Evidence-Based Preoperative Evaluation

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DISCLOSURE: Dr. Pfeifer does not have any relevant financial relationships with any commercial interest that pertains to the content of my presentation.

Learning Objectives

- Highlight cost-effective perioperative care
- Identify common areas of misunderstanding in perioperative medicine
- Utilize recent literature to provide evidence-based medical care to surgical patients

Medical Comorbidities and Surgery

- Surgical population continues to become older and sicker
- Bundles, value-based reimbursement & reporting metrics have increased pressure to lower complications and costs

Fundamentals

- Systematic process
  - Cardiovascular
  - Pulmonary
  - Hematologic
  - Endocrine
  - Renal
  - GI
  - Neuro
  - Medications

  *Preops are NOT for “clearance” – they are for optimization, risk communication, & postop care planning*

  - Communicate, communicate, communicate
  - No perfect, single risk assessment tool for an organ system
  - Even with best care practices, a small percentage of patients will have negative outcomes

A Big Topic

- Screening diagnostic studies
- Pulmonary
- Cardiovascular
- Hematologic
- Endocrine
- Infectious diseases
- Renal disease
- Other chronic conditions
- Medications

Focus for Today

Top practice changes you should implement starting now in:

- Screening diagnostics
- Pulmonary
- Cardiovascular
- Hematologic

Death by a Thousand Blood Draws

A 64 y/o gentleman with a PMH of HTN and hyperlipidemia presents for evaluation before undergoing a left inguinal hernia repair. He has otherwise felt well. His only meds are atenolol and atorvastatin. He reports no bleeding or easy bruising.

What screening diagnostic tests would you order before surgery?

A) BMP, CBC, UA, PT/INR, PTT, CXR, ECG
B) ECG, BMP, CBC, PTT, & PT/INR
C) ECG
D) Nothing
Coagulation
Timing

• Estimated $30 billion spent on unnecessary perioperative diagnostic testing
• CMS & other payers are targeting such unnecessary testing
• Needless testing also leads to unnecessary worry, further unneeded studies and delays in surgery

[Image of a page with a table and text]

Serum
bleeding
management

• Obtain
Screening
Does

• Urologic

• Exception:
• Coagulation studies – not necessary if history and exam identify no bleeding risks2,3
• Exception: intracranial surgery
• Timing of studies: repeating labs within 2–4 months unlikely to change management or impact outcomes if no change in clinical status5,6

Chromatography

• Routine laboratory screening for abnormalities in serum chromatography, coagulation studies or blood counts has low yield1,2
• When abnormalities are found, they rarely correlate with clinically significant risk1,2

[Image of a page with a table and text]

Indications for Preop Blood Tests

• If low-risk surgery (cataract, hernia), no labs indicated for preop purposes1
• Serum chemistries – obtain when otherwise indicated2,3
  • Example: patient on diuretic with no recent electrolyte or renal function testing
• Hemoglobin – obtain only if signs, symptoms or risk factors for anemia1,2,3
• Coagulation studies – not necessary if history and exam identify no bleeding risks2,3
  • Exception: intracranial surgery
• Timing of studies: repeating labs within 2–4 months unlikely to change management or impact outcomes if no change in clinical status5,6

Chest Radiography

• Screening CXR in asymptomatic patients is problematic1
  • Poor yield (~5–20%)
  • Poor correlation with risk
  • Rarely changes management (~5%)
• ABIM Foundation’s Choosing Wisely Campaign:
  • 3 different societies recommend against CXR in patients without signs or symptoms of disease
• Reserve for patients with active pulmonary disease or symptoms

Urinalysis

• USPSTF & IDSA guidelines: do not screen for asymptomatic bacteriuria (AB) except in1,2:
  • Pregnancy
  • Urologic surgery
• Screening and treatment of AB NOT indicated in other settings
  • Does not improve outcomes1,4
  • Does cause harm:
    • C. difficile infection
    • Antibiotic resistance
    • Actually increases risk of UTI & wound infection6
• Obtain if urinary symptoms

Preoperative ECGs

• ECG leads to change in management in ~2% of cases1
  • Main utility is to provide baseline for postop comparison
  • Advanced age alone is not an indication1,2
• 2014 ACC/AHA Guidelines1:

  | Reassuring for diagnosis of coronary artery disease, CHF, arrhythmias, electrolyte abnormalities, \( \Delta \text{ BUN/creatinine} \), or other significant clinical condition | Instruct patients to avoid known triggers for symptoms |
  | Reasonable for evaluation of chest pain, prior CAD, atypical symptoms, \( \Delta \text{ BUN/creatinine} \), or other significant clinical condition | If indicated, obtain within 1–3 months |

  * At Froedtert Hospital, we obtain in patients with coronary disease equivalents

**SCREENING DIAGNOSTICS – Key Points**

- Nothing should be reflexive – every test should have a clear indication/purpose
- Almost all lab indications are based upon patient characteristics rather than procedure
- Screening for asymptomatic bacteriuria does not improve outcomes & causes harm
- CXRs should be obtained only for active cardiopulmonary disease
- ECGs are not indicated for low-risk surgery (eg, procedures performed under moderate sedation)

**PULMONARY RISK ASSESSMENT**

Postoperative pulmonary complications (PPCs), including respiratory failure and pneumonia, are common yet underappreciated

- 5.8% in modern major abdominal surgery cohorts
- Account for >50% of negative perioperative outcomes
- Carry higher cost, morbidity and mortality than cardiac complications

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**Pulmonary Risk Assessment**

Requires assessment of 3 different components because available assessment tools do not capture risks for all 3:

- General pulmonary risk
- Airway/ventilation risk
- Sleep apnea risk

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**General Pulmonary Risk Factors**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Adjusted OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;65 y</td>
<td>1.30±</td>
</tr>
<tr>
<td>COPD</td>
<td>1.79±</td>
</tr>
<tr>
<td>OSA</td>
<td>1.86±</td>
</tr>
<tr>
<td>Smoking</td>
<td>1.52±</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>--±</td>
</tr>
<tr>
<td>Acute kidney injury</td>
<td>2.21±</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>1.84±</td>
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</tbody>
</table>

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**General Pulmonary Risk Indices**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Adjusted OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARISCAT (Canet et al) – 2010/2016</td>
<td>0.75–0.87</td>
</tr>
<tr>
<td>ACS Surgical Risk Calculator – 2013</td>
<td>0.870</td>
</tr>
<tr>
<td>PERISCOPE (Canet et al) 2015</td>
<td>0.82</td>
</tr>
</tbody>
</table>

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**General Pulmonary Risk Stratification**

- Multiple risk indices have been developed
- Many are highly specific to either population (eg, abdominal surgery) or unique complication (eg, acute lung injury)
- Most have not been externally validated
- Most created from databases in which OSA was not recorded
- A few have been more inclusive in terms of population and outcomes...
Which Index to Use

<table>
<thead>
<tr>
<th>CLASS</th>
<th>Risk Index</th>
<th>PPC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>2</td>
<td>2-2.2</td>
</tr>
<tr>
<td>Intermediate</td>
<td>6-7.5</td>
<td>2.2-5.0</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>5-5.5</td>
</tr>
</tbody>
</table>

General Pulmonary Risk Reduction Strategies

- Literature for different risk reduction strategies is mixed
- Available data would suggest several interventions can be beneficial:
  - Use of anesthesia methods other than general anesthesia
  - Use of lung-protective mechanical ventilation
  - Epidural and PCA-based opioid administration
  - Lung expansion maneuvers
  - Preoperative respiratory muscle therapy
  - Smoking cessation – even if shortly before surgery
- However, no literature to guide us on which to employ for which patients

General Pulmonary Risk Reduction – Suggested Approach for PCPs

LOW risk of PPCs:
- Obesity (BMI > 35) or obstructive sleep apnea
- Smoking
- Prolonged period of ventilation

INTERMEDIATE risk of PPCs: all of above +
- Comorbidities (coronary artery disease, heart failure, chronic obstructive pulmonary disease)

HIGH risk of PPCs: all of above +
- Morbid obesity (BMI > 40)
- Preoperative use of muscle relaxants

To Sleep, Perchance Never to Wake Up

60 y/o obese man with a PMH of HTN and type 2 DM presents for preop evaluation before undergoing left knee replacement. He reports no cardiac or respiratory symptoms. He admits to daytime fatigue and waking his bed partner up with his snoring. His BMI is 42 kg/m² and his measured neck circumference is 45 cm.

Which of the following is the best perioperative management plan for this patient?
A) Delay surgery and refer to a sleep medicine physician
B) Proceed with surgery with plan for continuous pulse oximetry monitoring

Sleep Apnea

- Prevalence of moderate-severe OSA (AHI ≥ 15) = 9-22% ±
- Severity of sleep-disordered breathing (SDB) in OSA patients is increased postop
- Associated with increased perioperative complications of multiple types:
  - Prolonged LOS, ICU transfers, respiratory failure, cardiovascular events, delirium, AKI, VTE, mortality

Airway Assessment

- Predictors of difficult ventilation:
  - Beard
  - Obesity (BMI > 26)
  - Age > 55
  - Edentulous
  - Snoring

If >1 risk factor for either, alert anesthesia team
Preoperative OSA Management Guidelines

- Use a high-sensitivity tool to screen for OSA.
- Increased risk of moderate-severe OSA: STOP-BANG ≥5
  - 35% probability of severe OSA
- Increased pulmonary complications if score ≥5
- Further evaluation indicated before surgery if:
  - STOP-BANG ≥5 + uncontrolled systemic condition (eg, pulmonary hypertension) or hypoxemia
  - STOP-BANG ≥3 + hypercarbia

Postoperative Risk Reduction for OSA

- Regional analgesic techniques & non-opioid analgesics when possible
- Use sedatives judiciously
- Non-supine positioning (elevate HOB)
- More conservative operative location & postop triage
  - Hospital OR for procedure instead of clinic or outpatient surgical center
  - Admit for observation instead of outpatient surgery
- CPAP
  - Continue if patient used preoperatively
  - Initiate postop if patient has severe hypoxemia or obstruction
- Continuous pulse oximetry (or capnography) with continuous monitoring

PULMONARY RISK – Key Points

- Assess for general, airway, and sleep apnea risk
- Optimize pulmonary disease & get patients to quit smoking – regardless of how little time before surgery
- Delay surgery for sleep medicine evaluation for STOP-BANG ≥5 plus uncontrolled systemic disease/hypoxia, or STOP-BANG ≥3 plus hypercarbia/hypercapnia
- Consider prehabilitation/inspiratory muscle training for high pulmonary risk patients
- Communicate airway management risks to the anesthesia team in advance of surgery

Pick An Index, Any Index?

67 y/o gentleman with a history of DM (on insulin), HTN, CKD and CAD (BMI 38) 4 years ago – no studies since) presents for evaluation before left total knee arthroplasty. He has had no recent exertional symptoms or chest pain. He has not seen cardiology since he moved 2 years ago.

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%.

Which of the following would you use for preop cardiac risk stratification?

A) Revised cardiac risk index (RCI)
B) ACS Surgical Risk Calculator (ACS-SRC)
C) Duke activity status index (DASI)
D) B-type natriuretic peptide (BNP)

CV RISK ASSESSMENT

- No single tool captures CV risk of all types – available ones just focus on ischemic risk
- Even when available tools suggest someone is low risk & requires no further evaluation, their rate of CV complications may still be as high as 3% depending on the procedure
- Little to no data supporting any interventions to reduce risk – specifically, revascularization does not improve outcomes in asymptomatic patients

Perioperative CV Management Guidelines

- Three different guidelines as well as newer literature offer different approaches – ACC/AHA, ESC/ESA, CCS
- 2014 ACC/AHA Guideline remains primary resource in the US
  - Algorithm for assessment of ischemic cardiac risk
  - Separate sections for other cardiac disease
    - Indicators for echocardiography
    - Valvular disease
    - Arrhythmias
    - Intracardiac devices
    - Cardiomyopathies/CHF
    - Pulmonary vascular disease

Cardiovascular Red Flags

Before even going through the algorithm, one should identify active/severe cardiac conditions that should prompt delay/reconsideration of surgery
- SYMPTOMS FIRST – any new or progressed symptoms of cardiac disease
- Severe valvular disease
- Pulmonary hypertension that is severe and/or associated with impaired RV function
- Uncontrolled arrhythmias (including AFib with HR >110)
- Recent CV events...

Timing of Surgery After Coronary Intervention

**Angioplasty without stent**
- Wait 14 days

**CABG**
- Wait 2-3 months

*Speak with patient's cardiologist*

Risk factors (number & location of events, DM, CKD) may make longer delays optimal

Optimally wait 26 months but may be OK after ≥3 months

MACE Risk Estimation – Revised Cardiac Risk Index (RCRI)

- Only tool that is externally validated
- Not designed for or validated in ambulatory or low-risk surgery
- Originally selected only for INPATIENT outcomes
- Re-validated in modern cohort and with new CKD definition (GFR <30) and without DM (5-factor RCRI)²

Revised Cardiac Risk Index (RCRI)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Score</th>
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<tbody>
<tr>
<td>Age &gt;70</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
</tr>
<tr>
<td>DM</td>
<td>1</td>
</tr>
<tr>
<td>CAD</td>
<td>1</td>
</tr>
<tr>
<td>CKD</td>
<td>1</td>
</tr>
<tr>
<td>CVA/TIA</td>
<td>1</td>
</tr>
<tr>
<td>High-risk surgery</td>
<td>1</td>
</tr>
<tr>
<td>Preoperative atrial fibrillation</td>
<td>1</td>
</tr>
</tbody>
</table>

RCRI ≥ 1
go to OR

MACE Risk Estimation – 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

Timing is Everything for CV Risk

Avoid surgery after recent cardiovascular events:
- MI
  - 18% increase in MACE risk within 60 days after MI¹²
  - Risk may persist up to 1 year if PCI performed for MI¹
- CVA³
  - CVA – OR 10.0 within 6 months
  - MI – OR 5.4 within 6 months
  - Mortality – OR 4.4 within 3 months

Ischemic Cardiac Risk Assessment

Coronary evaluation (stress testing) not indicated for asymptomatic patients with any of the following:
- Requiring non-elective, urgent surgery (<6 weeks)³
- Normal coronary evaluation or coronary revascularization within past year²
- Risk of major adverse cardiac event (MACE) <1%³
- Functional (exercise) capacity ≥4 METs³
- BNP <92 mg/L or NT-proBNP <300 mg/L³

Association Between Revised CV Events and Postoperative CV

<table>
<thead>
<tr>
<th>Event</th>
<th>Without 6 weeks</th>
<th>Revised 6 months</th>
</tr>
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<tbody>
<tr>
<td>MI</td>
<td>16%</td>
<td>7%</td>
</tr>
<tr>
<td>CVA</td>
<td>12%</td>
<td>3%</td>
</tr>
</tbody>
</table>

**MACE Risk Estimation – ACS Surgical Risk Calculator**

- Validated on single, but HUGE, study set from NSQIP database
- Recalibrated in 2015
- Assesses mortality, cardiac & 12 other outcomes
- >1500 different types
- C-stat = 0.895 (best of all)
- Several single-institution studies have found less predictive value

**Functional Capacity**

- Previously relied on clinicians’ subjective assessment
- Recently published METS trial found that was useless for all outcomes
- Duke Activity Status Index (DASI) has been validated as predictor of actual functional capacity and found to be more accurate than clinicians’ assessments
- METS trial found that only DASI (not cardiopulmonary exercise testing, biomarkers or subjective assessment) correlated with the primary outcome of 30-day MI and mortality
- DASI score cut-off to rule out prediction of low risk has been determined, with published in secondary analysis of meta analysis

**Preoperative Coronary Evaluation**

Recommended by the ACC/AHA guidelines if none of the “escape criteria” are met, and the results will change management

- **Exercise criteria:**
  - Can usually determine without further testing
  - Only if symptoms or left main/3-vessel disease
  - Multiple studies have shown that preoperative revascularization in asymptomatic patients does not improve surgical outcomes
  - Most peri-operative revascularizations do not meet current appropriateness criteria and can result in serious complications
  - Informed decision-making?
  - High-risk option vs lower risk option
  - Deferring surgery

**CARDIOVASCULAR DISEASE – Key Points**

- Think beyond the coronaries – often CAD is the least of our worries
- Recent CV events are associated with high-risk for postoperative morbidity and mortality
- Use RCRI of 0 as “rule out” need for further coronary evaluation, but otherwise use with caution & consider ACS Surgical Risk Calculator or Gupta MICA calculator to estimate risk of CV events
- Utilize DASI for functional capacity assessment
- Preoperative coronary revascularization does not improve outcomes

**BRIDGING ANTICOAGULATION**

- 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**

- Low risk
  - No bridging
  - INR < 1.5, no active bleeding or surgical site
  - INR < 2.0, no active bleeding or surgical site

- Intermediate risk
  - No bridging
  - INR < 1.5, active bleeding or surgical site
  - INR < 2.0, active bleeding or surgical site

- High risk
  - Bridging with LMWH
  - INR > 2.0

**Notes:**

Bridging Anticoagulation

The Evidence

• ORBIT-AF prospective registry study’s findings of >7000 AFib patients:
  - 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 (1.3% vs. 6.3%, adjusted OR 1.94, p<0.0001)
• Kaiser Permanente retrospective cohort study of >1000 VTE patients:
  - Bridging associated with increased bleeding (HR 17.2; 95% CI, 3.9-75.1)
  - No difference in VTE recurrence with bridging

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 (0.0)</td>
<td></td>
</tr>
<tr>
<td>Major bleeding</td>
<td>13 (1.4)</td>
<td>20 (2.2)</td>
<td>0.085</td>
</tr>
</tbody>
</table>

BRIDGE Limitations

• Few patients (6%) had a high CHADS2 score (5-6)
• Few patients with true valvular AFib (ie, mitral stenosis)
• Excluded patients with recent stroke (<3 months)
• Findings should not be applied to patients with mechanical heart valves or venous thromboembolism

2017 ACC Expert Consensus Decision Pathway for Periprocedural Management of Anticoagulation in Patients With Nonvalvular Atrial Fibrillation


- Evidence-based consensus of 7-member panel, which included PI of BRIDGE study (the largest source of influence on the pathway)
- Nonvalvular AFib = no rheumatic mitral stenosis, valve prosthesis (mechanical or biologic) or mitral valve repair

Which AFib Patients to Bridge

- WARFARIN:
  - Definitely
    - CHADS2, VASc >6 or thromboembolism (TE) within 3 months + NO patient risk factors for bleeding
  - Likely
    - CHADS2, VASc >6, or TE within 3 months + patient risk factors for bleeding using a PI’s criteria
  - Not likely
    - Any prior MI, NO patient risk factors for bleeding
  - DOACs: NO, NO, NO!
- In the only two studies in which DOACs were bridged, there was a much increased rate of bleeding

Patient Bleeding Risk Factors

- Major bleed or SAH within 3 mo
- Thromboembolism
- Stroke (any source) excluding AFib
- Severe hypertension
- Bleeding with previous bridging or similar procedure

J Am Coll Cardiol. 2017;69(7):871-88
Adjusting ACCP Guidelines

<table>
<thead>
<tr>
<th>Low (0-5%)</th>
<th>Intermediate (5-10%)</th>
<th>High (&gt;10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Characteristics</td>
<td>Bridging Strategy</td>
<td>ATE Risk Factors</td>
</tr>
<tr>
<td>Low risk, no bridging</td>
<td>Low risk, no bridging</td>
<td>AFib, ATE, Hypercoagulation, LV systolic dysfunction</td>
</tr>
<tr>
<td>Intermediate risk, low risk bridging</td>
<td>Intermediate risk, low risk bridging</td>
<td>Hypercoagulation, LV systolic dysfunction</td>
</tr>
<tr>
<td>High risk, bridging</td>
<td>High risk, bridging</td>
<td>Hypercoagulation, LV systolic dysfunction, ATE</td>
</tr>
</tbody>
</table>

BRIDGING ANTICOAGULATION – Key Points

- No study of bridging has ever shown benefits, and all studies have shown increased bleeding risk
- Think bleeding risk first
- High-risk patients (multiple VTE events, severe thrombophilia, mechanical mitral valve, CHA2DS2-VASc >6) may still be candidates for bridging – but do so with the greatest vigilance & coordination
- Say it with me – DON'T BRIDGE DOACS!

Summary

- Perioperative medicine will only continue to become more challenging and yet more critical
- Employment of available literature & guidelines in standardized protocols based upon institutional consensus will facilitate best care for your patient population

Thank You