Perioperative Medical Consultations

-the heart is just the start

Thomas Gearan, MD FACP
Maine Medical Partners
Internal Medicine

Steve Hess, MD MBA FACP FACCP
Maine Medical Partners
Hospital Medicine

September 21, 2018
Presenter Disclosures

• Thomas Gearan, MD FACP: None

• Steve Hess, MD FACP: None
Outline

- Peri-Operative Surgical Home
- Pre-Operative Assessment:
  - Assessment of cardiac risk
  - Assessment of functional capacity
  - Approach to pre-operative cardiac testing
  - Pre-operative approach to common medications prescribed by the internist
- Enhanced Recovery After Surgery
  - How these principles shape modern surgery and impact medical consultation
- Post-Operative/Hospital Management
Perioperative Surgical Home

- “An evolving concept of more rigorously coordinated and integrated perioperative management”
- Parallels the Patient-Centered Medical Home
  - Shares the concepts of improved clinical outcomes and reductions in cost of care through patient engagement and coordination of care
- Describes an enterprise-wide effort to optimize an episode of care by using proven methods and processes before, during, and after the surgical episode.

BITA A. KASH, * YICHEN ZHANG, * KAYLA M. CLINE, * TERRI MENSER, * and THOMAS R. MILLER †

*Texas A&M University; †American Society of Anesthesiologists

Milbank Quarterly, Vol. 92, No. 4, 2014
# Key Elements of Perioperative Surgical Home

## Preoperative Key Elements
- Admission through a centralized preoperative area/clinic
- Early preadmission assessments using standardized protocols
- Centralized systems to gather health and other information about patients before hospital admission
- Preoperative innovations such as “prehabilitation” programs for targeted patients
- A triage system to identify which patients need to attend a preadmission clinic or program
- Individualized perioperative care plans
- Use of a multidisciplinary team–based clinical care processes within the hospital to coordinate complex preparation of patients before surgery

## Intraoperative Key Elements
- Integrated pain management
- Fast-track surgery and discharge home
- Precise fluid management
- Operating room (OR) case–delay reduction techniques
- Increased OR efficiency through improved OR flow
- Scheduling initiatives to reduce cancellations and increase efficiency
- Anesthesiologist as the OR coordinator
- Enterprise-wide (integrated) scheduling
- Integrated ambulatory and inpatient electronic health record system

## Postoperative Key Elements
- Perioperative care plan continued
- Integrated pain management
- Early postoperative mobilization by physical therapy and integrated acute care and rehabilitation care
- Improved coordination of care from postoperation to discharge home or to rehabilitation facility
- Improved discharge protocol
- ERAS initiatives
- Increased patient and caretaker education concerning postdischarge care

Kash et al, Milbank Quarterly 2014
Maine Medical Center
Patient Readiness and Education Program (PREP)

- **Front End Program** for 34,500 surgical cases
  - Over 50% of all MMC adjusted discharges.

- **Patient Education, Assessment, and Preparation**
  - Begins in the surgeon’s office

- **Document Acquisition and Assembly**

- **Nurse Call System**
  - Comprehensive Nursing and Preoperative Risk Assessment
    - Targeted Clinical Information
    - Medication Reconciliation
  - Clinical algorithm maps severity of surgical risk against seriousness of medical co-morbidities and triages to:
    - Surgery
    - Electronic Provider Review
    - PREP Clinic Visit
MMC PREP Clinic

- **Multidisciplinary Team**
  - Nurses, APPs, Anesthesiologists, Internists and Clerical Staff

- **Anesthesia Plan of Care**
  - Initiated and consented

- **Medical Plan of Care**
  - Medical Consult created and passed to inpatient consult team

- **All Patients**
  - Medication reconciliation and instructions
  - Problem list initiated and prepared for Surgeon, Anesthesia, Med Consult, and “Epic” Primary Care
    - All team members are aware of relevant risks and the plan to address
PREP Clinic

- Identify and Optimize Risk
  - Application of Evidence Based Perioperative Protocols
    Glycemic Management, Anticoagulation, Medication Management
  - Protocol Driven Screening
    Stop Bang, Timed Up and Go, Mini-cog,
  - Fast Tack Programs
    OSA, Diabetes, Cardiac Risk Stratification, Anemia
- Perioperative Plan to maintain Optimization and avoid need for Rescue
Case

• **Patient:** 81 year old female

• **Reason for PREP Visit:** pre-operative visit prior to right total knee replacement, to be performed in 4 weeks.

• **HPI:**
  - Progressive right knee pain
  - Unresponsive to conservative management
  - Limiting her ability to do ADLs
  - X-ray demonstrates end-stage OA of right knee

• **PMHx:**
  - Atrial fibrillation:
    » Cardioversion 2017, recurrence
    » CHA2DS-VASc: 4, on Xarelto
  - Moderate mitral regurgitation
  - HTN
  - Asthma: mild-intermittent
  - Hypothyroidism
  - Peripheral neuropathy

• **PSHx:**
  - Right THR 2009
  - Hysterectomy
Case

• **Medications:**

  - Atenolol
  - Lisinopril
  - HCTZ
  - Rivaroxaban (Xarelto)
  - Simvastatin
  - Albuterol PRN
  - Levothyroxine
  - Gabapentin

• **Social History:**

  - Married
  - Lives in house with husband
  - Non-smoker
  - No alcohol.

• **Allergies:** shellfish
Ortho Visit (earlier today)

- Planning for surgery:
  - Dental care
  - Pain control planning
  - Anticoagulation plan:
    » Stop Xarelto 3 days ahead of surgery
Ortho Visit (earlier today)

• Planning for surgery:
  - Dental care
  - Pain control planning
  - Anticoagulation plan:
    » Stop Xarelto 3 days ahead of surgery
  - “Need Medical Clearance”
Medical Clearance
Medical Clearance
Medical Clearance

Preoperative Medical Assessment
Preoperative Medical Assessment

• Goals:
  - Identify issues and optimize management
  - Minimize risk, not “clearance” from risk
  - Be thorough, but do not create unnecessary delays
  - Where appropriate, develop a perioperative medical plan of care

• How:
  - Do your homework before you see the patient, including review of pertinent records, and a “pre-estimating” their cardiac risk
  - Take a history, focusing on most pertinent medical conditions, cardiac history, functional status, and ROS
  - Physical exam, with focus on heart, lungs, and volume status
  - Obtain additional testing when necessary
  - Make specific recommendations
Variables in the Preoperative Medical Assessment

- **Patient’s Medical Conditions**
  - Risk modification within timeline
  - Management options and customization to patient

- **Anticipated Surgery**
  - High Risk vs Intermediate Risk vs. Low Risk

- **Urgency of Surgery**
  - Emergent, Urgent, Elective

- **Anticipated Type of Anesthesia**
  - Recommending anesthesia type, not appreciated
  - Identifying issues in a timely fashion, appreciated

- **Anticipated Length of Stay**
  - Inpatient, Ambulatory, or Bedded Outpatient
High Risk Patients

- Low Functional Status (< 4 mets)
- BMI <17 or >45
- Neuro: cognitive deficits or CVA/TIA within 6 months
- Endocrine: poorly-controlled DM with A1c>8.5
- Renal: ESRD or GFR <45
- Substance abuse: ETOH> 4 drinks/day
- Liver:
  - Cirrhosis, ascites or esophageal varices
- Pulmonary:
  - Chronic O2 supplementation or hypercarbia
  - COPD with hospitalizations, ED visits, steroids within 3 months or frequent use of inhalers
High Risk Cardiac Disorders

• Congestive Heart Failure
  - Systolic dysfunction: Ejection Fraction <35%
  - Decompensated: hospitalized within 12 months

• Valvular Heart Disease
  - Aortic/Mitral (insufficiency important, stenosis critical)

• Significant Arrhythmias
  - Atrial Fibrillation, anticoagulation
  - QTc prolongation

• Devices
  - Pacemakers, defibrillators

• CAD
  - Unstable angina, MI within 12 months, stents within 1 year
Case

- **Patient:** 81 year old female
- **Reason for PREP Visit:** pre-operative visit prior to right total knee replacement, to be performed in 4 wk
- **HPI:**
  - Progressive right knee pain
  - Unresponsive to conservative management
  - Limiting her ability to do ADLs
  - X-ray demonstrates end-stage OA of right knee
- **ROS:** + SOB/DOE
- **PMHx:**
  - Atrial fibrillation on Xarelto
  - Moderate mitral regurgitation
  - HTN
  - Asthma: mild-intermittent
- **PSHx:** Right THR, Hysterectomy
- **Medications:**
  - Atenolol
  - Lisinopril
  - HCTZ
  - Rivaroxaban (Xarelto)
  - Simvastatin
  - Albuterol PRN
  - Levothyroxine
  - Gabapentin
- **Allergies:** shellfish
- **Social History:**
  - Married
  - Lives at home
  - Non-smoker, no alcohol
Preoperative Medical Assessment

- Cardiac risk and functional status assessment
- Consideration of need for any additional tests
- Medication reconciliation and recommendations
- Consideration of need for inpatient co-management between IM and ortho
Preoperative Medical Assessment

- Cardiac risk and functional status assessments
- Consideration of need for any additional tests
- Medication reconciliation and recommendations
- Consideration of need for inpatient co-management between IM and surgical service
2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

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

Endorsed by the Society of Hospital Medicine

Lee A. Fleisher et al. JACC 2014;64:e77-e137
Estimating Risk: RCRI/Lee

- Revised Cardiac Risk Index (Lee)
  - 6 items
    - “High risk surgery”: intraperitoneal, intrathoracic, supra-inguinal vascular
  - Score:
    - 0-1 Low risk
    - 2+ Elevated risk
Estimating Risk: NSQIP and Gupta

- NSQIP (National Surgical Quality Improvement Program)
  - Surgical Risk Calculator
    » 22 items to enter (but most pre-populated)
    » Provides estimate of risk for multiple types of complications

- NSQIP-MICA Risk Index (“Gupta Score”)
Estimating Risk: Deciding Functional Status

- **NSQIP User Guide**: “This variable focuses on the patient’s abilities to perform ADLs in the **30 days prior to surgery**. The best functional status demonstrated by the patient within the 30 days is reported.”
  - **Independent**: does not require assistance from another person for ADLs
  - **Partially dependent**: requires some assistance from another person for ADLs
  - **Totally dependent**: requires total assistance for all activities
Clinical Models for the Prediction of Cardiac Events in Patients Undergoing Major Noncardiac Surgery.

<table>
<thead>
<tr>
<th>Model Name and Study</th>
<th>Estimation of Risk</th>
<th>Definition of Outcome</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCR12,58; single-center study; last patient</td>
<td>Risk factors (high-risk surgery; ischemic heart disease; prior congestive heart</td>
<td>Myocardial infarction, pulmonary edema, ventricular fibrillation or primary cardiac</td>
<td>Patients were systematically monitored for myocardial infarction by means of</td>
</tr>
<tr>
<td>enrolled in 1994; 4315 patients; 92 events</td>
<td>failure, stroke, or transient ischemic attack; use of insulin therapy; and</td>
<td>arrest, or complete heart block</td>
<td>cardiac enzyme measurements and electrocardiography during the first few days</td>
</tr>
<tr>
<td></td>
<td>creatinine level &gt;2 mg/deciliter are each assigned 1 point. The risk of an event is</td>
<td></td>
<td>after surgery; research personnel collected data on risk factors.</td>
</tr>
<tr>
<td></td>
<td>0.5% with no points, 1.3% with 1 point, 3.6% with 2 points, and 9.1% with ≥3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>points.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSQIP MICA Risk Index24; &gt;250 centers; last</td>
<td>Relevant variables (age, dependent functional status [partial or total], American</td>
<td>Myocardial infarction or cardiac arrest. Myocardial infarction could be diagnosed</td>
<td>Patients were not systematically monitored for levels of cardiac biomarkers;</td>
</tr>
<tr>
<td>patient enrolled in 2008; 468,795 patients; 2772</td>
<td>Society of Anesthesiologists physical-status class, creatinine level &gt;1.5 mg/d</td>
<td>only on the basis of electrocardiographic findings (e.g., ST-segment elevation in ≥2</td>
<td></td>
</tr>
<tr>
<td>events</td>
<td>deciliter indicates higher risk), and type of surgery) are entered into an online</td>
<td>contiguous leads or new left bundle-branch block).</td>
<td>decisions regarding assessment for myocardial infarction were made by the</td>
</tr>
<tr>
<td></td>
<td>risk calculator (<a href="http://www.surgicalriskcalculator.com/miorcardiacarrest">www.surgicalriskcalculator.com/miorcardiacarrest</a>).</td>
<td></td>
<td>attending surgeons; trained nurses collected data on risk factors.</td>
</tr>
</tbody>
</table>

* NSQIP MICA denotes National Surgical Quality Improvement Program Myocardial Infarction and Cardiac Arrest, and RCRI Revised Cardiac Risk Index. High-risk surgery is defined as intraperitoneal, intrathoracic, or aortic surgery.

Stepwise approach to perioperative cardiac assessment for CAD

1. Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
   - Emergency: Yes → Clinical risk stratification and proceed to surgery
   - No → Check ACS† (Step 2)

2. ACS† (Step 2)
   - Yes → Evaluate and treat according to GDMT‡
   - No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

3. Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
   - Low risk (<1%) (Step 4)
   - Elevated risk (Step 5)

4. No further testing (Class III-NB)
   - Proceed to surgery

5. Moderate or greater (≥4 METs) functional capacity
   - No or unknown
     - Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
     - Yes → Pharmacologic stress testing (Class IIa)
     - No → Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

6. Moderate/Good (≥4–10 METs)
   - No further testing (Class IIb)

7. Excellent (≥10 METs)
   - Proceed to surgery

*See Sections 2.2, 2.4, and 2.5 in the full-text CPG for recommendations for patients with symptomatic HF, VHD, or arrhythmias.
†See UA/NSTEMI and STEMI CPGs (Table 2).
‡See GDMT guidelines (Table 1).

Fleisher L A et al. Circulation. 2014;130:e278-e333
**Assessment of Functional Capacity**

- **Subjective assessment**
  - “Flight of stairs”

- **Objective assessment tool:**
  - **Duke Activity Status Index (DASI)**

- **Recent study in Lancet June 30th, 2018:**
  - DASI improved prediction of 30 day MI or death compared to subjective assessment
  - (Wijeysundera et al. Vol 391, pg 2631)
Excellent (>10 METs)

Moderate or greater (≥4 METs) functional capacity

Moderate/Good (≥4–10 METs)

No or unknown

Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)

Yes

Pharmacologic stress testing (Class IIa)

No

Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

No further testing (Class IIb)

Proceed to surgery

Coronary revascularization according to existing CPGs (Class I)

If normal

If abnormal
Preoperative Medical Assessment

- Cardiac risk and functional status assessments
- Consideration of need for any additional tests
- Medication reconciliation and recommendations
- Consideration of need for inpatient co-management between IM and surgical service
**PREP ECG Testing Guidelines**

Based on the ACC/AHA 2014 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

**Low Risk Surgery?**

- **YES** → **No ECG**
- **NO** → **Intermediate Risk Surgery?**

**Intermediate Risk Surgery?**

- **Aortic**
- **Other major vascular**
- **Peripheral vascular Surgery**

- **YES** → **ECG**
- **NO** → **Any of the following?**

- Known Ischemic Heart Disease (CAD)
- Compensated or prior CHF
- Severe Valve Disease (e.g., severe AS, symptomatic MS)
- Cerebrovascular Disease (Hist CVA or TIA)
- Peripheral Artery Disease
- DM (Type 1 or II)
- Renal insufficiency (Creatinine ≥ 2 or dialysis)

- **ECG**
- **No** → **No ECG**

*ECG* should be done within 30 days of the planned procedure.

* Patients with moderate or worse aortic stenosis and poor exercise tolerance (less than 4 METs) must have an echo within 6 months of any surgery of intermediate or greater risk.

Created December 2010, Updated June 2016

---

**Maine Medical Center**

MaineHealth
PREP ECG Testing Guidelines

Based on the ACC/AHA 2014 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

Examples
- Endoscopic
- Superficial
- Eye
- Breast
- Ambulatory
- Arthroscopic
- Podiatry

Low Risk Surgery?
- YES
  - No ECG
- NO
  - Aortic
    - Other major vascular
    - Peripheral vascular Surgery
      - YES
        - ECG*
      - NO
        - Intermediate Risk Surgery?
          - NO
            - Any of the following?
              - Known Ischemic Heart Disease (CAD)
              - Compensated or prior CHF
              - Severe valve disease (e.g., severe AS, symptomatic MS)
              - Cerebrovascular Disease (Hx CVA or TIA)
              - Peripheral Artery Disease
              - DM (type I or II)
              - Renal insufficiency (Creatinine ≥ 2 or dialysis)
          - ECG*
            - YES
            - No ECG
            - NO

* ECGs should be done within 30 days of the planned procedure

+ Patients with moderate or worse aortic stenosis and poor exercise tolerance (less than 4 METs) must have an echo within 6 months of any surgery of intermediate or greater risk.

Created December 2010, Updated June 2016
PREP ECG Testing Guidelines

Based on the ACC/AHA 2014 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

Examples
- Endoscopic
- Superficial
- Eye
- Breast
- Ambulatory
- Arthroscopic
- Podiatry

Low Risk Surgery?
- YES
  - No ECG
- NO
  - Aortic
  - Other major vascular
  - Peripheral vascular Surgery
  - YES
    - ECG
  - NO
    - Intermediate Risk Surgery?
    - YES
      - Known Ischemic Heart Disease (CAD)
      - Compensated or prior CHF
      - Severe valve disease (e.g., severe AS, symptomatic MS)
      - Cerebrovascular Disease (e.g., CVA or TIA)
      - Peripheral Artery Disease
      - DM (type 1 or 2)
      - Renal insufficiency (Creatinine ≥ 2 or dialysis)
      - Any of the following:
        - ECG
        - No ECG
    - NO
      - ECG
      - No ECG

* ECGs should be done within 30 days of the planned procedure

+ Patients with moderate or worse aortic stenosis and poor exercise tolerance (less than 4 METs) must have an echo within 6 months of any surgery of intermediate or greater risk.

Created December 2016, Updated June 2016
PREP PreOp Laboratory Testing Guidelines

All blood tests are good for 12 weeks unless patient is unstable (in which case they are good for 2 weeks).

**Examples**
- Open Heart
- Major Vascular
- Risk of Blood Transfusion
- Major Spine, GYN, Urologic, General

**High Risk Surgery?**
- YES → CBC, T&S/T&C, INR & PTT, CMP
- NO → **Low Risk Surgery?**
- NO → Injection of Contrast Dye
- YES → End-Stage Renal Disease
- DM (Day of Procedure)
- Warfarin

**Intermediate Risk Surgery**

<table>
<thead>
<tr>
<th>CBC</th>
<th>BMP</th>
<th>Glucose</th>
<th>CMP</th>
<th>PTT</th>
<th>Hct/Hgb</th>
<th>T&amp;S/T&amp;C</th>
<th>A1C</th>
<th>INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- A routine pregnancy test before surgery is not recommended before the day of surgery. A careful history and local practice determine whether a pregnancy test is indicated.
- Renal Insufficiency is defined as: ESRD or Hx of Creatinine ≥ 2
- A PreOp INR should be considered for all patients on Warfarin regardless of surgical risk.
- CTX NOT INDICATED UNLESS PATIENT HAS ACUTE SYMPTOMS SUGGESTIVE OF SIGNIFICANT PULMONARY DISEASE.
- Abbreviations:
  - BMP = Basic Metabolic Panel (electrolytes, BUN & Creat)
  - CMP = Complete Metabolic Panel (BMP + LFTs)

Created May 2010, Updated May 2016
PREP PreOp Laboratory Testing Guidelines

All blood tests are good for 12 weeks unless patient is unstable (in which case they are good for 2 weeks).

Intermediate Risk Surgery

<table>
<thead>
<tr>
<th>CBC</th>
<th>BMP</th>
<th>Glucose</th>
<th>CMP</th>
<th>PTT</th>
<th>Hct/Hgb</th>
<th>T&amp;S/T&amp;C</th>
<th>A1C</th>
<th>INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- Liver Disease/ETOH Abuse (>4 Drinks/Day)
- Hx of Anemia/Current Status Unknown
- Renal Insufficiency
- Active Malign/Recent Chemo or XRT
- Hx of Bleeding (Personal/Family Hx)
- Cardiovascular or Periph Vasc Ds, DM, Diogen

- Obstructive, Active Thyroid Disease
- Morbid Obesity/Chronic Steroids
- Warfarin
- Possible EBL > 500cc
- Diabetes

- A routine pregnancy test before surgery is not recommended before the day of surgery. A careful history and local practice determine whether a pregnancy test is indicated.
- Renal Insufficiency is defined as: ESRD or Hx of Creatinine > 2
- A PreOp INR should be considered for all patients on Warfarin regardless of surgical risk.
- CXR NOT INDICATED UNLESS PATIENT HAS ACUTE SYMPTOMS SUGGESTIVE OF SIGNIFICANT PULMONARY DISEASE.
- Abbreviations:
  - BMP = Basic Metabolic Panel (electrolytes, BUN & Creat)
  - CMP = Complete Metabolic Panel (BMP + LFTs)

Created May 2010, Updated May 2016
Role of Preoperative Echocardiography

- Routine pre-op echocardiography seems to add little to established risk models

- A normal echo has a high NPV for cardiac outcomes, but an abnormal echo (e.g. systolic dysfunction, LVH) has a low PPV for poor outcomes

- Preoperative echo recommended for patients with:
  - Clinically suspected moderate or greater degrees of valvular stenosis or regurgitation if no prior echo within a year, or significant change in clinical status
  - Dyspnea of unknown origin
  - History of heart failure with worsening dyspnea or change in clinical status
Role of Preoperative Echocardiography

• Routine pre-op echocardiography seems to add little to established risk models

• A normal echo has a high NPV for cardiac outcomes, but an abnormal echo (e.g. systolic dysfunction, LVH) has a low PPV for poor outcomes

• Preoperative echo recommended for patients with:
  - Clinically suspected moderate or greater degrees of valvular stenosis or regurgitation if no prior echo within a year, or significant change in clinical status
  - Dyspnea of unknown origin
  - History of heart failure with worsening dyspnea or change in clinical status
Preoperative Medical Assessment

- Cardiac risk and functional status assessments
- Consideration of need for any additional tests
- Medication reconciliation and recommendations
- Consideration of need for inpatient co-management between IM and surgical service

Order List:
- Stress test
- EKG
- CBC
- BMP
- TTE
## Preoperative Medication Management

<table>
<thead>
<tr>
<th>Type of Medication</th>
<th>Continue</th>
<th>Hold on day of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>BB, CCB</td>
<td>Diuretics, ACE/ARB</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Statins</td>
<td>Niacin, fibrates, ezetimibe</td>
</tr>
<tr>
<td>GERD</td>
<td>PPI, H2 blockers</td>
<td>Theophylline</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>All inhalers</td>
<td>Theophylline</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Levothyroxine</td>
<td></td>
</tr>
<tr>
<td>Psych</td>
<td>SSRI, anti-psychotic, anxiety</td>
<td>Stimulants</td>
</tr>
<tr>
<td>Opiates</td>
<td>All, although buprenorphine use should be reviewed with anesthesia</td>
<td></td>
</tr>
<tr>
<td>Vitamins</td>
<td>Stop <strong>seven</strong> days prior to surgery</td>
<td></td>
</tr>
<tr>
<td>Gout</td>
<td>Colchicine, allopurinol</td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>Long-acting insulin</td>
<td>Oral meds, short-acting insulin</td>
</tr>
</tbody>
</table>
# Preoperative Medication Management

<table>
<thead>
<tr>
<th>Type of Medication</th>
<th>Continue</th>
<th>HOLD on day of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>BB, CCB</td>
<td>Diuretics, ACE/ARB</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Statins</td>
<td>Niacin, fibrates, ezetimibe</td>
</tr>
<tr>
<td>GERD</td>
<td>PPI, H2 blockers</td>
<td>Theophylline</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>All inhalers</td>
<td>Theophylline</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Levothyroxine</td>
<td></td>
</tr>
<tr>
<td>Psych</td>
<td>SSRI, anti-psychotic, anxiety</td>
<td>Stimulants</td>
</tr>
<tr>
<td>Opiates</td>
<td>All, although buprenorphine use should be reviewed with anesthesia</td>
<td></td>
</tr>
<tr>
<td>Vitamins</td>
<td>Stop seven days prior to surgery</td>
<td></td>
</tr>
<tr>
<td>Gout</td>
<td>Colchicine, allopurinol</td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>Long-acting insulin</td>
<td>Oral meds, short-acting insulin</td>
</tr>
</tbody>
</table>
Preoperative Medical Assessment

- Cardiac risk and functional status assessments
- Consideration of need for any additional tests
- Medication reconciliation and recommendations
- Consideration of need for inpatient co-management between IM and surgical service

**Order List:**
- Stress test (negative)
- EKG (Atrial fibrillation)
- CBC (normal)
- BMP (normal)
- TTE (stable mod MR, EF 56%)
- Hold diuretic and ACE
- Arranged Inpatient Med Consult to follow post-op
Case

- Patient Admitted to Hospital for TKR
  - Chronic Atrial fibrillation:
    » Cardioversion 2017, recurrence
    » CHA2DS-VASc: 4, on Xarelto
  - Moderate mitral regurgitation
  - HTN
  - Asthma: mild-intermittent
  - Hypothyroidism
  - Peripheral neuropathy

- Problem List Informs the Notes of:
  - Surgery, Anesthesia, Medicine
  - Rate Control
    » Atenolol taken
  - Anticoagulation held for 72 hours
  - Lisinopril and HCTZ Held
  - Albuterol taken
  - Synthroid taken
  - Gabapentin taken
Stress Response to Surgery

Local Wound
- Release of cytokines
- Oxygen free radical production
- Influx of neutrophils
- Release of proinflammatory mediators

Modulation by CNS
- Pain
- Anxiety
- Hypothermia
- Hyperthermia

Systemic Inflammation
- Increased Oxygen Consumption
- Increased Metabolic Rate
- Increased Temperature
- Protein Catabolism, Loss of Lean Body Mass
- Blood Flow Maldistribution Leading to Ischemia

Endocrine Response
- Catecholamines
- Glucagon
- Cortisol
- ACTH

Systemic Response
- Normal Wound Healing
- Fatigue
- SIRS
- Sepsis
- Multi-Organ Failure
Enhanced Recovery After Surgery
Multi-Modal Cumulative Impact

**Surgical Disruption**
- Laparoscopy
- Small transverse incisions
- Robots

**Anesthesia**
- Epidural/Spinal
- Short-acting agents
- Precise fluid management
- Normothermia
- Avoid PONV/Steroids

**Pharmacology**
- Insulin
- Ace/Arbs
- DVT prophylaxis
- Prophylactic antibiotics
- Non-opioid pain management
- Glucocorticoids
- Statins

**Insulin Resistance**
- Avoid Starvation
- Carbohydrate Load
- Early Refeeding

**Other Interventions**
- Patient preparation
- Early mobilization
- Risk optimization

Decrease Surgical Stress & Enhance Recovery
da Vinci Robot
Evolving Length of Stay

Surgical Admit vs Bedded Outpatient vs Ambulatory

- Perioperative Medical Plan must consider length of stay
- Medical Comorbidities may drive length of stay
  - Postoperative Outpatient Support
  - Two Midnight Rule
- Financial Impact & Insurance Requirements
  - Knees and Hips
  - Eligibility for Skilled Rehabilitation
  - Preoperative Consult may influence Prior Authorization or Support Discharge
ERAS
Multi-Modal Cumulative Impact

Surgical Disruption
- Laparoscopy
- Small transverse incisions
- Robots

Anesthesia
- Epidural/Spinal
- Short-acting agents
- Precise fluid management
- Normothermia
- Avoid PONV/Steroids

Pharmacology
- Insulin
- Ace/Arbs
- DVT prophylaxis
- Prophylactic antibiotics
- Non-opioid pain management
- Glucocorticoids
- Statins

Other Interventions
- Patient preparation
- Early mobilization
- Risk optimization

Insulin Resistance
- Avoid Starvation
- Carbohydrate Load
- Early Refeeding

Decrease Surgical Stress & Enhance Recovery
Insulin and Feeding Strategies

An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration*

Anesthesiology v126 (3) March 2017 page 376-393
Insulin and Feeding Strategies

Recommendations for Clear Liquids

- Clear liquids‡‡ may be ingested for up to 2 h before procedures requiring general anesthesia, regional anesthesia, or procedural sedation and analgesia.
  - These liquids should not include alcohol.
Insulin and Feeding Strategies

Recommendations for Solids and Nonhuman Milk

• A light meal or nonhuman milk may be ingested for up to 6 h before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation and analgesia. Additional fasting time (e.g., 8 or more hours) may be needed in cases of patient intake of fried foods, fatty foods, or meat.

• Consider both the amount and type of foods ingested when determining an appropriate fasting period.

• Since nonhuman milk is similar to solids in gastric emptying time, consider the amount ingested when determining an appropriate fasting period.
Insulin and Feeding Strategies

NPO after Midnight is an anachronistic medical tradition

In the absence of proven gastroparesis, gastric outlet obstruction or bowel obstruction, but not diabetes.
Insulin and Feeding Strategies

- Glycemic control
  - Settled Medical Science in Critical Care and Cardiac Surgery
    - In Colorectal and some other high Surgical Stress cases Blood Sugar >200 POD1 associated with SSI and increase in Mortality
  - Routine Steroids for PONV
  - Insulin Infusions for 24-36 hours post surgery
    » Early Feeding Strategies
    » Prandial Coverage and Basal Calculation
**ERAS**

**Multi-Modal Cumulative Impact**

**Surgical Disruption**
- Laparoscopy
- Small transverse incisions
- Robots

**Anesthesia**
- Epidural/Spinal
- Short-acting agents
- Precise fluid management
- Normothermia
- Avoid PONV/Steroids

**Pharmacology**
- Insulin
- Ace/Arbs
- DVT prophylaxis
- Prophylactic antibiotics
- Non-opioid pain management
- Glucocorticoids
- Statins

**Insulin Resistance**
- Avoid Starvation
- Carbohydrate Load
- Early Refeeding

**Other Interventions**
- Patient preparation
- Early mobilization
- Risk optimization

**Decrease Surgical Stress & Enhance Recovery**
Hypotension

- **Surgery vs Anesthesia vs Medicine**
  - Precise Fluid Administration and Transfusion Avoidance
  - Epidural Anesthesia
    - Local Anesthetic impacts Sympathetic Tone
  - Pulmonary Embolism, Sepsis, Ischemia, Drugs

- **Multifactorial & Multispecialty Causes**
  - Clear Communication and Broader Differential
Major Bowel Surgery

Case

- Patient: 81 year old female
- Uneventful RT TKA with tranexamic acid and 54 minutes tourniquet time
- Spinal Anesthesia with light propofol and post-operative adductor canal block
- LR 1000 cc, EBL 100, no foley
- DVT prophylaxis ASA according to guidelines from American Association of Orthopedic Surgeons

At arrival on floor:
- Awake alert oriented x 4
- Pain Free
- Vs: HR 90irr, 110/60 RR 14,
- Clear lungs
- Irregular Heart Rate
- Drain in place with knee on ice
- IVF LR 75 ml/hr d/c’d at evening meal

- Hgb Pre op 13.0 g/dl
  - Post op 12.4 g/dl
Post Op Day 1

- Patient is alert & oriented
- Physical Exam unchanged
- VS: Supine HR 80s BP 102/56
  Standing HR 90s BP 92/50
- Pain control and strength adequate to participate
- Hgb 12.4 g/dl to 9.8 g/dl

- Patient to mobilize
- Pain Management
  - Scheduled Acetaminophen
  - Gabapentin
  - Celecoxib
  - Oxycodone/OxyContin
- Restart Chronic Medications?
  - Xarelto
  - Lisinopril
Restart Medications

Thirty-Day Mortality Risk Associated With the Postoperative Nonresumption of Angiotensin-Converting Enzyme Inhibitors: A Retrospective Study of the Veterans Affairs Healthcare System

Seshadri C. Mudumbai, MD, MS1*, Steven Takemoto, PhD2, Brian A. Cason, MD2, Selwyn Au, MS3, Anjali Upadhyay, MS4, Arthur W. Wallace, MD, PhD2

1Anesthesia Service, Veterans Affairs Palo Alto Health Care System, Palo Alto and Department of Anesthesiology, Perioperative, and Pain Medicine, Stanford University, Stanford, California; 2Anesthesia Service, Veterans Affairs Medical Center, San Francisco, and Department of Anesthesiology and Perioperative Care, University of California, San Francisco, California; 3Cooperative Studies Program Coordinating Center, Veterans Affairs Palo Alto Health Care System, Palo Alto, California; 4Health Economics Resource Center, Veterans Affairs Palo Alto Health Care System, Palo Alto, California.

Vol 9(5)  May 2014  289-296
Restart Medications

Association between Withholding Angiotensin Receptor Blockers in the Early Postoperative Period and 30-day Mortality

A Cohort Study of the Veterans Affairs Healthcare System

Susan M. Lee, M.D., F.R.C.P.C., Steven Takemoto, Ph.D., Arthur W. Wallace, M.D., Ph.D.

Anesthesiology 2015 123: 288-306
Post Op Day 2

- Patient Alert and oriented
- Physical Exam Unchanged
- Drains out
- Participating with Therapy
- VS: supine HR 80s BP 124/80
  - Standing HR 80s BP 120/82
- Hgb 9.8 g/dl to 9.4 g/dl

- Pain Management
  - Received dose of OxyContin hs
  - Scheduled Acetaminophen
  - Gabapentin
  - Celecoxib

- Restart Lisinopril

- Prophylaxis
  - Asa 81 mg Twice Daily
  - Restart Xarelto?
Medication Restart

Xarelto

- Earliest anticoagulation after TKA is 48 hours
- Bridging initiated at 48 hours
- Patient will be fully anticoagulated about 1.5 hours after the first dose
- Inform Surgical Decision
  - Surgeon aware of Bleeding risk for their Procedure
  - Medicine can assist with informing urgency of Re-anticoagulation
  - Risk of early anticoagulation
Post Op Day 3

- Patient discharged home with therapies
- Xarelto Restarted
- Aspirin Discontinued
Patient is returning in December to have her other knee replaced

Questions?