Perioperative Assessment

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Goals

- Understand how to estimate peri-operative CV risk
- Know when to perform stress testing preoperatively
- Learn how to reduce risk perioperatively in those at higher risk

Key Points

1. Extensive testing is rarely needed to determine risk
2. Evaluation/Testing not needed if:
    a. Low risk surgery
    b. Good functional capacity and no cardiac symptoms
    c. No clinical risk factors

Key Points

4. Revascularization (surgery or PCI) should be considered only if standard indications are present

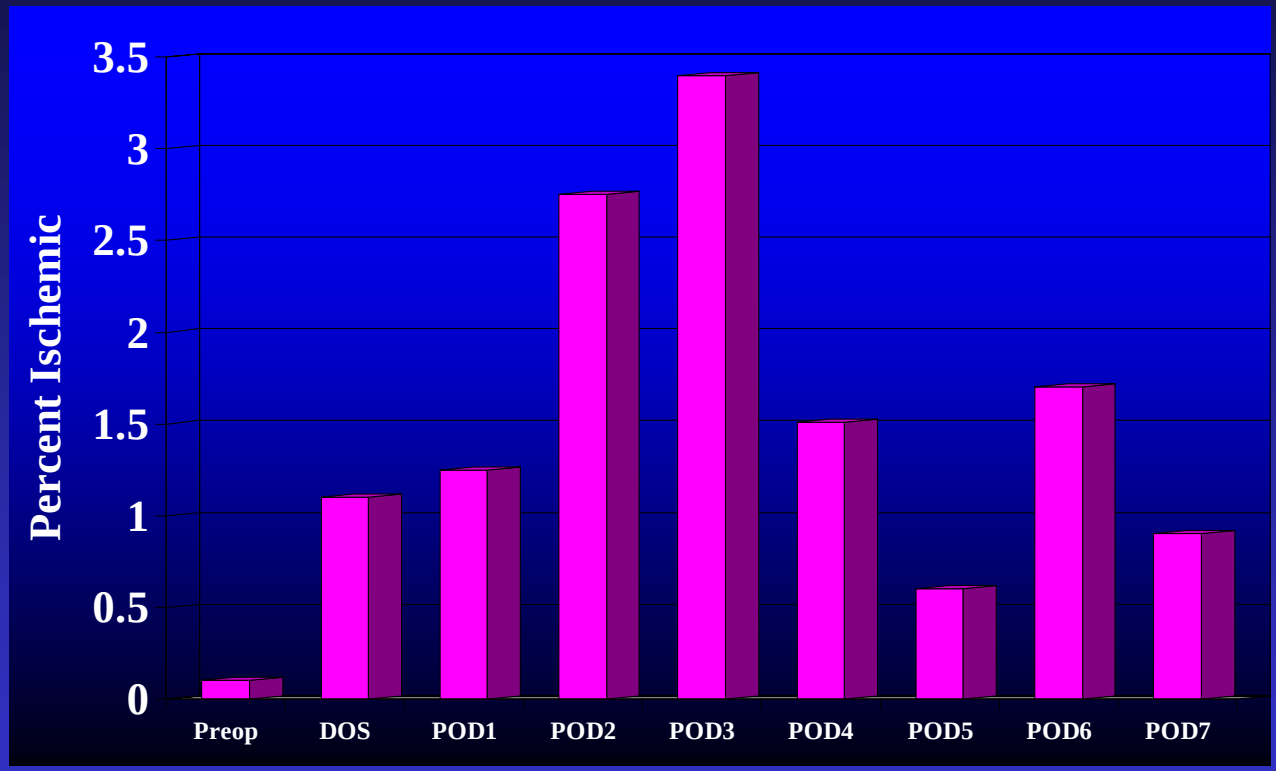
5. If PCI to be done, delay before non-cardiac surgery should be as follows:

   POBA: 14 days
   BMS: 30-45 days
   DES: > 365 days

Key Points

6. Cardiac complications (both ischemia and infarction) are often manifested by:
    a. Confusion, other MS changes
    b. Hypotension
    c. Dyspnea, heart failure
7. Cardiac complications tend to occur postoperatively and not intraoperatively, with a peak incidence on POD # 2-3

Key Points



ST Depression

Ref: Mangano, et al, JACC, 1991

Key Points

8. Outcomes in high risk patients optimized with:
    a. Beta blockers
    b. Aggressive pain control
    c. Avoidance of severe anemia
    d. Normothermia
    d. Vigilant monitoring

Perioperative Risk

- Patient
  - Underlying disease
  - Physiologic Reserve
- Procedure
  - Risk Classification
- Anesthetic Risk
- Environment

Patient-associated Factors

- Underlying (comorbid) conditions
  - More comorbidity = greater risk
  - Ischemic heart disease
  - CHF
  - Diabetes
  - Renal Insufficiency
  - Low serum albumin

Patient-associated Factors (cont.)

- Undiagnosed hypethyroidism
- Hepatitis
  - Acute, 10% mortality
- Cirrhosis
- Obesity

Diabetes

- “Heroic” efforts to control BS
- Decreased postop M&M significantly in cardiac surgery
- Must be aware of hypoglycemia
- Poor wound healing
- Postop infections
- Diabetic comorbidities

Cerebral Vascular Disease

- Stroke Risk
- Hypertensive vascular disease
- Associated comorbidities

Obesity

- BMI (wt/ht)(m^2)
  - BMI < 25 normal
  - BMI 25-30 overweight
  - BMI 31-40 obese
  - BMI > 40 morbidly obese

Obesity

- Decreased pulmonary reserve
  - Decreased FRC
- Wound infections
- Anesthesia difficulties:
  - Intubation
  - Venous access
  - Aspiration
- Thrombophlebitis
- Association with DM, CV disease and HTN

Patient Factors

- Renal function:
  - Approximately 1% decline in functional nephrons per year after age 40
- Pulmonary function:
  - refer to text

Overview

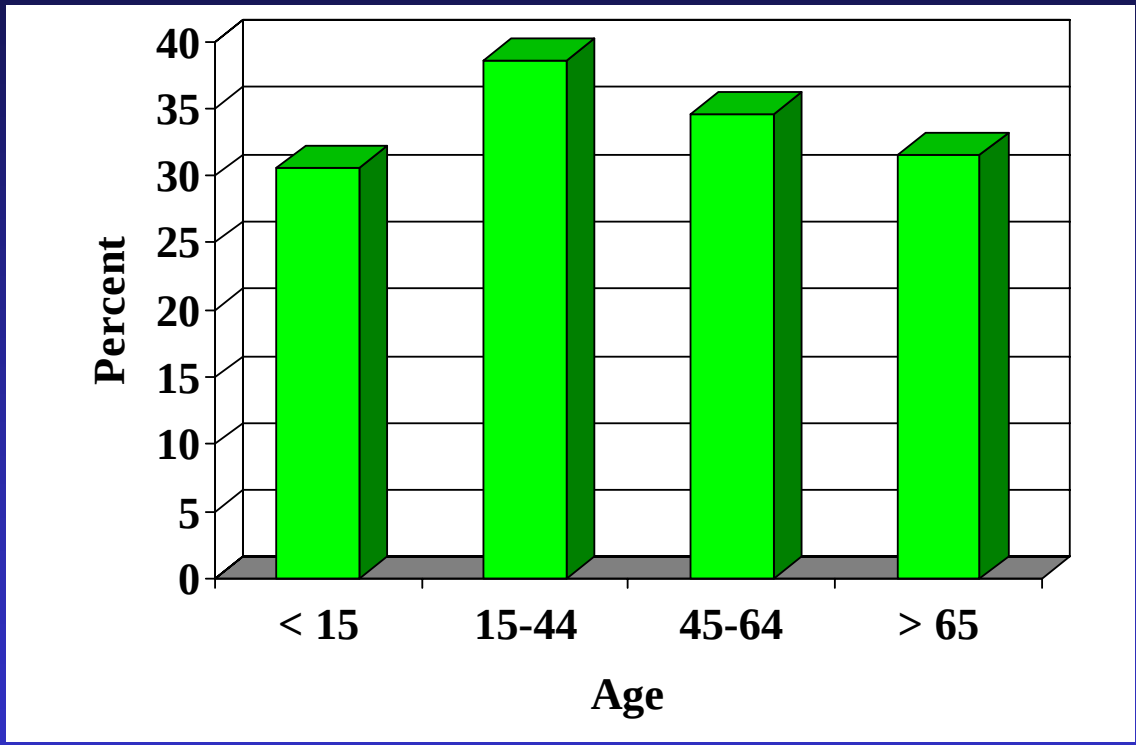
- Epidemiology
- Risk Assessment
- Preoperative Testing
- Postoperative Management to Reduce Risk
- Frequently asked questions
- Case studies

Epidemiology

- 43.9 million inpatient procedures annually
- CV complications are the leading cause of morbidity and mortality following surgery
  - Rates among all comers: 2%
  - >3 risk factors: 11%
- 20 Billion dollar annual cost

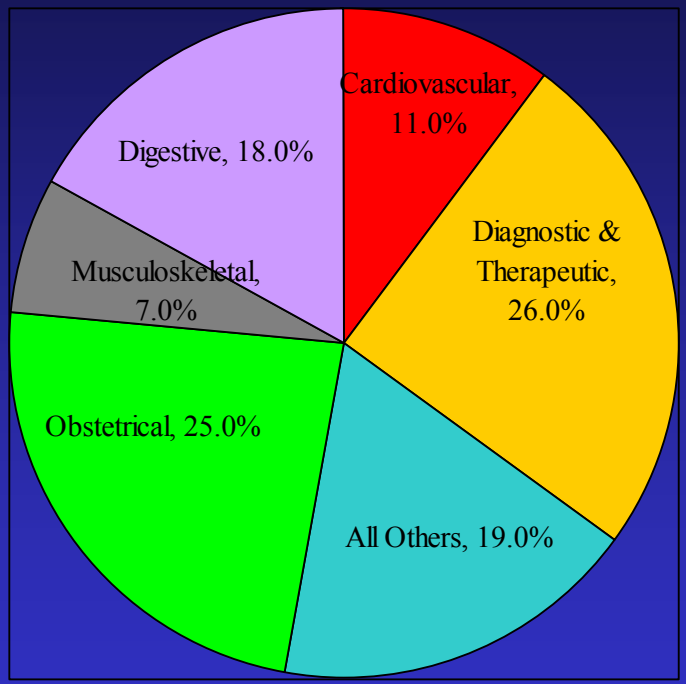
Source: CDC 2003 National Hospital Discharge Survey - Published July 8, 2005

Epidemiology

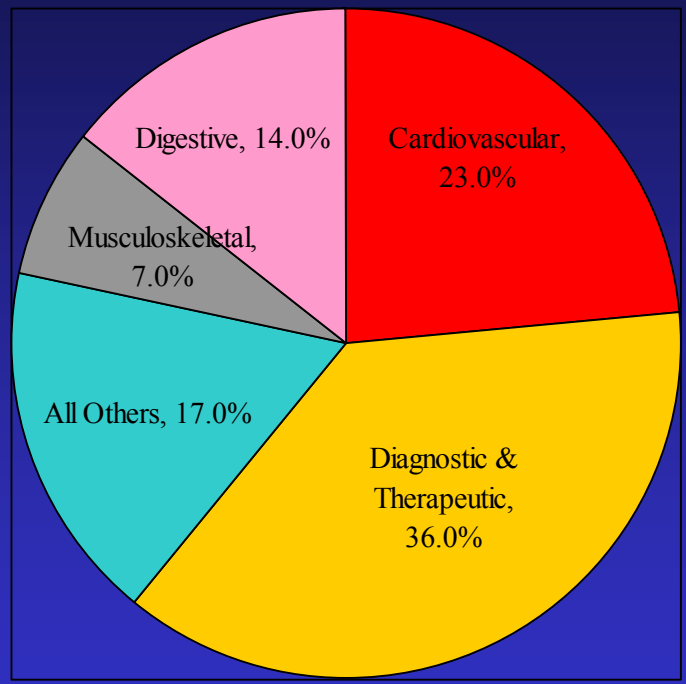


Source: CDC 2003 National Hospital Discharge Survey - Published July 8, 2005

Distribution of Procedure by Gender

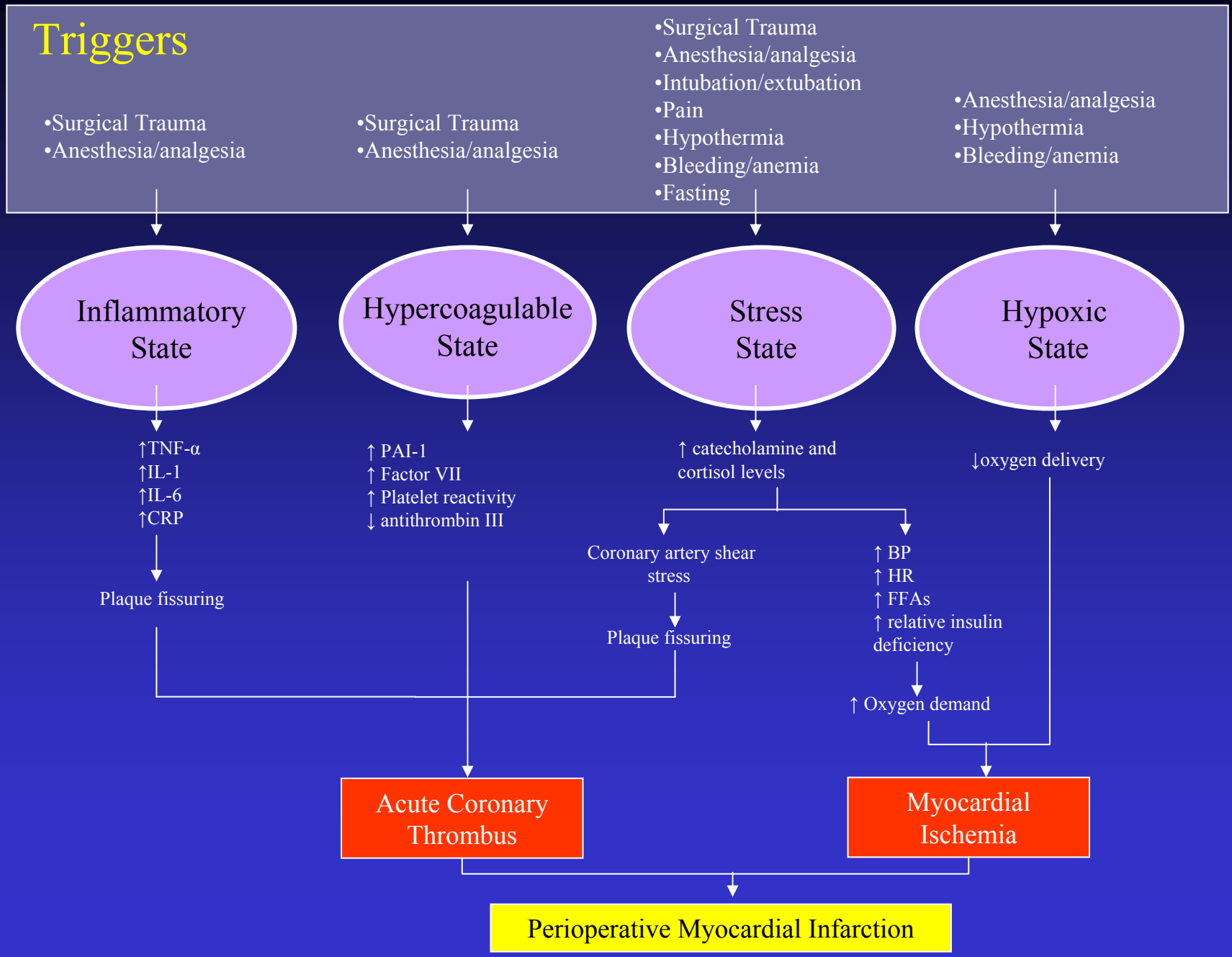


Women



Men

Source: CDC 2003 National Hospital Discharge Survey - Published July 8, 2005


Triggers
•Surgical Trauma
•Anesthesia/analgesia
•Surgical Trauma
•Anesthesia/analgesia
•Surgical Trauma
•Anesthesia/analgesia
•Intubation/extubation
•Pain
•Hypothermia
•Bleeding/anemia
•Fasting
•Anesthesia/analgesia
•Hypothermia
•Bleeding/anemia
Inflammatory State
Hypercoagulable State
Stress State
Hypoxic State
↑TNF-α
↑IL-1
↑IL-6
↑CRP
↑ PAI-1
↑ Factor VII
↑ Platelet reactivity
↓ antithrombin III
↑ catecholamine and cortisol levels
↓oxygen delivery
Plaque fissuring
Coronary artery shear stress
Plaque fissuring
↑ BP
↑ HR
↑ FFAs
↑ relative insulin deficiency
↑ Oxygen demand
Acute Coronary Thrombus
Myocardial Ischemia
Perioperative Myocardial Infarction

Men and woman are not the same

Gender Differences in Heart Disease

- Woman get it at a later age
- Woman are less likely to manifest with "typical" symptoms
- Women have worse outcomes in cardiac intervention
- Women (most) don't have wives to take care of them!

Overview

- Epidemiology
- Risk Assessment
- Preoperative Testing
- Postoperative Management to Reduce Risk
- Frequently Asked Questions
- Case Studies

Approaches to Risk Assessment

1. ASA/Dripps
2. Goldman Multifactorial Index
3. Detsky Modified Index
4. Revised Risk Index
5. ACC/AHA Task Force Recommendations

Quantitative

Strategic

Dripps/ASA Classification

Class	Systemic Disturbance	Mortality*
1	Healthy patient with no disease outside of the surgical process	**<0.03%**
2	Mild-to-moderate systemic disease caused by the surgical condition or by other pathologic processes	**0.2%**
3	Severe disease process which limits activity but is not incapacitating	**1.2%**
4	Severe incapacitating disease process that is a constant threat to life	**8%**
5	Moribund patient not expected to survive 24 hours with or without an operation	**34%**
E	Suffix to indicate an emergency surgery for any class	**Increased**

Goldman Risk Index

Third heart sound (S_3)	11
Elevated jugulovenous pressure	11
Myocardial infarction in past 6 months	10
EKG: premature arterial contractions or any rhythm other than sinus	7
EKG shows >5 premature ventricular contractions per minute	7
Age >70 yrs	5
Emergency procedure	4
Intra- Thoracic, intra-abdominal, or aortic surgery	3
Poor general status, metabolic or bedridden	3

Class	Point Total	None/ Minor Complication	Life-Threatening Complication	Cardiac Death
Class I	0-5	99%	0.7%	0.2%
Class II	6-12	93%	5%	2%
Class III	13-25	86%	11%	2%
Class IV	≥26	22%	22%	56%

Ref: Goldman M, Caldera D, Southwick, et al: Multifactorial index of cardiac risk in non-cardiac surgical procedures. *N Engl J Med* 148:2120-2127, 1988.

ACC/AHA Guidelines

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

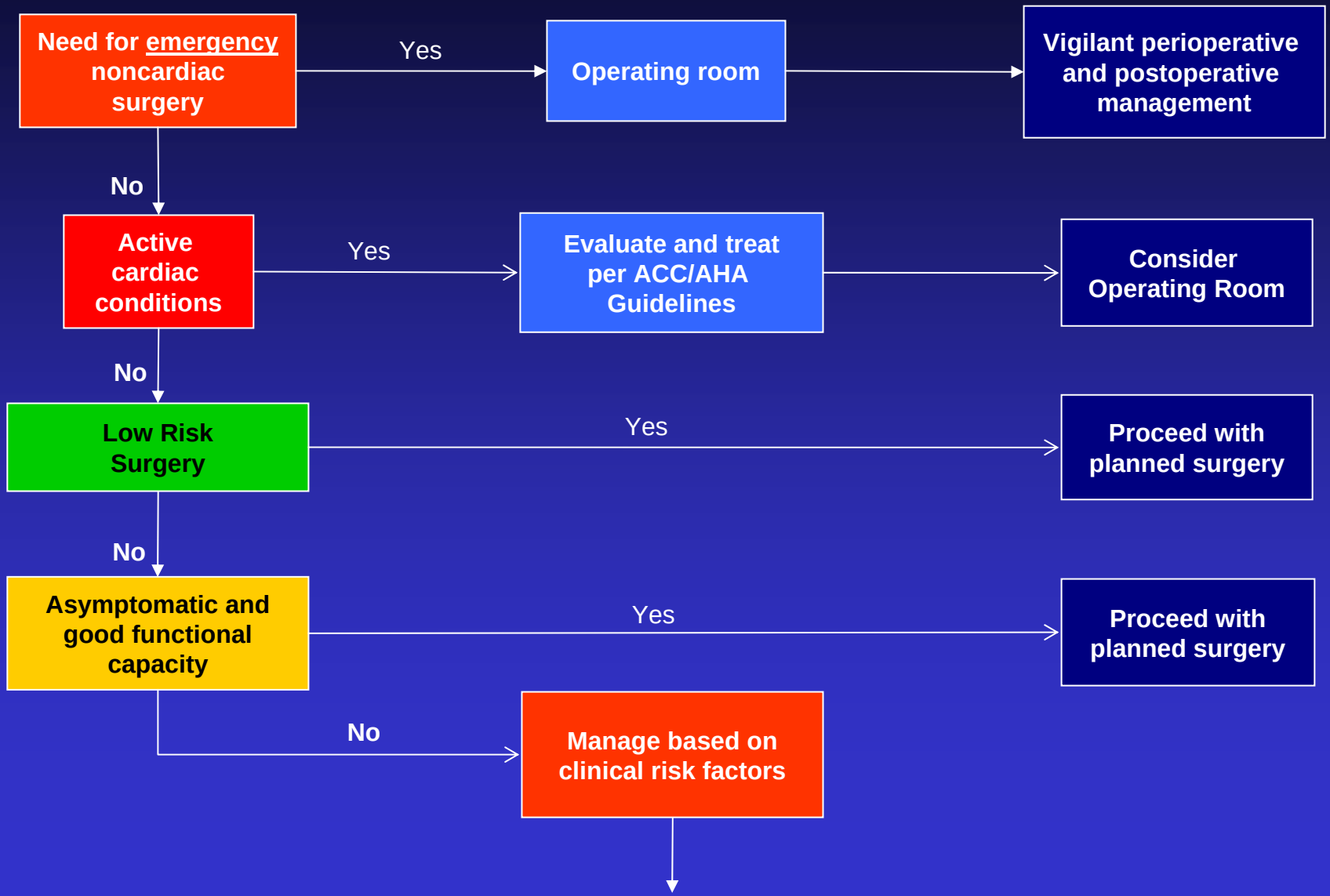
A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

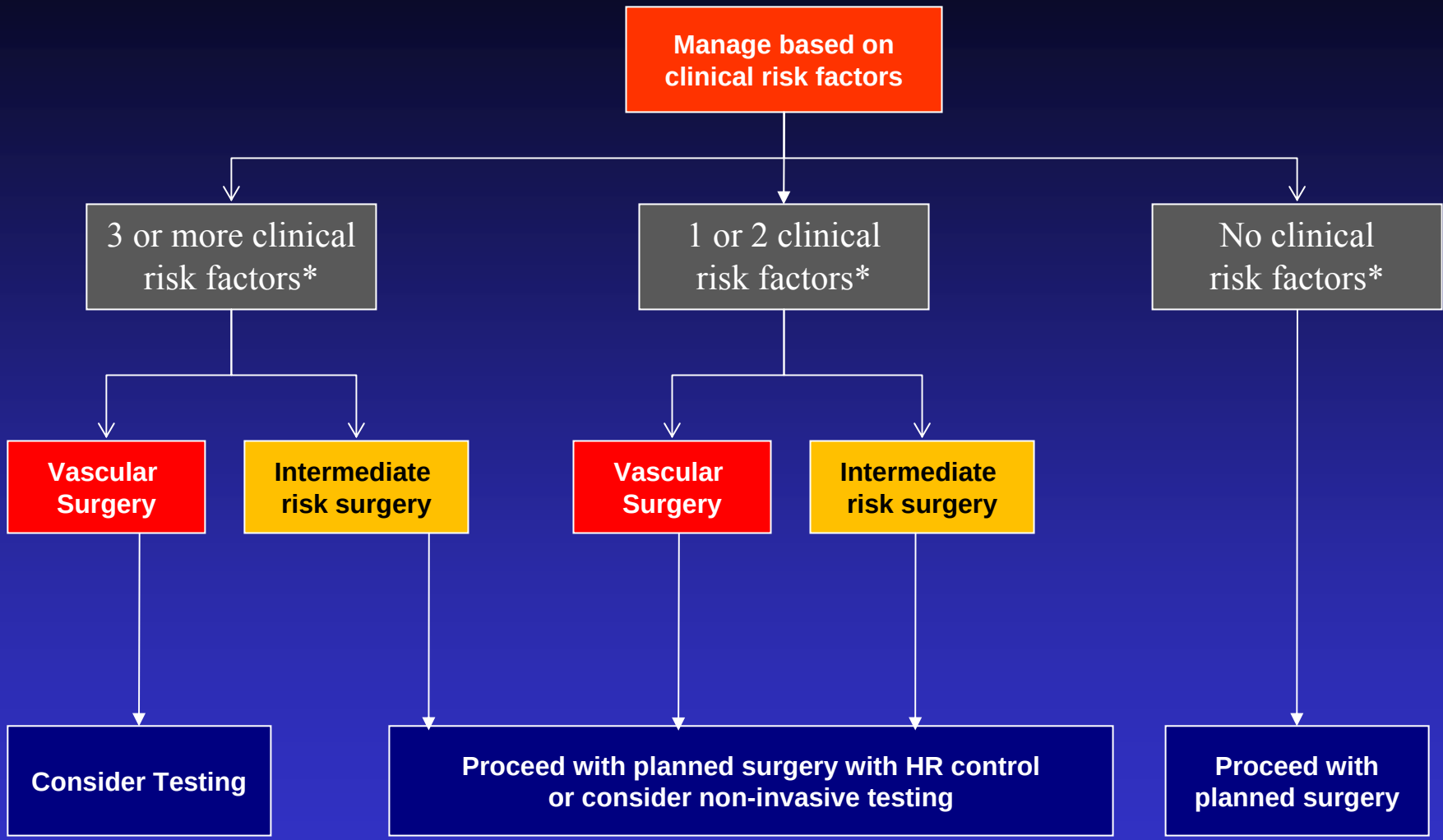
Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

J Am Coll Cardiol, 2007; 50:1707-1732

Stepwise Approach to the Pre-operative Evaluation

Stepwise Approach to Preoperative Cardiac Assessment



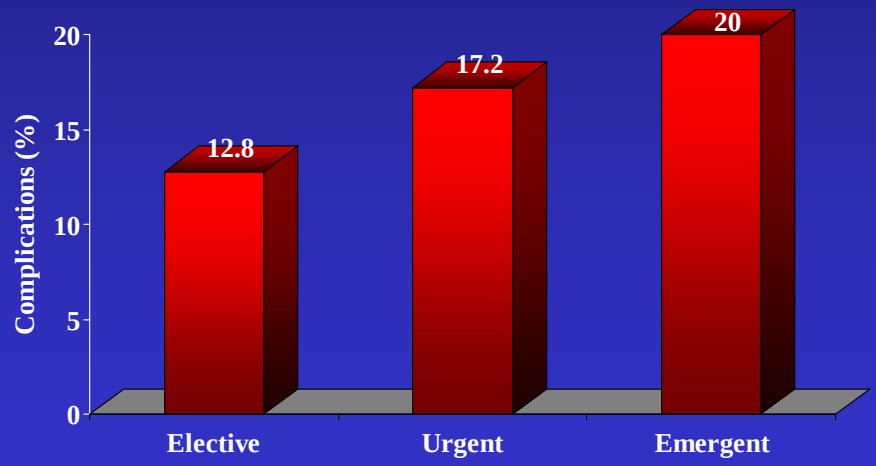


*Clinical risk factors = known ischemic heart disease, compensated or prior HF, diabetes, renal insufficiency, cerebrovascular disease

Importance of Surgical Urgency

Elective Surgery: Carried out at a time to suit the patient and surgeon
Urgent Surgery: Carried out within 24-hrs of admission
Emergency Surgery: Carried out within 2-hrs of admission or in conjunction with resuscitation

Non-Cardiac Surgery



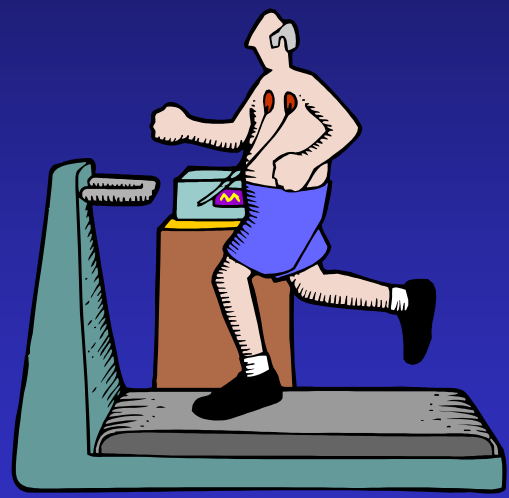
Source: Evaluation of National Confidential Enquiry into Perioperative Deaths (NCEPOD)

Surgical Urgency?

Key Point: Patients undergoing urgent or emergent surgery are at higher risk of postoperative complications and require closer surveillance postoperatively.

Functional Capacity

1. Correlates with maximum oxygen uptake on treadmill testing
2. Demonstrated predictor of future cardiac events
2. Poor functional capacity may hide low threshold cardiac symptoms



Duke Activity Status Index

1 MET Can you take care of yourself?

Eat, dress, or use the toilet?

Walk indoors around the house?

Walk a block or two on level ground at 2-3 mph or 3.2-4.8 km/h?

4 METs Do light work around the house like dusting or washing clothes?

MET = metabolic equivalent

4 METs Climb a flight of stairs or walk up a hill?

Walk on level ground at 4 mph or 6.4 km/h?

Run a short distance?

Do heavy work around the house like scrubbing floors or lifting or moving heavy objects?

Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?

10 METs Participate in strenuous sports like swimming, singles tennis, football, baseball, or skiing?

Assessing Risk

Active Cardiac Conditions

High Risk:

- Acute or recent MI (7-30 d)
- Unstable coronary syndrome
- Decompensated CHF
- Significant Arrhythmias
- Severe Valvular Disease

Clinical Risk Factors

Proceed Cautiously with:

- History of heart disease
- Compensated or prior CHF
- Cerebrovascular disease
- Diabetes Mellitus
- Renal Insufficiency

3 or more risk factors & Vascular surgery — Consider testing

1 – 2 risk factors — Proceed with surgery or consider testing

Low Risk Situations

Low Risk:

- Low risk surgery
- Good functional capacity
- No cardiac symptoms
- No "active cardiac conditions"
- No clinical risk factors

Reasonable to proceed with surgery

Surgery Related Risk

High Risk (Risk > 5%):

- Emergent major operations
- Aortic and other major vascular
- Peripheral vascular
- Anticipated prolonged or associated with large fluid shifts and/or blood loss

Intermediate Risk (Risk < 5%):

- Carotid endarterectomy
- Endovascular AAA repair
- Head and neck
- Intraperitoneal and intrathoracic
- Orthopedic
- Prostate

Low Risk Surgery (Risk < 1%):

- ✓ Endoscopic procedures
- ✓ Superficial procedure
- ✓ Cataract surgery
- ✓ Breast surgery

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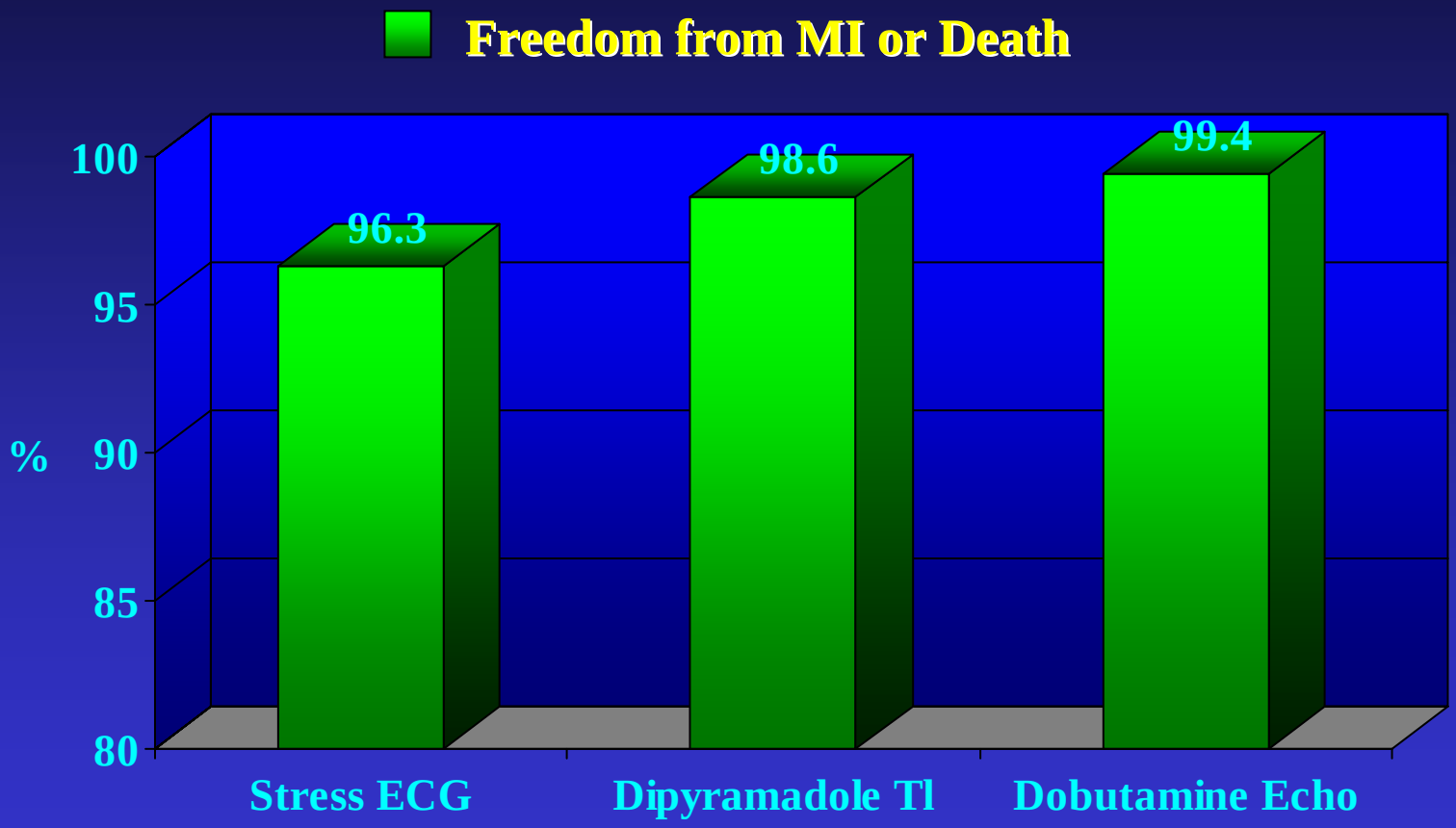
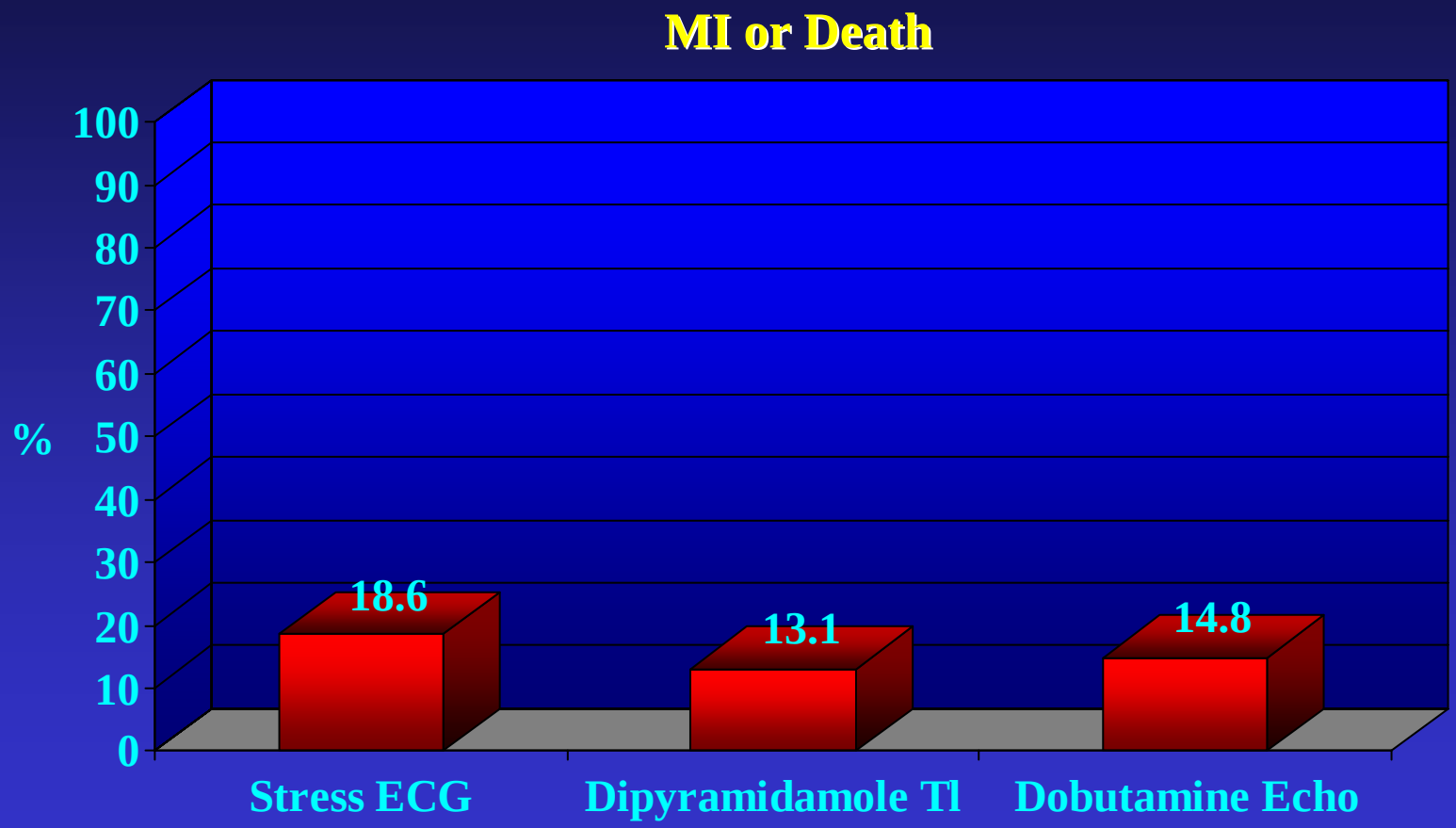
Preoperative Testing
Negative Predictive Value



Eagle et al. JACC 1996;27:910.

Preoperative Testing
Positive Predictive Value



ACC/AHA Recommendations

- Echocardiography:
  - Dyspnea of unknown origin (Class IIa)
  - Current or hx of HF and no echo in 12 months (Class IIa)
- 12 Lead ECG
  - Vascular surgery and 1 CRF (class I)
  - CRFs and intermediate risk surgery (class I)
  - All vascular surgery (class IIa)

ACC/AHA Recommendations

- Treadmill stress testing
  - High cardiac risk conditions
  - 3 CRFs, poor functional capacity & vascular surgery (class IIa)
- Nuclear stress testing

Which test to choose?

Most ambulatory patients	Treadmill Stress Test
Abnormal resting ECG (dig, LVH)	Exercise echo or sestamibi
LBBB Unable to exercise	DSE Adenosine sestamibi dipyridamole sestamibi

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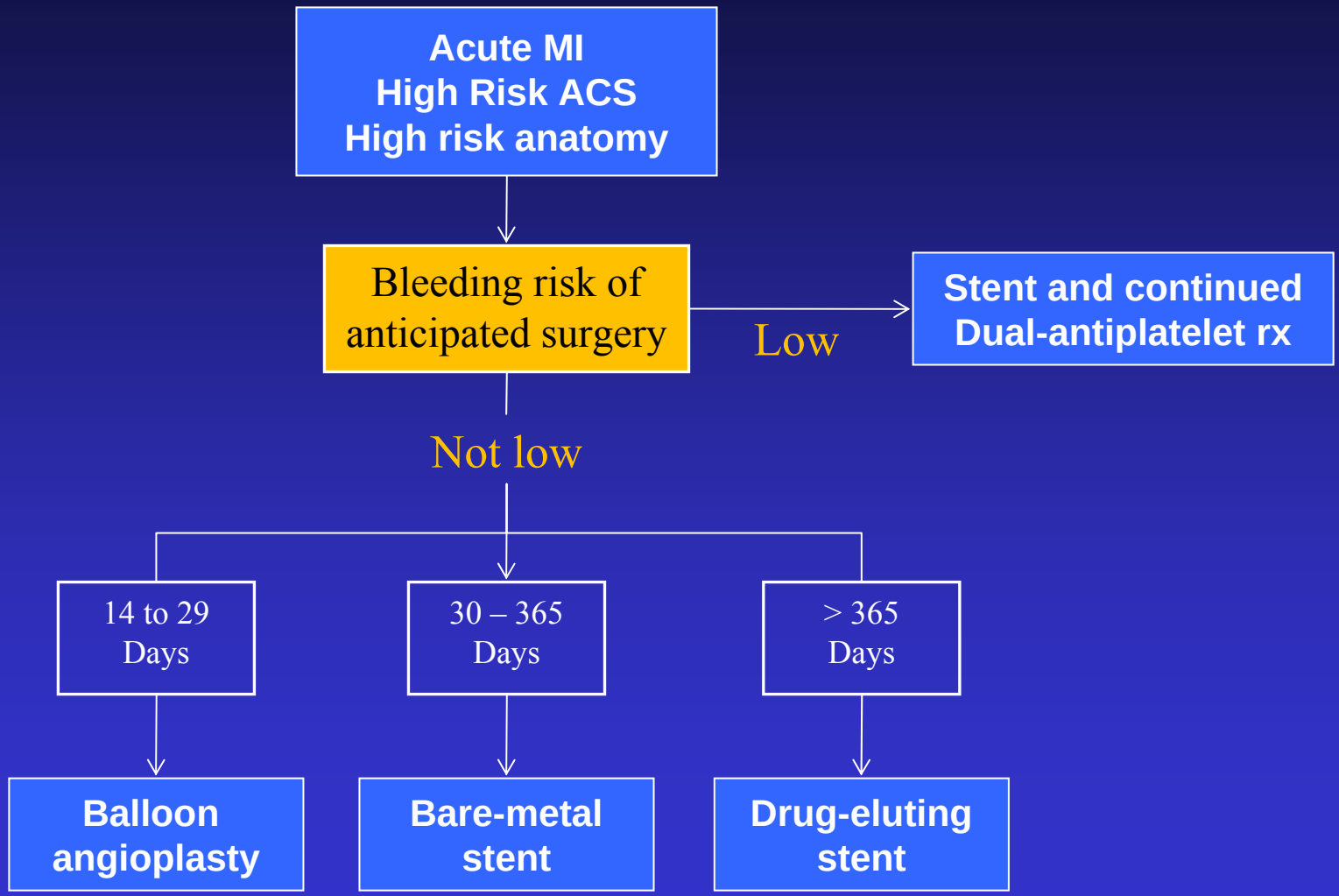
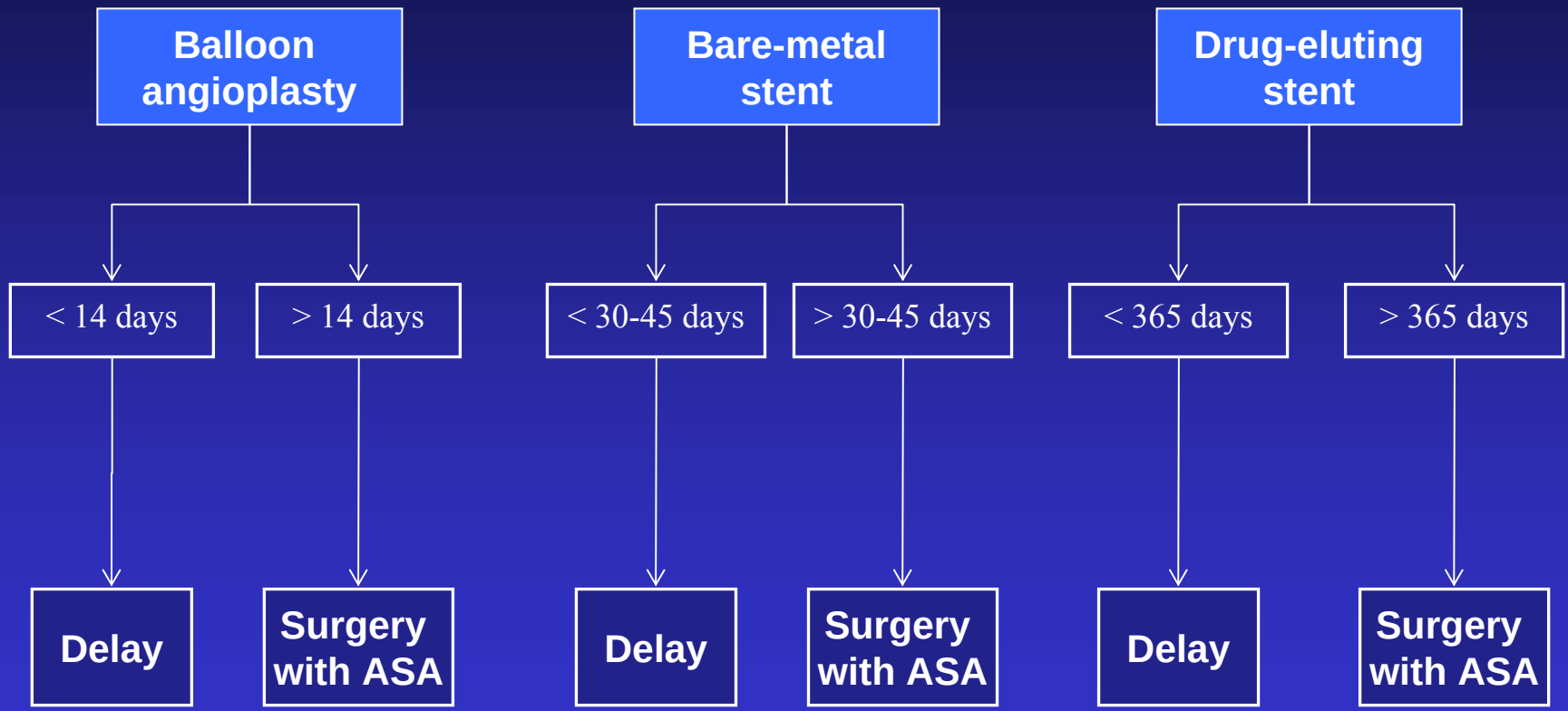
Perioperative Management

- Revascularization
- Beta blockers
- Statins
- Alpha-2 agonists
- Calcium channel blockers

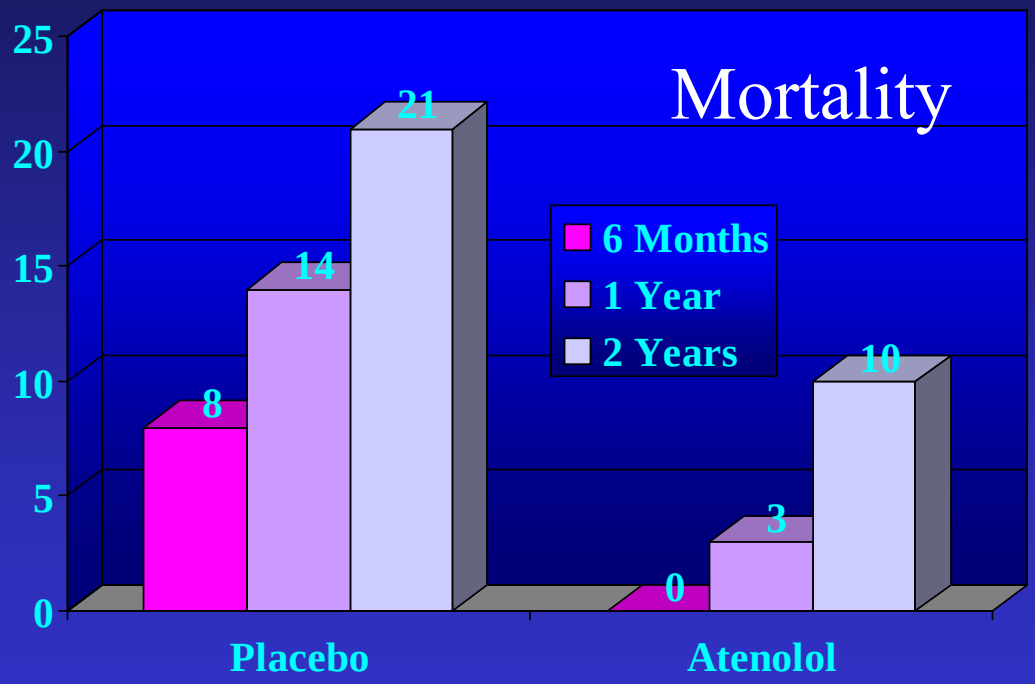
PCI before anticipated surgery



Timing of Surgery After PCI



Postoperative Mortality Reduction
Beta-Blockers

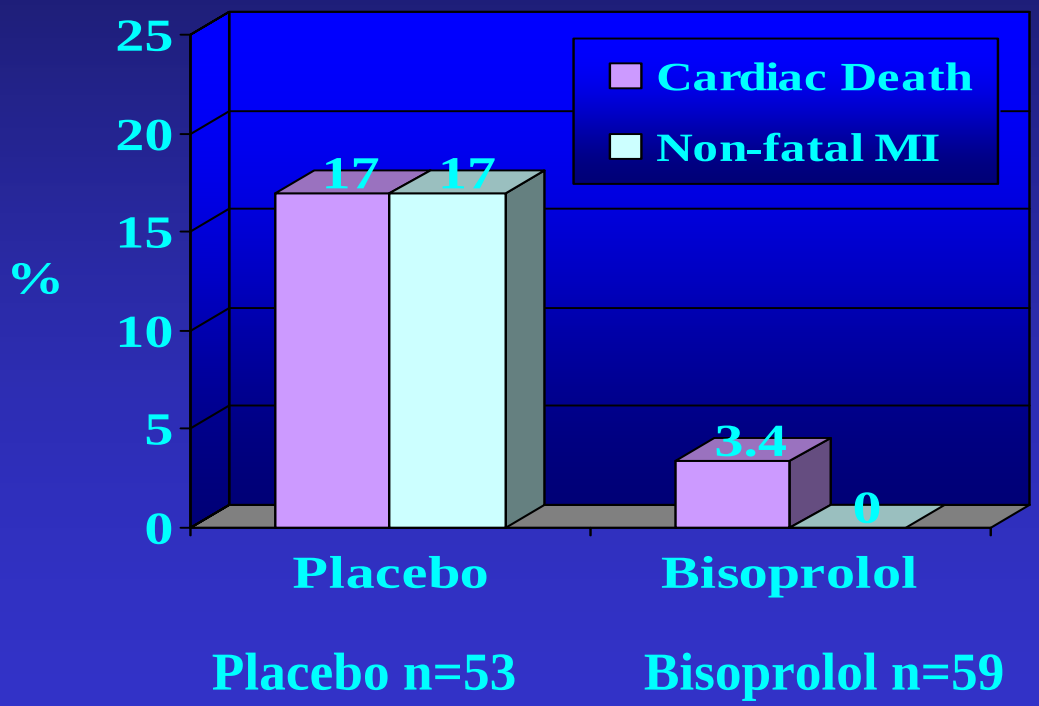


- 200 pts undergoing non-cardiac surgery
- Random assignment to:
  - IV followed by oral atenolol or
  - Placebo
- Double-blind follow-up over 2 years

Mangano, et al. NEMJ 1996;335:1713.

Postoperative Cardiac Events In High Risk Patients

Beta-Blockade



- 173 patients undergoing vascular surgery with positive DSE
- Randomized to BB 1 week pre-op or placebo
- Followed for 30 days

Poldermans et al. NEJM 1999;341:1789.

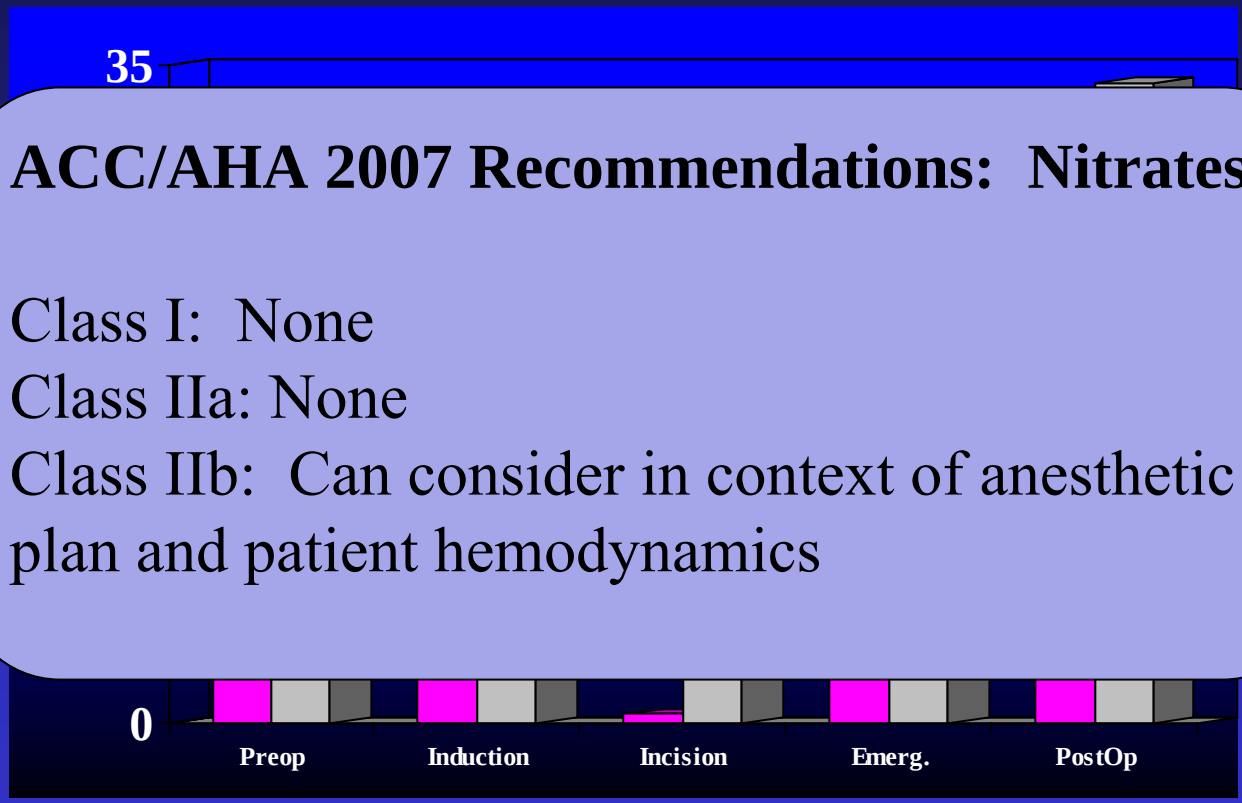
Perioperative Beta Blockers

AHA/ACC Recommendations: 2006 Update

- Beta blockers required in recent past to control symptoms of angina or patients with symptomatic arrhythmias or hypertension
- Patients at high cardiac risk owing to the finding of ischemia on preoperative testing who are undergoing vascular surgery
- Patients undergoing vascular surgery and with identified CAD
- Vascular surgery and multiple cardiac risk factors
- Moderate or high risk surgery and multiple cardiac risk factors

Key Point: if known or suspected CAD and undergoing moderate or high risk surgery, use a beta blocker!

Perioperative Nitrates?



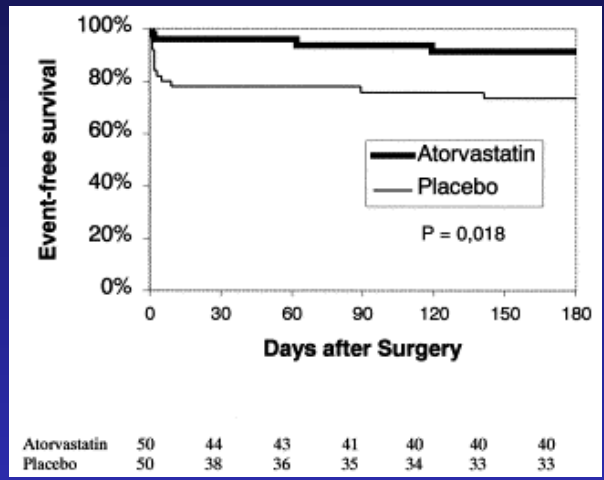
ACC/AHA 2007 Recommendations: Nitrates

Class I: None
Class IIa: None
Class IIb: Can consider in context of anesthetic plan and patient hemodynamics

Dodds, et al. Anesth. Analg. 1993;76:705-13

Perioperative Statins?

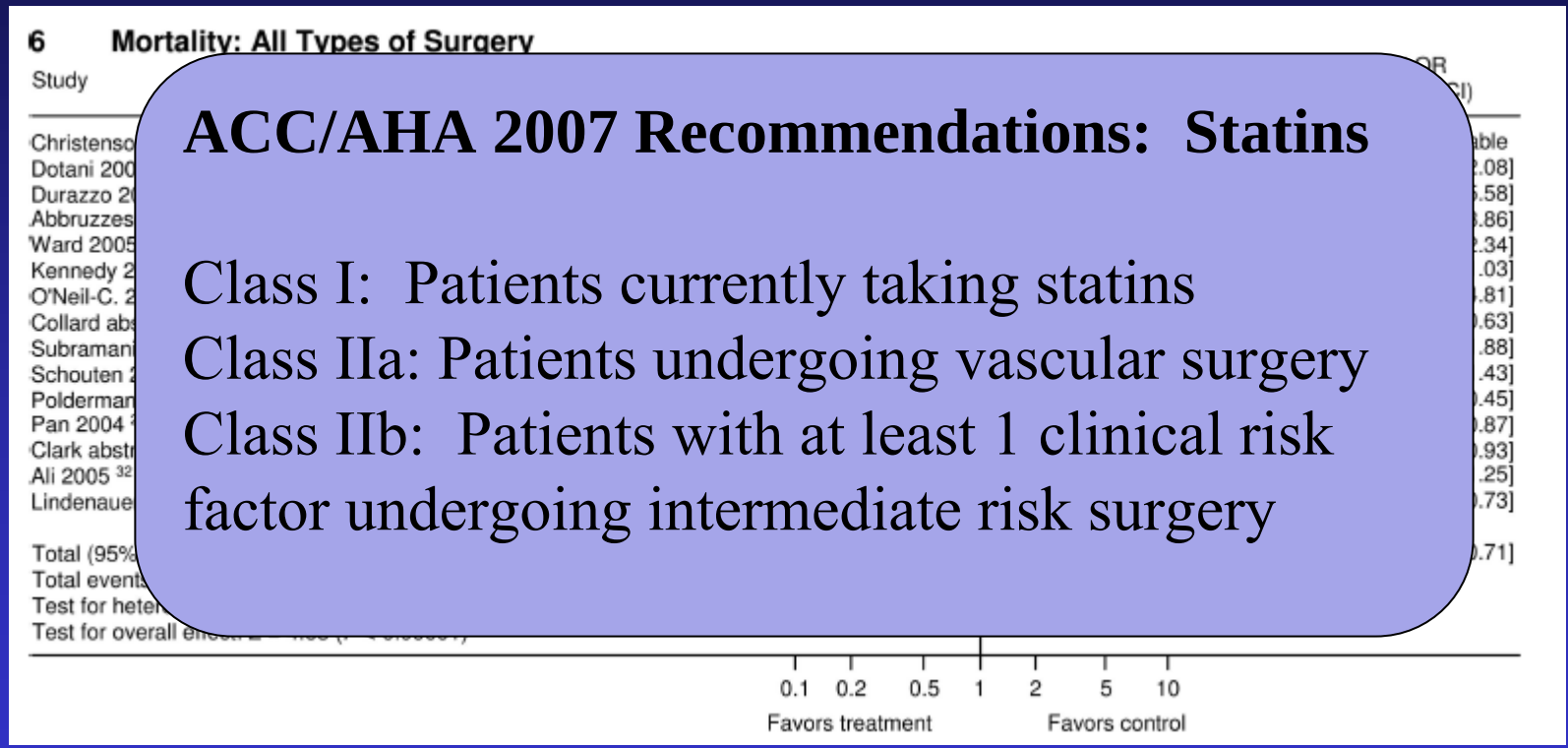
- 100 patients pre-op before vascular surgery
- Random assignment:
  - Atorvastatin 20 mg
  - Placebo
- Started 30 days preoperatively
- Follow-up 6 month
- Endpoint:
  - Cardiac death
  - Non-fatal MI
  - USA
  - Stroke



Characteristic	*Atorvastatin (n = 50)* *n*	*%*	*Placebo (n = 50)* *n*	*%*	P
Death from cardiac causes	1	2.0	2	4.0	1.000
Nonfatal acute myocardial infarction	3	6.0	8	16.0	.199
Unstable angina	—		1	2.0	1.000
Ischemic stroke	—		2	4.0	.495
Combined end point	4	8.0	13	26.0	.031

J Vasc. Surgery 2004;39:967

Perioperative Statins



ACC/AHA 2007 Recommendations: Statins

Class I: Patients currently taking statins
Class IIa: Patients undergoing vascular surgery
Class IIb: Patients with at least 1 clinical risk factor undergoing intermediate risk surgery

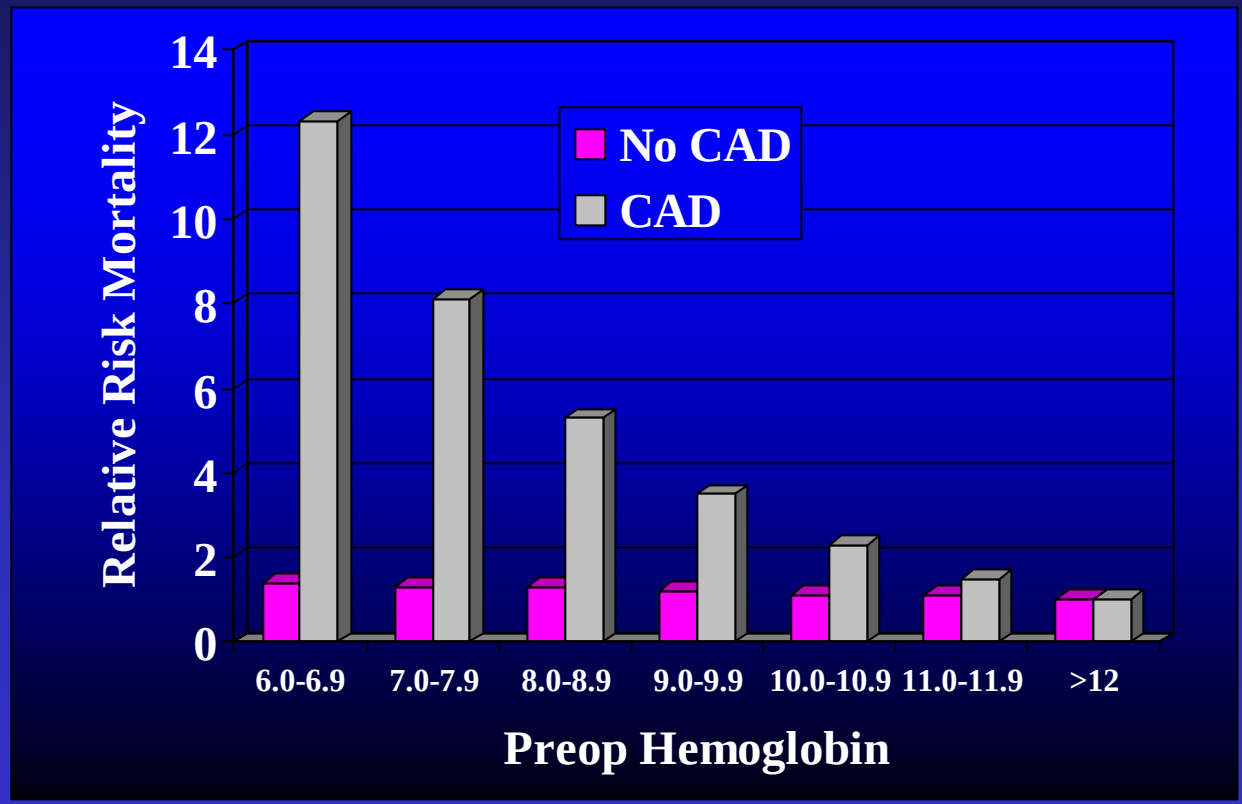
Hindler, et al. Anesthesiology 2006;105:1260-72

Treatment of Anemia?

- There is a direct relationship between preoperative anemia and risk of complications (CV complications, infection, mortality), especially if known CAD
- Decline in Hbg associated with increase in mortality, especially in those with CV disease
- Benefits of transfusion have not been proven

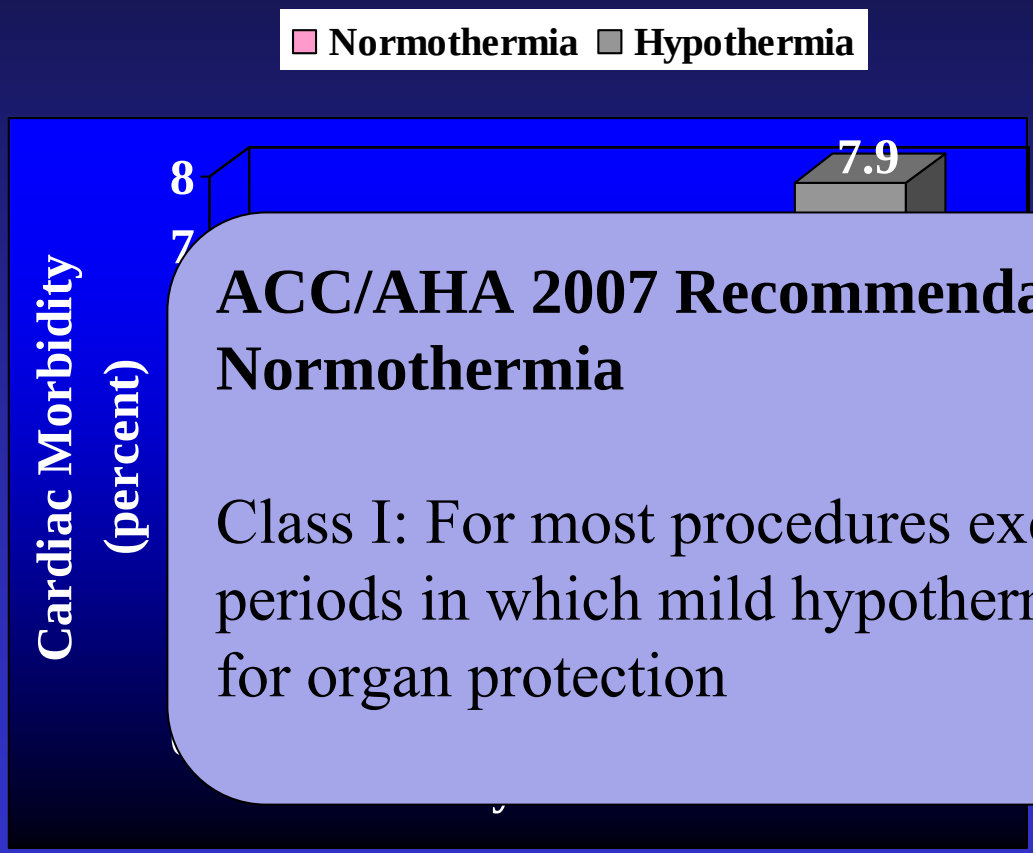
Preoperative Hgb and Mortality

Study of Untreated Anemia



Carson, et al. Lancet. 1996;348:1055-60

Perioperative Hypothermia



- 300 pts undergoing
  y
  double
  ment
  or

ACC/AHA 2007 Recommendations: Normothermia

Class I: For most procedures except during periods in which mild hypothermia is intended for organ protection

Frank SM JAMA 1997;227(14)

Key Point:

Avoid Sympathetic Stimulation in those at Risk!

- Beta blocker if able
- Limit hypothermia
- Aggressive post-operative pain control
- Avoid significant anemia

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FAQs

How should I handle the patient with a pacemaker or implantable defibrillator (ICD)?

- ICDs should be turned off immediate preoperative and turned on immediately postoperatively.
- Pacemakers can be left on perioperatively but should be interrogated pre- and post-op.

FAQs

How long should surgery be delayed after a myocardial infarction?

- In general, at least one month.
- In patients treated with PCI, delay based on type of treatment:
  - POBA: 14 days
  - BMS: 30 days
  - DES: 365 days

FAQs

How should I handle the patient with atrial fibrillation?

- If rate controlled, it is not a reason to delay surgery or expect problems.
- If on warfarin, should communicate with PCP or cardiologist about safety of discontinuing.

FAQs

Can anticoagulation be stopped in the patient with a mechanical heart valve?

- Low risk patients (bileaflet Aortic valve, no risk factors)
  - Stop warfarin 48-72 pre-op
  - Resume 24 hrs post-op
- High risk patients (mitral valve, aortic valve + any risk factor)
  - Bridge with UFH, starting when INR < 2

Risk factors: AF, previous thromboembolism, LV dysfunction, hypercoagulable state, older generation valve, mechanical tricuspid valve, more than one mechanical valve

Questions?