

# PERIOPERATIVE ASSESSMENT AND MANAGEMENT

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## A. **Internist's Preoperative Note** – *in addition to a typical consult note, include:*

- Type of surgery (and determine if elective, urgent or emergent)
- Specific consult question from surgeon or anesthesiologist, if any (many requests are for "Medical Clearance" without a specific request – this usually implies optimization of any medical conditions as well as an assessment of whether the patient needs preoperative cardiac evaluation)
- Any current symptoms (especially of cardiac or pulmonary disease)?
- PSH - bleeding complic (or h/o easy bruising) & anesthetic rxns (usually done by Anesthesia at OVMC)
- Risk assessment for cardiovascular, pulmonary, or other potential problems as identified
- Perioperative recommendations – answer consult question, if any
  - What medical therapy is needed before the patient is "optimized" for surgery?
  - Do not delay emergent/urgent surgeries for prolonged cardiac workups, unless necessary
  - Communicate recommendations clearly and specifically to the referring physicians in your note, and verbally for any urgent or complicated recommendations
  - Never say "Cleared for Surgery". Use "Medically optimized for surgery".

## B. **Preoperative Testing**

- *Routine* preop tests are rarely helpful, resulting in changes in care in only 0.2% of cases. Order selective labs and studies based on history & physical. Consider pregnancy test.
- Review tests ordered in the preceding 3-6 months. Many patients have had tests within months of surgery that, if normal, do not need to be repeated.
- *Routine* CXR is not recommended, even in smokers, unless the patient has signs or symptoms requiring one anyway. Consider in severely obese patients, where the physical exam is limited.
- A preop ECG may be able to detect a recent unrecognized MI. However, even in men > 75 yo the estimated incidence of an unrecognized MI w/in the prior 6 months is quite low (<0.5%). Obtain an ECG in patients with known CV dis, arrhythmias, structural heart disease and possibly obesity, but it is not needed for low-risk surgery. The utility of most preop ECGs is to have as a baseline.

## C. **Anesthesia**

- There is no one best anesthetic technique or agent. General (volatile, IV, or combo), Monitored Anesthetic Care (MAC = IV sedation +/- local) or Regional (neuraxial = spinal/epidural, or local) are thought to have similar balance of risks, although the risks may be slightly different.
- *Leave anesthetic recommendations to the anesthesiologists!*

## D. **Cardiac Risk Assessment and Management** (for non-cardiac surgery)

- There are several validated risk assessment tools. The 2014 ACC/AHA guidelines recommend using either (1) **RCRI** (gold standard for internists), (2) **Gupta perioperative cardiac risk calculator** (5 variables; Gupta, 2011), or (3) **ACS NSQIP surgical risk calculator** (23 variables; Cohen, 2013). The latter 2 assessment tools based on the American College of Surgeons database of hundreds of thousands of patients are slightly more accurate than the RCRI, but require on-line calculators and use variables such as "ASA class" and "functional status" that are less familiar to internists.

### Revised Cardiac Risk Index (RCRI, or the Goldman or Lee index)

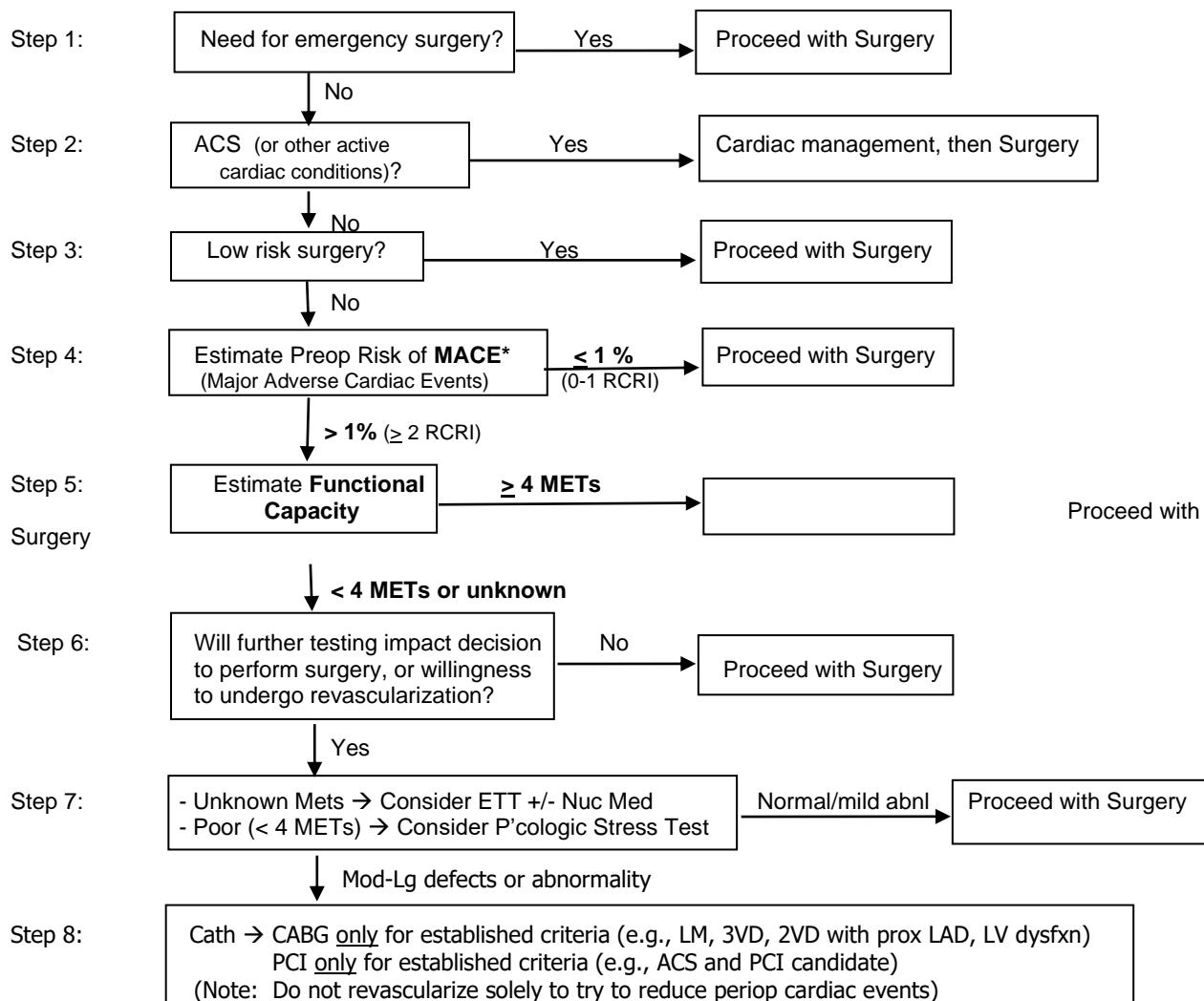
#### 6 Predictors:

- **High-risk surgical procedure** (intraperitoneal, intrathoracic, or suprainguinal vascular)  
(note: suprainguinal = above the groin)
- **Ischemic heart disease** (by clinical hx, ECG, stress test, or revascularization for ischemia)
- **Hx Heart Failure**
- **Hx CVA** (TIA or stroke)
- **Diabetes mellitus** (requiring insulin)
- **Cr  $\geq$  2.0 mg/dl**

#### Major Cardiac Complication Rate (of cardiac death, non-fatal MI or cardiac arrest)

0 predictor	0.4%
1 predictor	1.0 %
2 predictors	2.4 %
3+ predictors	5.4 %

**2014 ACC/AHA Perioperative Cardiac Evaluation Algorithm for Noncardiac Surgery**  
 (adapted & reformatted)



Cardiac Risk by Surgery	
Low (risk < 1%)	Elevated (risk > 1%)
Ophtho Plastics Breast Endoscopic Ambulatory Superficial	Head & Neck Intra-thoracic/peritoneal Orthopedic Prostate Vascular

> 1% MACE*	
Use any of the 3 risk assessment tools:	
(1) <b>≥ 2 RCRI</b> predictors: (Cr ≥ 2, CAD, IRDM, Hx HF, Hx CVA, intrath/abdom/vascular surgery)	
(2) <b>Gupta Perioperative Cardiac risk calculator</b> ( <i>search on Internet</i> )	
(3) <b>ACS NSQIP surgical risk calculator</b> ( <i>search on Internet</i> )	

Beta-Blocker Recs	
(1) Continue if on BB chronically	(2) Intermed-high risk ischemia on preop testing
(3) ≥ 3 RCRI predictors	Note: Start BB at least 2-7 days before surgery

**Level of exercise tolerance (Functional Capacity)**

Functional capacity	MET level	Daily activities
Poor	<4 METs	ADLs, walk indoors around the house or outside ≤ 2-3 miles/hr (slowly), golfing with cart, slow ballroom dancing
Moderate	4-6 METs	Walk at 4 miles/hr (mod-fast), climb a flight of stairs or walk up a hill, heavy housework, leisurely bicycling, walk a golf course
Good	7-10 METs	Jogging, moderately strenuous sports, vigorous calisthenics
Excellent	> 10 METs	Strenuous sports

- **Noninvasive Stress Testing**
  - Usually not needed if patient has good functional capacity at home (Class IIa indication for > 10 METs, Class IIb indication for 4-10 METs), or for low risk surgeries or procedures.
  - Consider noninvasive stress testing for:
    - Patients without good functional capacity, who require elevated risk surgery, and MACE > 1% (esp if significantly > 1%) - *but only if it will change management.*
    - However, the best RCTs to date (CARP, NEJM 2004; others) found that in patients with stable CAD, stress testing and subsequent revascularization of patients found to be at risk *does not reduce short-term or long-term morbidity or mortality.* Therefore, noninvasive preop stress testing should generally not be used to evaluate risk for clinically stable patients. The CARP trial excluded a small number of pts with Left Main disease (4.5%) or LVEF < 20% (0.9%), but most of these pts will be symptomatic. The main use of periop stress testing is for pts who have an indication for stress testing or revascularization *irrespective* of their need for surgery (e.g., ACS, or stable angina with known or suspected LM or extensive disease). There are few circumstances in which stress testing should be performed solely because the patient has upcoming surgery.
    - If revascularization is indicated, consider prior to elective surgery if there is a clear survival advantage (e.g., significant LM disease). However, if revascularization is for QOL (to decrease angina), remember that the elective surgery will likely be delayed for months (often 6-12 months with a DES), so consider risks & benefits of timing carefully.
- **Preop ECHO for:**
  - Dyspnea of unknown etiology
  - Heart failure with worsening dyspnea or change in clinical status
  - Consider reassessment of stable HF if no ECHO in past year (Class IIb indication)
  - Clinically suspicious murmur (mod-severe stenosis or regurg) if no prior ECHO within one year, or change in clinical status/exam since last evaluation.
    - Repair or replace valves before elective surgery based on standard indications.
- **Patients with CAD**
  - **Recent MI:** Patients should be risk stratified as one would with any MI (e.g., heart cath). If cath or stress test reveals no evidence of myocardium at risk, then perioperative MI risk is low. 2014 AHA/ACC recommendation is to wait at least 2 months post MI. But ideally wait  $\geq$  3-4 months per observational data - the longer the better, but balance with need for surgery.
  - Patients with prior CABG or PCI in patients who are clinically stable are generally at low risk. Wait at least 1-2 months after CABG.
  - **PCI/Stents:**
    - Drug-eluting stents (DES) require dual antiplatelet therapy (DAT = usu. Plavix and ASA) for at least one year. Delay elective surgeries for 12 months if possible, unless the surgeon can operate with Plavix/ASA. For urgent surgeries, can consider holding Plavix after at least 6 months (with Cardiology input). If surgery can't be postponed and Plavix needs to be held, ASA should be continued through surgery, then restart Plavix ASAP postop.
    - Bare metal stents (BMS) require Plavix/ASA for at least 30 days (and balloon angioplasty requires ASA for at least 14 days) and thus may be preferred for patients who require PCI before urgent non-cardiac surgery where Plavix is contraindicated.
  - **Beta-blockers:**
    - A 2014 AHA/ACC systematic review suggests that preop beta-blockers decrease cardiac events (RR 0.72) but increase other adverse outcomes such as stroke (RR 1.72), hypotension (RR 1.37) and bradycardia (RR 2.41). Perioperative death rate is not statistically affected.
    - The above RRs are present even after excluding controversial studies (DECREASE, discredited due to scientific misconduct; and POISE, which used large doses of metoprolol started immediately prior to surgery). It is estimated that for a hypothetical population of 1000 pts with a baseline 6% MI risk and 0.5% stroke risk, periop beta-blockers would cause 17 fewer MIs, but an additional 4 strokes and 6 deaths.
    - The 2014 AHA/ACC recommendations for beta-blockers include:
      - Continue perioperatively if already on BBs chronically (only Class 1 indication)

- May be reasonable for intermed-high risk ischemia on preop testing (Class IIb)
    - May be reasonable for  $\geq 3$  RCRI predictors (Class IIb)
  - Start the beta-blocker at least two days before surgery to assess tolerability (never the day of surgery), and be careful not to cause hypotension or excessive bradycardia.
  - Do *not* use in low risk individuals; beta-blockers are associated with adverse events.
- **When to refer to Cardiology**
    - Patients who need noninvasive or invasive testing
    - Patients with pacemakers, ICDs or prosthetic valves
    - Patients who have symptomatic cardiac disease or significant valvulopathies (e.g., mod-severe AS/MS/AR/MR) requiring recommendations for medical or surgical optimization.
  - **Hypertension**
    - Continue most meds through surgery; use non-oral forms if necessary (transdermal, IV, etc.)
    - There is little contemporary data on optimal BP for surgery. DBP  $> 110$  has long been known to be associated with major complications, and SBP  $> 200$  increases risk for vascular surgeries. DBP  $< 110$  does not appear to increase risk, unless the patient has end-organ damage (e.g., HF, renal insufficiency)
    - Many experts recommend canceling elective surgery for BP  $> 170-180/110$ . For **most elective surgeries at OVMC**, surgeons and anesthesiologists prefer BP  $< 160/90$  if possible. The potential benefits of delaying surgery to control BP preoperatively should be weighed against the risks of delay.
    - Secondary HTN workups can usually be postponed until after surgery if necessary, unless pheochromocytoma is suspected (up to 80% operative mortality in unsuspected cases).
    - Patients with HTN will have exaggerated perioperative BP lability (hypo and hypertension); it is the anesthesiologists job to control BP during and immediately after surgery.
  - **Heart Failure**
    - See above indications for Preop Echo.
    - Decompensated HF is associated with an increased risk → always treat before surgery.
    - Important to identify the underlying process responsible for the HF (ischemic, valvular, etc.)
    - HOCM is especially sensitive to even small increases or decreases in intravascular volume.
    - In patients with decompensated HF who require emergent surgery, consider PA catheter for intra-op monitoring (but no clear data to suggest its usefulness); obtain Cardiology consult.
  - **Valvular heart disease**
    - Indication for evaluation and treatment are identical to those in the non-preop setting.
    - Severe AS should be treated surgically before elective surgery.
    - Rate control and maintenance of normal sinus rhythm are important in MS to allow adequate filling time and prevent pulmonary congestion.
    - Regurgitant valve disease (MR, AR) is usually much better tolerated perioperatively.
    - Heart valve prostheses (see page 8 for anticoagulation indications, or get Cardiology input)
      - Make certain the valve is functioning properly
      - Consider appropriate anticoagulation management and endocarditis prophylaxis
  - **Arrhythmia and conduction abnormalities**
    - Indications for antiarrhythmic therapy or PM placement are the same as for nonsurgical pts.

## **E. Pulmonary Risk Assessment and Management**

1. **Pulmonary complications:**
  - Main complications = Bronchospasm, atelectasis, pneumonia, prolonged mech. ventilation.
  - Factors that increase risk:
    - Patient-related: Age  $> 50$ , poor functional status, smoking, COPD, symptomatic asthma, OSA, ASA  $>$  Class II, albumin  $< 3.0$ , sepsis/infection, pulmonary HTN
    - Procedure-related: emergency surgery, surgeries lasting  $> 3$  hours, surgical sites closest to the diaphragm (upper abdominal, thoracic), gen. anesthesia (controversial)
    - Obesity is not an independent risk factor for postop pulmonary complications, although it does ↑ risk of DVT/PE.
2. **Clinical pulmonary evaluation**
  - H&P: Evaluate exercise intolerance, chronic cough, dyspnea, abnormal lung exam.

- CXR: Only recommended if clinical signs or symptoms of a cardio-pulmonary process.
- Preop PFTs: Spirometry has a limited predictive value; routine preop PFTs are not recommended. Only indicated in lung resection surgeries and undiagnosed pulm problems.

### 3. Pulmonary risk-reduction strategies

#### a. Preoperative (for Internal Medicine consultants)

- **Smoking:** Use the preop visit as a “teachable moment” to encourage smoking cessation. Benefits appear best if stop > 8 weeks before surgery, but quitting at any time is beneficial to improve postop complications, especially wound healing. Smoking is not a contraindication for surgery, but if possible, smokers should abstain for 12-24 hrs prior to surgery to lower their carboxy-hemoglobin levels.
- **COPD and Asthma:** Treat airflow obstruction (wheezes) aggressively. Goal is for patient to be wheeze-free before surgery.
  - For poorly controlled COPD, a one-week preop course of prednisone is reasonable for patients with symptoms despite bronchodilator therapy.
  - For asthma patients with active disease, or PEFR <80% of predicted or <80% of their recent best values, consider treatment with steroid preoperatively; IV for one day before surgery or oral prednisone for several days preop.
  - Patients who receive preop steroids have a minimal risk of adrenocortical insufficiency, and do not have an increased risk of developing postop infections.
- **OSA:** Increases risk for upper airway collapse and other postop pulmonary complications. For known OSA, patients should utilize CPAP preoperatively as usual. For suspected or poorly controlled OSA, refer for Sleep Medicine evaluation if time allows.
- **Pulmonary HTN:** Patients with pulmonary HTN should be evaluated preoperatively by a pulmonary HTN specialist if they are at high risk for complications (i.e., Pulm Arterial HTN [Group 1], PAP > 70 or at least moderate RV dilation or dysfunction, or NYHA Class III or IV sxs).

#### b. Intraoperative and Postoperative (usually managed by Anesthesia and/or Surgery)

- Limit duration of surgery to < 3 hours if possible.
- For patients at high risk for pulmonary complications, anesthesiologist will consider spinal or epidural anesthesia (vs. general), and epidural analgesia (vs. IV narcotics)
- If OSA is known or suspected, anesthesiologists will consider: optimizing anesthesia and analgesia meds, non-supine positioning, prolonged postop O<sub>2</sub> and continuous pulse-ox monitoring, and CPAP trial.
- Patients should use post-op lung expansion aids such as deep-breathing exercises or incentive spirometry (educate preop if possible). Alternatives include postural drainage, percussion & vibration, suctioning and ambulation. Lung-expansion aids can decrease risk of postop pulmonary complications even in average-risk patients.
- CPAP has been shown to be at least as effective as deep breathing and incentive spirometry, but it is not as well tolerated.
- Chest PT for pts with established atelectasis or diseases causing secretion problems.
- NG tubes should be used selectively for postop N/V, inability to tolerate oral intake, or symptomatic abdominal distention. This may reduce rates of pneumonia and atelectasis.

## F. Misc. Perioperative Risk Assessment and Management

### 1. Diabetes:

- Blood glucose should be < 200 preoperatively, ideally closer to 150. There is no standard HgA1c, but some surgeons prefer to delay elective surgery until HgA1c is < 8-9.
- At OVMC, the anesthesiologist will usually provide instructions to the patient about managing their meds preop, and will manage perioperative hyperglycemia with insulin drip & D5W.
- If the internist consultant is involved, the usual preop recommendation for the patient is to take 1/2 to 2/3 of their usual intermediate-acting insulin (eg, NPH) the evening before and the morning of surgery, and no short-acting insulin (eg, Regular, Lispro) the AM of surgery. Basal long-acting insulin (eg, Glargine) can generally be given as a full dose or decreased by 20%.

- Most oral agents should be held the morning of surgery. Metformin is sometimes held 24 hours prior to surgery because of the risk of lactic acidosis if AKI develops postop; this is controversial. Oral drugs can be started postop when the patient starts eating again.
- Postoperatively, about ½ the preop insulin requirement can be given as a basal dose (NPH or Glargine), even if NPO, and then increased as oral intake is advanced.
- Insulin pumps: Usually stop preop and convert to glargine insulin the evening before surgery. Consult Endocrine.

## **2. Thyroid Disease:**

- Hyperthyroidism is a significant surgical risk for arrhythmias and thyroid storm, and must be corrected preoperatively with methimazole +/- beta-blockers. Consult Endocrine.
- Hypothyroidism is usually well tolerated; mild hypothyroidism is not a contraindication to surgery.

## **3. Liver Disease:**

- Abdominal (gastric, cholecystectomy and colectomy) surgeries and cardiac surgeries are associated with particularly high mortality rates in patients with decompensated cirrhosis. Ventral or inguinal herniorrhaphy and laparoscopic procedures are relatively safe in patients with cirrhosis.
- Elective surgeries should be delayed for patients with acute hepatitis, cholestatic jaundice, severe chronic hepatitis, cirrhosis with Child-Pugh Class C (or high MELD score, > 15), and decompensated liver disease. Severe extrahepatic manifestations of liver disease (e.g., hypoxia, cardiomyopathy, renal failure) are also relative contraindications. Consider liver transplantation for appropriate indications if surgery is needed.
- Patients with well compensated cirrhosis (Child's Class A) and mild chronic liver disease without cirrhosis usually tolerate surgery well. Child's Class B cirrhosis requires preop preparation.
- To prepare patients with more severe liver disease for surgery, treat the coagulopathy with vitamin K, FFP, Cryo, etc. to correct the PT to within 3 seconds of normal. Control ascites with Na<sup>+</sup> restriction, diuretics or large volume paracentesis.

## **4. Renal Disease:**

- Patients with preoperative elevated serum creatinine are at increased risk for postop acute and chronic renal failure, infection, and mortality.
- The major preoperative measures to reduce this risk include correcting any reversible disease (AKI), ensuring adequate hydration (without causing overhydration), and avoiding nephrotoxic drugs or contrast agents.

## **5. Cerebrovascular Disease (h/o stroke):**

- Delay elective surgery for at least one month after a moderately large ischemic stroke. Retrospective data suggests risk is significantly higher than baseline for at least 3 months, with risk dropping significantly at 6 months and stabilizing at about 9 months.
- Asymptomatic carotid bruits and stenosis do not increase stroke risk for patients who undergo non-cardiac surgeries. However, symptomatic disease is associated with about a 6% risk of stroke, and patients should undergo CEA or stenting for symptomatic extracranial carotid artery stenosis before elective non-cardiac surgery.

## **6. Dental Surgery:**

- Anticoagulation: No need to stop antiplatelets (ASA, Plavix, others) or warfarin (with therapeutic INR) for most dental surgeries, including extractions. Excess surgical bleeding can be controlled by patient biting on gauze, absorbable gelatin, or sutures per DDS. Consider holding aspirin if it is used for primary prophylaxis only, and dental surgery is major.
- Antibiotic prophylaxis: According to the most recent AHA/ACC recommendations, which takes a conservative view of antibiotic prophylaxis, there are only 4 indications:
  1. Hx of Bacterial endocarditis
  2. Prosthetic heart valve (metal or bio-prosthetic)
  3. Cardiac transplantation (with acquired graft valvular dysfunction)
  4. Repaired congenital heart disease (CHD) w/in 6 months, or repaired CHD with residual defect.

Recommended tx = Amoxicillin 2 gm PO 30-60 min before procedure. For PCN allergy, use cephalaxin (Keflex), clindamycin, azithromycin or clarithromycin.

## **G. Perioperative Medication Management**

1. Periop Meds: Very little literature available, so use common sense and clinical judgment. At OVMC, usually managed by Anesthesiologists. Most chronic meds can be given with a sip of water on the AM of surgery, and restarted after surgery when taking PO. Some meds with very long  $T_{1/2}$ 's can be held for days (eg, amiodarone, synthroid). If needed earlier, some can be given IV (eg, digoxin, beta-blockers), or by patch (eg, clonidine, nitrates). Meds with some information, or controversies, include:

	<b>PERIOPERATIVE RECOMMENDATIONS</b>	<b>COMMENTS</b>
<b>CARDIOVASCULAR</b>		
ACEI / ARBs	Controversial: Usually continue with sip of water through AM of surgery. Consider holding (or decrease dose) if high risk for hypotension (low BP, elderly, on diuretic)	May exacerbate hypotensive effects of anesthesia
Diuretics	Controversial: Often held the AM of surgery, but one RCT showed no difference either way.	Check electrolytes ( $K^+$ )
Statins	Continue periop. Start statin for Vascular surgery (or anyone w/ high CV risk) if not taking already	Do not discontinue; D/C may cause adverse vascular events
Peripheral $\alpha$ -blockers	Stop day before surgery; resume when taking orals	If taking before cataract surgery, alert ophthalmologist (risk of "floppy iris syndrome")
<b>ENDOCRINE</b>		
Insulin	½ the usual dose of NPH the morning of surgery; full Glargine dose (or ↓ by 20%); D5W during the intraop and postop periods; sliding scale	At OVMC, Anesthesiologists will instruct patient in Anesthesia preop clinic
Oral antidiabetics	Hold the AM doses (and perhaps the evening before, depending on control)	Metformin: some hold for 24 hrs prior
Corticosteroids	Consider stress dose hydrocortisone 100mg IV q8 hrs started the AM of surgery and continued for 24 hours following major surgery with quick taper to 50mg q8 hrs x1-2 dys; For minor-intermediate surgeries, one to two doses of ~ 25-50mg on the day of surgery Q 8-12 hrs	Consider in any patient who has received steroids > 5 mg prednisone chronically, ≥ 20 mg acutely for > 3 weeks in the last year, high dose MDIs for > 6 months
Oral contraceptive agents (OCPs)	Controversial: Stop ~ 4-6 weeks preop whenever possible; restart with next menstrual cycle	Increased risk of DVT/PE; balance with risk of pregnancy
Hormonal (estrogen) replacement	Controversial: Stop ~ 4-6 weeks preop whenever possible; restart when mobile postop	Increased risk of DVT/PE
SERMs (tamoxifen, etc.)	Similar to estrogens, above	Consider discussing risks with oncologist
<b>NEURO/PSYCH</b>		
TCAs	Controversial: Stop 1-2 weeks preop, restart when patient stable; low doses usually well tolerated with sip of water AM of surgery	May potentiate CNS depression of anesthesia; cause arrhythmias
SSRI/SNRI, antipsychotics	Continue with sip of water through AM of surgery. SSRI may mildly increase bleeding, esp with NSAIDs	Consider holding SSRIs for 2-3 weeks if even mild bleeding is a high risk for surgery
Lithium	Controversial: Taper off and discontinue several days preop vs. continue through AM of surgery (for most patients)	May prolong NM blockade; check electrolytes
MAOIs	Controversial: Taper off 2 wks preop vs. continue and review potential drug intxs with Anesthesia	
Parkinsonism drugs	Give AM of surgery with sip of water (as close to surgery as possible). Hold MAO-B inhibitors (selegiline, rasagiline) 1-2 wks before surgery or review potential drug intxs with anesthesiologist.	For prolonged NPO consider levodopa by NGT, benztropine IM/IV, apomorphine SQ
<b>MISC.</b>		
Herbs & supplements	Stop 7-10 days before surgery	In case a constituent interferes with bleeding or anesthesia
HIV medicines	Consider drug-drug intx with anesthesia	Consult with HIV physician
Immunosuppressants & Biologics (MTX, etanercept...)	Conflicting data: Continue through AM of surgery for most patients/meds (eg, MTX). For high risk of infection or strong biologics, consider holding 1-2 wks (or 3-4 half-lives) before/after surgery	Consult with specialist prescribing the medication.

## 2. Perioperative Anticoagulation Management:

- Hold warfarin for 4 days (last dose 5 days before surgery) for most major operations.
  - May need to hold longer for INR > 3
  - Goal INR < 1.5 on day of surgery
  - If the INR is 1.8 or higher the day before surgery, can administer a small dose of vitamin K (usually 1 mg PO - will decrease INR in 12 to 24 hours).
- For emergent/urgent surgery, reverse warfarin with FFP or Vit K (1-2.5 mg PO/IV)
- Low risk procedures in which warfarin can be continued through surgery (with therapeutic INR):
  - Cataract surgery, most routine endoscopies (except polypectomy, sphincterectomy, dilatations, variceal tx), uncomplicated dental procedures, simple dermatology procedures, joint aspirations/injections, minor podiatric procedures (eg, nail avulsion).
- Low risk conditions in which warfarin can be held for a few days without bridging with heparin:
  - Single DVT/PE > 3 months ago, A. Fib with CHADS<sub>2</sub> ≤ 3, mechanical AVR w/o risk factors
- High risk conditions that require bridging with heparin:
  - Recent DVT/PE (within 3 months), or recurrent DVT/PE
  - Known hypercoagulable state with h/o DVT/PE
  - Rheumatic A. fib; A. fib with mechanical valve; A fib with h/o cardioembolism (eg, stroke) or CHADS<sub>2</sub> score ≥ 4
  - Mechanical valve such as: all MVRs, "old" AVR (eg, tilted-disk, ball-in-cage), new AVR with risk factors (eg, A Fib, stroke/TIA, embolic event)
  - Acute intra-cardiac thrombus (on ECHO)
- Bridge with LMWH if possible:
  - Coordinate with patient, Anticoagulation Clinic (x4418), Pharmacy and Anesthesia
  - Enoxaparin 1 mg/kg SQ Q 12 hrs (for 3-5 days preop, when INR expected to be subtherapeutic)
  - Last preop dose 24 hours before surgery
  - Exclusions for LMWH (consider IV unfractionated heparin in hospital): Obese (> 150 kg); GFR < 30 ml/min; pregnant with mechanical valve; non-compliant, homeless, etc.
- Resume warfarin as soon as possible (usually the day after surgery), and start bridging heparin again ~ 24 hours after surgery until INR therapeutic with warfarin (usually 5-7 days).
- Newer oral anticoagulants (e.g., dabigatran, rivaroxaban, apixaban) have shorter T<sub>1/2</sub>'s (~10-12 hrs). Hold one day before surgery (2 days for GFR < 50 or bleeding risk); do not need to bridge.

## 3. Perioperative Antiplatelet Management

- Aspirin increases the risk of bleeding complications about 1.5x, but does not increase morbidity or mortality for most surgical procedures.
- Aspirin is almost always continued up to the day of surgery for patients with high thrombosis risk (e.g., vascular surgery, CABG, patient-related factors such as stroke/TIA or stents) and surgeries with low risk of bleeding (e.g., minor dental, dermatologic, cataract surgery).
- While EBM guidance is minimal, the generally accepted policy is to hold aspirin 7-10 days before most other surgery, assuming the risk of bleeding is greater than the thromboembolic risk if held. For conditions with mod-high thromboembolic risk, consider holding ASA for only 3-5 days preop.
- Clopidogrel (Plavix) is considered a stronger antiplatelet agent than ASA. Most surgeons prefer to hold Plavix at least 5 days prior to major surg, ticagrelor for 5 days, and prasugrel for 7 days.
- For NSAIDS, hold ibuprofen for 1 day, and other NSAIDS for about 3 days prior to surgery. Cox-2 inhibitors and non-acetylated salicylates (salsalate, diflunisal, choline-Mg-trisalicylate) do not inhibit platelets and don't need to be stopped preoperatively.
- The following surgeries have a high bleeding/complication risk and absolutely require holding antiplatelet meds: Intracranial neurosurgery, spinal cord surgery, posterior eye surgery, prostate/TURPs, and possibly middle ear surgery.
- If held, antiplatelet drugs can usually be restarted ~ 24 hours after the surgery (consider reload).

## REFERENCES:

- (1) Fleisher LA, et al. ACC/AHA 2014 Guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: J. Am Coll Cardiology 2014.
- (2) McFalls EO, et al. Coronary artery revascularization before major vascular surgery. NEJM 2004; 351:2795-804. (*The CARP trial; the first and largest RCT evaluating the utility of preoperative revascularization*)
- (3) Up-To-Date: Multiple monographs on perioperative evaluation & management, last reviewed November 2014.
- (4) Updates in Perioperative Medicine lectures from ACP and SGIM National meetings, 2011-2014.