
# Perioperative Cardiac Risk Assessment & Management

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# Disclosures



- No disclosures related to this activity

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SCHOOL OF MEDICINE - Department of Anesthesiology and Perioperative Medicine


# Learning objectives

- Identify the important elements in a patient's history of CAD
- Describe the determinants and predictors of MACE
- Review management of perioperative dual antiplatelet therapy
- Understand different purposes of preoperative evaluation, regulatory requirement vs patient care coordination
- Assure key evaluation and documentation requirements
- Promote importance of interdisciplinary collaboration and communication

# Introduction



- Medically complicated patients whose medical problems are optimized before surgery have few complications and better outcomes from surgery
- Medical issues, *not* surgical issues, are the most common cause of complications that happen after surgery
- Poor surgical outcomes are usually the result of system breakdowns, not "bad" health care providers

# Preanesthesia Assessment, Consultation, & Treatment Clinics



| Number staff | Role |
|---|---|
| 6 | Attending anesthesiologists with clinical interest in perioperative medicine |
| 30 | Certified Registered Nurse Practitioners |
| 14 | Registered Nurses |
| 7 | Patient Care and Laboratory Technicians |
| 2 | Anesthesiology Residents |
| 7 | Financial Counselors |

# 2019 PACT statistics



38,400 surgeries

24,758 PACT visits

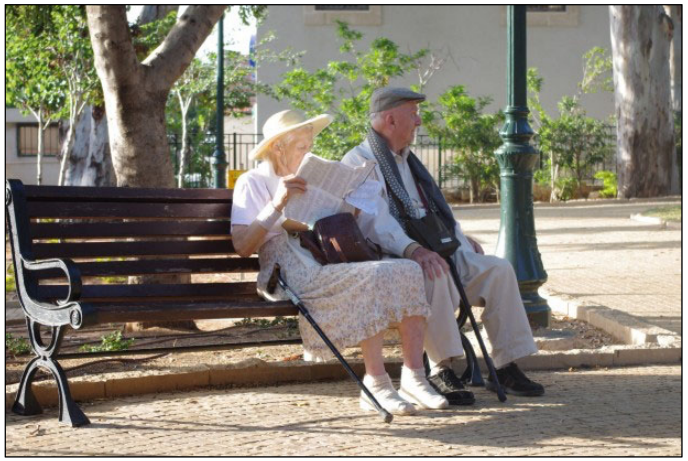
10,440 in-patient evaluations

# A hypothetical surgical case…or perhaps not



- BP-195/78
- BMI-38
- 1 ppd active smoker (40 pack-year)
- Type II diabetes (Last A1c-9.0%)
- Cardiac medications:
  - Apixaban for atrial fibrillation
  - Aspirin and clopidogrel for heart stents (2 yr ago)
  - High-potency statin
  - Blood pressure medications
- DASI: 15.2 (4.61 METS)
- History of depression and forgetfulness
- Limited functional capacity due to knee pain

A 68-year-old patient is scheduled for a right total knee arthroplasty for degenerative joint disease



# CAD history…what's important



- ***Symptoms*** of ischemia
- NYHA functional classification
- Functional capacity: can patient do 4 METS of activity?
- Prior MI/timing
- Prior revascularization
- Prior cardiac evaluations
- Planned surgical procedure

# Urgency vs risk



## Urgency

- Emergency: < 6 hours
- Urgent: 6-24 hours
- Time-sensitive: can delay 1-6 weeks
- Elective: can delay up to 1 year

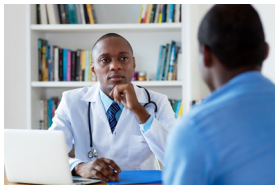
## Risk

- Low risk: < 1% MACE
- Elevated risk: ≥ 1% MACE

# Predictors of perioperative MACE…historical



| Major predictors | Intermediate predictors | Minor predictors |
|---|---|---|
| • Acute or recent MI<br>• Unstable or severe angina<br>• Strongly positive stress test<br>• Decompensated heart failure (NYHA III-IV)<br>• Severe valvular disease<br>• Significant arrhythmias<br>• Pulmonary hypertension with RV failure | • Mild angina<br>• Previous MI by history of Q-waves<br>• Compensated heart failure (NYHA I-II)<br>• Diabetes<br>• Renal insufficiency (Cr > 2.0)<br>• Stable pulmonary hypertension | • Advanced age<br>• Abnormal EKG<br>• Rhythm other than sinus<br>• Low functional capacity<br>• History of stroke |



# Active cardiac conditions indicating further evaluation



## Active clinical conditions

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

## Clinical risk factors

- History of ischemic heart disease, currently stable
- History of compensated heart failure
- Poor functional capacity
- History of cerebrovascular disease
- Insulin-dependent diabetes
- Renal failure

DeHert, S, et al. Preoperative evaluation of the adult patient undergoing noncardiac surgery: Guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol.* 2011;28(10):684-722.

# Risk stratification




**Low risk (< 1%)**

- Breast
- Dental
- Thyroid
- Ophthalmic
- Gynecologic
- Reconstructive
- Minor orthopedic
- Minor urology
- GI endoscopy


**Intermediate risk (1-5%)**

- Elective abdominal
- Transplant
- Carotid
- Endovascular aneurysm
- Head and neck
- Major neurosurgery
- Arthroplasty
- Thoracic, non-trauma
- Major urology


**High risk (> 5%)**

- Open aortic
- Major vascular
- Peripheral vascular
- Urgent body cavity
- Trauma

Patients who require urgent or emergent surgery, including trauma surgery, are at increased risk of MACE at any level of baseline risk

# Risk stratification




| Patient Factors | Effectiveness of care | Variation | Outcome |
|---|---|---|---|
| • Age and gender<br>• Co-morbidities<br>• Functional capacity<br>• ASA score<br><br>• Cardiac tests<br>• Biomarkers<br>• Socioeconomic factors<br>• Genotype | • Surgery-specific risk<br>• Urgency<br>• Intraoperative events<br><br>• Stress magnitude<br>• Quality of perioperative care<br>• Treatment of complications | • Predictable<br>• Special | ✓ 30-day mortality<br>✓ 90-day mortality<br>✓ Length of stay<br>✓ Adverse event rate<br>✓ Incidence of specific complications (MACE)<br>✓ Re-admission rate |

Adapted from: Assessment of the high-risk perioperative patient. Contin Educ Anaesth Crit Care Pain. 2013;14(1):12-17. doi:10.1093/bjaceaccp/mkt020. Contin Educ Anaesth Crit Care Pain | © The Author [2013]. Published by Oxford University Press on behalf of the British Journal of Anaesthesia. All rights reserved.

# Social determinants of health








**Economic Stability**
- Employment
- Income
- Expenses
- Debt
- Medical bills
- Support

**Physical environment**
- Housing
- Transportation
- Safety
- Parks
- Playgrounds
- Walkability
- Zip code / geography

**Education**
- Literacy
- Language
- Early childhood education
- Vocational training
- Higher education

**Food**
- Hunger
- Access to healthy options

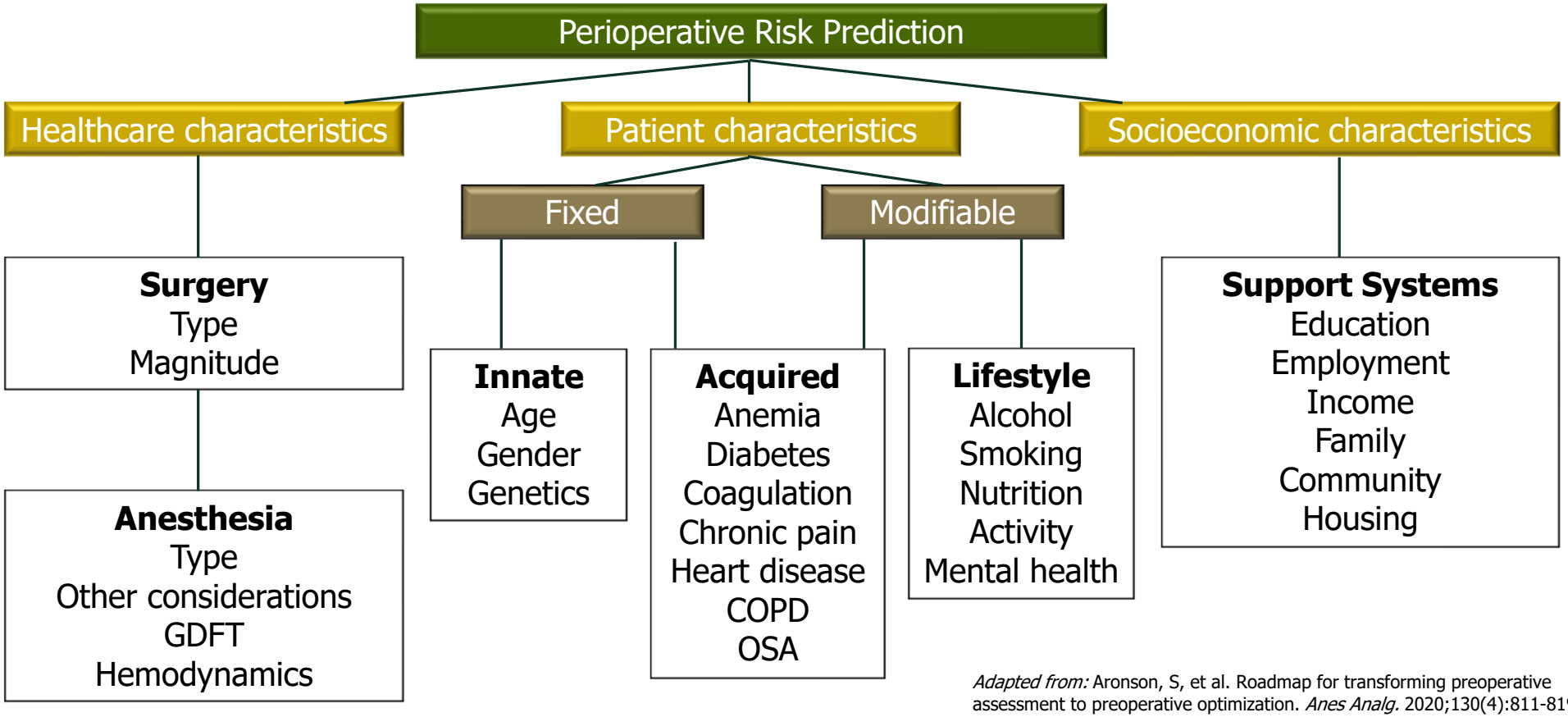
**Community and Social Context**
- Social integration
- Support systems
- Community engagement
- Discrimination
- Stress

**Health Care System**
- Health coverage
- Provider availability
- Provider linguistic and cultural competency
- Quality of care

***Health outcomes*** directly effected by social determinants of health
Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations

# Predictors of Perioperative Risk






*Adapted from:* Aronson, S, et al. Roadmap for transforming preoperative assessment to preoperative optimization. *Anes Analg.* 2020;130(4):811-819.

# Why optimize? *Surgery is not risk-free*



| | |
|---|---|
| 26% | • of all inpatient adverse events within the Medicare population are attributable to surgery and procedures |
| 44% | • of adverse perioperative events are preventable |
| 10% | • ≥ 45 years suffer an MI within 30-days of non-cardiac surgery<br>• 1% will die within 1 month |

Myocardial infarction is the leading cause of death in the 30-days following surgery

***Heart disease***
~ 635,000 deaths per year

***Cancer***
~ 600,000 deaths per year

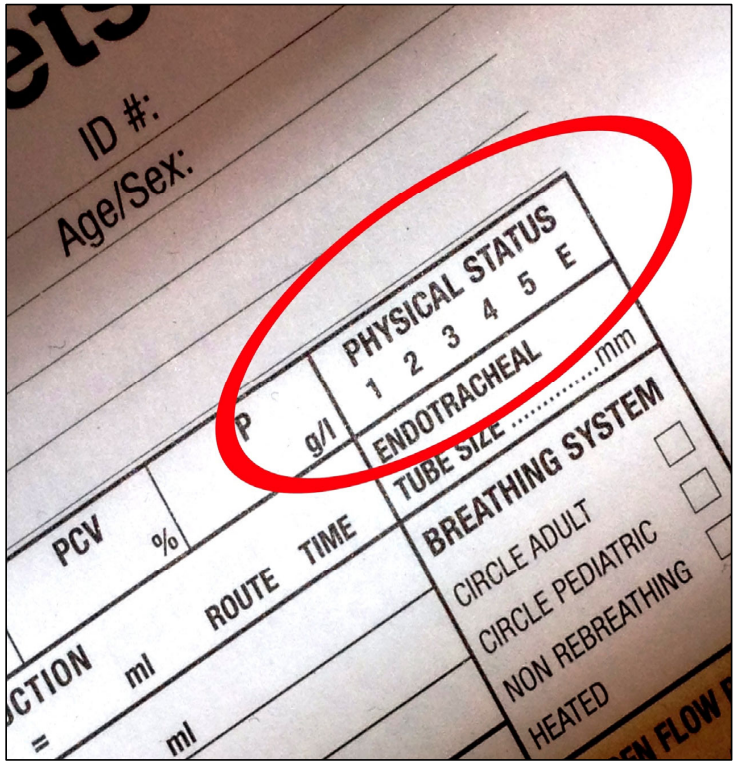
***Medical errors***
~ 250,000 deaths per year

If postoperative myocardial infarction were a disease, it would be the third leading cause of death in the US


- https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm
- Anderson, JG, Abrahamson, K. Your health care may kill you: Medical errors. *Stud Health Technol Inform.* 2017;234:12-17.
- https://www.hopkinsmedicine.org/news/media/releases/study_suggests_medical_errors_now_third_leading_cause_of_death_in_the_us

# Risk assessment begins with ASA physical status score



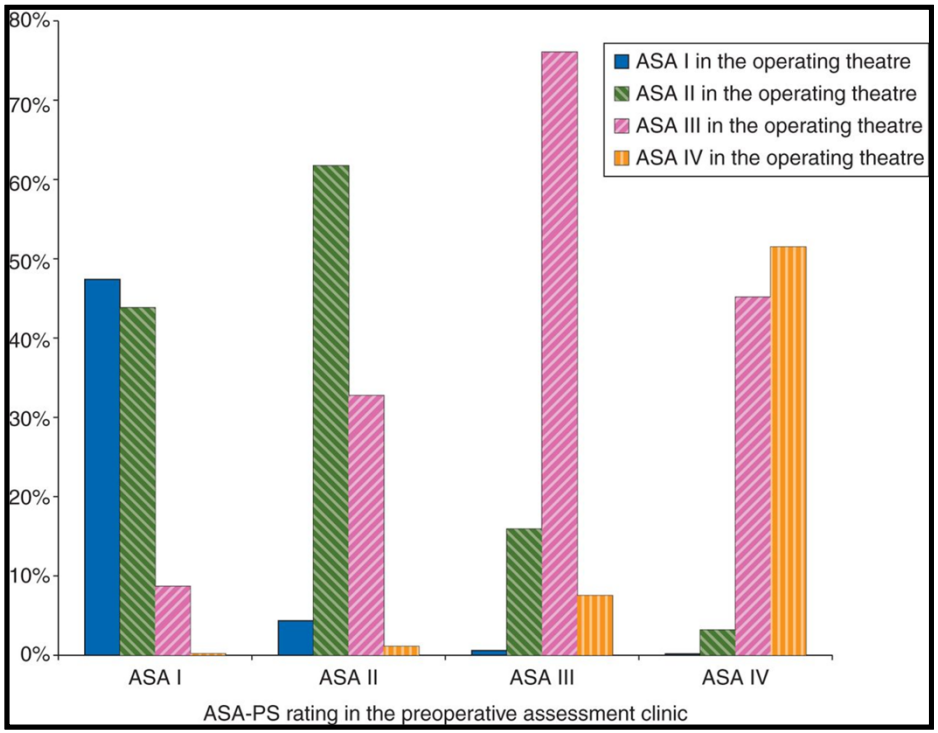



| | | |
|---|---|---|
| ASA 1 | Normal, healthy patient | Healthy, nonsmoker, non-obese |
| ASA 2 | Patient with mild systemic disease | Smoker, pregnancy, obesity, well-controlled HTN or DM, mild lung disease |
| ASA 3 | Patient with severe systemic disease | Poorly-controlled HTN, DM, COPD, morbid obesity, ESRD, CAD with stents |
| ASA 4 | Patient with severe systemic disease; constant threat to life | Sepsis, recent MI, CVA, ongoing cardiac ischemia, severely reduced LVEF |
| ASA 5 | Moribund patient not expected to survive without surgery | Ruptured aneurysm, massive trauma, ischemic bowel with significant cardiac dysfunction |

# ASA physical status score



- Used internationally and by other specialties
- Originally intended to be an assessment of health, not risk
- Simple, reproducible
- Strongly associated with perioperative risk
- Moderate inter-rater variability
- Subjective

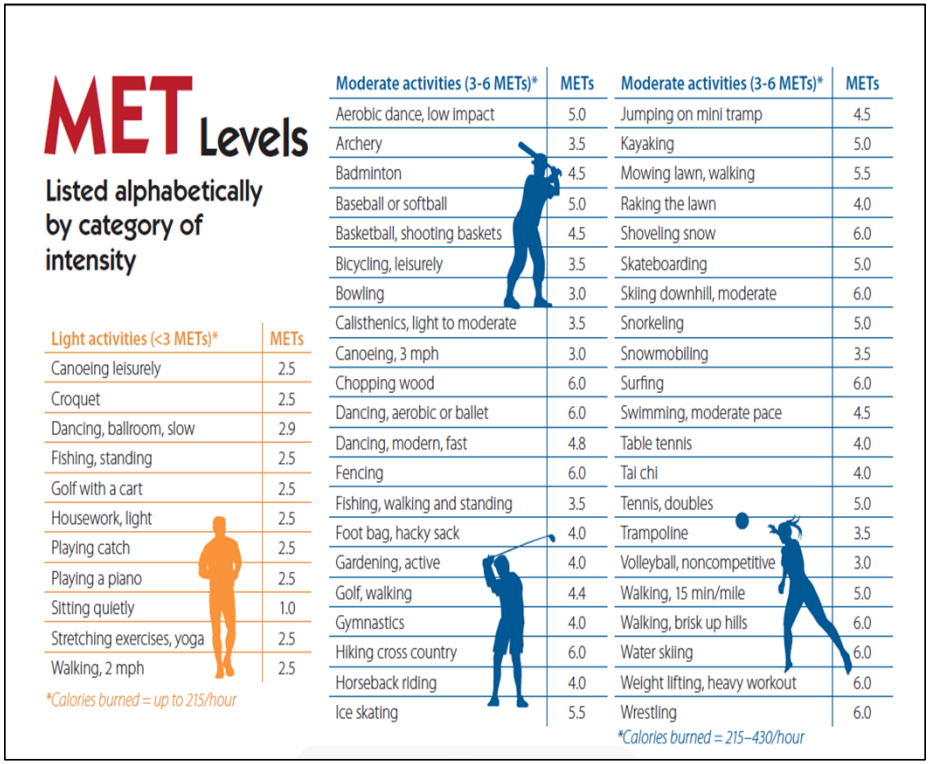



Sankar, A, Johnson, SR, Beattie, WS, et al. Reliability of the American Society of Anesthesiologists physical status scale in clinical practice. *BJA*. 2014;113(3):424-432.

# Determining functional capacity



- Preoperative functional capacity is a major determinant of surgical outcome, influencing
  - Postoperative complications
  - Activity and daily function
  - Level of independence
  - Quality of life
- Prehabilitation enhances physiological reserve
- **FUNCTIONAL CAPACITY**
  - < 4 mets: walking < 2 blocks level without stopping or unable to climb a flight of stairs
  - > 4 mets: climbing a flight of stairs *or* walk up (slight incline) hill 1-2 blocks w/o stopping or walk level ground ~ 4 mph or heavy housework (scrub floors, move furniture)



**MET Levels**

Listed alphabetically by category of intensity

| Light activities (<3 METs)* | METs |
|---|---|
| Canoeing leisurely | 2.5 |
| Croquet | 2.5 |
| Dancing, ballroom, slow | 2.9 |
| Fishing, standing | 2.5 |
| Golf with a cart | 2.5 |
| Housework, light | 2.5 |
| Playing catch | 2.5 |
| Playing a piano | 2.5 |
| Sitting quietly | 1.0 |
| Stretching exercises, yoga | 2.5 |
| Walking, 2 mph | 2.5 |

*Calories burned = up to 215/hour

| Moderate activities (3-6 METs)* | METs |
|---|---|
| Aerobic dance, low impact | 5.0 |
| Archery | 3.5 |
| Badminton | 4.5 |
| Baseball or softball | 5.0 |
| Basketball, shooting baskets | 4.5 |
| Bicycling, leisurely | 3.5 |
| Bowling | 3.0 |
| Calisthenics, light to moderate | 3.5 |
| Canoeing, 3 mph | 3.0 |
| Chopping wood | 6.0 |
| Dancing, aerobic or ballet | 6.0 |
| Dancing, modern, fast | 4.8 |
| Fencing | 6.0 |
| Fishing, walking and standing | 3.5 |
| Foot bag, hacky sack | 4.0 |
| Gardening, active | 4.0 |
| Golf, walking | 4.4 |
| Gymnastics | 4.0 |
| Hiking cross country | 6.0 |
| Horseback riding | 4.0 |
| Ice skating | 5.5 |

| Moderate activities (3-6 METs)* | METs |
|---|---|
| Jumping on mini tramp | 4.5 |
| Kayaking | 5.0 |
| Mowing lawn, walking | 5.5 |
| Raking the lawn | 4.0 |
| Shoveling snow | 6.0 |
| Skateboarding | 5.0 |
| Skiing downhill, moderate | 6.0 |
| Snorkeling | 5.0 |
| Snowmobiling | 3.5 |
| Surfing | 6.0 |
| Swimming, moderate pace | 4.5 |
| Table tennis | 4.0 |
| Tai chi | 4.0 |
| Tennis, doubles | 5.0 |
| Trampoline | 3.5 |
| Volleyball, noncompetitive | 3.0 |
| Walking, 15 min/mile | 5.0 |
| Walking, brisk up hills | 6.0 |
| Water skiing | 6.0 |
| Weight lifting, heavy workout | 6.0 |
| Wrestling | 6.0 |

*Calories burned = 215–430/hour

https://www.fitnesstipsforlife.com/the-value-of-mets-in-weight-loss-workouts.html

# Duke Activity Status Index (DASI)



**Duke activity status index questionnaire to determine functional capacity[1]**

| Activity | Weight |
|---|---|
| **Can you...** | |
| 1. Take care of yourself, that is, eating, dressing, bathing or using the toilet? | 2.75 |
| 2. Walk indoors, such as around your house? | 1.75 |
| 3. Walk a block or 2 on level ground? | 2.75 |
| 4. Climb a flight of stairs or walk up a hill? | 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 yardwork 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, doubles tennis, or throwing a baseball or football? | 6.00 |
| 12. Participate in strenuous sports like swimming, singles tennis, football, basketball or skiing? | 7.50 |

- **Total DASI score:** _____
- **METs [(DASI score × 0.43) + 9.6] / 3.5:** _____

The higher the DASI score, the more physically active the patient is. Patients who can achieve <4 METs have poor functional capacity, 4 to 10 METs suggest moderate functional capacity, and >10 METs suggest excellent functional capacity.

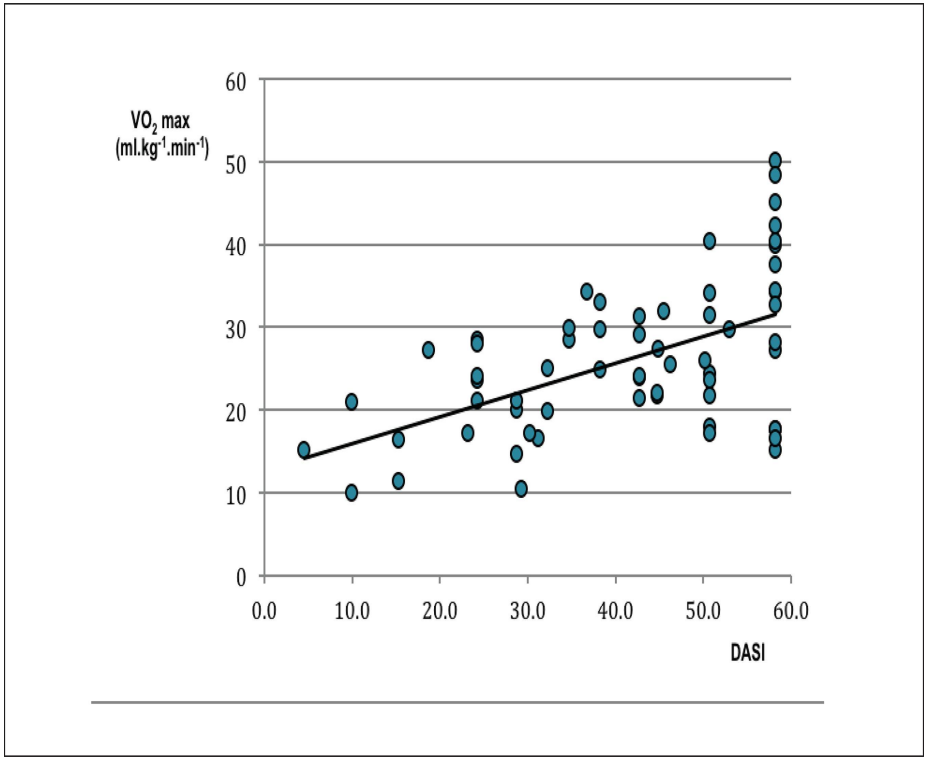
DASI: Duke activity status index; METs: metabolic equivalents.

*Reference:*

1. *Hlatky MA, Boineau RE, Higginbotham MB, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). Am J Cardiol 1989; 64:651.*



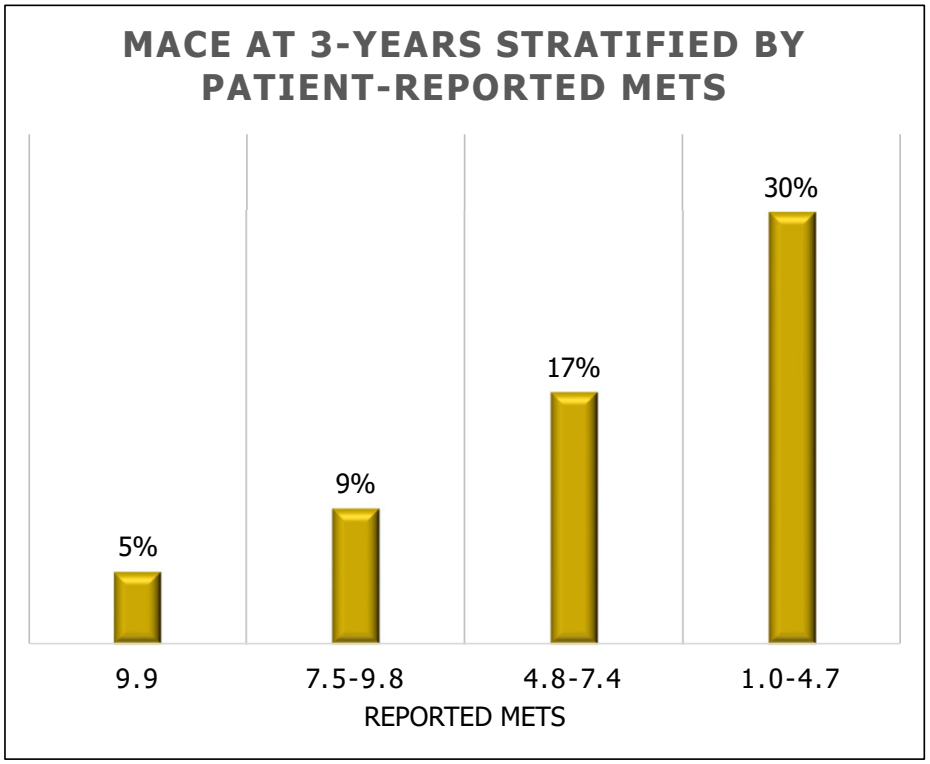
Sweitzer, BJ. Preanesthesia evaluation for noncardiac surgery. *UpToDate.* T. Post (ed.). Waltham, MA: UpToDate.

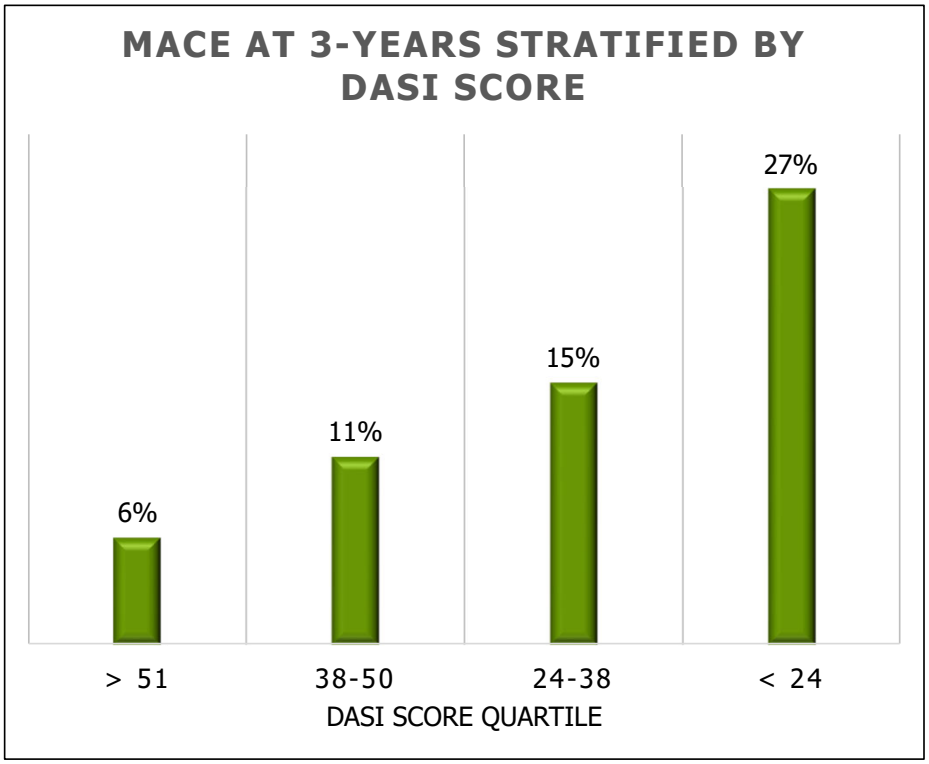



Coutinho-Myrrha, MA, et al. Duke Activity Status Index for cardiovascular diseases: Validation of the Portuguese translation. *Arch Brasil Cardiol.* 2014;102(4):383-390.

# Subjective vs objective





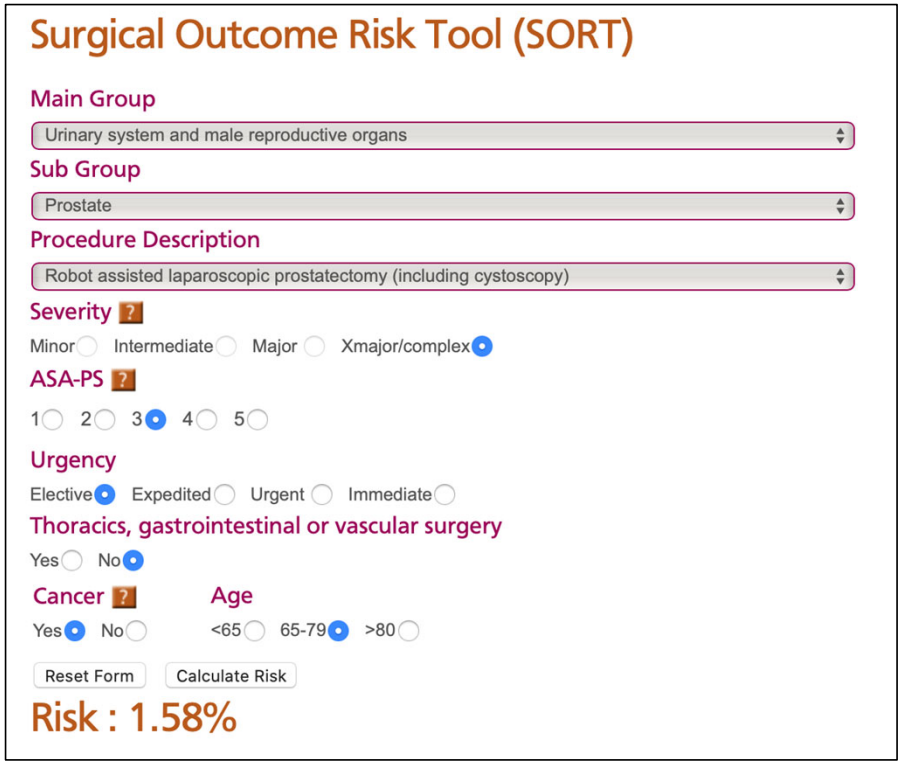




Tang, WHW, et al. Prognostic value of estimated functional capacity incremental to cardiac biomarkers in stable cardiac patients. *J Am Heart Assoc.* 2014;3:e000960.

# Perioperative risk stratification algorithms



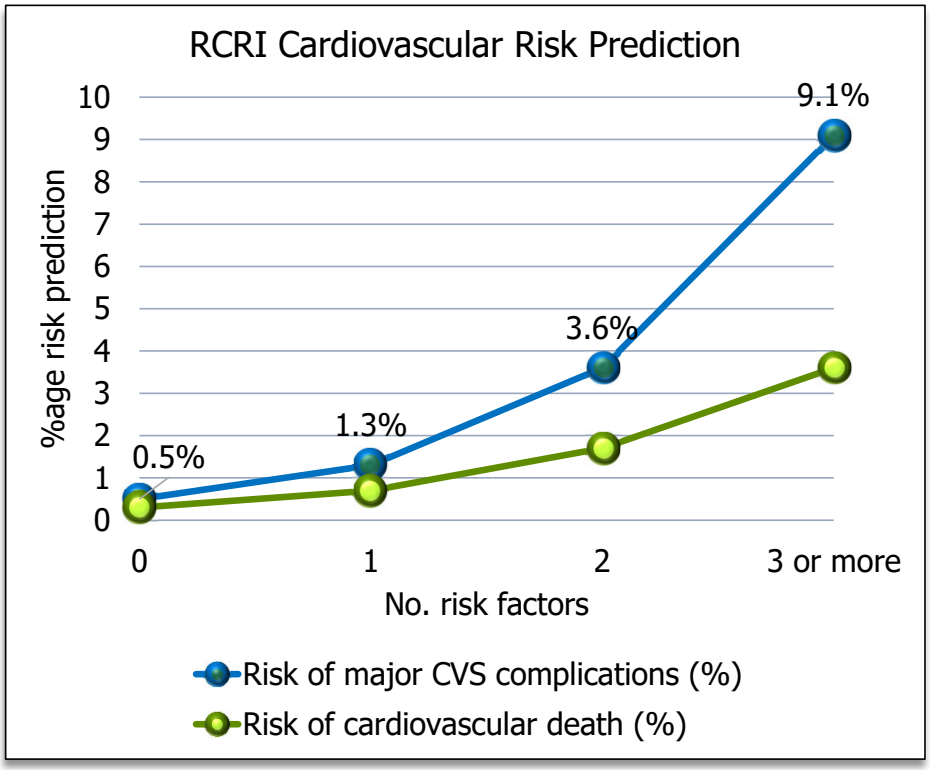
- Numerous risk assessment indices that include subjective and objective questions, scoring systems, and static and dynamic tests
  - Most somewhat validated
- Many varieties of factors considered



# RCRI cardiovascular risk prediction



- Risk factors/independent predictors
  - High-risk surgery
  - Ischemic heart disease
  - History CHF
  - History cerebrovascular disease
  - Insulin therapy for diabetes
  - Preoperative serum creatinine $\geq$ 1.7
- Major in-hospital cardiac complications
  - MI, VF, cardiac arrest, CHB, pulmonary edema
- Underestimates risk for vascular surgery

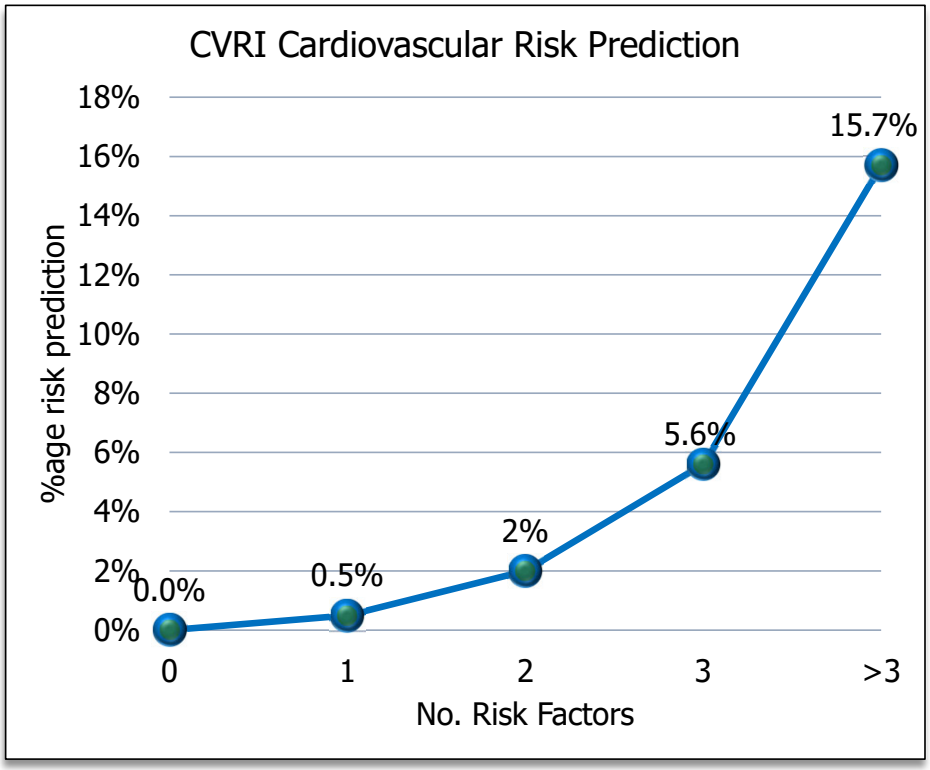



Lee, TH, Marcantonio, ER, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation.* 1999;100(10): 1043-1049.

# CVRI cardiovascular risk prediction



- Risk factors/independent predictors
  - Age ≥ 75
  - Any history of heart disease
  - Symptoms of angina or dyspnea
  - Hemoglobin ≤ 12 g/dL
  - Vascular surgery
  - Emergency surgery
- Identifies patient risk factors amenable to preoperative intervention

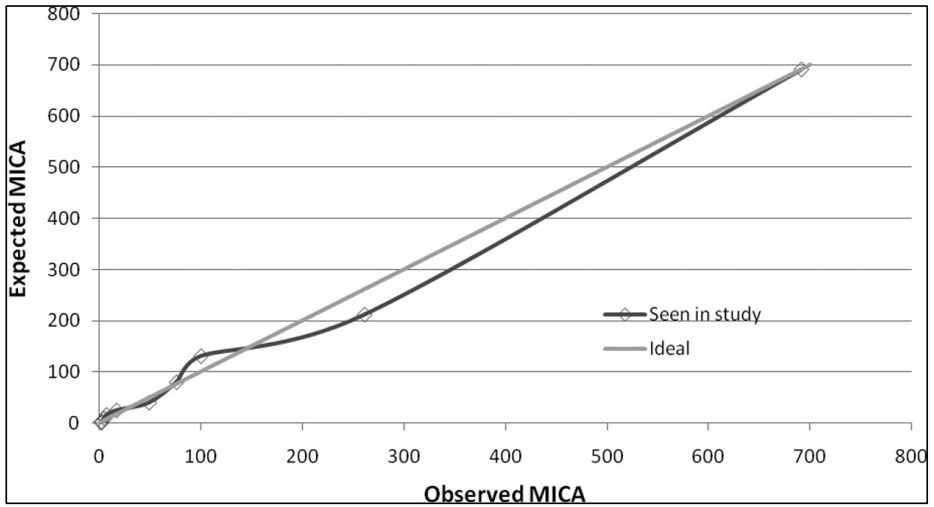



Dakik, HA, Chehab, O, et al. New index for preoperative cardiovascular evaluation. *J Am Coll Cardiol.* 2019;73:3067-3078.


# GUPTA (MICA) cardiovascular risk prediction



- Risk factors
  - Age
  - Dependent functional status
  - Serum creatinine ≥ 1.5
  - ASA physical status
  - Type of surgery
- Validated against NSQIP dataset with high predictive accuracy
- Predicts MI/CA within 30-days of surgery
- Better discriminative or predictive ability for MI/CA than RCRI or VSGNE-CRI
- Gupta MACE risk estimator:
  - < 1%: usually no further evaluation
  - > 1%: further evaluation may be indicated




- ***3.18%***: 65 year-old-male; ASA-4; independent; normal creatinine; aortobifemoral bypass
- ***0.7%***: 58-year-old; ASA-3; independent; normal creatinine; prostatectomy
- ***0.0%***: 44 year-old; ASA-2; independent; normal creatinine; kidney stone
- ***10.3%***: 70-year-old; ASA-4; partially dependent; elevated creatinine; Whipple

Gupta, PK, Gupta, H, Sundaram, A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. *Circulation.* 2011;124:381-387.

# RCRI vs MICA



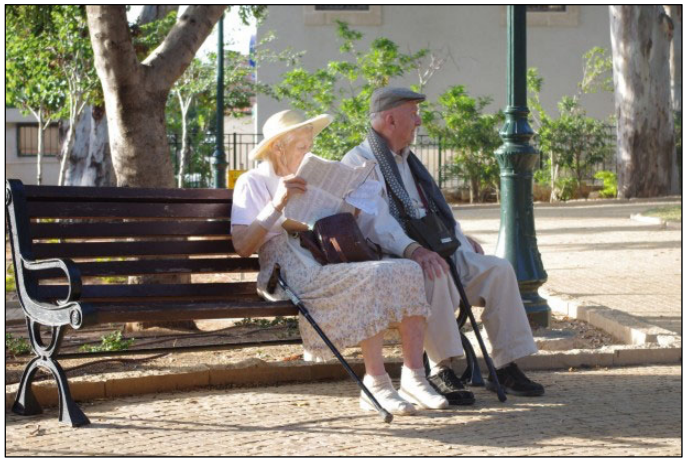
| RCRI | MICA |
| --- | --- |
| • Small database, single institution<br>• Overestimates low-risk, ambulatory patients<br>• Underestimates major vascular<br>• Includes CAD and CHF | • Large database, multiple large academic institutions<br>• Good for low-risk, ambulatory patients<br>• Does not include CAD and CHF |

# *Back to our patient…*



- MACE calculator (MICA)
  - Age…68
  - Functional status…independent by DASI
  - ASA…3
  - Creatinine…elevated at 1.7 mg/dL
  - Procedure…orthopedic
- MACE score:  1.2%

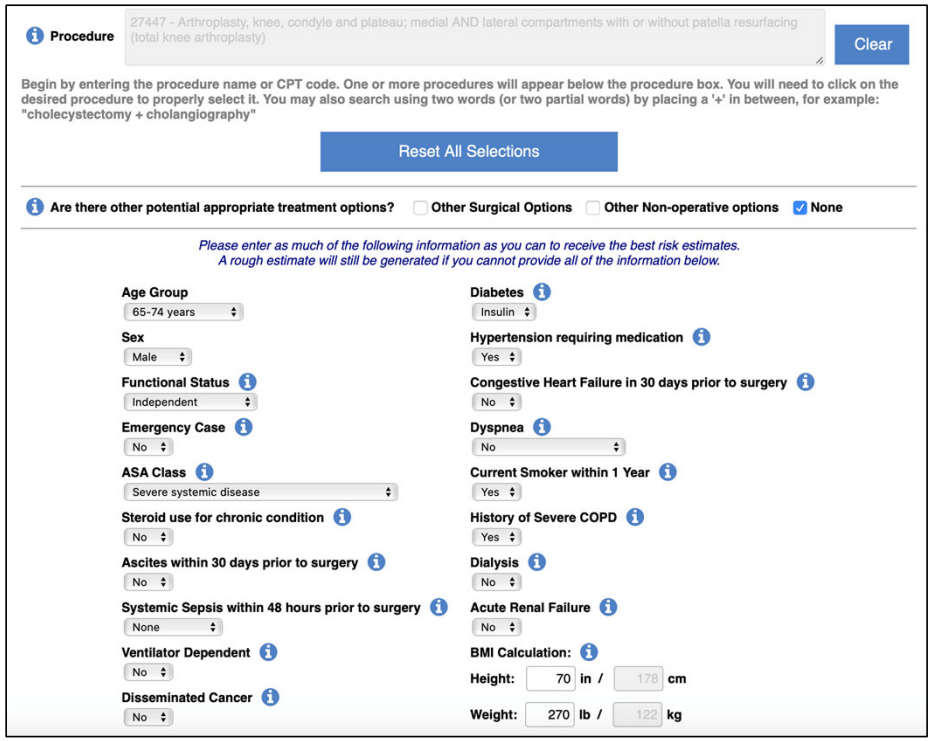
A 68-year-old patient is scheduled for a right total knee arthroplasty for degenerative joint disease

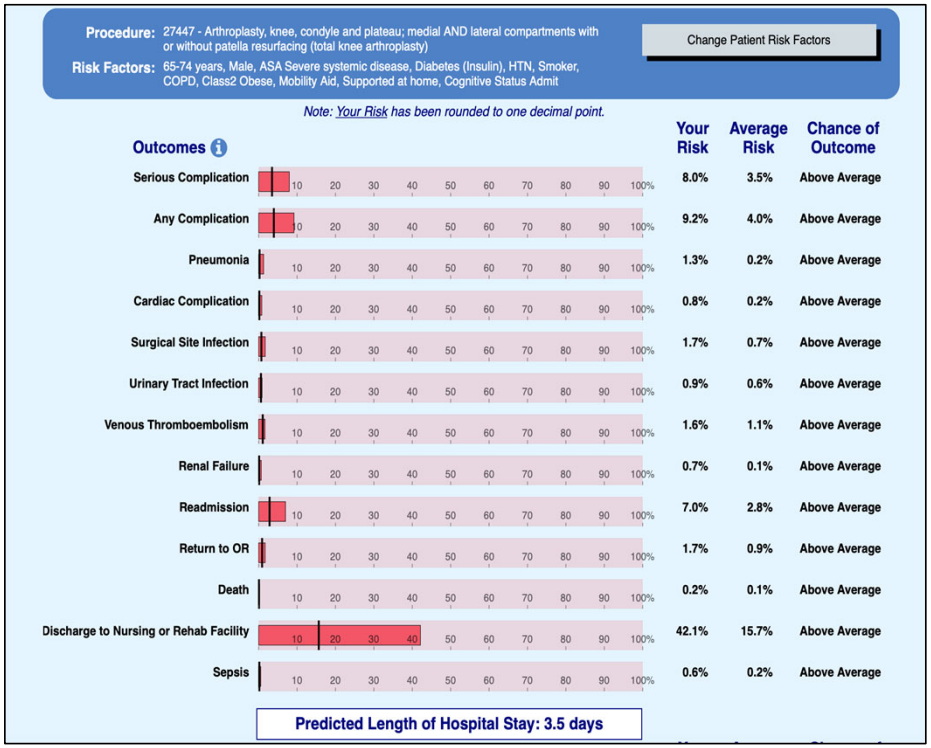


# NSQIP surgical risk calculator



Estimates surgical risk and 30-day outcomes; allows directed efforts at preoperative optimization




Billimoria, KY, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: A decision aide and informed consent tool for patients and surgeons. *J Am Coll Surg.* 2013;217(5):833-842.

# Variability between risk prediction models



## Impact of the Choice of Risk Model for Identifying Low-risk Patients Using the 2014 American College of Cardiology/American Heart Assoc. Perioperative Guidelines

**Retrospective Observational Study Using a Sample of 10,000 Patient Records**

Comparison of surgical risk models to patients as low risk (less than 1%) of developing a major adverse cardiac event:

| | |
|---|---|
| RCI | Revised Cardiac Index |
| NSQIP | American College of Surgeons National Surgical Quality Improvement Program Surgical Risk Calculator |
| MICA | Myocardial Infarction or Cardiac Arrest Calculator |

Patients were divided into two groups: low risk (<1%) *versus* high risk (≥1%) of major adverse cardiac event. The agreement between the three models was compared.

| Agreement between: | Intraclass correlation coefficient, 95% CI |
|---|---|
| NSQIP and MICA | 0.68 (0.66 to 0.70) |
| NSQIP and RCI | 0.37 (0.34 to 0.40) |
| MICA and RCI | 0.26 (0.23 to 0.30) |

The three prediction models disagreed 29% of the time on which patients were low risk.

**There is wide variability in the predicted risk of cardiac complications using different risk-prediction tools. The choice of risk-prediction tool can have an impact on the calculated risk and subsequent clinical decisions.**

Glance LG, *et al.* ANESTHESIOLOGY. November 2018.

ANESTHESIOLOGY
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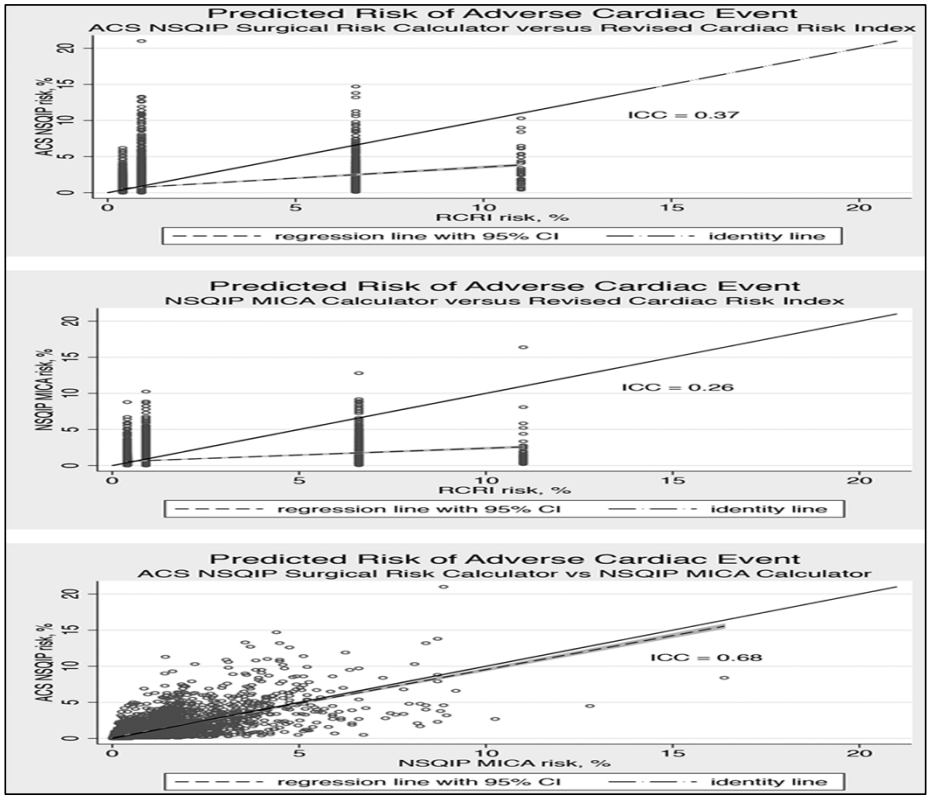
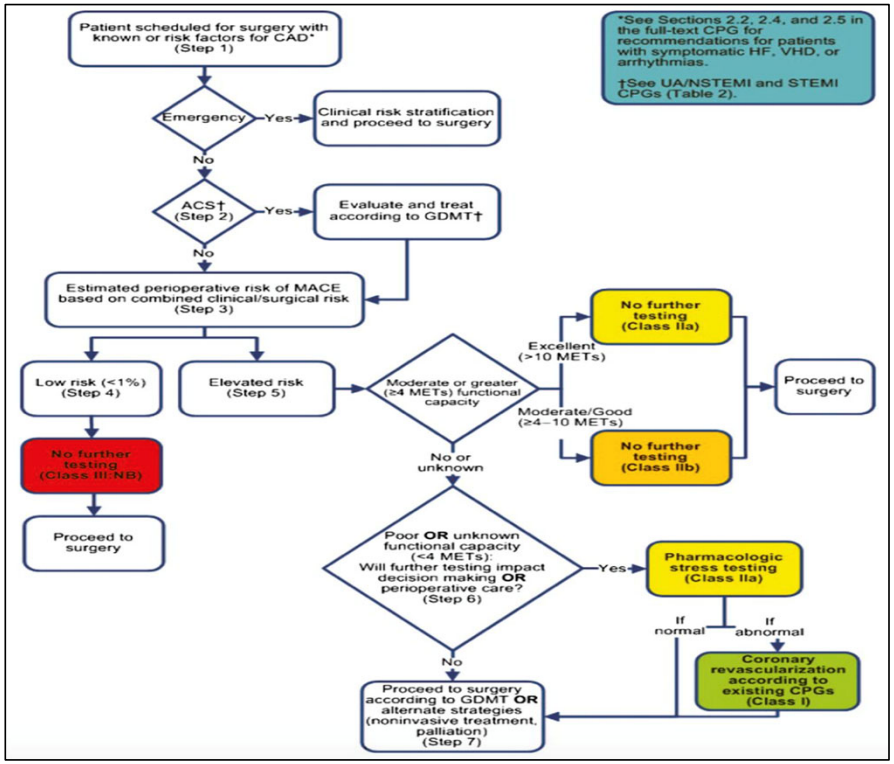


# Algorithmic approach to perioperative cardiac management



- Low-risk patients (MACE < 1% )
  - No additional cardiovascular testing
- Elevated-risk patients (MACE ≥ 1%)
  - If METS > 4: no additional testing
  - If METS < 4: further evaluation if influences perioperative care




Fleischer, LA, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery. *J Am Coll Cardiol.* 2014;62(22):e77-e137.

# Cardiac testing: EKG



## Not useful

- Asymptomatic patients undergoing low-risk surgical procedures

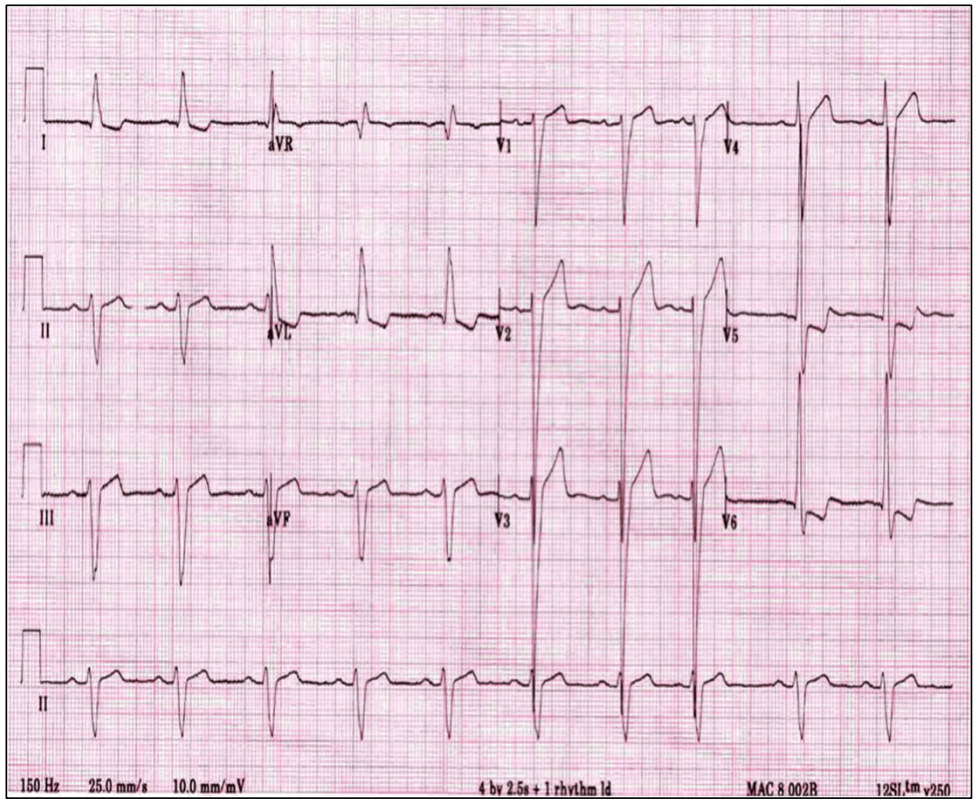
## Reasonable

- Known CAD
- Significant arrhythmia
- Peripheral arterial disease
- Cerebrovascular disease
- Structural heart disease

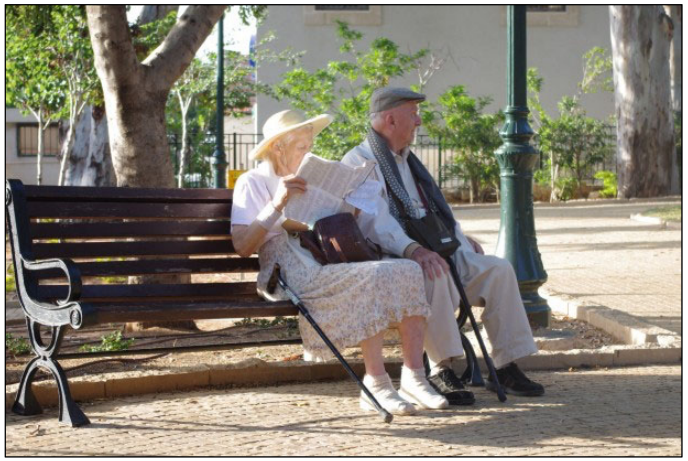
van Klei WA, et al. The value of routine preoperative electrocardiography in predicting myocardial infarction after noncardiac surgery. *Annals of surgery.* 2007;246:165-70.

# *Back to our patient…*






A 68-year-old patient is scheduled for a right total knee arthroplasty for degenerative joint disease



# Which test?



- Exercise stress test preferred
  - Aerobic, but need to achieve target heart rate
  - CPET preferred…gaining importance
- Pharmacologic…if unable to exercise
  - Dobutamine Stress Echo
    - Fewer false positives
    - Increased heart rate/blood pressure
  - Dipyridamole/adenosine nuclear
    - Use with LBBB
    - Avoid with COPD/bronchospasm
- Cardiac CT or MRI
- Cardiac catheterization
  - If abnormal non-invasive test, NYHA III-IV, unstable angina
- Resting 2D ECHO only for valvular disease, heart failure, pulmonary hypertension

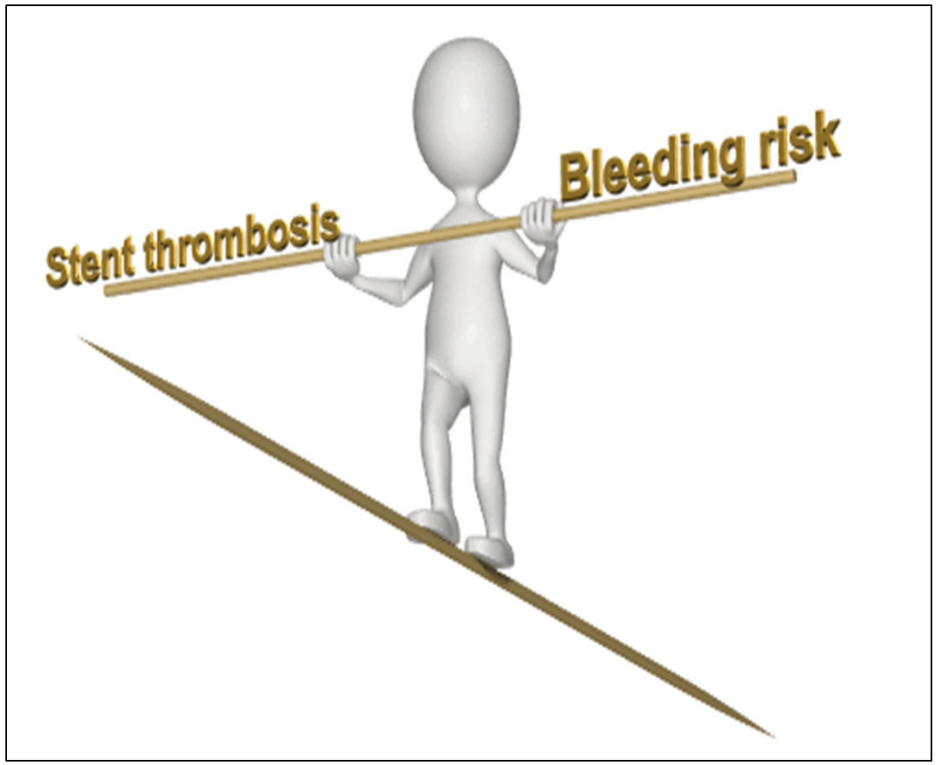
# Preoperative cardiovascular testing/therapy



| Noninvasive pharmacological stress testing before noncardiac surgery | | |
|---|---|---|
| Recommendations | COR | Level of evidence |
| It is reasonable for patients who are at an *elevated risk* for noncardiac surgery and have *poor functional capacity* (< 4 METS) to undergo noninvasive pharmacological stress testing (DSE) **IF** it will change management | IIa | B |
| Routine screening with noninvasive stress testing is not useful for patients undergoing low-risk noncardiac surgery | III: no benefit | B |
| **Preoperative coronary angiography before noncardiac surgery** | | |
| Recommendations | COR | Level of evidence |
| Routine preoperative coronary angiography is not recommended | III: no benefit | C |
| **Coronary revascularization before noncardiac surgery** | | |
| Recommendations | COR | Level of evidence |
| Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is ***indicated according to existing clinical practice guidelines*** | I | C |
| It is *not recommended* that routine coronary revascularization be performed before noncardiac surgery *exclusively to reduce perioperative cardiac events* | III: no benefit | B |

# Noncardiac surgery after coronary stent placement






- Risk factors for stent thrombosis
  - Advanced age (> 75 years)
  - ACS as reason for PCI within last 12 months
  - Extensive CAD with multiple (> 2) MIs
  - Diabetes mellitus (A1c > 9%)
  - Chronic kidney disease (Cr > 2.0 mg/dL)
  - LVEF < 40%
  - First-generation drug-eluting stent
  - Stent in left main, proximal LAD, proximal RCA, proximal circumflex
  - Multiple stents (> 2 in same vessel)
  - Stent-in-Stent in same vessel

Raza, S, et al. Perioperative stent thrombosis. *Interv Cardiol.* 2010;2(6):821-828.

# Perioperative stopping of DAPT

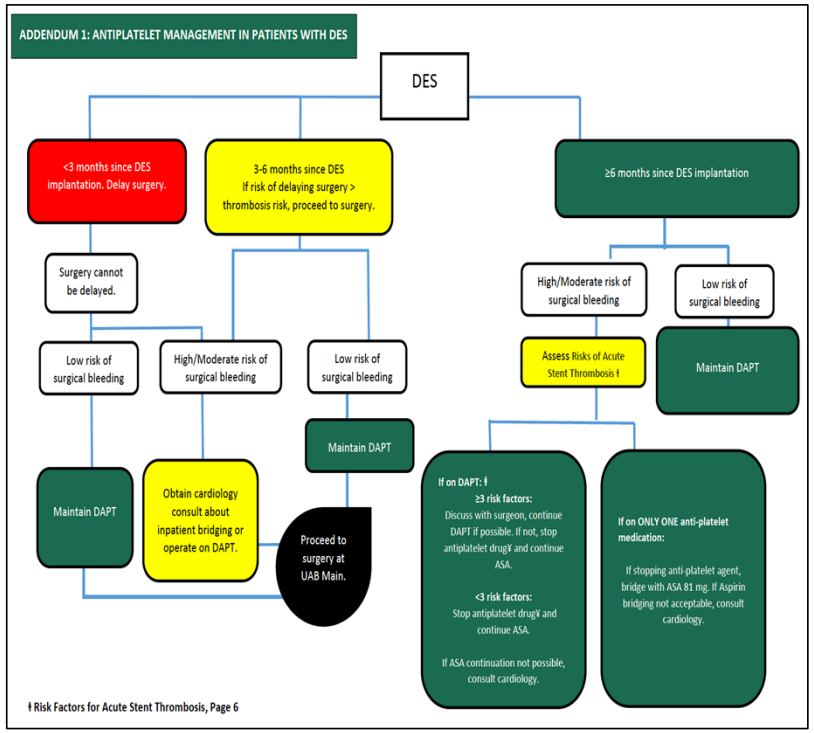


| Timing of elective noncardiac surgery in patients with previous PCI | | |
|---|---|---|
| Recommendations | COR | Level of evidence |
| Elective noncardiac surgery should be **delayed 30 days after bare metal stent** implantation and optimally **6 months after drug eluting stent** implantation | I | B-NR |
| In patients treated with DAPT after coronary stent implantation who must undergo surgical procedures that mandate the discontinuation of $P2Y_{12}$ inhibitor therapy, it is recommended that **aspirin be continued if possible and $P2Y_{12}$ therapy be restarted as soon as possible after surgery**. | I | C-EO |
| When noncardiac surgery is required in patients currently taking a $P2Y_{12}$ inhibitor, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy is useful | IIa | C-EO |
| ***Delay surgery for 14-days following balloon angioplasty*** | I | C |
| Elective noncardiac surgery after DES implantation in patients for whom $P2Y_{12}$ inhibitor therapy will need to be discontinued **may be considered after 3 months if the risk of further delay of surgery is greater than the expected risks of stent thrombosis**. | IIb | C-EO |
| **Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 3 months after DES implantation** in patients in whom DAPT will need to be discontinued perioperatively. | III: harm | B-NR |

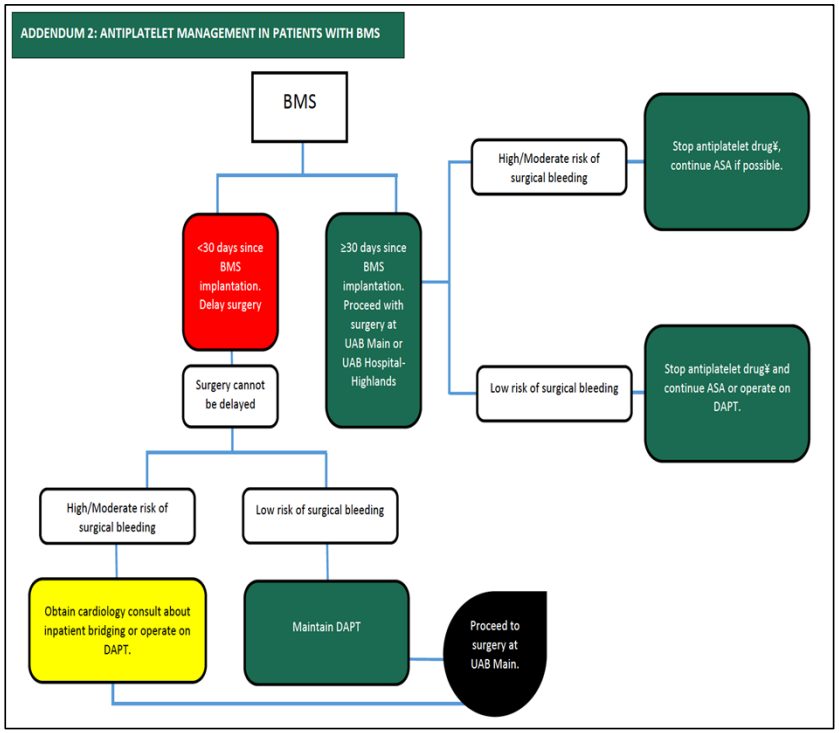
# Stratification by stent type



## Drug-eluting stents

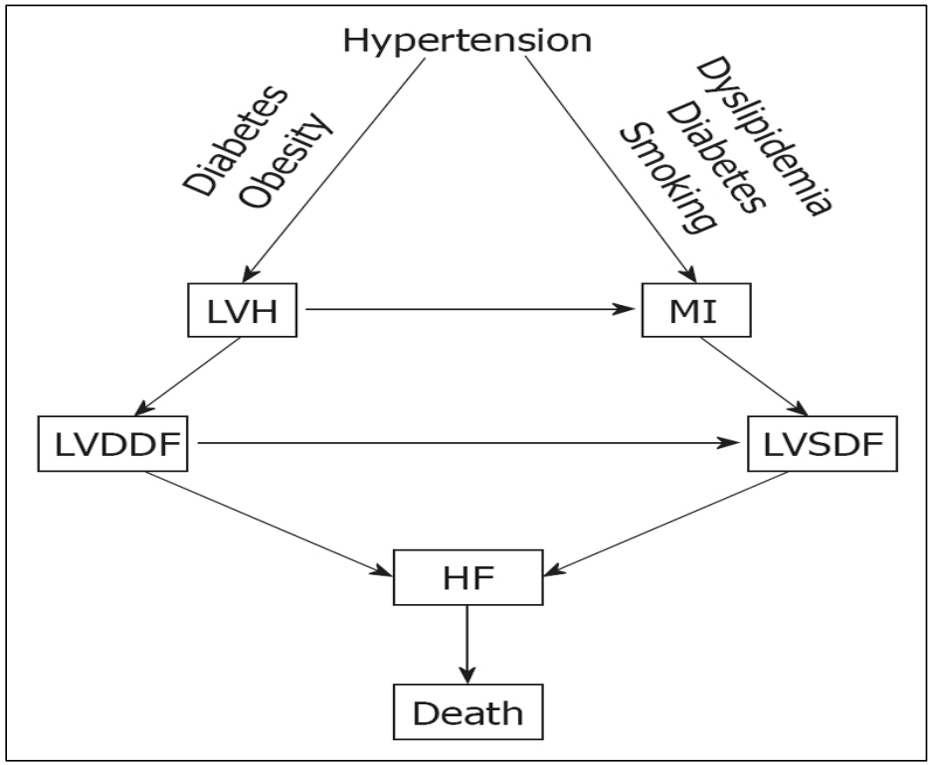


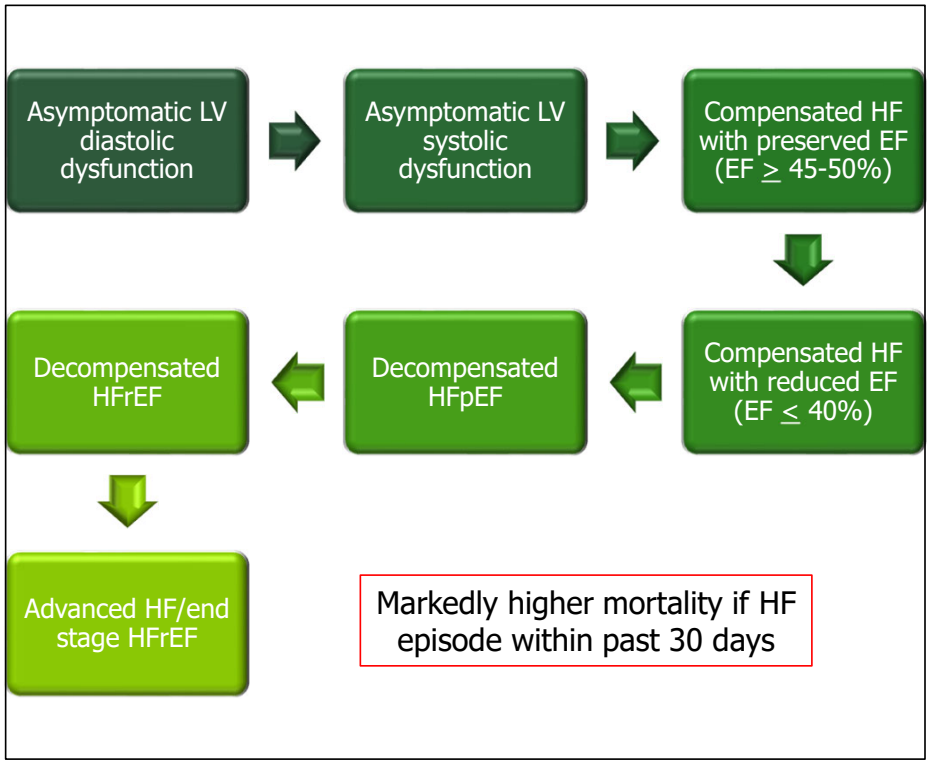

## Bare metal stents



# Heart failure as a risk factor



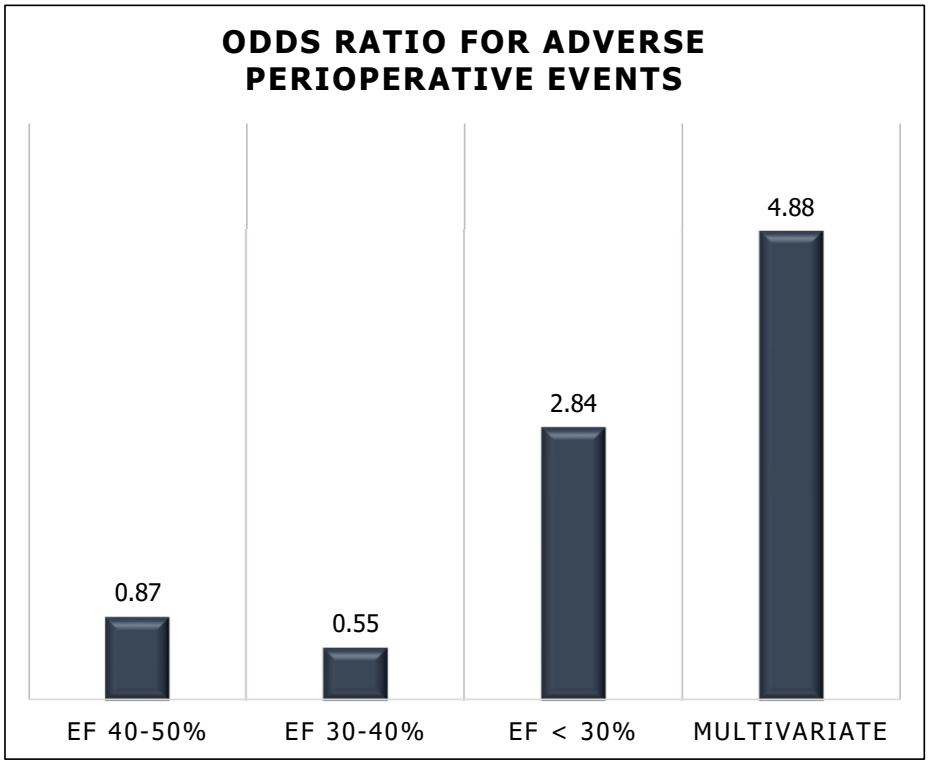


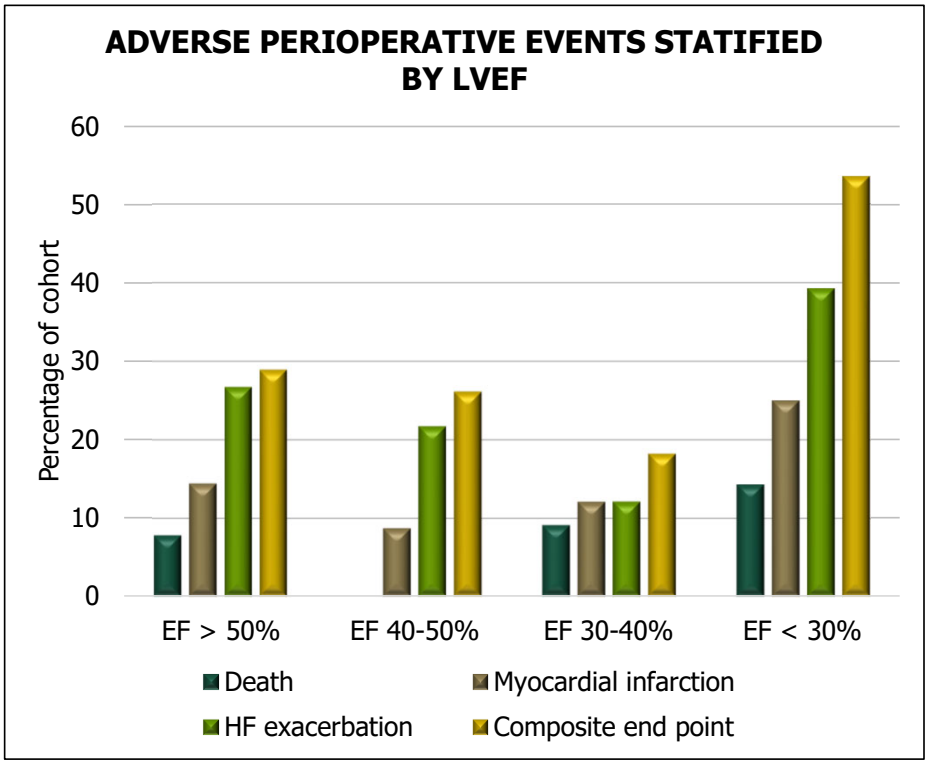




Chrysant, SG. Stopping the cardiovascular disease continuum: Focus on prevention. *World J Cardiol.* 2010;2(3):43-49.

# Ejection fraction independently predicts perioperative morbidity and mortality






Healy, KO, et al. Perioperative outcome and long term mortality for heart failure patients undergoing intermediate and high risk non-cardiac surgery: Impact of left ventricular ejection fraction. *Congest Heart Fail.* 2010;16(2):45-49.

# New York Heart Association (NYHA) Classification



| Class | Functional Capacity (subjective) | Class | Objective Assessment |
|---|---|---|---|
| I | • Without resulting imitation of physical activity<br>• Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or anginal pain | A | • No objective evidence of cardiovascular disease |
| II | • Slight limitation of physical activity<br>• Comfortable at rest; ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain | B | • Objective evidence of minimal cardiovascular disease |
| III | • Marked limitation of physical activity<br>• Comfortable at rest; less than ordinary activity causes fatigue, palpitation, dyspnea, or anginal pain | C | • Objective evidence of moderately severe cardiovascular disease |
| IV | • Inability to carry on any physical activity without discomfort<br>• Symptoms of heart failure or angina may be present even at rest<br>• If any physical activity is undertaken, discomfort is increased | D | • Objective evidence of severe cardiovascular disease |

The Criteria Committee of the New York Heart Association. *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels.* 9th ed. Dolgin, M, ed. Boston, Mass: Little, Brown & Co; 1994:253-256.

# Preoperative ECHOs in heart failure patients



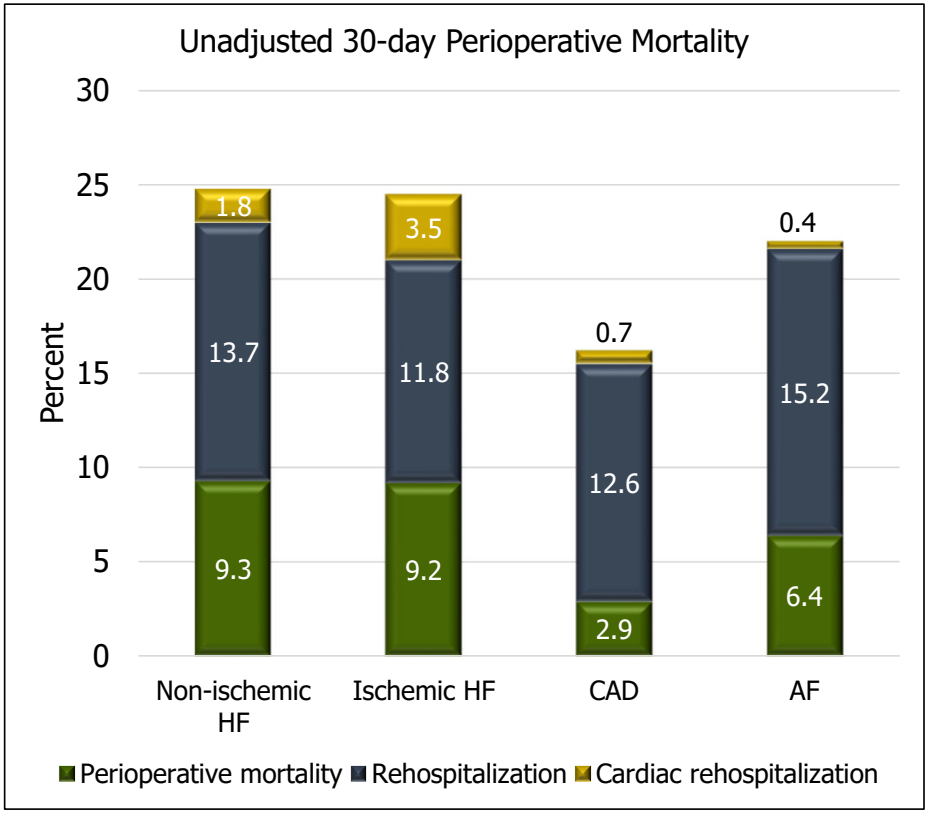
| Assessment of LV function | | |
|---|---|---|
| Recommendations | COR | LOE |
| It is reasonable for patients with ***dyspnea of unknown origin*** to undergo preoperative evaluation of LV function | IIa | C |
| It is reasonable for patients with HF with ***worsening dyspnea or other change in clinical status*** to undergo preoperative evaluation of LV function | IIa | C |
| Reassessment of LV function in clinically stable patients with previously documented LV dysfunction ***may be considered if there has been no assessment within a year*** | IIb | C |
| Routine preoperative evaluation of LV function is ***not recommended*** | III no benefit | B |

Fleishcher, LA, Fleischmann, KE, Auerbach, AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol.* 2014;64(22):e77-137.

# Outcomes with HF compared to CAD and AF



- HF risk varies
- HF greater risk of postop complications (including operative mortality) than CAD
- Associated with increased LOS and 30-day readmissions
- Worsening HF associated with increased postop morbidity and noncardiac complications




Van Diepen, S. et al. Mortality and Readmission of Patients With Heart Failure, Atrial Fibrillation, or Coronary Artery Disease Undergoing Noncardiac Surgery: An Analysis of 38 047 Patients. *Circulation*. 2011;124:289-296.

# Blood Pressure Categories

American Heart Association | American Stroke Association

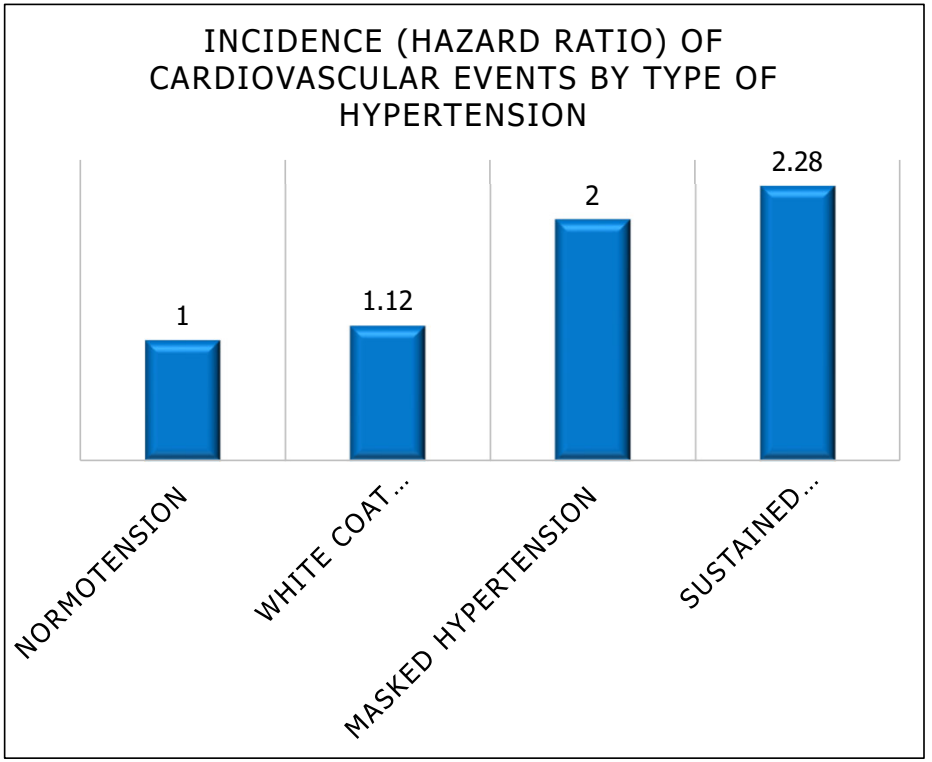
| BLOOD PRESSURE CATEGORY | SYSTOLIC mm Hg (upper number) | | DIASTOLIC mm Hg (lower number) |
|---|---|---|---|
| NORMAL | LESS THAN 120 | and | LESS THAN 80 |
| ELEVATED | 120 – 129 | and | LESS THAN 80 |
| HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1 | 130 – 139 | or | 80 – 89 |
| HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2 | 140 OR HIGHER | or | 90 OR HIGHER |
| HYPERTENSIVE CRISIS (consult your doctor immediately) | HIGHER THAN 180 | and/or | HIGHER THAN 120 |

# Hypertension risk stratification…in search of the elusive baseline blood pressure



- ***Community readings*** more accurately reflect the nature of chronic hypertension
  - Primary Care Clinic readings may not accurately reflect hypertension

*"…the incidence of cardiovascular events is not significantly different between WCHT and true normotension, whereas the outcome is worse in patients with masked or sustained hypertension."*




Fagard, RH, Cornelissen, VA. Incidence of cardiovascular events in white-coat, masked and sustained hypertension versus true normotension: a meta-analysis. *J Hypertens.* 2007;25(11):2193-2198.

# Hypertension, hypertensive heart disease & perioperative risk



- Meta-analysis of 30 observational studies
  - Association of hypertension and perioperative cardiac risk: OR 1.35 (1.17-1.56)
  - Statistically, *but not clinically*, significant

- < 180/110
  - Little evidence of perioperative risk
  - *Recommendation: No cancellation of surgery*

- ≥ 180/110
  - Equivocal evidence for perioperative risk
  - *Recommendation: May proceed; ensure cardiovascular stability*
    - Maintain intraoperative blood pressure within 20% of patient baseline

Howell, SJ, Sear, JW, Föex, P. Hypertension, hypertensive heart disease and perioperative cardiac risk. *BJA.* 2004.92(4):570-583.


# What patients should be considered for cancellation?



**Definitely**

- Hypertensive urgency or crisis
- Positive toxicity (cocaine)
- Untreated pheochromocytoma

**Maybe**

- High risk surgery with cardiac risk factors
- No prior diagnosis of hypertension
- Diastolic ≥ 110 mmHg

**Don't**

- Blood pressure < 180/110
- Blood pressure > 180/110 without symptoms

*NO randomized clinical trial data showing what the optimal blood pressure should be at the time of surgery*

# *The big question…should we treat it?*

- Fix the fixable
  - Give the skipped dose of antihypertensive
  - Treat anxiety and/or pain
- Don't just treat the number
  - No evidence that treating elevated blood pressure in the immediate preoperative phase decreases morbidity or mortality
    - ***BUT***… preoperative treatment can lead to significant intraoperative hypotension
    - Intraoperative hypotension ***DOES*** increase morbidity and mortality

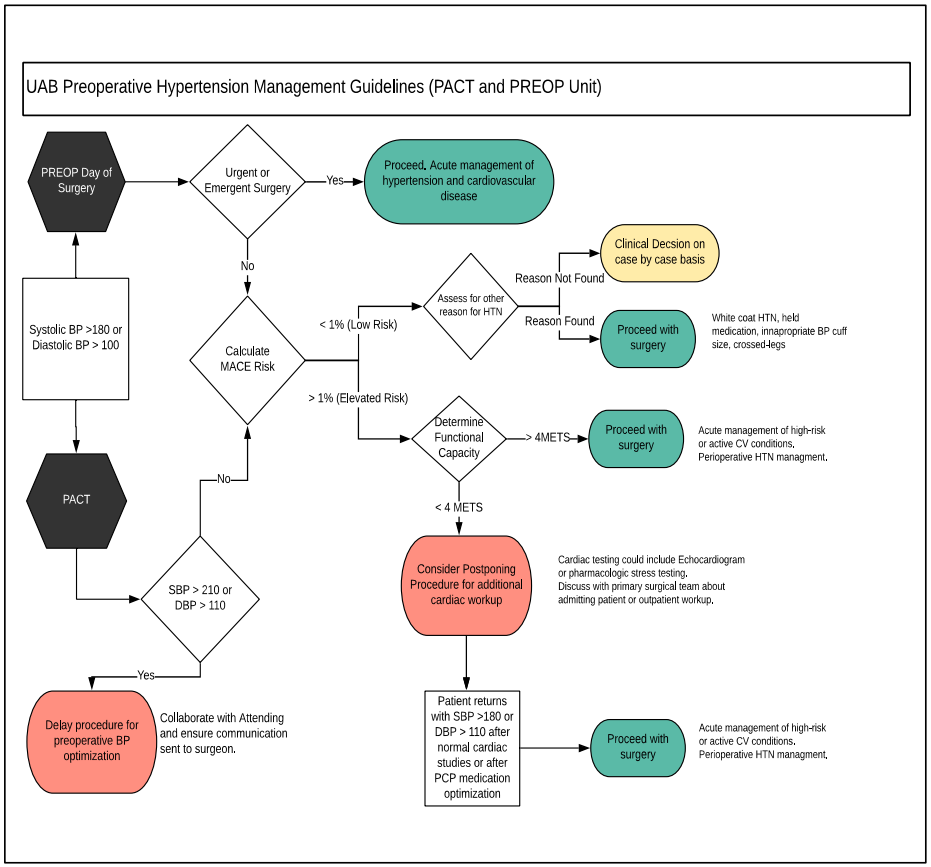
Elderly patients usually have isolated systolic hypertension and wide pulse pressures. Treating systolic hypertension in these patients may cause diastolic hypotension and compromised end-organ perfusion.

Dobyns, JB, and Vetter, TR, Perioperative Hypertension Management in the Elderly Patient, in *Perioperative Care of the Elderly Patient,* Barnett, SR (ed), Cambridge University Press, London, England, 2016.

# Algorithmic approach to perioperative hypertension management



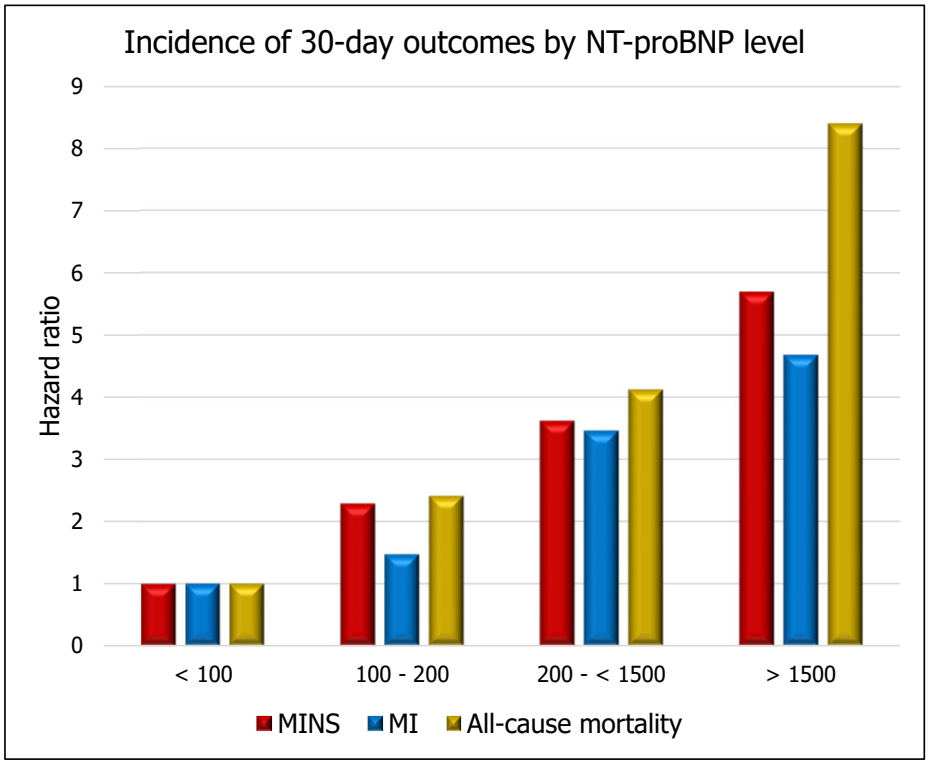
- Practice guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care[1]




1. Practice Guidelines for Perioperative Blood Management
An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. *Anesthesiology.* 2015; 122(2):1-35.

# …of MACE and MINS





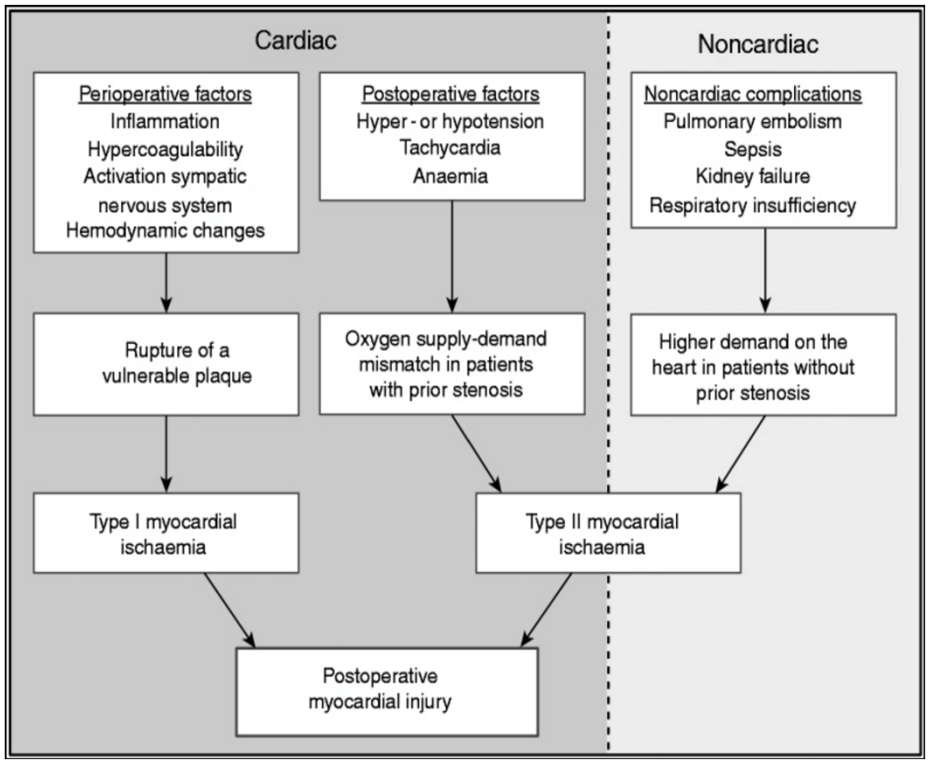

Duceppe, E, et al. Preoperative N-terminal Pro-B-Type natriuretic peptide and cardiovascular events after noncardiac surgery. *Ann Int Med.* 2020;172:96-104.

- Preoperative administration of beta-blockers, aspirin, statins, clonidine, ACEI, ARB, and preoperative revascularization have all been investigated
  - Only ***statins*** have shown efficacy at MINS reduction
  - Preoperative initiation of statins should be considered in high-risk statin naïve patients

Verbree-Willemsen, L, et al. Causes and prevention of postoperative myocardial injury. *Eur J Prev Cardiol.* 2019;26(1):59-67.

# Myocardial injury after noncardiac surgery (MINS)






Verbree-Willemsen, L, et al. Causes and prevention of postoperative myocardial injury. *Eur J Prev Cardiol.* 2019;26(1):59-67.

| Prediction | Prevention | Management |
|---|---|---|
| • Risk stratification<br>• EKG; imaging<br>• Biomarkers | • Medication<br>• Revascularization<br>• Prehabilitation<br>• Intraoperative measures | • Medication<br>• Routine follow-up |


# Tips/recommendations for risk assessment

## Risk assessment

- RCRI
  - Don't use for low risk/ambulatory surgery, AAA, major vascular surgery[1]
- MICA/Gupta
  - Different definition of MI
  - Troponin > 3 times upper limit of normal
  - Good correlation with NSQIP
- Exercise capacity
  - Worse prognosis if limited by chest pain/SOB
  - Unclear when limited by other factors
  - Use DASI to quantify
- Obtain previous cardiovascular test results

## Risk management/mitigation

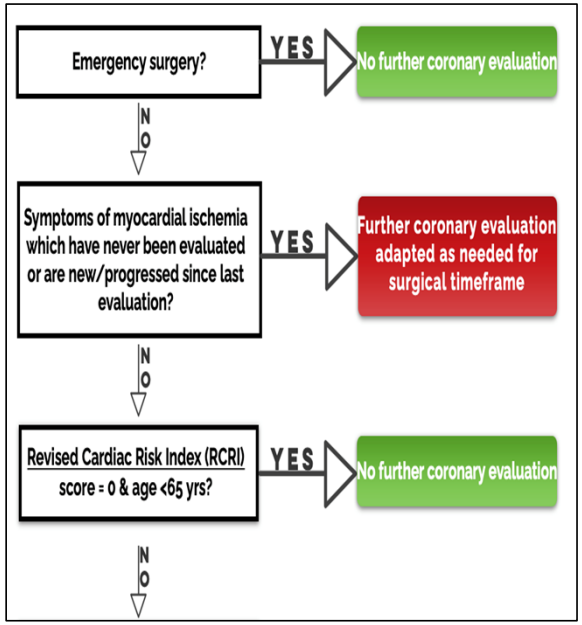
- Interventions
  - Revascularization rarely necessary to get patient through surgery
- Medication management
  - NCS may be OK between 3 and 6 months after DES placement
    - Try to continue aspirin or DAPT
  - Beta blocker data still a bit controversial
    - Continue but don't start
  - Statins beneficial
    - Continue perioperatively
    - Reasonable to initiate in vascular or high-risk surgery

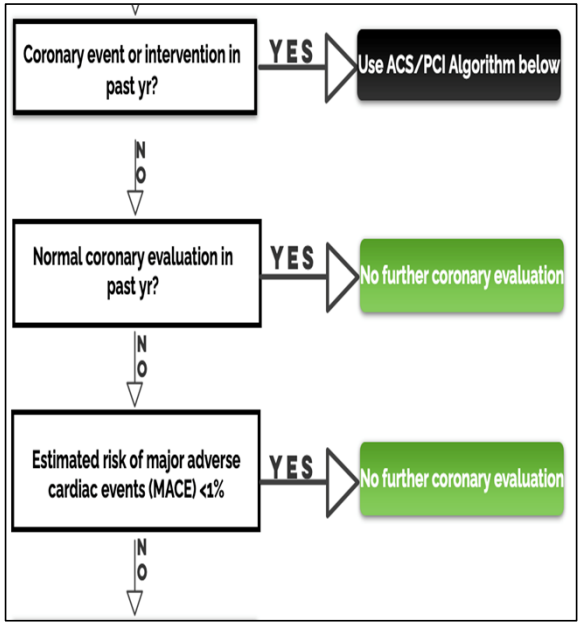
1. Ford, MK, et al. Systematic review: Prediction of perioperative cardiac complications and mortality by the revised cardiac risk index. *Ann Intern Med.* 2010;152(1):26-35.

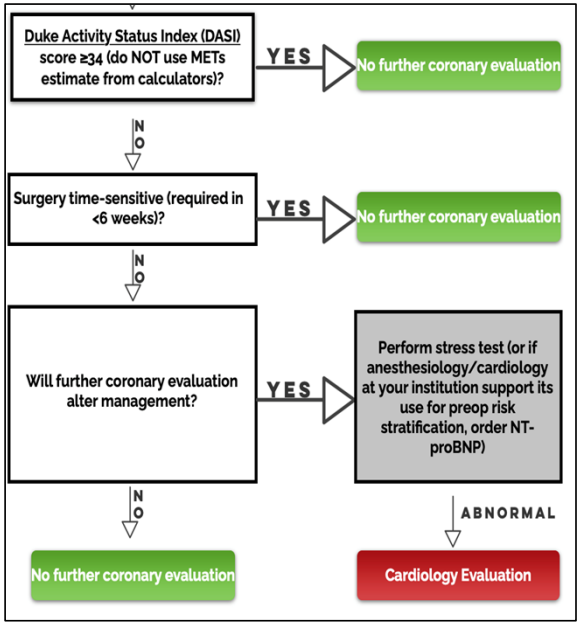
Surgery is a shared-decision making endeavor…involve the patient, care-givers, PCP, medical specialists, surgeon in collaboration and discussion

# Algorithmic approach to risk stratification

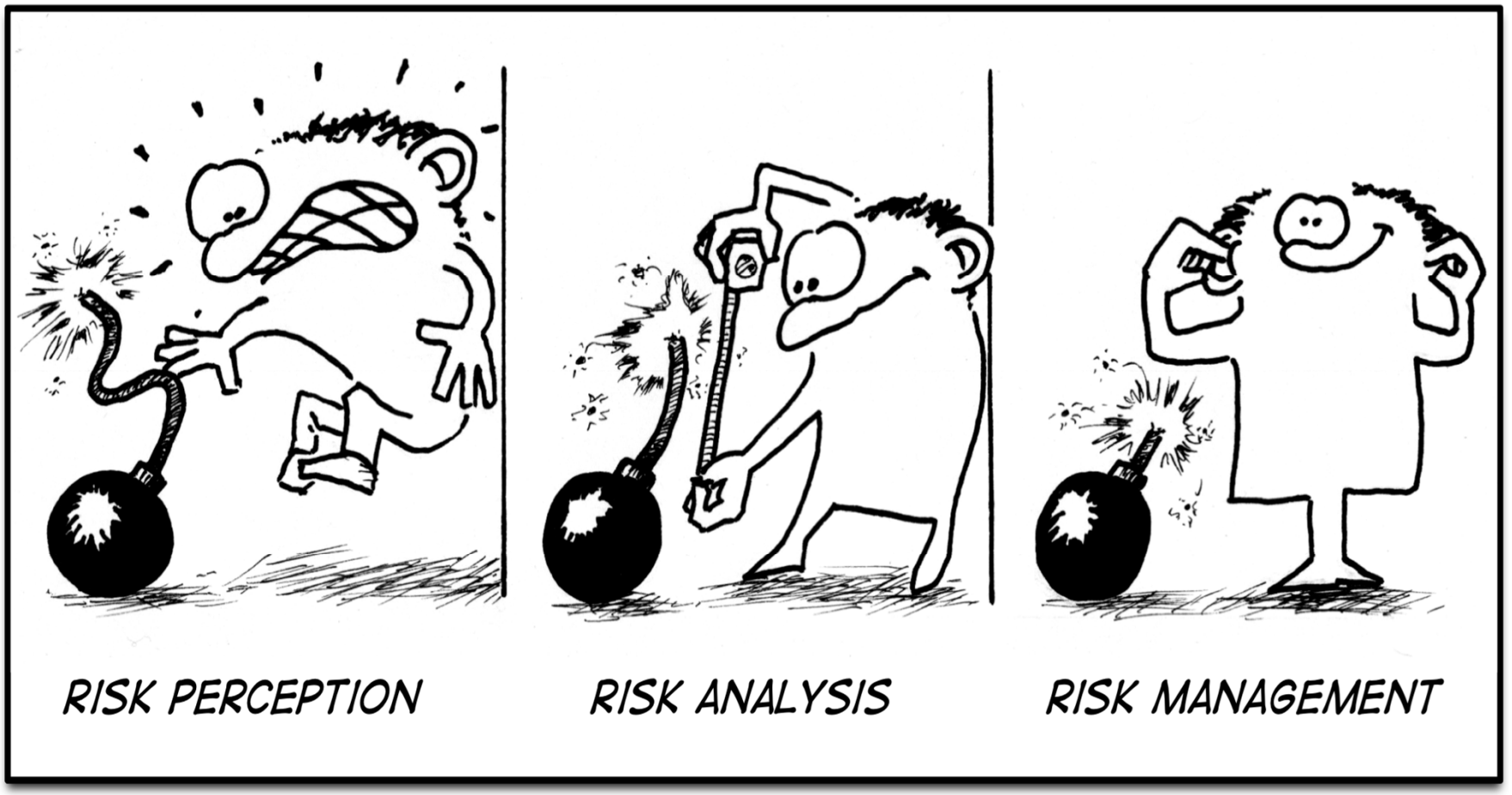





Used with permission from Pfeifer, K. Guide to Preoperative Evaluation. www.preopevalguide.com, 2020.



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