Perioperative Cardiovascular Management: An Update

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April 11, 2025

Disclosures

- No relevant relationships with industry
- I am married to an anesthesiologist

Objectives

1

Highlight what's new in the ACC/AHA guidelines and appropriate use criteria

2

Foster interdisciplinary collaboration in care of complex patients

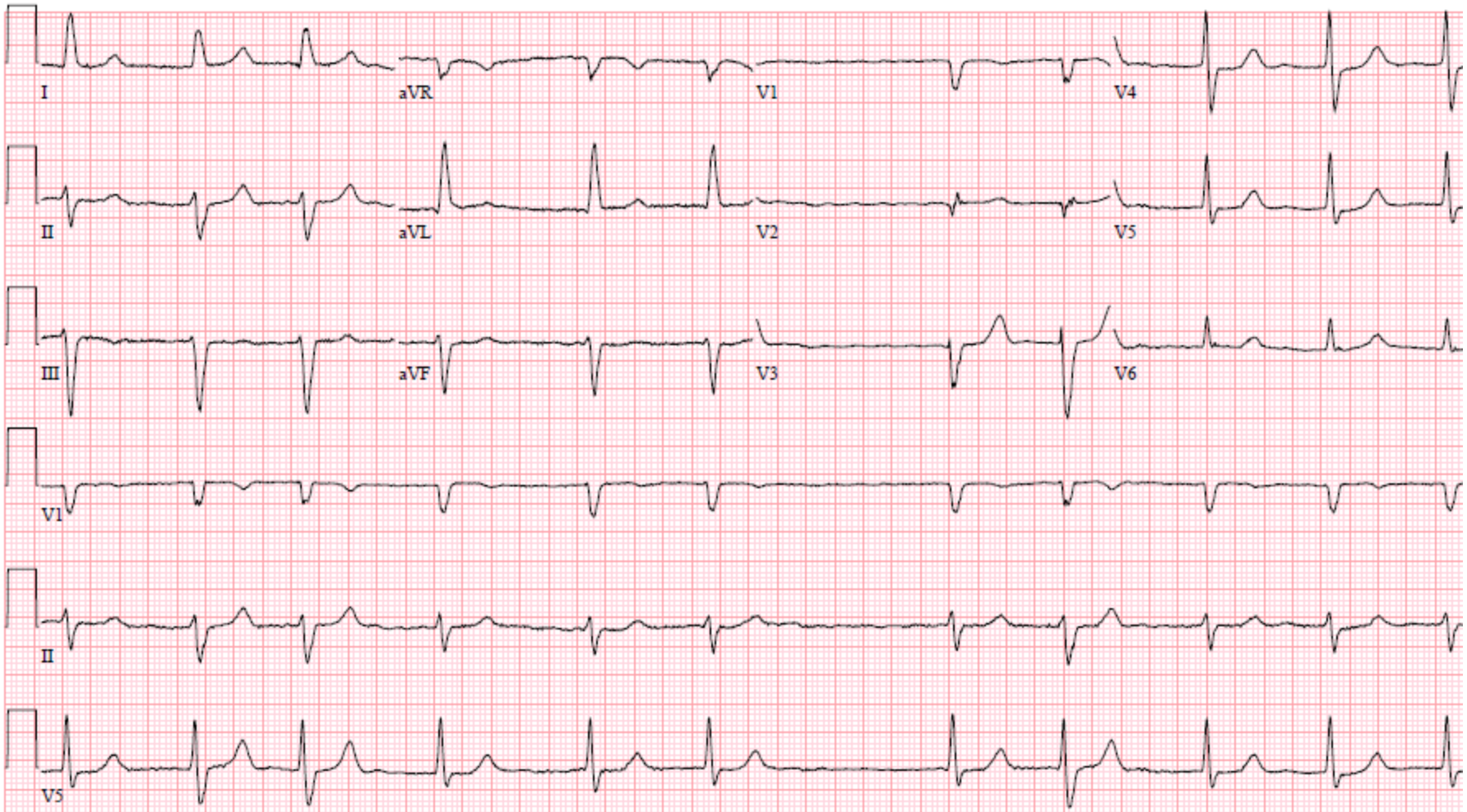
3

Reframe perioperative management as a patient-centered process

Case: an unfortunate surprise

- 65yoM with DM, HTN, and ESKD on HD x 3 years, interested in living-donor kidney transplant
- Presented to Domino Farms for dobutamine stress test
- Felt poorly on dialysis and was sedentary
- Endorsed fatigue but no DOE or angina at low-level exertion

ECG



Workup and management

- Dobutamine stress test canceled
- My exam: JVP ~12 cm H2O above the right atrium, bibasilar rales, 2+ pitting edema to lower thighs
- Ultrafiltration intensified, with improvement in DOE
- AF already rate controlled with beta-blocker
- Regadenoson SPECT: fixed inferior and apical defects c/w prior MI; no reversible ischemia; coronary angiography not pursued
- Underwent transplant with immediate urine production and appropriate downward trend in Cr
- Quality of life greatly improved

The most important component of the preoperative evaluation is the history and physical examination.

-Kim Eagle, MD

2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery

A Report of the American Heart Association/American College of Cardiology 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 of Cardiovascular Magnetic Resonance, and the Society for Vascular Medicine

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SOCIETAL STATEMENT

2024 Perioperative Cardiovascular Management for Noncardiac Surge Guideline-at-a-Glance

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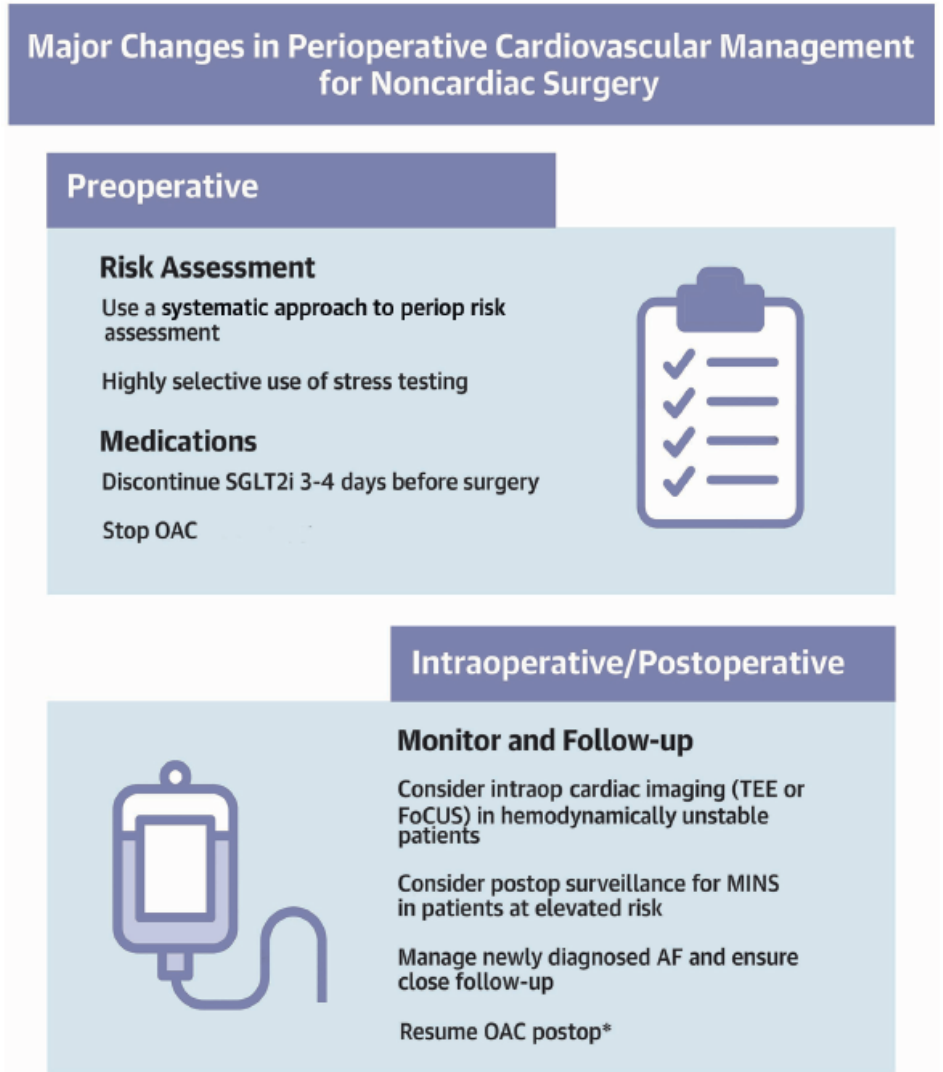
CENTRAL ILLUSTRATION 2024 Perioperative Cardiovascular Management for Noncardiac Surgery Guideline-at-a-Glance



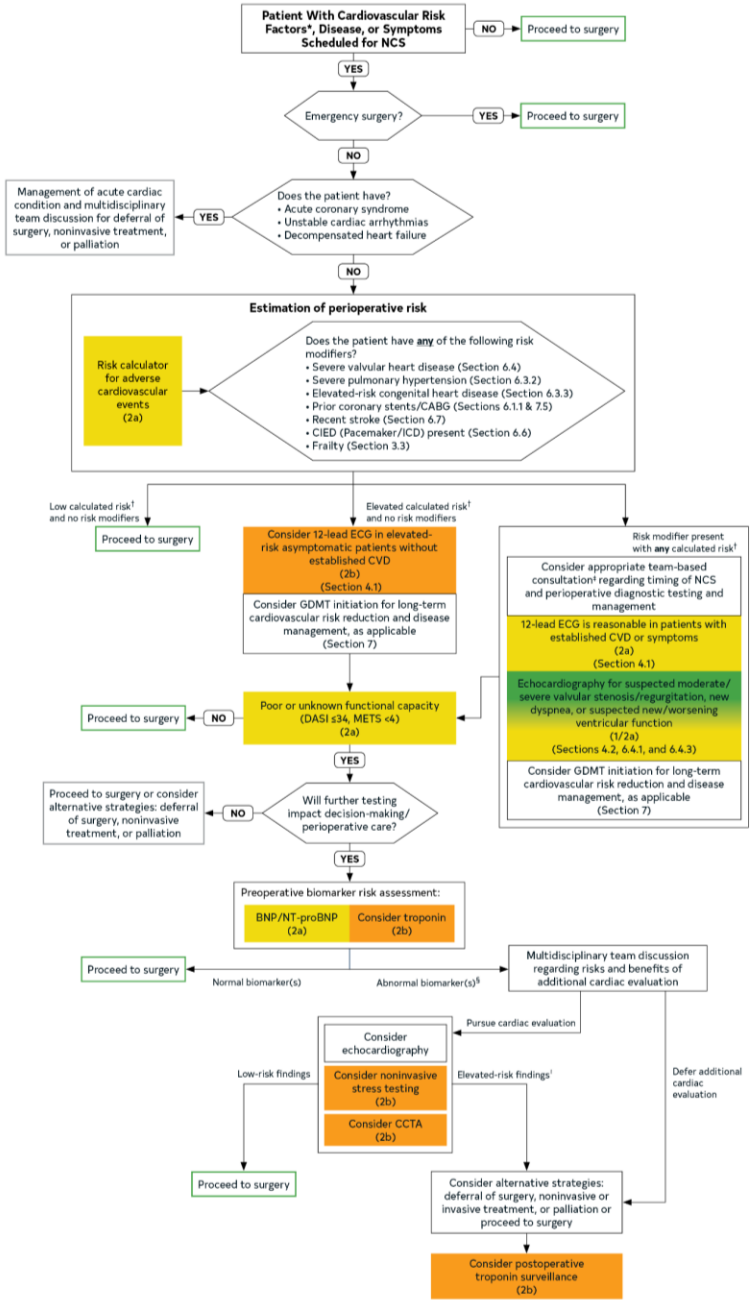
Bhave SD, et al. JACC. 2024;84(19):1970-1975.

*For warfarin, pre- and postop bridging only if high thrombotic risk. AF = atrial fibrillation; FoCUS = focused cardiac ultrasound; MINS = myocardial injury after noncardiac surgery; OAC = oral anticoagulant; periop = perioperative; postop = postoperative; SGLT2i = sodium-glucose cotransporter-2 inhibitors; TEE = transesophageal echocardiography.

Top Take Home Messages

1. A stepwise approach to perioperative cardiac assessment assists clinicians in determining when surgery should proceed or when a pause for further evaluation is warranted.

Figure 1. Stepwise Approach to Perioperative Cardiac Assessment.



Interactive version available at: jacc.org/guidelines/perioperative-cardiovascular-management/interactive (Search: JACC periop tool)

*Cardiovascular risk factors: HTN, smoking, high cholesterol, diabetes, women age >65; men age >55; obesity; family history of premature CAD.

†Determining elevated calculated risk depends on the calculator used. Traditionally, 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.

§Abnormal biomarker thresholds: troponin >99th percentile URL for the assay; BNP >92 ng/L, NT-proBNP ≥300 ng/L.

‡Conditions that pose additional risk for MACE.

‖Noninvasive stress testing or CCTA suggestive of LM or multivessel CAD.

Perioperative Guideline JACC Interactive Tool: **A Stepwise Approach to Preoperative Cardiac Assessment**

Use this tool to assess patients with cardiovascular risk factors, diseases, or symptoms who are scheduled for noncardiac surgery.

Abbreviations | FAQ |

Modify Selections

- Noncardiac surgery evaluation
- CV risk factors, disease, symptoms: Yes
- Emergency surgery: No
- Acute cardiac condition: No
- Additional risk modifiers: No

Start Over | Back

Calculate risk for adverse cardiovascular events using a validated perioperative risk calculator

Determining elevated calculated risk depends on the calculator used. Traditionally, 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.

Download Risk Scores and Calculators Table

Next Step

https://www.jacc.org/guidelines/perioperative-cardiovascular-management/interactive

What risk calculator to use?

- Revised cardiac risk index (RCRI)
  - 6 variables: ischemic heart disease, cerebrovascular disease, heart failure, IDDM, SCr>2, intraperitoneal/intrathoracic/vascular case
  - Predicts only cardiac complications
  - Score of 2: ~10% risk at 30 days
  - Available on MDCalc.com
- American College of Surgeons NSQIP
  - 20 variables
  - Predicts cardiac complications, infectious complications, VTE, etc.
  - Available at Riskcalculator.facs.org

Not all risk is cardiac…

Frailty

Recommendation for Frailty Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendation**
2a	**B-NR**	**1. In all patients ≥65 years of age and in those <64 years with perceived frailty who are undergoing elevated-risk NCS, preoperative frailty assessment using a validated tool can be useful for evaluating perioperative risk and guiding management.**

Duke Activity Status Index (DASI)

Activity: Can you…	Weight
take care of yourself (eg, eating, dressing, bathing, or using the toilet)?	2.75
walk indoors, such as around your house?	1.75
walk a block or 2 on level ground?	2.75
climb a flight of stairs or walk a hill?	5.5
run a short distance?	8
do light work around the house (eg, dusting, washing dishes)?	2.7
do moderate work around the house (eg, vacuuming, sweeping floors, carrying in groceries)?	3.5
do heavy work around the house (eg, scrubbing floors, lifting or moving heavy furniture)?	8
do yardwork (eg, raking leaves, weeding, pushing a power mower)?	4.5
have sexual relations?	5.25
participate in moderate recreational activities (eg, golf, bowling, dancing, doubles tennis, throwing a baseball or football)?	6
participate in strenuous sports (eg, swimming, singles tennis, basketball, skiing)?	7.5

Score ≤34: Increased odds of 30-day death or MI

Top Take Home Messages

2. Cardiovascular screening and treatment of patients undergoing noncardiac surgery (NCS) should adhere to the same indications as nonsurgical patients, carefully timed to avoid delays in surgery and chosen in ways to avoid overscreening and overtreatment.

Top Take Home Messages

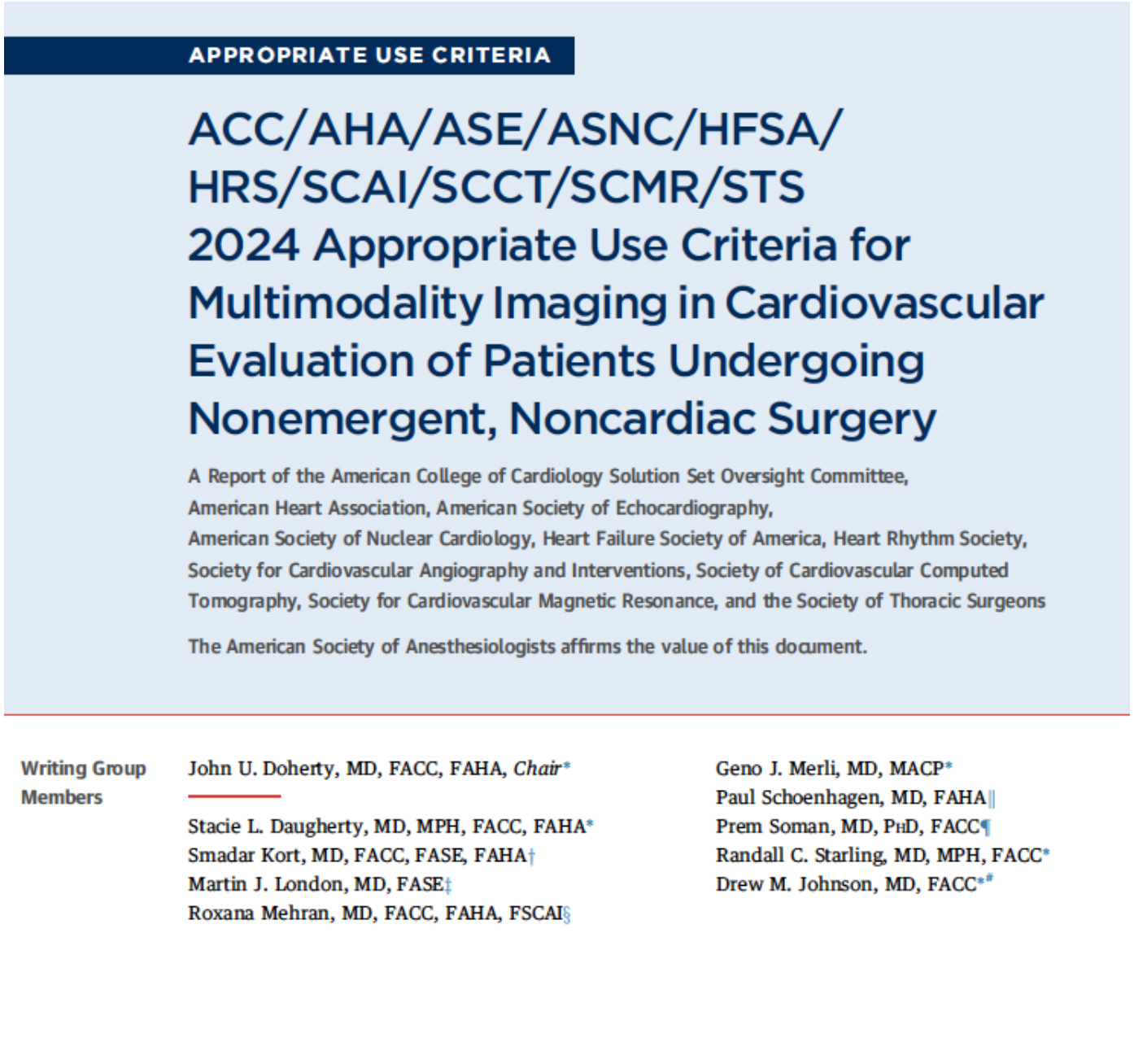
3. Stress testing should be performed judiciously in patients undergoing NCS, especially those at lower risk, and only in patients in whom testing would be appropriate independent of planned surgery.

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.		
COR	**LOE**	**Recommendations**
2a	**B-NR**	**1. 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.**
2b	**B-NR**	**2. 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 perioperative risk.**

How should we operationalize use of preoperative biomarkers? The jury is still out…

Who should have an echo or a stress test before surgery?



APPROPRIATE USE CRITERIA

ACC/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2024 Appropriate Use Criteria for Multimodality Imaging in Cardiovascular Evaluation of Patients Undergoing Nonemergent, Noncardiac Surgery

A Report of the American College of Cardiology Solution Set Oversight Committee, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society of Thoracic Surgeons

The American Society of Anesthesiologists affirms the value of this document.

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Preoperative AUC: overview

- First AUC document to address preoperative cardiac testing
- Multimodality document
- 182 clinical scenarios
  - Known or suspected heart disease?
  - Any prior cardiac testing?
  - Functional status (<4 METs vs. ≥4 METs)
  - Type of surgery
- Imaging less likely to be considered appropriate for asymptomatic, functional patients and those having low-risk surgery
- Payors pay attention to AUC!

Asymptomatic, functional patients

TABLE 1.1 No New or Worsening Symptoms AND a Functional Status ≥4 METs

Clinical Scenario Text	TTE (With or Without 3D; With or Without Contrast-Enhancing Agent)	TEE	ECG Stress Only	Exercise Stress Echo/ DSE	MPI (SPECT/PET) (Exercise or Pharmacologic)	Stress Perfusion MRI	CT Coronary Calcium Scoring	CT Coronary Angiography (With or Without FFR CT)	Gated Chest CT (With or Without Contrast-Enhancing Agent)	Cardiac MR (for Structure and Function, With or Without Contrast-Enhancing Agent)	Invasive Coronary Angiography
1. Patient undergoing low-risk nonvascular surgery	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)
2. Patient undergoing intermediate-risk nonvascular surgery	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)
3. Patient undergoing high-risk nonvascular surgery	4 (M)	1 (R)	3 (R)	2 (R)	2 (R)	2 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)
4. Patient undergoing low-risk vascular surgery	2 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)	1 (R)
5. Patient undergoing intermediate-risk vascular surgery	3 (R)	1 (R)	3 (R)	2 (R)	2 (R)	1 (R)	1 (R)	1 (R)	1 (R)	2 (R)	1 (R)
6. Patient undergoing high-risk vascular surgery	4 (M)	1 (R)	4 (M)	3 (R)	3 (R)	3 (R)	1 (R)	3 (R)	1 (R)	3 (R)	2 (R)
7. Patient undergoing solid organ transplantation (recipient only)	7 (A)	1 (R)	4 (M)	5 (M)	5 (M)	5 (M)	3 (R)	4 (M)	1 (R)	3 (R)	3 (R)

Doherty et al., J Am Coll Cardiol. 2024

Patients with symptoms or poor functional status

TABLE 2.2 New or Worsening Symptoms OR a Functional Status <4 METs

Clinical Scenario Text	TTE (With or Without 3D; With or Without Contrast - Enhancing Agent)	TEE	ECG Stress Only	Exercise Stress Echo/ DSE	MPI (SPECT/PET) (Exercise or Pharmacologic)	Stress Perfusion MRI	CT Coronary Calcium Scoring	CT Coronary Angiography (With or Without FFR CT)	Gated Chest CT (With or Without Contrast-Enhancing Agent)	Cardiac MR (for Structure and Function, With or Without Contrast-Enhancing Agent)	Invasive Coronary Angiography
Known or Suspected Ischemic Heart Disease											
22. Patient undergoing low-risk nonvascular surgery	5 (M)	1 (R)	3 (R)	4 (M)	4 (M)	4 (M)	1 (R)	3 (R)	1 (R)	3 (R)	2 (R)
23. Patient undergoing intermediate-risk nonvascular surgery	6 (M)	1 (R)	4 (M)	6 (M)	6 (M)	6 (M)	1 (R)	5 (M)	1 (R)	3 (R)	3 (R)
24. Patient undergoing high-risk nonvascular surgery	7 (A)	1 (R)	5 (M)	7 (A)	7 (A)	7 (A)	1 (R)	6 (M)	1 (R)	3 (R)	4 (M)
25. Patient undergoing low-risk vascular surgery	5 (M)	1 (R)	4 (M)	6 (M)	6 (M)	6 (M)	1 (R)	5 (M)	1 (R)	3 (R)	3 (R)
26. Patient undergoing intermediate-risk vascular surgery	7 (A)	1 (R)	5 (M)	7 (A)	7 (A)	7 (A)	2 (R)	6 (M)	2 (R)	3 (R)	4 (M)
27. Patient undergoing high-risk vascular surgery	8 (A)	1 (R)	6 (M)	8 (A)	8 (A)	8 (A)	1 (R)	7 (A)	1 (R)	4 (M)	5 (M)
28. Patient undergoing solid organ transplantation (recipient only)	8 (A)	1 (R)	7 (A)	8 (A)	8 (A)	8 (A)	1 (R)	7 (A)	2 (R)	4 (M)	6 (M)

Doherty et al., J Am Coll Cardiol. 2024

Stress Testing

Recommendations for Stress Testing Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendations**
2b	**B-NR**	**1. For patients undergoing elevated-risk NCS with poor or unknown functional capacity and elevated risk for perioperative cardiovascular events based on a validated risk tool, stress testing may be considered to evaluate for inducible myocardial ischemia.**
3: No benefit	**B-R**	**2. In patients who are at low risk for perioperative cardiovascular events, have adequate* functional capacity with stable symptoms, or who are undergoing low-risk procedures, routine stress testing before NCS is not recommended due to lack of benefit.**

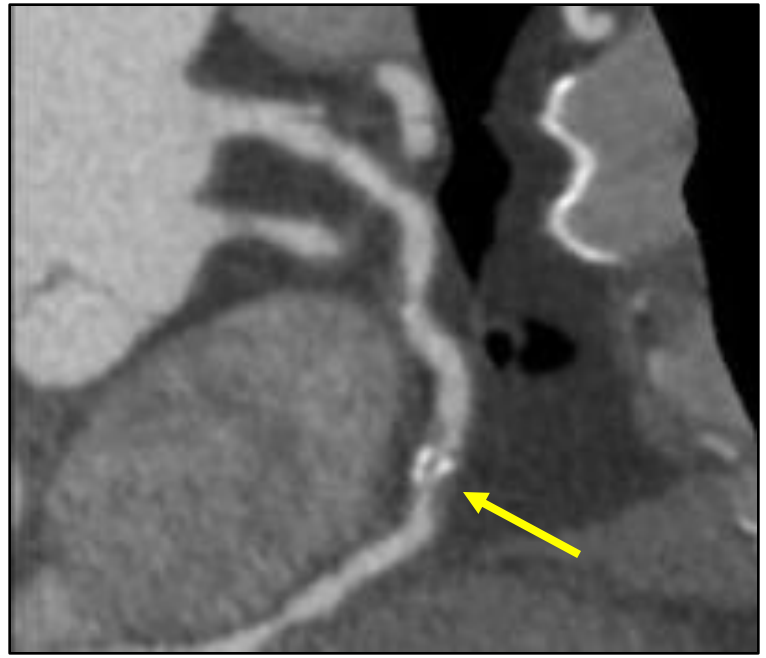
*Poor functional capacity is considered <4 METS or a DASI score of ≤34.

Considerations and Contraindications for Specific Stress Testing Modalities

Modality	**Contraindication***
Vasodilator pharmacological stress imaging	Significant arrhythmias (eg, VT, second- or third-degree atrioventricular block), significant hypotension (SBP <90 mm Hg), known or suspected bronchoconstrictive or bronchospastic disease or recent use of dipyridamole or methylxanthines (eg, aminophylline, caffeine) within 12 h
Exercise stress testing (with or without imaging)	Inability to exercise
Dobutamine stress echocardiography	Critical aortic stenosis, hemodynamically significant LVOT obstruction

Coronary CTA

- Greatest strength: high negative predictive value
  - Order when you expect it to be normal!
- Coronary calcium can confound interpretation
- Equivocal results are common
- Contrast load: greater than for diagnostic cath
- Wait times are shorter than for PET or SPECT



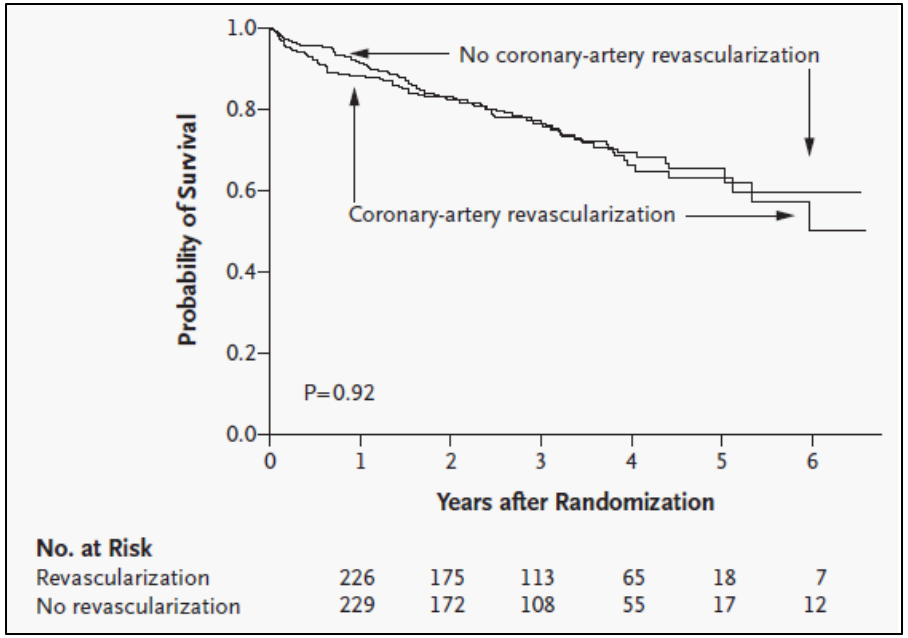
Invasive Coronary Angiography

Recommendation for Invasive Coronary Angiography		
COR	**LOE**	**Recommendation**
3: No benefit	**C-LD**	**1. In patients undergoing NCS, routine preoperative invasive coronary angiography (ICA) is not recommended to improve perioperative outcomes.**

Why not just cath all high-risk patients? CARP Trial

- 5859 VA patients scheduled for major elective vascular surgery (AAA repair or lower extremity revascularization)
- All underwent coronary angiography
- Randomized to coronary revascularization vs. no revascularization
- Exclusion criteria: left main disease, severe AS, severe LV dysfunction

Postop MI: 12% of revasc group, 14% of no-revasc group (P=0.37)



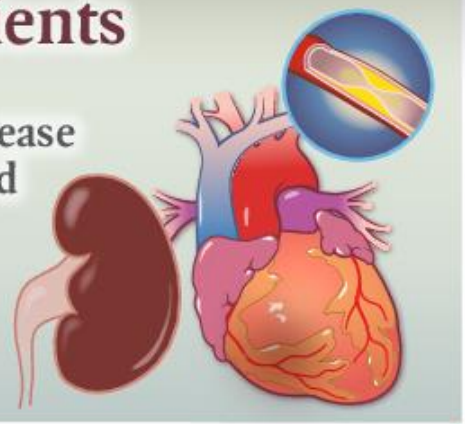
McFalls et al., NEJM 2004

The NEW ENGLAND JOURNAL of MEDICINE

Managing Coronary Disease in Advanced Kidney Disease

OPEN-LABEL RANDOMIZED, CONTROLLED TRIAL

777 Patients
with stable coronary disease and advanced CKD

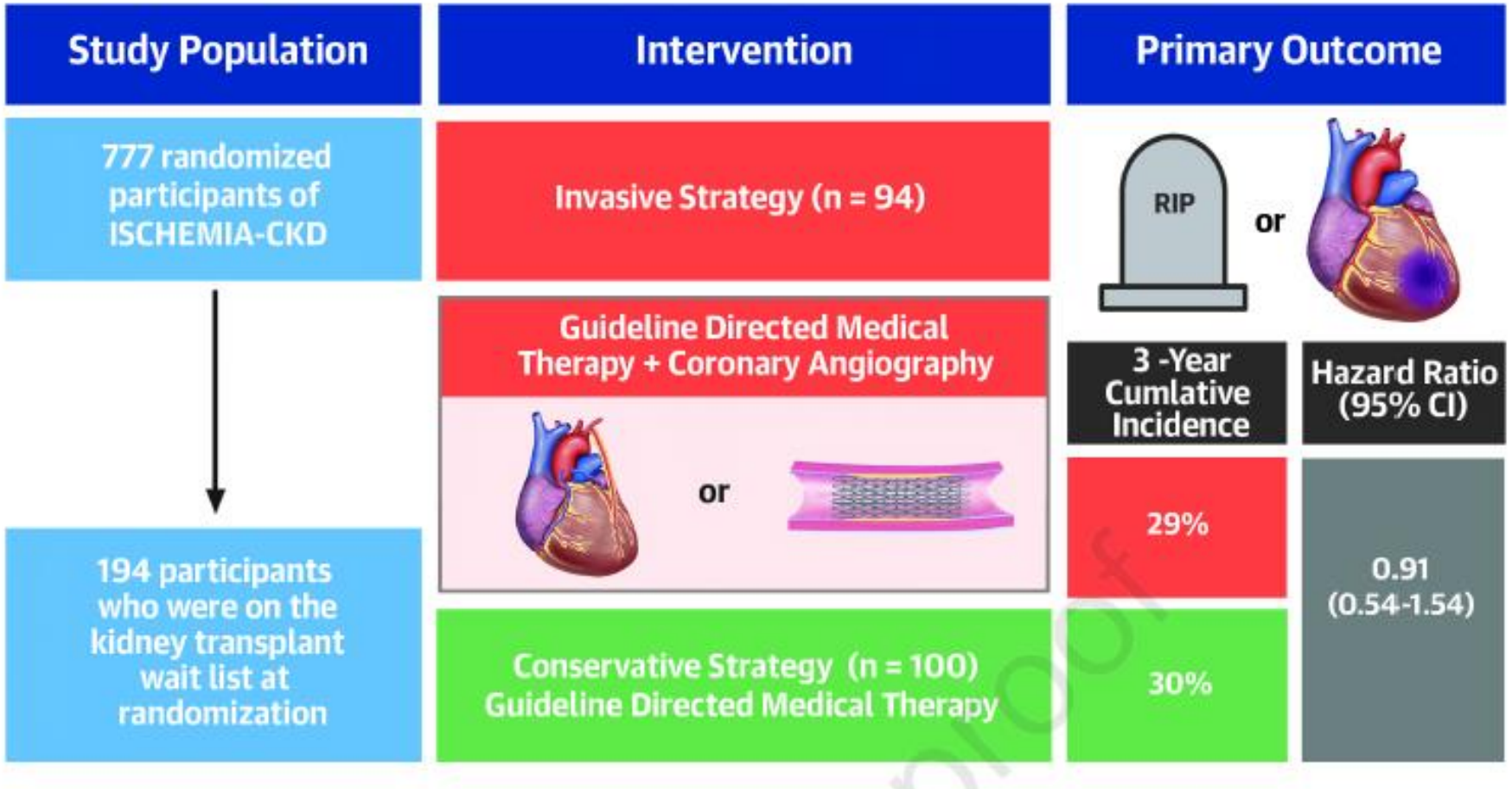


	Invasive Strategy	Conservative Care
	+ Medical therapy	Medical therapy
	(N=388)	(N=389)
Death or nonfatal MI	123	129
	Adjusted HR 1.01; 95% CI, 0.79–1.29; P=0.95	
Angina-related health status	No difference in Seattle Angina Questionnaire summary score	

Invasive treatment did not reduce the rate of death or nonfatal MI or improve angina-related health status

S. Bangalore et al. 10.1056/NEJMoa1915925

ISCHEMIA-CKD: transplant post-hoc analysis



Herzog et al., J Am Coll Cardiol. 2021

If they need a stress test or a cath for life, they should probably have it before elective surgery.

If not, think twice before ordering.

AMERICAN COLLEGE of CARDIOLOGY

Top Take Home Messages

5. New therapies for management of diabetes, heart failure, and obesity have significant perioperative implications. SGLT2 inhibitors should be discontinued 3-4 days before surgery to minimize the risk of perioperative ketoacidosis associated with their use.

What about other cardiac medications?

- Beta-blockers: continue (don't start *de novo*)
- Statins: continue
- Most antihypertensives: continue
- ACEI, ARB, ARNI: consider 24-hr hold

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	1. 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.[1-6]
2a	C-EO	2. In patients on chronic RAASi for HFrEF, perioperative continuation is reasonable.†[1,2]

*Patients with controlled BP and undergoing elevated-risk surgical procedures. †Modified from the "2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure."[7]

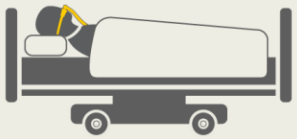
STOP-or-NOT trial

JAMA

QUESTION Is a continuation strategy of renin-angiotensin system inhibitors (RASIs) before major noncardiac surgery associated with better postoperative outcomes than discontinuation?

CONCLUSION In patients undergoing major noncardiac surgery and treated long-term with RASIs, a continuation strategy of the medication was associated with a similar rate of all-cause mortality or major postoperative complications vs a discontinuation strategy.

POPULATION



1451 Men 771 Women

Adults taking RASIs and undergoing noncardiac surgery

Mean age: 67 years

LOCATIONS

40 Hospitals in France

INTERVENTION

2222 Patients randomized

1115

Discontinuation of RASIs

Discontinue use of RASIs 48 h prior to surgery (last dose 3 d before surgery)

1107

Continuation of RASIs

Continue use of RASIs until the day of surgery

PRIMARY OUTCOME

Composite of all-cause mortality and major postoperative complications within 28 d after surgery

FINDINGS

All-cause mortality or major postoperative complications

Discontinuation of RASIs	Continuation of RASIs
245 events (22% of patients)	247 events (22% of patients)

Discontinuation of RASIs was not associated with a higher rate of all-cause mortality or major postoperative complications:

Risk ratio, 1.02 (95% CI, 0.87 to 1.19); *P* = .85

Legrand M, Falcone J, Cholley B, et al, for the Stop-or-Not Trial Group. Continuation vs discontinuation of renin-angiotensin system inhibitors before major noncardiac surgery: the Stop-or-Not randomized clinical trial. *JAMA*. doi:10.1001/jama.2024.17123

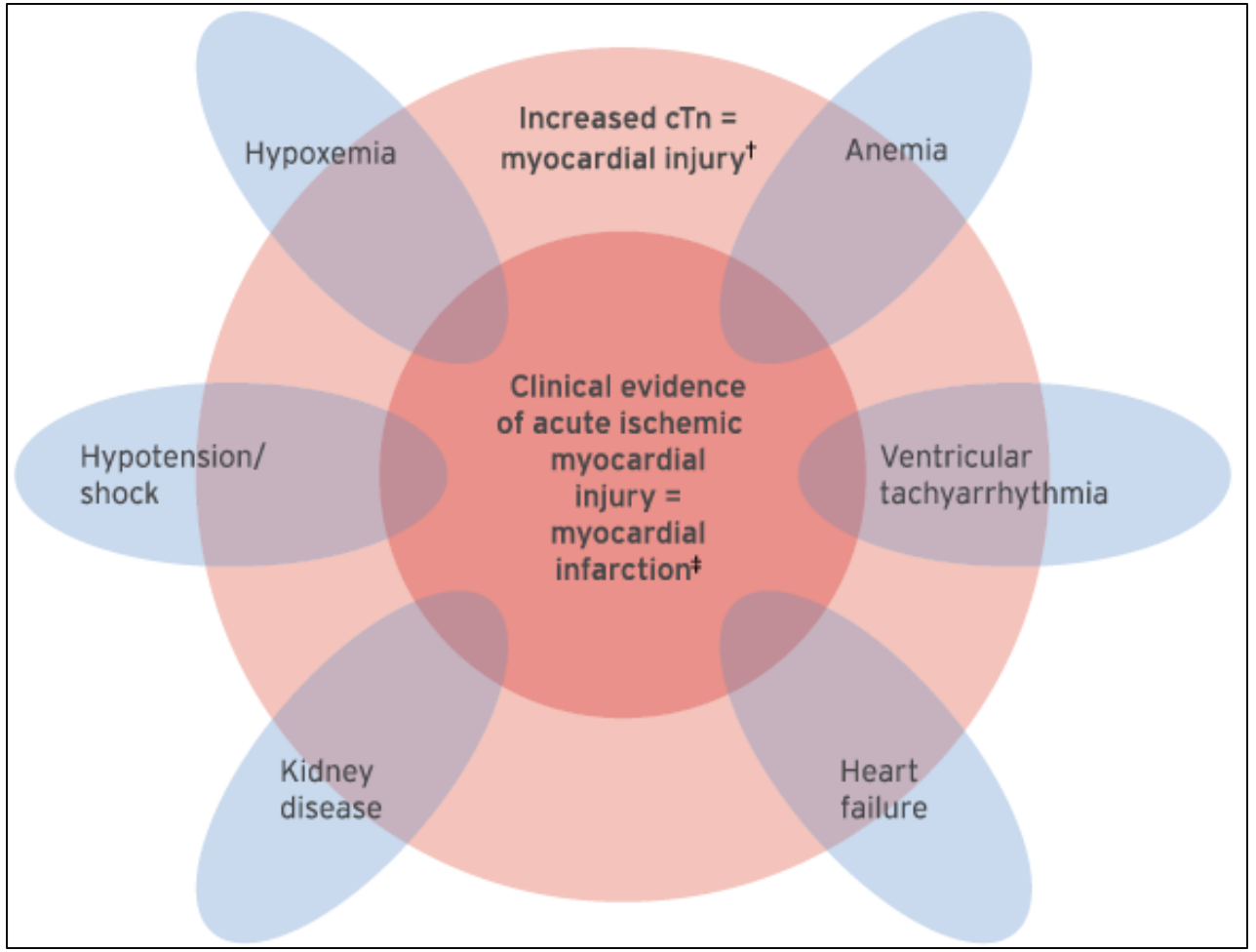
More hypotension in continuation group:
54% vs. 41%,
risk ratio 1.31

Top Take Home Messages

6. Myocardial injury after NCS **(MINS)** is a newly identified disease process that should not be ignored because it portends real consequences for affected patients.

Definition: >1 elevated troponin (>99th %ile) of presumed ischemic origin

Beware: Not all myocardial injury is ischemic…



4th Universal Definition of Myocardial Infarction, Thygesen et al., Circulation 2018

Is it plaque rupture or not??

- If higher suspicion for type II MI (supply-demand mismatch), start with conservative management, correcting anemia, tachycardia, hypotension; then consider coronary angiography only if patient worsens clinically
  - Warrants outpatient workup (cardiology visit, and vasodilator perfusion study or coronary angiography)
- If high suspicion for type I MI (plaque rupture), consider urgent coronary angiography
- Please consult us!

Myocardial Injury After Noncardiac Surgery: Surveillance and Management

Recommendations for Myocardial Injury After Noncardiac Surgery Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendations**
		MINS Surveillance
2b	**B-NR**	**1. 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.**
3: No benefit	**B-NR**	**2. In patients undergoing low-risk NCS, routine postoperative screening with cTn levels is not indicated without signs or symptoms suggestive of myocardial ischemia or MI.**

Myocardial Injury After Noncardiac Surgery: Surveillance and Management

MINS Management		
2a	B-NR	1. In patients who develop MINS, especially in those not previously known to have excess cardiovascular risk, outpatient follow-up is reasonable for optimization of cardiovascular risk factors.
2b	C-LD	2. In patients who develop MINS, antithrombotic therapy may be considered to reduce thromboembolic events.

Very controversial

Top Take Home Messages

7. Patients with newly diagnosed atrial fibrillation identified during or after NCS have an increased risk of stroke. These patients should be followed closely after surgery to treat reversible causes of arrhythmia and to assess the need for rhythm control and long-term anticoagulation.

Atrial Fibrillation

Recommendations for Atrial Fibrillation		
COR	**LOE**	**Recommendations**
		Perioperative
2a	**C-LD**	**1. In patients with rapid AF identified in the setting of NCS, it is reasonable to treat potential underlying triggers contributing to AF and rapid ventricular response (eg, sepsis, anemia, pain).***
2a	**C-LD**	**2. In patients with new-onset AF identified in the setting of NCS, initiation of postoperative anticoagulation therapy can be beneficial after considering the competing risks associated with thromboembolism and perioperative bleeding.***
		Post-discharge
1	**C-LD**	**3. In patients with new-onset AF identified in the setting of NCS, outpatient follow-up for thromboembolic risk stratification and AF surveillance are recommended given a high risk of AF recurrence.***

*Adapted from the "2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation."

Atrial fibrillation tends to come back.
Don’t assume it won’t.
Keep me informed.

Top Take Home Messages

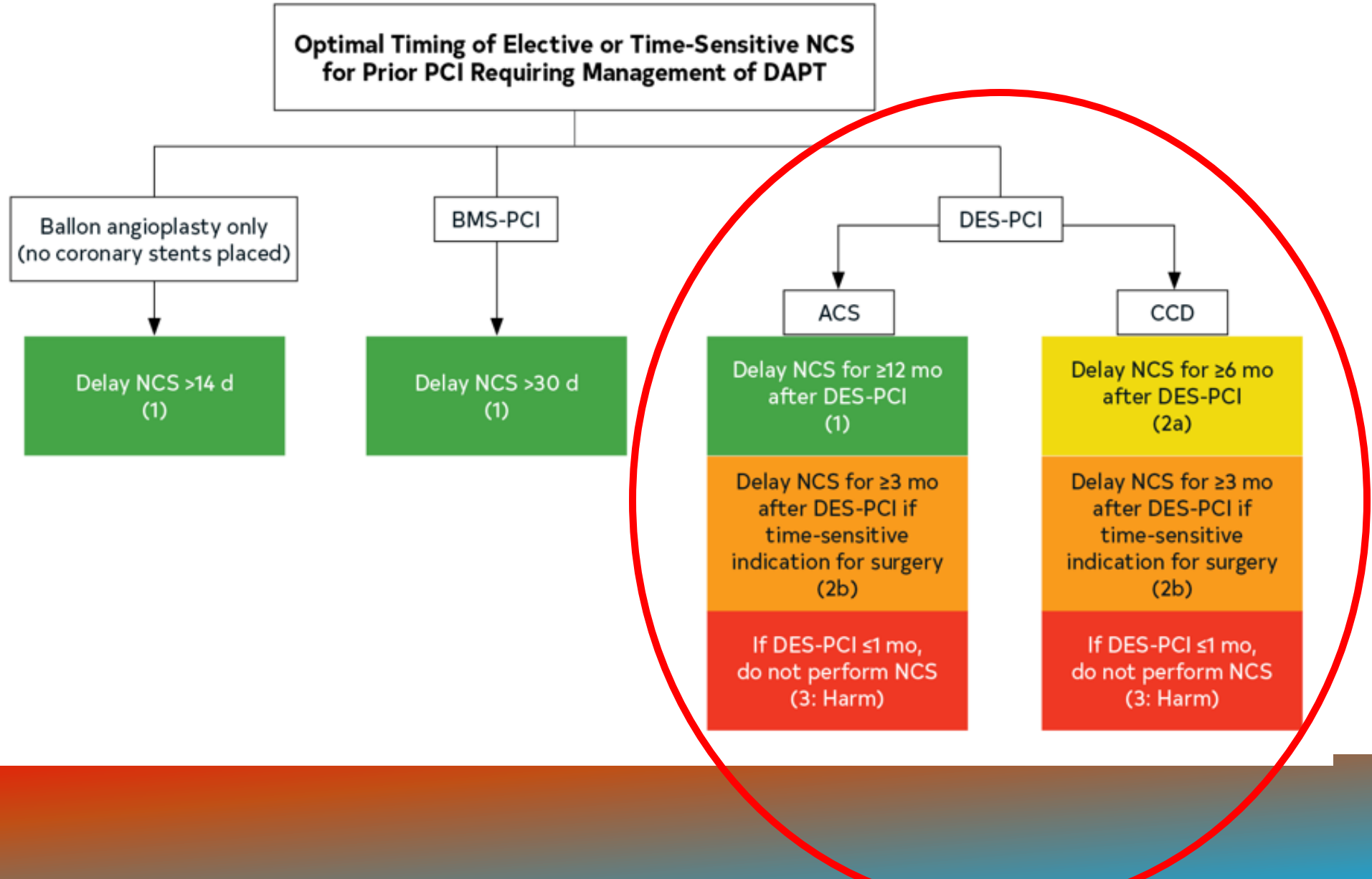
8. Perioperative bridging of oral anticoagulant therapy should be used selectively only in those patients at highest risk for thrombotic complications and is not recommended in the majority of cases.

High thromboembolic risk conditions

Risk Category	Venous Thromboembolism	Atrial Fibrillation	Mechanical Valve	Other Indications
High	Recent VTE (<1 mo or <3 mo)	CHA_2DS_2-VASc ≥7 (or 5-6 with recent stroke or TIA) AF with rheumatic valvular heart disease	Mechanical mitral valve Caged ball or tilting-disk valve Mechanical heart valve in any position with recent stroke or TIA (<3 mo)	Recent cardioembolic stroke (<3 mo)‡ Active cancer a/w high VTE risk LV thrombus (within last 3 mo) Severe thrombophilia, antiphospholipid antibodies

For patients at high thromboembolic risk, clear documentation of the perioperative anticoagulation plan is critical.

Figure 5. Optimal Timing of Elective or Time-Sensitive NCS for Prior PCI Requiring Management of DAPT.

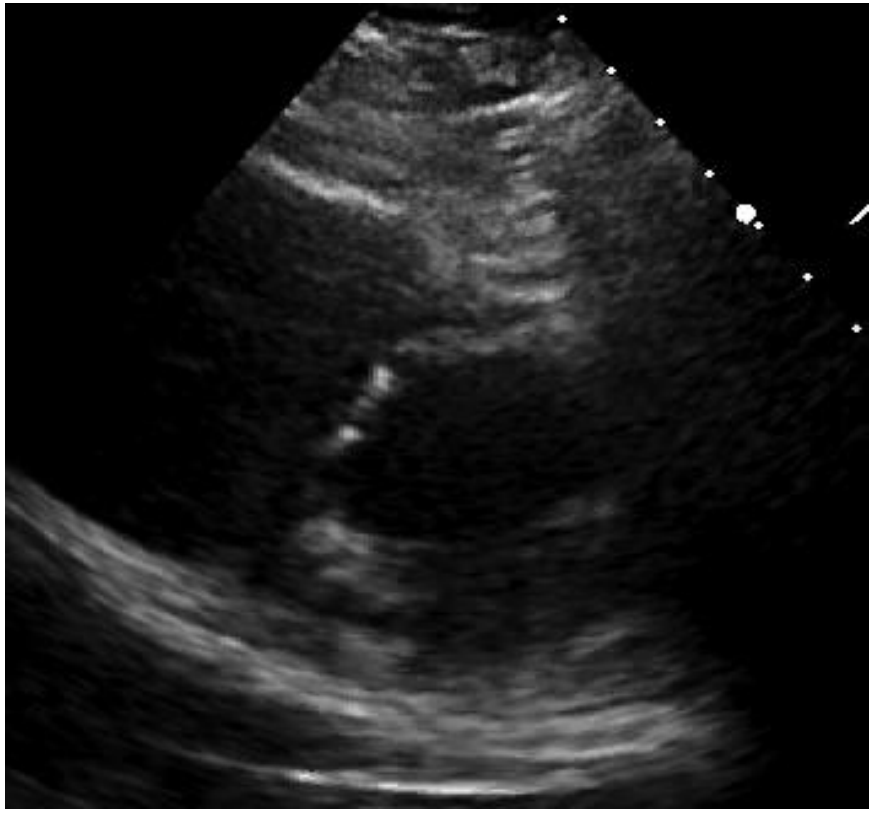


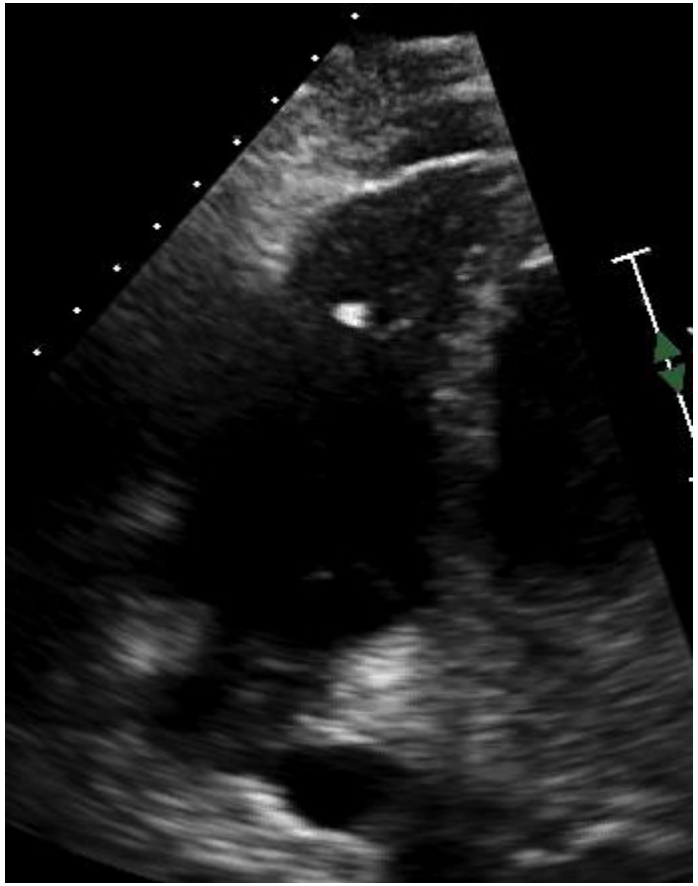
BMS indicates bare-metal stent; DAPT, dual antiplatelet therapy; DES, drug-eluting stent; NCS, noncardiac surgery; and PCI, percutaneous coronary intervention.

Top Take Home Messages

9. In patients with unexplained hemodynamic instability and when clinical expertise is available, emergency focused cardiac ultrasound can be used for preoperative evaluation; however, focused cardiac ultrasound (FoCUS) should not replace comprehensive transthoracic echocardiography.

FoCUS: just the basics





Bringing it back to the patient

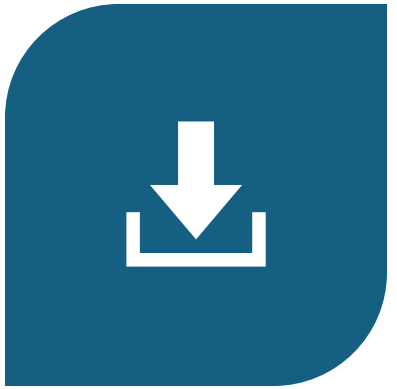
- Make the preoperative visit an opportunity to educate about cardiac conditions and risks of surgery
- Engage in shared decision-making
- Be transparent about workup, interdisciplinary discussions, and areas of uncertainty
- Emphasize importance of postoperative follow up for new and existing cardiovascular conditions

Thank you

Resources

ACC GUIDELINE HUB:
ACC.ORG/GUIDELINES

ACC PATIENT-FACING PAGE:
CARDIOSMART.ORG



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