Pre-Operative Evaluation for the Primary Care Provider

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Pre-operative Medicine Clinic

- No disclosures to report

PMC at OHSU

Our team consists of physicians, advanced practice providers (NPs & PAs), and nurses who have extensive experience delivering perioperative care.

Our vision in the Pre-Operative Medicine Clinic (PMC) is to work as a clinic-wide team to partner with our multidisciplinary partners at OHSU to serve the diverse peri-operative/peri-procedural needs of patients across the Pacific NW to provide high-quality patient-centered care and opportunities for optimization that enhance the entire peri-operative/peri-procedural experience.

What is pre-operative or peri-operative medicine?

This type of clinical care focuses on evaluating health and striving for best possible outcomes before (pre-) and surrounding (peri-) surgery and anesthesia

Primary goal is reviewing overall health to ensure a patient is optimized to proceed with planned surgery or procedure

At OHSU we work very closely with surgery and anesthesiology teams to ensure the safest surgery and smoothest recovery process possible

Objectives

- Participants will be able to understand the American College of Cardiology (ACC)/American Heart Association (AHA) guidelines for perioperative risk assessment in non-cardiac surgery
- Participants will be able to identify at least one risk assessment tool for calculating perioperative risk
- Participants will better understand the testing options depending on the patient and type of surgery
- Participants will be able to identify resources for appropriate medication management prior to surgery

Teaching points

- Differentiating “clearance” versus optimization
- Types of anesthesia
- ACC/AHA guidelines: ASA scoring, risk of surgery
- Risk calculators
- Functional status/DASI
- When testing is indicated

Teaching points, cont.

- Most common reasons for delay
- Medication management
- Frailty screening
- Anemia management

Why call it pre-operative optimization versus “clearance”

"Clearance" implies the patient is has low risk for surgery.

We do NOT use this term in our clinic (although surgeons still do)

Optimization isn’t eliminating patient’s risk factors, instead it's a holistic approach to patient's medical conditions to lower their risk of anesthesia and surgery as much as possible

Our goal is to learn about overall health and patient’s current condition to determine readiness for surgery or procedure, or what we can do to get them there: aka "optimization"

Anesthesia History

Specific problems

- Malignant hyperthermia -MUST be flagged
  - requires complex DOS planning including equipment turn-over
  - make sure in history/problem tab (and consider adding to "allergy" tab)
- Delayed emergence—explore or discuss with anesthesia if true "delayed emergence" versus expected "took a while to wake up"
- Intraop awareness—confirm/clarify history if true
- PONV—place FYI in chart

CONSEQUENCES OF PONV[1]

Patient:
- discomfort
- dehydration
- aspiration
- wound dehiscence
- anxiety

Healthcare System:
- prolonged PACU stay
- delays in OR schedule
- unintended hospitalization
- increased cost
- morbidity

Anesthesia Specific History

Difficult Intubation

- If known/reports by patient—track down last anesthesia note or flag documentation within the OHSU system/Care Everywhere
- If suspected based on exam (Mallampati 4, small mouth opening, thick neck, limited neck ROM, hx neck radiation/scarring)

ASA Physical Status Classification System

The American Society of Anesthesiologists' (ASA) Physical Status Classification System has been in use for over 60 years. The purpose of the system is to assess and communicate a patient's pre-anesthesia

medical co-morbidities

The classification system alone does not predict the perioperative risks, but used with other factors (eg, type of surgery, frailty, level of deconditioning), it can be helpful in predicting perioperative risks.

Current Definitions and ASA-Approved Examples

ASA PS Classification	Definition	Adult Examples, Including, but not Limited to:	Pediatric Examples, Including but not Limited to:	Obstetric Examples, Including but not Limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use	Healthy (no acute or chronic disease), normal BMI percentile for age	
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease	Asymptomatic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI percentile for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations	Normal pregnancy*, well controlled gestational HTN, controlled preeclampsia without severe features, diet-controlled gestational DM.
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. 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, history (>3 months) of MI, CVA, TIA, or CAD/stents.	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition. Full term infants <6 weeks of age.	Preeclampsia with severe features, gestational DM with complications or high insulin requirements, a thrombophilic disease requiring anticoagulation.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent (<3 months) MI, CVA, TIA or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, shock, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.	Preeclampsia with severe features complicated by HELLP or other adverse event, peripartum cardiomyopathy with EF <40, uncorrected/decompensated heart disease, acquired or congenital.
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.	Uterine rupture.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes			

Surgery Risk Stratification

The Surgical Risk Score assigns a numerical value to reflect the risk level associated with the procedure ranging from 1 (very low risk) to 5 (very high risk). These categories identify operations with increased potential for substantial blood loss or other intraoperative and postoperative risks.

Surgical Risk Score	Surgery Types
1- Very Low Risk	**Procedures that usually require only minimal or moderate sedation and have few physiologic effects** •Eye surgery that can be performed under Monitored Anesthesia Care •Simple GI endoscopy (without stents) •Dental procedures
2- Low Risk	**Procedures associated with minimal physiologic effect** •Hernia repair •ENT procedures without planned flap or neck dissection •Diagnostic cardiac catheterization •Interventional radiology •Interventional GI endoscopy •Eye surgery that requires General Anesthesia •Cystoscopy
3- Intermediate Risk	**Procedures associated with moderate changes in hemodynamics, risk of blood loss** •Intracranial and spine surgery •Gynecologic and urologic surgery •Intra-abdominal surgery without bowel resection •Intra-thoracic surgery without lung resection •Cardiac catheterization procedures including electrophysiology studies, ablations, AICD, pacemaker
4- High Risk	**Procedures with possible significant effect on hemodynamics, blood loss** •Colorectal surgery with bowel resection •Kidney transplant •Major joint replacement (shoulder, knee, and hip) •Open radical prostatectomy, cystectomy •Major oncologic general surgery or gynecologic surgery •Major oncologic head and neck surgery •Spine deformity surgery
5- Very High Risk	**Procedures with major impact on hemodynamics, fluid shifts, possible major blood loss** •Aortic surgery •Cardiac surgery •Intra-thoracic procedures with lung resection •Major transplant surgery (heart, lung, liver)

Functional Status

Metabolic equivalents (METs)

A way to measure the amount of energy used during exercise or to complete a task

Duke Activity Status Index (DASI)

Estimates functional capacity of patients

Predicts death & MI

More reliable than subjective assessment for detecting <4 METs

EXERCISE INTENSITY (METs) FOR DAILY LIFE ACTIVITIES

from the Compendium of Physical Activities

Light exercise

General cleaning & straightening up	2.5
Washing dishes, clearing the table	2.5
Walking 2.0 mph (strolling)	2.8

Moderate exercise

Sweeping, vacuuming	3.3
Scrubbing the floor	3.8
Gardening, weeding	4.0

Moderate exercise

Multiple household tasks at once with vigorous effort	4.3
Walking 3.0 mph	3.5
Walking 4.0 mph*	5.0
Walking with a light (15 lb) load	5.0
Walking 3.0 mph at 3-5% grade (uphill)	5.3
Mowing the lawn	5.5

Moving furniture and carrying boxes	5.8

Vigorous exercise

Climbing stairs	8.0

**Energy ratings are based on METs (metabolic equivalent). Light exercise is less than 3.0 METs. Moderate exercise is 3.0-5.9 METs. Vigorous exercise is 6.0 METs and above.*

whyiexercise.com

MET Levels

Listed alphabetically by category of intensity

Light activities (<3 METs)*	METs
Canoeing leisurely	2.5
Croquet	2.5
Dancing, ballroom, slow	2.9
Fishing, standing	2.5
Golf with a cart	2.5
Housework, light	2.5
Playing catch	2.5
Playing a piano	2.5
Sitting quietly	1.0
Stretching exercises, yoga	2.5
Walking, 2 mph	2.5

*Calories burned = up to 215/hour

Moderate activities (3–6 METs)*	METs
Aerobic dance, low impact	5.0
Archery	3.5
Badminton	4.5
Baseball or softball	5.0
Basketball, shooting baskets	4.5
Bicycling, leisurely	3.5
Bowling	3.0
Calisthenics, light to moderate	3.5
Canoeing, 3 mph	3.0
Chopping wood	6.0
Dancing, aerobic or ballet	6.0
Dancing, modern, fast	4.8
Fencing	6.0
Fishing, walking and standing	3.5
Foot bag, hacky sack	4.0
Gardening, active	4.0
Golf, walking	4.4
Gymnastics	4.0
Hiking cross country	6.0
Horseback riding	4.0
Ice skating	3.5

Moderate activities (3–6 METs)*	METs
Jumping on mini tramp	4.5
Kayaking	5.0
Mowing lawn, walking	5.5
Raking the lawn	4.0
Shoveling snow	6.0
Skateboarding	5.0
Skiing downhill, moderate	6.0
Snorkeling	5.0
Snowmobiling	3.5
Surfing	6.0
Swimming, moderate pace	4.5
Table tennis	4.0
Tai chi	4.0
Tennis, doubles	5.0
Trampoline	3.5
Volleyball, noncompetitive	3.0
Walking, 15 min/mile	5.0
Walking, brisk up hills	6.0
Water skiing	6.0
Weight lifting, heavy workout	6.0
Wrestling	6.0

*Calories burned = 215–430/hour

Vigorous activities (>6 METs)*	METs
Aerobic dance	6.5
Aerobic dance, high impact	7.0
Aerobic stepping, 6–8 inches	8.5
Backpacking	7.0
Basketball game	8.0
Bicycling, 12–13 mph	8.0
Bicycling, 20+ mph	16.0
Calisthenics, heavy, vigorous	8.0
Canoeing, 5 mph or portaging	7.0
Fishing in stream with waders	6.5
Football, competitive	9.0
Football, touch/flag	8.0
Frisbee, ultimate	8.0
Hockey, field or ice	8.0
Ice skating, social	7.0
Jogging, 12 min/mile	8.0
Judo/karate/tae kwan do	10.0

Vigorous activities (>6 METs)*	METs
Lacrosse	8.0
Logging/felling trees	8.0
Mountain climbing	8.0
Racquetball	10.0
Racquetball, team	8.0
Roller skating	7.0
Rollerblading, fast	12.0
Rope skipping, slow	8.0
Rope skipping, fast	12.0
Running, 10 min/mile	10.0
Running, 6 min/mile	16.0
Running, 7 min/mile	14.0
Running, 8 min/mile	12.5
Running, 9 min/mile	11.0
Skiing cross country, slow	7.0
Skiing cross country, moderate	8.0
Skiing cross country, racing uphill	16.5

Vigorous activities (>6 METs)*	METs
Skiing cross country, vigorous	9.0
Skiing down hill, vigorous	8.0
Skin diving	12.5
Snow shoeing	8.0
Soccer, casual	7.0
Soccer, competitive	10.0
Swimming laps, fast	10.0
Swimming laps, moderate pace	7.0
Swimming laps, sidestroke	8.0
Swimming recreational	6.0
Tennis	7.0
Volleyball, competitive/beach	8.0
Walking, 11 min/mile	11.0
Walking up stairs	8.0
Water jogging	8.0
Water polo	10.0

*Calories burned = 430+/hour

How many calories is that? You can calculate the number of calories you burn for any activity by using the following equation:

Exercise calories = (MET level of activity x 3.5 x Weight (kg) x minutes of activity) / 200

From 2024 ACC/AHA Guidelines

Table 5. Duke Activity Status Index (DASI)

Activity: Can you…	Weight
take care of yourself (eg, eating, dressing, bathing, or using the toilet)?	2.75
walk indoors, such as around your house?	1.75
walk a block or 2 on level ground?	2.75
climb a flight of stairs or walk a hill?	5.5
run a short distance?	8
do light work around the house (eg, dusting, washing dishes)?	2.7
do moderate work around the house (eg, vacuuming, sweeping floors, carrying in groceries)?	3.5
do heavy work around the house (eg, scrubbing floors, lifting or moving heavy furniture)?	8
do yardwork (eg, raking leaves, weeding, pushing a power mower)?	4.5
have sexual relations?	5.25
participate in moderate recreational activities (eg, golf, bowling, dancing, doubles tennis, throwing a baseball or football)?	6
participate in strenuous sports (eg, swimming, singles tennis, basketball, skiing)?	7.5

Duke Activity Status Index (DASI)

Estimates functional capacity.

INSTRUCTIONS

Answers are self-reported. Provides an estimate of functional capacity, and may not be as accurate as objective measurements such as exercise stress testing.

When to Use

Is the patient able to:

Take care of self e.g. eating, dressing, bathing, using the toilet	No 0	Yes +2.75
Walk indoors	No 0	Yes +1.75
Walk 1–2 blocks on level ground	No 0	Yes +2.75
Climb a flight of stairs or walk up a hill	No 0	Yes +5.5
Run a short distance	No 0	Yes +8
Do light work around the house		

58.2 points

The higher the score (maximum 58.2), the higher the functional status.

9.89 METs

Copy Results

Next Steps

Risk Stratification

AHA/ACC GUIDELINES

RISK CALCULATORS AND APPS

American Heart Association (AHA)/American College of Cardiology (ACC)

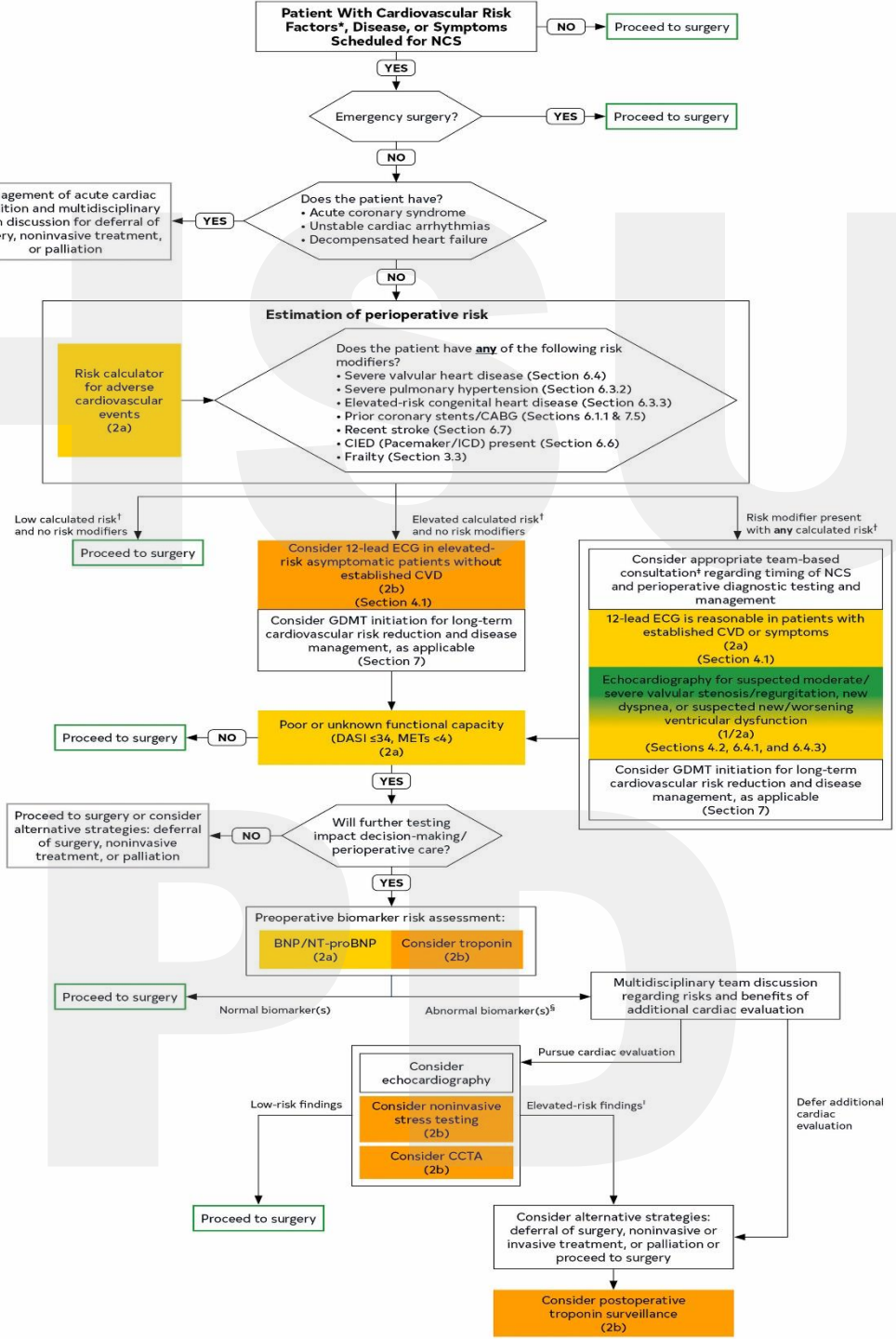
2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

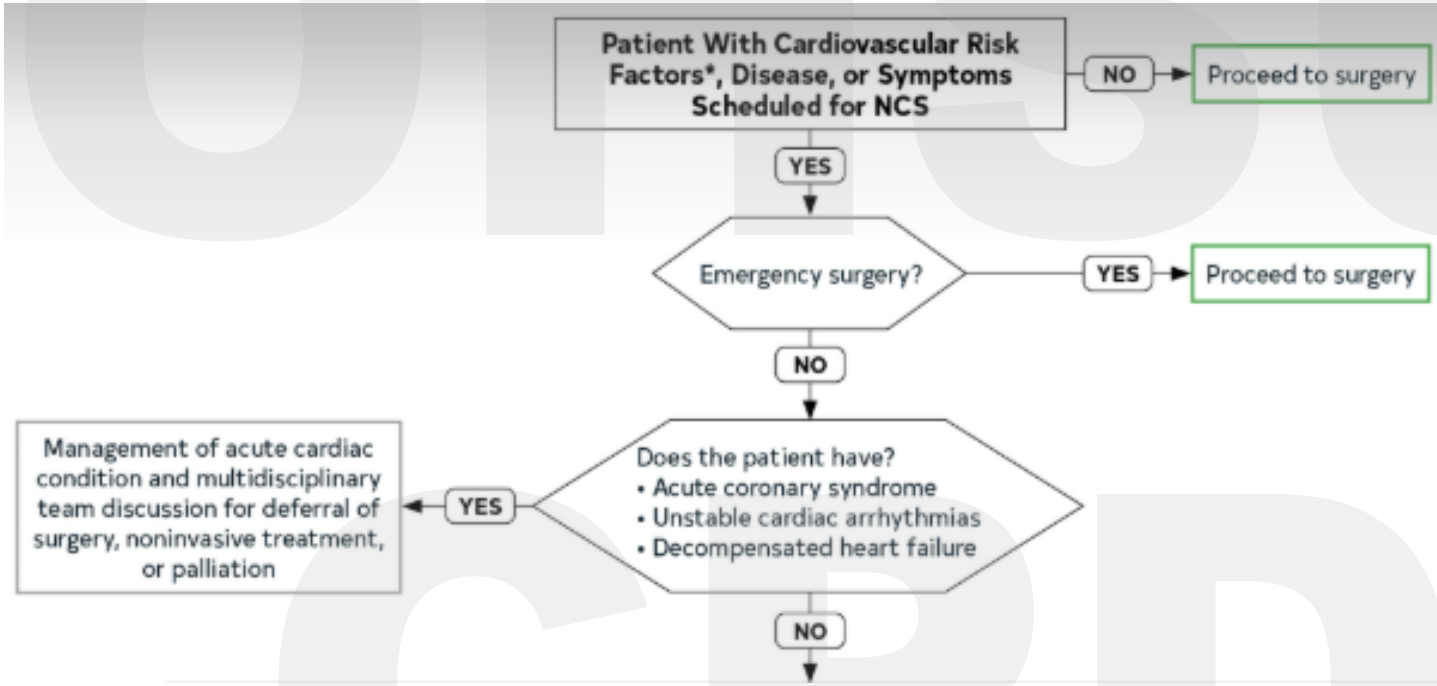
https://www.ahajournals.org/doi/10.1161/CIR.0000000000001285

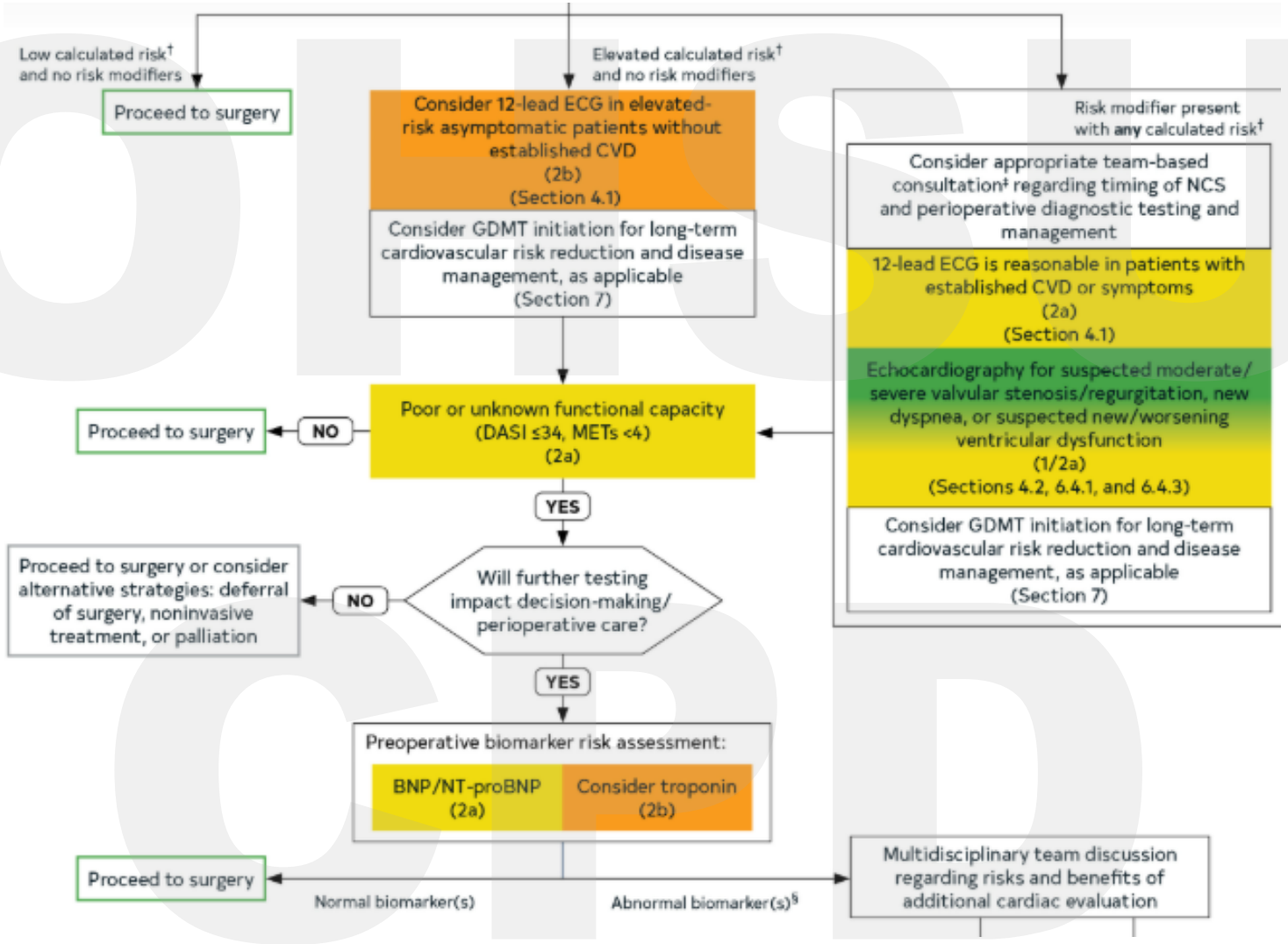
American Heart Association

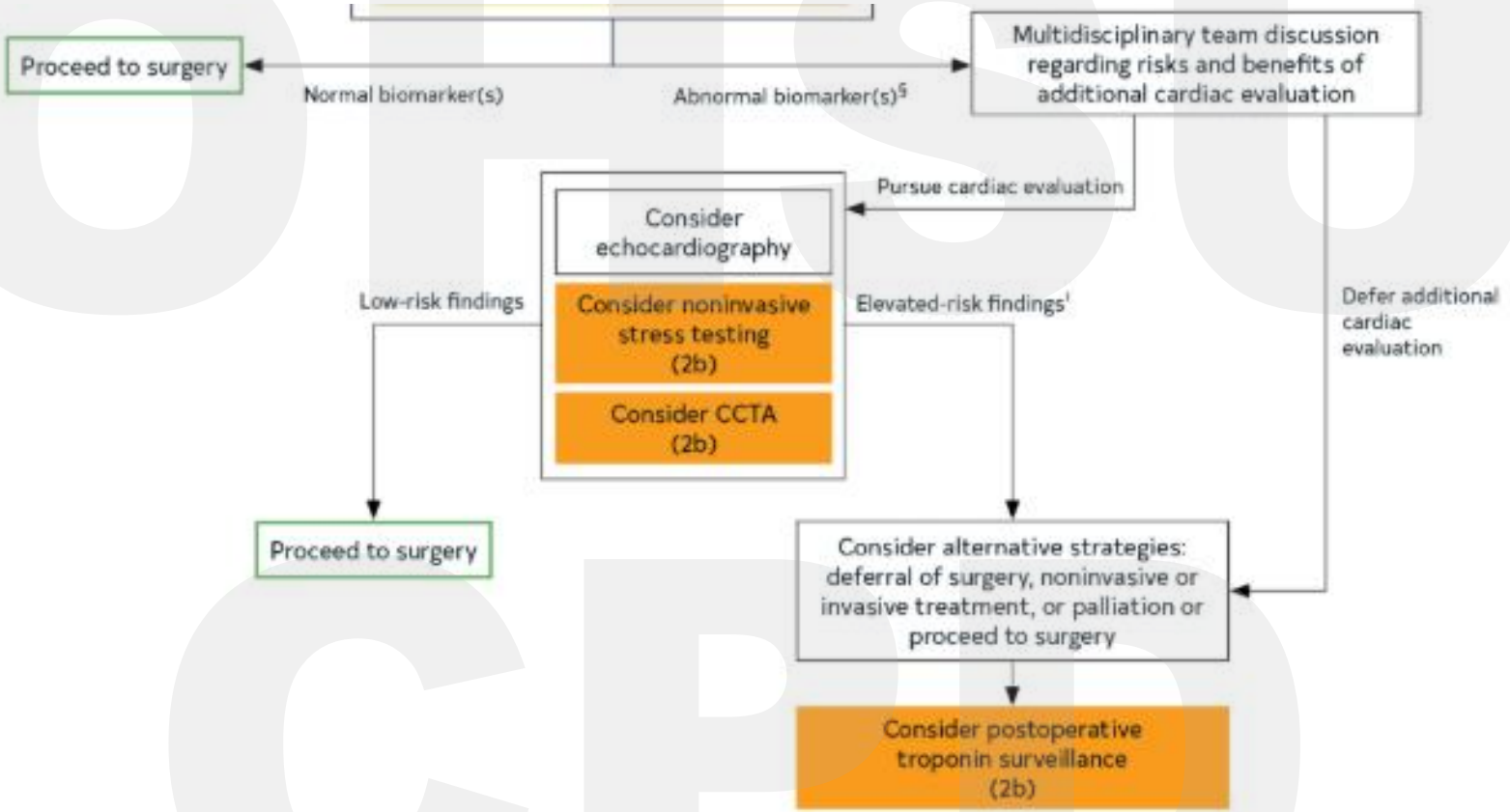
Learn and Live

Reviewing the guidelines for cardiac risk in non-cardiac surgery

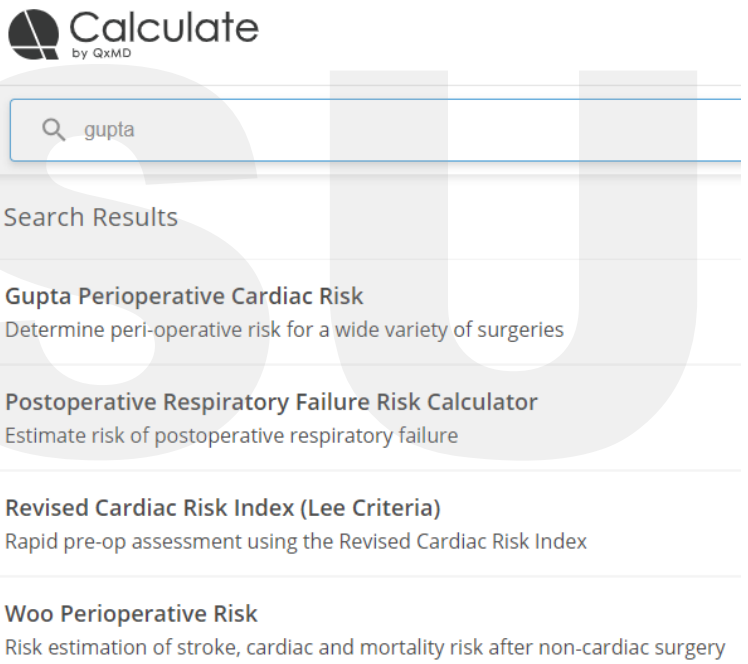



Patient With Cardiovascular Risk Factors*, Disease, or Symptoms Scheduled for NCS
NO
Proceed to surgery
YES
Emergency surgery?
YES
Proceed to surgery
NO
Does the patient have?
• Acute coronary syndrome
• Unstable cardiac arrhythmias
• Decompensated heart failure
YES
Management of acute cardiac condition and multidisciplinary team discussion for deferral of surgery, noninvasive treatment, or palliation
NO


Low calculated risk† and no risk modifiers
Proceed to surgery
Elevated calculated risk† and no risk modifiers
Consider 12-lead ECG in elevated-risk asymptomatic patients without established CVD (2b) (Section 4.1)
Consider GDMT initiation for long-term cardiovascular risk reduction and disease management, as applicable (Section 7)
Risk modifier present with any calculated risk†
Consider appropriate team-based consultation‡ regarding timing of NCS and perioperative diagnostic testing and management
12-lead ECG is reasonable in patients with established CVD or symptoms (2a) (Section 4.1)
Echocardiography for suspected moderate/severe valvular stenosis/regurgitation, new dyspnea, or suspected new/worsening ventricular dysfunction (1/2a) (Sections 4.2, 6.4.1, and 6.4.3)
Consider GDMT initiation for long-term cardiovascular risk reduction and disease management, as applicable (Section 7)
Poor or unknown functional capacity (DASI ≤34, METs <4) (2a)
NO
Proceed to surgery
YES
Will further testing impact decision-making/ perioperative care?
NO
Proceed to surgery or consider alternative strategies: deferral of surgery, noninvasive treatment, or palliation
YES
Preoperative biomarker risk assessment:
BNP/NT-proBNP (2a)
Consider troponin (2b)
Proceed to surgery
Normal biomarker(s)
Abnormal biomarker(s)§
Multidisciplinary team discussion regarding risks and benefits of additional cardiac evaluation


Proceed to surgery
Normal biomarker(s)
Abnormal biomarker(s)[5]
Multidisciplinary team discussion regarding risks and benefits of additional cardiac evaluation
Pursue cardiac evaluation
Consider echocardiography
Low-risk findings
Consider noninvasive stress testing (2b)
Consider CCTA (2b)
Elevated-risk findings[1]
Defer additional cardiac evaluation
Proceed to surgery
Consider alternative strategies: deferral of surgery, noninvasive or invasive treatment, or palliation or proceed to surgery
Consider postoperative troponin surveillance (2b)

Risk Calculator Apps



MD+CALC

QxMD

Gupta vs RCRI

- Gupta (NSQIP)
  - Factors considered: age, pre-op Cr, ASA class, functional status, surgery category
  - Underestimates risk of cardiac outcomes (documented EKG changes, trop 3x normal), but more robust "n" than RCRI
- RCRI
  - Factors considered: CAD, CHF, CV disease, ISDM, renal insufficiency
  - Determined to be more effective in predicting post-op outcomes for intra-abdominal, vascular and transplant surgeries
  - Oldest, relatively small study, overestimates risk in low-risk surgery

When testing is indicated

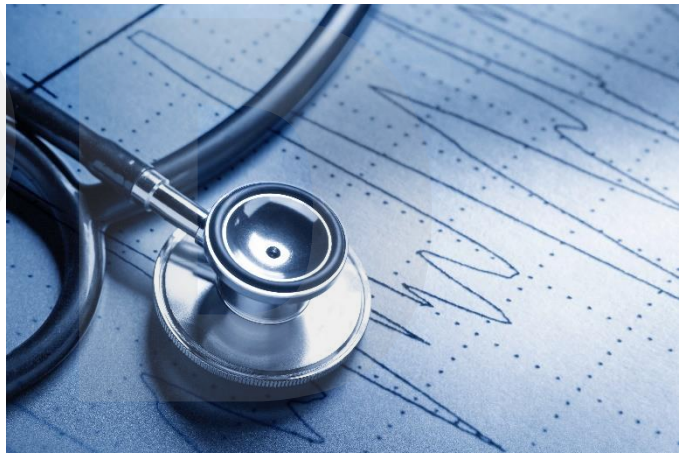
Overarching philosophy: What patient, is having what surgery, for what reason?

- Who is this patient, as an individual with a specific PMHx, having this surgery?
- The most important pre-op tool or "test" is your H&P!
- What surgery?
  - It is low/intermediate/high risk?
  - Is a minimally invasive surgery being planned or considered as an alternative?
  - Are non-operative options (medical management, palliative) being discussed?
- What is the timeline for the planned surgery?
- Think like an anesthesiologist in the OR when you can—will the ECHO, etc., change INTRA-op management even if you don't think it would change post-op medical co-management as a hospitalist

Cardiovascular

(Coronary artery disease, Valvular heart disease, Arrhythmias, Implanted Cardiac devices, Congenital heart disease, Hypertension)

- Consider renal function/electrolyte panel (CKD)
- EKG
- Echocardiogram (updated)
- Stress testing
- Carotid imaging (syncope)



Pulmonary

(COPD, asthma, tobacco use, URI, Restrictive lung disease, OSA, Obesity hypoventilation syndrome, Pulmonary hypertension)

- PFTs (updated)
- CXR
- Tobacco cessation
  - Nicotine replacement
- STOP-BANG
- Sleep study
- EKG (OSA)

STOP-Bang Questionnaire

1. Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
2. Tired: Do you often feel tired, fatigued, or sleepy during daytime?
3. Observed: Has anyone observed you stop breathing during your sleep?
4. Blood pressure: Do you have or are you being treated for high blood pressure?
5. BMI: more than 35 kg/m^2?
6. Age: over 50 years old?
7. Neck circumference: greater than 40 cm?
8. Gender: male?

Low risk of OSA: Yes to 0–2 questions
Intermediate risk of OSA: Yes to 3–4 questions
High risk of OSA: Yes to 5–8 questions

Used with permission from University Health Network, Toronto. www.stopbang.ca

Endocrine

(Diabetes, Hypo/hyperthyroidism, Chronic steroid use, adrenal insufficiency, pituitary insufficiency)

- Update A1c if >3 months old
- Low threshold for BMP to assess renal function
- TSH & Free T4 within a year if last one WNL

GI/Hepatology

(GERD, Chronic liver disease/ESLD/cirrhosis, Liver transplant, IBD on immunosuppression)

- CMP and INR
- Calculate MELD and/or Child-Pugh
- Consider albumin/prealbumin (IBD)
- CBC to assess for anemia

Renal/Electrolytes/GU

(CKD, ESRD on dialysis, Renal transplant, hyponatremia, potassium, BPH/incontinence)

- BMP, consider Mg and Phos (renal function panel)
- Consider albumin
- Calculate GFR

Hematologic

(Anemia, Leukopenia/leukocytosis, Thrombocytopenia, Bleeding diathesis, DVT/PE, Oncology)

- CBC
- Iron studies/anemia panel
- Consider hematology referral
- INR depending on time until surgery if on Coumadin
- Albumin/prealbumin to assess nutritional status
- Updated EKG depending on risk of cardiotoxities

Geriatrics
(MCI/dementia, Frailty)

- Frailty screening in clinic for applicable patients (in later slide)
- Consider albumin (renal function panel over BMP)
- Considering using full NSQIP risk calculator over Gupta to paint more nuanced picture of peri-op risk

Infectious Disease
(Active infection, MRSA history, HIV)

- Consider UA if active symptoms of potential UTI (versus specific surgery screening protocols regardless of any symptoms)
- Document MRSA history
- Document last CD4 and VL (unusual to repeat de novo in clinic)

Neuro-muscular

(Rheumatology, Cervical spine stenosis, Myasthenia gravis, Muscular dystrophy, Multiple sclerosis, Parkinson's disease, Epilepsy)

- Consider albumin/prealbumin if concern for chronic inflammatory state/poor nutrition
- Consider cervical extension/flexion films
- Occasionally pursue spine imaging, especially with neck hyperextension (cardiac surgery)—extension/flexion cervical spine xrays, rare pursuit of MRIs

Psychiatry

(Depression, Bipolar d/o, schizophrenia, PTSD)

Generally, not a major barrier to surgery unless appears to have unstable depression, bipolar d/o, schizophrenia that might impair post-op adherence or recovery supports

- EKG if on QT prolonging agents
- BMP (creatinine, Na) and consider TFTS with lithium
- PTSD: Ask about specific (especially healthcare related) triggers, ex startling when awoken at night, claustrophobia as courtesy to patient and the inpatient team

Other behavioral or miscellaneous concerns

- Try to flag any major concerns that might affect patient or staff safety or experience:
  - Major behavioral challenges/agitation/aggression
  - Severe needle phobia
  - Difficult IV access/phlebotomy

Substance use disorder and MAT (medication for substance use disorder)

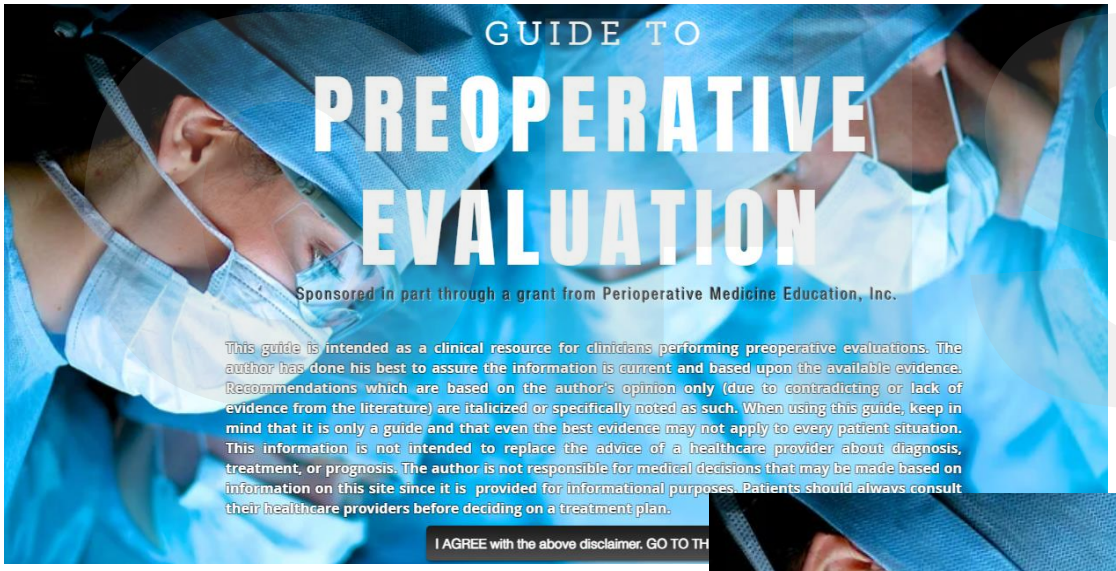
- Active IVDU—potential concerns include infection risk, overall psychosocial stability, ability to adhere/self-care post-op
- Heroin/narcotics—ability to safely dose and manage post-op pain
- Methamphetamines and cocaine—risk cardiac instability (or past cardiac pathology)

Substance use disorder and MAT, cont.

- Alcohol use disorder—history of WD including DT or seizures? Risk of withdrawal post-op. Risk alcohol-related liver disease
- SUD in remission—Medication Assisted Treatment (MAT) management: consult with prescriber for post-op plan , risk of relapse with post-op opioids
- Known complications—liver disease? HCV? HIV? h/o endocarditis? h/o MRSA?
- Recommend IMPACT consult (OHSU)

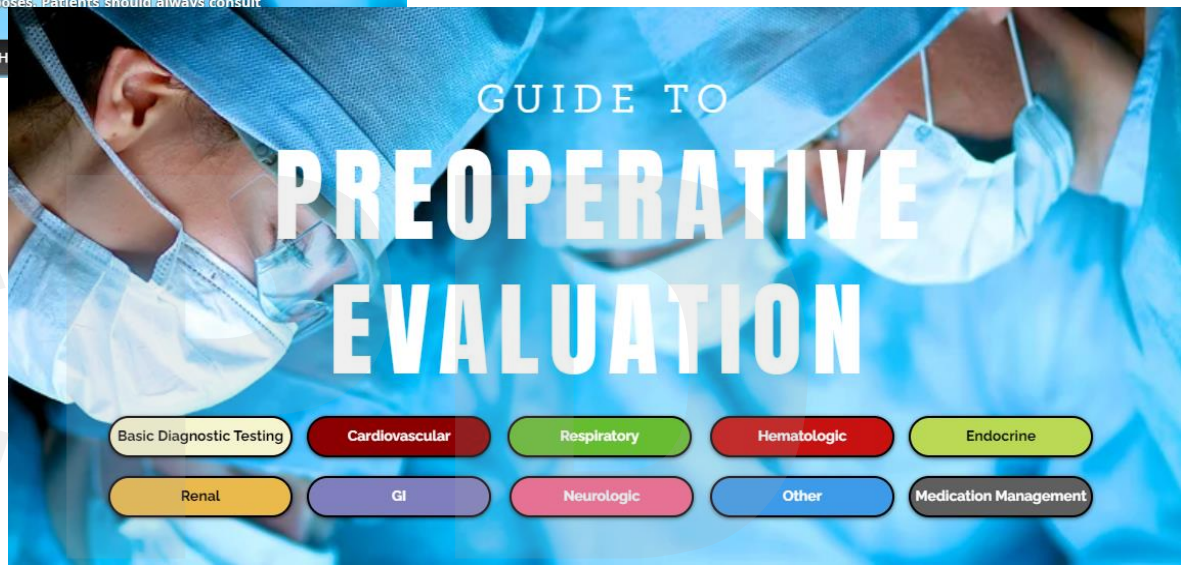
Substance use disorder and MAT, cont.

- EKG if on QT prolonging agents
- CMP and INR if ETOH-use disorder
- CMP and INR if hepatitis C or HIV



www.preopevalguide.com

Created by Dr. Kirk Pfiefer: specialist in Periop Medicine



In the words of our amazing
Medical Director, Dr. Avital O'Glasser:

*"You should **quantify** and **qualify** the known comorbid conditions"*

Case study 1

- 65 y.o. male is scheduled for right Total Knee Arthroplasty

- PMHx: CAD, HTN, HLD, prediabetes

Case study 1, continued

- CAD – hx STEMI July 15, 2022, with drug-eluting stent to RCA, mild – mod disease otherwise
  - On ASA, statin, beta blocker
  - TTE 7/16/2024 - normal LVEF, no wall motion abnormalities
  - Asymptomatic with good METS, golfing 18 holes 1-2x/week in summer, carries his clubs. Walks on weekend at Mt Tabor, ~3 miles.
  - Followed by cardiology at OHSU, last OV 8/23/24
- HTN – stable, well controlled on 2 agents (ARB, BB), last BP 124/68
- HLD – controlled on statin
- Prediabetes – stable, diet-controlled, last Hb a1c – 6.0% (6/2024)

Case study 1, cont'd

- Okay to proceed?

Case study 1, cont'd

- Does the patient have cardiovascular risk factors, disease or symptoms?
  - **Yes**
- Do they have ACTIVE cardiopulmonary symptoms (acute coronary syndrome, unstable cardiac arrhythmias, decompensated HF)?
  - **No**
- Any Risk Modifiers?
  - Severe valvular heart disease, severe pulm HTN, elevated risk congenital heart disease, **prior stents/CABG**, recent stroke, pacemaker/ICD present, frailty
- Calculate surgical risk
  - **Gupta – 0.6%; RCRI - 1**
- If Risk Modifier present, ECHO would be indicated for suspected mod-severe valvular disease, new dyspnea, or suspected new/worsening ventricular dysfunction
  - **No**
- Calculate functional capacity
  - **If >4 METS and/or DASI >34, no further cardiac risk stratification is indicated**
  - If < or = 4 METS and/or DASI < or = 34, consider additional cardiac testing

Case study 1, cont'd

- Recommendation:
  - Okay to proceed without additional cardiac testing

Case study 1, cont'd

- What if we have the same patient, but he has not been followed by cardiology?
  - He does not have recent echo and has poor functional capacity
  - Reports he is sedentary due to knee pain. He is unable to walk to his mailbox. He gets short of breath going from recliner to bathroom with walker.

Case study 1, cont'd

- Does the patient have cardiovascular risk factors, disease or symptoms?
  - **Yes**
- Do they have ACTIVE cardiopulmonary symptoms (acute coronary syndrome, unstable cardiac arrhythmias, decompensated HF)?
  - **Maybe?**
- Any Risk Modifiers?
  - Severe valvular heart disease, severe pulm HTN, elevated risk congenital heart disease, **prior stents/CABG**, recent stroke, pacemaker/ICD present, frailty
- Calculate surgical risk
  - **Gupta – 1.2% (increased from 0.6 d/t functional capacity); RCRI - 1**
- If Risk Modifier present, ECHO would be indicated for suspected mod-severe valvular disease, new dyspnea, or suspected new/worsening ventricular dysfunction
  - **Unknown**
- Calculate functional capacity
  - If >4 METS and/or DASI >34, no further cardiac risk stratification is indicated
  - **If < or = 4 METS and/or DASI < or = 34, consider additional cardiac testing**
    - **Consider biomarkers (BNP, NT-pro BNP), echo and/or stress testing, or refer back to cardiology**

Case study 2

- 70 yo female with primary hyperparathyroidism. Her associated symptoms are hypercalcemia and osteoporosis with history of hip fracture and kidney stones.
- Her prior medical history is significant for:
  - severe OSA on BiPAP, type II DM, CKD stage IIIb, obesity, tobacco dependence (40 pack year hx)
- Current physical activity:
  - Walks around stores using her cane or shopping cart, but can do it carrying a basket, too. Reports she is limited by knee pain. She can climb a flight of stairs with her groceries. Denies any chest pain. Some mild DOE, but unchanged from baseline. Overall feels getting better in terms of conditioning.

Case study 2, cont'd

- BP 110/52, HR 58, R 18, T 36.3, SpO2 97% on RA
- BMI 45.53 kg/m2
- OSA, severe – controlled on BiPAP
  - TTE 5/2023 - low-normal LVEF (53%), mild LVH, mild mitral insufficiency, mild-mod diastolic dysfunction, RVSP 36 mHg
- Type II DM – well controlled on metformin 1000 mg BID. Last a1c – 6.7% (7/2024)
- HTN – well controlled on 3 agents (CCB, ARB, BB)
- CKD stage IIIb – stable, baseline creat 1.46, GFR 38. Last renal panel done 6 months ago
  - Followed by nephrology at OHSU, some suspicion that hypercalcemia contributing to CKD
- Class 3 severe obesity, with BMI 45-49.9 kg/m2 in adult

Case study 2, cont'd

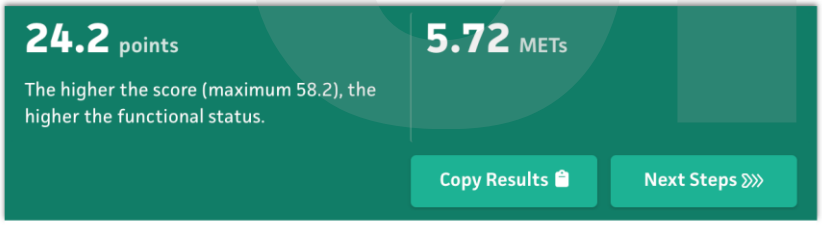
- Does the patient have cardiovascular risk factors, disease or symptoms?
  - **Yes**

- Do they have ACTIVE cardiopulmonary symptoms (acute coronary syndrome, unstable cardiac arrhythmias, decompensated HF)?
  - **No**

- Any Risk Modifiers? Severe valvular heart disease, severe pulm HTN, elevated risk congenital heart disease, prior stents/CABG, recent stroke, pacemaker/ICD present, frailty
  - **No, and relatively recent TTE with mild pHTN**

- Calculate surgical risk
  - **Gupta – 0.4-0.7%**
- If Risk Modifier present, ECHO would be indicated for suspected mod-severe valvular disease, new dyspnea, or suspected new/worsening ventricular dysfunction
  - **No**

- Calculate functional capacity
  - **If >4 METS and/or DASI >34, no further cardiac risk stratification is indicated**
  - If < or = 4 METS and/or DASI < or = 34, consider additional cardiac testing



Case study 2, cont.

What type of testing would you consider ordering?

A. Metabolic panel
B. CBC
C. Hb a1c
D. INR
E. EKG

Case study 2, cont.

What type of testing would you consider ordering?

A. Metabolic panel

B. CBC

C. Hb a1c

D. INR

E. EKG

Reasons for cancellation - New symptoms

Cardiac: chest pain, DOE, palpitations, orthopnea, LE edema

Respiratory: cough, SOB, URI

GI: abdominal pain, nausea, vomiting or diarrhea

Constitutional: fevers, s/sx of infection

Reasons for cancellation – new signs

Cardiac:

- Recent MI/stent - recommend waiting at least 6 (preferably 12) months after drug eluting stenting for non-emergent surgery
- Abnormal EKG – new/uncontrolled atrial fibrillation, high degree HB, sustained SVT, new LBBB
- Decompensated HF – SOB, edema, elevated JVP, pulmonary edema on chest x-ray
- Murmurs - New murmur, evaluate old murmur

Re-evaluating murmur

Otto, C. M., . (2021)

	Type of Valve Lesion			
Stage	**Aortic Stenosis***	**Aortic Regurgitation**	**Mitral Stenosis**	**Mitral Regurgitation**
Progressive (Stage B)	Every 3–5 y (mild severity; V_{max} 2.0–2.9 m/s)	Every 3–5 y (mild severity)	Every 3–5 y (MV area >1.5 cm^2)	Every 3–5 y (mild severity)
	Every 1–2 y moderate severity; V_{max} 3.0–3.9 m/s)	Every 1–2 y (moderate severity)		Every 1–2 y (moderate severity)
Severe asymptomatic (Stage C1)	Every 6–12 mo (V_{max} ≥4 m/s)	Every 6–12 mo	Every 1–2 y (MV area 1.0–1.5 cm^2)	Every 6–12 mo
		Dilating LV: More frequently	Every year (MV area <1.0 cm^2)	Dilating LV: More frequently

Patients with mixed valve disease may require serial evaluations at intervals earlier than recommended for single-valve lesions. These intervals apply to most patients with each valve lesion and do not take into consideration the etiology of the valve disease.

*

With normal stroke volume.

LV indicates left ventricle; MV, mitral valve; VHD, valvular heart disease; and V_{max}, maximum velocity.

Reasons for cancellation – new signs

- Recent stroke/TIA - delay at least 3 months, if possible 9-12 months (Benesch C, 2021)
- New VTE – at least 30 days, ideally > 3 mo of anticoagulation
- Poorly controlled DM - Hb A1c >8% (varies by surgery)
- Anemia (new or unexplained)
- AKI
- Abnormal TSH/free T4
- Abnormal electrolytes (Na+, K+, etc)
- Abnormal vitals (BP, HR, room air sats)

Medication Management

- ACC/AHA periop guideline
- UpToDate – Perioperative medication management
- Preopevalguide.com- Medication management
- SPAQI – Position papers

Medication Management

Cardiac medications

- Continue: beta blockers, calcium channel blockers, alpha blockers, antiarrhythmics
- Hold: diuretics DOS
  - Consider holding ACEI/ARB 24 hours prior
- Continue statins

Medication management

Diabetes medications

- Hold PO hypoglycemics day of surgery
  - Some discussion of continuing metformin perioperatively
- GLP1
  - Weekly dosing- do not take within 7 days of surgery
  - Daily dosing – hold 24 hours prior
- SGLT2i (*hot topic*) – hold 3-4 days prior to surgery
  - although some discussion about continuing in HF patients; should be discussed with cardiologist and/or institution

Medication management

Diabetes medications

- Insulin –
  - Long-acting insulin only – take 50% night before and/or morning of
  - Long acting + short acting insulin – 80% night before and/or morning of, hold short acting DOS
  - 70/30, NPH – usual dose night before, 1/3 -½ dose DOS
  - U-500 – continue as usual night before, 1/3 dose DOS
  - Pump: continue basal rate, consider lowering to 80% overnight, bring pump supplies with you

Medication Management

Anticoagulation

- Aspirin
  - hold 7 days if for primary prevention
  - If history of stent, consider continuing perioperatively
- Clopidogrel/ticagrelor
  - Hold 5-7 days prior
  - If within 1 year of stroke/stent, should have neuro/cardiology consult
- Warfarin
  - Hold 5 days prior to surgery
  - Bridging?

Medication Management

Warfarin Bridging Based on Thromboembolism Risk Stratification

TE Risk	Patient Characteristics			Bridging Strategy
	AFib	Mechanical Valve	VTE	
Low (<4%/yr ATE, <2%/mo VTE)	CHA_2DS_2-VASc score 1-4	Bileaflet aortic valve without stroke risk factors*	Single VTE >12 mo previous with no other risk factors	**No bridging**
Intermediate (4-10%/yr ATE, 4-10%/mo VTE)	CHA_2DS_2-VASc score 5-6	Bileaflet aortic valve with stroke risk factors*	Recurrent VTE	**No bridging *unless unique considerations***
			VTE within past 3-12 mo	
		Mitral valve without stroke risk factors*	Nonsevere thrombophilia (prothrombin gene mutation or factor V Leiden heterozygosity)	
			Active, non-high VTE risk cancer within 5 years	
High (>10%/yr ATE, >10%/mo VTE)	Rheumatic valvular disease	Mitral mechanical valve with stroke risk factors*	VTE within past 3 mo	**Bridge with therapeutic LMWH or UFH**
			Antiphospholipid antibody syndrome	
	CHA_2DS_2-VASc score ≥7	Caged ball/tilting disc aortic mechanical valve	Severe thrombophilia (protein C/S deficiency, antithrombin deficiency, prothrombin gene mutation or factor V Leiden homozygosity)	
	Recent (<3 months) TIA/CVA	Any mechanical valve with recent (<3 months) TIA/CVA	Active cancer with high VTE risk (heme, pancreatic, primary brain, gastric, esophageal)	

*** Stroke Risk Factors**

- AFib
- Prior CVA/TIA
- Prior valve thrombosis
- Rheumatic heart disease
- Hypertension
- DM
- CHF
- Age ≥75 years

Evidence regarding bridging of mechanical heart valves remains limited – proceed with multidisciplinary shared decision-making with patient.

TE = thromboembolism, AFib = atrial fibrillation, ATE = arterial thromboembolism, VTE = venous thromboembolism

Medication Management

DOACs

Apixaban/Rivaroxaban/Edoxaban/Betrixaban Interruption

Bleeding Risk	PREOP										Surgery		POSTOP							
	-5		-4		-3		-2		-1		0		+1		+2		+3		+4	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Low/intermediate + no neuraxial anesthesia	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗*	✓	✓	✓	✓	✓	✓
High + no neuraxial anesthesia	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	?		✓	✓	✓
Neuraxial anesthesia or neuraxial surgery[37]	✓	✓	✓	✓	✓**	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			✓	✓	✓

* If procedure completed >24 hrs before PM dose, may be OK to take – speak with surgeon

** Last dose ≥72 hrs before neuraxial anesthesia[37]

? Speak with surgeon – may be able to restart if bleeding risk sufficiently low

Medication Management

Dabigatran Interruption

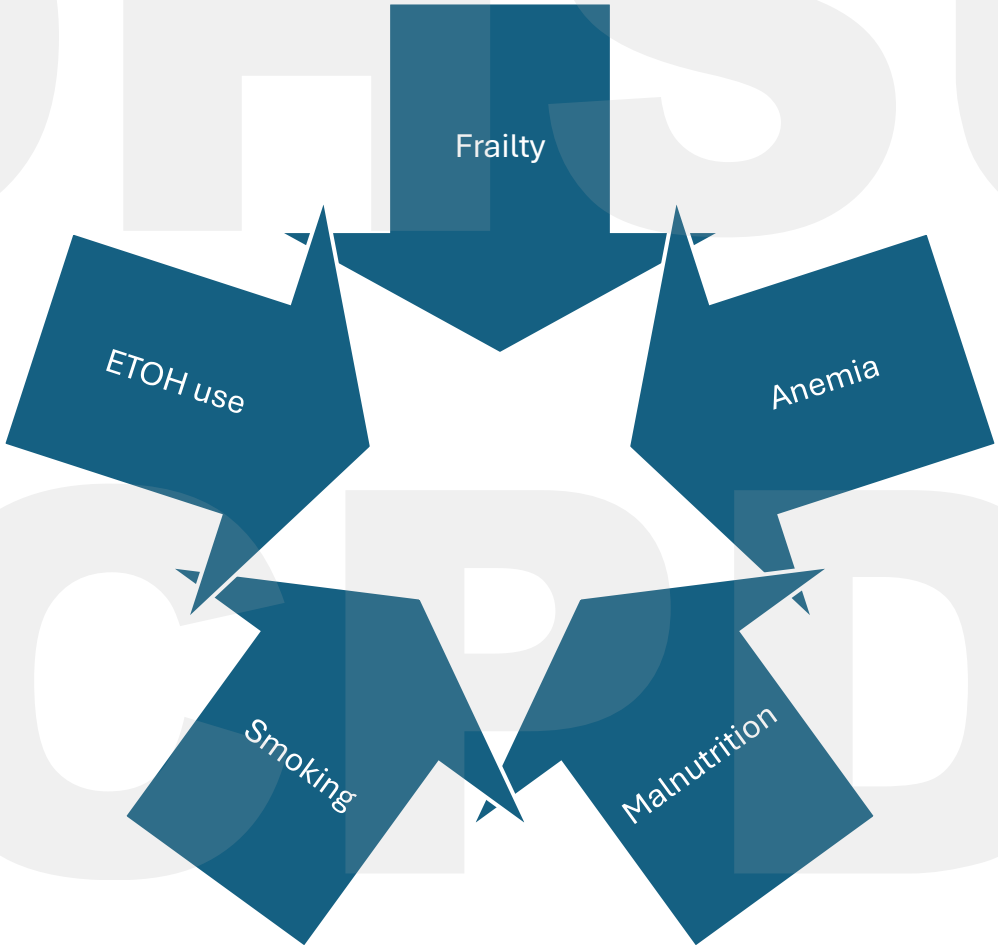
Bleeding Risk	CrCl (ml/min)	PREOP												Surgery		POSTOP							
		-6		-5		-4		-3		-2		-1		0		+1		+2		+3		+4	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Low/intermediate + no neuraxial anesthesia	≥50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗*	✓	✓	✓	✓	✓	✓
	<50	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓
High + no neuraxial anesthesia	≥50	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	?			✓	✓	✓
	<50	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			✓	✓	✓	✓
Neuraxial anesthesia (general recommendation)**		✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			✓	✓	✓	✓

* If procedure completed >24 hrs before PM dose, may be OK to take – speak with surgeon

? Speak with surgeon – may be able to restart if bleeding risk sufficiently low

** If age ≤65 + no HTN + no antiplatelet/platelet abnormalities – last dose can be later based on CrCl: ≥80 → 72 hrs; 50-79 → 96 hrs, <50 → 120 hrs (ASRA Guideline)

Other factors affecting surgery



Frailty

- "Get up and go", Mini-cog (clock draw, word recall), Edmonton Frail Scale
- Virtual visit – use Animal Naming test

Geriatrics/Frailty

- Be attune during history, esp for subtleties of memory impairment
- Personal history of post-op delirium?
- Associated with higher risk complications
- If concerned about risk/benefit of surgery versus goals of care, talk to the surgeon directly

Anemia Management

The World Health Organization has defined anemia as a hemoglobin concentration less than 13 g/dl in men and 12 g/dl in women

- Anemia work-up (within last 6 months):
  - Ferritin
  - Iron and TIBC
  - Reticulocyte count
  - C-Reactive protein
  - TSH with reflex free T4
  - B12
- Depending on timeline, optimize prior to surgery

Other factors

- Malnutrition -
  - Prealbumin
  - Consider protein supplement/shakes
- Smoking -
  - Ask, Advise, Refer
- ETOH use -
  - Quantity and frequency of use
  - Monitor for symptoms of withdrawal (CIWA protocol)

Thank you!

Please contact us with questions

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