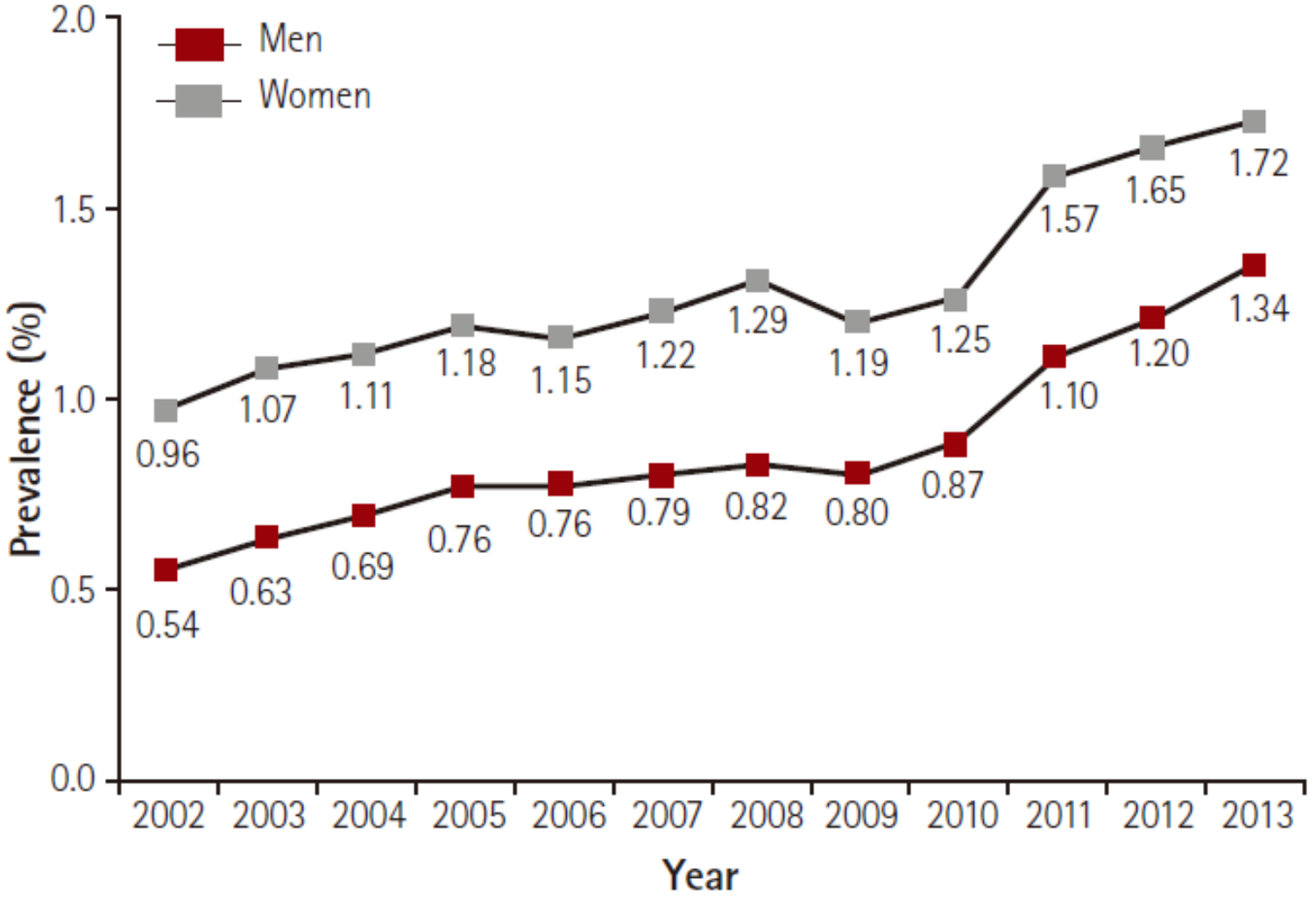
2017 Annual Spring Scientific Conference of the KSC
Heart Failure 1
Living with Heart Failure (09:30-09:50)

Perioperative Consultation for Heart Failure

Min-Seok Kim, MD, PhD

Department of Cardiology, Asan Medical Center,
University of Ulsan College of Medicine, Seoul, Korea

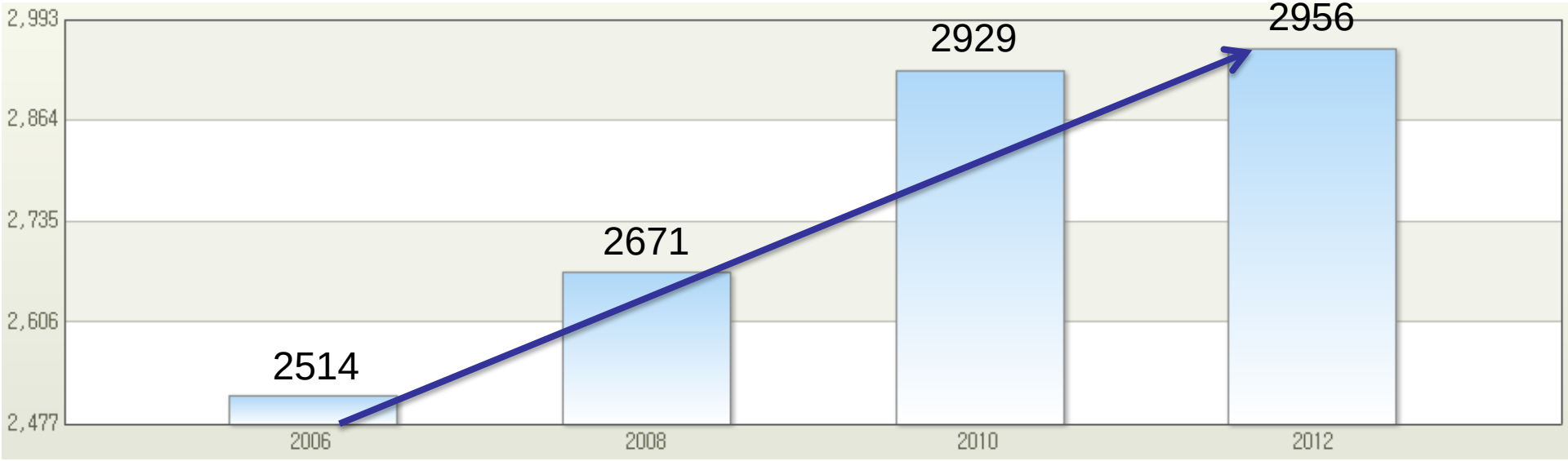
Increasing prevalence of HF in Korea



In 2013, national prevalence of HF is estimated as **1.53% (~52,000 patients)**

Lim NK, et al. Korean Circ J 2016;46:e95.

Patient number for operation per 100,000 persons in Korea



통계청 2017

Epidemiology

- **The number of patients with HF requiring preoperative assessment may be increasing in Korea.**

HF as a significant risk for perioperative morbidity and mortality

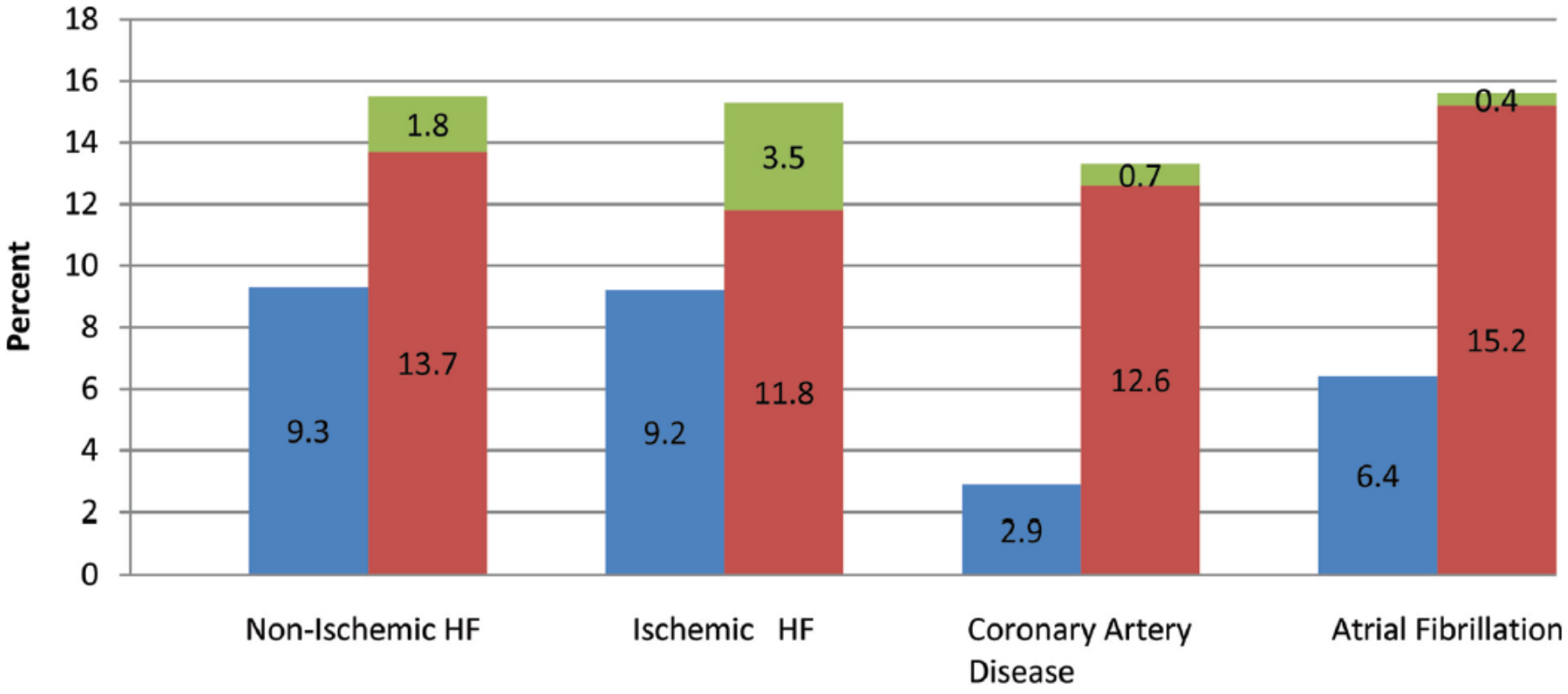
- Medicare claims data from 1997 to 1998

	HF (n = 1,532)	CAD (n = 1,757)	Control (n = 44,512)	p Value*
Primary outcome: 30-day mortality (95% CI)				
Observed (%)	15.4 (13.6–17.3)	6.6 (5.5–7.8)	6.1 (5.9–6.3)	
Risk-adjusted (%)	11.7 (10.2–13.1)	6.6 (5.4–7.8)	6.2 (6.0–6.4)	<0.001
Mortality during surgery admission (95% CI)				
Observed (%)	10.7 (9.2–12.0)	5.0 (4.0–6.1)	4.1 (3.9–4.2)	
Risk-adjusted (%)	7.9 (6.8–9.0)	4.6 (3.6–5.5)	4.1 (3.9–4.3)	<0.001
30-day mortality in discharged patients (95% CI)				
Observed (%)	8.4 (6.9–9.9)	2.9 (2.1–3.7)	3.3 (3.1–3.5)	
Risk-adjusted (%)	6.5 (5.4–7.6)	3.3 (2.4–4.3)	3.2 (3.0–3.4)	<0.001
Readmission rate within 30 days (95% CI)				
Observed (%)	23.6 (21.5–25.8)	15.5 (13.8–17.2)	10.9 (10.6–11.2)	
Risk-adjusted (%)	20.0 (18.3–21.8)	14.2 (12.5–15.8)	11.0 (10.7–11.3)	<0.001
Mean length of stay (days ± SD)	11.0 ± 10.6	9.3 ± 10.5	8.9 ± 11.1	
Mean length of ICU stay (days ± SD)	4.9 ± 6.0	4.2 ± 5.2	4.1 ± 5.6	0.015
Patients with an ICU stay (%)	44.7	48.2	28.0	0.053
Mean time to readmission (days ± SD)	13.0 ± 8.5	13.3 ± 8.5	13.2 ± 8.4	0.709

Hernandez AF, et al. JACC 2004;44:1446-53.

HF as a significant risk for perioperative morbidity and mortality

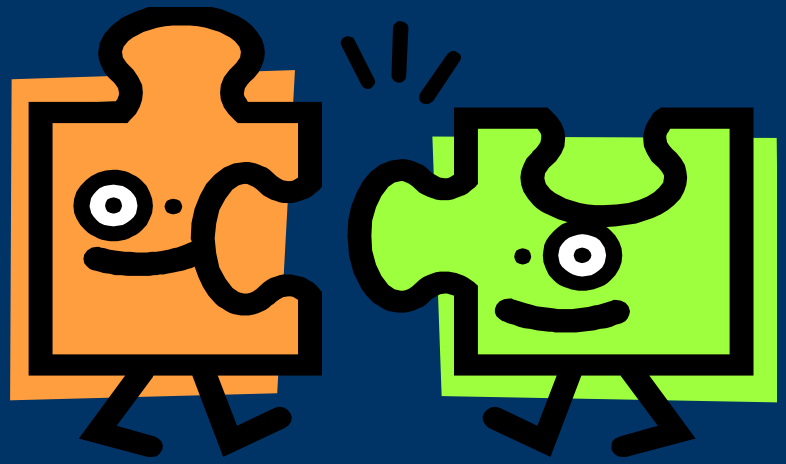
- Population-based data analysis of 4 cohorts of 38,047 consecutive patients



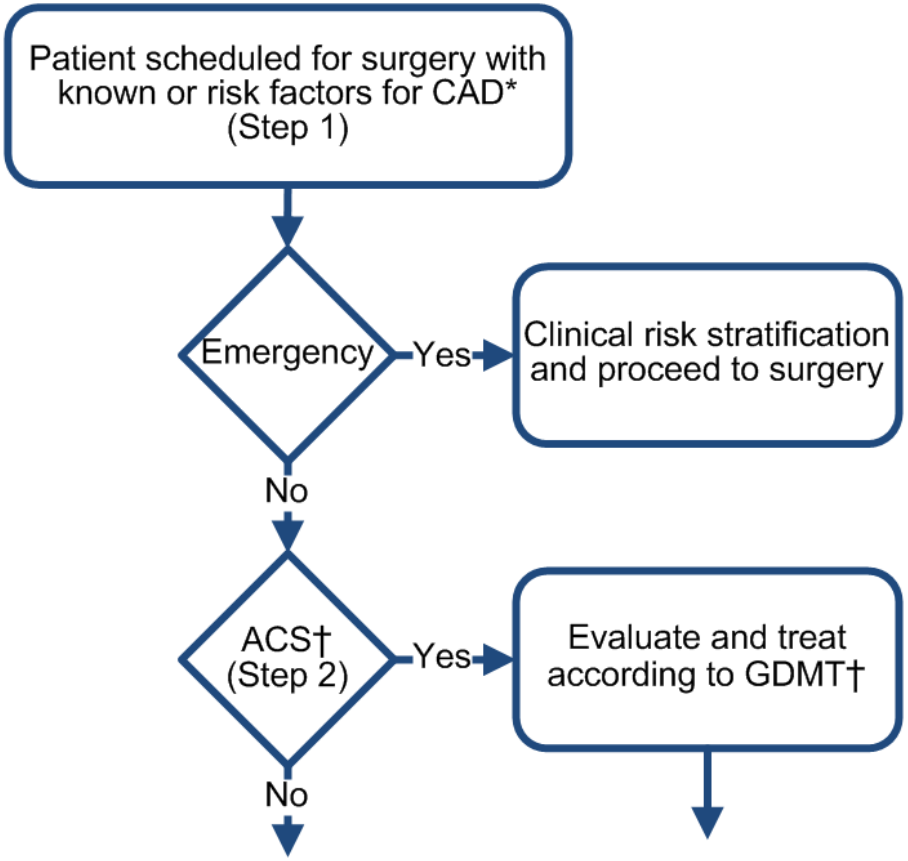
30-day perioperative mortality (blue), rehospitalization (red), and cardiac rehospitalization (green)

van Diepen S, et al. Circulation 2011;124:289-96.

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

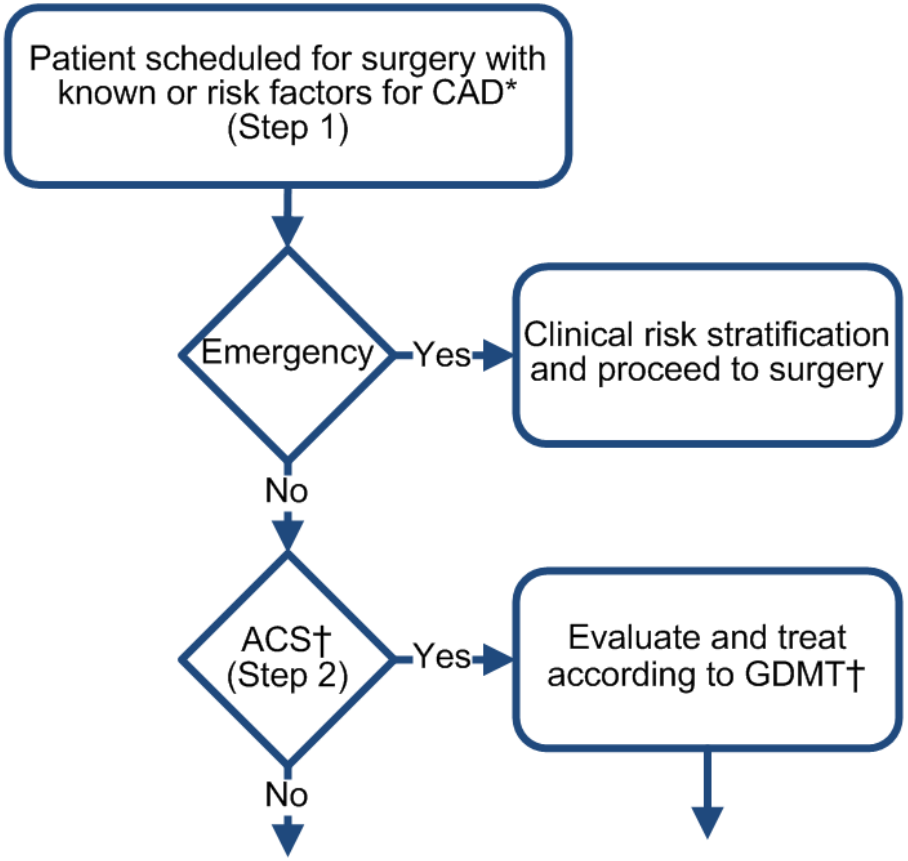


Stepwise Approach to Perioperative Cardiac Assessment
Step 1:



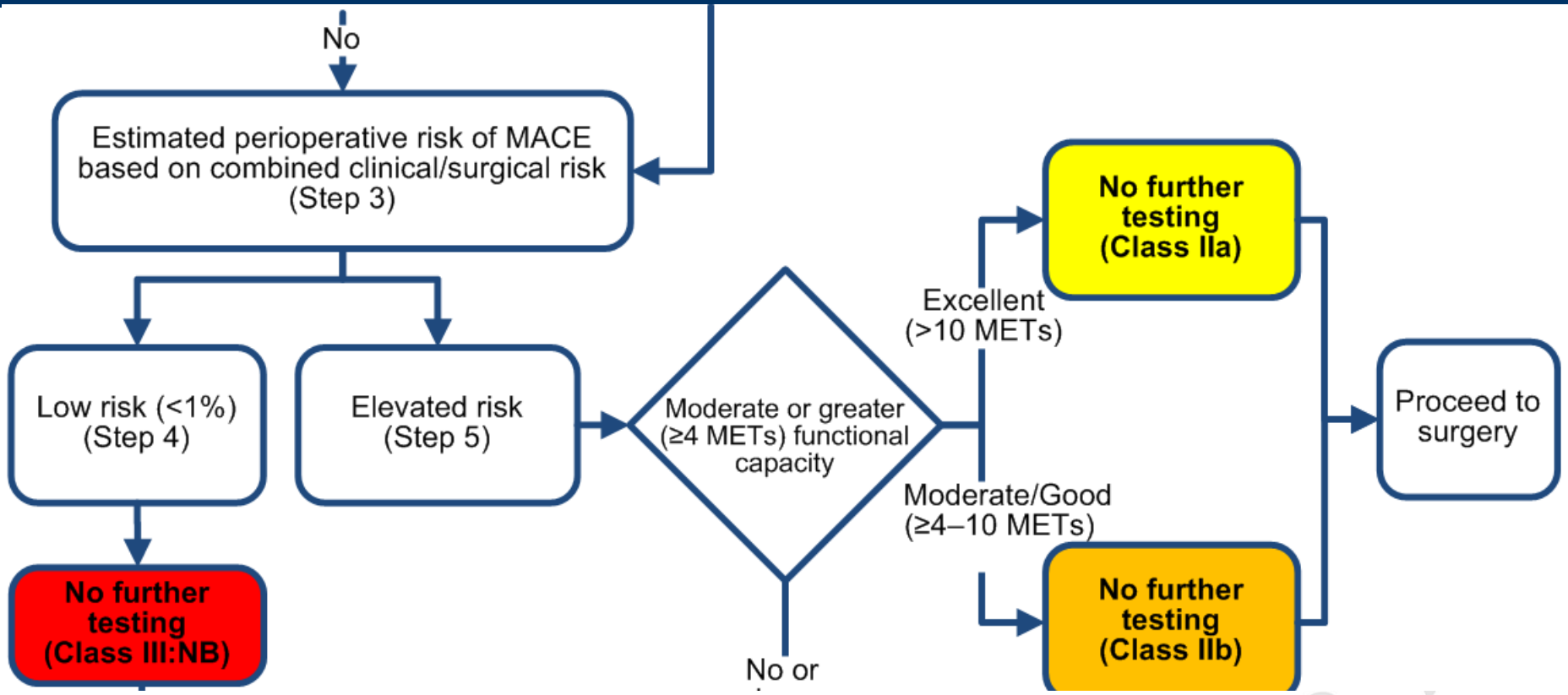
Step 1: In patients scheduled for surgery with risk factors for or known CAD, determine the urgency of surgery. If an emergency, then determine the clinical risk factors that may influence perioperative management and proceed to surgery with appropriate monitoring and management strategies based on the clinical assessment (see Section 2.1 for more information on CAD). (For patients with symptomatic HF, VHD, or arrhythmias, see Sections 2.2, 2.4, and 2.5 for information on evaluation and management.)

Stepwise Approach to Perioperative Cardiac Assessment Step 2:



Step 2: If the surgery is urgent or elective, determine if the patient has an ACS. If yes, then refer patient for cardiology evaluation and management according to GDMT according to the UA/NSTEMI and STEMI CPGs (18, 20).

Stepwise Approach to Perioperative Cardiac Assessment Step 3:



Step 3: If the patient has risk factors for stable CAD, then estimate the perioperative risk of MACE on the basis of the combined clinical/surgical risk. This estimate can use the American College of Surgeons NSQIP risk calculator (http://www.surgicalriskcalculator.com) or incorporate the RCRI (131) with an estimation of surgical risk. For example, a patient undergoing very low-risk surgery (e.g., ophthalmologic surgery), even with multiple risk factors, would have a low risk of MACE, whereas a patient undergoing major vascular surgery with few risk factors would have an elevated risk of MACE (Section 3).

American College of Surgeons NSQIP Calculator

- 21 predictors of risk for major cardiac complications
- NSQIP MICA risk-prediction rule created in 2011
- 525 US hospitals participated
- > 1 million operations included
- Outperformed RCRI in discriminative power (esp. with vascular)
- Calculates risk of:
  - MACE, death, PNA, VTE, ARF, return to OR, unplanned intubation discharge to rehab/nursing home, surgical infection, UTI
- Predicts length of hospital stay
- Limitations:
  - Not validated outside NSQIP
  - ASA status
  - Functional status/dependence

2011 NSQIP MICA (Myocardial Infarction and Cardiac Arrest) risk evaluation (Gupta perioperative cardiac risk, http://www.surgicalriskcalculator.com/miorcardiacarrest)

Gupta Perioperative Cardiac Risk

By clicking on the "Submit" button below, you acknowledge that you have read, understand, and agree to be bound by the terms of the QxMD Online Calculator End User Agreement.

Estimate risk of perioperative myocardial infarction or cardiac arrest.

Age	65
Creatinine	≥1.5 mg/dL / 133 µmol/L
ASA Class	ASA 2

ASA 1 = Normal healthy patient
ASA 2 = Patients with mild systemic disease
ASA 3 = Patients with severe systemic disease
ASA 4 = Patients with severe systemic disease that is a constant threat to life
ASA 5 = Moribund patients who are not expected to survive without the operation

Preoperative Function	Partially Dependent
Procedure	Neck (Thyroid and Parathyroid)

Submit

2011 NSQIP MICA (Myocardial Infarction and Cardiac Arrest) risk evaluation (Gupta perioperative cardiac risk, http://www.surgicalriskcalculator.com/miorcardiacarrest)

Gupta Perioperative Cardiac Risk

Estimated risk of perioperative myocardial infarction or cardiac arrest: 0.3 %.

About this calculator

This risk calculator provides an estimate of perioperative cardiac risk for individual patients based on a model derived from a large sample (>400 000) of patients. This is intended to supplement the clinician's own judgment and should not be taken as absolute. Certain limitations exist such as absence of information on preoperative stress test, echocardiography, arrhythmia, and aortic valve disease. Unfortunately, known/remote coronary artery disease (except prior PCI and cardiac surgery) was also not controlled for in the multivariate analysis. In spite of the absence of these variables, the predictive ability of the calculator as measured by c-statistic was 0.88 (88%), much higher than previous models such as Revised Cardiac Risk Index.

The details of the methodology are provided in the published paper.

Citations

Gupta PK, Gupta H, Sundaram A, Kaushik M, Fang X, Miller WJ, Esterbrooks DJ, Hunter CB, Pipinos II, Johanning JM, Lynch TG, Forse RA, Mohiuddin SM, Mooss AN. Development and validation of a risk calculator for prediction of cardiac risk after surgery. Circulation. 2011 Jul 26;124(4):381-7. Epub 2011 Jul 5.

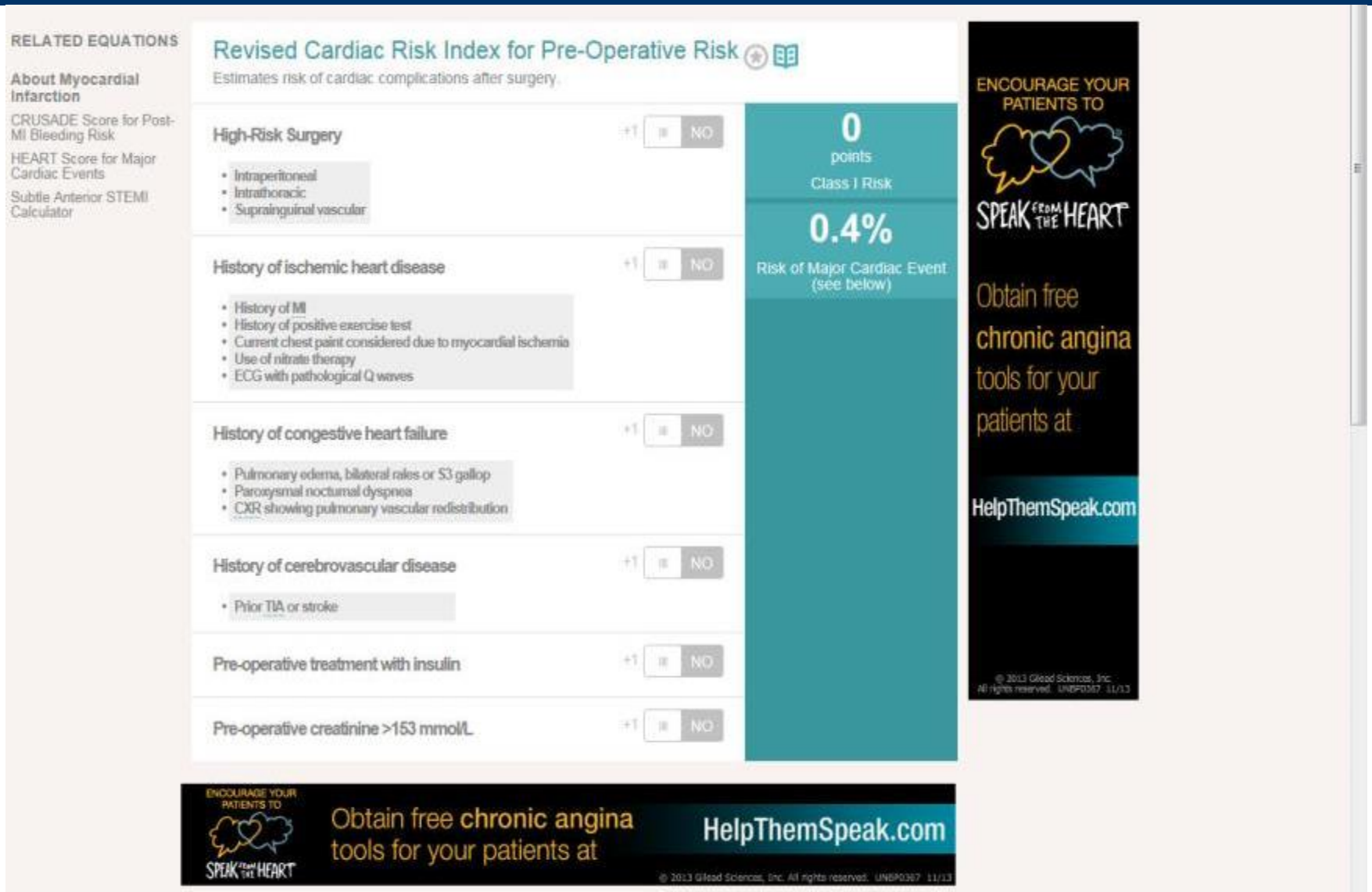
RCRI - Revised Cardiac Risk Index

- 6 predictors of complications
- Major cardiac complications included:
  - Myocardial infarction
  - Ventricular fibrillation
  - Cardiac arrest
  - Complete heart bock
  - Pulmonary edema
- 0-1 predictors = low risk
- 2+ = high risk

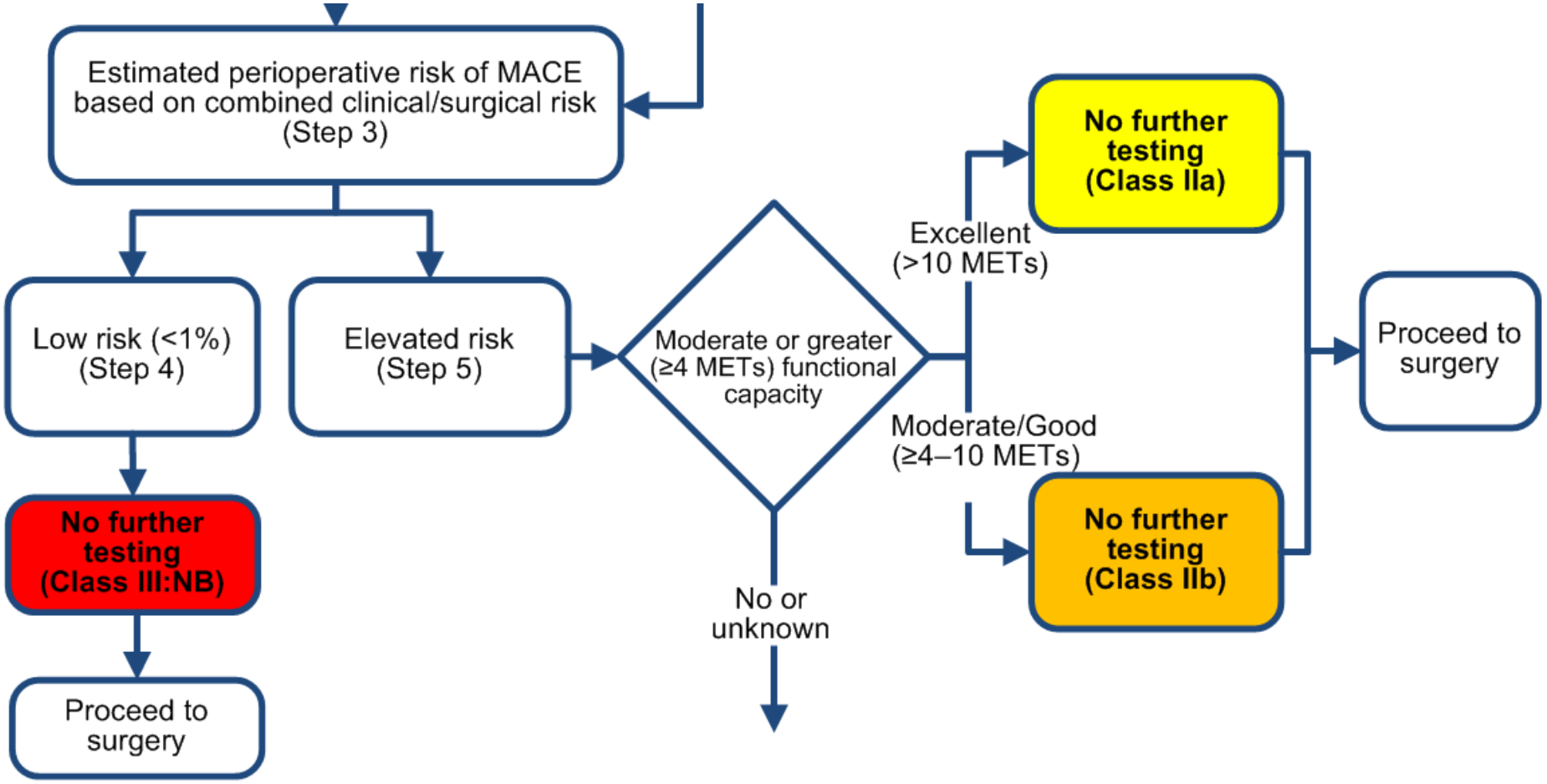
Revised Cardiac Risk Index
1. History of ischemic heart disease
2. History of congestive heart failure
3. History of cerebrovascular disease (stroke or transient ischemic attack)
4. History of diabetes requiring preoperative insulin use
5. Chronic kidney disease (creatinine > 2 mg/dL)
6. Undergoing suprainguinal vascular, intraperitoneal, or intrathoracic surgery
Risk for cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest:0 predictors = 0.4%, 1 predictor = 0.9%, 2 predictors = 6.6%, ≥3 predictors = >11%

Lee TH, et al. Circulation 1999;100:1043-9.

RCRI - Revised Cardiac Risk Index
http://www.mdcalc.com/revised-cardiac-risk-index-for-pre-operative-risk/

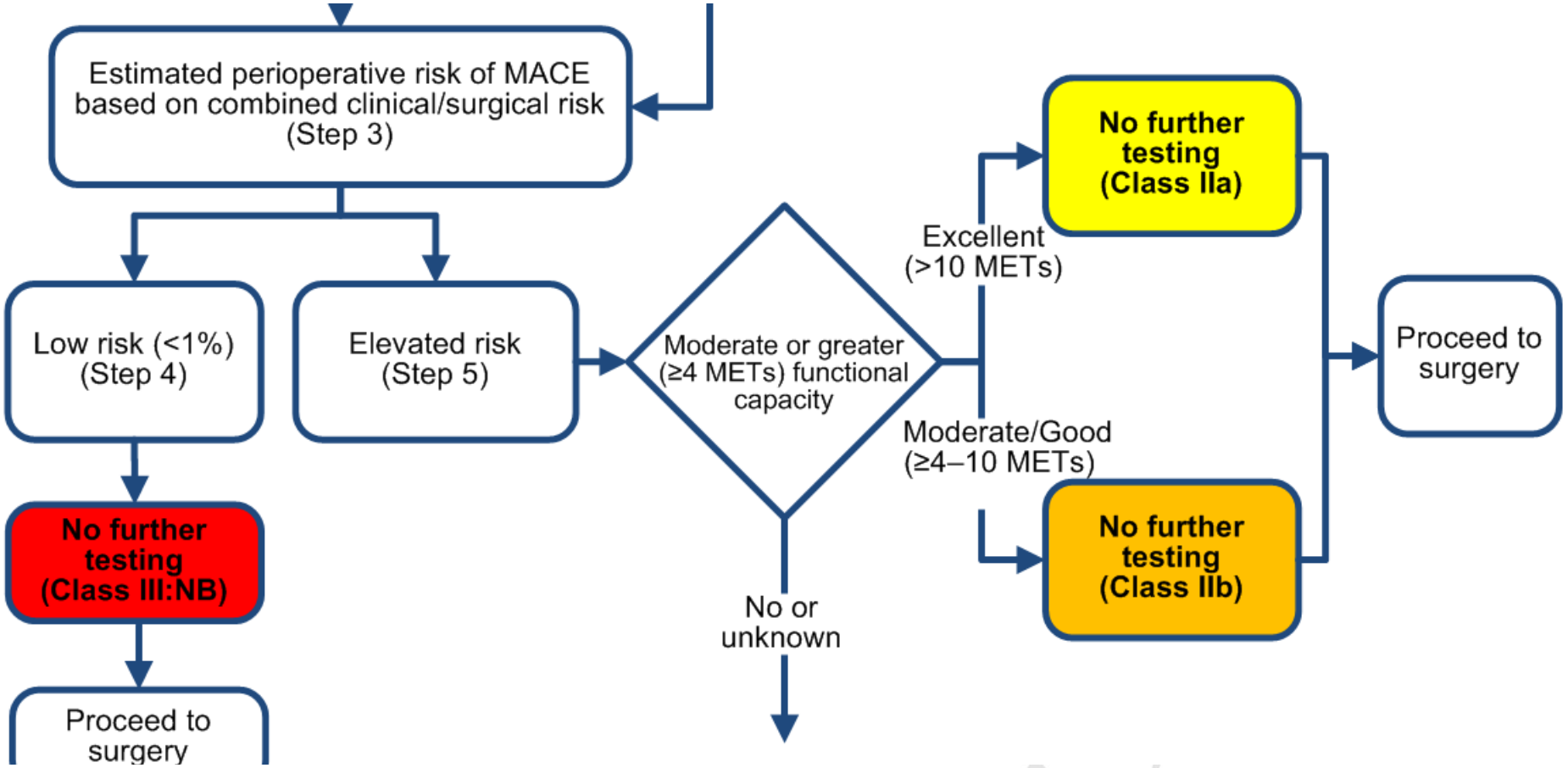


Stepwise Approach to Perioperative Cardiac Assessment Step 4:



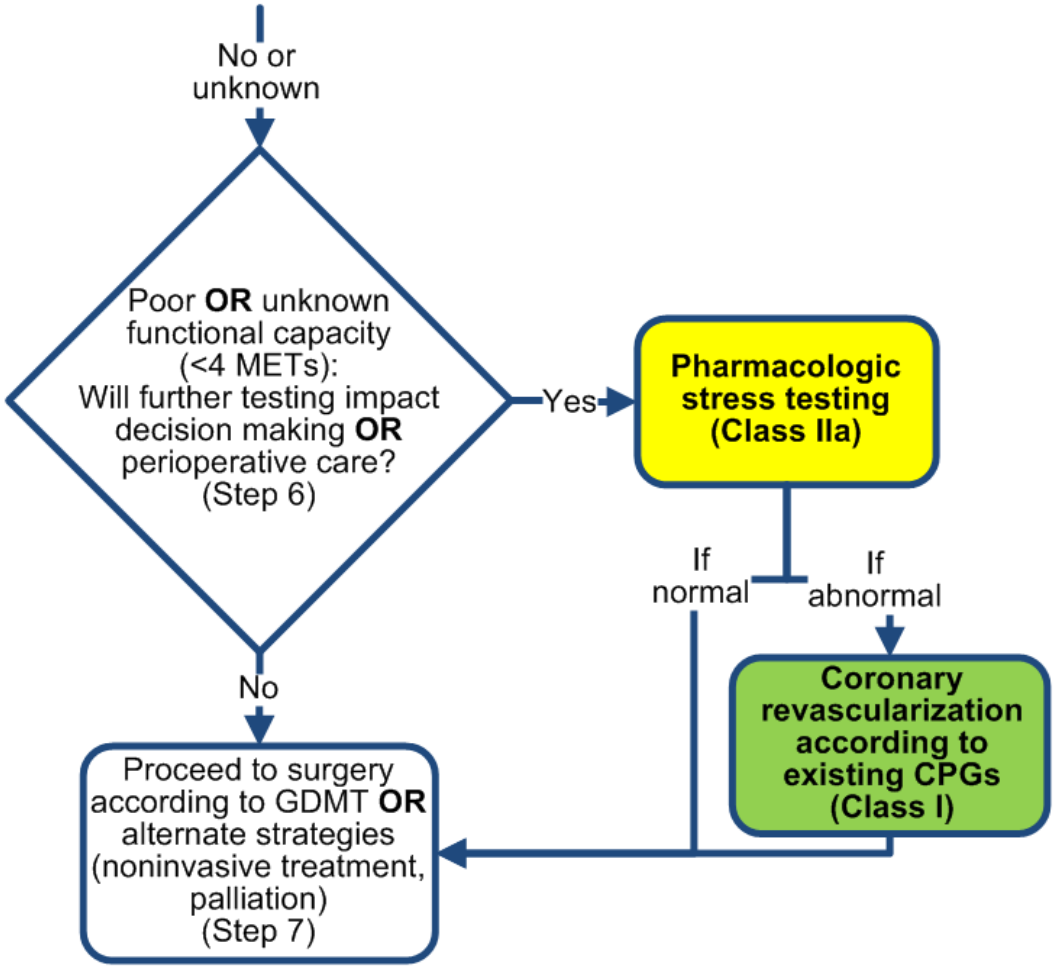
Step 4: If the patient has a low risk of MACE (<1%), then no further testing is needed, and the patient may proceed to surgery (Section 3).

Stepwise Approach to Perioperative Cardiac Assessment Step 5:



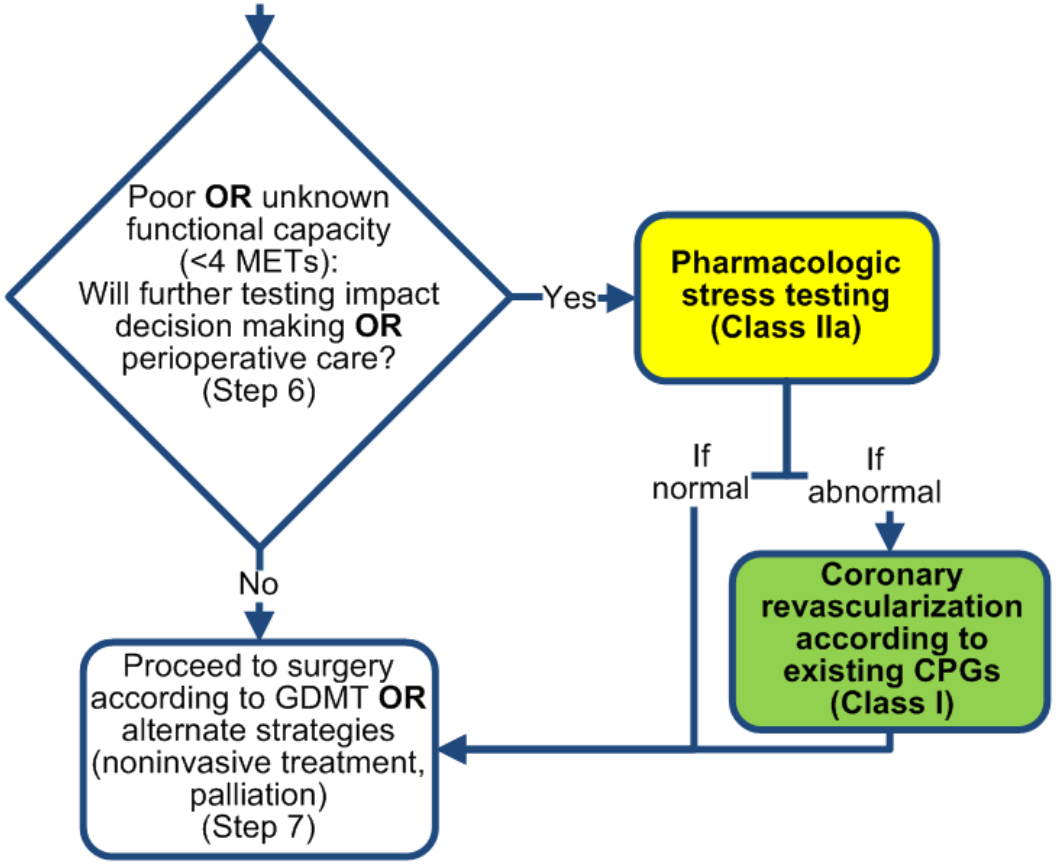
Step 5: If the patient is at elevated risk of MACE, then determine functional capacity with an objective measure or scale such as the DASI (133). If the patient has moderate, good, or excellent functional capacity (≥4 METs), then proceed to surgery without further evaluation (Section 4.1).

Step 6:



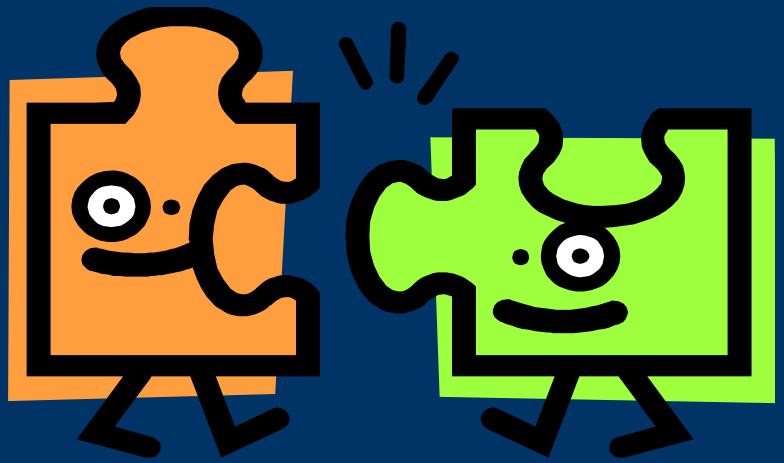
Step 6: If the patient has poor (<4 METs) or unknown functional capacity, then the clinician should consult with the patient and perioperative team to determine whether further testing will impact patient decision making (e.g., decision to perform original surgery or willingness to undergo CABG or PCI, depending on the results of the test) or perioperative care. If yes, then pharmacological stress testing is appropriate. In those patients with unknown functional capacity, exercise stress testing may be reasonable to perform. If the stress test is abnormal, consider coronary angiography and revascularization depending on the extent of the abnormal test. The patient can then proceed to surgery with GDMT or consider alternative strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation. If the test is normal, proceed to surgery according to GDMT (Section 5.3).

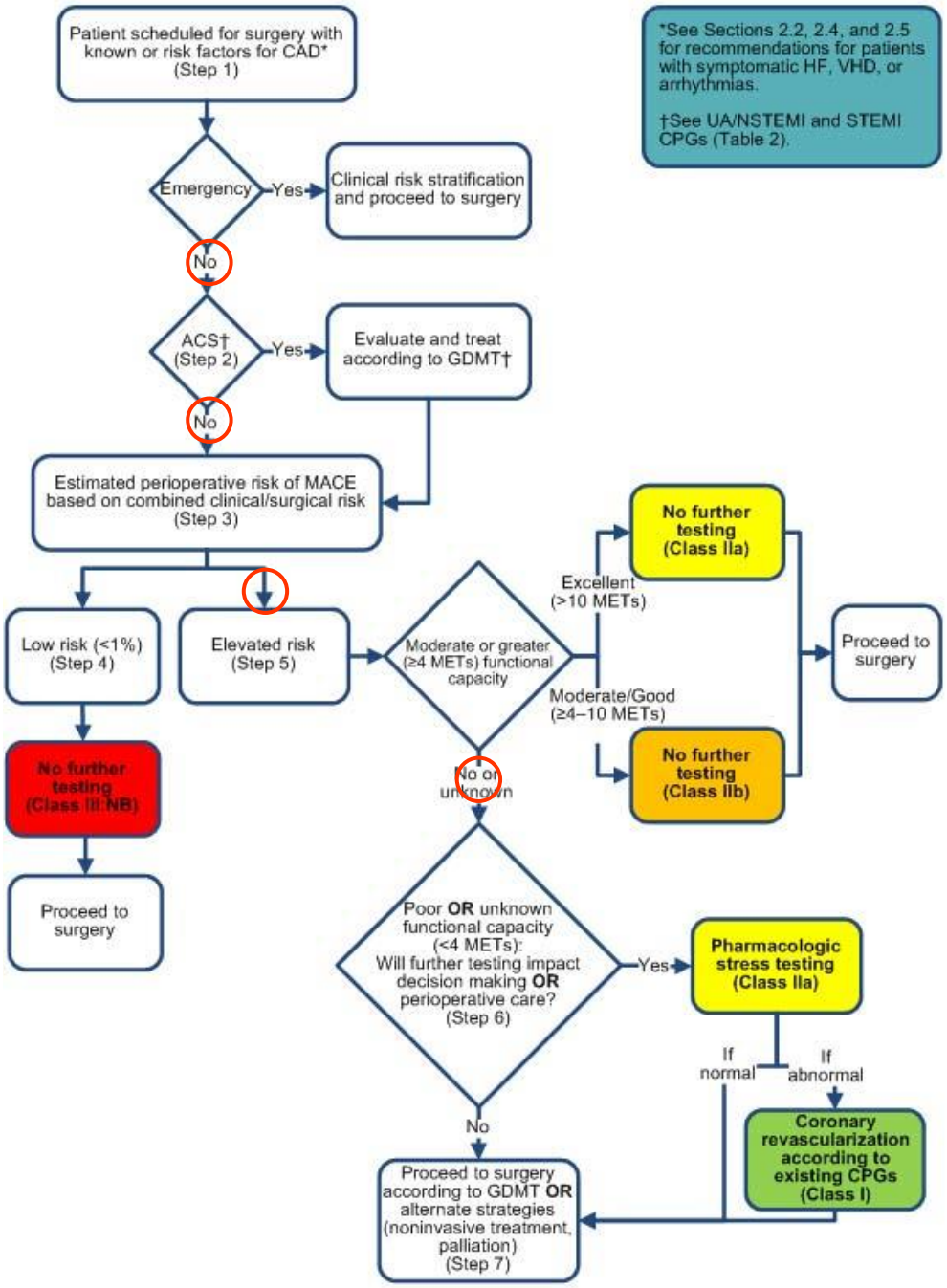
Stepwise Approach to Perioperative Cardiac Assessment
Step 7:



Step 7: If testing will not impact decision making or care, then proceed to surgery according to GDMT or consider alternative strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation.

Case review



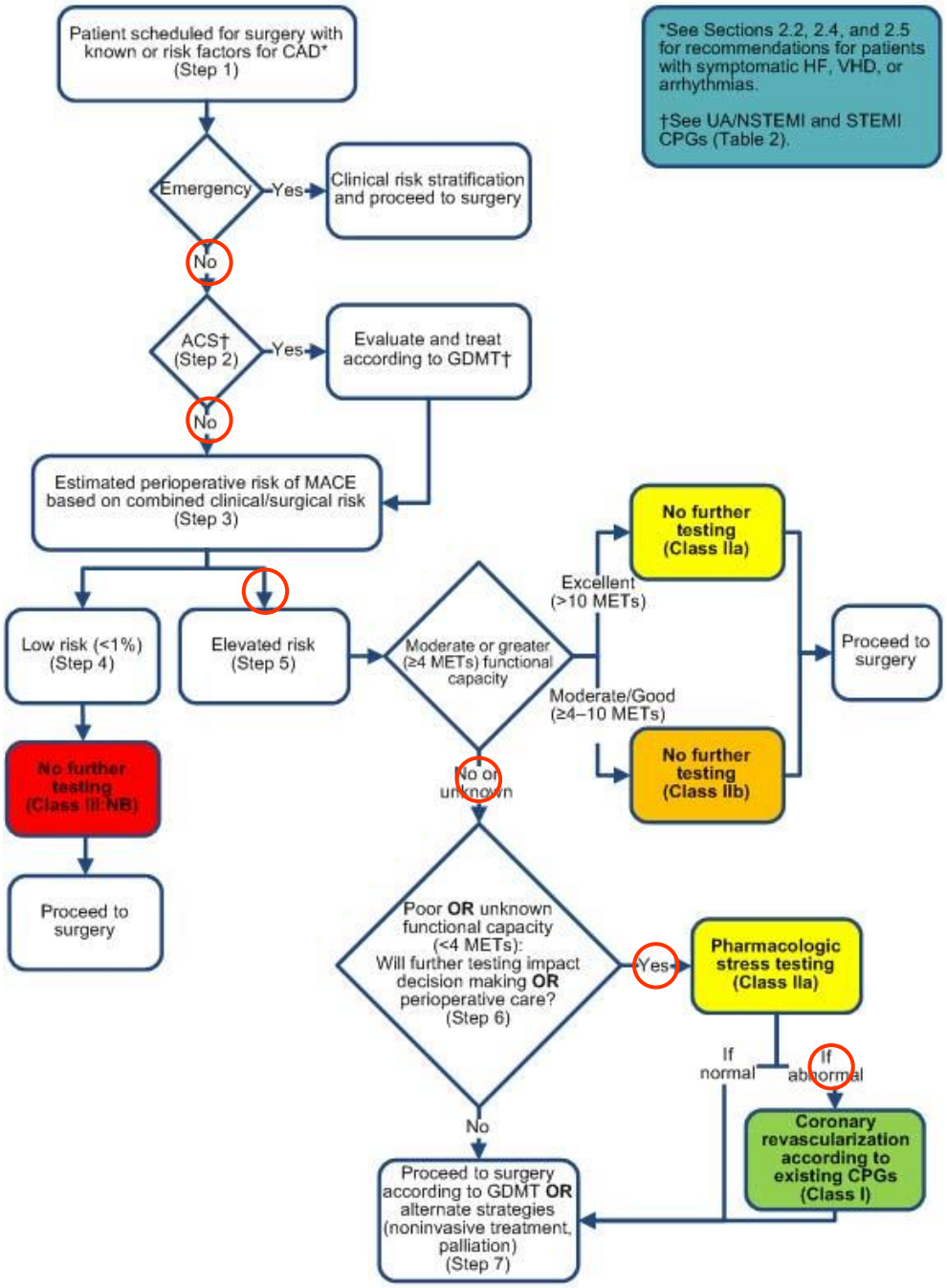


- M/59
- For radical cystectomy d/t bladder cancer
- 3VD, s/p CABG (2002.1)
- DM, CKD (Cr 2.83 md/dL)

- DOE: NYHA Fc II, Chest pain (-)
- CXR: Bilateral pleural effusion
- EKG: NSR, LAE, ST-T wave abnormality, r/o lateral ischemia
- TTE: EF 31%, ischemic insult of RCA & LAD territory, moderate MR, resting pulmonary HTN (TR Vmax 3.8 m/s, TVPG 61mmHg)

1. pul. HTN 원인이 불명합니다. pul. embolism 가능성 확인 위해 d-dimer를 먼저 확인하여 D-dimer 상승이 확인되면, 가능하면 pul. embolism CT까지 검사하여 확인해 보는 것이 좋을 것으로 보입니다.

2. TTE상 ischemic insult가 확인되는 환자로 thallium SPECT 결과까지 확인이 필요할 것으로 보입니다.



- Tl spect:
  Fixed large sized moderate to severely decreased perfusion in apex to mid anteroseptum, basal inferior, and mid-bassal inferolateral wall

- Coronary CT:
  nonvisualized T-RA to OM graft
  patent LIMA to LAD, SVG to PDA
  total occlusion of pLAD, D1, OM, dLCx
  severe stenosis of RCA

1. 3VD로 CABG 시행했던 환자로 현재 ACS 증상 없는 상태이며, graft 모두 patent한 상태로 수술 진행이 가능할 것으로 보입니다.

2. 다만 EchoCG에서 pul. HTN 및 mild LV dysfunction을 보이고 있어 수술 진행후에 volume overload에 주의를 기울여 주시고 2~3일간은 daily ECG & cardiac enz. & CXR f/u 부탁드립니다.

3. HF에 대하여 aldactone 12.5mg qd, digoxin 0.125mg qd를 추가하실 것을 추천드립니다.

Questions

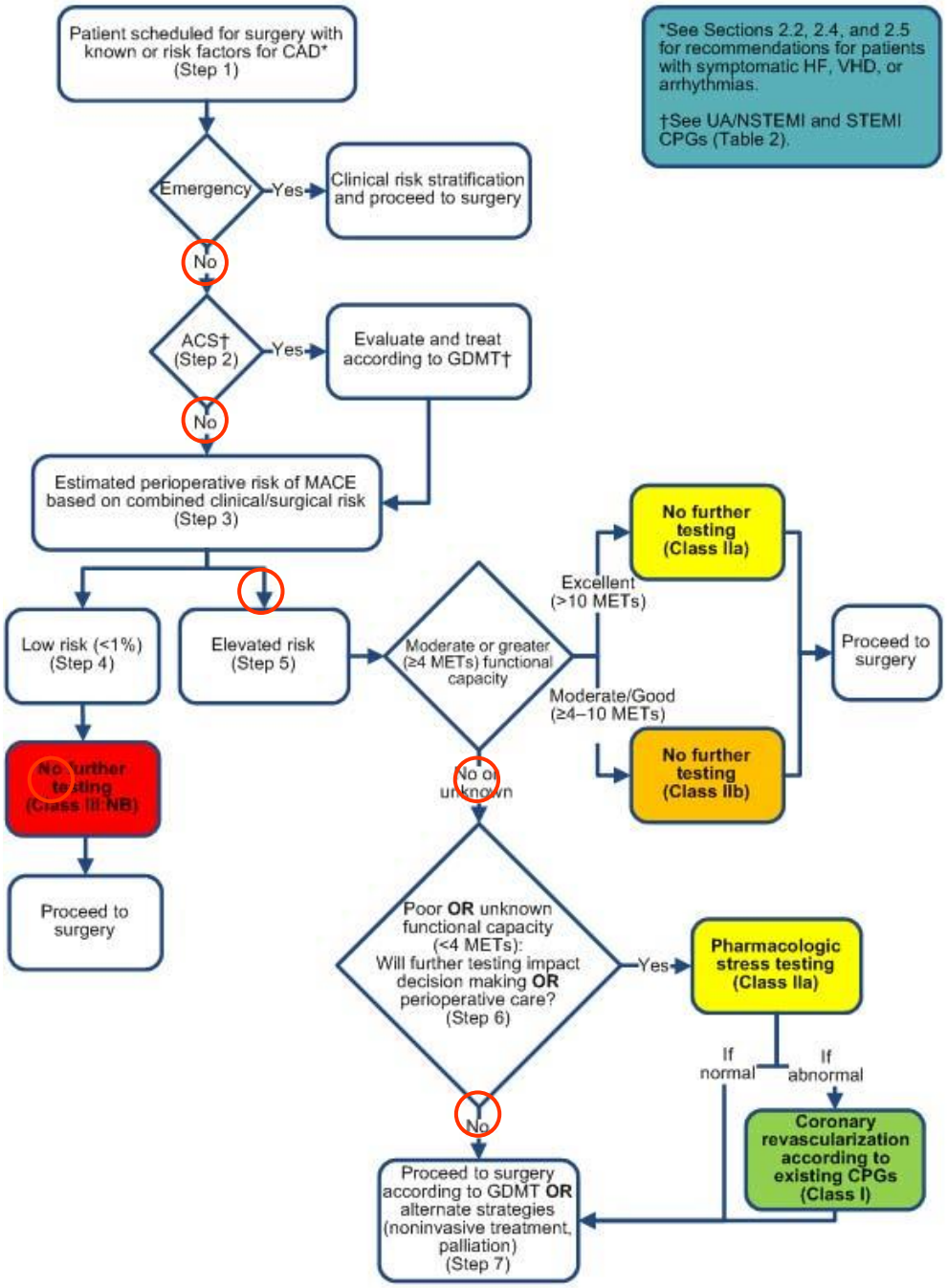
Q1. Is it OK for op now?

Q2. What is the risk of MACE?

Q3. Further w/u?

Q4. Periop management

Q5. Periop monitoring


Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
*See Sections 2.2, 2.4, and 2.5 for recommendations for patients with symptomatic HF, VHD, or arrhythmias.
†See UA/NSTEMI and STEMI CPGs (Table 2).
Emergency
Yes
Clinical risk stratification and proceed to surgery
No
ACS† (Step 2)
Yes
Evaluate and treat according to GDMT†
No
Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
Low risk (<1%) (Step 4)
Elevated risk (Step 5)
Moderate or greater (≥4 METs) functional capacity
Excellent (>10 METs)
No further testing (Class IIa)
Moderate/Good (≥4–10 METs)
No further testing (Class IIb)
Proceed to surgery
No further testing (Class III: NB)
Proceed to surgery
No or unknown
Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
Yes
Pharmacologic stress testing (Class IIa)
If normal
If abnormal
Coronary revascularization according to existing CPGs (Class I)
No
Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

Questions

Q1. Is it OK for op now? Mostly,,,

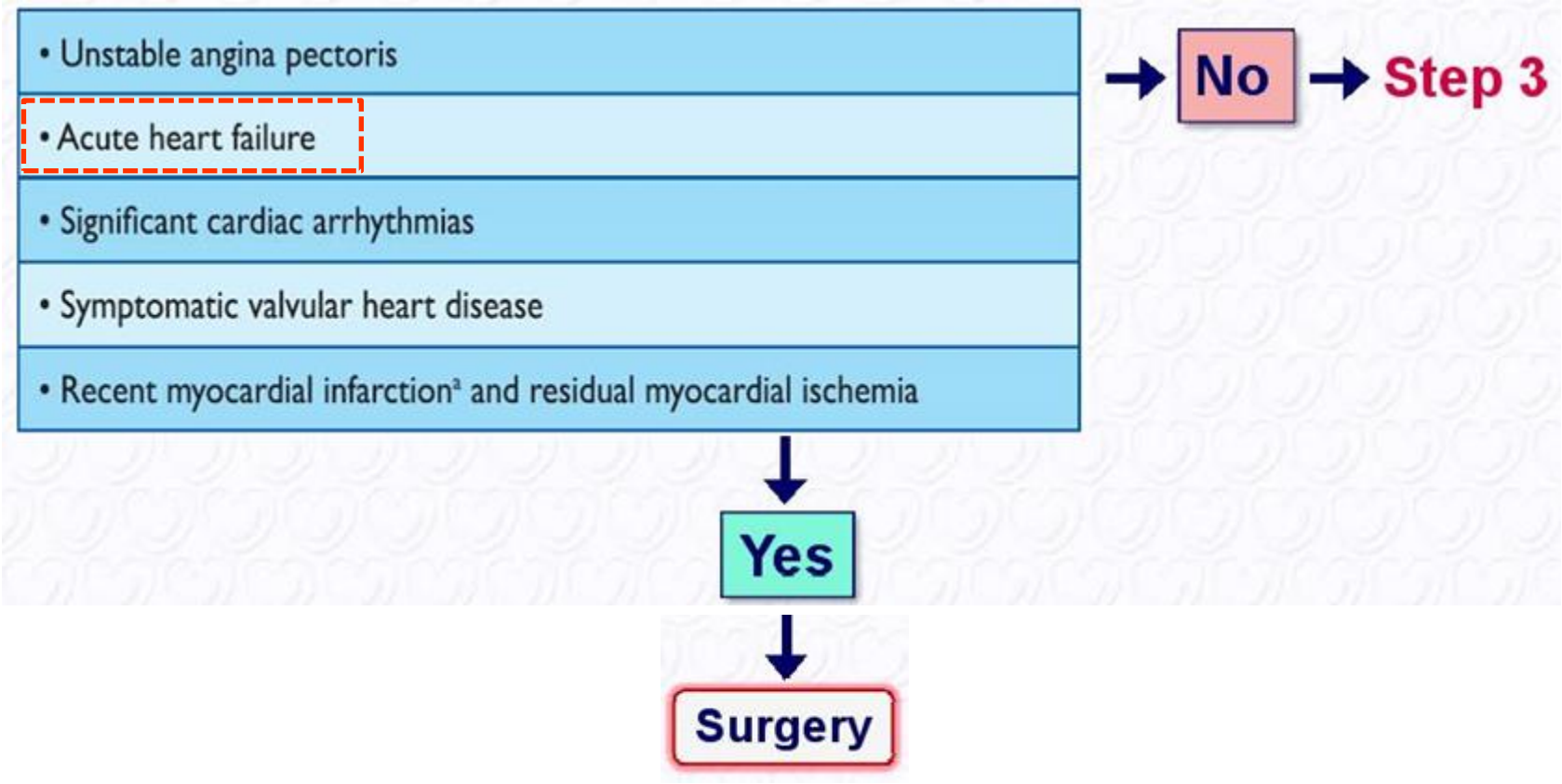
Q2. What is the risk of MACE?

Q3. Further w/u?

Q4. Periop management

Q5. Periop monitoring

Active or unstable cardiac condition(s)



- Postpone the procedure
- Treatment options should be discussed in a multidisciplinary team involving all peri-operative care physicians

Kristensen SD , et al. Eur Heart J 2014;35:2383-2431.

Questions

Q1. Is it OK for op now?

Q2. What is the risk of MACE?

Q3. Further w/u?

Q4. Periop management

Q5. Periop monitoring

Goldman Cardiac Risk factors

- Third heart sound (S3) 11
- Elevated jugulovenous pressure 11
- Myocardial infarction in past 6 months 10
- ECG: premature arterial contractions or any rhythm other than sinus 7
- ECG shows >5 premature ventricular contractions per minute 7
- Age >70 years 5
- Emergency procedure 4
- Intra-thoracic, intra-abdominal or aortic surgery 3
- Poor general status, metabolic or bedridden 3

score	death	Severe cardiovascular complications
> 25	56%	22%
< 26	4%	17%
< 6	0.2%	0.7%

Goldman L, et al. N Engl J Med 1977;297:845-50.

RCRI - Revised Cardiac Risk Index

- 6 predictors of complications
- Major cardiac complications included:
  - Myocardial infarction
  - Ventricular fibrillation
  - Cardiac arrest
  - Complete heart bock
  - Pulmonary edema
- 0-1 predictors = low risk
- 2+ = high risk

Revised Cardiac Risk Index
1. History of ischemic heart disease
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6. Undergoing suprainguinal vascular, intraperitoneal, or intrathoracic surgery
Risk for cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest:0 predictors = 0.4%, 1 predictor = 0.9%, 2 predictors = 6.6%, ≥3 predictors = >11%

Lee TH, et al. Circulation 1999;100:1043-9.

Questions

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Q2. What is the risk of MACE?

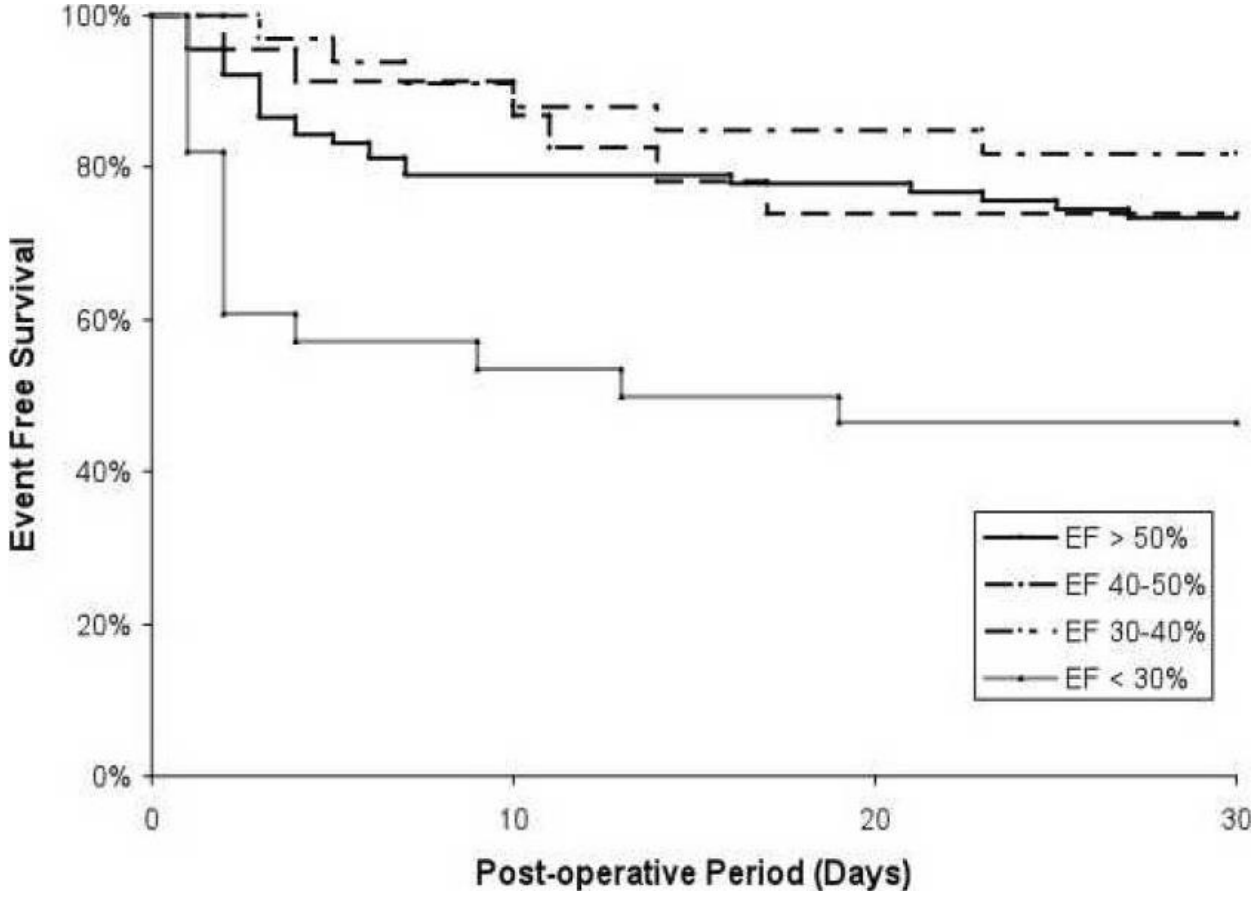
Q3. Further w/u?

Q4. Periop management

Q5. Periop monitoring

Risk of HF Based on LVEF

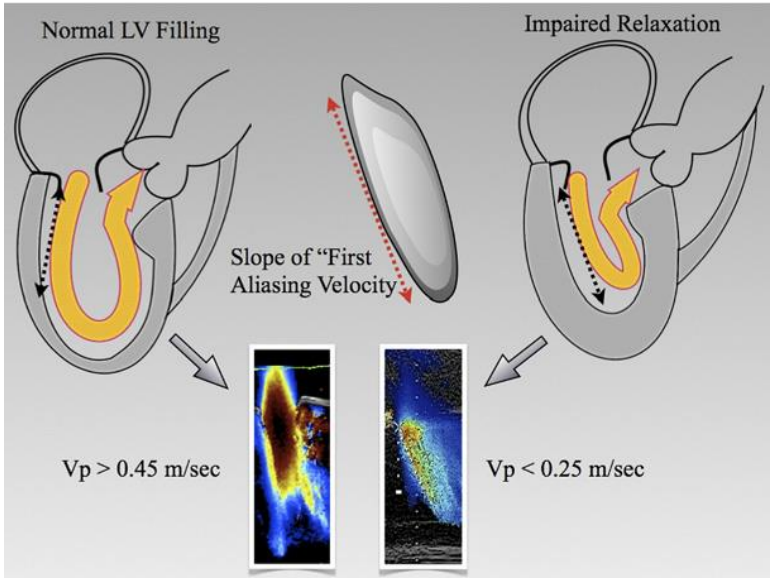
- Severely decreased (<30%) LVEF is an independent contributor to perioperative outcome and a long-term risk factor for death in HF patients.

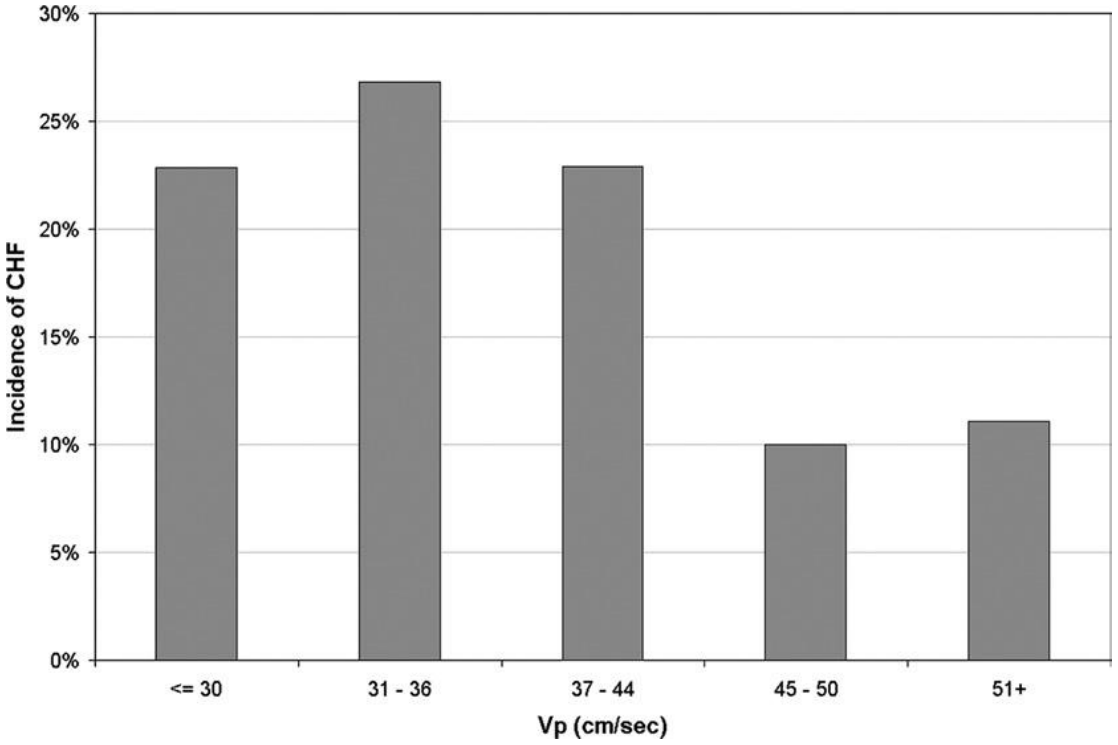


Healy KO, et al. Congest Heart Fail 2010;16:45-9.

Risk of HF Based on Diastolic Function

- The presence of perioperative diastolic dysfunction as assessed with Vp is an independent predictor of postoperative CHF after major vascular surgery.

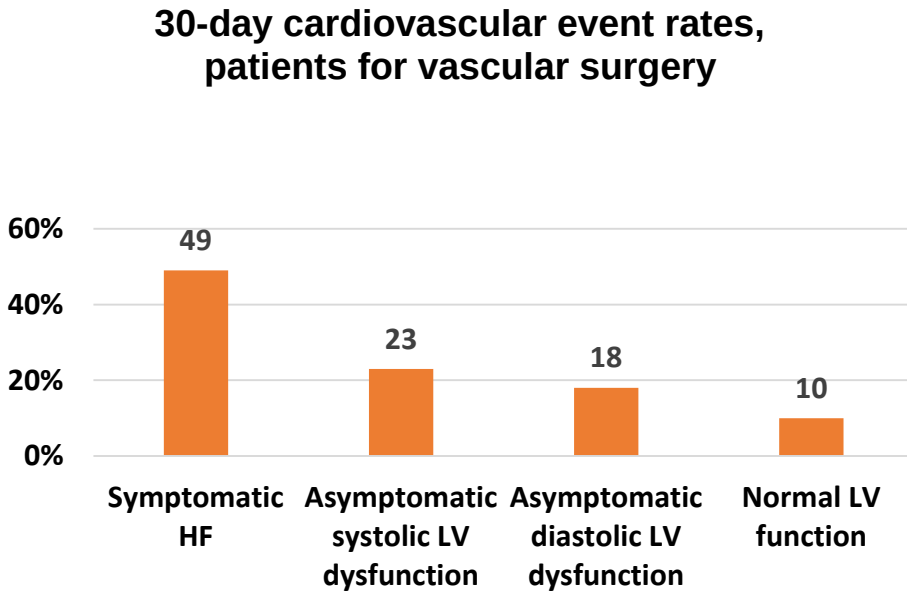


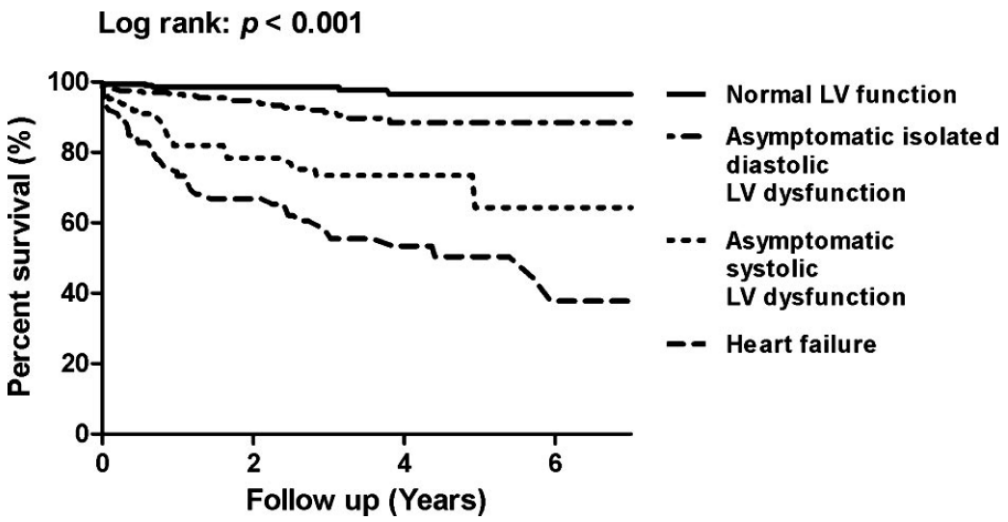


Matyal R, et al. J Vasc Surg 2009;50:70-6.

Asymptomatic LV dysfxn on perioperative outcomes

- Prospective cohort study on the role of preoperative echocardiography in 1005 consecutive patients undergoing elective vascular surgery





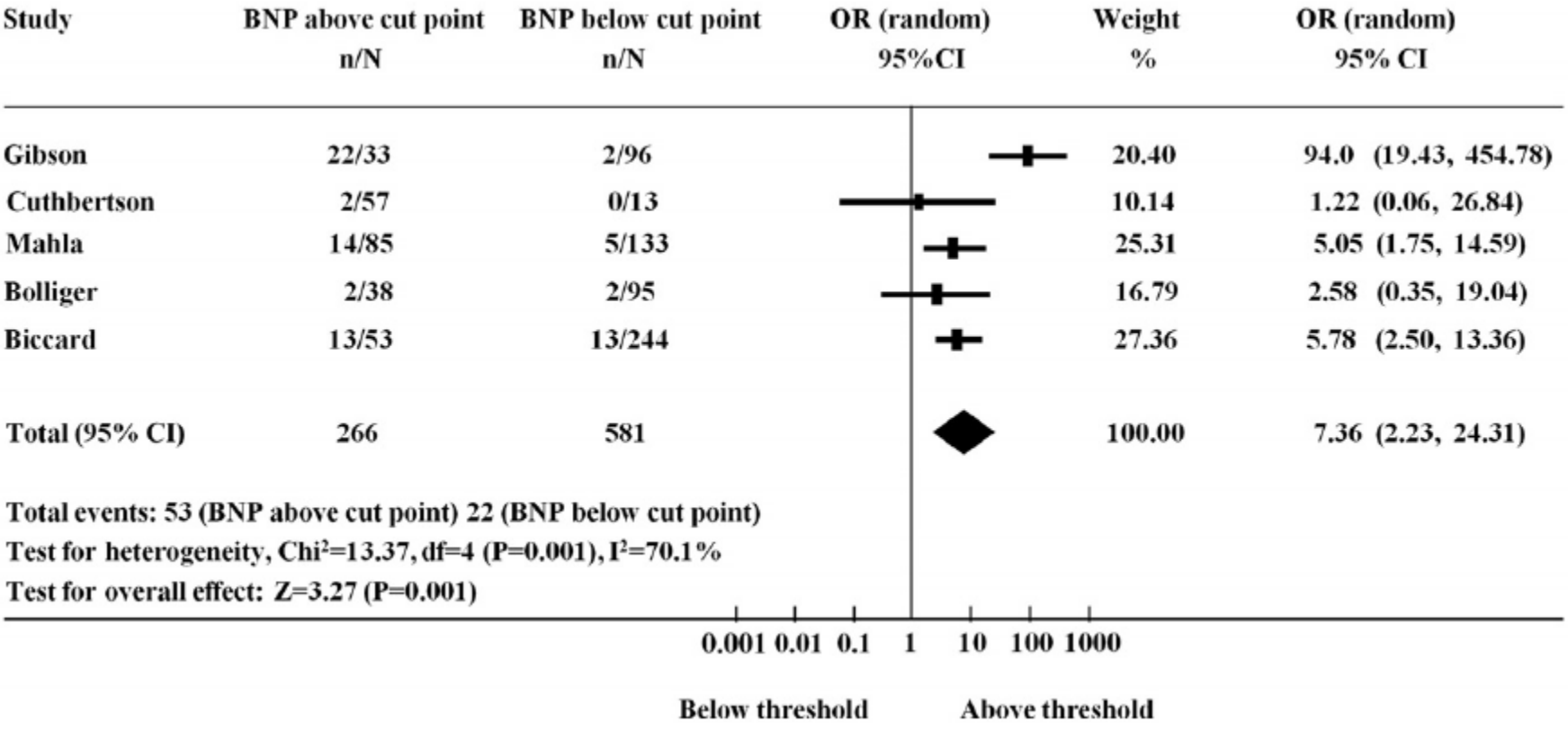
Flu WJ, et al. Anesthesiology 2010;112:1316-24.

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

Role of natriuretic peptides in perioperative risk of HF

- Unadjusted ORs for a preoperative BNP or NT-proBNP concentration above the optimal general cut point (BNP 116 pg/ml, NT-proBNP 277.5 pg/ml) in predicting cardiovascular outcomes 30 days after surgery



Rodseth RN, et al. J Am Coll Cardiol 2011;58:522-9.

Role of natriuretic peptides in perioperative risk of HF

- Preoperative natriuretic peptide levels significantly improve the predictive performance of the Revised Cardiac Risk Index (RCRI).

RCRI Risk Category	MACE	No MACE	Total
Low risk	19 (5.9%)	301 (94.1%)	320
Intermediate risk	45 (9.5%)	431 (90.5%)	476
High risk	11 (20.4%)	43 (79.6%)	54

NP-Reclassified Risk Category	MACE	No MACE	Total
Low risk	22 (3.7%)	574 (96.3%)	596
Intermediate risk	14 (15.1%)	79 (84.9%)	93
High risk	39 (24%)	122 (76%)	161

Rodseth RN, et al. J Am Coll Cardiol 2011;58:522-9.

Questions

Q1. Is it OK for op now?

Q2. What is the risk of MACE?

Q3. Further w/u?

Q4. Periop management

Q5. Periop monitoring

Preoperative stability of HF is important

- In a retrospective single-center cohort study of patients with stable HF who underwent elective noncardiac surgery between 2003 and 2006, perioperative mortality rates for patients with stable HF were not higher than for the control group without HF (p=0.09).

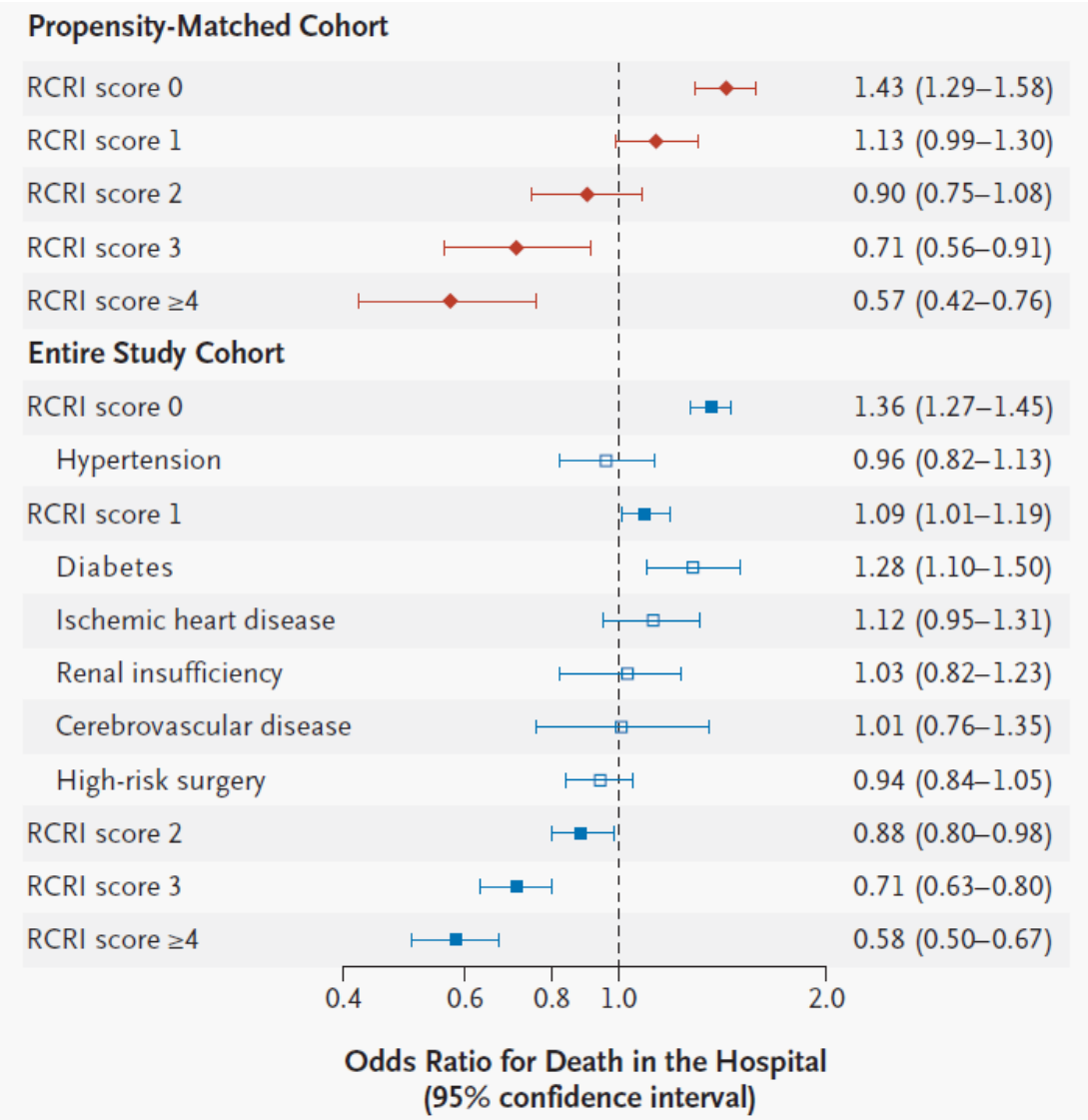
Xu-Cai YO, et al. Mayo Clin Proc 2008;83:280-8.

Perioperative Beta-Blocker Therapy

2014 ACC/AHA guideline

Recommendations	COR	LOE
Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically.	I	B^{SR}
It is reasonable for the management of beta blockers after surgery to be guided by clinical circumstances, independent of when the agent was started.	IIa	B^{SR}
In patients with intermediate- or high-risk myocardial ischemia noted in preoperative risk stratification tests, it may be reasonable to begin perioperative beta blockers.	IIb	C^{SR}
In patients with 3 or more RCRI risk factors (e.g., diabetes mellitus, HF, CAD, renal insufficiency, cerebrovascular accident), it may be reasonable to begin beta blockers before surgery.	IIb	B^{SR}

Perioperative Beta-Blocker Therapy



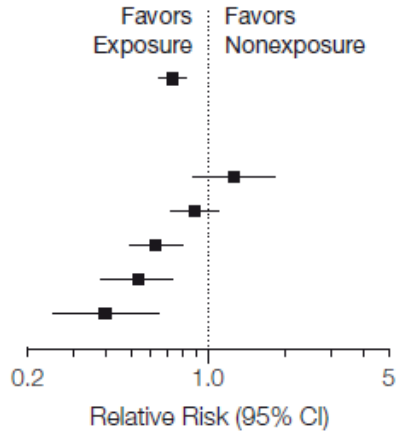
Lindenauer PK, et al. NEJM 2005;353:349-61.

Perioperative Beta-Blocker Therapy

Figure 1. Thirty-Day Mortality Propensity Model

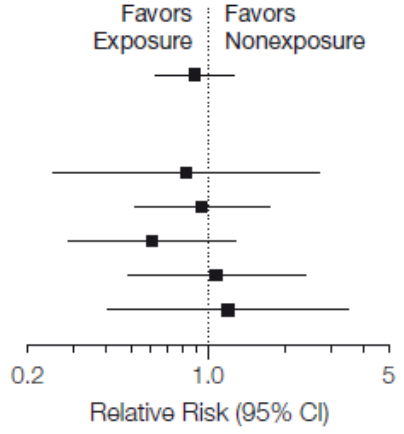
A All surgery

	No. of Patients		No. of Deaths	
	Exposed	Not Exposed	Exposed	Not Exposed
All Patients	37 805	37 805	426	583
No. of Revised Cardiac Risk Index predictors				
0	12 250	12 250	67	53
1	16 057	16 057	166	186
2	6795	6795	111	176
3	2090	2090	59	110
>4	613	613	23	58



B Vascular surgery

	No. of Patients		No. of Deaths	
	Exposed	Not Exposed	Exposed	Not Exposed
All Patients	3999	3999	55	62
No. of Revised Cardiac Risk Index predictors				
0	857	857	5	6
1	1593	1593	20	21
2	1033	1033	11	18
3	403	403	13	12
>4	113	113	6	5



London MJ, et al. JAMA 2013;309:1704-13.

Perioperative RAS blocker Therapy

2014 ACC/AHA guideline

Recommendations	COR	LOE
Continuation of ACE inhibitors or angiotensin-receptor ARBs perioperatively is reasonable.	IIa	B
If ACE inhibitors or ARBs are held before surgery, it is reasonable to restart as soon as clinically feasible postoperatively.	IIa	C

2014 ESC guideline

Recommendations	COR	LOE
In patients with heart failure and systolic dysfunction, ACEI should be considered before surgery	IIa	C

Hemodynamic Assist Devices

Recommendation	COR	LOE
Use of hemodynamic assist devices may be considered when urgent or emergency noncardiac surgery is required in the setting of acute severe cardiac dysfunction (i.e., acute MI, cardiogenic shock) that cannot be corrected before surgery.	IIb	C

Questions

Q1. Is it OK for op now?

Q2. What is the risk of MACE?

Q3. Further w/u?

Q4. Periop management

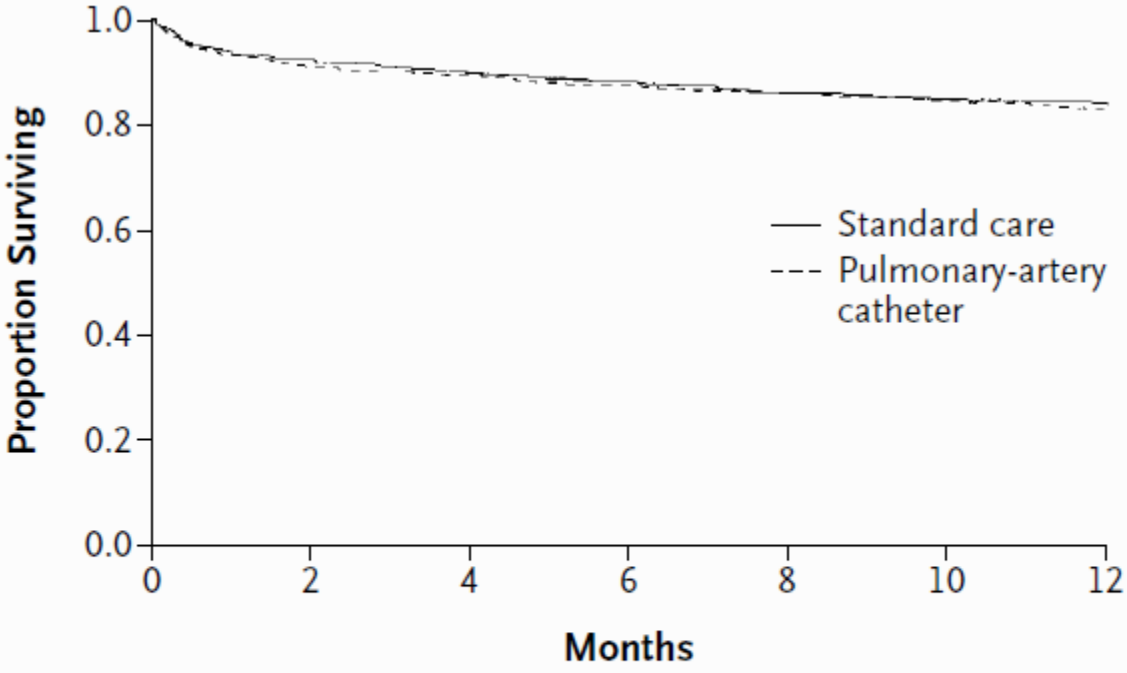
Q5. Periop monitoring

Perioperative Use of Pulmonary Artery Catheters

Recommendations	COR	LOE
The use of pulmonary artery catheterization may be considered when underlying medical conditions that significantly affect hemodynamics (i.e., HF, severe valvular disease, combined shock states) cannot be corrected before surgery.	IIb	C
Routine use of pulmonary artery catheterization in patients, even those with elevated risk, is not recommended.	III: No Benefit	A

Perioperative Use of Pulmonary Artery Catheters

- RCT with 1994 patients who underwent surgery



No. at Risk							
Standard care	997	885	861	844	803	794	786
Pulmonary-artery catheter	997	842	826	808	773	761	747

Sandham JD, et al. NEJM 2003;348:5-14.

Summary

- Most of patients with compensated HF can undergo surgery. However, they have an elevated risk of cardiac events.
- Especially, if they have history of IHD, stroke, DM, or CKD, or undergo major surgery, perioperative risk for MACE will increase up to more than 6%.
- Preoperative compensation may reduce the risk.
- The estimation of BNP and HF medication may be helpful to stratify the risk and reduce cardiac events, but there is a paucity of data.
- Perioperative monitoring is not sufficiently established.


Thank You for Your Attention!!!

Case

- M/59
- For radical cystectomy d/t bladder cancer
- 3VD, s/p CABG (2002.1.)
- DM, CKD (Cr 2.83 mg/dL)

- DOE: NYHA Fc II, Chest pain (-)
- CXR: Bilateral pleural effusion
- EKG: NSR, LAE, ST-T wave abnormality, r/o lateral ischemia
- TTE: EF 31%, ischemic insult of RCA & LAD territory, moderate MR, resting pulmonary HTN (TR Vmax 3.8 m/s, TVPG 61mmHg)

Case

- M/59
- For radical cystectomy d/t bladder cancer
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- DM, CKD (Cr 2.83 mg/dL)

- DOE: NYHA Fc II, Chest pain (-)
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Q1. Is it OK for op now?

Q2. What is the risk of MACE?

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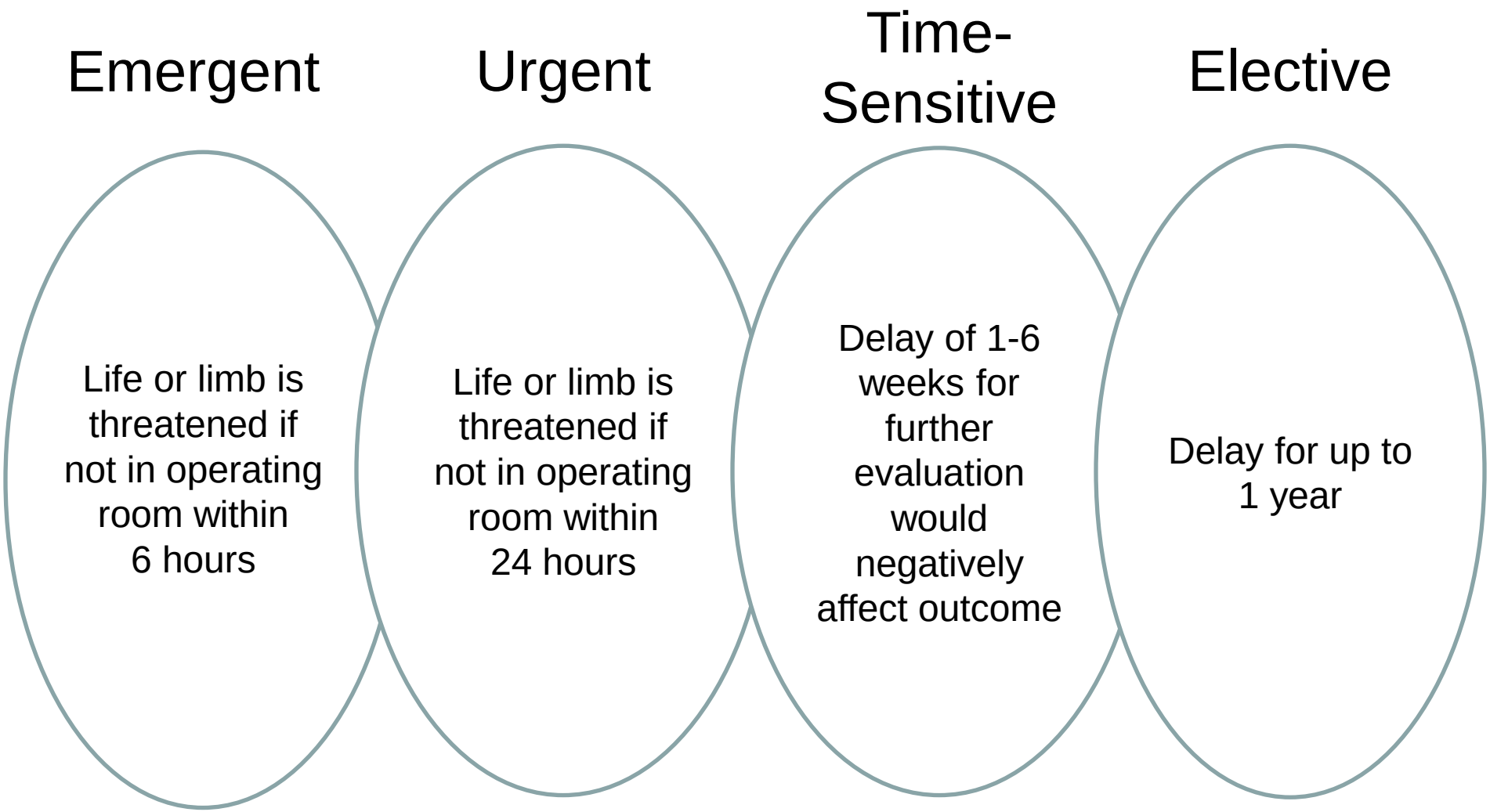
Q4. Periop management

Q5. Periop monitoring

Two leading hypotheses for sex differences in mortality

- Systolic function
- Etiology

Definition of Timing of Surgery



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2011 NSQIP MICA (Myocardial Infarction and Cardiac Arrest) risk evaluation (Gupta perioperative cardiac risk, http://www.surgicalriskcalculator.com/miorcardiacarrest)