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“The Periop Drop” – Perioperative Medicine for the NP and PA

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Clinical Assistant Professor
Stanford University School of Medicine

A little background

- Stanford Surgical Co-Management
- Established in 2012
- 12 dedicated hospitalists for 3 surgical services
  - Orthopedics
  - Neurosurgery
  - ENT
- Goal is to predict, prevent, and treat medical issues that may result from surgery

Our team

- Dr. Rita Pandya, Chief, Surgical Co-management Section
- Dr. Gregory Auda
- Dr. Laura Derry
- **Dr. Sarita Khemani**
- Dr. Kate Luenprakansit
- Dr. Saloni Kumar Maharaj
- **Dr. Jessie Markovits**
- Dr. Natasha Steele
- Dr. Nidhi Rohatgi
- Dr. Jane Wang
- Dr. Jessica Tran
- Dr. Jonathan Hanisch

Objectives

- Perform a cardiac risk stratification
- Discuss the appropriate preoperative cardiac testing
- Manage anticoagulation in the perioperative period
- Manage cardiac medications in the perioperative period

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Perioperative Cardiac Risk Assessment

“Clearance” is for sales, **not** for pre-op

- Cardiac risk
  - Average
  - Elevated

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Case 1

75 year old man presents for preoperative evaluation prior to cataract surgery

- History of CAD s/p stent in 2010, chronic systolic heart failure (LVEF 35%), HTN, HLD, CKD 3 (Cr 1.1-1.3), osteoarthritis of both knees
- Home medications: aspirin, atorvastatin, lisinopril, furosemide, carvedilol
- No smoking, drinking, or drug use
- Does not ambulate much – most strenuous activity is walking around his 1-floor house limited by his knee pain
- Denies chest pain, dyspnea, edema, orthopnea, PND
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- Echo 9 months ago: Stable EF

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Surgery-specific cardiac risk

High (>5% cardiac risk)

- Aortic and major vascular surgery
- Peripheral vascular surgery

Intermediate (1-5% cardiac risk)

- Intraperitoneal or intrathoracic surgery
- Carotid endarterectomy
- Head and neck surgery
- Orthopedic surgery
- Prostate surgery

Low (<1% cardiac risk)

- Ambulatory procedures
- Endoscopic procedures
- Cataract surgery
- Breast surgery

ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery. Circulation. Volume 105, Issue 10, 12 March 2002; Pages 1257-1267. https://doi.org/10.1161/circ.105.10.1257.

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When to order preoperative EKG: 2014 ACC/AHA Guideline

- Reasonable to order if known CAD, significant arrhythmia, PAD, CVA or other significant structural heart disease except in low-risk surgery
- May be considered for asymptomatic patients except in low-risk surgery

J Am Coll Cardiol 2014;64:e77–137

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When to order preoperative EKG: 2022 ESC Guideline

- Recommended for patients with known cardiovascular disease or risk factors (including age ≥ 65 years old) or symptoms suggestive of cardiovascular disease before intermediate or high-risk surgery

European Heart Journal, Volume 43, Issue 39, 14 October 2022, Pages 3826–3924, https://doi.org/10.1093/eurheartj/ehac270

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When to order preoperative echocardiogram

2014 ACC/AHA guideline

- Reasonable to order if dyspnea of unknown origin or worsening heart failure symptoms
- Recommended for moderate-severe valve disease without echo in past year or significant change in clinical status or exam since last exam

J Am Coll Cardiol 2014;64:e77–137

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When to order preoperative echocardiogram

2022 ESC guideline

- Recommended in patients with poor functional capacity and/or high NT-proBNP/BNP, or if murmurs are detected before high-risk non-cardiac surgery

European Heart Journal, Volume 43, Issue 39, 14 October 2022, Pages 3826–3924, https://doi.org/10.1093/eurheartj/ehac270

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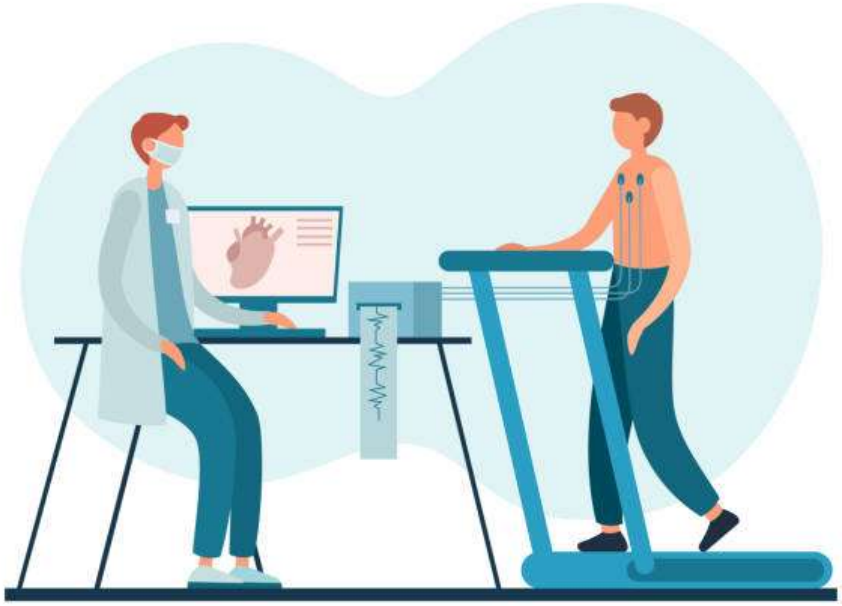
When to order a preoperative stress test?

- May be considered for patients with elevated risk with unknown or poor functional capacity if it will change management



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What preoperative testing would be reasonable to order?

A) Stress Test

B) Echo

C) EKG

D) None

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Case 2

75 year old man presents for preoperative evaluation prior to elective total knee replacement

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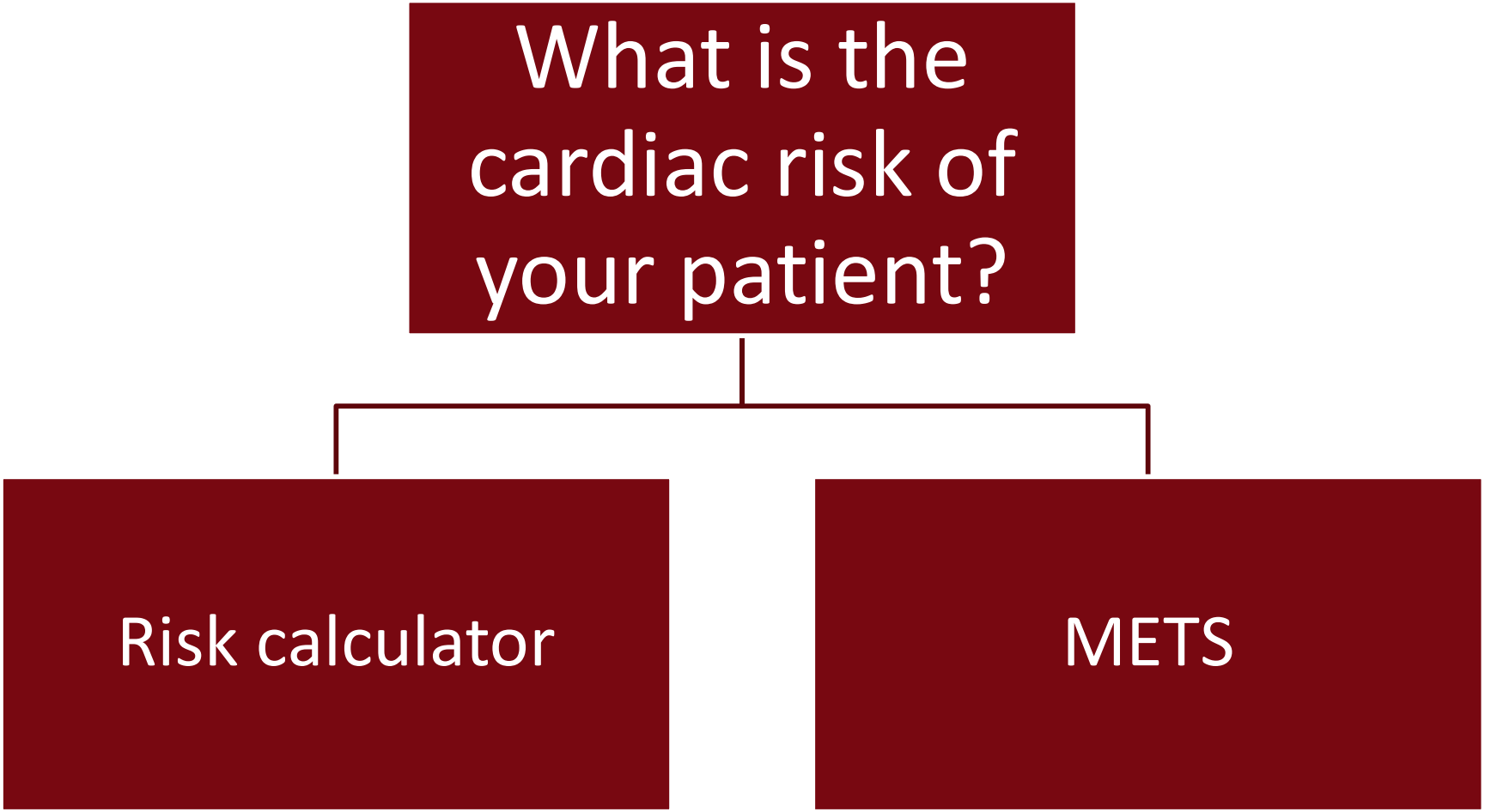

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Cardiac risk stratification (MACE)

- RCRI- Revised Cardiac Risk Index (1 point for each)
  - High risk surgery
  - History of ischemic heart disease
  - History of CHF
  - History of CVA/TIA
  - DM requiring treatment with insulin
  - Cr > 2
- Risk for in-hospital risk of MI, pulmonary edema, VF, cardiac arrest, complete heart block
  - 0 = 0.4%
  - 1 = 0.9%
  - 2 = 6.6%
  - 3+ = 11%

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NSQIP

National Surgical Quality Improvement Program

Procedure 27447 - Arthroplasty, knee, condyle and plateau; medial AND lateral compartments with or without patella resurfacing (total knee arthroplasty) Clear

Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a '+' in between, for example: "cholecystectomy + cholangiography"

Reset All Selections

Are there other potential appropriate treatment options? ☐ **Other Surgical Options** ☐ **Other Non-operative options** ☑ **None**

Please enter as much of the following information as you can to receive the best risk estimates.
A rough estimate will still be generated if you cannot provide all of the information below.

Age Group: 75-84 years

Sex: Male

Functional Status: Partially Dependent

Emergency Case: No

ASA Class: Severe systemic disease

Steroid use for chronic condition: No

Ascites within 30 days prior to surgery: No

Systemic Sepsis within 48 hours prior to surgery: None

Ventilator Dependent: No

Disseminated Cancer: No

Diabetes: No

Hypertension requiring medication: Yes

Congestive Heart Failure in 30 days prior to surgery: Yes

Dyspnea: No

Current Smoker within 1 Year: No

History of Severe COPD: No

Dialysis: No

Acute Renal Failure: No

BMI Calculation:

Height: 70 in / 178 cm

Weight: 180 lb / 82 kg

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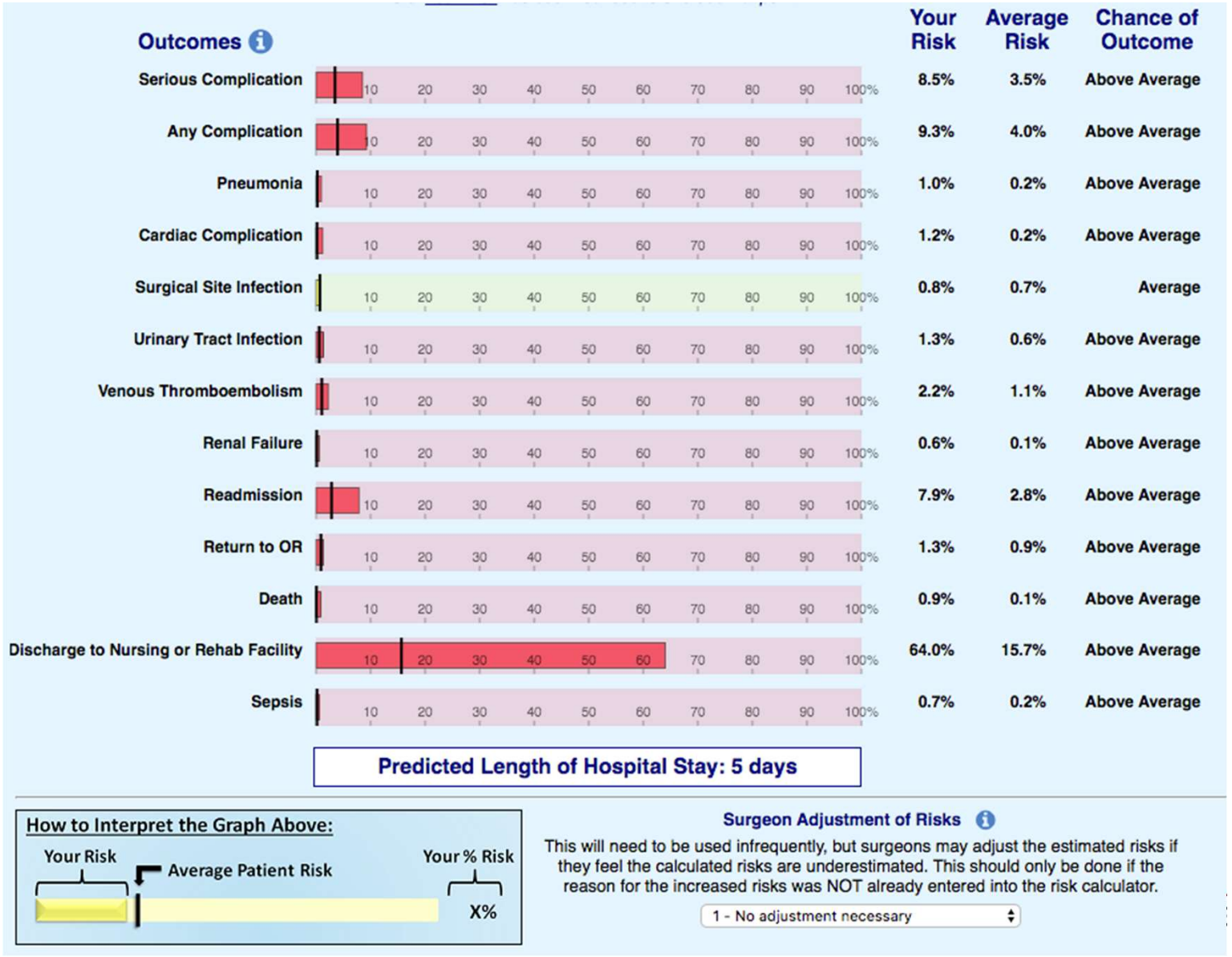
National Surgical Quality Improvement Program



Metabolic equivalents (METS)

4 METS
Climbing a flight of stairs or walking up a hill
Walking on ground level for 2 blocks
Running a short distance
Heavy housework (scrubbing floors, moving heavy furniture)
Moderate recreational activities (golfing, dancing, throwing a baseball)

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Duke Activity Score Index (DASI)

Is the patient able to:

Take care of self e.g. eating, dressing, bathing, using the toilet	No 0	**Yes +2.75**
Walk indoors	No 0	**Yes +1.75**
Walk 1–2 blocks on level ground	**No 0**	Yes +2.75
Climb a flight of stairs or walk up a hill	**No 0**	Yes +5.5
Run a short distance	**No 0**	Yes +8
Do light work around the house e.g. dusting, washing dishes	No 0	**Yes +2.7**
Do moderate work around the house e.g. vacuuming, sweeping floors, carrying in groceries	**No 0**	Yes +3.5
Do heavy work around the house e.g. scrubbing floors, lifting or moving heavy furniture	**No 0**	Yes +8
Do yardwork e.g. raking leaves, weeding, pushing a power mower	**No 0**	Yes +4.5
Have sexual relations	**No 0**	Yes +5.25
Participate in moderate recreational activities e.g. golf, bowling, dancing, doubles tennis, throwing a baseball or football	**No 0**	Yes +6
Participate in strenuous sports e.g. swimming, singles tennis, football, basketball, skiing	**No 0**	Yes +7.5

7.2 points

The higher the score (maximum 58.2), the higher the functional status.

3.63 METs

Copy Results

Next Steps

MET Repair Questionnaire

• *Carrying upstairs a suitcase (10-20kg / 20 - 40lb);* • *Running.*	8	☐	☐
○ Moving furniture, household items; ○ Lifting light loads; ○ Running, playing with children or animals at vigorous effort; ○ Recreational swimming.	5	☐	☐
• *Carrying groceries upstairs;* • *Jogging;* • *Recreational soccer or tennis.*	7	☐	☐
○ Descending stairs; ○ Making beds; ○ Vacuuming or sweeping floors; ○ Walking the dog for pleasure; ○ Play with children at moderate effort.	3	☐	☐
• *Stair climbing at slow pace;* • *Hanging laundry;* • *Cleaning the bathroom;* • *Mowing lawn (power mower);* • *Raking lawn or sweeping outside the house;* • *Leisure bicycling;* • *Walking for exercise, level, moderate pace.*	4	☐	☐
○ Sitting, reading, watching TV, listening to music	1	☐	☐
• *Moving household items upstairs, carrying boxes (upstairs);* • *Climbing hills carrying ≥ 20 kg / ≥ 40 lb.;* • *Swimming fast.*	7.5	☐	☐
○ Hiking cross country; ○ Walking for exercise uphill; ○ Biking to/from work at self-selected pace; ○ Scrubbing floors on hands and knees, vigorous effort; ○ Mowing lawn (hand mower); ○ Shoveling snow; ○ Chopping wood, vigorous effort.	6	☐	☐
• *Walk indoors, such as around your house;* • *Dressing/undressing.*	2	☐	☐
○ Carrying loads ≥ 25 kg / 50 lb. (e.g. furniture, 2 suitcases) upstairs; ○ Running 10 km/h. / 6mph Please notice: *10km/h or 6 mph is faster than a bicycle at leisure pace.*	8.5	☐	☐

Quantification of metabolic equivalents (METs) by the MET-REPAIR questionnaire: A validation study in patients with a high cardiovascular burden, Journal of Clinical Anesthesia, Volume 76, 2022, https://doi.org/10.1016/j.jclinane.2021.110559.

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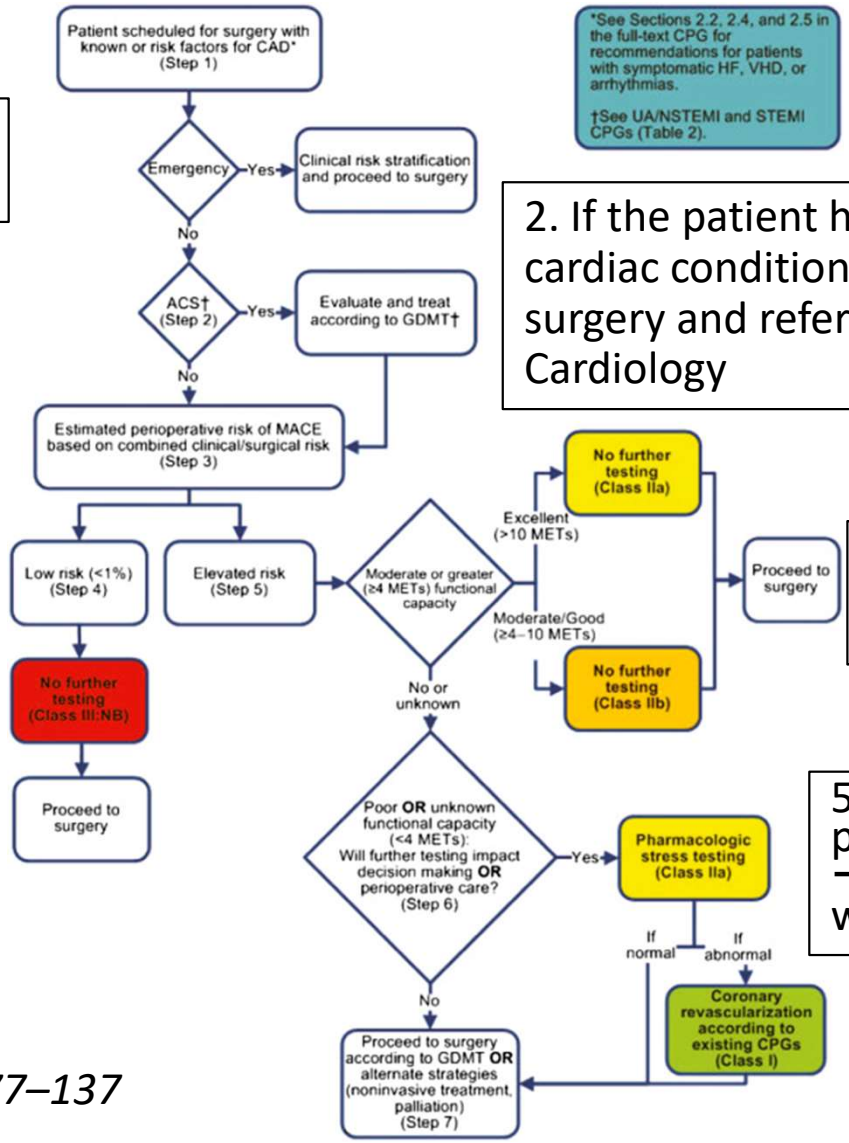
1. If surgery is emergent → proceed to OR



2. If the patient has an acute cardiac condition → postpone surgery and refer to Cardiology

3. If the patient is having a low risk surgery → no further testing indicated

4. If the RCRI ≤ 1 or patient able to do > 4 METS → no stress testing indicated

5. If RCRI ≥ 2 with poor/unknown functional status → consider stress testing if it would change management

J Am Coll Cardiol 2014;64:e77–137

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Case 2

75 year old man presents for preoperative evaluation prior to elective total knee replacement

- History of CAD s/p stent in 2010, chronic systolic heart failure (LVEF 35%), HTN, HLD, CKD 3 (Cr 1.1-1.3), osteoarthritis
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What preoperative testing would be reasonable to order?

A) Stress Test

B) Echo

C) EKG

D) None

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Case 3

75 year old man presents to the ED with a hip fracture. Medicine consulted for preoperative evaluation before surgery. Plan for OR tomorrow morning.

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What preoperative testing would be reasonable to order?

A) Stress Test

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C) EKG

D) None

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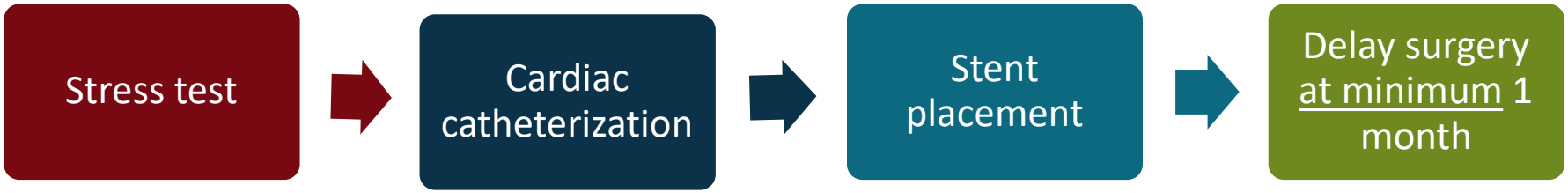
Factors to consider when ordering preoperative stress testing in “urgent” surgery

- Will it change management?
- Can surgery be delayed?



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Are we over-stressing stress testing?

- Ask yourself: ”Is the cardiac intervention more important than the surgery being done?”
  - Example: curative cancer surgery versus cosmetic surgery
- Stress testing leads to increased cardiac testing/interventions which decreases the likelihood of surgery without improving mortality
- CARP trial - randomized high-risk patients to re-vascularization or no revascularization and found no difference in mortality
- For patients with a new anginal equivalent, work them up as you usually would and is irrespective of surgery

Pappas MA, Auerbach AD, Kattan MW, Blackstone EH, Rothberg MB, Sessler DI. Consequences of preoperative cardiac stress testing-A cohort study. J Clin Anesth. 2023 Nov;90:111158. doi: 10.1016/j.jclinane.2023.111158. Epub 2023 Jul 5. PMID: 37418830; PMCID: PMC10530324.

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Cardiac conditions needing evaluation prior to non-cardiac surgery

- Unstable coronary symptoms
- Decompensated heart failure
- Significant arrhythmias
- Severe valvular disease

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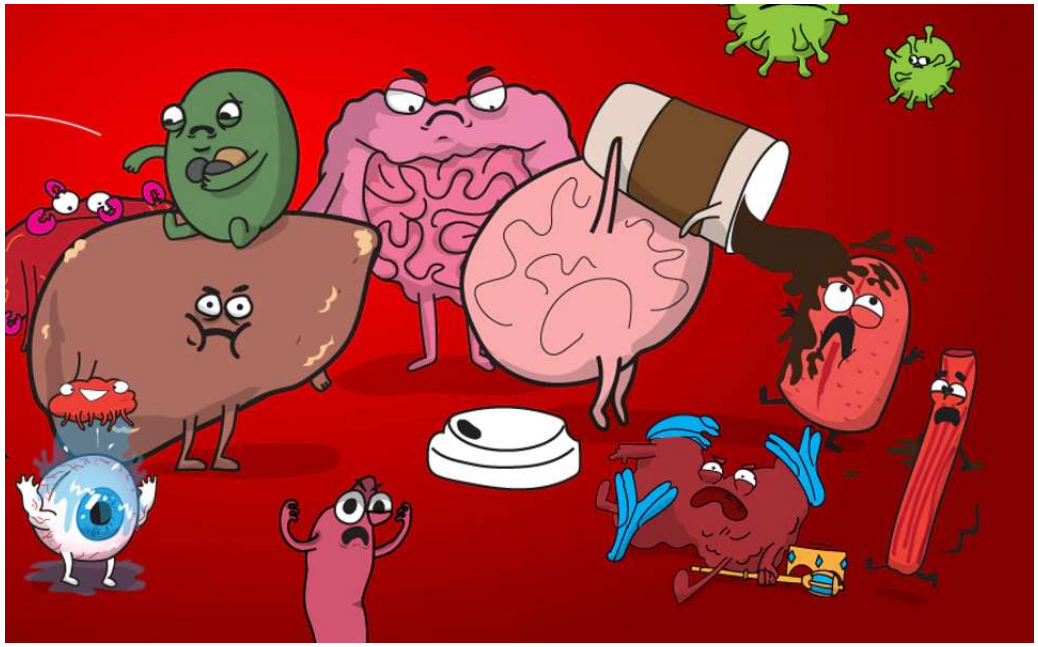
Surgeries can affect many organ systems



What helps most in perioperative medical management?

Rohatgi, Perioperative Risk Calculators and the Art of Medicine, doi: 10.1001/jamainternmed.2019.4914

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Preoperative Anticoagulation and Antiplatelets

Case 4

82 year old presents for preoperative evaluation one week prior to total knee arthroplasty (TKA)

- History of persistent atrial fibrillation (CHA2DS2-VASC = 4), rheumatoid arthritis (no DMARDs or steroids), provoked pulmonary embolism after shoulder surgery in 2004, gout, and CKD 3 (serum creatinine 1.5-1.7 mg/dL; CrCl 40 mL/min)
- Home medications: carvedilol, warfarin, allopurinol
- Denies smoking, drinking, or drug use
- Avid golfer and still practicing part-time as a cardiologist
- Labs today in clinic: INR 2.3, Cr 1.56 mg/dL

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82 year old presents for preoperative evaluation one week prior to total knee arthroplasty (TKA)

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Home medications: carvedilol, warfarin, allopurinol

Denies smoking, drinking, or drug use

Avid golfer and still practicing part-time as a cardiologist

Labs today in clinic: INR 2.3, Cr 1.56 mg/dL

When would you stop warfarin before TKA?

A) Stop warfarin 3 days before surgery

B) Stop warfarin 4 days before surgery

C) Stop warfarin 5 days before surgery

D) Stop warfarin 7 days before surgery

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82 year old presents for preoperative evaluation one week prior to <u>total knee arthroplasty (TKA)</u>

History of persistent atrial fibrillation (CHA2DS2-VASC = 4), rheumatoid arthritis (no DMARDs or steroids), provoked pulmonary embolism after shoulder surgery in 2004, gout, and CKD 3 (serum creatinine 1.5-1.7 mg/dL; CrCl 40 mL/min)

Home medications: carvedilol, warfarin, allopurinol

Denies smoking, drinking, or drug use

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What do you recommend for bridging?

A) No bridging

B) Bridge with therapeutic lovenox (1 mg/kg BID)

C) Bridge with prophylactic lovenox (lovenox 30-40 mg daily)

D) Bridge with heparin SQ

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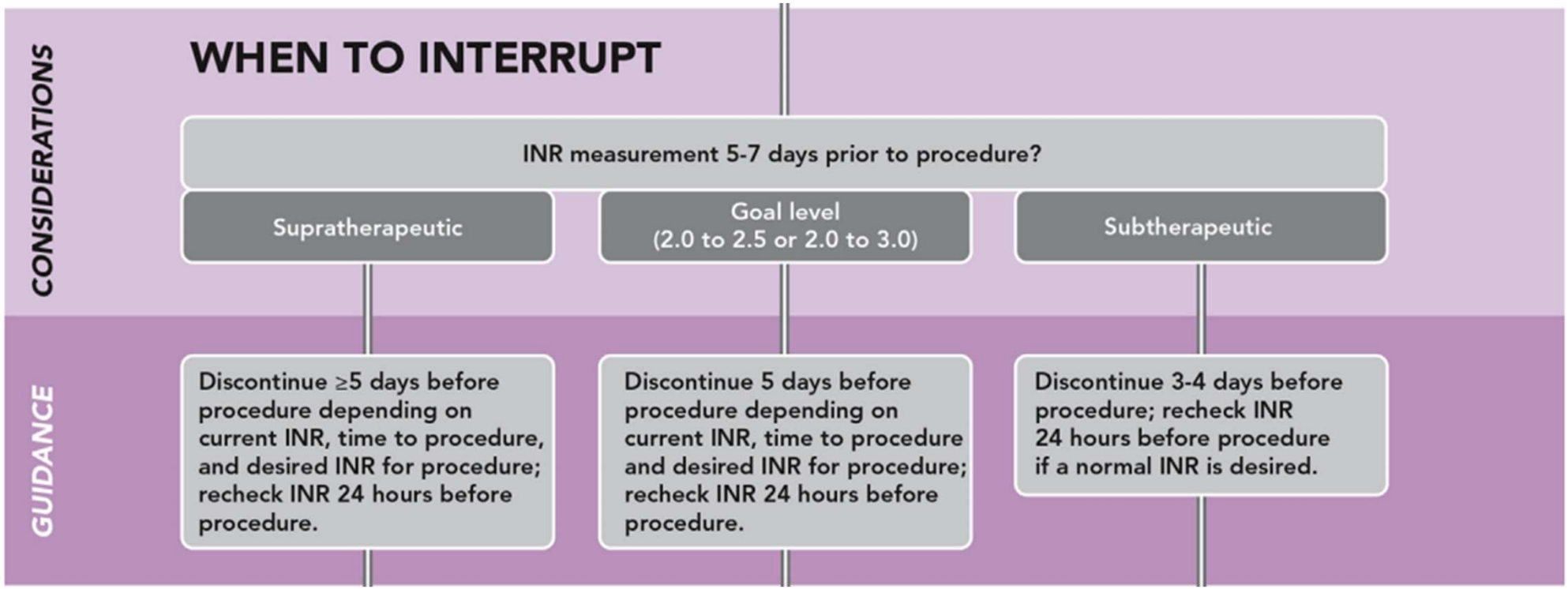
Warfarin interruption for NVAF: 2017 ACC Expert Consensus



J Am Coll Cardiol 2017;69:871–98

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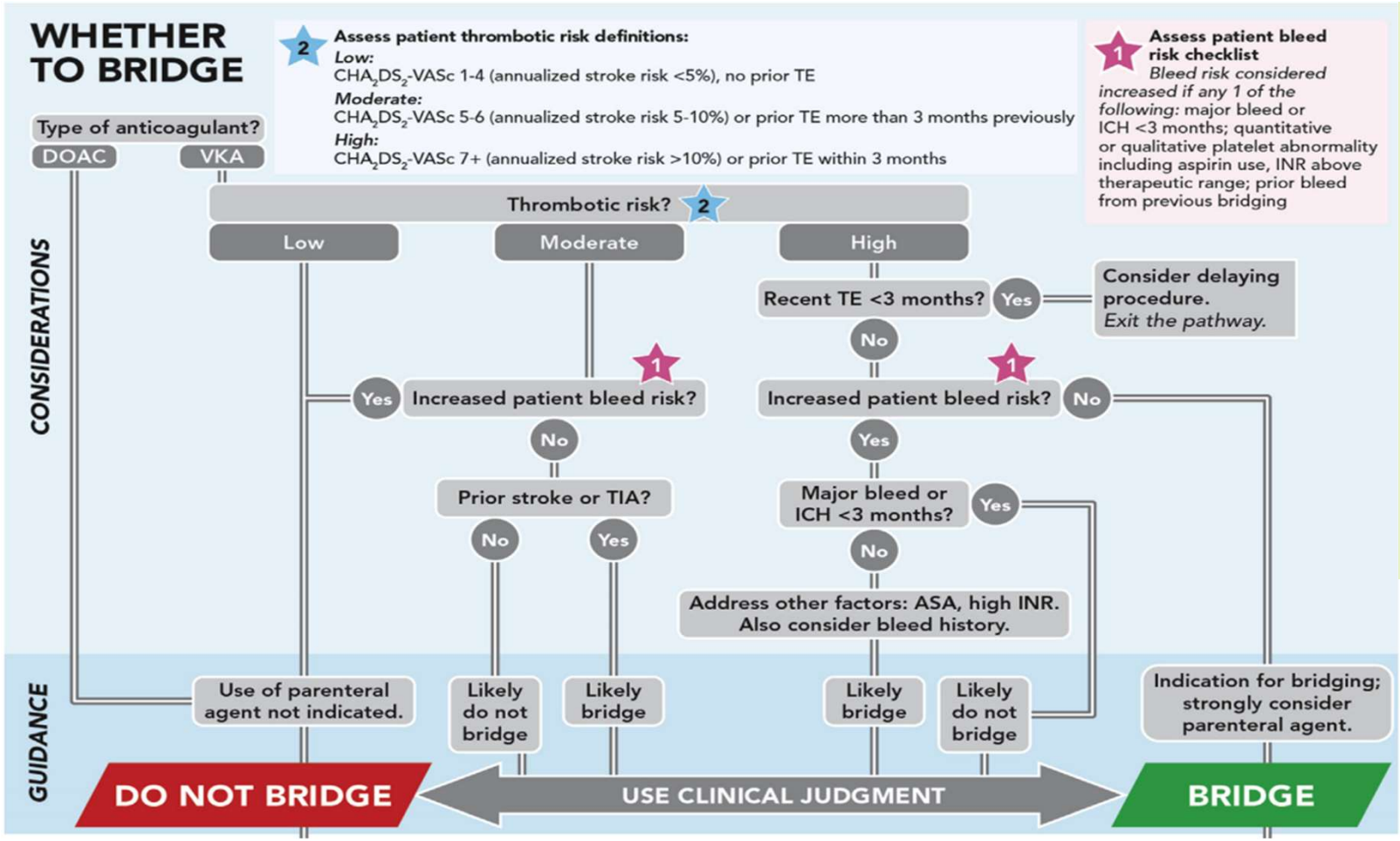
NVAF: Who should be bridged - 2017 ACC Expert Consensus



J Am Coll Cardiol 2017;69:871–98

Non-valvular AF: Does not imply no valvular disease (it excludes mechanical valve and moderate to severe mitral stenosis)

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Perioperative management of warfarin in non-valvular atrial fibrillation: BRIDGE trial

- Rate of arterial thromboembolism (CVA/TIA and systemic embolism)
  - Not bridging = Bridging
- Rate of major bleeding
  - Higher with bridging than not bridging
- 1884 patients randomized to LMWH bridge or no bridge
  - ~85% of patients with CHADS2-Vasc ≤ 3
  - Only 12% underwent "Major surgery/procedure"
  - ~35% were also on aspirin (either held < or > 7 days, or continued)

N Engl J Med 2015; 373:823-833

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What do you recommend for bridging?

A) No bridging

B) Bridge with therapeutic lovenox (1 mg/kg BID)

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D) Bridge with heparin SQ

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Case 5 - A year later

- With evidence for reduced-dose direct oral anticoagulants (DOACs) in patients >80 years with renal insufficiency, patient is switched from warfarin to apixaban 2.5 mg BID about 6 months ago

- He now presents to your preoperative clinic prior to undergoing ankle surgery.

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With evidence for reduced-dose direct oral anticoagulants (DOACs) in patients >80 years with renal insufficiency, patient is switched from warfarin to apixaban 2.5 mg BID about 6 months ago

He now presents to your preoperative clinic prior to undergoing ankle surgery.

History of persistent atrial fibrillation (CHA2DS2-VASC = 4), rheumatoid arthritis (no DMARDs or steroids), provoked pulmonary embolism after shoulder surgery in 2004, gout, and CKD 3 (serum creatinine 1.5-1.7 mg/dL; CrCl 40 mL/min)

What do you recommend regarding holding apixaban preoperatively?

A) Stop apixaban 2 days before surgery and no bridging

B) Stop apixaban 4 days before surgery and no bridging

C) Stop apixaban 5 days before surgery and bridge with LMWH

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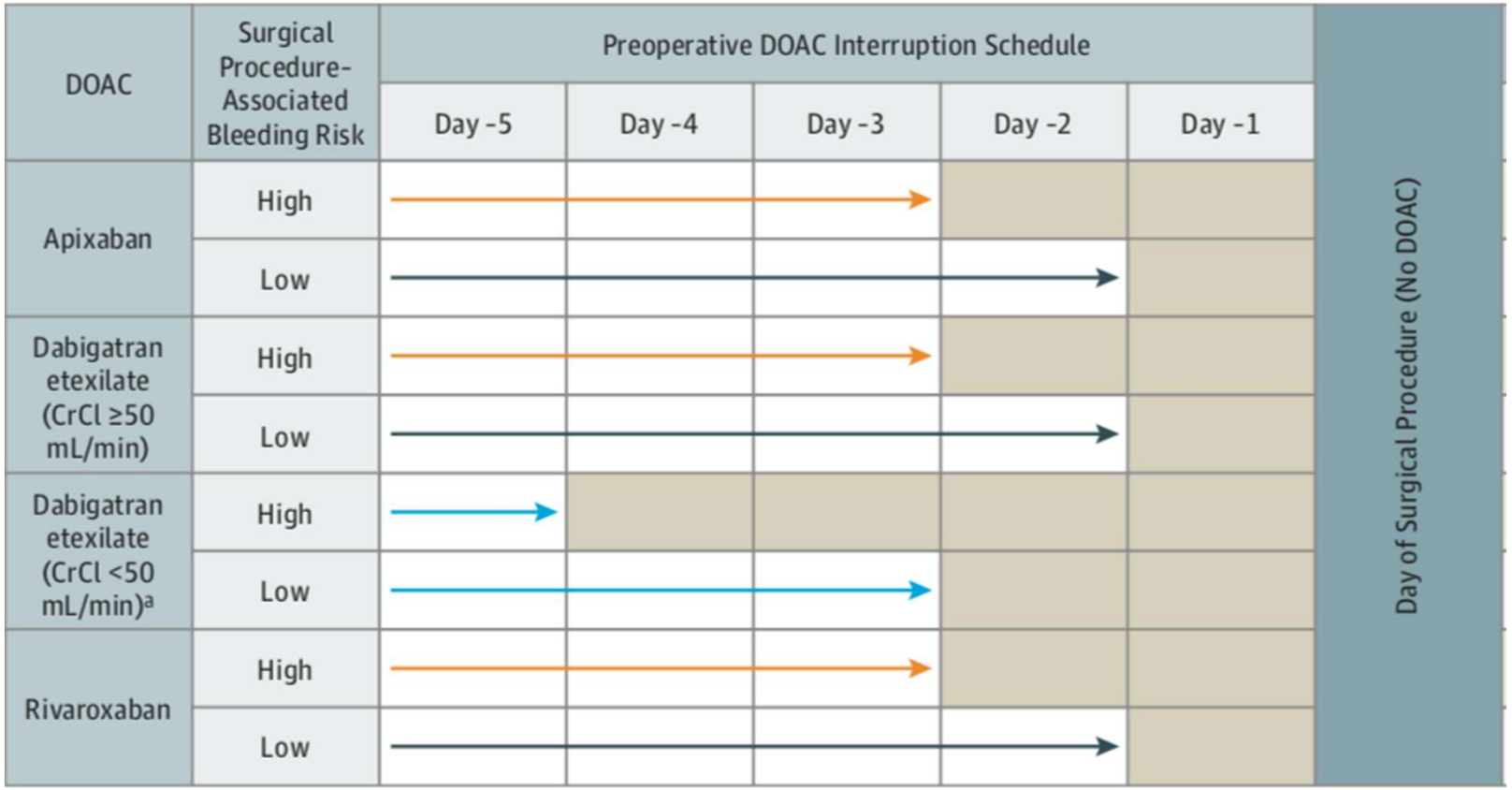
PAUSE trial



Apixaban group excluded CrCl <25

Dabigatran and rivaroxaban groups excluded CrCl<30

JAMA Intern Med. 2019 Aug 5. doi: 10.1001/jamainternmed.2019.2431

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PAUSE trial

- 3,007 patients at 23 centers on perioperative DOAC management of apixaban, rivaroxaban, and dabigatran
- About 35% CT surgery and 10-15% orthopedic
- No bridging was performed
- CHADS2-Vasc score was 3-4 on average
- At 30 days, major bleeding was < 2% and stroke < 1%

JAMA Intern Med. 2019 Aug 5. doi: 10.1001/jamainternmed.2019.2431

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American Society of Regional Anesthesia and Pain Medicine Guidelines

- Hold DOAC for 72 hours before epidural or spinal anesthetic

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DOACs and bridging? **NO!**

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Case 5 - A year later

- With evidence for reduced-dose direct oral anticoagulants (DOACs) in patients >80 years with renal insufficiency, patient is switched from warfarin to apixaban 2.5 mg BID about 6 months ago

- He now presents to your preoperative clinic prior to undergoing ankle surgery.

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He now presents to your preoperative clinic prior to undergoing ankle surgery.

History of persistent atrial fibrillation (CHA2DS2-VASC = 4), rheumatoid arthritis (no DMARDs or steroids), provoked pulmonary embolism after shoulder surgery in 2004, gout, and CKD 3 (serum creatinine 1.5-1.7 mg/dL; CrCl 40 mL/min)

What do you recommend regarding holding apixaban preoperatively?

A) Stop apixaban 2 days before surgery and no bridging

B) Stop apixaban 4 days before surgery and no bridging

C) Stop apixaban 5 days before surgery and bridge with LMWH

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Case 6 - 3 years later

- Patient again presents to your preoperative clinic. He has worsening knee pain and his orthopedic surgeon suspects the knee hardware loosening and wants to schedule him for a non-urgent revision surgery
- Interim medical history updates:
  - 2 years ago, he underwent ablation for atrial fibrillation. No recurrence of AF was noted on ambulatory testing and he was eventually taken off apixaban
  - 2 months ago, he had an NSTEMI and overlapping drug-eluting stents were placed in his LAD. He has been on clopidogrel 75 mg and aspirin 81 mg daily since then

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What is your plan regarding dual anti-platelet agents perioperatively?

A) Stop ASA and clopidogrel 7 days preoperatively

B) Stop clopidogrel 5 days preoperative and continue ASA perioperatively

C) Continue both ASA and clopidogrel perioperatively

D) Postpone surgery

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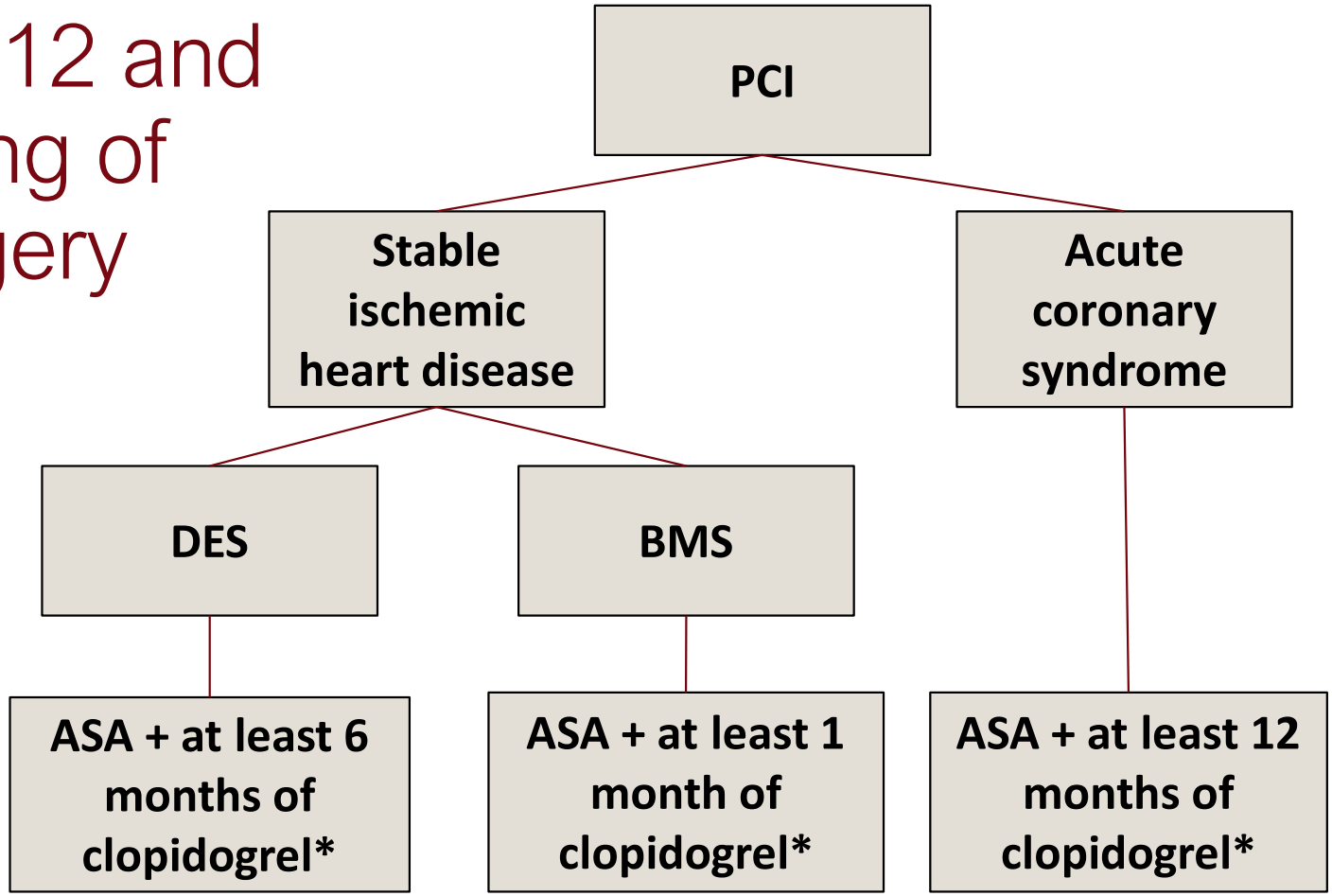
Duration of P2Y12 and timing of surgery

Class 1 Recommendations



*If high bleeding risk or overt bleeding, duration may be shortened in consultation with cardiology

J Thorac Cardiovasc Surg. 2016 Nov;152(5):1243-1275

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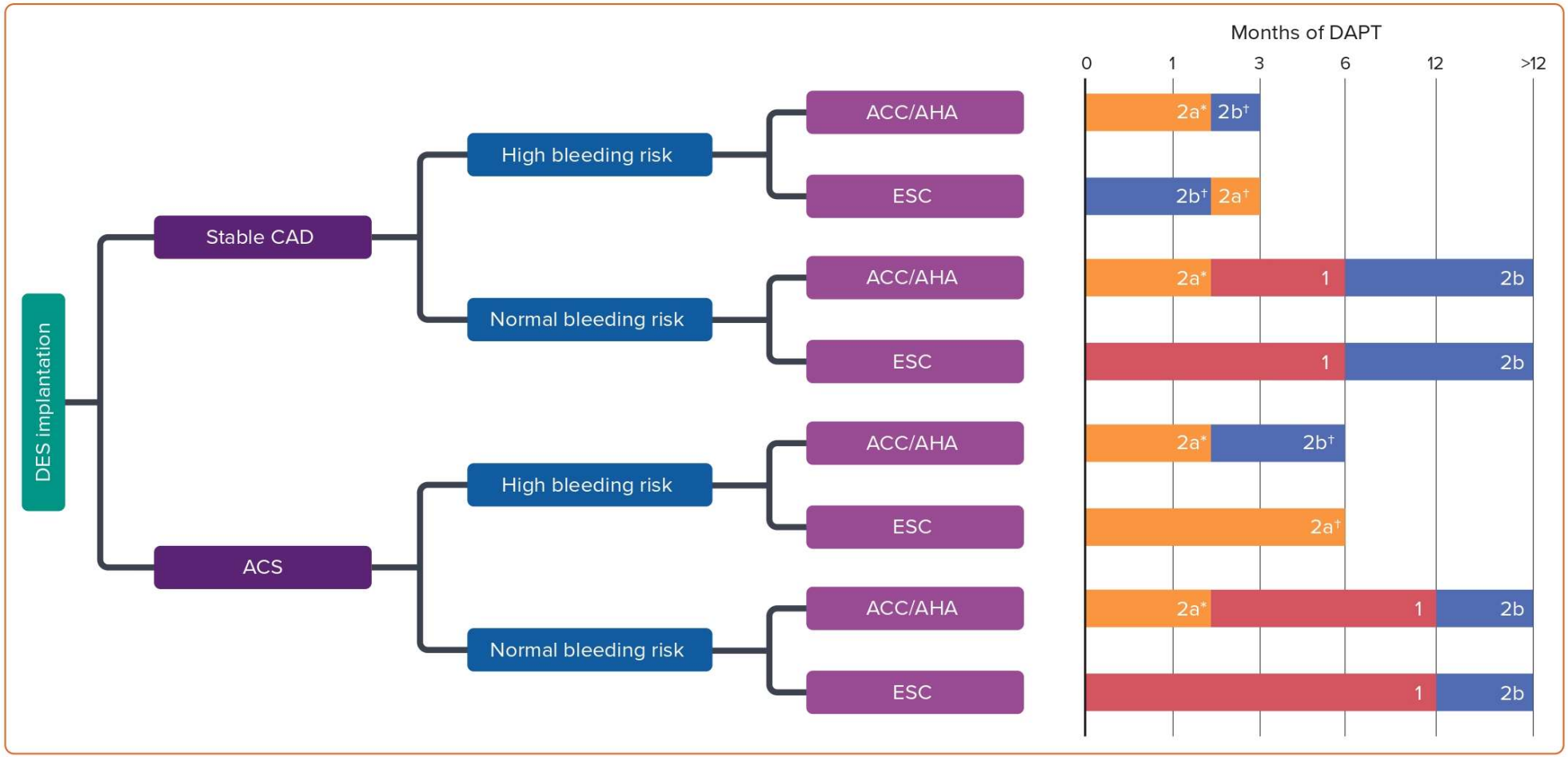

**Discontinuation of aspirin after 1–3 months with P2Y12 receptor inhibitor monotherapy; †Discontinuation of $P2Y_{12}$ receptor inhibitor with aspirin monotherapy. ACC = American College of Cardiology; ACS = acute coronary syndrome; AHA = American Heart Association; CAD = coronary artery disease; DAPT = dual antiplatelet therapy; DES = drug-eluting stent; ESC = European Society of Cardiology.*

Shortened duration of dual antiplatelet therapy following percutaneous coronary intervention. Interventional Cardiology Review. 2023. https://www.icrjournal.com/articles/shortened-duration-dual-antiplatelet-therapy-following-percutaneous-coronary-intervention

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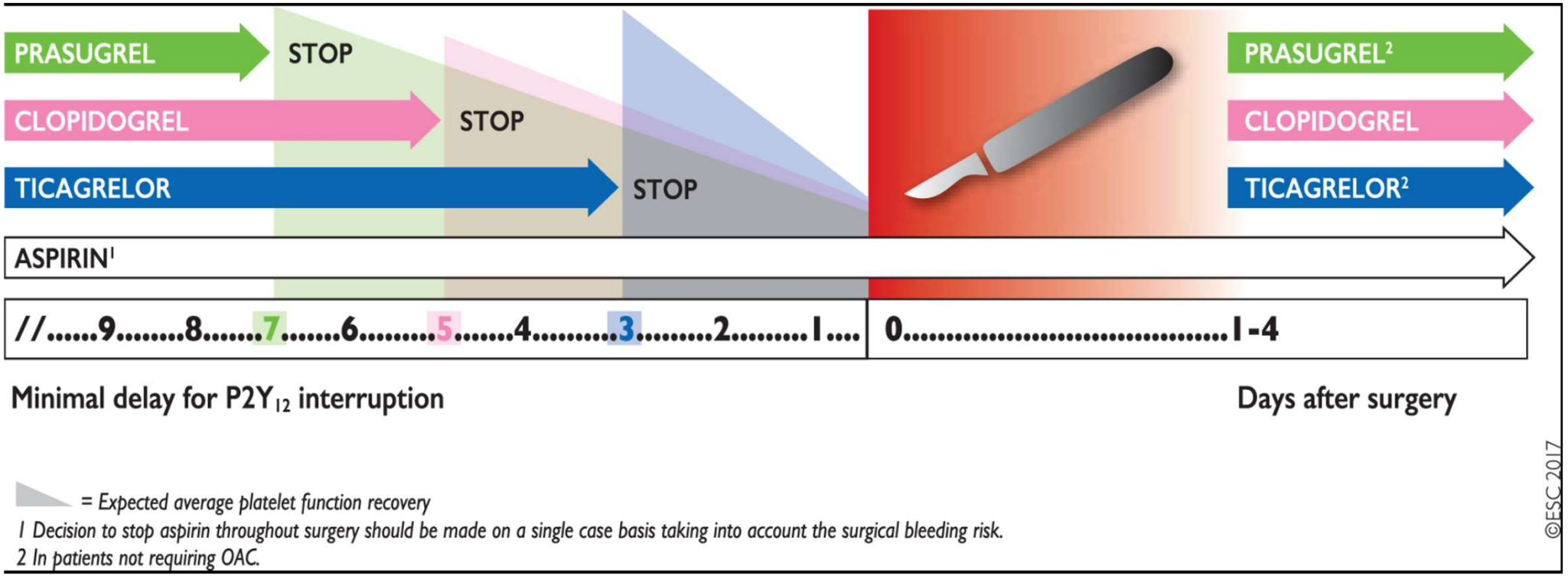
Minimal duration of DAPT interruption: 2017 ESC/EACTS guidelines



Eur Heart J. 2018;39(3):213-60

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Holding or continuing aspirin perioperatively?

- Randomized control trial
- Patients undergoing noncardiac surgery > 1 year after PCI with DES
- No difference in mortality, MI, stent thrombosis, stroke at 30 days in those who continued aspirin perioperatively versus held 5 days preoperatively
- Increased minor bleeding in patients who continued aspirin

JACC. Aug 31, 2024. Epublished DOI: 10.1016/j.jacc.2024.08.024

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Perioperative Cardiac Medications

Case 7

A 65 year old woman presents with a L4 fracture with plan for OR tomorrow.

- History of hypertension, chronic diastolic heart failure, hyperlipidemia, and CKD 2 (Cr 0.8).
- Home medications: amlodipine, hydrochlorothiazide, lisinopril, furosemide and atorvastatin
- Vitals in clinic notable for SBP 120/70

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History of hypertension, chronic diastolic heart failure, hyperlipidemia, and CKD 2 (Cr 0.8).
Home medications: amlodipine, hydrochlorothiazide, lisinopril, furosemide and atorvastatin
Vitals in clinic notable for SBP 120/70

What do you do with her medications preoperatively?

A) Continue all medications the day of surgery

B) Continue amlodipine and atorvastatin but hold hydrochlorothiazide, lisinopril, and furosemide

C) Continue amlodipine, lisinopril, hydrochlorothiazide, and atorvastatin but hold furosemide

D) Hold all home medications the day of surgery

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Cardiac medications

- Continue most cardiac medications on the day of surgery with the following exceptions:

Medication class	Concern	Perioperative management
ACEi and ARB	Intractable hypotension intraoperatively and AKI postoperatively	Usually hold the day of surgery, newer studies suggest it's okay to continue perioperatively
Diuretics	Hypotension intraoperatively and AKI postoperatively	Hold the morning of surgery
SGLT2-inhibitors	Euglycemic DKA	Hold 3-4 days preoperatively

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Notable cardiac medications

- Continue any anti-arrhythmic medications
- Continue clonidine to avoid rebound hypertension
- Do not start beta blockers new on the morning of surgery but continue if already on it
- Continue pulmonary hypertension vasodilators
- Continue statins

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