complications after noncardiothoracic surgery: systematic review for the American College of Physicians. *Annals of Internal Medicine.* Apr 18 2006;144(8):596-608.

Perioperative Pulmonary Risk Reduction Strategies

- Smoking cessation
  - May help reduce the incidence of postop pulmonary complications
  - However, smoking cessation immediately (< 8 weeks) prior to surgery may increase the risk of postop pulmonary complications
- Anesthesia techniques need to be considered
  - Patients who had residual muscle blockade after receiving the long-acting neuromuscular-blocking agent pancuronium had an increased rate of postop pulmonary complications compared to patients without residual muscle blockade
  - Use of regional anesthesia, compared to general anesthesia, may also reduce the incidence of postop pulmonary complications

Source: Lawrence VA, et al. Strategies to reduce postoperative pulmonary complications after noncardiothoracic surgery: systematic review for the American College of Physicians. *Annals of Internal Medicine*. Apr 18 2006;144(8):596-608.

General versus Regional Anesthesia Complications

Propensity Matched General Surgical Population (NSQIP) (n=328,540)

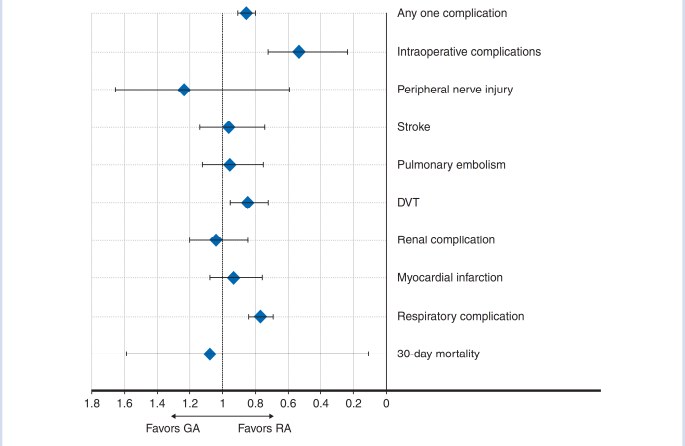
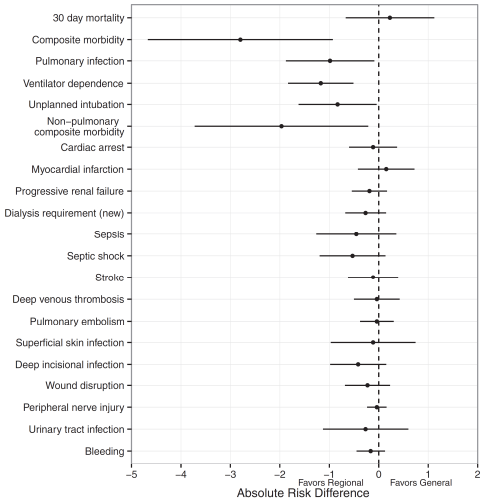


Fig 2 Adjusted odd ratios of primary and secondary outcomes and their 95% confidence intervals.

Source: Saied NN et al. Effect of anaesthesia type on postoperative mortality and morbidities: a matched analysis of the NSQIP database. Br J Anaesth. 2017 Jan;118(1):105-111.

General versus Regional Anesthesia Complications

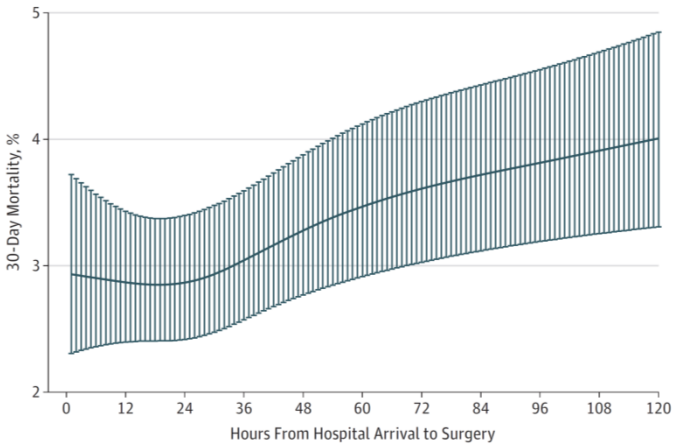
Propensity Matched COPD Patients (NSQIP) (n=5288)



Source: Hausman MS Jr at al. Regional versus general anesthesia in surgical patients with chronic obstructive pulmonary disease … Anesth Analg. 2015 Jun;120(6):1405-12.

The Timing of Surgery for Hip Fracture Patients

- Retrospective cohort analysis of 42,230 hip fracture patients in Ontario
- Mean age around 80, around 70% female
- Primary outcome was 30-d mortality



Source: Pincus D, Ravi B, Wasserstein D, et al. Association Between Wait Time and 30-Day Mortality in Adults Undergoing Hip Fracture Surgery. JAMA. Nov 28 2017;318(20):1994-2003..

Periop Issues for OSA Patients

- Both respiratory and cardiovascular periop complications are more common in patients with untreated OSA than comparable patients without OSA
- Prescribing CPAP for patients with OSA perioperatively reduced the risk of cardiovascular but not pulmonary complications
- Neglecting to prescribe CPAP in patients on CPAP when postop in the hospital is an “unforced error”

Source: Mutter TC, Chateau D, Moffatt M, Ramsey C, Roos LL, Kryger M. A matched cohort study of postoperative outcomes in obstructive sleep apnea: could preoperative diagnosis and treatment prevent complications? *Anesthesiology.* Oct 2014;121(4):707-718.

Periop Issues for Obese Patients

- There are an increasing number of case reports of obese patients having postop rhabdomyolysis
- It is likely that the immobilization and weight on the gluteal muscle results in necrosis
- If an obese patient has postop AKI, consider rhabdomyolysis and check a CK
- Obese patients has restrictive lung physiology, and so consider CPAP in hypoxic obese patients postop

Source: Cote DR, Fuentes E, Elsayes AH, Ross JJ, Quraishi SA. A "crush" course on rhabdomyolysis: risk stratification and clinical management update for the perioperative clinician. J Anesth. 2020 Aug;34(4):585-598

Frailty

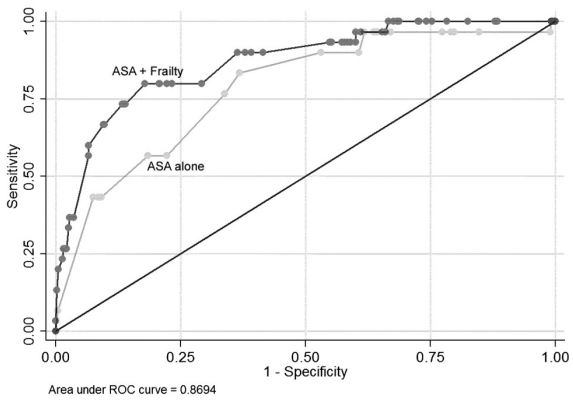
Fried Frailty Index:

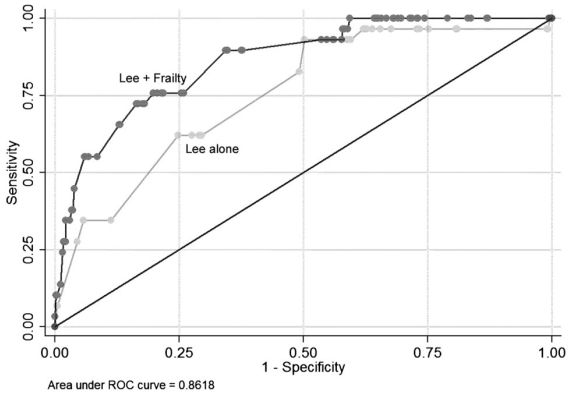
1. **Shrinking**: Unintentional weight loss ≥ 10 lbs
2. **Physical endurance/energy**: During the last 4 weeks how often you rested in bed during day?
3. **Low physical activity**: Low frequency of mildly energetic, moderately energetic and very energetic physical activity
4. **Weakness**: Based on poor handgrip strength
5. **Slow walking speed**: Taking ≥ 6-7 sec to walk over 15 feet (depending on sex and height)

Sources: Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. Mar 2001;56(3):M146-156.
Kunadian V, Neely RDG, Sinclair H, et al. Study to Improve Cardiovascular Outcomes in high-risk older patients …. BMJ Open. 2016;6(8):e012091.

Frailty Can Help Predict Outcomes

Outcome being predicted: surgical complications and discharge to an assisted or skilled nursing facility





Source: Makary MA, Segev DL, Pronovost PJ, et al. Frailty as a predictor of surgical outcomes in older patients. *J Am Coll Surg.* Jun 2010;210(6):901-908.

Enhanced Preop Evaluation of Frail Patients May Impact Mortality

Figure. Interrupted Time Series Analysis

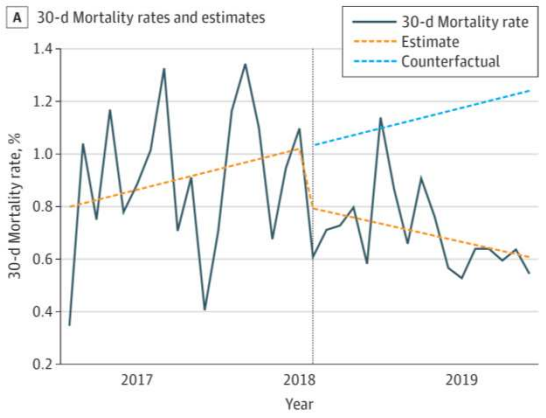
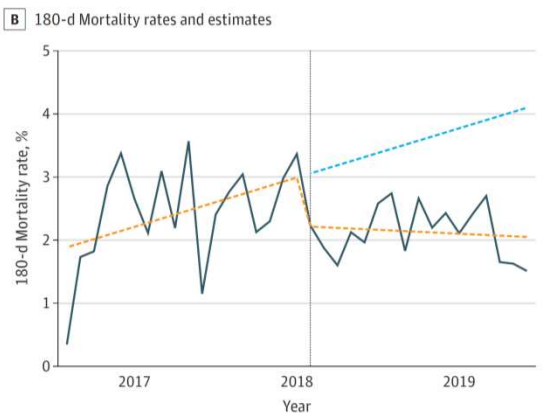


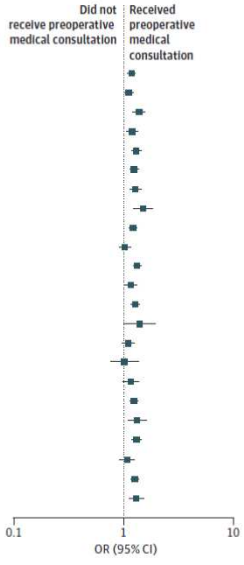
Figure. Interrupted Time Series Analysis



Source: Varley PR et al. Association of Routine Preoperative Frailty Assessment With 1-Year Postoperative Mortality. JAMA Surg. 2023 Feb 22:e228341.

Figure. Odds Ratios (ORs) for 30-Day Mortality Among Patients Who Received Preoperative Medical Consultation vs Those Who Did Not (in Matched Subgroups)

Group	OR (95% CI)
Entire matched cohort	1.19 (1.11-1.29)
Year 2005-2010	1.12 (1.02-1.23)
Year 2011-2017	1.39 (1.23-1.56)
Teaching hospital	1.20 (1.07-1.35)
Nonteaching hospital	1.31 (1.19-1.45)
Male	1.25 (1.14-1.38)
Female	1.29 (1.15-1.46)
Age 40-64 y	1.51 (1.23-1.86)
Age ≥65 y	1.22 (1.13-1.32)
Ischemic heart disease	1.03 (0.91-1.18)
No ischemic heart disease	1.33 (1.22-1.46)
Diabetes	1.17 (1.03-1.33)
No diabetes	1.29 (1.18-1.41)
RCRI = 0	1.40 (1.01-1.94)
RCRI = 1-2	1.10 (0.98-1.25)
RCRI ≥ 3	1.02 (0.76-1.38)
Pulmonary disease	1.17 (0.99-1.38)
No pulmonary disease	1.25 (1.15-1.36)
Vascular procedure	1.34 (1.11-1.62)
Abdominal/thoracic procedure	1.32 (1.19-1.46)
Orthopedic procedure	1.08 (0.92-1.27)
Anesthesia consultation	1.27 (1.16-1.38)
No anesthesia consultation	1.31 (1.12-1.53)



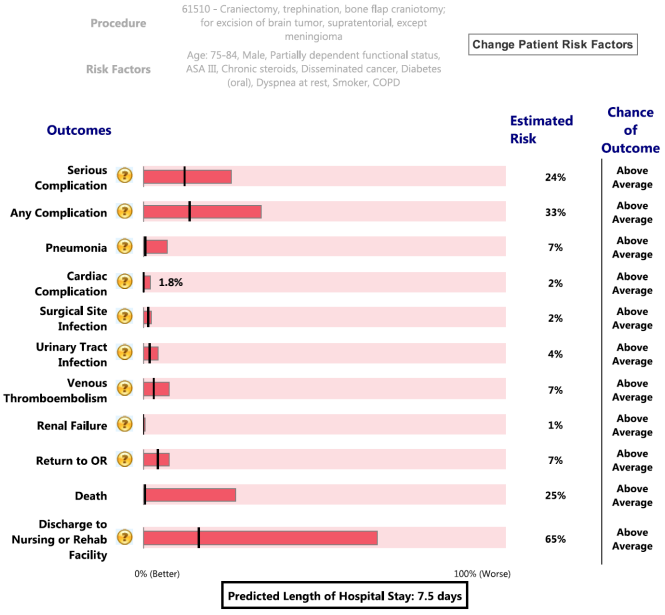
RCRI indicates Revised Cardiac Risk Index.

Source: Varley PR, Buchanan D, Bilderback A, Wisniewski MK, Johanning J, Nelson JB, Johnson JT, Minnier T, Hall DE. Association of Routine Preoperative Frailty Assessment With 1-Year Postoperative Mortality. JAMA Surg. 2023 May 1;158(5):475-483.

Clinical Case

- 76-year-old male with severe COPD, on 3 L of home O_2 and chronic prednisone 7.5 mg daily, DMII on metformin, dyspnea with minimal exertion.
- No history of MI or CHF. His EKG is essentially normal.
- He has metastatic colon cancer, with a single metastasis to the brain causing left arm weakness
- You are seeing him in consultation prior to neurosurgery scheduled 48 h from now to resect the metastasis
- He underwent successful resection of a colon mass 3 years ago

Clinical Case



Clinical Case

- What actually happened:
  - The neurosurgeon cancelled the case
  - The patient was scheduled for brain XRT instead
  - Surgery remained on the table as an option
- If the patent undergoes surgery, consider cort stim versus stress dose steroids

Summary/Take Home Points

- Use one of the on-line risk assessment tools to determine the MACE risk of your patients
- Consider the role for the various perioperative risk reduction interventions
  - Medical: beta blockers, statins
- Have a plan for perioperative management of different medications, such as ACEI/ARBs, ASA, and diabetes medications
- Perioperative risk is more than just cardiovascular risk
- Communicate with the surgeon and anesthesiologist