

# **Evaluation of Cardiac and Pulmonary Risk** in the Preop Patient

Adam C. Schaffer, MD, MPH
Associate Physician, Hospital Medicine Unit
Department of Medicine
Brigham and Women's Hospital
Assistant Professor or Medicine, Part-Time
Harvard Medical School



#### Adam Schaffer, MD, MPH



University of Pennsylvania School of Medicine Medicine Residency at Columbia Assistant Professor of Medicine, Part-time, HMS

- Clinical focus: Perioperative Medicine and Hospital Medicine
- Research Focus: Patient Safety



#### Disclosures

• I have no conflicts of interest to declare



#### Objectives

Upon completion of this activity, participants will be able to:

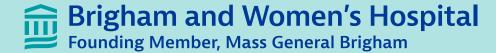
- Summarize the recently revised perioperative guidelines
- Apply various tools for preoperative risk assessment
- Identify the importance of non-cardiac perioperative risks
- Recognize the risks specific to certain patient populations in the perioperative setting



#### 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





## Perioperative AHA/ACC Guidelines

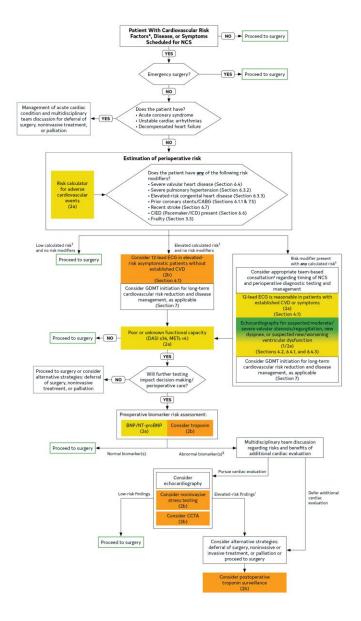
#### New Periop Guidelines were Published in November 2024

#### **CLINICAL PRACTICE GUIDELINES**

2024 AHA/ACC/ACS/ASNC/HRS/SCA/ SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

Developed in Collaboration With and Endorsed by the American College of Surgeons, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society for Vascular Medicine

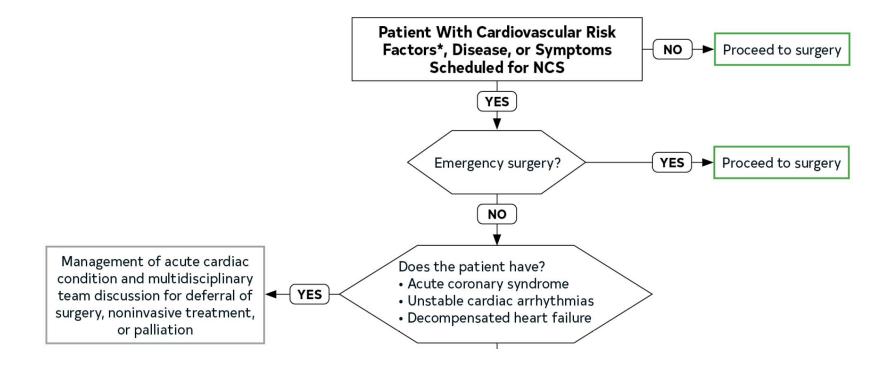




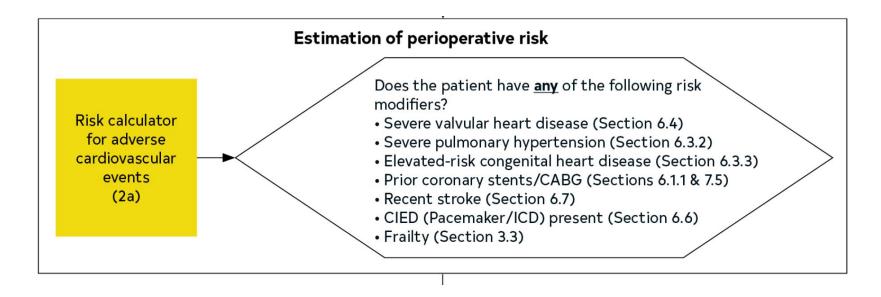


Source: 2024

AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SV M Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery ... Circulation. 2024 Nov 5;150(19):e351-e442.







"MACE [major adverse cardiac event] with any perioperative risk calculator >1% is used as a threshold to identify patients at elevated risk."



#### Risk Assessment in the 2024 Periop Guidelines

- For risk assessment, the 2024 guidelines recommend estimating the preoperative risk of a major adverse cardiac event (MACE)
- 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 2024 Periop Guidelines

The guidelines suggest three ways to determine if the MACE risk is  $\geq 1\%$ :

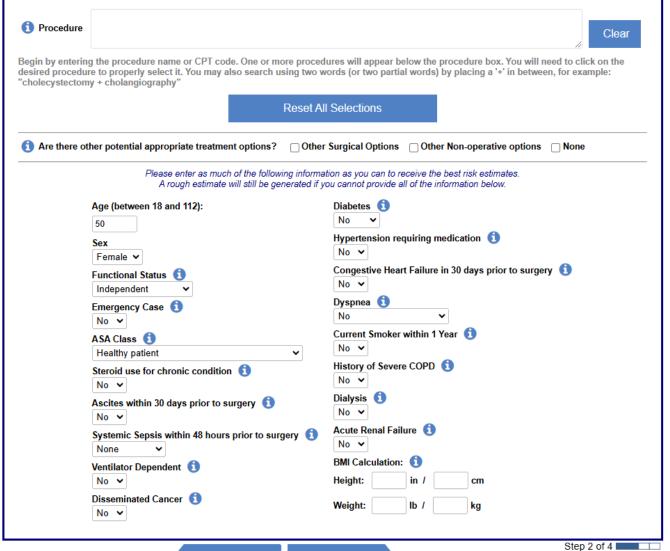
- ACS NSQIP Surgical Risk Calculator
   (https://riskcalculator.facs.org/RiskCalculator/)
- Perioperative Cardiac Risk Calculator (https://www.mdcalc.com/calc/4038/gupta-perioperative-risk-myocardial-infarction-cardiac-arrest-mica)
- 3. RCRI score (though one of the two options above is preferred because they outperform the RCRI score)

"Although many risk scores exist, data are lacking to support the use of one risk index over another, and research is underway to further refine perioperative risk."



#### ACS NSQIP Surgical Risk Calculator

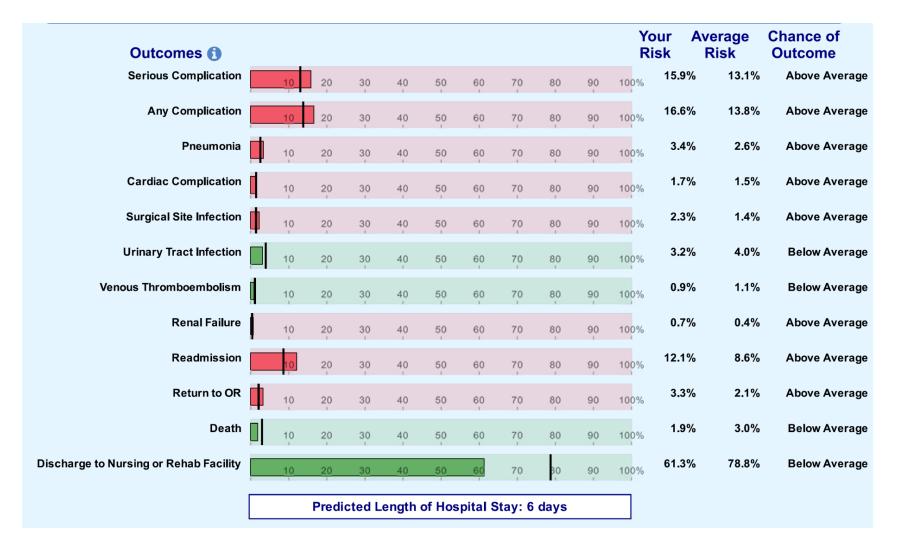
#### **Enter Patient and Surgical Information**





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





## 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

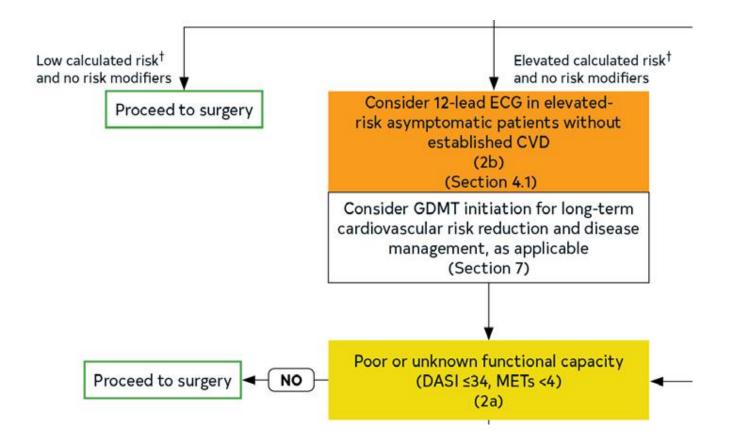


#### Revised Cardiac Risk Index

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	

"Traditionally **a RCRI >1** or a calculated risk of MACE with any perioperative risk calculator >1% is used as a threshold to identify patients at elevated risk."





Source: 2024
AHA/ACC/ACS/ASNC/HRS/SCA/SC
CT/SCMR/SVM Guideline for
Perioperative Cardiovascular
Management for Noncardiac
Surgery ... Circulation. 2024 Nov
5;150(19):e351-e442.



#### **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)

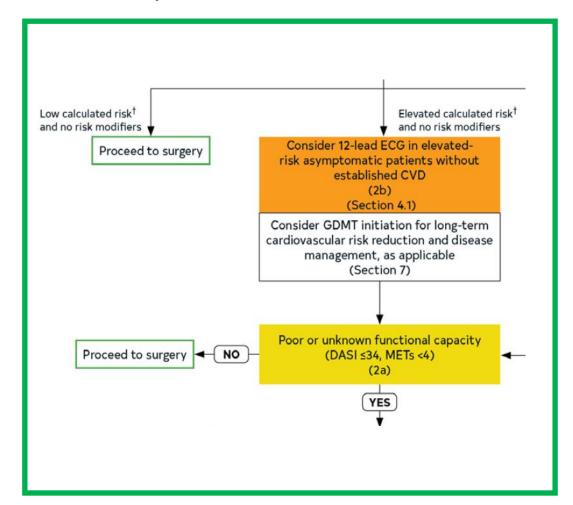


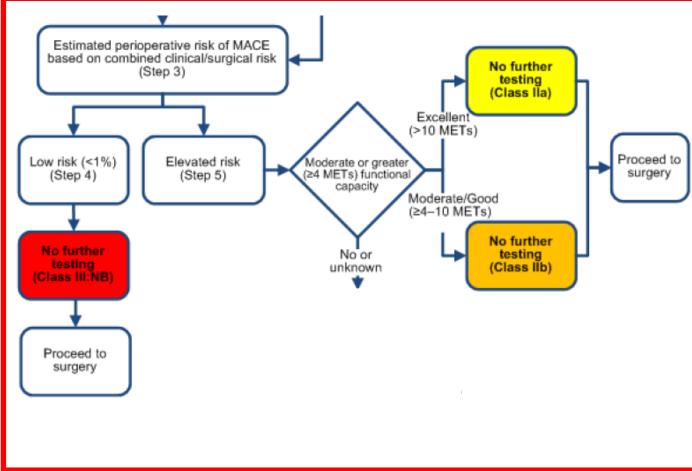
#### **Duke Activity Status Index**

- 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



#### ACC/AHA 2024 vs. 2014 Periop Guidelines: Fundamental Similarity

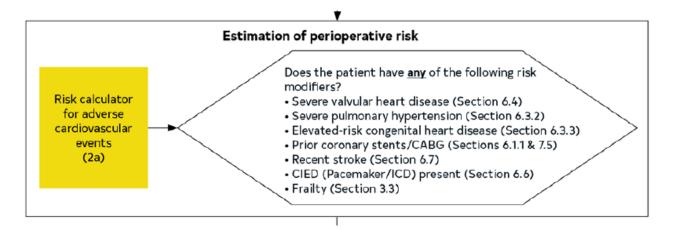






Source: 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery ... Circulation. 2024 Nov 5;150(19):e351-e442.

Source: 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management...Circulation. 2014 Dec 9;130(24):e278-333.



Risk modifier present with **any** calculated risk<sup>†</sup>

Consider appropriate team-based consultation<sup>†</sup> regarding timing of NCS and perioperative diagnostic testing and management

12-lead ECG is reasonable in patients with established CVD or symptoms (2a) (Section 4.1)

Echocardiography for suspected moderate/ severe valvular stenosis/regurgitation, new dyspnea, or suspected new/worsening ventricular dysfunction

> (1/2a) (Sections 4.2, 6.4.1, and 6.4.3)

Consider GDMT initiation for long-term cardiovascular risk reduction and disease management, as applicable (Section 7)



Source: 2024

AHA/ACC/ACS/ASNC/HRS/SCA/SC

CT/SCMR/SVM Guideline for

Perioperative Cardiovascular

Management for Noncardiac

5;150(19):e351-e442.

Surgery ... Circulation. 2024 Nov

Table 6. Frailty Assessment Tools

Name	Items	Scoring
Physical Frailty Phenotype (Fried phenotype) <sup>15</sup>	Slowness, low activity, weight loss, exhaustion, weakness (1 point each)	0=Nonfrail
		1-2=Prefrail
		3-5=Frail
Deficit Accumulation Index <sup>16</sup>	Variable; typically 30-70 items from multiple domains	Number of deficits/number of items scored; higher scores indicate greater frailty
Edmonton Frail Scale <sup>17</sup>	10 items across multiple domains	Sum of scores/17; higher scores indicate greater frailty
FRAIL Scale <sup>18</sup>	Fatigue, stair climb, ambulation, illnesses >5, weight loss ≥5% (1 point each)	0=Nonfrail
		1-2=Intermediate
		3-5=Frail
Clinical Frailty Scale <sup>19</sup>	9 categories ranging from very fit to terminally ill as assessed by clinicians	Categories 5-8 indicate mild, moderate, severe, and very severe frailty
SPPB <sup>20</sup>	Gait speed, chair stands, balance tests	Maximum 4 points per item, range, 0-12 points; ≥10=Nonfrail, 3-9=Frail, ≤2=Disabled

Adapted with permission from frailtyscience.org. Copyright 2021 FrailtyScience.org. SPPB indicates Short Physical Performance Battery.



#### Clinical Frailty Scale

#### CLINICAL FRAILTY SCALE People who need help with all outside activities and with keeping house. Inside, they often have problems with MODERATE stairs and need help with bathing and FRAILTY VERY People who are robust, active, energetic might need minimal assistance (cuing, and motivated. They tend to exercise standby) with dressing. regularly and are among the fittest for their age. Completely dependent for personal care, from whatever cause (physical or FIT People who have no active disease cognitive). Even so, they seem stable symptoms but are less fit than category and not at high risk of dying (within ~6 FRAILTY 1. Often, they exercise or are very active occasionally, e.g., seasonally. Completely dependent for personal care and approaching end of life. Typically, People whose medical problems are WITH VERY MANAGING they could not recover even from a WFII well controlled, even if occasionally SEVERE minor illness. FRAILTY symptomatic, but often are not regularly active beyond routine walking. Approaching the end of life. This TERMINALLY Previously "vulnerable," this category category applies to people with a life expectancy < 6 months, who are not WITH marks early transition from complete otherwise living with severe frailty. independence. While not dependent on VERY MILD (Many terminally ill people can still FRAILTY others for daily help, often symptoms exercise until very close to death.) limit activities. A common complaint is being "slowed up" and/or being tired SCORING FRAILTY IN PEOPLE WITH DEMENTIA during the day. The degree of frailty generally In moderate dementia, recent memory is People who often have more evident very impaired, even though they seemingly corresponds to the degree of slowing, and need help with high can remember their past life events well. dementia. Common symptoms in mild dementia include forgetting They can do personal care with prompting. order instrumental activities of daily the details of a recent event, though In severe dementia, they cannot do living (finances, transportation, heavy FRAILTY still remembering the event itself, personal care without help. housework). Typically, mild frailty repeating the same question/story In very severe dementia they are often progressively impairs shopping and and social withdrawal. bedfast. Many are virtually mute. walking outside alone, meal preparation, medications and begins to restrict light Clinical Frailty Scale @2005-2020 Rockwood. **DALHOUSIE** housework. Version 2.0 (EN), All rights reserved. For permission:

UNIVERSITY

www.geriatricmedicineresearch.ca

www.geriatricmedicineresearch.ca

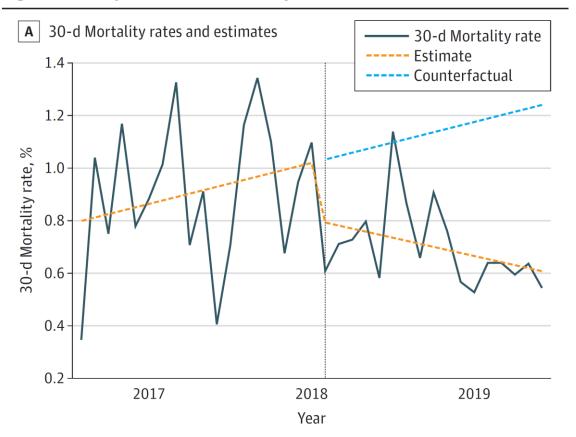
Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489-495.



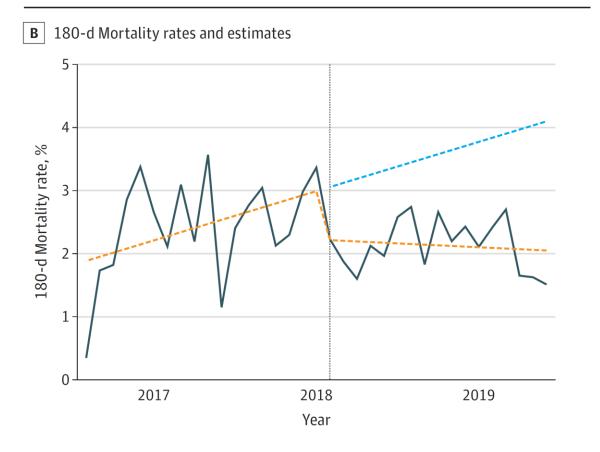
Sources: Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005 Aug 30;173(5):489-95 and Rockwood K, Theou O. Using the clinical frailty scale in allocating scarce health care resources. Can Geriatr J. 2020 Sep 1;23(3):210-215.

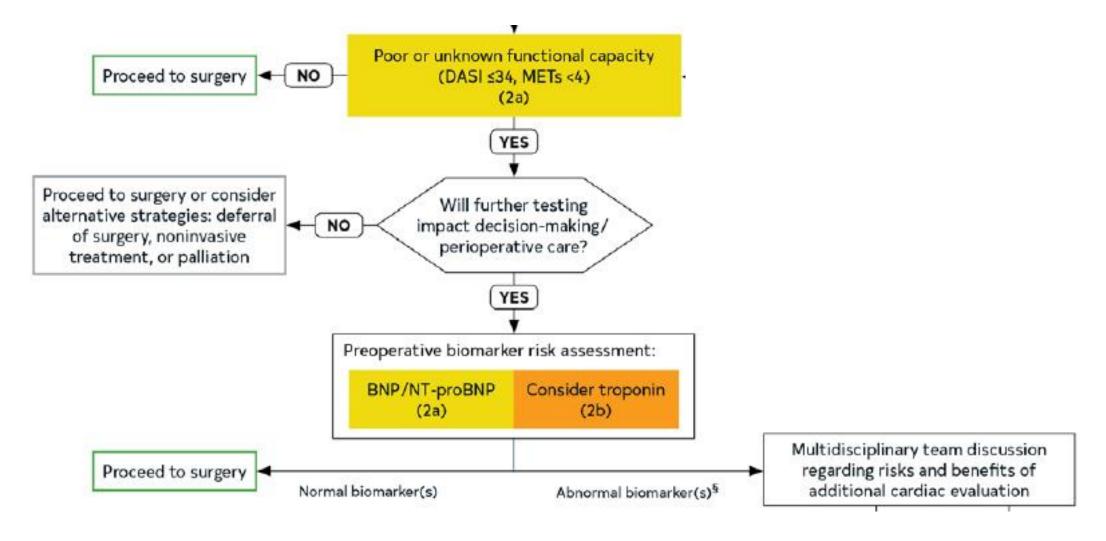
#### Enhanced Preop Evaluation of Frail Patient May Impact Mortality

#### Figure. Interrupted Time Series Analysis

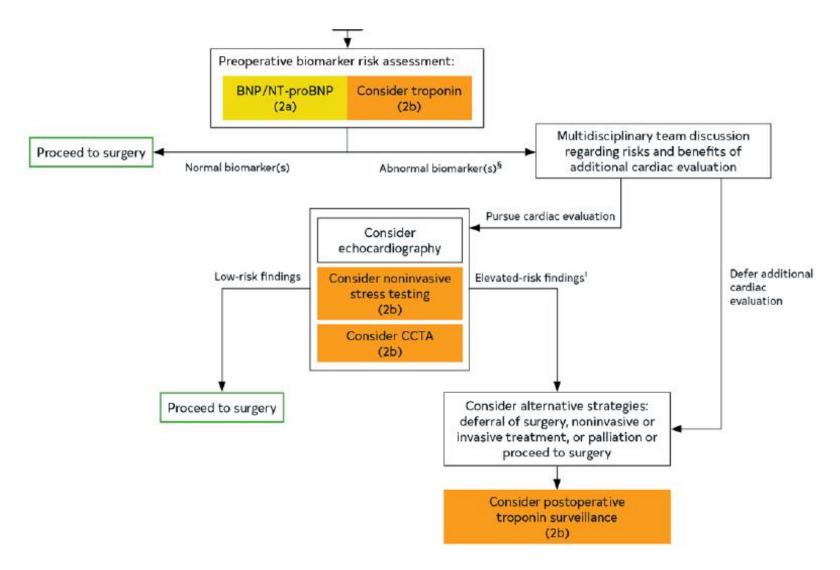


#### Figure. Interrupted Time Series Analysis







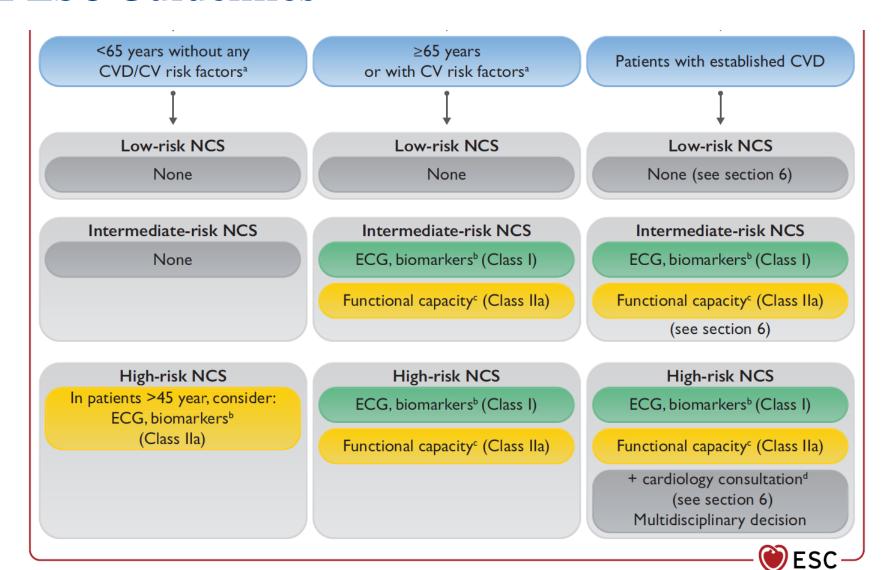




#### Perioperative Troponin Measurements: Guideline Recommendations

- 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"

# Perioperative Troponin Measurements: 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.

# Preoperative Troponin Measurements: ACC/AHA 2024 Periop Guidelines

## 3.4. Preoperative Biomarkers for Risk Stratification

Recommendations for Preoperative Biomarkers for Risk Stratification Referenced studies that support the recommendations are summarized in the Online Data Supplement.

summarized in the Online Data Supplement.			
COR	LOE	Recommendations	
2a	B-NR	<ol> <li>In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it is reasonable to measure B-type natriuretic peptide (BNP) or N- terminal pro–B-type natriuretic peptide (NT-proBNP) before surgery to supplement evaluation of perioperative risk.<sup>1-3</sup></li> </ol>	
2b	B-NR	<ol> <li>In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it may be reasonable to measure cardiac troponin (cTn) before surgery to supplement evaluation of peri- operative risk.<sup>4-6</sup></li> </ol>	

- On BNP: "Optimal threshold values of BNP or NTproBNP for perioperative risk prediction are not clearly established."
- On troponins: "There is no action predicated on this knowledge alone, although preoperative baseline troponin concentrations also inform the interpretation of postoperative troponin measurements and can help confirm a diagnosis of acute myocardial injury in the postoperative setting."
- "Abnormal biomarker thresholds: troponin >99th percentile peer reference limit for the assay; BNP >92 ng/L, NT-proBNP ≥300 ng/L"



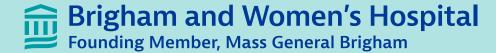
# Postoperative Troponin Measurements: ACC/AHA 2024 Periop Guidelines

## 9.1. Myocardial Injury After Noncardiac Surgery Surveillance and Management

Recommendations for Myocardial Injury After Noncardiac Surgery Surveillance and Management Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
MINS Surveillance		
2b	B-NR	In patients with known CVD, symptoms of CVD, or age ≥65 years with cardiovascular risk factors undergoing elevated-risk NCS, it may be reasonable to measure cTn at 24 and 48 hours after surgery to identify myocardial injury.¹-⁴
3: No benefit	B-NR	<ol> <li>In patients undergoing low-risk NCS, routine post- operative screening with cTn levels is not indicated without signs or symptoms suggestive of myocardial ischemia or MI.<sup>5,6</sup></li> </ol>





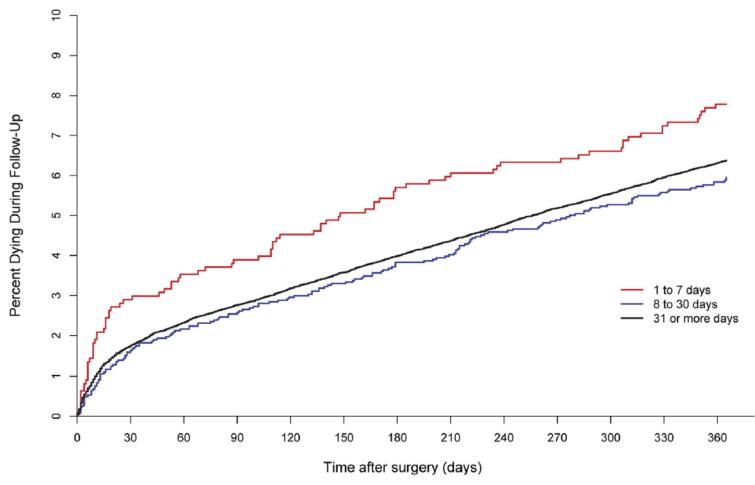
## Perioperative Medical Therapy

### Perioperative Beta Blockers: The POISE Trial (prospective RCT)

- 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



### Perioperative Beta Blockers: Cohort Study





### Perioperative Beta Blockers: ACC/AHA 2024 Periop Guidelines

Recommendations for Perioperative Beta Blockers Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
1	B-NR	In patients on stable doses of beta blockers undergoing NCS, beta blockers should be continued through the perioperative period as appropriate based on the clinical circumstances. <sup>1,2</sup>
2b	B-NR	<ol> <li>In patients scheduled for elective NCS who have a new indication for beta blockade, beta blockers may be initiated far enough before surgery (optimally &gt;7 days) to permit assessments of tolerability and drug titration if needed.<sup>3</sup></li> </ol>
3: Harm	B-R	3. In patients undergoing NCS and with no immediate need for beta blockers, beta blockers should not be initiated on the day of surgery due to increased risk for postoperative mortality.4



#### Perioperative Statins

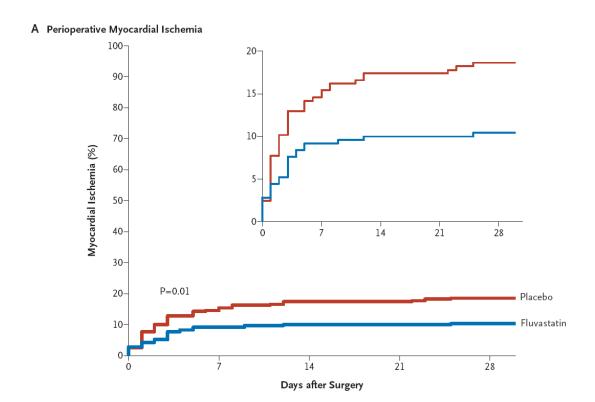
- The DECREASE-III trial enrolled 497 patients, age > 40, at elevated cardiac risk, scheduled to undergo noncardiac vascular surgery
- All patients had to be statin naïve
- All patients were on beta blockers
  - Patients who were already taking a beta blocker were continued on this beta blocker
  - Patients 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

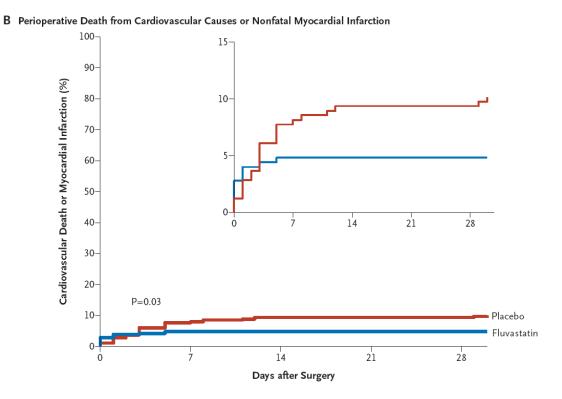


#### Perioperative Statins

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)





#### Perioperative Statins: Meta-Analysis

	Stati	n	No sta	ntin	Odds Ratio			Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	Year	M-H, Random, 95% CI
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	<del></del>
Abbruzzese	2	88	3	84	3.3%	0.63 [0.10, 3.86]	2004	<del></del>
Ward	2	72	9	374	4.2%	1.16 [0.25, 5.48]	2005	<del></del>
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	<del></del>
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	<del></del>
Kor	9	85	4	62	5.9%	1.72 [0.50, 5.85]	2008	<del>  •   •   •   •   •   •   •   •   •   •</del>
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	<del></del>
Puato	0	39	0	19		Not estimable	2010	
McNally	0	181	11	220	1.5%	0.05 [0.00, 0.86]	2010	<del></del>
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: Tau <sup>2</sup> =	0.19; Chi	$i^2 = 24.5$	51, df = 1	4 (P = 0.	$04); I^2 = 43$	3%		
Test for overall effect:				•				0.01 0.1 1 10 100 Favours statin Favours no statin



Outcome:

all-cause mortality

# Perioperative Statins: ACC/AHA 2024 Periop Guidelines

**Recommendations for Statins** 

Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
1	B-NR	<ol> <li>In patients currently on statins and scheduled for NCS, continuation of statin therapy is recommended to reduce the risk of MACE.<sup>1-3</sup></li> </ol>
1	B-R	<ol> <li>In statin-naïve adult patients who meet criteria for statin use based on ASCVD history or 10-year risk assessment and are scheduled for NCS, periopera- tive initiation of statin is recommended with intention of long-term use.<sup>4,5</sup></li> </ol>



#### 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)



#### 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



#### Perioperative Aspirin

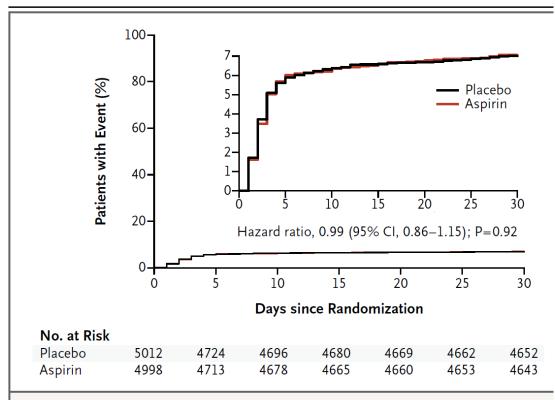


Figure 1. Kaplan-Meier Estimates of the Primary Composite Outcome of Death or Nonfatal Myocardial Infarction at 30 Days.

The inset shows the same data on an enlarged y axis.

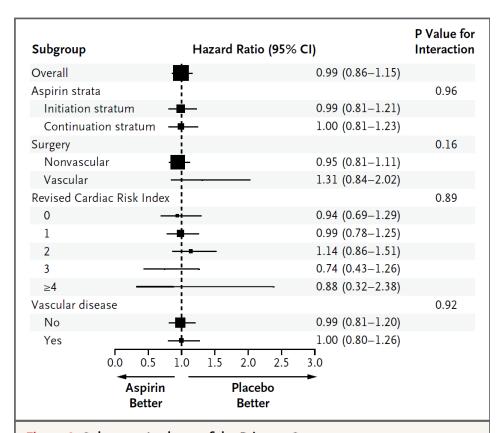


Figure 2. Subgroup Analyses of the Primary Outcome.

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.



#### Perioperative Aspirin: ACC/AHA 2024 Periop Guidelines

Recommendations for Antiplatelet Therapy and Timing of Noncardiac Surgery in Patients With Coronary Artery Disease Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
2b	B-R	11. In patients with CCD without prior PCI undergoing elective NCS, it may be reasonable to continue aspirin in selected patients when the risk of cardiac events outweighs the risk of bleeding. <sup>27,34,35</sup>
3: No benefit	B-R	12. In patients with CAD but without prior PCI who are undergoing elective noncarotid NCS, routine initiation of aspirin is not beneficial. <sup>27,36</sup>

CCD=chronic coronary disease



#### **Polling Question**

A 74-year-old male with a history of HFrEF, hypertension, and hyperlipidemia is scheduled for a partial colectomy for colon cancer in one week. His medications include metoprolol, atorvastatin, and losartan.

How would you manage his medications on the day of surgery?

- a) Hold his metoprolol
- b) Hold his atorvastatin
- c) Hold his losartan
- d) Continue all the listed medications



#### Perioperative ACEi/ARB: ACC/AHA 2024 Periop Guidelines

Recommendations for Perioperative Renin-Angiotensin-Aldosterone System Inhibitors

Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
2b	B-R	<ol> <li>In select* patients on chronic renin-angiotensin- aldosterone system inhibitors (RAASi) for hypertension undergoing elevated-risk NCS, omission 24 hours before surgery may be beneficial to limit intraoperative hypotension.<sup>1-6</sup></li> </ol>
2a	C-EO	<ol> <li>In patients on chronic RAASi for HFrEF, perioperative continuation is reasonable. † 1,2</li> </ol>

\*Patients with controlled BP and undergoing elevated-risk surgical procedures.

†Modified from the "2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure."



JAMA | Original Investigation

#### Continuation vs Discontinuation of Renin-Angiotensin System Inhibitors Before Major Noncardiac Surgery The Stop-or-Not Randomized Clinical Trial

*JAMA*. 2024;332(12):970-978. doi:10.1001/jama.2024.17123 Published online August 30, 2024.



- Prospective RCT of 2222 patients in France
- Patients were on a renin-angiotensin system inhibitors (RASIs) (ACEi or ARB) for ≥ 3 months
- Patients were randomized 1:1 to the continuation group (continued ACEi/ARB to the day of surgery) or discontinuation group (held ACEi/ARB for 48 h before surgery)



No. at risk

Figure 3. Cumulative Incidence of the Primary Outcome by Treatment Group

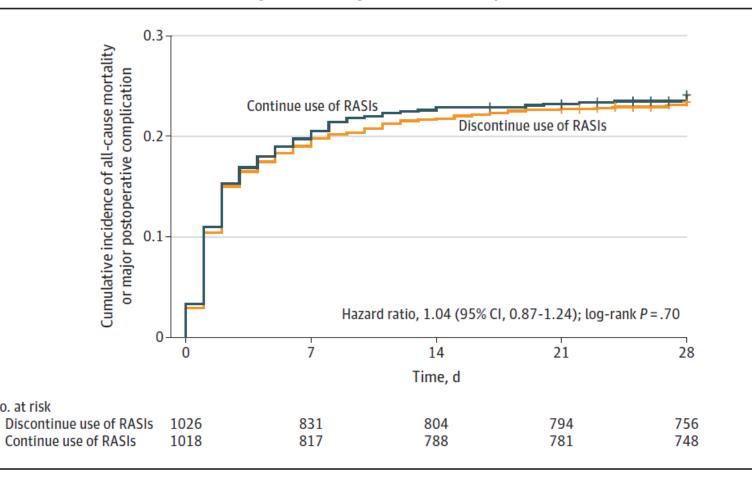




Figure 2. Primary Outcome for All Patients and by Individual Patient Subgroups

	Discontinued use of RASIs		Continued use of RASIs			Favors	Favors		
	No. of events	No. of patients	No. of events	No. of patients	Risk ratio (95% CI)	continuing use of RASIs	discontinuing use of RASIs	P value for interaction	
Primary outcome									
All patients	245	1115	247	1107	1.02 (0.87-1.19)	_	: •	.85	
Patient subgroups									
Age group, y									
≤80	225	1026	230	1037	1.01 (0.86-1.19)	-	<u>-</u>	.82	
>80	20	89	17	70	1.08 (0.61-1.90)		-	.02	
History of chronic kidney disease									
No	212	1013	208	1011	0.98 (0.83-1.17)	-	<u>.</u>	.23	
Yes	33	102	39	96	1.26 (0.87-1.82)	_		.23	
History of heart failure									
No	230	1043	231	1038	1.01 (0.86-1.19)	-	-	.77	
Yes	15	72	16	69	1.11 (0.60-2.07)		-	.//	



#### Perioperative Considerations for GLP-1 Agonists

Guidance from the American Society of Anesthesiologists:

- For patients who take GLP-1 agonists daily, consider holding the medication on the day of surgery
- For patients who take GLP-1 agonists weekly, consider holding the medication a week prior to surgery
- If the patient has GI symptoms such as serious bloating or N/V, consider delaying the procedure
- If the patient has no GI symptoms but did not hold the GLP-1 agonist, then use "full stomach" precautions



#### Perioperative Considerations for GLP-1 Agonists

#### Guidance from the American Society of Anesthesiologists:

- For patients who take GLP-1 agonists daily, consider holding the medication on the day of surgery
- For patients who take GLP-1 agonists weekly, consider holding the medication a week prior to surgery
- If the patient has GI symptoms such as serious bloating or N/V, consider delaying the procedure
- If the patient has no GI symptoms but did not hold the GLP-1 agonist, then use "full stomach" precautions

#### However, critics of this guidance have noted:

- EGD studies that examined whether GLP-1 agonist use is associated with retained gastric contents
  have yielded mixed results
- The duration that GLP-1 agonist need to be held to reduce the risk of retained gastric contents is unclear
- The benefits of better glycemic control may be offsetting



#### Periop Management of Diabetes Medications

Figure. Suggested Administration of Insulin and Other Diabet	es Medicat	ions on the M	orning of Surgery		
Patient due for elective surgery	Medica	tion plan for	morning of surgery		
No known type 1 diabetes and no similar clinical features	Hold	50% Dose	Continue normal therapy		
▶ Noninsulin therapies only			1		
Combination of insulin and noninsulin therapies  Long- and intermediate-acting insulin		•			
▶ Short- or rapid-acting insulin and noninsulin therapies					
Known type 1 diabetes or similar clinical features present <sup>a</sup>	Continue	Continue basal insulin therapy			
Combination of short- or rapid-acting and intermediate-acting insulin  • Short- or rapid-acting insulin	•				
► Intermediate-acting insulin		•	1 1 1 1 1 1		
Combination of short- or rapid-acting and long-acting insulin  • Short- or rapid-acting insulin	•				
► Long-acting insulin (appropriate dose)			•		
► Long-acting insulin (inappropriately high dose)			1 1 1 1 1		
Indications for inappropriately high long-acting insulin dose: Frequent hypglycemia, especially at night or early morning Steep overnight decline in blood glucose (>40 mg/dL) Patient requires bedtime snack to avoid hypoglycemia Long-acting insulin dose is >60% of total daily insulin dose		•			
Insulin pump therapy • Continued perioperative insulin pump use is not indicated	•		insulin pump and inous insulin infusion therapy		
► Continued perioperative insulin pump use is indicated					
Indications for continued perioperative use: Patient has good glucose control and is adept at pump usage Short surgery duration (<2 h) and quick recovery expected No hemodynamic compromise Pump infusion site is not close to surgical field			Reduce to 25% if basal rate is inappropriately high		



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<sub>2</sub> risk factors.
- The mean CHADS<sub>2</sub> score was 2.3



## **Bridging Anticoagulation**

Table 3. Study Outcomes.								
Outcome	No Bridging (N=918)	Bridging (N=895)	P Value					
	number of pati	ents (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†					

<sup>\*</sup> P value for noninferiority.

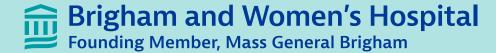


<sup>†</sup> P value for superiority.

## Perioperative Management of DOACS

Preoperative DOAC Schedule												
		Preoper	ative Inte	rruption				Surgery/ Procedure	Postoperative Resumption			
	Procedure Bleeding Risk	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day 0	Day +1	Day +2	Day +3	Day +4
Apixaban, edoxaban,	High	*	*	*	*	t	t	t	†	t	*	*
rivaroxaban	Low/Moderate	*	*	*	*	*	t	t	*	*	*	*
	Minimal	*	*	*	*	*	*	*	*	*	*	*
Apixaban, edoxaban,	High	*	*	*	†	†	t	t	†	t	*	*
rivaroxaban with renal impairment (CrCl <30	Low/Moderate	*	*	*	*	†	t	t	*	*	*	*
mL/min)	Minimal	*	*	*	*	*	*	*	*	*	*	*
Dabigatran CrCl ≥50	High	*	*	*	*	†	t	t	†	t	*	*
mL/min	Low/Moderate	*	*	*	*	*	†	t	*	*	*	*
	Minimal	*	*	*	*	*	*	*	*	*	*	*
Dabigatran CrCl <50 mL/min	High	*	*	†	†	†	†	t	†	t	*	*
	Low/Moderate	*	*	*	*	†	†	t	*	*	*	*
	Minimal	*	*	*	*	*	*	*	*	*	*	*





## Perioperative Pulmonary Considerations

#### Perioperative Pulmonary Complications

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

	$\begin{array}{c} \beta \text{ Regression} \\ \text{Coefficients} \end{array}$	Score
Age (yr)		
≤50	0	0
51-80	0.331	3
>80	1.619	16
Preoperative Spo <sub>2</sub>		
≥96%	0	0
91-95%	0.802	8
≤90%	2.375	24
Respiratory infection in th	e last month	
No	0	0
Yes	1.698	17
Preoperative anemia (Hb s	≤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

<sup>\*</sup>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<sub>2</sub> = 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</li>
- 26-45 denotes a 13.0% risk
- >45 denotes a 38.0% risk



#### 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.



#### **Polling Question**

A 68-year-old women with a history of hypertension, hyperlipidemia, osteoarthritis, and cigarette smoking presents for preop evaluation prior to a knee replacement, which is scheduled in one week. Her MACE risk is 0.7%. She has no cardiac symptoms. Her medications include metoprolol, atorvastatin, and amlodipine. Which perioperative recommendation is most appropriate?

- a) Preoperative pharmacologic MIBI stress test
- b) Preoperative cardiac echo
- c) Continue the metoprolol and atorvastatin
- d) Quit smoking



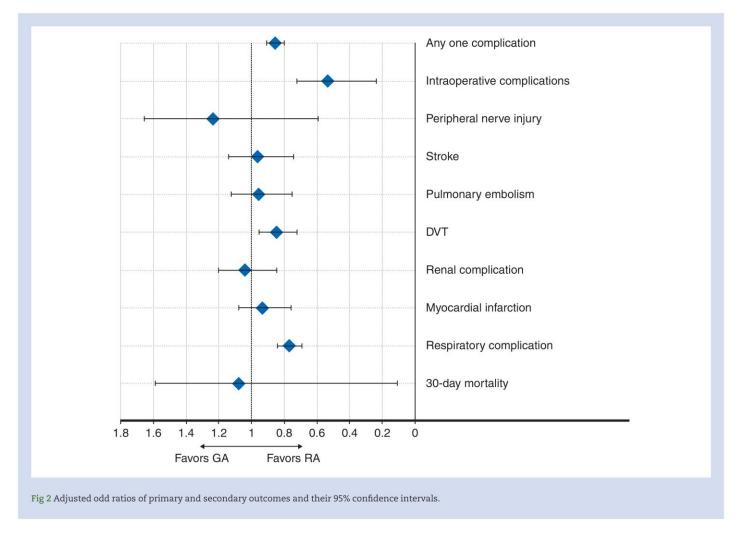
#### Perioperative Pulmonary Risk Reduction Strategies

- 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
  - Use of regional anesthesia, compared to general anesthesia, reduces the incidence of postop pulmonary complications



### General versus Regional Anesthesia Complications

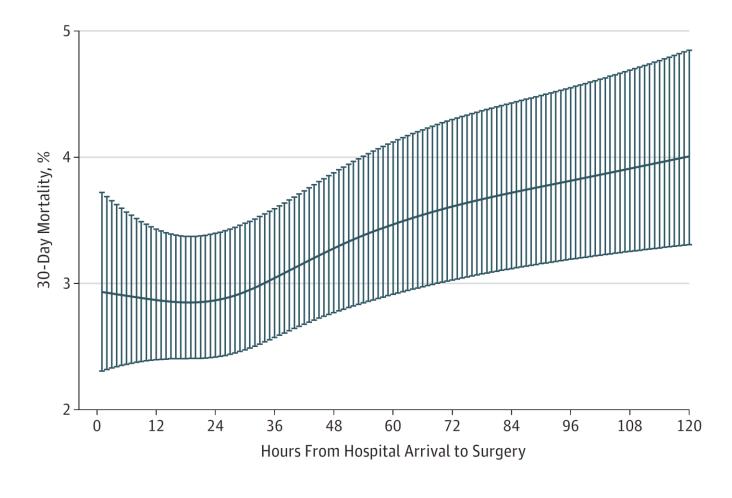
Propensity Matched General Surgical Population (NSQIP) (n=328,540)





#### 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





#### 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 can reduce postop complications
- Neglecting to prescribe CPAP in patients on CPAP when postop in the hospital is an "unforced error"
- Opioids need to be used with caution in OSA patients



#### 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

#### **MOC Reflective Statement**

- 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 and ASA
- Recognize that perioperative risk is more than just cardiovascular risk
- Assess patients for frailty
- Communicate with the surgeon and anesthesiologist



#### Selected References

- 1. Thompson A, et al. 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery: ... Circulation. 2024 Nov 5;150(19):e351-e442. doi: 10.1161/CIR.000000000001285.
- 2. Legrand M, et al. Continuation vs Discontinuation of Renin-Angiotensin System Inhibitors Before Major Noncardiac Surgery: The Stop-or-Not Randomized Clinical Trial. JAMA. 2024 Sep 24;332(12):970-978. doi: 10.1001/jama.2024.17123.
- 3. Varley PR, et al. Association of Routine Preoperative Frailty Assessment With 1-Year Postoperative Mortality. JAMA Surg. 2023 May 1;158(5):475-483. doi: 10.1001/jamasurg.2022.8341.
- 4. Smilowitz NR, Berger JS. Perioperative Cardiovascular Risk Assessment and Management for Noncardiac Surgery: A Review. JAMA. 2020 Jul 21;324(3):279-290.
- 5. Simha V, Shah P. Perioperative Glucose Control in Patients With Diabetes Undergoing Elective Surgery. JAMA. 2019 Jan 29;321(4):399-400. doi: 10.1001/jama.2018.20922.

