Update in Perioperative Medicine 2016

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No conflicts of interest to disclose
Learning Objectives

• Utilize the ACC/AHA guidelines in the assessment of perioperative cardiovascular risk
• Manage antiplatelet therapy in patients with coronary stents undergoing surgery
• Manage chronic anticoagulant therapy perioperatively
Cardiac Conundrum

75 y/o gentleman with a history of DM (on insulin), HTN, CKD and CAD (BMS to LAD 4 years ago – no studies since) presents for evaluation before left total hip replacement. Other than his hip pain, he has been feeling fine, though unable to exercise, take stairs or walk for any significant distance for at least 2 years due to his hip pain.

His exam is normal except for BP 146/92 and BMI 38. His laboratory studies are normal except for his baseline CKD (creatinine 1.6) and A1c of 6.8%.

Should you perform noninvasive coronary evaluation prior to this surgery?
CARDIAC RISK ASSESSMENT
Out with the Old

Step 1: Need for emergency noncardiac surgery?
- Yes (Class I, LOE C) → Operating room → Perioperative surveillance and postoperative risk stratification and risk factor management
- No

Step 2: Active cardiac conditions
- Yes (Class I, LOE B) → Evaluate and treat per ACC/AHA guidelines → Consider operating room
- No

Step 3: Low risk surgery
- Yes (Class I, LOE B) → Proceed with planned surgery†
- No

Step 4: Functional capacity greater than or equal to 4 METs without symptoms†
- Yes (Class IIa, LOE B) → Proceed with planned surgery‡

Step 5: No or unknown
- 3 or more clinical risk factors¶
  - Vascular surgery → Class IIa, LOE B → Consider testing if it will change management¶
- 1 or 2 clinical risk factors¶
  - Intermediate risk surgery
- No clinical risk factors
  - Class I, LOE B

Proceed with planned surgery†
In with the New
More to the Heart

• The algorithm is **NOT** a one-stop shop for cardiac risk assessment

• Specific, separate recommendations now included for:
  • Valvular disease
  • Indications for echo
  • Arrhythmias
  • Intracardiac devices
  • Cardiomyopathy/CHF
  • Pulmonary vascular disease

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*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).

Initial Screening for Risk Assessment Necessity

- “Known or risk factors for CAD” – not explicitly defined
- Reasonable to infer these are the same as the risk factors in the Revised Cardiac Risk Index (RCRI)
- If you have an RCRI of 0, risk of major adverse events will definitely be <1%\(^1\,\,2\) – can proceed to OR

Urgency of Surgery

- If surgery is an emergency, proceed to OR
- Even if not a true surgical emergency, timeframe for surgical intervention should always be part of preoperative planning
  - Hip fracture repair (72 hours)
  - Cancer surgery (~few weeks?)
- When in doubt, talk it out
  - If uncertain how much time may be available until surgery must be done, speak with the surgeon
### Acute Coronary Syndromes

- **Current unstable angina** → delay surgery\(^1\)
- **MI (regardless of revascularization)**
  - Wait at least **60 days**\(^{1,2}\)

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

- Clinicians’ understanding and assessment of surgery-specific risk is suboptimal
- No consistent, reliable system of categorizing “low-risk” surgery
- Newer risk calculators which combine surgical and patient risk predictors may have superior predictive value
Patient/Surgical Risk

RCRI

- Only tool that is externally validated
- **Not designed for or validated in ambulatory or low-risk surgery**
- Cardiac outcomes: MI, cardiac death/VFib, pulmonary edema, complete heart block
- C-stat = 0.747\(^1\)

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<table>
<thead>
<tr>
<th>RCRI Points</th>
<th>Original Lee Cohort</th>
<th>Davis Cohort</th>
<th>Davis 5 factor RCRI*(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>1</td>
<td>1.1%</td>
<td>2.6%</td>
<td>2.9%</td>
</tr>
<tr>
<td>2</td>
<td>4.6%</td>
<td>7.2%</td>
<td>7.4%</td>
</tr>
<tr>
<td>≥3</td>
<td>9.7%</td>
<td>14.4%</td>
<td>17.0%</td>
</tr>
</tbody>
</table>

* high-risk surgery, IHD, CVA, CHF, GFR<30ml/min; NOT DM

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Revised Cardiac Risk Index (RCRI)

CAD
CHF
CKD
DM
CVA/TIA

High-risk surgery
- Intraperitoneal
- Intrathoracic
- Suprainguinal vascular

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Patient/Surgical Risk

PMICA Calculator

• Validated on single, but large, study set from NSQIP database
• Cardiac outcomes: 30-day MI and cardiac arrest
• 5 variables plugged into protected calculator:
  – Age
  – Creatinine
  – Functional status
  – Procedure – 21 different
  – ASA classification
• C-stat = 0.874
Patient/Surgical Risk

ACS Surgical Risk Calculator

- Validated on single, but HUGE, study set from NSQIP database
- Assesses mortality, cardiac & 8 other outcomes
- Cardiac outcomes: 30-day MI and cardiac arrest
- 21 variables, including functional status, ASA classification & surgical type (>1500 different types)
- C-stat = 0.895
Surgical Risk Calculator

Procedure: 27447 - Arthroplasty, knee, condyle and plateau; medial AND lateral compartments with or without patella resurfacing (total knee arthroplasty)

Risk Factors:
- Age: 75-84
- Male
- ASA III
- Diabetes (insulin)
- HTN
- Previous cardiac
- Obese (Class II)

Outcomes:

- Serious Complication: Estimated Risk 5%, Chance of Outcome: Above Average
- Any Complication: Estimated Risk 8%, Chance of Outcome: Above Average
- Pneumonia: Estimated Risk 1%, Chance of Outcome: Above Average
- Cardiac Complication: Estimated Risk 1%, Chance of Outcome: Above Average
- Surgical Site Infection: Estimated Risk 1%, Chance of Outcome: Above Average
- Urinary Tract Infection: Estimated Risk 1%, Chance of Outcome: Above Average
- Venous Thromboembolism: Estimated Risk 2%, Chance of Outcome: Above Average
- Renal Failure: Estimated Risk 1%, Chance of Outcome: Above Average
- Return to OR: Estimated Risk 1%, Chance of Outcome: Above Average
- Death: Estimated Risk <1%, Chance of Outcome: Above Average
- Discharge to Nursing or Rehab Facility: Estimated Risk 45%, Chance of Outcome: Above Average

Predicted Length of Hospital Stay: 3.5 days

http://riskcalculator.facs.org/
Patient/Surgical Risk

Functional Status

- In newer models, functional status has been a consistent predictor of multiple complications, including cardiac, pulmonary & death.
- Functional status = capacity to perform ADLs (personal hygiene, feeding, toileting, cooking).

**Best level of self-care within the 30 days prior surgery:**
- **Independent**: No assistance from another person for any ADLs. Includes patients able to function independently with prosthetics, equipment, or devices.
- **Partially dependent**: Requires some assistance from another person for ADLs.
- **Totally dependent**: Total assistance for all ADLs.
Patient/Surgical Risk
ASA Classification

- First developed in 1960s
- Intended as a patient-specific assessment of risk independent of procedure type
- Consistently predictive of adverse outcomes
- Despite this, has wide inter-rater variability, even among anesthesiologists
- Updated with examples in 10/2014

<table>
<thead>
<tr>
<th>Class</th>
<th>Definition</th>
<th>Examples, including, but not limited to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA I</td>
<td>A normal healthy patient</td>
<td>Healthy, non-smoking, no or minimal alcohol use</td>
</tr>
<tr>
<td>ASA II</td>
<td>A patient with mild systemic disease</td>
<td>Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 &lt; BMI &lt; 40), well-controlled DM/HTN, mild lung disease</td>
</tr>
<tr>
<td>ASA III</td>
<td>A patient with severe systemic disease</td>
<td>Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA &lt; 60 weeks, history (&gt;3 months) of MI, CVA, TIA, or CAD/stents.</td>
</tr>
<tr>
<td>ASA IV</td>
<td>A patient with severe systemic disease that is a constant threat to life</td>
<td>Examples include (but not limited to): recent (&lt;3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis</td>
</tr>
</tbody>
</table>

https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system
If the risk of MI/cardiac arrest is <1%, further testing has no benefit → proceed to the OR.
If the risk of MI/cardiac arrest is ≥1%, functional capacity is the next determination.

For most surgeries, the CV stress comes from anesthesia, which studies have shown to be ~4 METs.
Functional Capacity

- Self-reported exertion that a patient regularly experiences without cardiac symptoms
- **Walking 4 blocks or climbing 2 flights of stairs** at any speed strongly associated with low risk\(^1\)
- Duke Activity Status Index (DASI) validated as predictor of actual functional capacity\(^2\)
  - More accurate than clinicians’ assessments\(^3\)
  - Available at [www.iheartmyheart.com](http://www.iheartmyheart.com)

### DUKE ACTIVITY STATUS INDEX

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you take care of yourself (eating, dressing, bathing or using the toilet)?</td>
<td>3.75</td>
<td>0</td>
</tr>
<tr>
<td>Can you walk indoors, such as around your house?</td>
<td>1.75</td>
<td>0</td>
</tr>
<tr>
<td>Can you walk a block or two on level ground?</td>
<td>2.75</td>
<td>0</td>
</tr>
<tr>
<td>Can you climb a flight of stairs or walk up a hill?</td>
<td>0.50</td>
<td>0</td>
</tr>
<tr>
<td>Can you run a short distance?</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>Can you do light work around the house, such as dusting or washing dishes?</td>
<td>2.70</td>
<td>0</td>
</tr>
<tr>
<td>Can you do moderate work around the house, such as vacuuming, sweeping floors or carrying in groceries?</td>
<td>3.50</td>
<td>0</td>
</tr>
<tr>
<td>Can you do heavy work around the house, such as scrubbing floors or lifting and moving heavy furniture?</td>
<td>8.00</td>
<td>0</td>
</tr>
<tr>
<td>Can you do yard work, such as raking leaves, weeding or pushing a power mower?</td>
<td>4.50</td>
<td>0</td>
</tr>
<tr>
<td>Can you have sexual relations?</td>
<td>5.25</td>
<td>0</td>
</tr>
<tr>
<td>Can you participate in moderate recreational activities, such as golf, bowling, dancing, doubles tennis or throwing a baseball or football?</td>
<td>6.00</td>
<td>0</td>
</tr>
<tr>
<td>Can you participate in strenuous sports, such as swimming, singles tennis, football, basketball or skiing?</td>
<td>7.50</td>
<td>0</td>
</tr>
</tbody>
</table>

Duke Activity Status Index (DASI) = sum of “Yes” replies

\[ \text{VO2peak} = (0.43 \times \text{DASI}) \times 8.8 \]

\[ \text{VO2peak} = \frac{\text{mL/kg/min}}{3.5 \text{mL/kg/min}} = \text{METs} \]

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• If patients can achieve $\geq 4$ METs, no further coronary evaluation is indicated
• If such patients don’t manifest coronary disease in their usual activities, they shouldn’t manifest it during a procedure with less stress than they experience every day

If patients cannot achieve ≥4 METs…

*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).

Welcome To The Jungle!!!

You’re gonna die!
If It Will Change Management...

• Changing medical management?
  – Can determine without further testing

• Informed decision making?
  – High-risk option vs lower risk option
  – Defer surgery

• Revascularization?
  – Multiple studies have shown that preoperative revascularization in asymptomatic patients does not improve surgical outcomes
  – No new data to suggest this helps
  – Consistent with literature on intervention for stable CAD in general population – no benefit

Coronary Revascularization Before Noncardiac Surgery

- Indications are the same as for nonsurgical patients
  - Symptomatic
  - Asymptomatic
    - Left main $\geq 50\%$ stenosis
    - LAD $\geq 70\%$ stenosis with severe ischemia on stress testing
    - $\geq 70\%$ stenosis in 3 major coronary vessels
    - $\geq 70\%$ stenosis in 2 major coronary vessels with severe ischemia on stress testing

- For these indications, intervention reduces mortality in the general setting

Circular Argument?

• We shouldn’t stress test patients with the intent of revascularizing, but if we find a “widow maker”, we should revascularize?

• Should we stress test everyone since anyone may be hiding such disease?

• **NO**
  – Costs: would spend millions to find few cases
  – Harms: would cause many more cases of contrast-induced nephropathy (10%) and stroke (0.5%) to find one case of critical CAD
When Would I Stress Test

- Symptoms of cardiac disease **AND** non-urgent surgery
- MACE risk ≥1%, poor functional capacity, elective surgery **AND** clear plan for how results will be used
When Would I **NOT** Stress Test
(Even Though the Algorithm Suggests It)

- Coronary evaluation within past year **AND** no cardiac symptoms since
  - Coronary angiography without significant obstructive CAD
  - Coronary CT angio without significant obstructive CAD
  - Stress test with no ischemia
- Coronary revascularization within past year **AND** no cardiac symptoms since

What If the Stress Test is Abnormal

• Understand that results may or may not indicate a problem – PPV ~20%
• Refer patient to cardiology
  – Explain the situation that led to ordering the stress test
  – Tactfully explain that your referral is not an inferred expectation of cath + intervention

– 60.6% of pts undergoing preop cardiac cath are asymptomatic
– 48.1% of caths abnormal in pts with abnormal stress testing
– 72% of revascularized pts had no, atypical or stable angina
  • 1.3% had left main stenosis >70%
  • 13.8% had proximal LAD >70% stenosis
– Among revascularized pts, 14 died, 83 experienced a stroke, and 473 had an MI before surgery
76 y/o AAM with HTN, DM2 and CAD who underwent PCI with everolimus-eluting stenting 4 months ago presents for right total knee arthroplasty revision (he has loosening of the components causing joint instability). He has been asymptomatic and his vital signs, labs and ECG are normal.

When would you be OK with surgery occurring?
CARDIAC RISK MANAGEMENT

For ischemic cardiac disease (CAD):

• Appropriate antiplatelet management
• Beta-blockade
• Statin therapy
• Postoperative MI surveillance
Perioperative Antiplatelet/PCI Management

Guidelines for surgical delay after coronary revascularization

- **Angioplasty without stent**
  - Wait 14 days

- **Bare metal stents (BMS)**
  - Wait 30 days

- **Drug-eluting stents (DES)**
  - Optimally wait 1 year but can proceed after 6 months if risks of delay > risks of stent thrombosis
  - Recent studies suggest thrombotic risk with newer generation DES is much lower and plateaus at 3-6 months after placement

- **CABG**
  - Wait 4-6 weeks?

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2016 ACC/AHA Guideline Update

When you gotta go, you gotta go...

- When possible and especially when surgery is necessary prior to optimal delay, continue dual antiplatelet therapy (DAPT) through surgery.
- When continuing DAPT is not possible, continue aspirin (81 mg) through surgery.
A 79 y/o AAF comes to clinic for preop evaluation before undergoing a cystectomy for newly diagnosed bladder cancer
PMH: AFib, HTN, DM2 (controlled), CHF (stable, LVEF 35%) Meds: warfarin, metformin, atenolol
Exam: unremarkable except for irregular rhythm and right hip DJD
ECG: AFib with HR 72
Labs: BMP normal (GFR >60), CBC normal, INR 2.2

Would you provide perioperative anticoagulation bridging?
Until the last year, the decision to provide bridging anticoagulation during warfarin interruption was largely empirical. Much recent data has triggered rethinking of previous guidelines.
**2012 ACCP Guidelines for Perioperative Bridging of Warfarin Patients**

<table>
<thead>
<tr>
<th>BRIDGE/CLASS</th>
<th>BILEAFLET mechanical aortic valve without AFib, CVA, or other risk factors (CHADS$_2$ factors)</th>
<th>No bridging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (≤5%)</td>
<td>AFib + CHADS$_2$ score ≤2 and no prior CVA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VTE &gt;12 mo previous with no other risk factors</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BRIDGE/CLASS</th>
<th>Bileaflet mechanical aortic valve + AFib or CHADS$_2$ score &gt;0</th>
<th>Bridging on case-by-case basis; use therapeutic- or LMWH only an option in patients with VTE as their indication for chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>AFib + CHADS$_2$ score 3-4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BRIDGE/CLASS</th>
<th>Mitral or caged ball/tilting disc aortic mechanical valve, or bileaflet mechanical aortic valve with recent CVA</th>
<th>Bridge with therapeutic LMWH or UFH</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (≥10%)</td>
<td>AFib + CHADS$_2$ score &gt;4, rheumatic valvular heart disease (mitral stenosis), or recent CVA or TIA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VTE within past 3 mo or with severe thrombophilia</td>
<td></td>
</tr>
</tbody>
</table>

CHADS$_2$ & CHA$_2$DS$_2$-VASc equally predictive of postop CV events (including stroke)²

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¹ Douketis JD et al. Chest. 2012;141(S2):e326S-e350S.
Bridging Anticoagulation

New Evidence

- ORBIT-AF prospective registry study’s findings of >7000 AFib patients:¹
  - Bleeding was more common in bridged patients than non-bridged (5.0% vs. 1.3%, adjusted OR 3.84, p<0.0001)
  - MI, embolic events, major bleeding and death within 30 days were also more common in bridged patients (13% vs. 6.3%, adjusted OR 1.94, p=0.0001)

- Kaiser Permanente retrospective cohort study of >1000 VTE patients:²
  - Bridging associated with increased bleeding (HR 17.2; 95% CI, 3.9-75.1)
  - No difference in VTE recurrence with bridging

BRIDGING ANTICOAGULATION IN PATIENTS WHO REQUIRE TEMPORARY INTERRUPTION OF WARFARIN THERAPY FOR AN ELECTIVE PROCEDURE OR SURGERY

- Large (~1800 patients) multicenter RCT of AFib patients with CHADS$_2$ >0 using therapeutic-dose LMWH for bridging
- Warfarin cessation and LMWH dosing per ACCP guidelines

## BRIDGE Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No Bridging (N=918)</th>
<th>Bridging (N=895)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>4 (0.4)</td>
<td>3 (0.3)</td>
<td>0.73</td>
</tr>
<tr>
<td>Stroke</td>
<td>2 (0.2)</td>
<td>3 (0.3)</td>
<td></td>
</tr>
<tr>
<td>TIA</td>
<td>2 (0.2)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td><strong>Major bleeding</strong></td>
<td>12 (1.3)</td>
<td>29 (3.2)</td>
<td><strong>0.005</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No Bridging (N=918)</th>
<th>Bridging (N=895)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>5 (0.5)</td>
<td>4 (0.4)</td>
<td>0.88</td>
</tr>
<tr>
<td>MI</td>
<td>7 (0.8)</td>
<td>14 (1.6)</td>
<td>0.10</td>
</tr>
<tr>
<td>DVT</td>
<td>0 (0)</td>
<td>1 (0.1)</td>
<td>0.25</td>
</tr>
<tr>
<td>PE</td>
<td>0 (0)</td>
<td>1 (0.1)</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Minor bleeding</strong></td>
<td>110 (12.0)</td>
<td>187 (20.9)</td>
<td><strong>&lt;0.001</strong></td>
</tr>
</tbody>
</table>

BRIDGE Limitations

- Few patients (6%) had a high CHADS$_2$ score (5-6)
- Few patients with true valvular AFib (i.e., with mitral stenosis)
- Excluded patients with recent stroke (<3 months)
- Findings should not be applied to patients with mechanical heart valves or venous thromboembolism

Moving Forward – Adjusting ACCP Guidelines Based on New Evidence

<table>
<thead>
<tr>
<th>TE Risk (annual rate)</th>
<th>Patient Characteristics</th>
<th>Bridging Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt;5%)</td>
<td>BILEAFLET mechanical aortic valve without AFib, CVA, or other risk factors (CHADS₂ factors)</td>
<td>No bridging</td>
</tr>
<tr>
<td></td>
<td>AFib + CHADS₂ score ≤4 and no recent CVA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VTE &gt;12 mo previous with no other risk factors</td>
<td></td>
</tr>
<tr>
<td>Intermediate (5%-10%)</td>
<td>Bileaflet mechanical aortic valve + AFib or CHADS₂ score &gt;0</td>
<td>Bridging on case-by-case basis; use therapeutic- or prophylactic-dose&lt;sup&gt;a&lt;/sup&gt; LMWH or UFH</td>
</tr>
<tr>
<td></td>
<td>AFib + CHADS₂ score &gt;4, rheumatic valvular heart disease (mitral stenosis), or recent CVA or TIA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recurrent VTE or VTE within past 3-12 mo or associated with thrombophilia or active cancer</td>
<td></td>
</tr>
<tr>
<td>High (&gt;10%)</td>
<td>Mitral or caged ball/tilting disc aortic mechanical valve, or bileaflet mechanical aortic valve with recent CVA</td>
<td>Bridge with therapeutic LMWH or UFH</td>
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<td></td>
<td>VTE within past 3 mo</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Prophylactic-dose LMWH only an option in patients with VTE as their indication for chronic anticoagulation.

Weight of evidence suggests foregoing bridging unless very high thrombotic risk and low bleeding risk.

Adapted from Douketis JD et al. Chest. 2012;141(S2):e326S-e350S.
Conclusions

• The last few years have produced much new data in the area of perioperative medicine, and the coming years will likely be similar

• Taken together, they continue to confirm the fundamentals of perioperative medical care:
  – Be thorough
  – Be thoughtful
  – Be a strong communicator
  – Do what you would do in the general practice setting
Thank You

Did a preop today

Didn’t use the word “clearance”

For a copy of my guide to preop evaluation, e-mail: kpfeifer@mcw.edu