Preoperative Cardiac Evaluation 2018:
Guidelines vs “The Real World?”

John E. Ellis MD
johnellis1700@gmail.com
Conflicts of interest?

- destinationCME LLC
Outline

• 2014 American (AHA/ACCF) and European (ESA) guidelines
• Value of preop stress testing?
• Value of preop biomarkers?
• Value of postop surveillance (troponin)?
Outline

• Is this reducible to guidelines?
  • Practice variations
  • Outcome variations
    • Does clinician “quality” trump guidelines?
• Guideline pushback!
• New Canadian guidelines (Sessler, Devereaux)
WHAT’S THE GOAL OF PREOP EVAL?

- Is patient in best possible shape?
- Can the patient be made better?
- Risk assessment?
  - Who should not have surgery?
What will kill the patient?

• Triple vessel CAD
• Left main CAD
• Aortic stenosis
The changing landscape
Limitations of "traditional" evaluation

Tend to focus on 1 organ system

Often the heart

Yet, surgical morbidity and mortality have changed
Association of the Pattern of Use of Perioperative β-Blockade and Postoperative Mortality

Arthur W. Wallace, M.D., Ph.D., * Selwyn Au, M.S., † Brian A. Cason, M.D. ‡
Fleisher LA, et al.
2014 ACC/AHA Perioperative Guideline: Executive Summary

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

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, and Society of Cardiovascular Anesthesiologists

Endorsed by the Society of Hospital Medicine
2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management

The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA)
Emergency surgery or acute cardiac syndrome?
“Bedside” Risk Factors (RCRI)

- High risk surgery
- h/o ischemic heart disease
- h/o CHF
- h/o CVA
- Insulin Rx
- Creatinine > 2.0 mg/dL

Lee TH et al  Circulation 1999
Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery

Prateek K. Gupta, MD; Himani Gupta, MD; Abhishek Sundaram, MBBS, MPH; Manu Kaushik, MD; Xiang Fang, PhD; Weldon J. Miller, MS; Dennis J. Esterbrooks, MD; Claire B. Hunter, MD; Iraklis I. Pipinos, MD; Jason M. Johanning, MD; Thomas G. Lynch, MD; R. Armour Forse, MD, PhD; Syed M. Mohiuddin, MD; Aryan N. Mooss, MD

- 2007 NSQIP database (250 hospitals)
- 211,410 patients, 1371 PMI/arrests (0.65%)
- 5 predictors of PMI/arrest:
  - type of surgery
  - dependent functional status
  - abnormal creatinine
  - ASA class
  - increasing age

http://www.surgicalriskcalculator.com
### 2014 European guidelines

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical risk indices are recommended to be used for peri-operative risk stratification.</td>
<td>I</td>
<td>B</td>
<td>43,44</td>
</tr>
<tr>
<td>The NSQIP model or the Lee risk index are recommended for cardiac peri-operative risk stratification.</td>
<td>I</td>
<td>B</td>
<td>43,44,54</td>
</tr>
</tbody>
</table>

http://dcme.co/2014_ESA_periop_guidelines
2014 European periop guideline

High-risk: > 5%

- Aortic and major vascular surgery
- Open lower limb revascularization or amputation or thromboembolectomy
- Duodeno-pancreatic surgery
- Liver resection, bile duct surgery
- Oesophagectomy
- Repair of perforated bowel
- Adrenal resection
- Total cystectomy
- Pneumonectomy
- Pulmonary or liver transplant

http://dcme.co/2014_ESA_periop_guidelines
Estimate clinical risk

Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

Low risk (<1%) (Step 4)

Elevated risk (Step 5)

No further testing (Class III:NB)

Proceed to surgery

http://content.onlinejacc.org/article.aspx?articleid=1893784
### Recommendations on pre-operative evaluation

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Ref. &lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected patients with cardiac disease undergoing low-and intermediate-risk non-cardiac surgery may be referred by the anaesthesiologist for cardiological evaluation and medical optimization.</td>
<td>IIb</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>A multidisciplinary expert team should be considered for pre-operative evaluation of patients with known or high risk of cardiac disease undergoing high-risk non-cardiac surgery.</td>
<td>IIA</td>
<td>C</td>
<td>8</td>
</tr>
</tbody>
</table>

Clinician discretion

http://dcme.co/2014_ESA_periop_guidelines
Assess functional status.
Stress testing for < 4 METS?
Assess functional status.
Stress testing for < 4 METS?
Comparison Between the 2007 and 2014 American College of Cardiology/American Heart Association Guidelines on Perioperative Evaluation for Noncardiac Surgery

Adriana D. Oprea, MD,* Manuel L. Fontes, MD,* Mark W. Onaitis, MD,† and Miklos D. Kertai, MD, PhD‡
2007 vs 2014

<table>
<thead>
<tr>
<th>Noninvasive testing</th>
<th>2007</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>For patients with poor ($&lt;4$ METs) or unknown functional capacity and $\geq 3$ RCRI criteria scheduled for vascular surgery, may consider testing if it would change management (Class IIA)</td>
<td>For patients with poor ($&lt;4$ METs) or unknown functional capacity and $\geq 3$ RCRI criteria scheduled for intermediate-risk surgery, may consider noninvasive testing if it would change management (Class IIB)</td>
<td>For patients with poor ($&lt;4$ METs) or unknown functional capacity, pharmacologic stress testing should be performed if the result would change decision making (either undergo revascularization for CAD or consider less invasive options as an alternative to surgery) (Class IIA)</td>
</tr>
</tbody>
</table>


simpler
Table 1
Duke Activity Status Index

<table>
<thead>
<tr>
<th>Activity</th>
<th>Weight (in METs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you...</td>
<td></td>
</tr>
<tr>
<td>1. Take care of yourself, that is, eating, dressing, bathing, or using the toilet?</td>
<td>2.75</td>
</tr>
<tr>
<td>2. Walk indoors, such as around your house?</td>
<td>1.75</td>
</tr>
<tr>
<td>3. Walk a block or 2 on level ground?</td>
<td>2.75</td>
</tr>
<tr>
<td>4. Climb a flight of stairs or walk up a hill?</td>
<td>5.50</td>
</tr>
<tr>
<td>5. Run a short distance?</td>
<td>8.00</td>
</tr>
<tr>
<td>6. Do light work around the house like dusting or washing dishes?</td>
<td>2.70</td>
</tr>
<tr>
<td>7. Do moderate work around the house like vacuuming, sweeping floors, or carrying groceries?</td>
<td>3.50</td>
</tr>
<tr>
<td>8. Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?</td>
<td>8.00</td>
</tr>
<tr>
<td>9. Do yardwork like raking leaves, weeding, or pushing a power mower?</td>
<td>4.50</td>
</tr>
<tr>
<td>10. Have sexual relations?</td>
<td>5.25</td>
</tr>
<tr>
<td>11. Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?</td>
<td>6.00</td>
</tr>
<tr>
<td>12. Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?</td>
<td>7.50</td>
</tr>
</tbody>
</table>
 Significant discrepancies exist between clinician assessment and patient self-assessment of functional capacity by validated scoring tools during preoperative evaluation

John Whitemore Stokes¹, Jonathan Porter Wanderer² and Matthew David McEvoy²*
MY FACE

WHEN YOU LIE TO ME
“You lie!”

"68 patients who answered affirmatively to DASI question regarding stair climbing

• 13 patients were unable to demonstrate the ability to climb a flight of stairs (McGlade et al. 2001)."

Self-reported fitness of American Society of Anesthesiologists class 3 patients undergoing endovascular aneurysm repair predicts patient survival

Margaret Boult, BSc, GDIM, a Stuart Howell, PhD, b Prue Cowled, BSc (Hons), PhD, a Tania De Loryn, MA, Dip Clin Psych, a and Robert Fitridge, MBBS, MS, FRACS, a Adelaide, South Australia, Australia
"Patients classified as ASA 3A if they could manage the stairs or could walk briskly for at least 1 km or ASA 3B if they could not achieve either activity."

Fig. Kaplan-Meier survival curves for patients stratified by fitness group. $P = .0002$ (log-rank test). ASA, American Society of Anesthesiologists.
The Frail, Elderly Patient
Simple psoas cross-sectional area measurement is a quick and easy method to assess sarcopenia and predicts major surgical complications

K. I. Jones*, B. Doleman†, S. Scott†, J. N. Lund‡ and J. P. Williams‡

*Department of Surgery, Oxford University Hospitals, Oxford, UK †Surgery, Royal Derby Hospital, Derby, UK and ‡School of Medical Sciences and Graduate Entry Medicine, University of Nottingham, Derby, UK

Received 28 May 2014; accepted 6 September 2014; Accepted Article online 18 October 2014
Lee = RCRI

Area under ROC curve = 0.8618
Cardiopulmonary testing?

- Used in England
- Integrates
- Low anaerobic threshold (<11 ml/kg/min) or VO₂max associated with poor outcome
- Training can improve these
- Effects on outcome unclear
Prelim CPT data (n=100)

Fig 3 ROC curves for the CPET indices AT and VO₂ peak in the preoperative prediction of all complications and MACE. Area under ROC curves: AT 0.64 (0.52 – 0.77) for all complications and 0.83 (0.69 – 0.96) for MACE; VO₂ peak 0.64 (0.52 – 0.77) for all complications and 0.81 (0.68 – 0.93) for MACE.
Why not prehabilitation?
But that’s not all…

Changing nature of cardiovascular disease
Mortality and Readmission of Patients With Heart Failure, Atrial Fibrillation, or Coronary Artery Disease Undergoing Noncardiac Surgery
An Analysis of 38,047 Patients

Sean van Diepen, MD; Jeffrey A. Bakal, PhD; Finlay A. McAlister, MD, MSc; Justin A. Ezekowitz, MBBCh, MSc

Circulation 2011, 124:289-296: originally published online June 27, 2011
Figure 3. Unadjusted 30-day perioperative mortality (blue), rehospitalization (red), and cardiac rehospitalization (green). HF indicates heart failure.
For these patients, even non-cardiac minor interventions could be associated with an elevated risk of early postoperative mortality, even greater than the risk of having a diagnosis of coronary artery disease.”
LondonCardioClinic's channel.
https://youtu.be/ey-QHyWsxDE
Preoperative Evaluation Clinic Visit Is Associated with Decreased Risk of In-hospital Postoperative Mortality

Jeanna D. Blitz, M.D., Samir M. Kendale, M.D., Sudheer K. Jain, M.D., Germaine E. Cuff, Ph.D., Jung T. Kim, M.D., Andrew D. Rosenberg, M.D.
Do we order too many tests and consults???
"I'll want to run a few tests on you, just to cover my ass."
Original contribution

Anesthesiologists’ preferences for preoperative cardiac evaluation before vascular surgery: results of a mail survey

John E. Ellis MD (Adjunct Professor)\textsuperscript{a,\,*}, Avery Tung MD (Professor)\textsuperscript{b}, Helen Lee MD, MPH (Acting Assistant Professor)\textsuperscript{c}, Hubert Lee BA (Member)\textsuperscript{d}, Kristen Kasza MS (Biostatistician)\textsuperscript{e}
Desire for preop stress test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% Confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comorbidity (sick vs. healthy)</td>
<td>3.01</td>
<td>(2.06, 4.38)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Surgery (aortic vs. femoral)</td>
<td>1.74</td>
<td>(1.15, 2.63)</td>
<td>0.009</td>
</tr>
<tr>
<td>Perioperative MI likelihood as assessed by anesthesiologist</td>
<td></td>
<td></td>
<td>0.004</td>
</tr>
<tr>
<td>0-1% (ref)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-5%</td>
<td>3.15</td>
<td>(1.63, 6.07)</td>
<td></td>
</tr>
<tr>
<td>5-10%</td>
<td>2.84</td>
<td>(1.44, 5.63)</td>
<td></td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>3.83</td>
<td>(1.73, 8.44)</td>
<td></td>
</tr>
</tbody>
</table>
Desire for preop stress test?

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% Confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected blood loss</td>
<td>1.09</td>
<td>(1.02, 1.17)</td>
<td>0.009</td>
</tr>
<tr>
<td>(per 100-unit increase)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (female vs. male)</td>
<td>1.79</td>
<td>(1.11, 2.87)</td>
<td>0.02</td>
</tr>
<tr>
<td>Region (New England vs. other)</td>
<td>2.16</td>
<td>(1.01, 4.62)</td>
<td>0.05</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>0-5 yrs (ref)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-10</td>
<td>0.73</td>
<td>(0.35, 1.53)</td>
<td></td>
</tr>
<tr>
<td>10-15</td>
<td>0.59</td>
<td>(0.28, 1.23)</td>
<td></td>
</tr>
<tr>
<td>15-20</td>
<td>0.47</td>
<td>(0.22, 1.01)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 5. Predictors of Preoperative Cardiac Stress Testing**  (N = 74,117)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>All P &lt; 0.05</th>
<th>Least in Pacific NW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (patients, not docs!)</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Year of surgery</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Charlson comorbidity index</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Size of MSA</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>US region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital size</td>
<td>↑</td>
<td></td>
</tr>
</tbody>
</table>

*MSA indicates metropolitan statistical area.*

All $P < 0.05$
Overuse of Preoperative Cardiac Stress Testing in Medicare Patients Undergoing Elective Noncardiac Surgery

Kristin M. Sheffield, PhD,* Patricia S. McAdams, BA,* Jaime Benarroch-Gampel, MD,* James S. Goodwin, MD,†
Casey A. Boyd, MD,* Dong Zhang, PhD,† and Taylor S. Riall, MD, PhD*
No active cardiac issues!

FIGURE 1. Use of preoperative cardiac stress testing in Medicare patients with no active cardiac conditions or clinical risk factors who underwent elective noncardiac, nonvascular surgical procedures, 1996 to 2008.

Non-invasive cardiac stress testing before elective major non-cardiac surgery: population based cohort study

Duminda N Wijeysundera,1,2,3 W Scott Beattie,2 Peter C Austin,1,4 Janet E Hux,1,5 Andreas Laupacis1,6,7

- Matched cohorts
  - 1 yr mortality
    - 7.0% testing
    - 7.5% no testing
    - NNT 221

BMJ doi:10.1136/bmj.b5526
Cardiac Stress Testing during Workup for Abdominal Aortic Aneurysm Repair Is Not Associated with Improved Patient Outcomes

* P > 0.25 for all comparisons

Ann Vasc Surg 2017; : 1–9
http://dx.doi.org/10.1016/j.avsg.2016.10.057
Preop biomarkers?
Timing of Preoperative Troponin Elevations and Postoperative Mortality After Noncardiac Surgery

Michael D. Maile, MD, MS, Elizabeth S. Jewell, MS, and Milo C. Engoren, MD

Cardiac Complications in Patients Undergoing Major Noncardiac Surgery

P.J. Devereaux, M.D., Ph.D., and Daniel I. Sessler, M.D.
Preop BNP better?

• “Measurement of natriuretic peptide levels is thus preferable to stress testing because it is more accurate and convenient, faster, and less expensive.

**BNP meta-analysis**

**2179 patients 18 studies**

<table>
<thead>
<tr>
<th>Test result</th>
<th>Risk estimate, %</th>
<th>95% CI for the risk estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>NT-proBNP &lt; 300 ng/L or BNP &lt; 92 mg/L</td>
<td>4.9</td>
<td>3.9%-6.1%</td>
</tr>
<tr>
<td>NT-proBNP value ≥ 300 ng/L or BNP ≥ 92 mg/L</td>
<td>21.8</td>
<td>19.0%-24.8%</td>
</tr>
</tbody>
</table>

BNP, brain natriuretic peptide; CI, confidence interval; NT-proBNP, N-terminal pro-brain natriuretic peptide.

*Canadian Journal of Cardiology, Volume 33, 2017*
Preop BNP better?

• “In fact, measurement of natriuretic peptide levels costs less than an internal medicine or cardiology consultation, so the test might be used to decide which patients should be referred for consultation with a specialist.”

BNP? 2014 ESA guidelines

| NT-proBNP and BNP measurements may be considered for obtaining independent prognostic information for peri-operative and late cardiac events in high-risk patients. | IIb | B | 52,53,55 |
| Universal pre-operative routine biomarker sampling for risk stratification and to prevent cardiac events is not recommended. | III | C |  |  |
Society Guidelines

Canadian Cardiovascular Society Guidelines on Perioperative Cardiac Risk Assessment and Management for Patients Who Undergo Noncardiac Surgery

Emmanuelle Duceppe, MD, Joel Parlow, MD, MSc (Co-chair), Paul MacDonald, MD, Kristin Lyons, MDCM, Michael McMullen, MD, Sadeesh Srinathan, MD, MSc, Michelle Graham, MD, Vikas Tandon, MD, Kim Styles, MD, Amal Bessissow, MD, MSc, Daniel I. Sessler, MD, Gregory Bryson, MD, MSc, and P.J. Devereaux, MD, PhD (Co-chair)


Society Guidelines

Canadian Cardiovascular Society Guidelines on

Duceppe et al.
Perioperative Cardiac Risk Assessment & Management

<table>
<thead>
<tr>
<th>Patients</th>
<th>Patients age ≥45 years or 18-44 years with known significant cardiovascular disease* undergoing noncardiac surgery requiring overnight hospital admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing of surgery</td>
<td>Emergency surgery</td>
</tr>
<tr>
<td>Preoperative assessment</td>
<td>Proceed to surgery without additional preoperative cardiac assessment</td>
</tr>
<tr>
<td></td>
<td>If patient’s age ≥65 years or 18-64 years with significant cardiovascular disease*</td>
</tr>
<tr>
<td>Postoperative monitoring</td>
<td>Measure troponin daily x 48-72 hrs Obtain ECG in PACU Consider in-hospital shared-care management**</td>
</tr>
<tr>
<td></td>
<td>Positive NT-proBNP ≥300 mg/L or BNP ≥92 mg/L NT-proBNP or BNP not available</td>
</tr>
</tbody>
</table>
Society Guidelines

Canadian Cardiovascular Society Guidelines on

Elective surgery

Assessment of perioperative cardiac risk
Risk stratification with RCRI

If a patient’s age ≥65 years, RCRI ≥1, or age 45-64 years with significant cardiovascular disease* → order NT-proBNP/BNP

Positive NT-proBNP
≥300 mg/L or BNP ≥92 mg/L

NT-proBNP or BNP not available

Negative NT-proBNP
<300 mg/L or BNP < 92 mg/L
RECOMMENDATION

12. We recommend against performing preoperative pharmacological stress echocardiography to enhance perioperative cardiac risk estimation (Strong Recommendation; Low-Quality Evidence).

13. We recommend against performing preoperative pharmacological stress radionuclide imaging to enhance perioperative cardiac risk estimation (Strong Recommendation; Moderate-Quality Evidence).

Values and preferences. The panel believed that the cost and potential delays associated with these stress tests should be taken into account because of the absence of evidence of an overall absolute net improvement in risk reclassification.
Stress tests limits (1)
1/3 of MIs / deaths in patients with normal results on preoperative thallium-201 stress

Type 2 Perioperative Myocardial Infarction

Can We Close Pandora’s Box?

Martin J. London, M.D., F.A.S.E.

Etiology of Acute Coronary Syndrome after Noncardiac Surgery

Mohammad A. Helwani, M.D., M.S.P.H., Amit Amin, M.D., Paul Lavigne, M.D., Srikar Rao, M.D., M.S., Shari Oesterreich, M.D., Eslam Samaha, M.D., Jamie C. Brown, M.D., Peter Nagele, M.D., M.Sc.

2018. doi:10.1097/ALN.0000000000002107
Primary study outcomes included types of MI: type 1 (plaque rupture, coronary occlusion), type 2 MI (demand ischemia), and type 4B (stent thrombosis); acute coronary syndrome was also classified per electrocardiogram and biomarker presentation as ST–elevation MI, non–ST–elevation MI, or unstable angina. Secondary outcomes included hospital length of stay.

**Table 3.** Coronary Angiography Findings

<table>
<thead>
<tr>
<th></th>
<th>All Events, n = 146 (100%)</th>
<th>Type 1 MI, n = 37 (25.3%)</th>
<th>Type 2 MI, n = 106 (72.6%)</th>
<th>Type 4B MI, n = 3 (2.1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal or mild disease, n (%)</td>
<td>39 (26.7)</td>
<td>2 (5.4)</td>
<td>37 (34.9)</td>
<td>0</td>
</tr>
<tr>
<td>Calcification, n (%)</td>
<td>78 (53.4)</td>
<td>25 (67.6)</td>
<td>53 (50)</td>
<td>0</td>
</tr>
<tr>
<td>Haziness, n (%)</td>
<td>77 (52.7)</td>
<td>33 (89.2)</td>
<td>41 (38.7)</td>
<td>3 (100)</td>
</tr>
<tr>
<td>Ulceration, n (%)</td>
<td>28 (19.2)</td>
<td>25 (67.6)</td>
<td>1 (0.9)</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>Thrombus, n (%)</td>
<td>5 (3.4)</td>
<td>2 (5.4)</td>
<td>0</td>
<td>3 (100)</td>
</tr>
<tr>
<td>Stress-induced cardiomyopathy, n (%)</td>
<td>14 (9.6)</td>
<td>0</td>
<td>14 (13.2)</td>
<td>0</td>
</tr>
</tbody>
</table>

MI = myocardial infarction.
Primary study outcomes included types of MI: type 1 (plaque rupture, coronary occlusion), **type 2 MI (demand ischemia)**, and type 4B (stent thrombosis); acute coronary syndrome was...
Stress tests limits (2)

Overestimation of risk can have negative consequences:

• Cardiac cath (CARP study)
• Delay cancer surgery
• Use ICU resources inefficiently
• “But I just care about my patient!”

Case

70-year-old, 80-kg, 176-cm man w/ asymptomatic R carotid bruit.

PMHx: elevated cholesterol, hypertension, smoking (<75 pack years, quit recently), COPD, chronic stable angina, and PVD (severe right calf pain with “vigorous walking”).

Meds: benazepril (20 mg/d), verapamil (240 mg/d), pravastatin (40 mg/d), aspirin (325 mg/d), and hydroxyzine.

PSHx: AAA at 50 yo. Cholecystectomy at 54 yo.
“Bedside” Risk Factors (RCRI)

• High risk surgery
• h/o ischemic heart disease
• h/o CHF
• h/o CVA
• Insulin Rx

Lee TH et al  Circulation 1999
Carotid duplex

- 80-99% stenosis R internal carotid artery (ICA),
- 50% stenosis R external carotid artery (ECA),
- 50% - 79% stenosis of the L ICA
- 50% stenosis of L ECA and R subclavian artery; extensive, irregular heterogenous plaque at bifurcation of R ICA/ECA.
- Carotid angiogram confirmed these findings.
Carotid angiogram

- Surgery was postponed after the patient suffered a mild stroke with transient aphasia and right-sided weakness during the carotid angiogram.
- The patient participated in stroke rehabilitation, stopped smoking.
- 1 year later, CEA was rescheduled.
Stress test

• A rest and stress myocardial perfusion study showed no stress-induced perfusion defects, a normal resting left ventricle, normal wall motion, and an ejection fraction of 75%.

• Repeat carotid duplex ultrasound examination was unchanged.
ECG

• 2 months before surgery showed normal sinus rhythm at 61 beats/min (otherwise normal).

• Repeat ECG the week before surgery showed NSR (same rate), and new nonspecific ST-segment and T-wave changes in inferior leads when compared with earlier tracings.
Isolated abnormal ECG?

Preoperative Electrocardiogram Abnormalities Do Not Predict Postoperative Cardiac Complications in Geriatric Surgical Patients

Linda L. Liu, MD, Samir Dzankic, MD, and Jacqueline M. Leung, MD, MPH

• “Abnormalities on preoperative ECGs are common but are of limited value in predicting postoperative cardiac complications in older patients undergoing noncardiac surgery.”
PGA meeting

“Look here, Ellis: I practice in Miami, Florida. If my patient has NSSTWΔ, I’m getting a cards consult. I don’t care what “your” guidelines say. In fact, I hate guidelines!” Anonymous
Intraop course

- GA induced
- Somewhat hypotensive
- Inferior ST ischemia
- Ephedrine, phenylephrine boluses
- Dopamine, epi, norepi, NTG drips
- Surgery finished expeditiously
Postop ECG

27-DEC-1930 (70 yr)
Male
Caucasian
Vent. rate 69 BPM
PR interval * ns
QRS duration 96 ns
QT/QTc 400/428 ns
P-X-T axes 67 -126

25mm/s 10mm/mV 40Hz 003A-003B 12SL 250 CID 14

05-FEB-2001 11:01 UCD MED CENTER-OR RR ROUTINE RECORD

05-FEB-2001 16:16 05-FEB-2001 ORDER:

DIAGNOSIS:

UNDETERMINED RHYTHM
LOW VOLTAGE QRS
MARKED ST ABNORMALITY, POSSIBLE INFERIOR SUBENDOCARDIAL INJURY
MARKED ST ABNORMALITY, POSSIBLE ANTEROLATERAL SUBENDOCARDIAL INJURY
ABNORMAL ECG

WHEN COMPARED WITH ECG OF 31-JAN-2001 15:43,
SIGNIFICANT CHANGES HAVE OCCURRED

Technicians: 38
Postop course

- 80 min PACU stay
- PAC placed s/p hypotension
- Off to cath lab
Cath lab

• Echocardiogram showed normal valves, enlarged RA and RV, no pericardial effusion, and severe LV and RV hypokinesis.
• IABP placed
• Cardiac catheterization performed, which showed a severely calcified left coronary system
Fig 2. Cardiac catheterization findings. Significant occlusion of the left main coronary artery is shown before stent placement.
Cath lab (2)

- Pronounced dead approximately 60 minutes after arrival in the cardiac catheterization laboratory.
CASE 2—2006
Catastrophic Cardiovascular Collapse During Carotid Endarterectomy

James G. Hecker, PhD, MD,* Lawrence Laslett, MD,†
Emily Campbell, CRNA,‡ Mark Nunnally, MD,§
Anne O’Connor, MD,¶ John E. Ellis, MD,§
Jonathan K. Frogel, MD,* and Lee A. Fleisher, MD*
Society Guidelines

Canadian Cardiovascular Society Guidelines on Perioperative Cardiac Risk Assessment and Management for Patients Who Undergo Noncardiac Surgery

RECOMMENDATION

8. We recommend against performing preoperative resting echocardiography to enhance perioperative cardiac risk estimation (Strong Recommendation; Low-Quality Evidence).
If a patient’s age $\geq 65$ years, RCRI $\geq 1$, or age 45-64 years with significant cardiovascular disease* $\rightarrow$ order NT-proBNP/BNP

- Negative NT-proBNP $< 300 \text{ mg/L}$ or BNP $< 92 \text{ mg/L}$
  - No additional routine postoperative monitoring
Society Guidelines

Canadian Cardiovascular Society Guidelines on

If patient’s age ≥65 years or 18-64 years with significant cardiovascular disease*

Positive NT-proBNP ≥300 mg/L or BNP ≥92 mg/L

NT-proBNP or BNP not available

Measure troponin daily x 48-72 hrs
Obtain ECG in PACU
Consider in-hospital shared-care management**
THE PATIENT IS ASA 5-CLASSIFIED!!

WELL, 3 OF THE 5 ARE DUE TO THE EXPECTED SURGEON...
Surgical Skill and Complication Rates after Bariatric Surgery

John D. Birkmeyer, M.D., Jonathan F. Finks, M.D., Amanda O’Reilly, R.N., M.S., Mary Oerline, M.S., Arthur M. Carlin, M.D., Andre R. Nunn, M.D., Justin Dimick, M.D., M.P.H., Mousumi Banerjee, Ph.D., and Nancy J.O. Birkmeyer, Ph.D., for the Michigan Bariatric Surgery Collaborative

Bleeding and beta blockade = bad!
Impact of Perioperative Bleeding on the Protective Effect of β-Blockers during Infrarenal Aortic Reconstruction

Yannick Le Manach, M.D.,* Gary S. Collins, Ph.D.,† Cristina Ibanez, M.D.,‡ Jean Pierre Goarin, M.D.,‡ Pierre Coriat, M.D.,§ Julien Gaudric, M.D.,|| Bruno Riou, M.D., Ph.D.,# Paul Landais, M.D., Ph.D.**

Anesthesiology. 2012 Dec;117(6):1203-1211.
“Major hemorrhage = receipt of 4 U of PRBCs or whole blood during noncardiac surgery”
Pick your surgeons wisely.
Pick your anesthesiologist wisely?
Postoperative surveillance?
## Table. Relationship Between Peak Postoperative Fourth-Generation Troponin T and 30-Day Mortality and Time to Death

<table>
<thead>
<tr>
<th>Peak Troponin (ng/mL)</th>
<th>30-Day Mortality (%)</th>
<th>Time to Death (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.01</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>0.02</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>0.03–0.29</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>≥0.3</td>
<td>17</td>
<td>6</td>
</tr>
</tbody>
</table>

Modified with permission from the Vascular Events In Noncardiac Surgery Patients Cohort Evaluation (VISION) Study Investigators.\(^{10}\)
2014 AHA/ACCF guideline / troponin

Class III: No Benefit

- Routine postoperative screening with troponin levels in unselected patients without signs or symptoms suggestive of myocardial ischemia or MI is not useful for guiding perioperative management (Evidence: B)
Society Guidelines

Canadian Cardiovascular Society Guidelines on

Emergent/urgent

Elective

Postop Troponin Surveillance
Intense Cardiac Troponin Surveillance for Long-Term Benefits Is Cost-Effective in Patients Undergoing Open Abdominal Aortic Surgery: A Decision Analysis Model

Srinivas Mantha, MD*

Joseph Foss, MD†

John E. Ellis, MD‡

Michael F. Roizen, MD†
“Troponitis?”

Even in absence of CAD, portends poor outcome
Component Results

<table>
<thead>
<tr>
<th>Component</th>
<th>Your Value</th>
<th>Standard Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TROPOIN I</strong></td>
<td>1.28 NG/ML</td>
<td>0.00 - 0.03 NG/ML</td>
</tr>
</tbody>
</table>

REFERENCE RANGE = 0.00 TO 0.03 NG/ML
SUGGESTIVE OF CARDIAC DAMAGE = 0.04 TO 0.5 NG/ML
CONSISTENT WITH MYOCARDIAL INFARCTION = >0.5 NG/ML

CONCLUSIONS:

* 1. Mild CAD: No Stenosis >50% *
* 2. Borderline LV Systolic Function *
* 3. Elevated LVEDP *
3904 patients with elevated hs Troponin assessed for ischemia

- 6.9% had ischemic symptoms
- 25% had ECG change (63% of pts had ECG)
- 17% had new echo abnormality (24% had echo)
Unexpected Cardiac Computed Tomography Findings in Patients With Postoperative Myocardial Injury

Remco B. Grobben, MD, PhD,*† Judith A. R. van Waes, MD, PhD,† Tim Leiner, MD, PhD,‡ Linda M. Peelen, PhD, †§ Gert Jan de Borst, MD, PhD,¶ Henri C. Vogely, MD, PhD, † Diederick E. Grobbee, MD, PhD, § Pieter A. Doevendans, MD, PhD,* Wilton A. van Klei, MD, PhD,† and Hendrik M. Nathoe, MD, PhD,* on behalf of the CHASE Investigators

<table>
<thead>
<tr>
<th>Table 2. Cardiac CTA Outcomes</th>
</tr>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Coronary artery disease</td>
</tr>
<tr>
<td>Total occlusion</td>
</tr>
<tr>
<td>Coronary artery calcium score</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
</tr>
</tbody>
</table>

Data are represented as n (%) unless indicated otherwise.
Abbreviations: CI, confidence interval; CTA, computed tomography angiography; PMI, postoperative myocardial injury.
*Median (interquartile range).
The Long-Term Impact of Early Cardiovascular Therapy Intensification for Postoperative Troponin Elevation After Major Vascular Surgery

Arnaud Foucier, MD,*† Reitze Rodseth, MD,‡§ Mohamed Aissaoui, MD,*† Cristina Ibanes, MD,*† Jean-Pierre Goarin, MD,*† Paul Landais, MD, PhD,|| Pierre Coriat, MD,*† and Yannick Le Manach, MD, PhD¶

+ Troponin N=66
Intensive Rx

Intensive Rx
Wait!
POISE and POISE-2 said...
Clonidine in Patients Undergoing Noncardiac Surgery

Conclusions

• Fewer cardiac events reduce value of preop testing
• Preop eval should be guided by history
  – Stress tests are marginally useful
  – Best used to reclassify intermediate risk patients
Conclusions

• Other factors more important than CAD?
  – Heart failure
  – Arrhythmias
  – Valvular heart disease
  – Fraility
Cardiac Complications in Patients Undergoing Major Noncardiac Surgery

P.J. Devereaux, M.D., Ph.D., and Daniel I. Sessler, M.D.

Preoperative Cardiac Evaluation 2018: Guidelines vs “The Real World?”

John E. Ellis MD

johnellis1700@gmail.com
Society Guidelines

Canadian Cardiovascular Society Guidelines on

Duceppe et al.
Perioperative Cardiac Risk Assessment & Management

<table>
<thead>
<tr>
<th>Patients</th>
<th>Patients age ≥45 years or 18-44 years with known significant cardiovascular disease* undergoing noncardiac surgery requiring overnight hospital admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing of surgery</td>
<td>Emergency surgery</td>
</tr>
<tr>
<td></td>
<td>Proceed to surgery without additional preoperative cardiac assessment</td>
</tr>
<tr>
<td></td>
<td>Urgent/semiurgent surgery</td>
</tr>
<tr>
<td></td>
<td>Proceed to surgery; only undertake preoperative cardiac assessment if unstable cardiac condition or suspected undiagnosed severe PHTN or obstructive cardiac disease**</td>
</tr>
<tr>
<td></td>
<td>Elective surgery</td>
</tr>
<tr>
<td></td>
<td>Assessment of perioperative cardiac risk Risk stratification with RCRI³</td>
</tr>
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<td>If a patient’s age ≥65 years, RCRI ≥1, or age 45-64 years with significant cardiovascular disease* → order NT-proBNP/BNP</td>
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