# Perioperative Assessment of the Hospitalized Patient

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# Disclosures

- None

# Objectives

- Develop a framework for perioperative cardiac and pulmonary risk assessment before non-cardiac surgery in hospitalized patients
- Review management of a few cardiac medications perioperatively
- Highlight key perioperative studies for reference

# Our patient

85 yo woman is admitted with difficulty walking and leg pain, found to have chronic limb ischemia.

She is being considered for a revascularization surgery due to her severe pain and desire to avoid amputation.

You are asked to provide pre-operative "clearance" for this patient to proceed to surgery within the next few days.

# Our patient

## Past medical history

Coronary artery disease

Congestive heart failure with preserved EF

COPD

Aortic stenosis, moderate

Hypertension

Atrial fibrillation

Peripheral vascular disease

## Medications

Metoprolol

Lisinopril

Furosemide

Aspirin

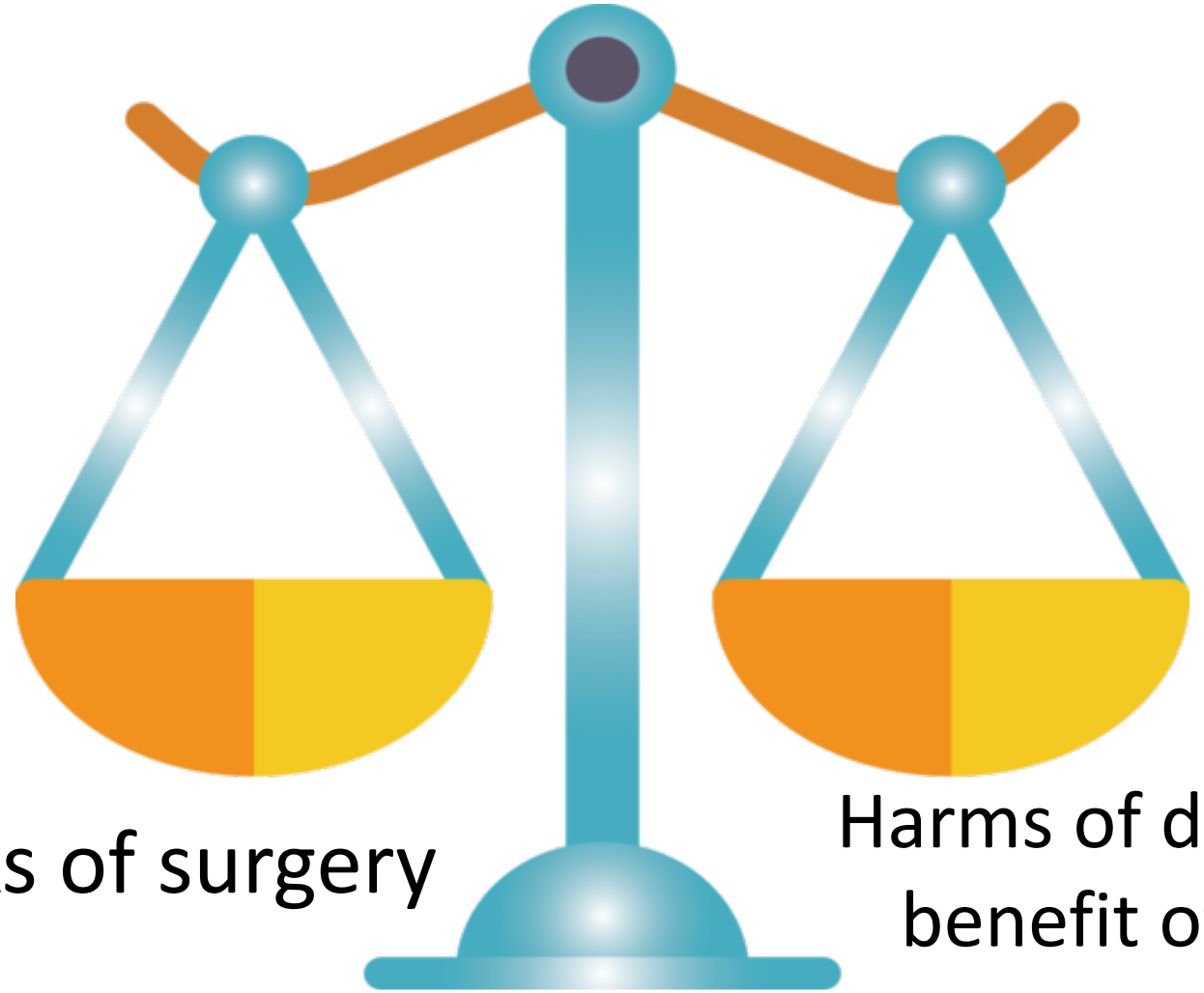
Atorvastatin

Fluticasone/salmeterol

Albuterol inhaler

Warfarin

# The “Art” of Perioperative Medicine



Benefits vs. risks of surgery

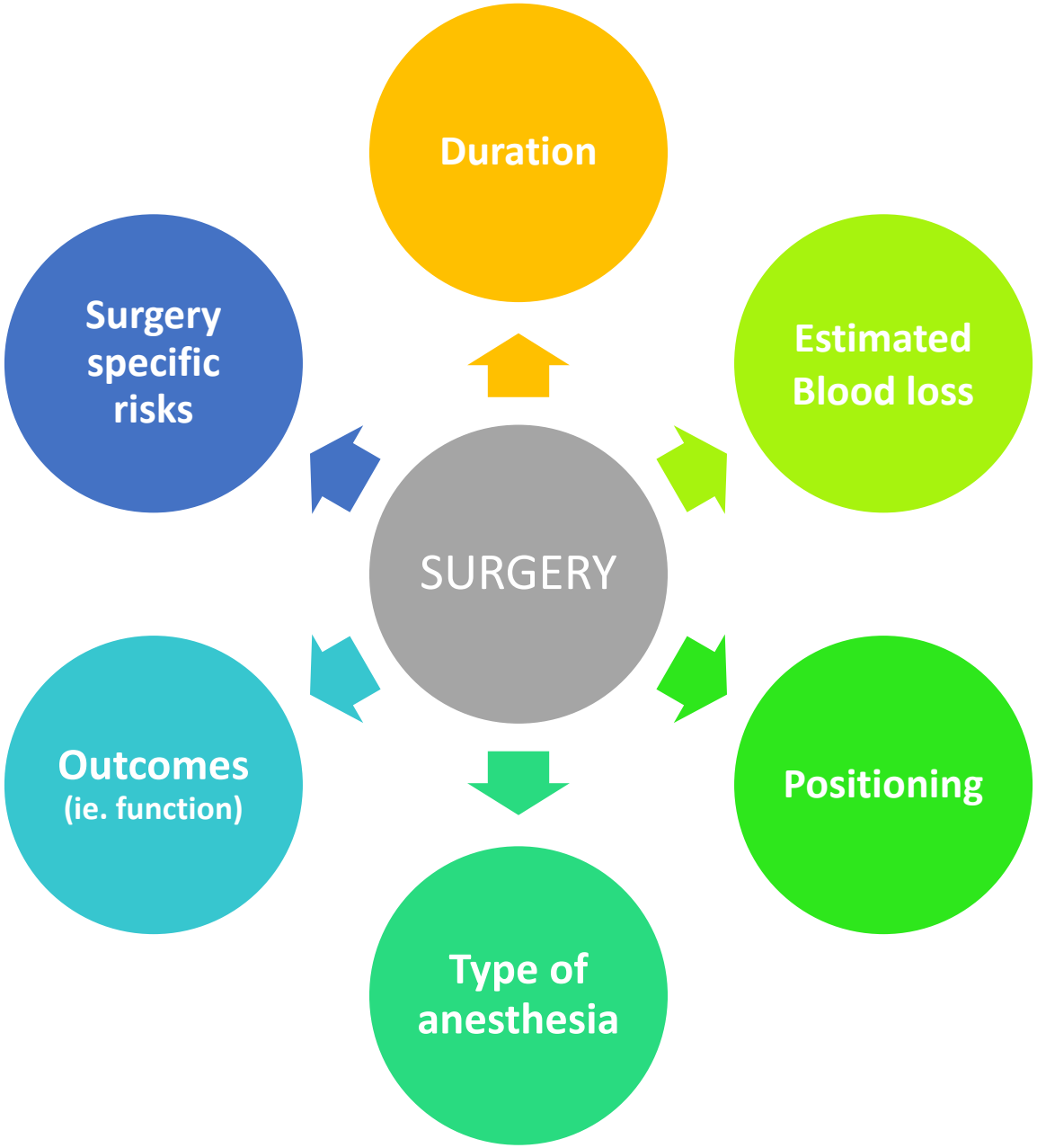
Harms of delaying surgery vs. benefit of further testing, management

# Framework for perioperative risk assessment before urgent surgery

- What is the urgency of surgery?
- Are there active medical conditions and can/should they be optimized prior to surgery?
- What is their exercise tolerance?
- What is their risk of perioperative complications?
- Do the surgical benefits outweigh the risks?
- Is surgery within their goals of care? Are the risks acceptable to the patient?

*Cohn SL. CCJM 2014 Dec; 81(12):742-751*

# Surgical considerations

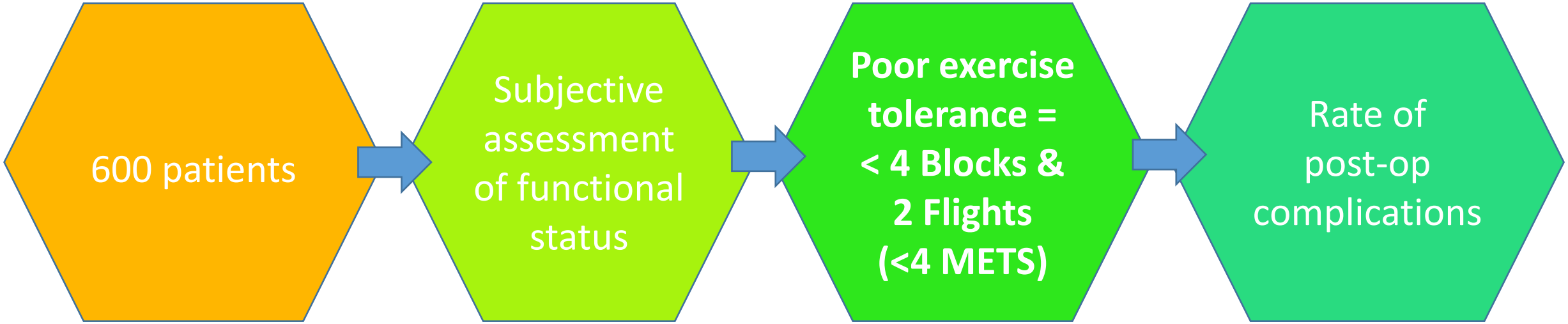


# Perioperative Cardiac Risk Assessment

# Acute cardiac conditions

| | |
|---|---|
| **Acute coronary syndrome** | • Prioritize management as standard, consider Cardiology evaluation |
| **Severe valvular disease, particularly aortic stenosis** | • Consider Cardiology evaluation, medical mgmt. of fluid status, post-op ICU monitoring, valve replacement/repair |
| **Decompensated heart failure** | • Will pre-op volume mgmt. change outcomes (ventilation, ability to lay flat, healing of incision with peripheral edema)? |
| **Arrhythmia** | • Prioritize management |
| **Recent PCI (0-6mo prior)** | • Can dual anti-platelet therapy be interrupted safely? |

# Self-reported exercise tolerance




Patients reporting poor exercise tolerance had more perioperative complications (20.4% vs 10.4%; *P*<.001).

↑ rates of myocardial ischemia, general CV events, and neuro events

*Reilly DF, et al. Arch Intern Med. 1999;159:2185–92.*

# METS Study

Subjective assessment of functional status

Vs.

Cardiopulmonary exercise testing

Vs.

Duke Activity Status Index questionnaire

Vs.

NT pro-BNP

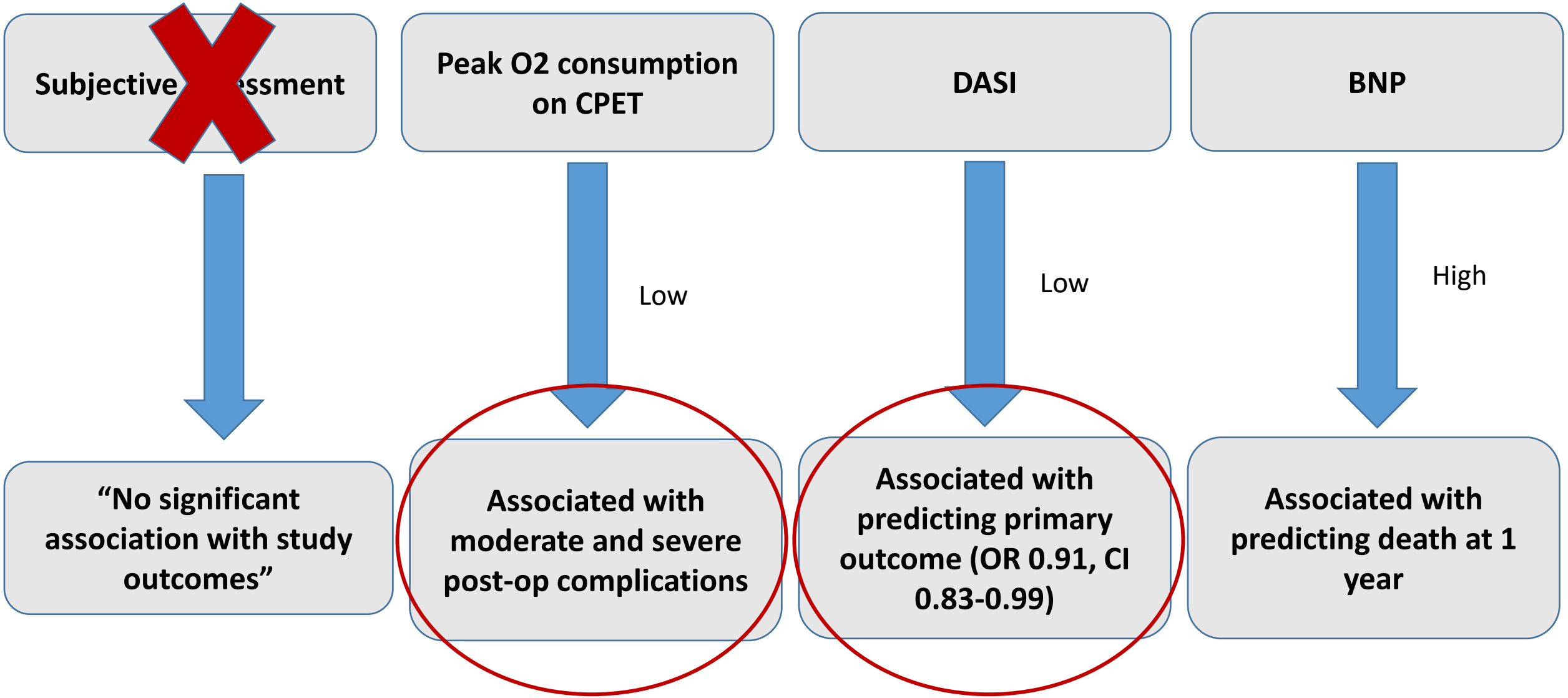
**In predicting death or myocardial infarction within 30 days of surgery**

# Duke Activity Status Index

| | Can you: | Yes | No | Weight |
|---|---|---|---|---|
| 1 | Take care of self (i.e., eating, dressing, bathing, or using the toilet)? | | | 2.75 |
| 2 | Walk indoors, such as around the house? | | | 1.75 |
| 3 | Walk a block or two on level ground? | | | 2.75 |
| 4 | Climb a flight of stairs or walk uphill? | | | 5.50 |
| 5 | Run a short distance? | | | 8.00 |
| 6 | Do light work around the house like dusting or washing dishes? | | | 2.70 |
| 7 | Do moderate work around the house like vacuuming, sweeping floors or carrying in groceries? | | | 3.50 |
| 8 | Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture? | | | 8.00 |
| 9 | Do yard work around the house like raking leaves, weeding, or pushing a power mower? | | | 4.50 |
| 10 | Have sexual relations? | | | 5.25 |
| 11 | Participate in moderate recreational activities like, golf, bowling, dancing, double tennis or throwing a baseball or football? | | | 6.00 |
| 12 | Participate in strenuous sports like swimming, single tennis, football, basketball, or skiing? | | | 7.50 |

*Hlatky MA, et al. Am J Cardiol. 1989;64(10):651–654.*

# Results


Subjective assessment
Peak O2 consumption on CPET
DASI
BNP
Low
Low
High
"No significant association with study outcomes"
Associated with moderate and severe post-op complications
Associated with predicting primary outcome (OR 0.91, CI 0.83-0.99)
Associated with predicting death at 1 year

As a general rule, if no active cardiac conditions and adequate functional status, patients can proceed to urgent surgery without further cardiac testing or specific pre-op management.

# When should pre-operative cardiac testing be considered?

# Echocardiogram

## Obtain

- Moderate to severe valve disease is suspected
- Change in symptoms/exam with valve disease  and concern for severe disease (or overdue for imaging)

## Consider

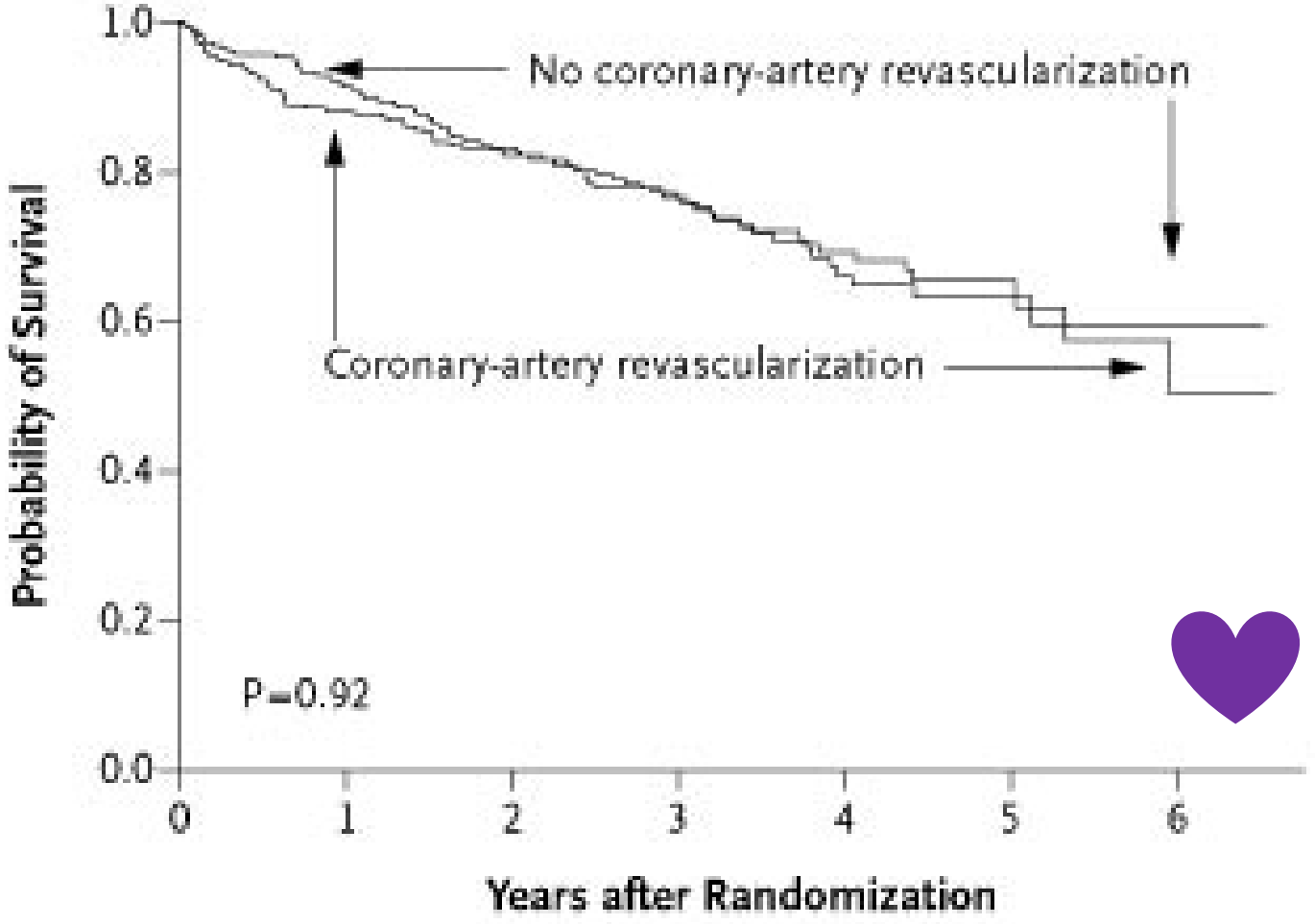
- Suspected severe pulmonary hypertension
- Suspected (new) heart failure*
- Unexplained dyspnea

* Recommend prioritizing volume mgmt. over imaging

*Fleisher LA, et al. Circulation. 2014;130(24):2215-45*

# Pre-op stress testing & cardiac revascularization

Reserved for evaluation of ACS or angina, guided by Cardiology




*McFalls EO, et al. N Engl J Med. 2004;351(27):2795-804.*
*Garcia S, et al. Am J Cardiol. 2008;102(7):809-13.*

# What is her risk of perioperative cardiac complications?

# Clinical cardiac risk stratification tools

| | |
|---|---|
| **RCRI score**<br>(Revised Cardiac Risk Index) | • 1999, 4000 patients, >age 50, single center, elective non-cardiac surgery |
| **MICA/Gupta**<br>(Myocardial infarction and cardiac arrest) | • 2007, NSQIP database, 211k total patients, 1300 developed cardiac complications |
| **ACS NSQIP**<br>(American College of Surgeons National Surgical QI Program) | • Procedure-specific risk based on CPT code and patient factors |
| **BNP**<br>(Brain Natueritc Peptide) | • ↑ BNP associated with periop cardiac events and mortality |


*1. Lee TH, et al. Circulation 1999;100:1043–1049*
*2. Gupta, et al. Circulation. 2011;124:381-387*
*3. Bilimoria KY, et al. J Am Coll Surg. 2013;217(5):833-42.e1-3.*

# Revised Cardiac Risk Index (RCRI)

| Point | Risk factor | Odds Ratio (OR) |
|---|---|---|
| 1 | History of CHF | 4.3 |
| 1 | Known CAD | 3.8 |
| 1 | History of TIA/CVA | 3 |
| 1 | DM on insulin | 2.6 |
| 1 | CKD (Cr>2.0) | 1.0 |
| 1 | High risk surgery | 0.9 |

| # of Risk Factors | % Major Cardiac Complications* |
|---|---|
| 0 | 0.4 (0.05-1.5) |
| 1 | 0.9 (0.3-2.1) |
| 2 | 6.6 (3.9-10.3) |
| >3 | 11 (5.8-18.4) |

* Major Cardiac Complications = MI, cardiac arrest, ventricular fibrillation, pulmonary edema, heart block

*Lee TH, et al. Circulation 1999;100:1043–1049*

# RCRI score – update

Updated in 2017, based on pooled data from multiple external validation studies.

Numbers are significantly higher as compared to original study .

Mdcalc.com

| # of Risk Factors | % Major Cardiac Complications |
|---|---|
| 0 | 3.9 (2.8-5.4) |
| 1 | 6.0 (4.9-7.4) |
| 2 | 10.1 (8.1-12.6) |
| >3 | 15 (11.1-20) |

*Duceppe E et al. Can J Cardiol. 2017;33(1):17-32*

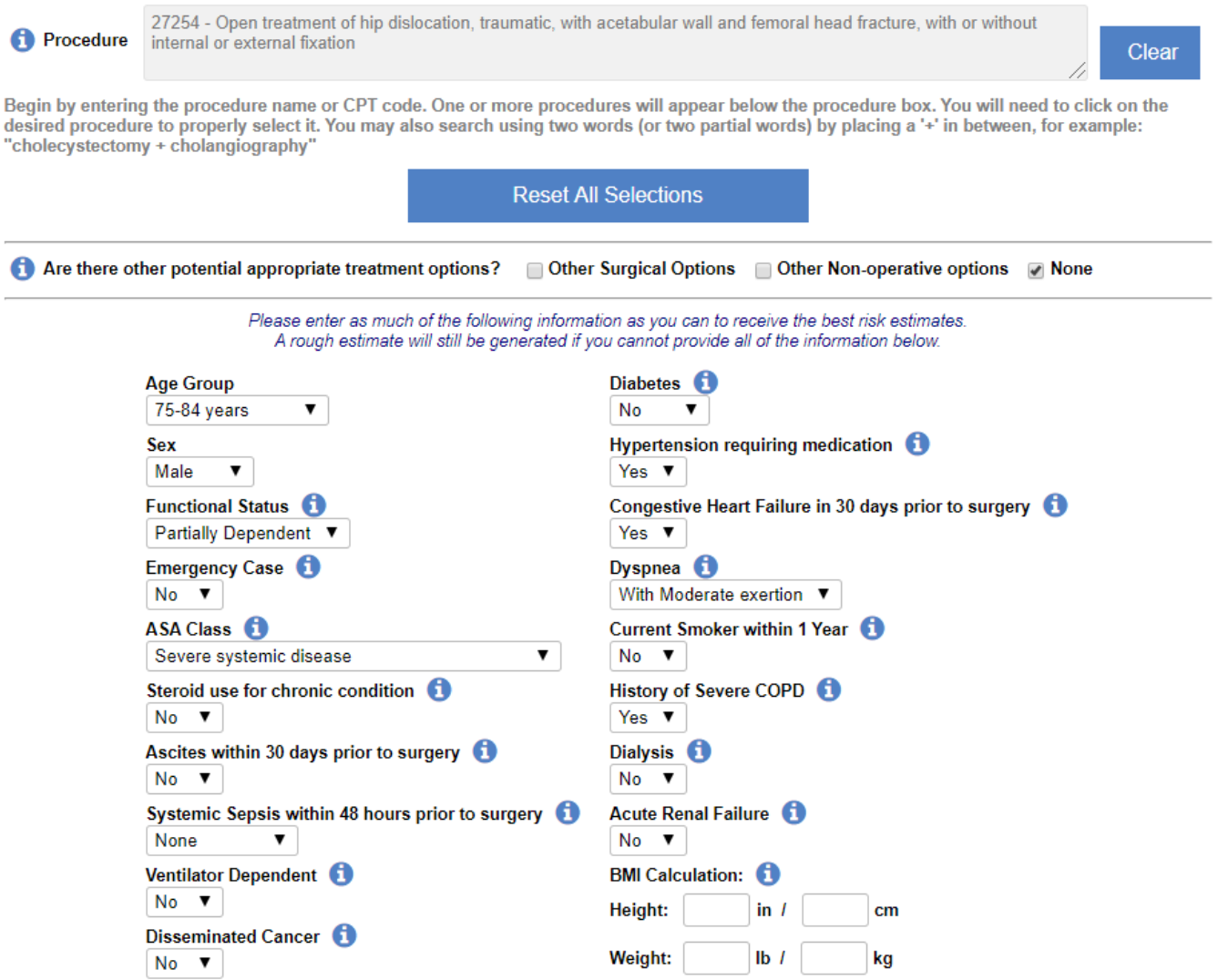
# MICA Risk Calculator

| |
|---|
| Age |
| American Society of Anesthesiologists (ASA) Class (1-5) |
| Type of Surgery (21 Options) |
| Functional status<br>Totally independent, partially dependent, totally dependent |
| Creatinine ≥ 1.5 |

https://qxmd.com/calculate/calculator_245/gupta-perioperative-cardiac-risk

*Gupta, et al. Circulation. 2011;124:381-387*

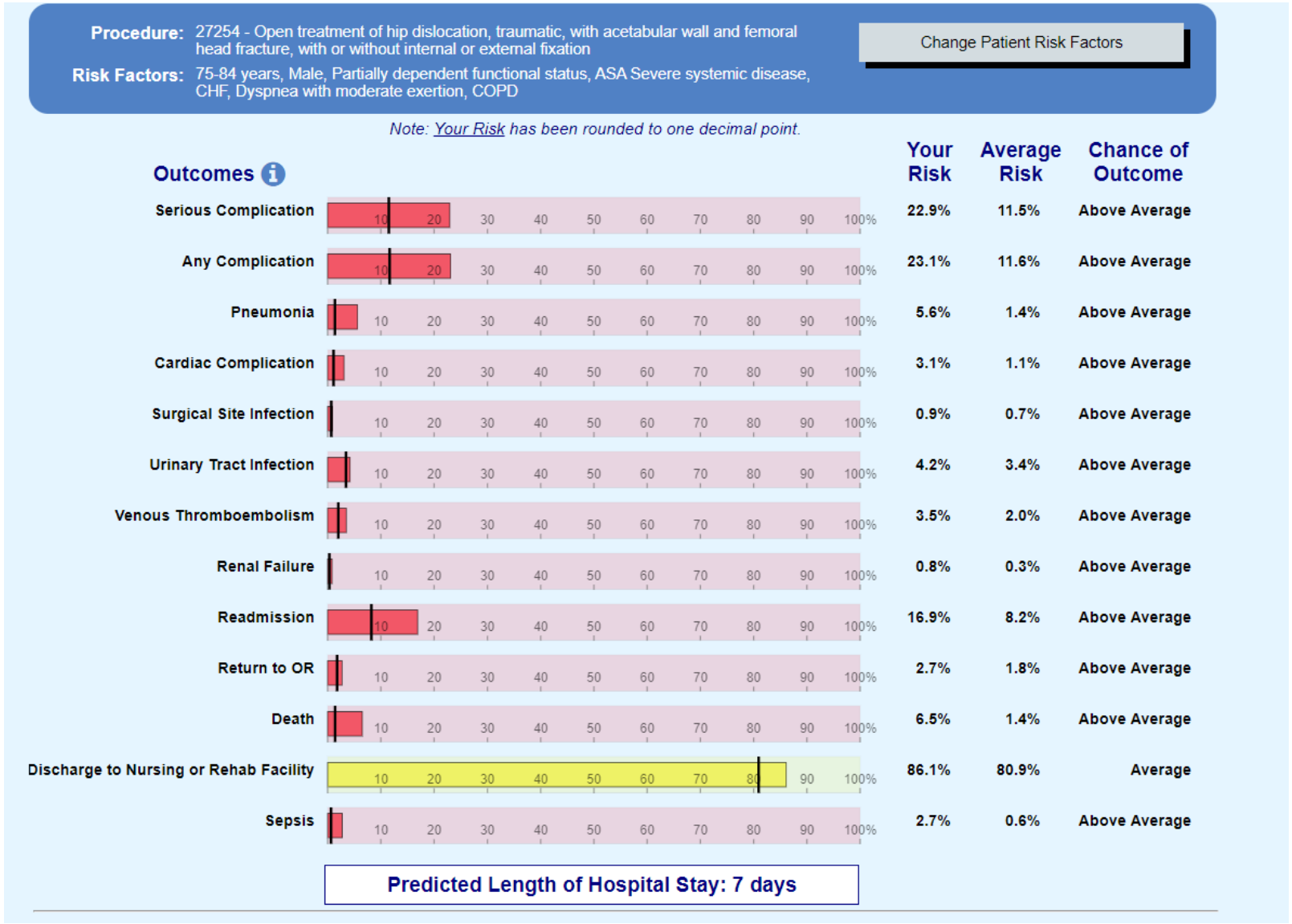
# ACS NSQIP Risk Calculator




http://www.riskcalculator.facs.org/

*Bilimoria KY, et al. J Am Coll Surg. 2013;217(5):833-42.e1-3.*

# ACS NSQIP Risk Calculator




http://www.riskcalculator.facs.org/

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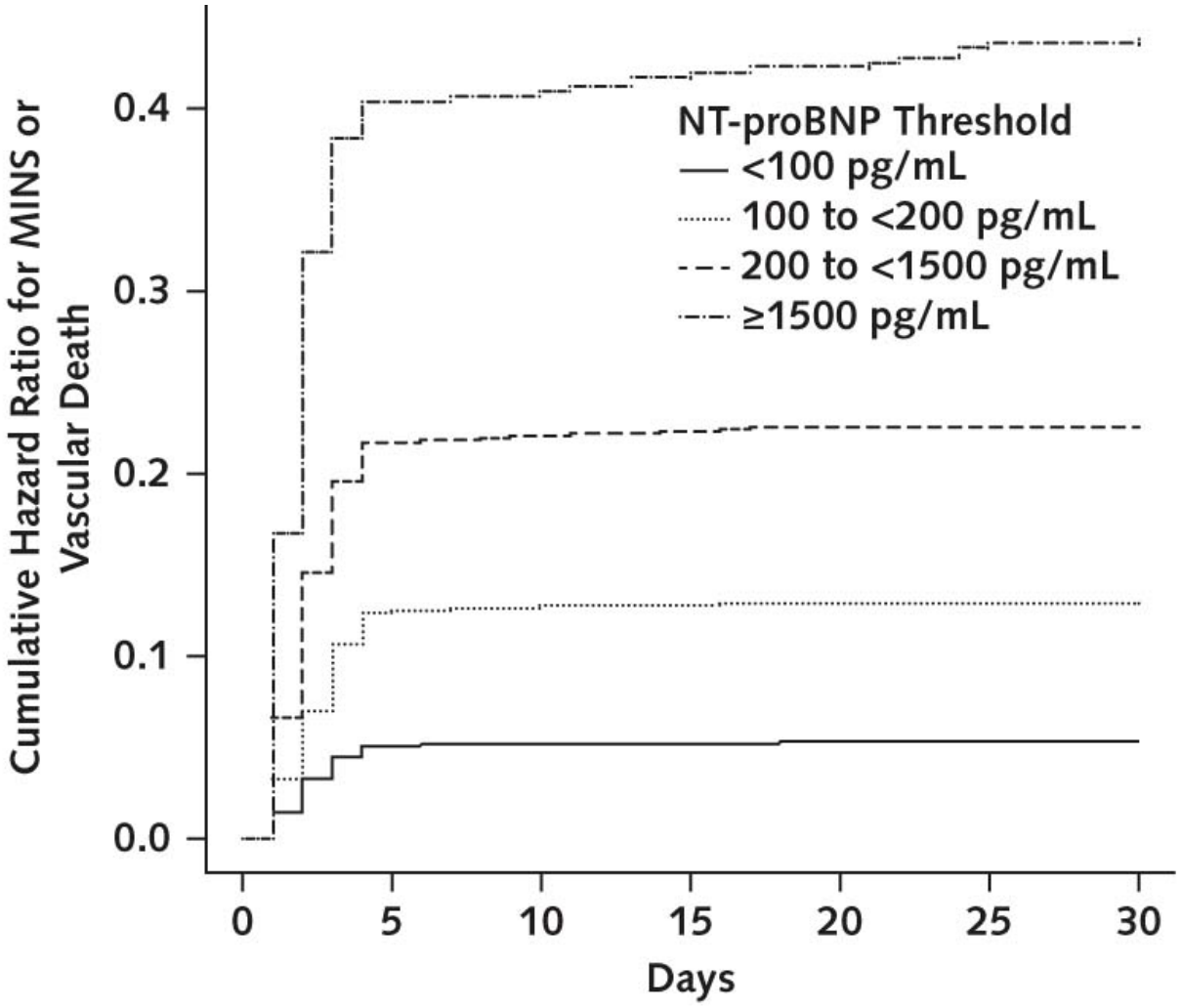
# Brain Natriuretic Peptide (BNP)




- Canadian guidelines recommend post-op troponins and medical co-management in patients with elevated BNP (>92) pre-operatively[2]


1. *Duceppe E, et al. Ann Intern Med. 2019: [Epub ahead of print]*
2. *Duceppe E, et al. Can J Cardiol. 2017:33 (1): p17-32*

# Our patient

RCRI score 3 – **11%** risk of major cardiac complications

(updated) RCRI score 3 – **15% risk**

MICA risk calculator – **1.8%** risk of MI, cardiac arrest

ACS NSQIP – **3.1%** risk of cardiac complications

# The use of risk calculators

- Serve as decision aids; not replacement of clinical evaluation or judgement
- May not change management significantly prior to urgent surgery
- Developed in specific surgical populations
- Exclude clinically important issues (ie. aortic stenosis, arrhythmia, acute cardiac conditions)
- Any of the risk tools can be used

What recommendations do you make about her cardiac medications perioperatively?

# Beta-blockers

- Continue without interruption as tolerated[1]
- Do not initiate immediately pre-op, unless indicated for acute cardiac condition
- Holding parameters are important due to frequency of post-op hypotension
- POISE trial demonstrated elevated risk of stroke and mortality in patients started on high dose beta-blockers immediately pre-op[2]


1. *Wijeysundera DN, et al. Circulation. 2014;130:2246–64*
2. *POISE Study Group, et al. Lancet. 2008;371(9627):1839-47.*

# ACE-inhibitors and ARBs

- Hold within 24 hours of surgery and immediately post-op (unless BP> 180/100)

- Data shows higher rate of intra-op hypotension when continued[1]
  - No proven higher risk of AKI or other cardiac complications with continuation[1,2]


1. *Shiffermiller JF, et al. J Hosp Med. 2018 Sep;13(10):661-667.*
2. *Fleisher LA, et al. Circulation. 2014;130(24):2215-45*

# Aspirin

- If DES placement within 0-3 (or 6) months and high surgical bleeding risk, then discuss with Cardiology
- Hold if primary preventative therapy
- No clear guidance if secondary preventative therapy; base on surgical bleeding risk
- POISE-2 trial - higher risk of major bleeding with perioperative ASA; same cardiac event rate[1]
  - Subgroup analysis – benefit for patients with prior PCI?[2]


1. *Devereaux PJ, et al. NEJM.2014;370(16):1494-1503.*
2. *Graham MM, et al. Ann Intern Med. 2018;168(4):237-244.*

# Bridging warfarin for atrial fibrillation

- Consider if high risk based on CHADS2 or recent stroke
- BRIDGE trial showed non-inferiority of periop bridging vs. no bridging in regards to embolic rate[1]
  - Higher rate of bleeding in bridging group
  - Overall included lower risk patients and lower risk surgeries
- Post-op bridging often limited by surgical bleeding risk
- Per guidelines, DOAC therapy does not require bridging anticoagulation[2]


1. Douketis JD, et al. NEJM. 2015;373(9):823-33
2. Doherty Juet al. J Am Coll Cardiol. 2017;69(7):871-898

# Diuretics

- Consider holding loop and non-loop diuretics on morning of surgery
- Theoretical concern for periop hypokalemia and intra-operative hypotension
- Data does not support this concern
  - (Though we still advise to hold for elective surgeries)

*Cohn SL. CCJM 2014 Dec; 81(12):742-751*

# Perioperative Pulmonary Risk Assessment

# Perioperative Pulmonary Complications

- Postoperative pulmonary complications are common
- Associated with higher readmission risk, morbidity, and mortality than cardiac complications[1,2]
- Airway assessment by Anesthesia plays a large role
- Regional vs. general anesthesia, per Anesthesia

*1. Manku K, et al. Anesth Analg. 2003;96(2):583-9*
*2. Qaseem A, et al. Ann Intern Med. 2006;144(8):575-580*

# Acute pulmonary conditions

| | |
|---|---|
| **Wheezing, bronchospasm** | • Treat pre-operatively |
| **Pleural effusion(s)** | • If large or affecting ventilation, consider pre-operative thoracentesis |
| **Pulmonary edema** | • Will pre-op volume mgmt. change outcomes (ventilation, ability to lay flat, healing of extremity incision)? |
| **Hypercapnia** | • NiPPV, ventilator management |
| **Pneumonia** | • Treat pre-operatively<br>• Recent respiratory infection = ↑↑ periop resp complications |

# ARISCAT risk tool

| Risk Factor | | Score |
|---|---|---|
| Age (yrs) | 51-80 | 3 |
| | > 80 | 16 |
| Preop Spo2 (%) | 91-95% | 8 |
| | < 91 | 24 |
| Respiratory infection in past month | | 17 |
| Location of surgery | Upper abdominal | 15 |
| | Thoracic | 24 |
| Duration of surgery | > 2 to 3 | 16 |
| | > 3 | 23 |
| Emergency Surgery | | 8 |
| Preop Hgb <10 g/dL | | 11 |

| Risk Class | Risk Score | PPCs (%) |
|---|---|---|
| Low | < 26 | 1.6-3.4 |
| Intermediate | 26-44 | 13-13.3 |
| High | > 44 | 38-42.1 |

*Respiratory infection requiring antibiotics, hypoxia or respiratory failure, pleural effusion, atelectasis, bronchospasm, pneumothorax, aspiration pneumonitis*

*Canet, et al. Anesthesiology. 2010; 113(6):1338-5*

# Pulmonary Hypertension (PH)

- Moderate to severe pulmonary HTN associated with 7-18% periop mortality after non-cardiac surgery
  - Esp. with Group I PAH, > 70mHg, RV dysfunction, NHYA class III
- Mortality from respiratory failure and RV failure
- Presence of severe pulmonary HTN requires careful assessment of risks vs. benefits of surgery

*Minai OA , et all. Conn Med . 2006;70 (4): 239-243*
*Ramakrishna G, et al. J Am Coll Cardiol 2005; 45:1691–1699*
*Minai OA, et al. CHEST 2013; 144(1):329–340*

# Obstructive sleep apnea (OSA)

- OSA associated with ↑ periop complications of multiple types[1]
- Clinical screening tools (ie. STOP-BANG) can identify high risk patients[2]
  - STOP-BANG ≥ 4-5 = ↑ complications[3]
- Post-op CPAP in severe OSA patients – improved AHI and O2 sats, but no change in other complications[4]

**S** – Snoring
**T** – Tiredness
**O** – Observed apnea
**P** – Hypertension (Pressure)
**B** – BMI>35
**A** – Age > 50
**N** – Neck >40cm
**G** – Male Gender


*1. Hwang D, et al. Chest. 2008 ; 133 ( 5 ): 1128 - 1134*
*2. Chung F et al. Anesthesiology . 2008 ; 108 ( 5 ): 812 – 821*
*3. Chung F et al. Chest. 2013;143(5):1284-93.*
*4. Pu L et al, Anesthesiology 2013; 119:837–847*

# Pulmonary Risk Management

- Consideration of anesthetic and surgical approach
- Monitor use of sedating medications
- Head of bed > 30 post-op
- Home or auto-CPAP and supplemental O2
- Incentive spirometer, pulmonary hygeine
- Consider post-op ICU admission

*Cohn SL. CCJM 2014 Dec; 81(12):742-751*

# Take Home Points

- Perioperative cardiopulmonary assessment prior to urgent non-cardiac surgery should start with evaluation and management of active conditions
- In complex or acutely ill patients, a multi-disciplinary team approach is recommended
- Several cardiac and pulmonary risk calculators are available to help quantify periop risks
- Risk calculators should be used in conjunction with clinical assessment

Thank you!

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