

2025 Update in Perioperative Medicine



AT THE FOREFRONT
UChicago
Medicine

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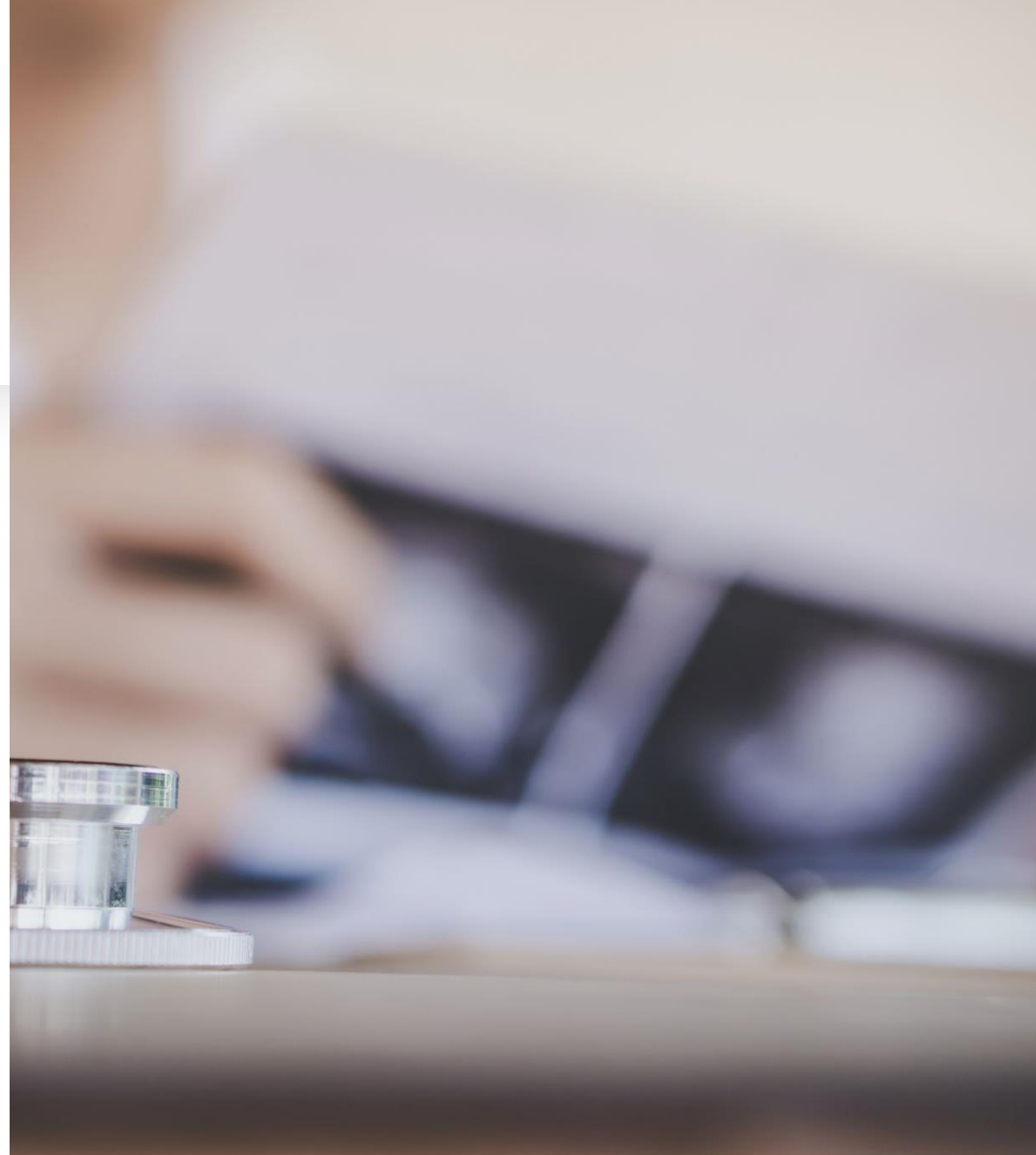
University of Chicago

Disclosures

I have NO relevant financial disclosures or conflicts of interest with the presented material in this presentation

Objectives & Overview

- Apply new perioperative medicine knowledge to patient care
- Educate patients with chronic disease on how best to optimize their surgical risk
- Review one's own perioperative management, appraisal and assimilation of scientific evidence, and improvements in patient care



CLINICAL PRACTICE GUIDELINE

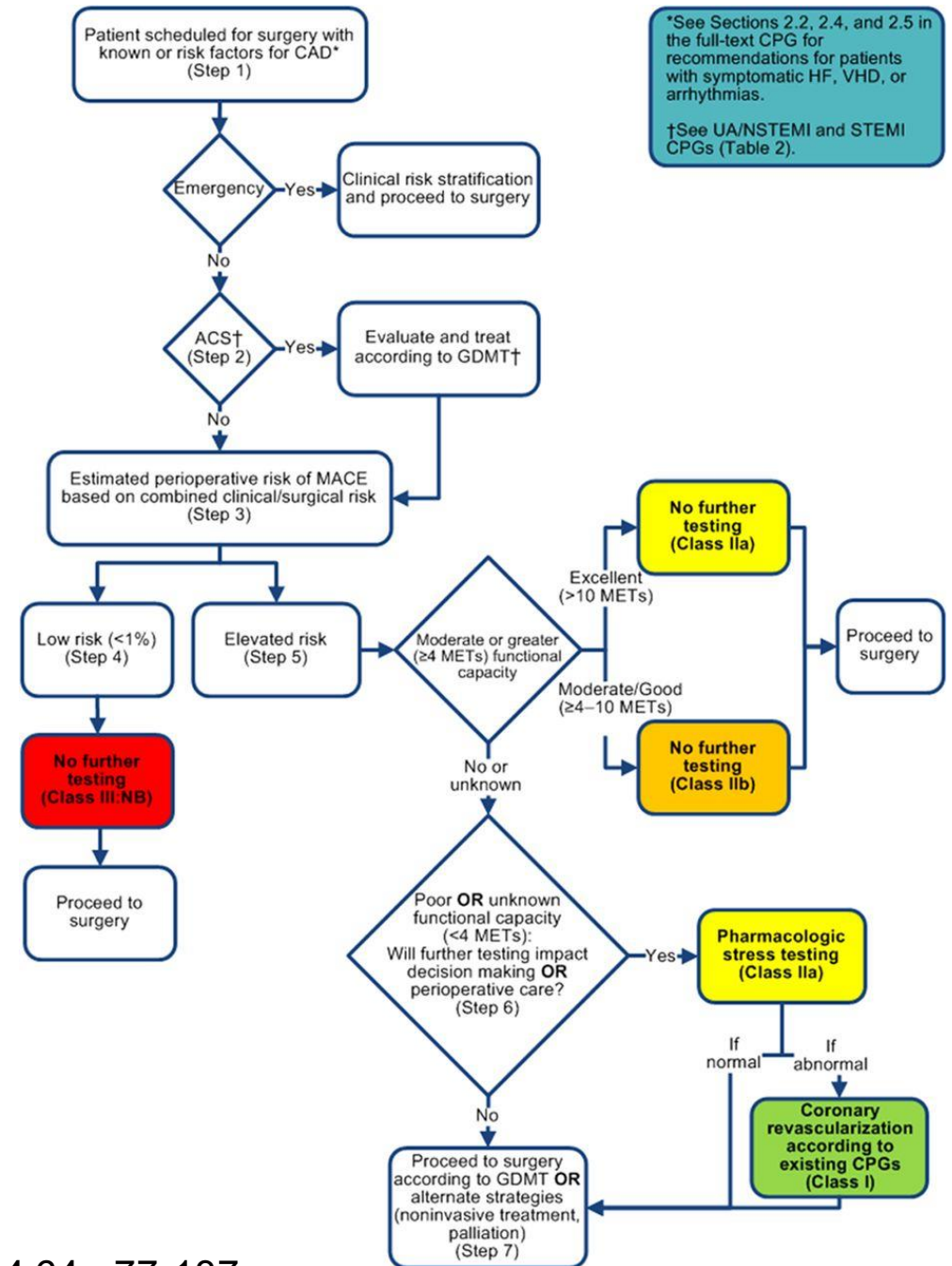
2024 AHA/ACC/ACS/ASNC/HRS/ SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association
Joint Committee on Clinical Practice Guidelines

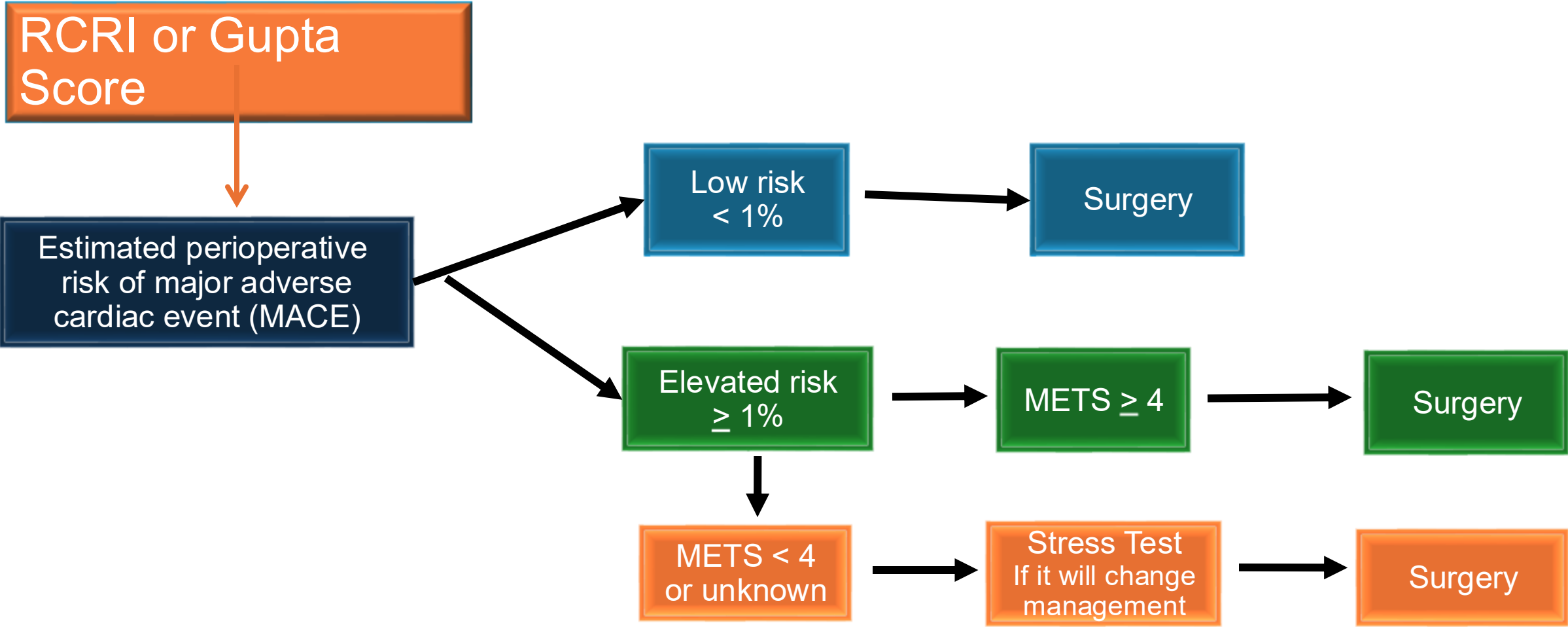
Developed in Collaboration With and Endorsed by the American College of Surgeons,
American Society of Nuclear Cardiology, Heart Rhythm Society,
Society of Cardiovascular Anesthesiologists, Society of Cardiovascular Computed Tomography,
Society for Cardiovascular Magnetic Resonance, and the Society for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

Perioperative Guideline History

2014 ACC/AHA Guidelines



2014 ACC/AHA Guidelines

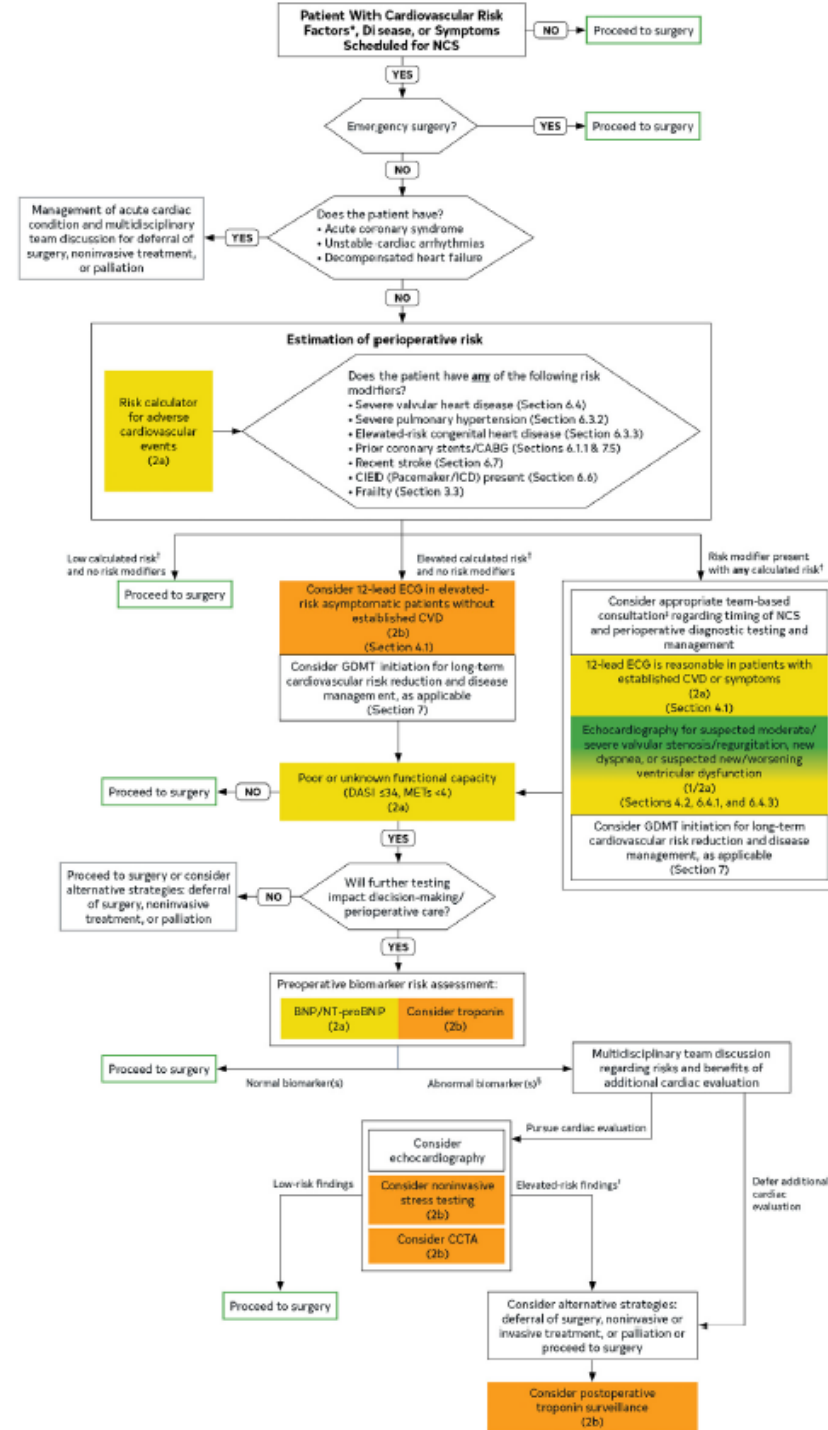


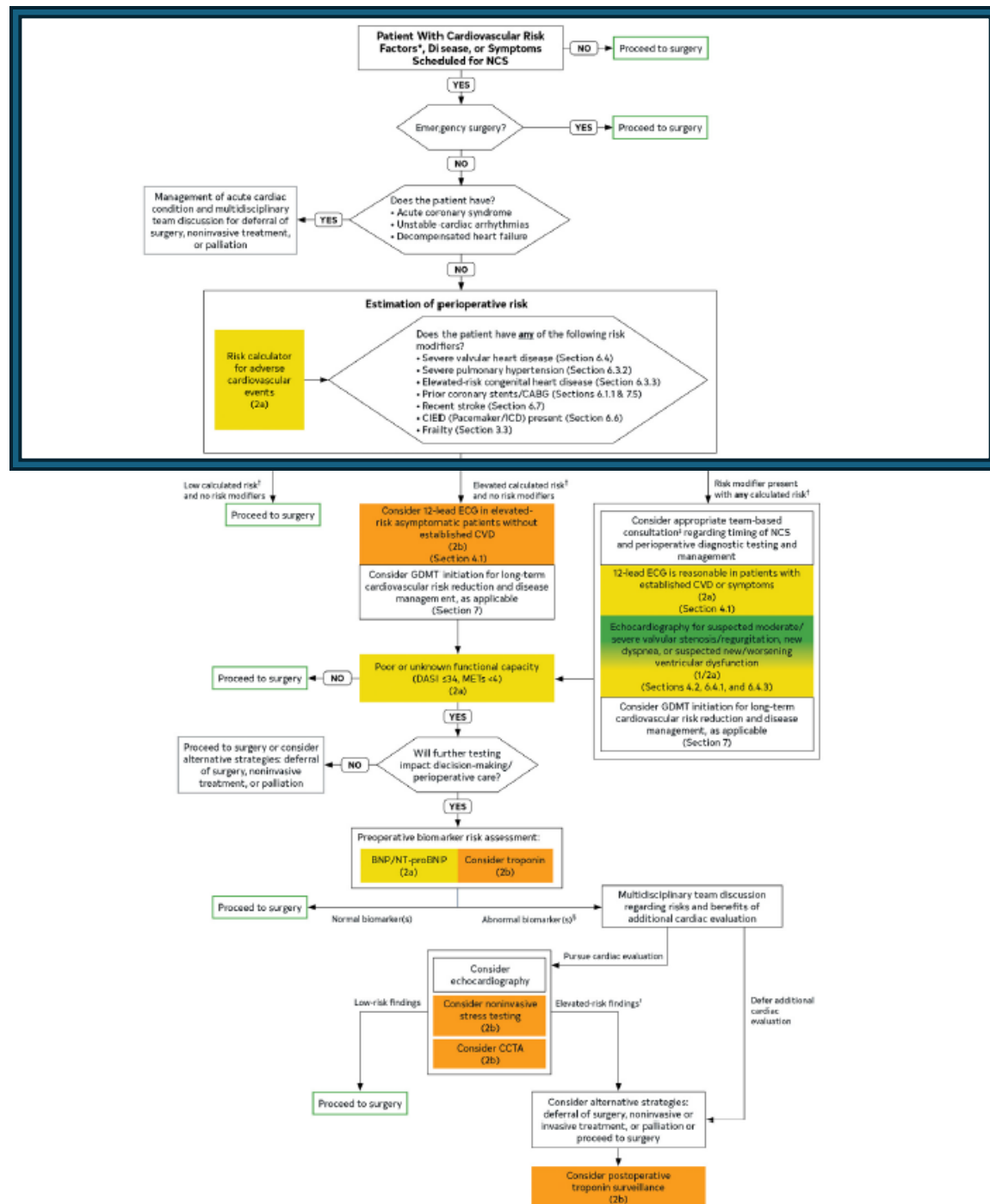
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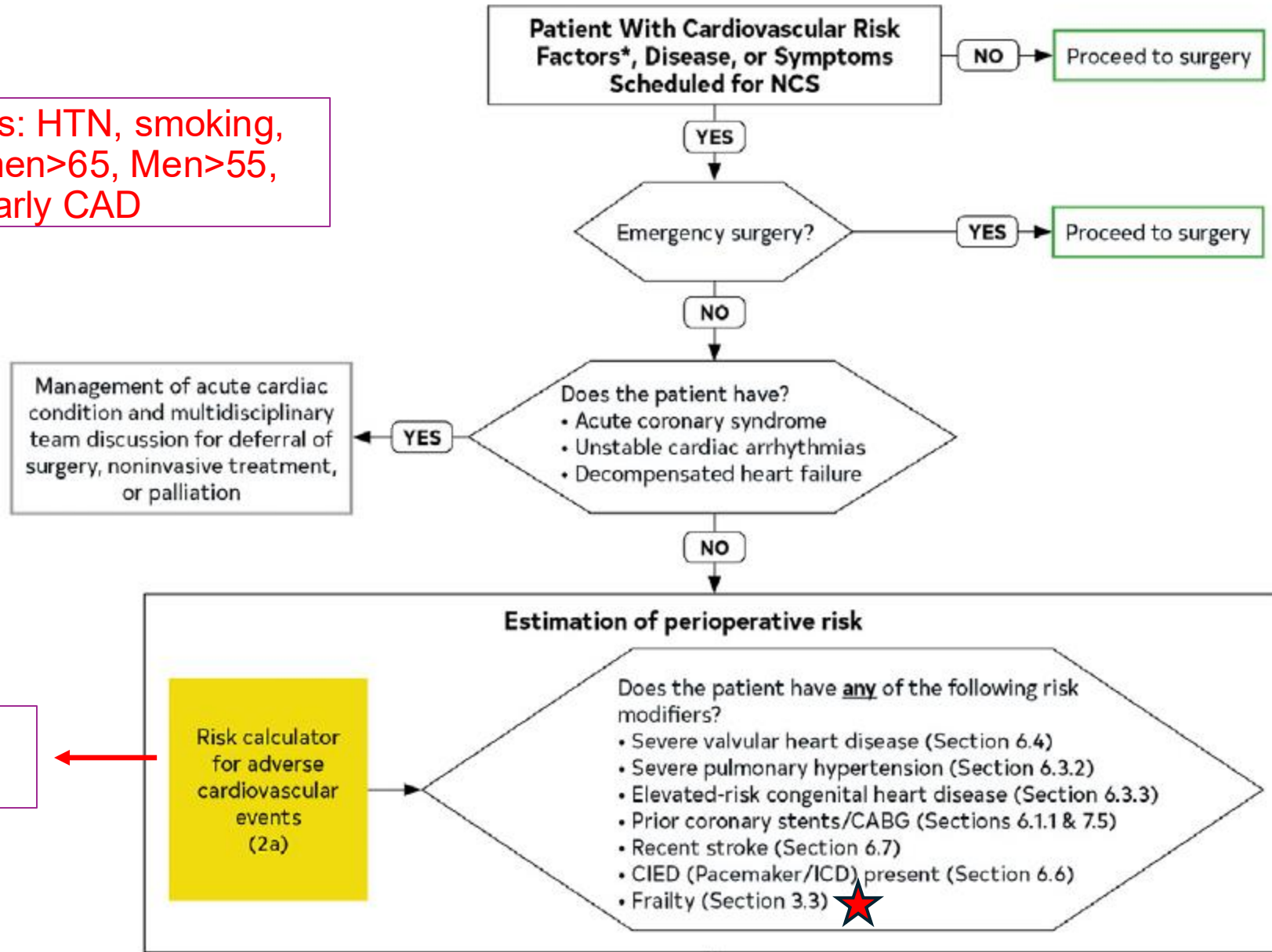
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*CV Risk factors: HTN, smoking, HLD, DM, Women>65, Men>55, obesity, FMH early CAD



RCRI, Gupta, NSQIP, etc.

TABLE 3 Applying the American College of Cardiology/American Heart Association Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care (Updated May 2019)

CLASS (STRENGTH) OF RECOMMENDATION	LEVEL (QUALITY) OF EVIDENCE‡
CLASS 1 (STRONG) Benefit >>> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is recommended • Is indicated/useful/effective/beneficial • Should be performed/administered/other • Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> – Treatment/strategy A is recommended/indicated in preference to treatment B – Treatment A should be chosen over treatment B 	LEVEL A <ul style="list-style-type: none"> • High-quality evidence‡ from more than 1 RCT • Meta-analyses of high-quality RCTs • One or more RCTs corroborated by high-quality registry studies
CLASS 2a (MODERATE) Benefit >> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is reasonable • Can be useful/effective/beneficial • Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> – Treatment/strategy A is probably recommended/indicated in preference to treatment B – It is reasonable to choose treatment A over treatment B 	LEVEL B-R (Randomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more RCTs • Meta-analyses of moderate-quality RCTs
CLASS 2b (WEAK) Benefit ≥ Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • May/might be reasonable • May/might be considered • Usefulness/effectiveness is unknown/unclear/uncertain or not well-established 	LEVEL B-NR (Nonrandomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies • Meta-analyses of such studies
CLASS 3: No Benefit (MODERATE) Benefit = Risk (Generally, LOE A or B use only) Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is not recommended • Is not indicated/useful/effective/beneficial • Should not be performed/administered/other 	LEVEL C-LD (Limited Data) <ul style="list-style-type: none"> • Randomized or nonrandomized observational or registry studies with limitations of design or execution • Meta-analyses of such studies • Physiological or mechanistic studies in human subjects
Class 3: Harm (STRONG) Risk > Benefit Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Potentially harmful • Causes harm • Associated with excess morbidity/mortality • Should not be performed/administered/other 	LEVEL C-EO (Expert Opinion) <ul style="list-style-type: none"> • Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR 1 and 2a; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely-used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

Frailty

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. ¹⁻⁵

- Associated with increased risk of 30-day complications and mortality
- Multiple assessment tools available (FRAIL scale, Clinical Frailty Scale, Edmonton Frail Scale)
- Routine screening linked to decreased 30-day mortality
- May guide shared-decision making on whether to proceed to surgery



Understanding Frailty in Perioperative Care

Frailty was highlighted in the [2024 ACC/AHA guidelines](#) as a distinct entity separate from disability or comorbidities. It significantly affects surgical stress response and postoperative recovery.

- ① **Key Paradigm Shift:** Identifying frailty enables proactive management—helping providers mitigate risk rather than simply predict it.

Implementing Frailty-Informed Care



Screening Strategy

Select one validated tool, master its use, and apply consistently. Focus on actionable interventions, not just documentation.



Preoperative Optimization

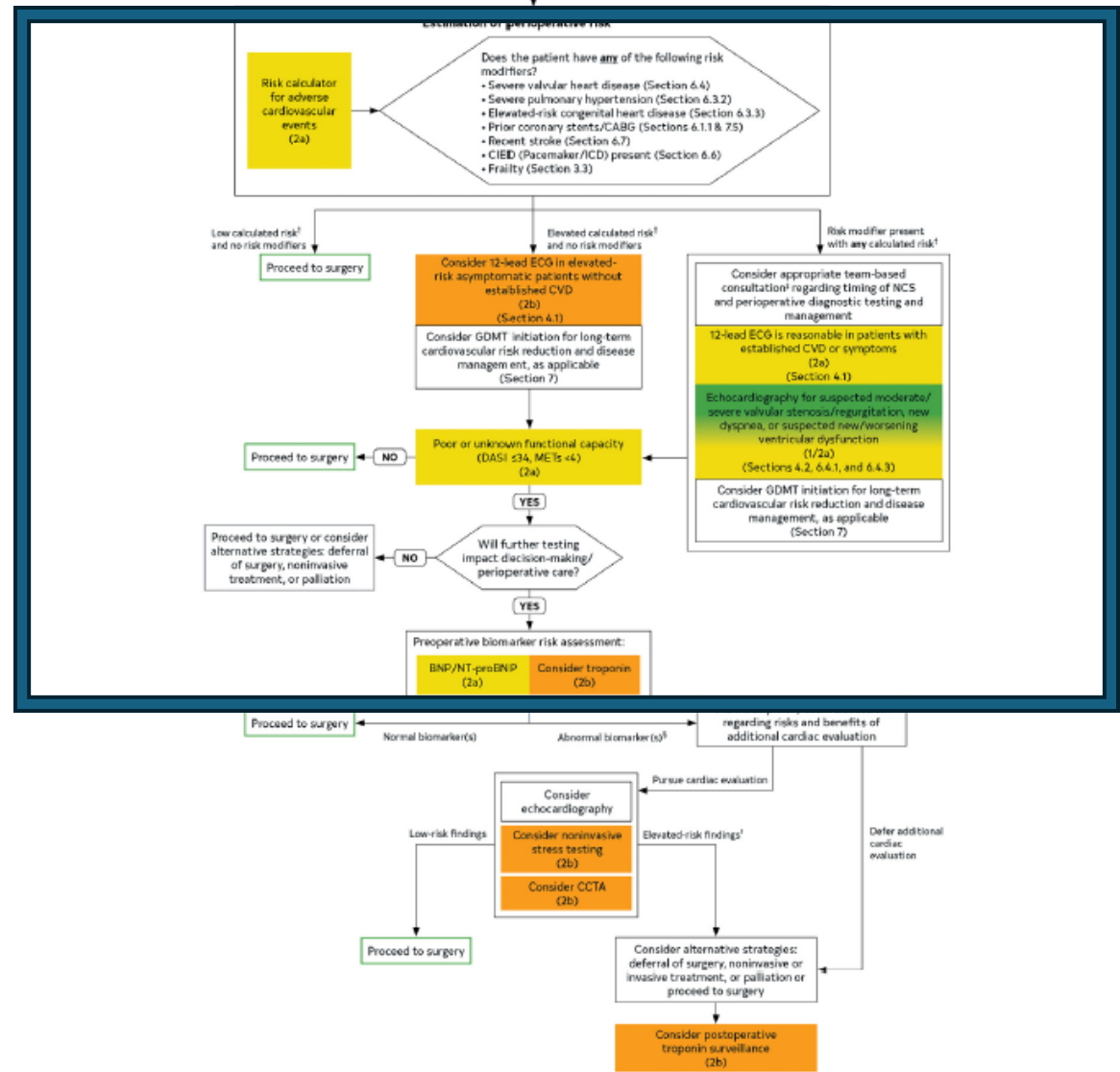
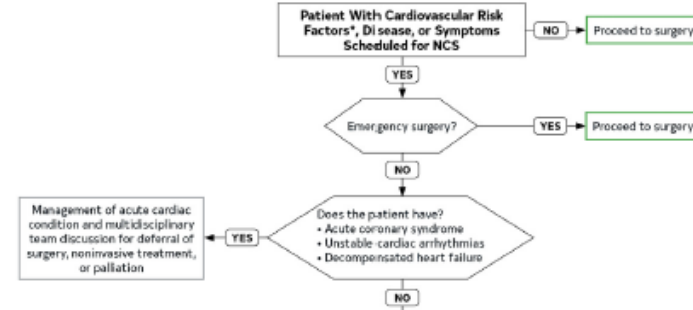
Implement prehabilitation programs to build strength and endurance. Assess support systems and social determinants early.



Postoperative Support

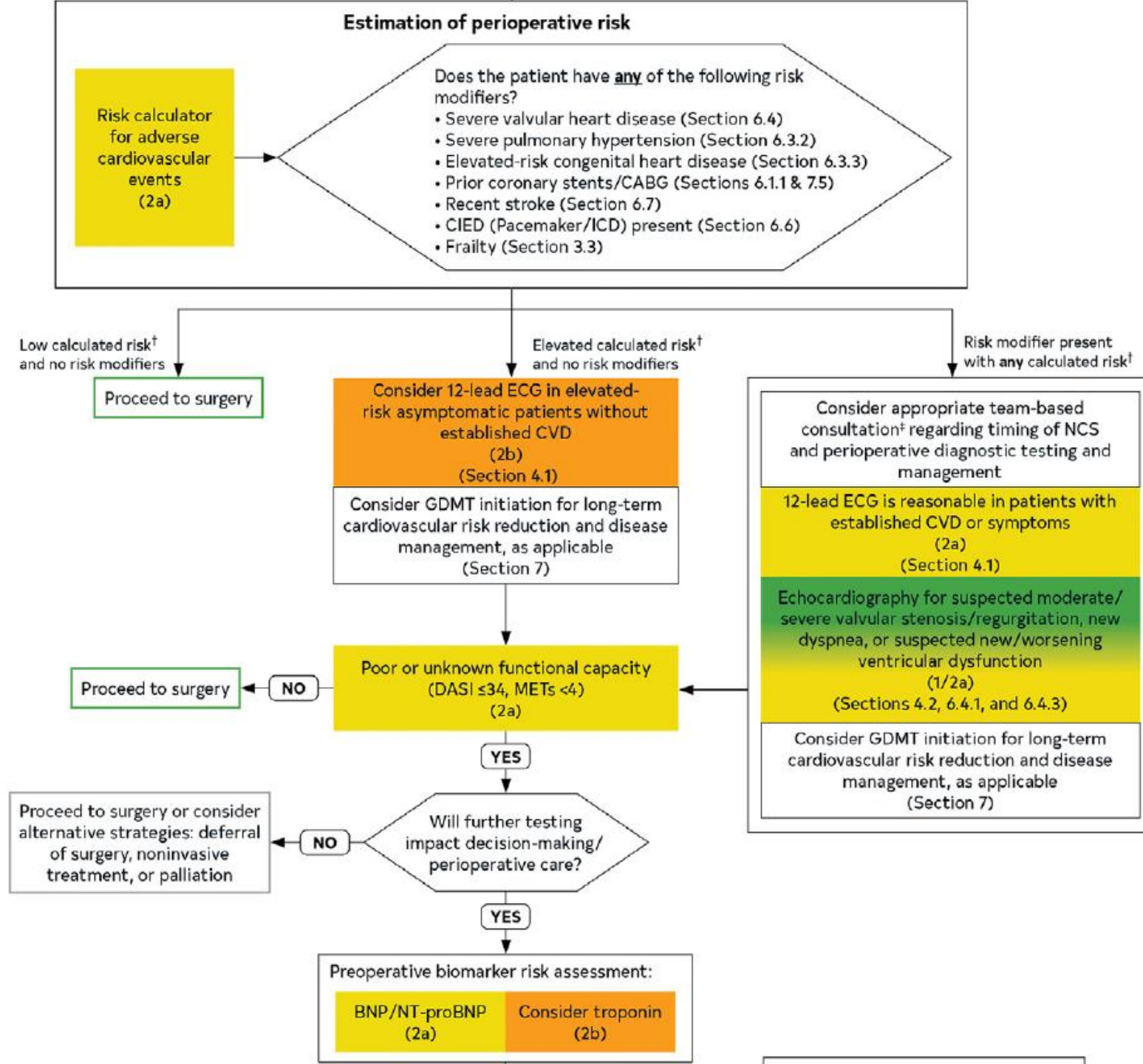
Engage geriatrics consultation when appropriate. Utilize institutional pathways and consider addiction medicine for substance-use disorders.

Remember: Frailty management extends beyond the operating room—structured postoperative care is crucial for optimal recovery.



Traditional Elevated risk = calculated risk of MACE >1%

The new model was recalibrated to GUPTA > 1% or RCRI > 1 as the key cutoff, removing previous percentage-based thresholds for RCRI



Preoperative Biomarkers

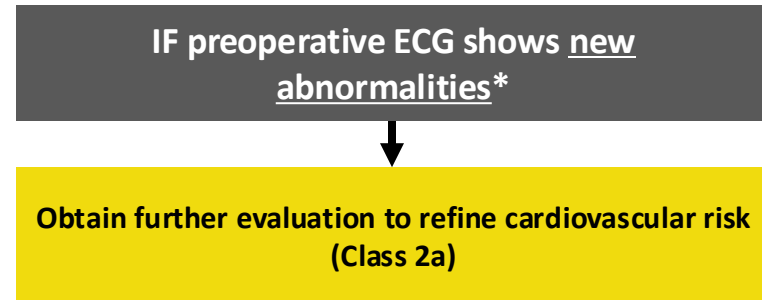
COR	LOE	RECOMMENDATIONS
2a	B-NR	1. In patients with known CVD, or age ≥ 65 years, or age ≥ 45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it is reasonable to measure B-type natriuretic peptide (BNP) or N-terminal pro-B-type natriuretic peptide (NT-proBNP) before surgery to supplement evaluation of perioperative risk. ¹⁻³
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. ⁴⁻⁶

- Elevated preoperative biomarkers associated with increased perioperative risk
- No good data on how values should change management
- Preoperative troponin can serve as a baseline for postoperative values

Preoperative ECG

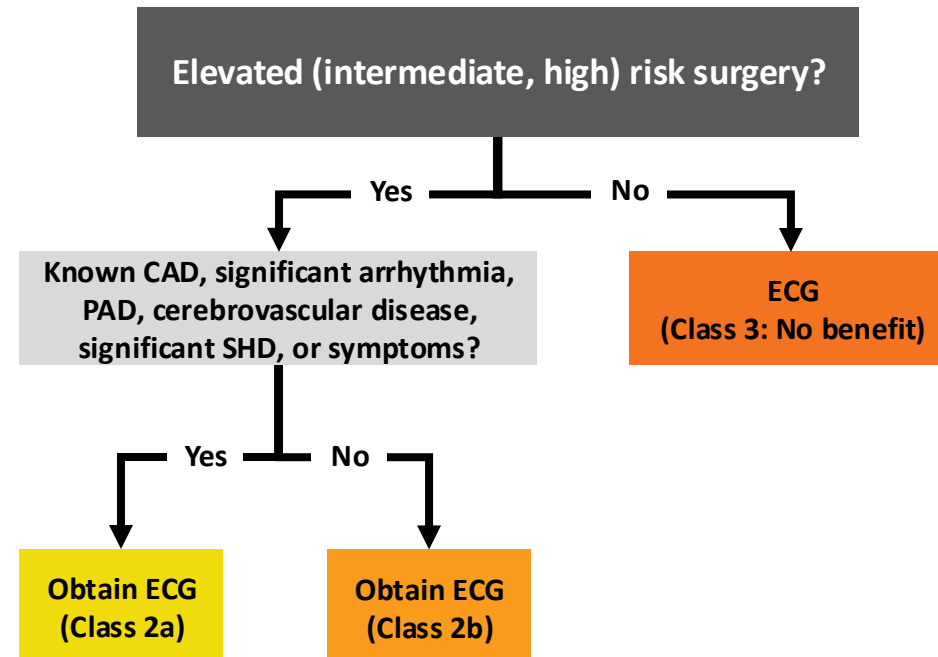
COR	LOE	RECOMMENDATIONS
2a	B-NR	1. For patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, other significant structural heart disease, or symptoms* of CVD undergoing elevated-risk surgery, a preoperative resting 12-lead electrocardiogram (ECG) is reasonable to establish a preoperative baseline and guide perioperative management. ^{1,2}
2b	B-NR	3. For asymptomatic patients undergoing elevated-risk surgeries without known CVD, a preoperative resting 12-lead ECG may be considered to establish a baseline and guide perioperative management. ^{3,9,10}
3: No benefit	B-NR	4. For asymptomatic patients undergoing low-risk surgical procedures, a routine preoperative resting 12-lead ECG is not recommended to improve outcomes. ¹¹

Simplified Preoperative Cardiovascular Diagnostic Testing: 12-Lead ECG



*Abnormalities may include:

- ST segment elevation or depression, T wave inversions
- Left ventricular hypertrophy
- Significant pathologic Q-waves
- Mobitz type II or higher AV block
- Bundle branch block
- QT prolongation
- Atrial fibrillation



Preoperative TTE

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients undergoing NCS with new dyspnea, physical examination findings of HF, or suspected new/worsening ventricular dysfunction, it is recommended to perform preoperative evaluation of LV function to help guide perioperative management. ¹⁻⁸
2a	C-LD	2. In patients with a known diagnosis of HF with worsening dyspnea or other change in clinical status undergoing NCS, preoperative assessment of LV function is reasonable to help guide perioperative management. ^{1,4,7,9-11}
3: No benefit	B-NR	3. In asymptomatic and clinically stable patients undergoing NCS, routine preoperative evaluation of LV function is not recommended due to lack of benefit. ¹²⁻¹⁵

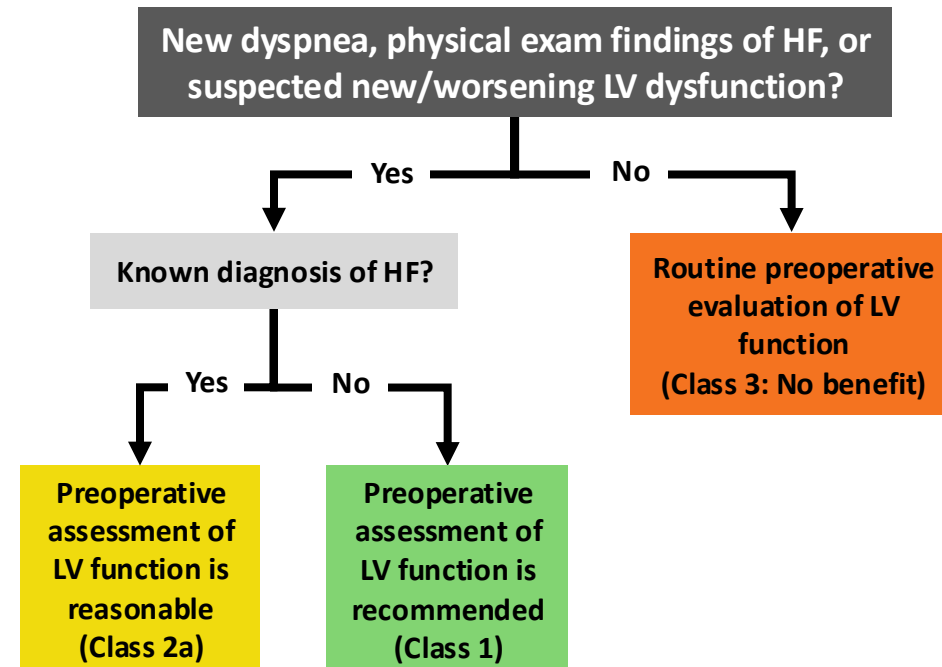
- Assessment of LV function may be reasonable in those with elevated BNP
- Symptomatic and asymptomatic HF associated with 90-day mortality (greater risk than CAD)

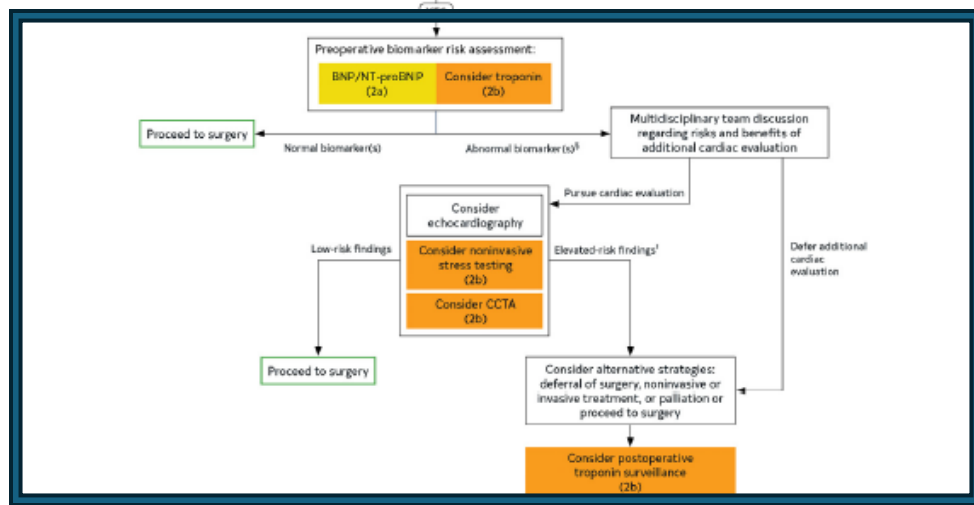
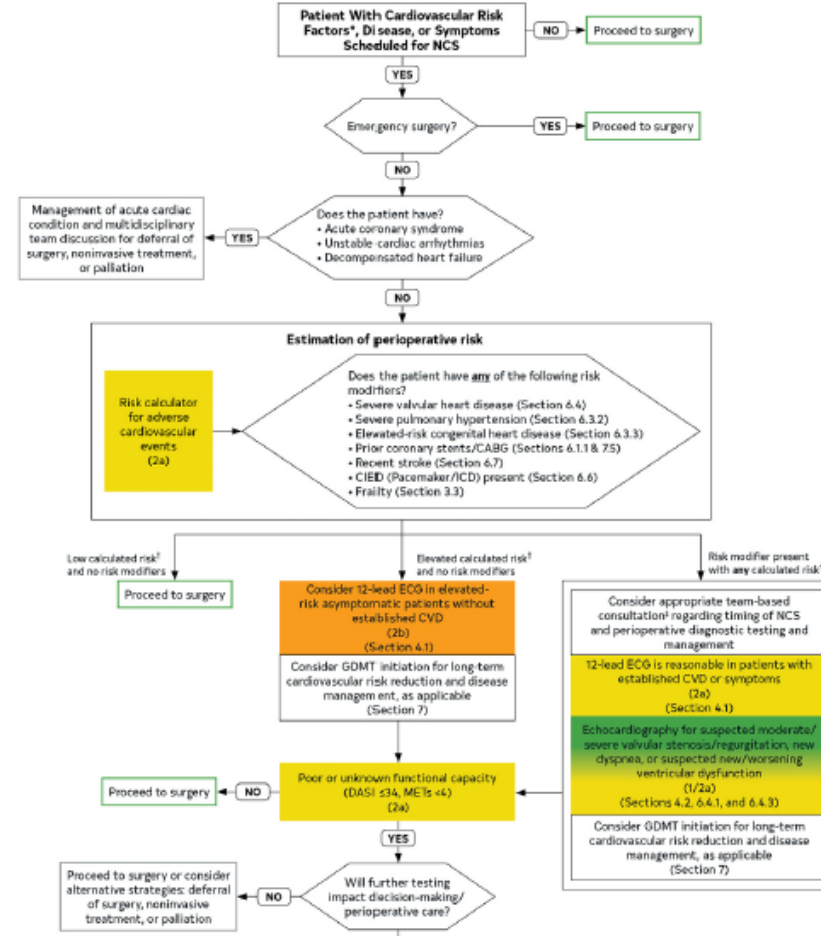
Simplified Preoperative Cardiovascular Diagnostic Testing: **Assessing Ventricular Function**

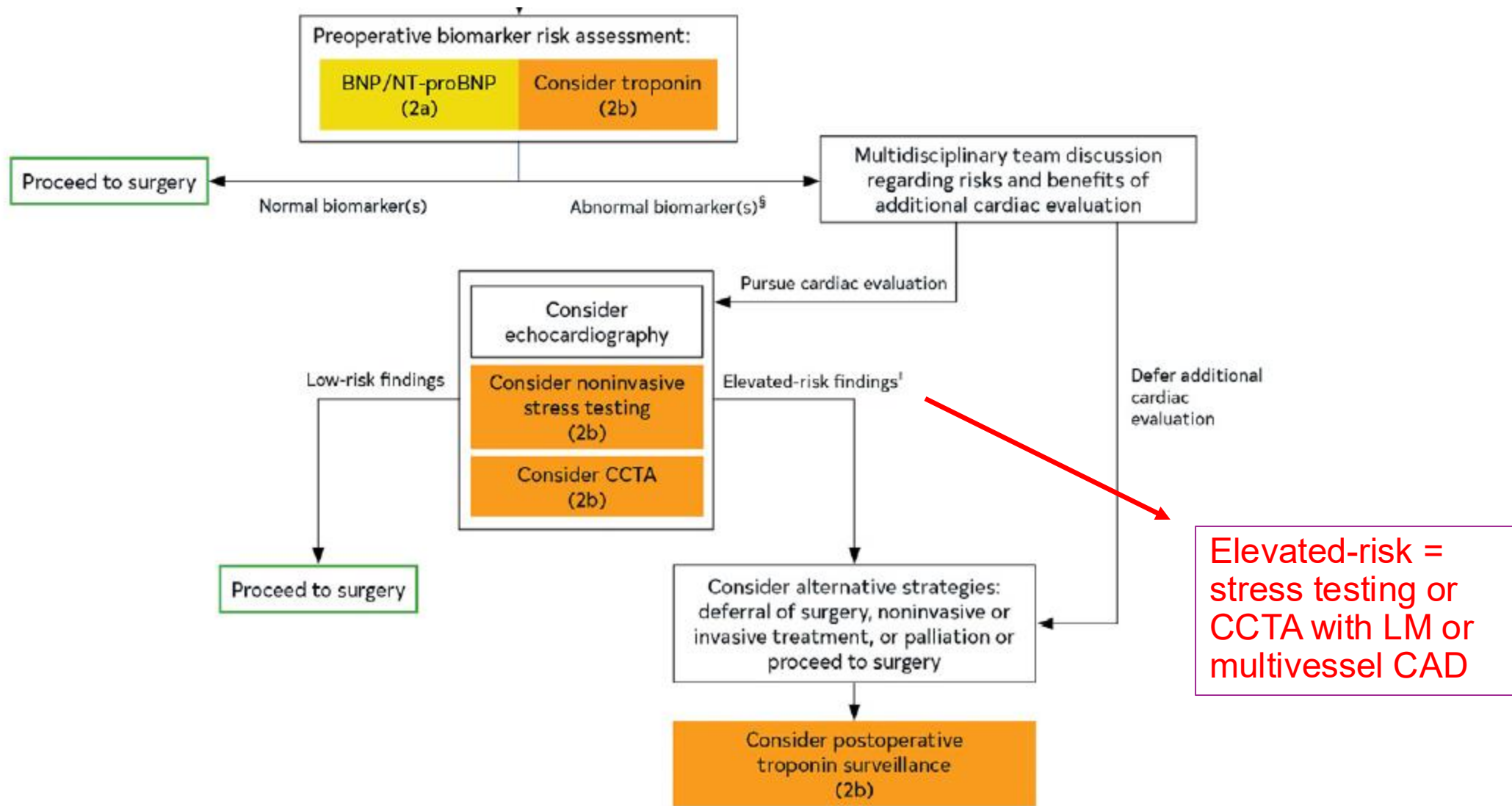
Right Ventricular Function

- RV dysfunction associated with adverse CV outcomes in NCS.
- Routine preoperative evaluation of RV function **is not recommended** in asymptomatic and clinically stable patients.

Left Ventricular Function





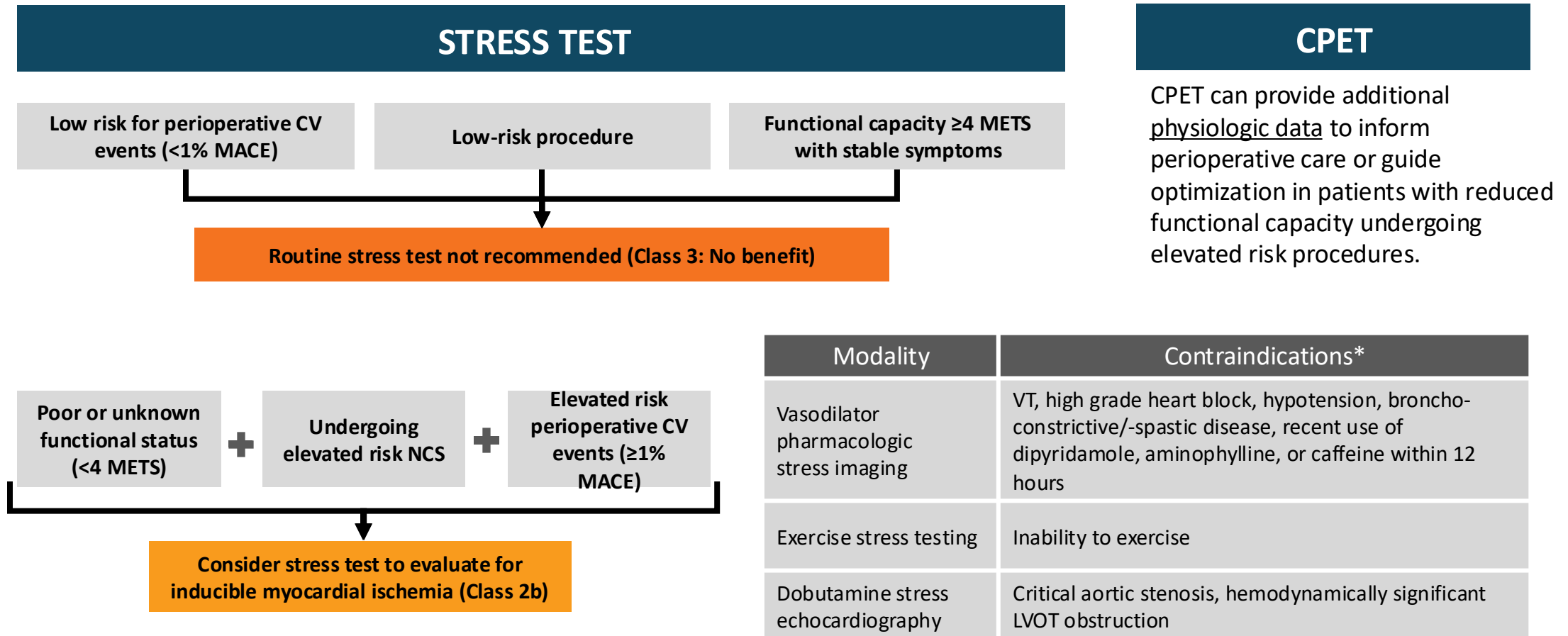


Preoperative Stress Testing

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. ¹
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. ¹⁻³

- Role of stress tests is limited
 - Abnormal test has modest positive predictive value
 - Limited increased prognostic value compared to biomarkers, risk calculators
 - Expensive, can delay care
 - Coronary revascularization before surgery of limited benefit in stable patients

Preoperative Cardiovascular Diagnostic Testing: Stress Test and CPET



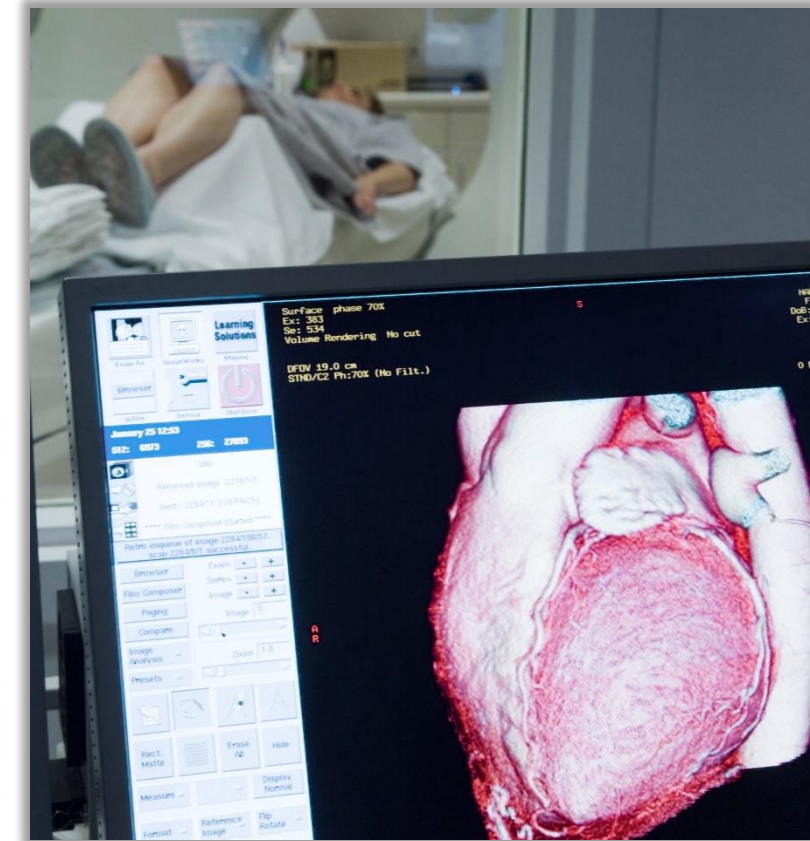
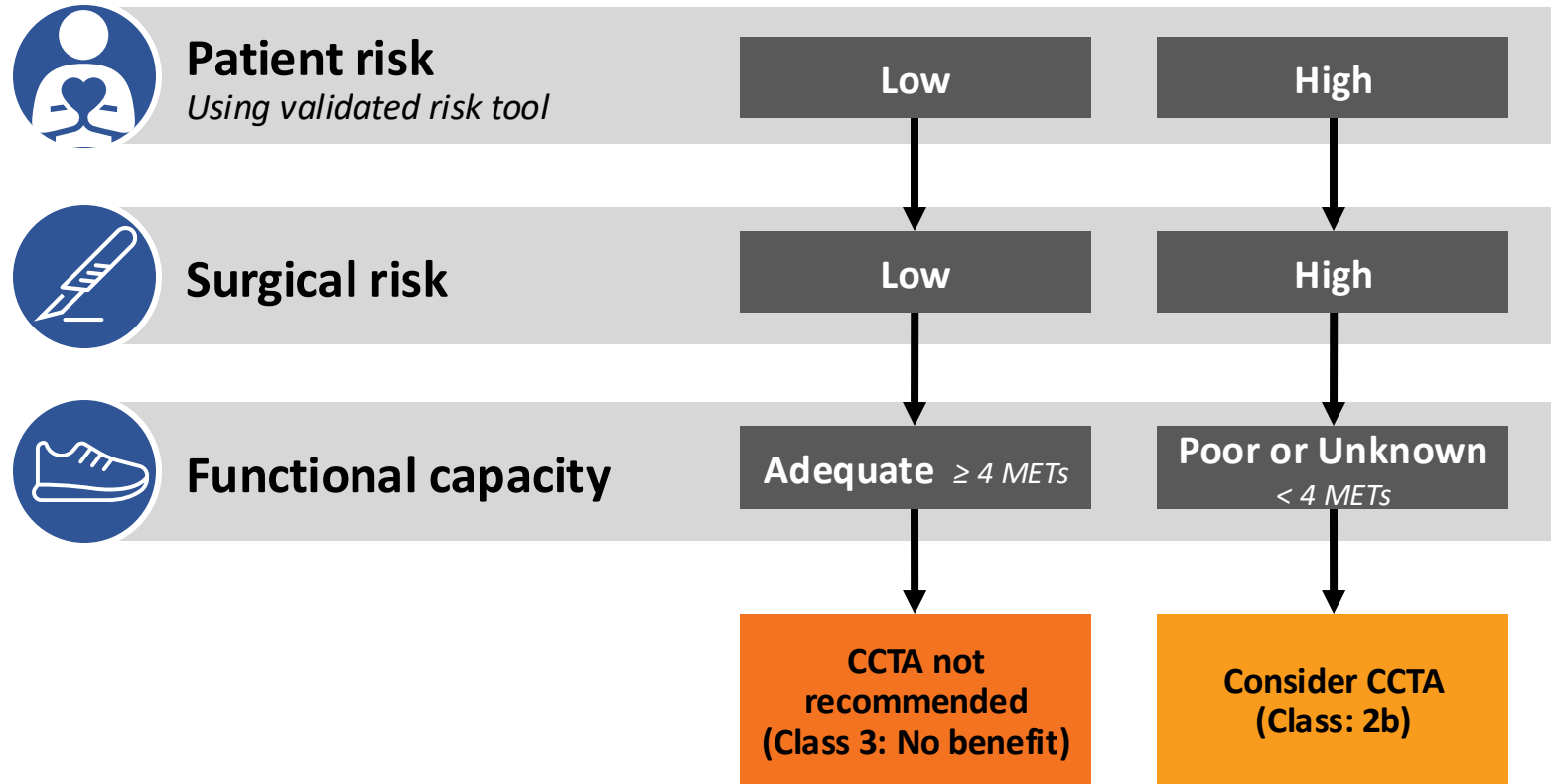
Abbreviations: CPET indicates cardiopulmonary exercise testing; CV, cardiovascular; LVOT, left ventricular outflow tract; MACE, major adverse cardiovascular events; MET, metabolic equivalent; NCS, non-cardiac surgery; and VT, ventricular tachycardia

Preoperative CCTA

COR	LOE	RECOMMENDATIONS
2b	B-NR	1. For patients undergoing elevated-risk surgery with poor* or unknown functional capacity, and elevated risk for perioperative cardiovascular events based on a validated risk tool, coronary computed tomography angiography (CCTA) for the detection of high-risk coronary anatomy† may be considered. ¹⁻⁴
3: No benefit	B-NR	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 CCTA before NCS is not recommended due to lack of benefit. ^{1,5}

- High risk anatomy - >50% left main stenosis or significant 3 vessel disease (>70% stenosis)

Preoperative Testing: Coronary CT Angiography



- **Abbreviations:** CCTA indicates coronary computed tomography angiography; CT, computed tomography; and METs, metabolic equivalents.

Preoperative Revascularization


COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients with ACS being considered for elective NCS, coronary revascularization as appropriate and deferral of surgery is recommended to reduce perioperative cardiovascular events. ¹⁻⁹
2a	C-LD	2. In patients with CCD and hemodynamically significant left main coronary artery stenosis $\geq 50\%$ who are planning elective NCS, coronary revascularization and deferral of surgery is reasonable to reduce perioperative cardiovascular events. ^{10,11}
3: No benefit	B-R	3. In patients with non-left main CAD who are planned for NCS, routine preoperative coronary revascularization is not recommended to reduce perioperative cardiovascular events.* ¹²⁻¹⁵

- Revascularize if ACS or hemodynamically significant left main stenosis (>50% stenosis)



Case 1

Clinical Case Presentation

 This case represents a common scenario in perioperative medicine: an elderly patient with multiple cardiac risk factors requiring elective orthopedic surgery.

Patient Demographics

76-year-old female scheduled for elective total hip arthroplasty

Functional Assessment

Walks dog daily for 20 minutes (**approximately 4-5 METs**), indicating adequate functional capacity

Medical History

- Hypertension (well-controlled)
- Type 2 Diabetes mellitus
- Prior myocardial infarction with percutaneous coronary intervention (5 years ago)

Current Medications



Aspirin
Secondary prevention



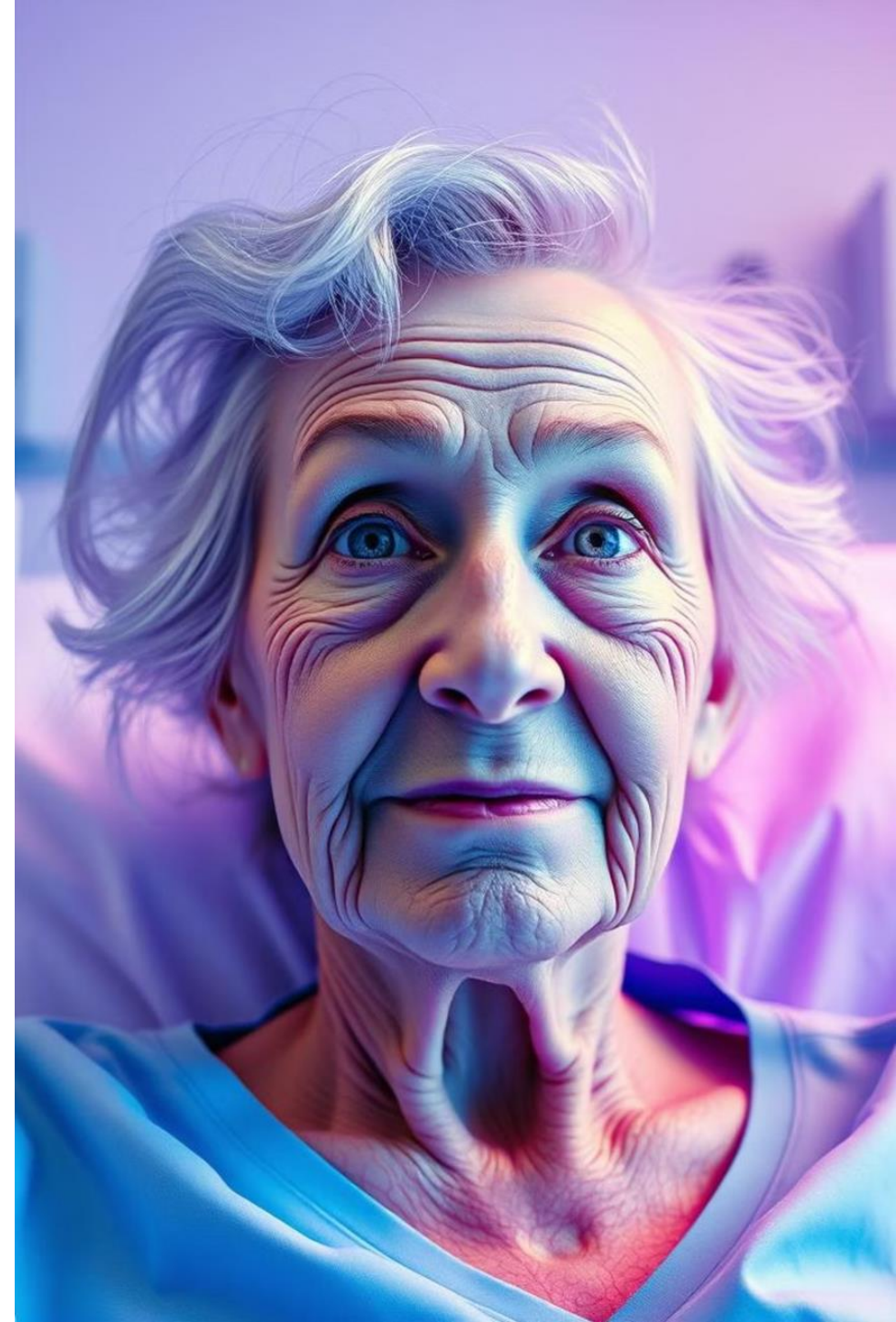
Beta-blocker
Cardioprotective



Statin
Lipid management



Insulin
Glycemic control



Clinical Decision Points

Consider these key questions when optimizing this patient for surgery:

Cardiovascular Risk Stratification

What is the patient's perioperative MACE risk? Should surgery be delayed for further cardiac optimization?

Diagnostic Testing Requirements

Is additional testing warranted? Consider EKG, stress testing, or echocardiography based on risk assessment.

Beta-blocker Management

Should current beta-blocker therapy be continued, modified, or discontinued perioperatively?

Antiplatelet Therapy Strategy

Balance bleeding risk versus thrombotic risk for aspirin continuation in secondary prevention.

Evidence-based perioperative cardiac risk management requires systematic evaluation of patient factors, surgical risk, and functional capacity.

Systematic Risk Assessment Framework



Surgery Urgency Classification

Elective procedure allows for comprehensive risk stratification and optimization



Active Cardiac Conditions Screen

No active conditions identified: No unstable angina, decompensated heart failure, or new arrhythmias. Prior MI >60 months with good management.



MACE Risk Calculation

RCRI Score = 2 (ischemic heart disease + insulin-dependent diabetes) indicates **elevated risk**



Functional Capacity Assessment

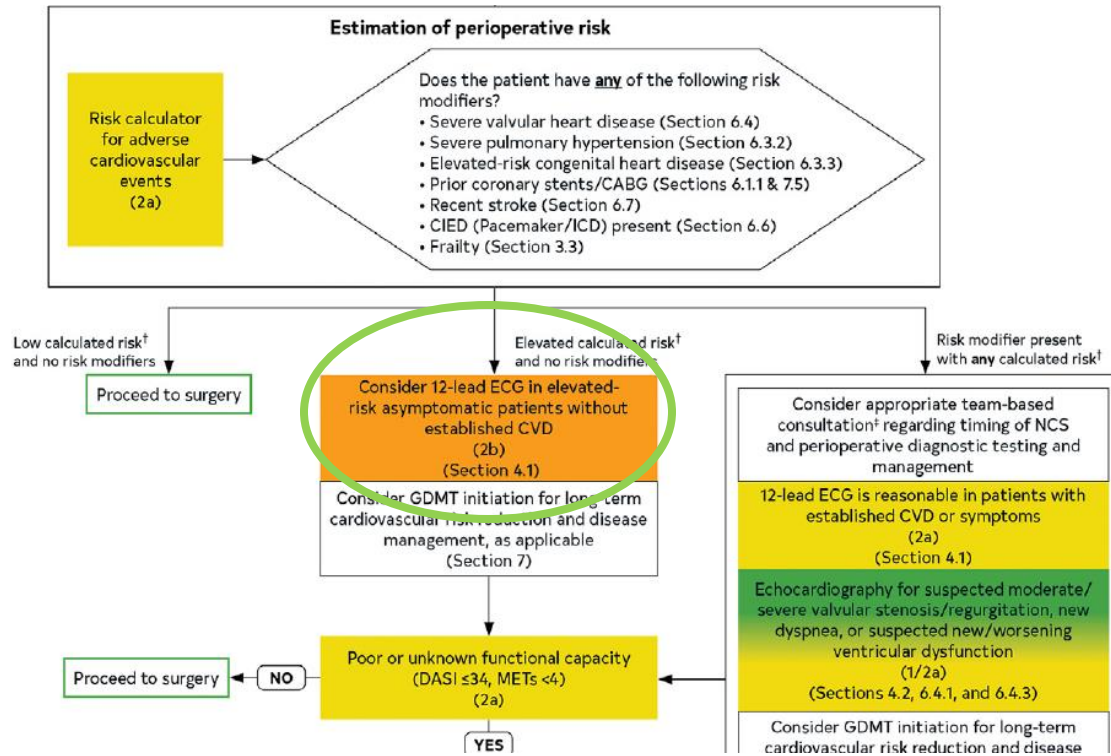
METs >4 demonstrates adequate functional reserve for major surgery

✔ **Clinical Decision:** No additional stress testing or cardiology consultation required. Consider baseline EKG for documentation.

Perioperative Medication Management

Medication	Recommendation	Clinical Rationale
Beta-blocker	Continue	Cessation increases perioperative MACE risk
Statin	Continue	Strong vascular protection evidence
Aspirin	Continue if low bleeding risk	Balance secondary prevention benefits vs bleeding

Updated Risk Stratification Guidelines



Evolution of Risk Thresholds



Traditional Model

Elevated risk defined as calculated MACE risk >1%



Updated Approach

Recalibrated to **GUPTA >1%** or **RCRI >1** as key cutoffs

i The updated model eliminates previous percentage-based thresholds for RCRI scoring, providing more clinically relevant risk stratification for perioperative decision-making.

This modernized approach enhances precision in identifying patients who would benefit from enhanced perioperative cardiac monitoring and management strategies.

Case 2





Preoperative Risk Assessment: Open AAA Repair

Patient Profile

- 58-year-old male with hypertension
- 30 pack-year smoking history
- Limited functional capacity (<1 block)
- No known CAD, but high risk factors

Cardiovascular Status

- No chest pain, orthopnea, or PND
- Not on beta-blockers or statins
- No prior cardiac workup or stress testing
- Poor functional capacity (<4 METs)

Planned procedure: **Elective open abdominal aortic aneurysm repair** (high cardiac risk procedure)

Risk Stratification Considerations

1 What is the RCRI score?

Calculate the Revised Cardiac Risk Index to quantify perioperative cardiac risk

2 What are the METs?

Assess functional capacity to determine exercise tolerance and cardiac reserve

3 Is further testing recommended?

Determine if additional cardiac evaluation would change management

4 Should we start preoperative medications?

Consider evidence-based pharmacologic optimization



Preoperative Optimization Recommendations

RCRI Assessment

Score: 1 point (high-risk surgery)

Open AAA repair is classified as high cardiac risk vascular surgery

Functional Capacity

<4 METs (poor)

Unable to walk >1 block without fatigue

Indicative of limited cardiac reserve



Recommended Testing

CPET (Cardiopulmonary Exercise Testing) is preferred for objective assessment

Alternative: Pharmacologic stress echo or nuclear test if CPET unavailable



Medication Recommendations

Statin therapy strongly recommended for vascular surgery patients

Consider beta-blocker if testing reveals ischemic risk



Myocardial Injury After Non-Cardiac Surgery (MINS)

MINS Definition

1

Troponin Elevation

At least one elevated troponin measurement exceeding the 99th percentile of upper reference limit

2

Rise/Fall Pattern

- $\geq 20\%$ rise after surgery (4th generation cTn)
- Increase of $\geq 14\text{ng/L}$ from preoperative baseline (hs-cTnT)
- Increase in hs-cTnT of $\geq 5\text{ng/L}$ with peak $> 20\text{ng/L}$

3

Ischemic Origin

Presumed ischemic etiology, excluding pulmonary embolism, sepsis, or stroke as primary causes

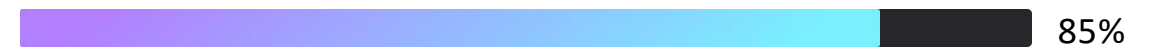
Reference: Ruetzler K. Circulation 2021 144 no.19 e287-305

MINS Prevalence and Clinical Impact



Prevalence

Non-cardiac surgery patients develop MINS



Asymptomatic

Cases undetected without troponin screening

Mortality Risk Associated with MINS

10x increased risk of 3-day mortality

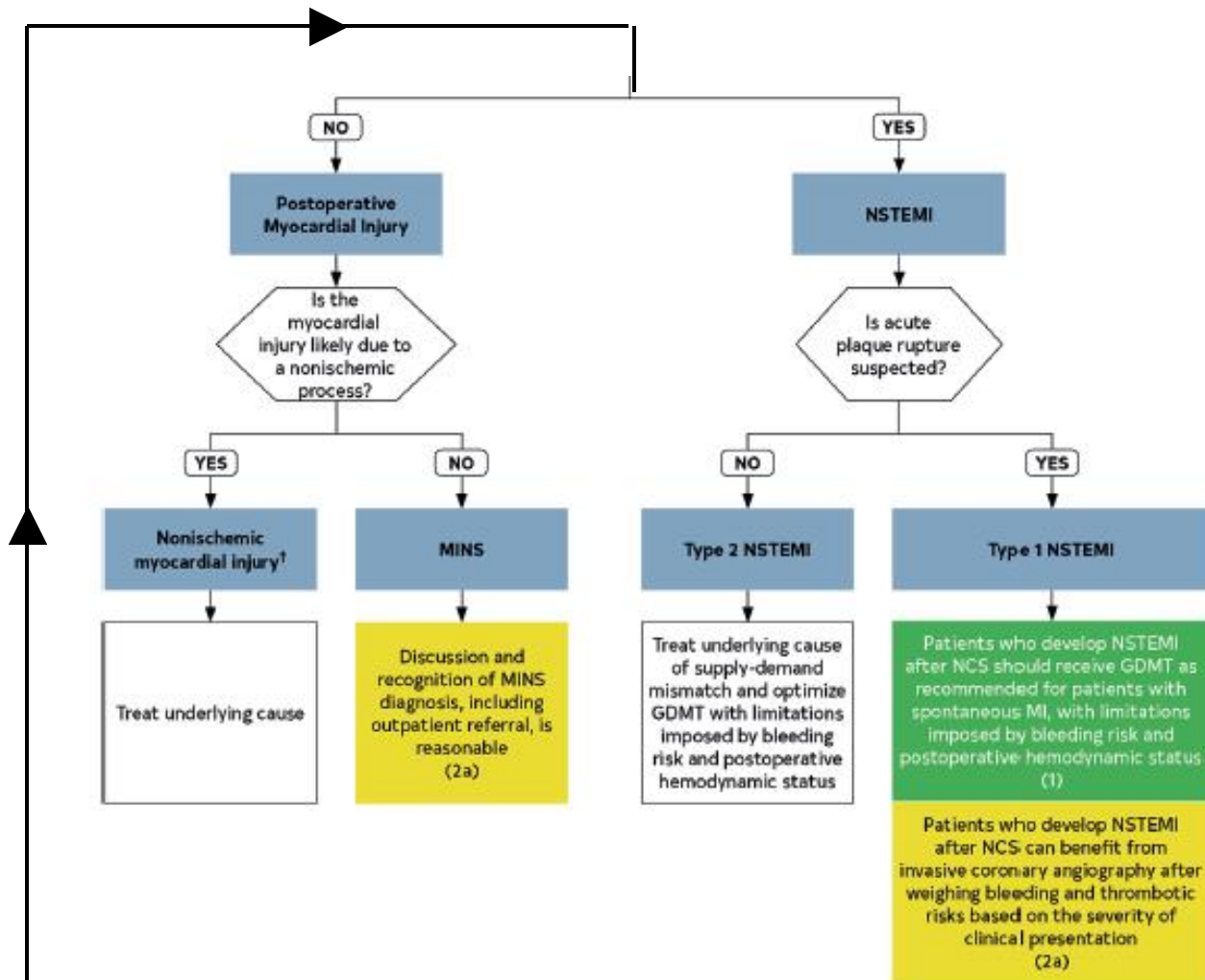
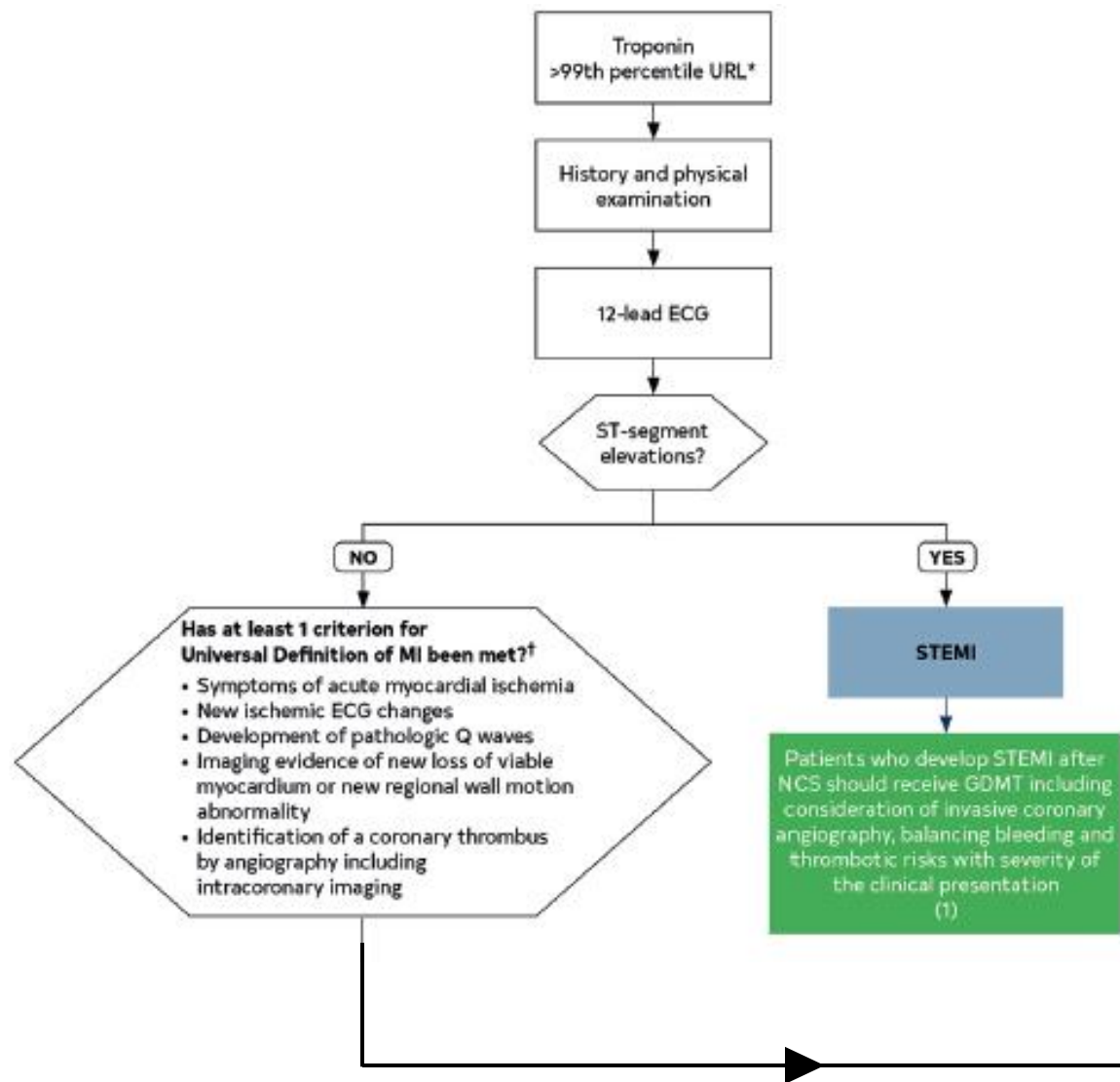
8-10x increased risk of 30-day mortality

2-4x increased risk of 1-year mortality

Reference: Ruetzler K. Circulation 2021 144 no.19 e287-305

2024 ACC/AHA MINS Recommendations

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. ¹⁻⁴
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. ^{5,6}
MINS Management		
2a	B-NR	3. 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. ^{4,7-10}
2b	C-LD	4. In patients who develop MINS, antithrombotic therapy may be considered to reduce thromboembolic events. ^{4,11}





2024 ACC/AHA Expert Consensus

"MINS is an underrecognized clinical dilemma requiring further investigation to understand its underlying pathophysiological mechanisms. There are limited data regarding optimal therapy for risk mitigation after the diagnosis of MINS, including the use of antiplatelet agents and statins."

Key knowledge gaps persist in optimal MINS management strategies

MINS Management Strategy

Evidence-limited approach focusing on cardiovascular risk optimization

Cardiology Consultation

- Potential mortality benefit with specialist evaluation and risk stratification

Medical Therapy Intensification

- Statin therapy (consider lower LDL targets)
- Aspirin initiation
- Optimized blood pressure control

Risk Factor Modification

- Glycemic control optimization
- Smoking cessation counseling
- Alcohol moderation guidance
- Activity modification as appropriate



Reference: Ruetzler K. Circulation 2021 144 no.19 e287-305

MINS Clinical Bottom Line

1 Significant Prognostic Implications

MINS substantially increases short and long-term mortality risk

3 Systematic Monitoring Approach

- Preoperative troponin and ECG
- PACU ECG monitoring
- Troponins on postoperative days 1 and 2

2 Targeted Screening Protocol

Focus on patients >65 years or those with known CVD requiring optimization

4 Perioperative Risk Stratification

Consider MINS as a "stress test" guiding outpatient cardiovascular management



Reference: Ruetzler K. Circulation 2021 144 no.19 e287-305



Case 3



Complex Spine Surgery: Cardiac Risk Evaluation

Patient Profile

- 74-year-old male for elective lumbar fusion
- Hypertension, T2DM, Stage 3 CKD
- Stable CAD, PCI 4 years ago
- Cardiac: Asymptomatic, mild DOE (NYHA II)

Medical Optimization

- Currently on aspirin
- Lisinopril (ACE inhibitor)
- Metoprolol (beta-blocker)
- Atorvastatin (statin)
- Insulin for diabetes management

i Clinical Question: Should this patient have perioperative cardiac biomarker monitoring, and how would the results guide management?

The Role of Cardiac Biomarkers in Perioperative Management

Key Clinical Questions

For this 74-year-old with multiple cardiac risk factors undergoing spine surgery:

- 1 Should preoperative biomarkers be obtained?**
Which biomarkers provide the most value for risk stratification?
- 2 Is postoperative biomarker monitoring indicated?**
What is the clinical significance of elevated postoperative values?
- 3 How do biomarker results influence management?**
What interventions should be considered based on these findings?



Preoperative Cardiac Biomarkers: 2024 ACC Guidelines

Natriuretic Peptides (BNP/NT-proBNP)

- Recommended for patients >65 or with risk factors undergoing intermediate/high-risk surgery
- Elevated levels **predict postoperative MACE and mortality**

High-sensitivity Troponin (hs-cTn)

- Consider in patients with known CAD, CKD, or multiple risk factors
- Elevation suggests **silent ischemia or myocardial injury risk**

❏ Patient's Baseline Results

NT-proBNP: 790 pg/mL (elevated)

hs-cTn-T: 16 ng/L (above 99th percentile URL)

Clinical Interpretation

Elevated NT-proBNP and hs-cTn indicate **high cardiac risk**

Consider intensifying perioperative surveillance and modifying surgical risk discussion

Postoperative Biomarker Monitoring

2024 ACC Guideline Recommendations

- Monitor hs-cTn post-op in high-risk patients, **even when asymptomatic**
- Detects Myocardial Injury after Noncardiac Surgery (MINS)
- MINS is often clinically silent but strongly linked to poor outcomes
- Early detection enables timely intervention

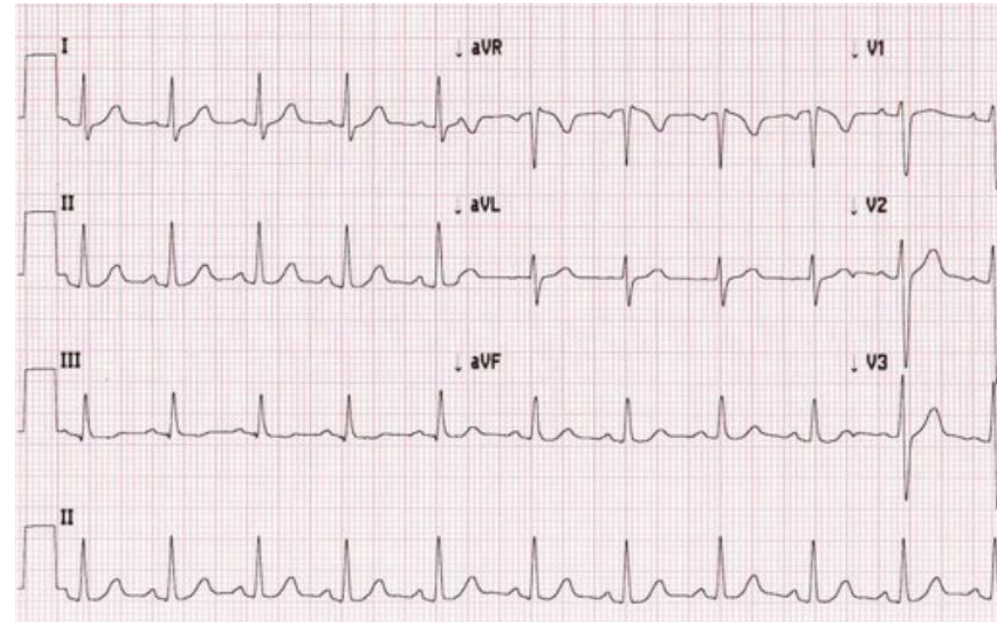
⊗ Case Patient (POD #1)

hs-cTn-T: 42 ng/L (↑ from baseline 16 ng/L)

ECG: Normal sinus rhythm, no ST changes

Symptoms: No chest pain, hemodynamically stable

Diagnosis: Meets criteria for **MINS** → requires cardiology consultation, medication optimization



Clinical Implications & Evidence-Based Management

Risk Stratification

Use **NT-proBNP/BNP and hs-cTn** preoperatively in intermediate/high-risk noncardiac surgery

Elevated values identify patients requiring enhanced surveillance

Surveillance Protocol

Implement **postoperative troponin monitoring** in high-risk patients regardless of symptoms

Any significant elevation = MINS, associated with 30-day mortality increase

Management Strategy

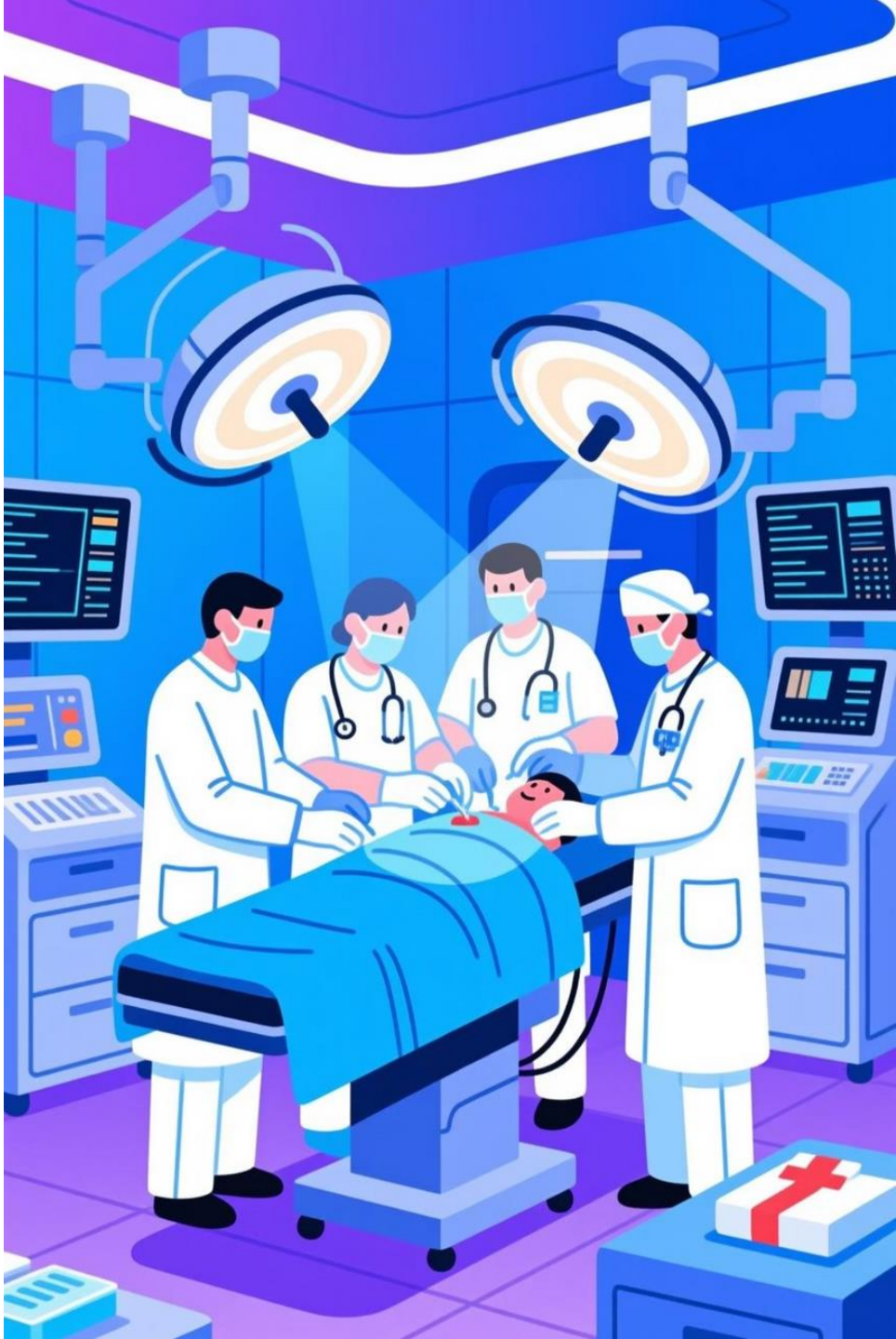
For MINS: Optimize cardiac medications (statins, beta-blockers), assess for reversible ischemia, ensure close follow-up

Consider post-op echocardiogram to evaluate for new wall motion abnormalities

Key Takeaway

Biomarker-guided management represents a **paradigm shift in perioperative care**, enabling early detection and intervention for subclinical cardiac events

Case 4



Clinical Case Presentation

Patient Profile

- 59-year-old woman
- CAD with history of 4 MIs
- DM type 2
- CVA in 2012 with cognitive impact
- HTN and OSA on CPAP
- Remote seizure history (none since age 16)

Current Presentation

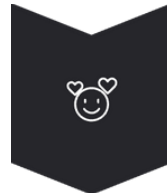
- Syncopal episode resulting in open fracture
- No memory of event, head trauma, or preceding symptoms
- No fever, chest pain, SOB, or palpitations
- Functional capacity: Can climb 10 steps without symptoms

Medications

- **Ozempic** (GLP-1 agonist) - last dose 5 days prior
- **Jardiance** (SGLT2 inhibitor) - taken day before admission
- Plavix - compliance unclear (filled 90-day supply recently)



Critical Clinical Questions



Cardiovascular Risk

Should surgery be delayed based on cardiac risk factors?



Syncope Evaluation

Does the syncopal episode increase perioperative risk?



Trauma Assessment

Is additional trauma evaluation indicated given the fall?

Medication Concerns

SGLT2 Inhibitor (Jardiance)

- Risk of euglycemic DKA
- Perioperative management strategy needed

GLP-1 Receptor Agonist (Ozempic)

- Potential effects on surgical outcomes
- Implications for glucose management

Preoperative Risk Assessment

Surgery-Specific Risk High risk (>5% cardiac death/MI) <ul style="list-style-type: none">• Urgent procedure• Open fracture repair	Patient Clinical Risk Elevated due to: <ul style="list-style-type: none">• Recent syncope (concern for arrhythmia)• Cannot rule out ischemic event• Multiple cardiac risk factors	Functional Capacity ≥4 METs (moderate) <ul style="list-style-type: none">• Can climb flight of stairs without symptoms• Relatively preserved exercise tolerance
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Risk Modifiers

While the patient's functional capacity (METs) appears moderate, her extensive list of comorbidities (multiple MIs, CVA with cognitive impact, advanced age) raises a significant **concern for frailty**. Frailty is an important independent predictor of adverse perioperative outcomes and should be considered as a critical risk modifier in her overall assessment.

Surgery Timing: **Urgent/Emergent (<24 hours)**

Based on 2024 ACC/AHA guidelines incorporating RCRI score, frailty, surgical risk, and baseline functional capacity:

Recommended Actions:

- Cardiology consultation given syncope and cardiac history
- Trauma evaluation to assess for additional injuries
- TTE to evaluate cardiac/valvular function
- Telemetry monitoring for arrhythmias
- **Hold Jardiance and Ozempic perioperatively**
- Monitor for euglycemic DKA

Postop Labs

Component	4 d ago (5/9/25)	4 d ago (5/9/25)	4 d ago (5/9/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)
Glucose	156 ▲	132 ▲	216 ▲	191 ▲	174 ▲	209 ▲	133 ▲
Urea Nitrogen	15	18	19	20	18	19	21 ▲
Creatinine	0.97	1.12 ▲	1.24 ▲	1.19 ▲	1.08 ▲	1.28 ▲	1.09 ▲
Sodium	140	141	139	138	140	140	140
Potassium	3.9	3.9	4.4	4.3	4.2	4.7	4.2
Chloride	104	105	103	101	103	103	104
Carbon Dioxide	25	27	24	18 ▼	21 ▼	21 ▼	26
Anion Gap	11	9 CM	12 CM	19 ▲ CM	16 ▲ CM	16 ▲ CM	10 CM

Component	4 d ago (5/9/25)	4 d ago (5/9/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)
Beta Hydroxybutric Acid	1.60 ▲	3.37 ▲	6.22 ▲	6.21 ▲	4.42 ▲	3.36 ▲	1.49 ▲

Postoperative Laboratory Findings

Critical Lab Abnormalities

- Elevated anion gap (19) despite glucose 191
- Low bicarbonate (18)
- Evidence of metabolic acidosis
- Elevated Beta Hydroxybutric Acid

Clinical Diagnosis

Euglycemic Diabetic Ketoacidosis

Classic DKA triad present, but with relatively normal blood glucose:

- Metabolic acidosis
- Ketosis
- Absence of significant hyperglycemia

5 d ago
(5/8/25)

191 ^
20
1.19 ^
138
4.3
101
18 v
19 ^ CM

Component	4 d ago (5/9/25)	4 d ago (5/9/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)	5 d ago (5/8/25)
Beta Hydroxybutric Acid	1.60 ^	3.37 ^	6.22 ^	6.21 ^	4.42 ^	3.36 ^	1.49 ^

Euglycemic DKA: A Complication of SGLT2 Inhibitors

Figure 1: Proposed Mechanisms of EDKA

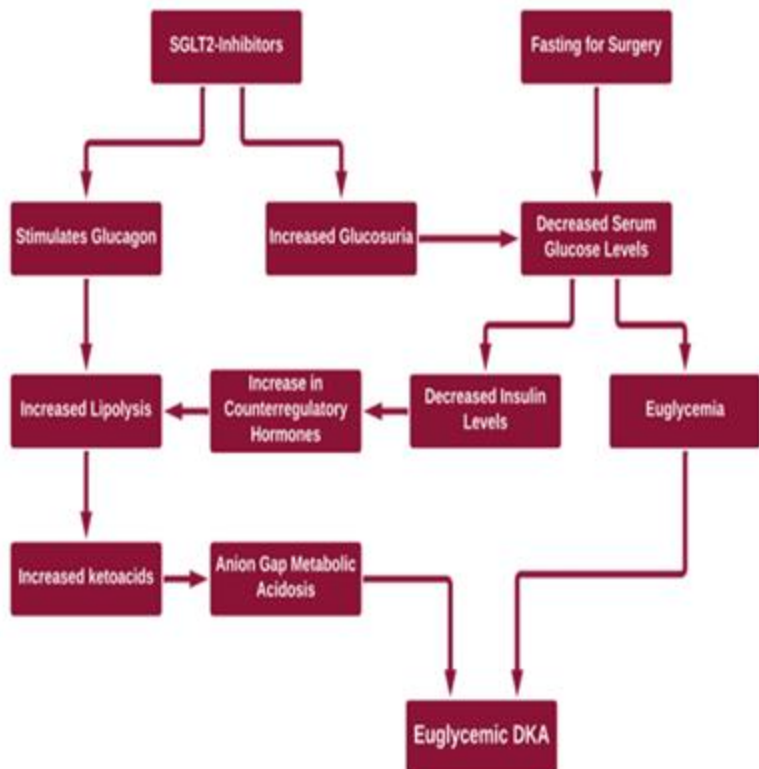


Figure 1: Proposed Mechanisms of EDKA.¹⁻³ Courtesy of Kumar S, Bhavnani SP, Goyal P, Rich MW, Krishnaswami A.

Management

1

Initial treatment with dextrose IV fluids, subcutaneous insulin (aspart 19 units), and basal insulin (lantus 10 units)

2

Transient resolution followed by recurrent gap widening

3

Required ICU transfer for insulin drip

Perioperative SGLT2i Guidelines

Current guidelines recommend holding SGLT2 inhibitors the day prior to elective surgery

⊗ **For emergent surgery:** Close glucose and ketone monitoring is essential even with normal glucose values

The mechanism involves increased urinary glucose excretion via SGLT2 inhibition, leading to lower blood glucose levels despite ongoing ketogenesis and insulin deficiency

Thank You!

There are many more recommendations in the 2024 ACC Update that we could not go over due to time, but for reference have provided additional slides which include take home points.

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AT THE FOREFRONT
UChicago
Medicine



ADDITIONAL ACC/AHA RECOMMENDATIONS

Blood Pressure Management

COR

LOE

RECOMMENDATIONS

Preoperative Blood Pressure Management

2a

C-EO

1. In most* patients with hypertension planned for elective NCS, it is reasonable to continue medical therapy for hypertension throughout the perioperative period.†

2b

C-LD

2. In patients undergoing elective elevated-risk surgery who have cardiovascular risk factors for perioperative complications‡ and recent history of poorly controlled hypertension (systolic blood pressure [SBP] ≥ 180 mm Hg or diastolic blood pressure [DBP] ≥ 110 mm Hg before the day of surgery), deferring surgery may be considered to reduce the risk of perioperative complications.† 1²

Intraoperative Blood Pressure Management

1

B-NR

3. In patients undergoing NCS, maintaining an intraoperative mean arterial pressure (MAP) ≥ 60 to 65 mm Hg or SBP ≥ 90 mm Hg is recommended to reduce the risk of myocardial injury.³⁻⁹

Postoperative Blood Pressure Management

1

B-NR

4. In patients undergoing NCS, treatment of hypotension (MAP < 60 -65 or SBP < 90 mm Hg) in the postoperative period is recommended to limit the risk of cardiovascular, cerebrovascular, renal events, and mortality.⁶

1

C-EO

5. In patients with hypertension undergoing NCS, it is recommended that preoperative antihypertensive medications be restarted as soon as clinically reasonable to avoid complications from postoperative hypertension.

Heart Failure Medication Management

COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients with HF undergoing elective NCS, sodium-glucose cotransporter-2 inhibitors (SGLT2i) should be withheld for 3 to 4 days* before surgery when feasible to reduce the risk of perioperative metabolic acidosis. ¹⁻³
2a	C-LD	2. In patients with compensated HF undergoing NCS, it is reasonable to continue GDMT (excluding SGLT2i) in the perioperative period, unless contraindicated, to reduce the risk of worsening HF. ⁴⁻⁸

*Canagliflozin, dapagliflozin, and empagliflozin should be stopped ≥ 3 days and ertugliflozin ≥ 4 days before scheduled surgery.³

Pulmonary Hypertension Management

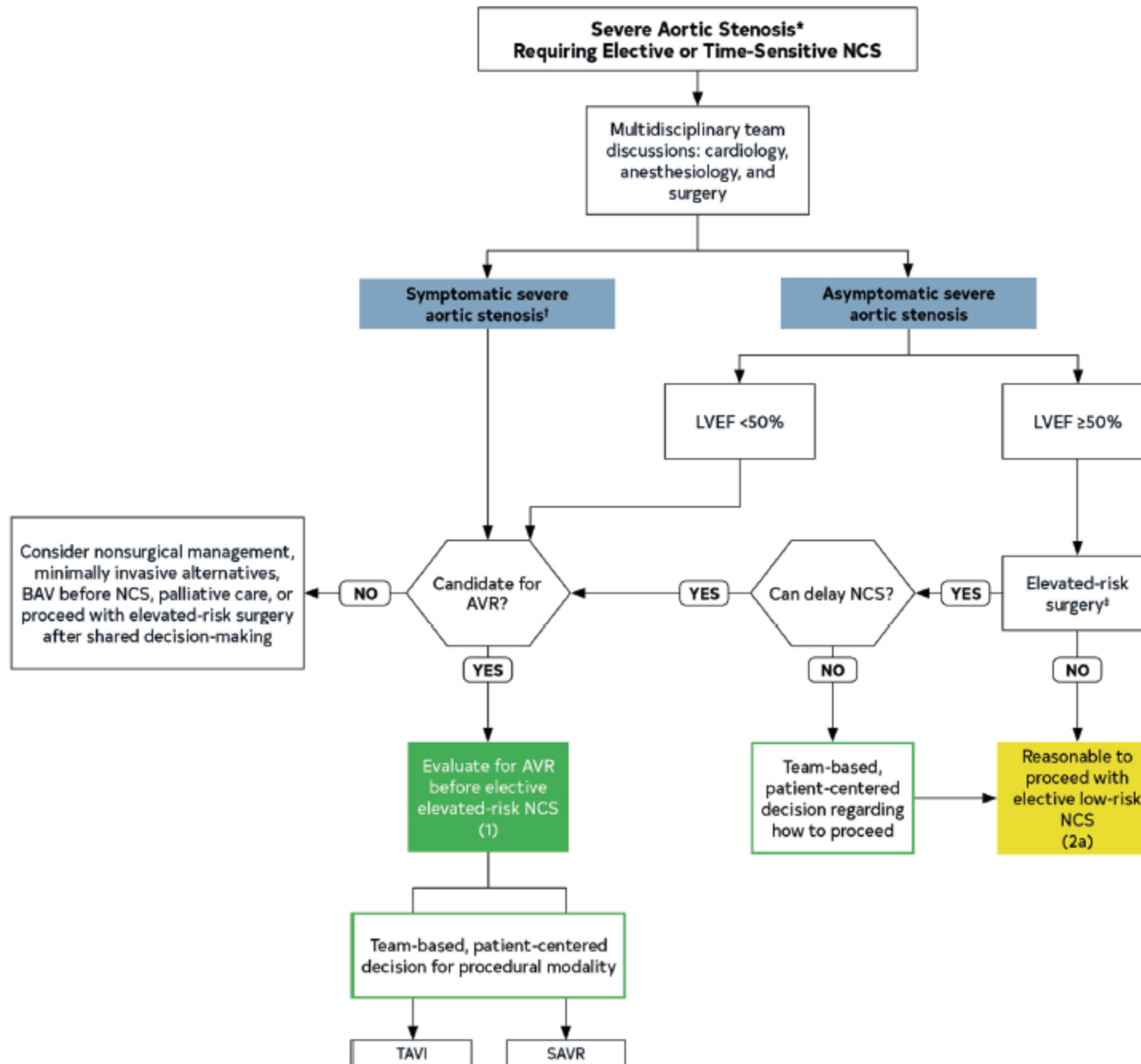
COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients receiving stable doses of targeted medical therapies* for pulmonary arterial hypertension (PAH) undergoing NCS, it is recommended to continue these agents to reduce the risk for the development of perioperative MACE. ¹
2a	C-LD	2. In patients with severe† PH undergoing elevated-risk NCS, referral to or consultation with a specialized PH center that can support risk assessment, optimization, and postoperative management (with consideration of intensive care after NCS) is reasonable to reduce perioperative cardiopulmonary complications. ²
2a	C-LD	3. In patients with severe† PH undergoing elevated-risk NCS, invasive hemodynamic monitoring is reasonable to guide intraoperative and postoperative care. ³⁻⁵
2b	C-EO	4. In patients with precapillary PH undergoing elevated-risk NCS, perioperative administration of short-acting inhaled pulmonary vasodilators (eg, nitric oxide, aerosolized prostacyclins) may be reasonable to reduce elevated RV afterload and prevent acute decompensated right HF. ⁶

*For example, nitric oxide pathway mediators, endothelin receptor antagonists, prostacyclin pathway agonists, or a combination of these. †Severe PH is defined according to hemodynamics (severe precapillary PH component by right heart catheterization and echocardiography) and additional data derived from clinical assessment, exercise tests, and laboratory biomarkers. Hemodynamically, severe PH displays a mean pulmonary artery (PA) pressure >40 mm Hg, pulmonary vascular resistance >5 Wood units, or echocardiographic evidence of significant RV dysfunction (eg, RV-to-LV diastolic diameter ratio >0.8 or RV dysfunction that is graded as moderate or severe). Although all 5 World Symposium on Pulmonary Hypertension group classifications display some degree of risk for developing severe PH, Group 1 (PAH), Group 3 (PH due to lung disease), and Group 4 (chronic thromboembolic PH) are at high risk for developing severe PH if left untreated and may be best managed and followed at a center with PH specialists.

Aortic Stenosis Management

COR	LOE	RECOMMENDATIONS
1	C-LD	1. Patients with severe AS should be evaluated for the need for aortic valve intervention before elective NCS to reduce perioperative risk.* ^{1,2}
1	C-EO	2. In patients with suspected moderate or severe AS who are undergoing elevated-risk NCS, preoperative echocardiography is recommended before elective NCS to guide perioperative management.*
2a	C-LD	3. In asymptomatic patients with moderate or severe AS and normal LV systolic function as assessed by echocardiography within the past year, it is reasonable to proceed with elective low-risk NCS. ³⁻⁵

*Modified from the "2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease."⁶



Atrial Fibrillation Management

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).^{*1-5}

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.^{*4,6}

Postdischarge

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.^{*7-11}

Perioperative Medical Therapy:

Antiplatelet Therapy and Timing of NCS in Patients with CAD

Antiplatelet Therapy	
COR	RECOMMENDATIONS
1	In patients with CAD undergoing elective NCS, perioperative management of antiplatelet therapy and timing of surgery should be determined by a multidisciplinary team with shared decision making to weigh the risks of bleeding, thrombosis, and consequences of delayed surgery.

Perioperative Antiplatelet Management Post PCI	
COR	RECOMMENDATIONS
1	In patients with prior PCI undergoing NCS, it is recommended to continue low-dose aspirin* (75-100 mg), if possible, to reduce the risk of cardiac events.
1	In patients with CAD who require time sensitive NCS within 30 days of PCI with BMS or <3 months of PCI with DES, DAPT should be continued unless the risk of bleeding outweighs the benefit of the prevention of stent thrombosis.

*P2Y12 inhibitors monotherapy may be considered if surgical bleeding risks are acceptable or if aspirin is not tolerated

- **Abbreviations:** BMS indicates bare-metal stent; CAD, coronary artery disease; DES, drug-eluting stent; DAPT, dual antiplatelet therapy; NCS, non-cardiac surgery; and PCI, percutaneous coronary intervention.



Perioperative Medical Therapy:

Antiplatelet Therapy and Timing of NCS in Patients with CAD

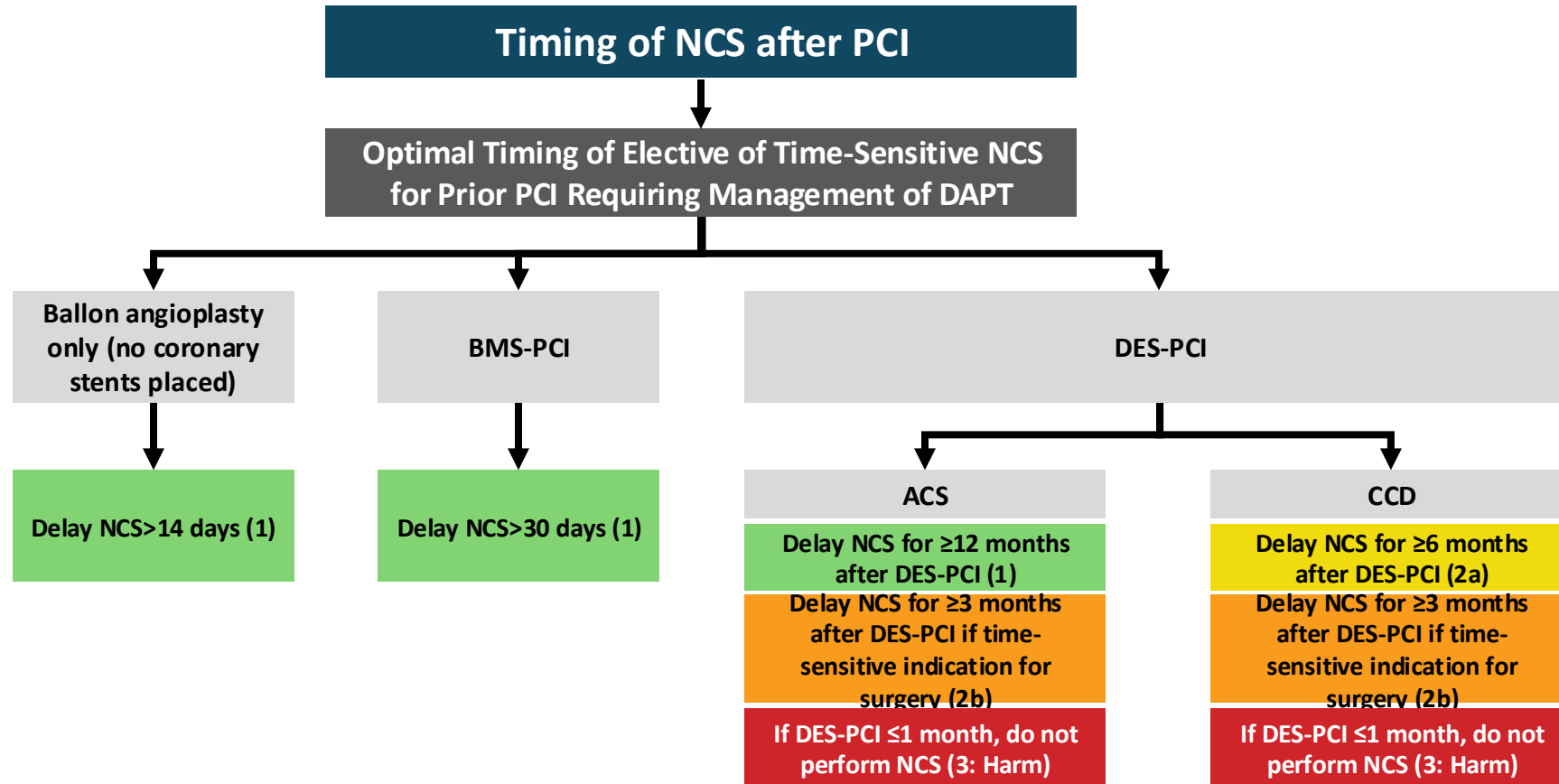
Perioperative Antiplatelet Management Post PCI - <i>continued</i>	
COR	RECOMMENDATIONS
1	In patients with prior PCI in whom OAC monotherapy must be discontinued prior to NCS, ASA should be substituted when feasible in the perioperative period until the OAC can be safely re-initiated.
2a	In select patients after PCI who have a high thrombotic risk, perioperative bridging with intravenous antiplatelet therapy may be considered <6 months after DES or <30 days after BMS if NCS cannot be deferred.
Perioperative Antiplatelet Management in Patients without Prior PCI	
COR	RECOMMENDATIONS
2b	In patients with CCD without prior PCI undergoing elective NCS, it may be reasonable to continue ASA in selected patients when the risk of cardiac events outweighs the risk of bleeding.
3: No Benefit	In patients with CAD but without prior PCI undergoing elective non-cardiac non-carotid surgery, routine ASA is not beneficial.



Abbreviations: ASA indicates aspirin; BMS, bare-metal stent; CAD, coronary artery disease; CCD, chronic coronary disease; DES, drug-eluting stent; NCS, noncardiac surgery; OAC, oral anticoagulation; and PCI, percutaneous coronary intervention.

Perioperative Medical Therapy:

Antiplatelet Therapy and Timing of NCS in Patients with CAD



Perioperative Medical Therapy: Oral Anticoagulants

OAC Management

COR	RECOMMENDATIONS
1	In patients with CVD receiving OAC who require elective NCS, multidisciplinary team-based approach to duration of interruption* is recommended to balance competing risks of thromboembolism and bleeding.

OAC Bridging

COR	RECOMMENDATIONS
2a	In patients with CVD and high thrombotic risk* undergoing NCS where interruption of VKA is required, preoperative bridging with parenteral heparin can be effective for thromboembolic risk reduction.
3: Harm	In most patients with CVD who are planned for an elective NCS where OAC interruption is warranted, routine bridging is not recommended due to increased bleeding risk.

OAC Resumption

COR	RECOMMENDATIONS
2a	In patients with preoperative OAC interruption, resumption of OAC is reasonable after hemostasis is achieved.



Additional Highlights

Delay elective surgery until 3 months after TIA or stroke

Continue statins, start one if indicated

Hold renin-angiotensin-aldosterone system inhibitors for hypertension for 24 hours preop, continue those prescribed for HFrEF

Patients on warfarin with high thrombotic risk benefit from bridging

If patients have a new indication for beta blockade, ideally start >7 days before surgery

Additional Highlights

Ok to continue metformin perioperatively

Hold SGLT-2i 3-4 days pre-op

Neuraxial vs general anesthesia – no difference in CV events

Maintenance of normothermia reduces perioperative complications

In those with iron deficiency anemia, preoperative iron therapy (PO or IV) is reasonable to reduce blood transfusions



Top Take Home Messages

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.

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.

Top Take Home Messages

4. Team-based care should be emphasized when managing patients with complex anatomy or unstable cardiovascular disease.

Top Take Home Messages

5. New therapies for management of diabetes, heart failure, and obesity have significant perioperative implications. Sodium-glucose cotransporter 2 inhibitors should be discontinued 3 to 4 days before surgery to minimize the risk of perioperative ketoacidosis associated with their use.

Top Take Home Messages

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

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.

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.

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 should not replace comprehensive transthoracic echocardiography.

Thank You!

