Pre-Operative Evaluation

March 2023

DeAnn Cummings, MD

GOAL

- Try to determine what our role really is when we do a preoperative evaluation.
  - Are we just a “rubber stamp” or are we actually accomplishing something?

Definitions of Surgical Urgency

- Emergency – surgery needed within 6 hrs to avoid loss of life or limb
- Urgent – surgery needed within 6-24 hrs
- Time-Sensitive – surgery should not be delayed more than 1-6 weeks (eg – cancer surgery)
- Elective – Could be delayed up to a year

References

ACC/AHA Clinical Practice Guideline

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

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Up To Date

MAYO CLINIC | School of Continuous Professional Development

Home Find a Course Specialties Nursing About Us Contact Us My Account

Home Internal Medicine and Subspecialties An Overview of Perioperative Medicine 2022...

An Overview of Perioperative Medicine 2022: From Outpatient Preoperative Assessment to Inpatient Postoperative Care - Livestream

Syllabus/Presentations/Recordings

Beyond “Clearance”

- What is our role in planning for a patient’s surgery?
  - Give info on how bad a patient’s chronic condition is and try to optimize the status of that condition.
  - Give guidelines for management of ALL meds – including plan if patient unable to take oral meds
  - Make recommendations to decrease risk
    - *Anticoagulation recommendations*
  - Order pre-op testing that will help optimize a chronic problem OR will result in a change of plan

Does it make a difference?

- Poor quality studies
  - Likelihood of mortality was 69% less when patients had a pre-op medicine consult as opposed to an anesthesia consult.

Don’t just stop at cardiac risk!

- Pulmonary Risk
- OSA
- DVT Risk
- Delirium Risk
- Perioperative Medication Mgt
- Liver Disease
- Chronic Kidney Disease

Case #1- Youthful Yvonne

- 45 year old female arrives in your office for “preop clearance”. She is scheduled for breast reduction surgery in 2 weeks.
- She feels well and has no complaints.
- Other than obesity (BMI = 32), she has no PMH and takes no meds. She denies smoking, alcohol or drugs.
- Exam is normal. BP = 120/80.
- What does she need for preoperative evaluation?
  - ECG? Labs?

Class III: No Benefit

1. **Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures.[35,141] *(Level of Evidence: B)***

ECG

AHA 2014

What is a low risk surgical procedure?

Table 5 **Surgical risk estimate according to type of surgery or intervention**

Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast • Dental • Endocrine: thyroid • Eye • Gynaecological: minor • Orthopaedic minor (meniscectomy) • Reconstructive • Superficial surgery • Urological minor: (transurethral resection of the prostate) • VATS minor lung resection	• Carotid asymptomatic (CEA or CAS) • Carotid symptomatic (CEA) • Endovascular aortic aneurysm repair • Head or neck surgery • Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy • Intrathoracic: non-major • Neurological or orthopaedic: major (hip and spine surgery) • Peripheral arterial angioplasty • Renal transplants • Urological or gynaecological: major	• Adrenal resection • Aortic and major vascular surgery • Carotid symptomatic (CAS) • Duodenal-pancreatic surgery • Liver resection, bile duct surgery • Oesophagectomy • Open lower limb revascularization for acute limb ischaemia or amputation • Pneumonectomy (VATS or open surgery) • Pulmonary or liver transplant • Repair of perforated bowel • Total cystectomy

Based on risk of MI or death

ESC 2022

Labs

- Creatinine
  - Makes sense to check this in people over 50
  - NO evidence that it changes anything
  - CKD does increase post-op mortality
- Electrolytes
  - Usually not indicated
  - Makes sense for people with CKD or on certain meds (diuretics, ACE)

Labs

- Glucose and HgbA1C
  - No evidence that identifying hyperglycemia preop makes any difference.
  - However, orthopedic and cardiovascular surgery has been shown to be adversely affected by diabetes.
  - As a PCP, this (to me) is a good time to screen the appropriate people for diabetes.

Labs

- Liver enzymes
  - NOT recommended.
  - Severe liver disease does increase morbidity and mortality but asymptomatic, mild elevation of liver enzymes does not.
- PT, PTT, VonWillebrand
  - ONLY recommended if the history or family hx suggests a bleeding disorder

Labs

- Urinalysis/Urine culture
  - Generally NO indication without symptoms
  - Checking for and treating asymptomatic bacteruria prior to joint replacement in order to prevent infection is controversial (leave it up to the orthopod!).
- Pregnancy test – ALL women of reproductive age

Labs

- CBC
  - Indicated if major surgery planned with expected sig blood loss (>500 mL) or if there is concern for anemia.
  - NOT indicated for minor surgery.
  - Only done to identify anemia or thrombocytopenia if it will change management.

Lab Summary

- Usually people will get CBC and BMP regardless of age or history.
  - Done in preadmission testing (PAT)
- Rarely are abnormal results a reason to delay surgery.

Case #1 – Youthful Yvonne

- On further questioning, she admits to heavy periods for the past 5 years.
- No other bleeding issues.
- You opt to get a CBC and BMP:
  - Hgb = 9, platelets = 142
  - BMP is normal
- She is anemic – What do we do now?

Pre-Operative Anemia

- Study of > 200,000 patients
  - Even mild anemia increased morbidity and mortality
- Study of > 39,000 patients
  - Anemia increased mortality, LOS and post-op ICU care
- Even iron deficiency WITHOUT anemia increases 90 day mortality!
- However, these are observational studies
- There is no data that treating iron deficiency pre-op reduces mortality.

Pre-Operative Anemia

- There IS data that shows correction of iron deficiency anemia pre-op decreases transfusions and decreases length of stay in the hospital.
- Long term survival is reduced by 50% after perioperative transfusion.
- Because of this, guidelines now recommend treating iron deficiency and anemia pre-op for surgeries at risk of significant blood loss.

Check Ferritin if procedure is high risk for blood loss

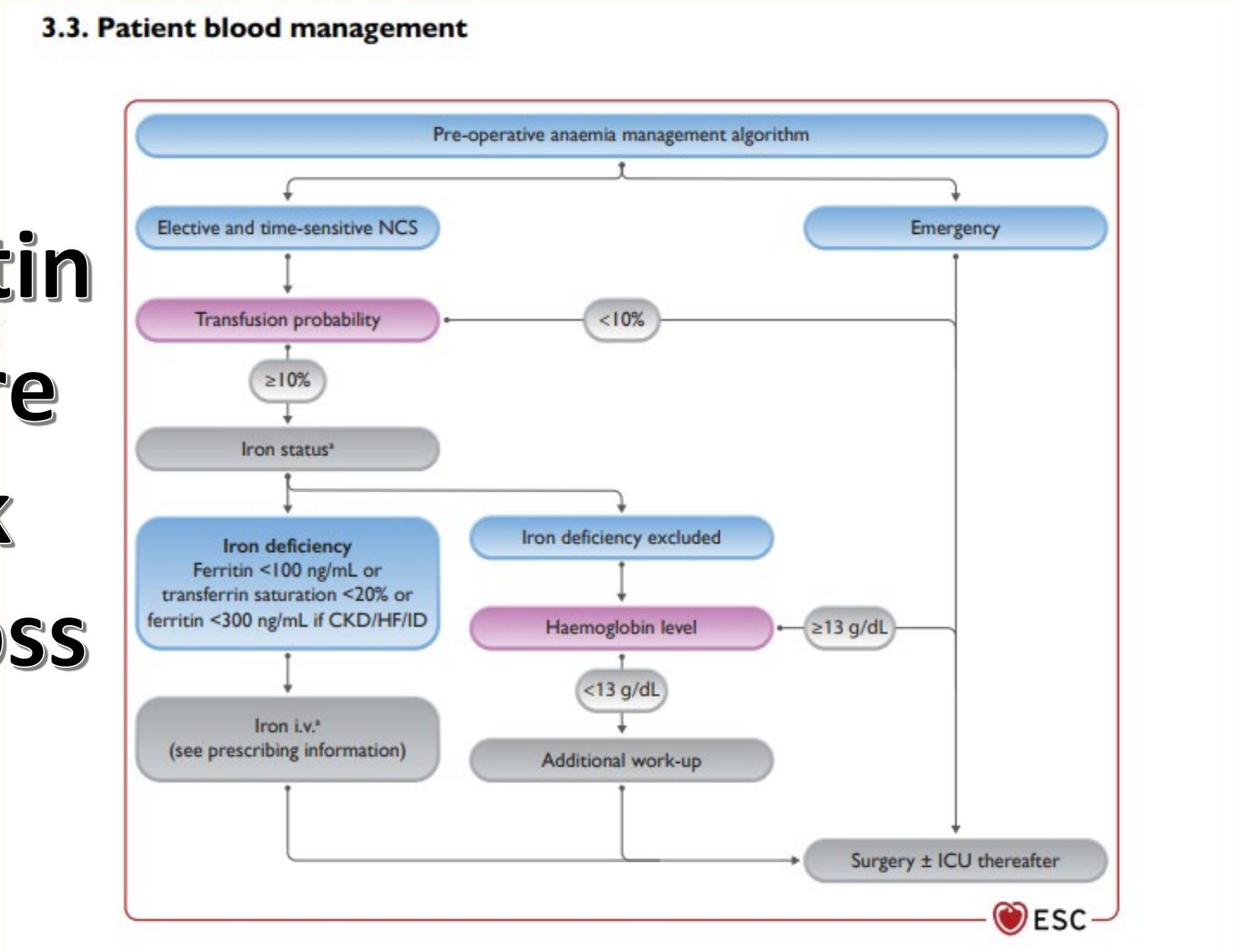


Table 9 **Bleeding risk according to type of non-cardiac surgery**

Surgery with minor bleeding risk	Surgery with low bleeding risk (infrequent or with low clinical impact)	Surgery with high bleeding risk (frequent or with significant clinical impact)
• Cataract or glaucoma procedure • Dental procedures: extractions (1–3 teeth), periodontal surgery, implant positioning, endodontic (root canal) procedures, subgingival scaling/cleaning • Endoscopy without biopsy or resection • Superficial surgery (e.g. abscess incision, small skin excisions/ biopsy)	• Abdominal surgery: cholecystectomy, hernia repair, colon resection • Breast surgery • Complex dental procedures (multiple tooth extractions) • Endoscopy with simple biopsy • Gastroscopy or colonoscopy with simple biopsy • Large-bore needles procedures (e.g. bone marrow or lymph node biopsy) • Non-cataract ophthalmic surgery • Small orthopaedic surgery (foot, hand arthroscopy)	• Abdominal surgery with liver biopsy, extracorporeal shockwave lithotripsy • Extensive cancer surgery (e.g. pancreas, liver) • Neuraxial (spinal or epidural) anaesthesia • Neurosurgery (intracranial, spinal) • Major orthopaedic surgery • Procedures with vascular organ biopsy (kidney or prostate) • Reconstructive plastic surgery • Specific interventions (colon polypectomy, lumbar puncture, endovascular aneurysm repair) • Thoracic surgery, lung resection surgery • Urological surgery (prostatectomy, bladder tumour resection) • Vascular surgery (e.g. AAA repair, vascular bypass)

Iron Deficiency Anemia

- Try to determine source of bleeding and treat
- Give iron if ferritin < 100 (< 300 in patients with anemia of chronic disease or due to CKD)
  - Oral iron if you have 4-6 weeks
  - IV iron if you only have < 4 weeks

Anemia of Chronic Disease

- If Hgb < 12, consider Epogen plus iron before major surgery.
- Preop autologous blood donation is not done often – donations cause anemia.

Case #1 – Youthful Yvonne

- Yvonne has surgery scheduled in 2 weeks.
- Since her surgery is low risk, you opt to NOT delay the surgery.
- You start her on oral iron daily.
- Her BMP is normal.
- She proceeds to surgery.

Case #1 – Youthful Yvonne

- Patient proceeds with her breast reduction and has no complications.
- Pelvis US shows fibroids and she and her gyn have decided she needs an open hysterectomy (really BIG fibroids).
- This is an intermediate risk surgery. Does she need more eval? ECG?

Surgical Risk by Procedure

Table 5 **Surgical risk estimate according to type of surgery or intervention**

Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast	• Carotid asymptomatic (CEA or CAS)	• Adrenal resection
• Dental	• Carotid symptomatic (CEA)	• Aortic and major vascular surgery
• Endocrine: thyroid	• Endovascular aortic aneurysm repair	• Carotid symptomatic (CAS)
• Eye	• Head or neck surgery	• Duodenal-pancreatic surgery
• Gynaecological: minor	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy	• Liver resection, bile duct surgery
• Orthopaedic minor (meniscectomy)	• Intrathoracic: non-major	• Oesophagectomy
• Reconstructive	• Neurological or orthopaedic: major (hip and spine surgery)	• Open lower limb revascularization for acute limb ischaemia or amputation
• Superficial surgery	• Peripheral arterial angioplasty	• Pneumonectomy (VATS or open surgery)
• Urological minor: (transurethral resection of the prostate)	• Renal transplants	• Pulmonary or liver transplant
• VATS minor lung resection	• Urological or gynaecological: major	• Repair of perforated bowel
		• Total cystectomy

Based on 30 day risk of MI, stroke or death

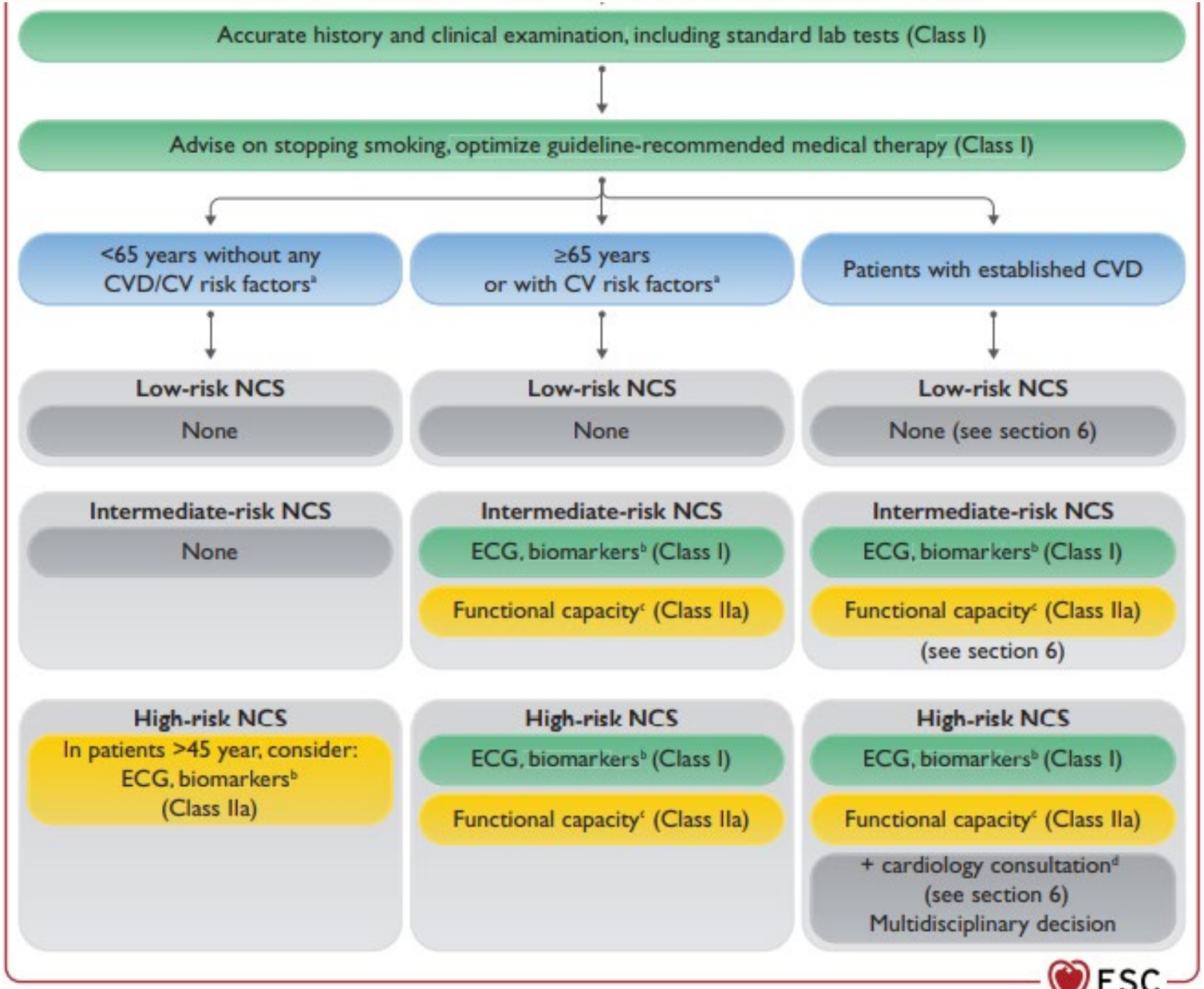
ESC 2022

ECG – Intermediate Risk Surgery

Class IIb

1. **Preoperative resting 12-lead ECG may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery.**[37,138–140] ***(Level of Evidence: B)***

AHA 2014


Accurate history and clinical examination, including standard lab tests (Class I)
Advise on stopping smoking, optimize guideline-recommended medical therapy (Class I)
<65 years without any CVD/CV risk factors[a]
≥65 years or with CV risk factors[a]
Patients with established CVD
Low-risk NCS
None
Low-risk NCS
None
Low-risk NCS
None (see section 6)
Intermediate-risk NCS
None
Intermediate-risk NCS
ECG, biomarkers[b] (Class I)
Functional capacity[c] (Class IIa)
Intermediate-risk NCS
ECG, biomarkers[b] (Class I)
Functional capacity[c] (Class IIa)
(see section 6)
High-risk NCS
In patients >45 year, consider: ECG, biomarkers[b] (Class IIa)
High-risk NCS
ECG, biomarkers[b] (Class I)
Functional capacity[c] (Class IIa)
High-risk NCS
ECG, biomarkers[b] (Class I)
Functional capacity[c] (Class IIa)
+ cardiology consultation[d] (see section 6) Multidisciplinary decision
ESC

2022

Low Risk Non-Cardiac Surgery

- Both guidelines agree that NOBODY needs an EKG for a low risk procedure!
  - Includes patients with known cardiac disease.

Intermediate Risk Surgery

- ESC – If < 65 and no cardiac risk factors, NO need for ECG.
- ACC – Consider ECG at any age.
  - WE WILL BE GETTING AN ECG UNLESS THE NEW ACC GUIDELINES SAY OTHERWISE

High Risk Surgery

- Everyone gets an ECG!

Case #1 – Youthful Yvonne

- You get an ECG and it shows T wave inversions in leads II, III and AVF as well as two PAC's.
- There is no old ECG for comparison.
- Her surgery is scheduled for next week! What do you do?

ECG Abnormalities

- PAC's and PVC's – no further eval needed in an asymptomatic patient without hx of heart disease.
- Sinus Bradycardia – For a HR > 45 with no symptoms, NO further eval is required.
- Sinus Tachycardia – For HR < 125 with no symptoms, NO further eval is required other than to look for reason for the sinus tachycardia.

ECG Abnormalities

- Findings that are seen on an old ECG usually need no further evaluation as long as there are no symptoms.
  - Chamber enlargement
  - BBB
  - Q waves
  - ST depressions and T wave inversions
- BUT IF YOU DON'T HAVE AN OLD EKG OR THEY ARE NEW, YOU HAVE TO EVALUATE THESE FINDINGS!

Case #1 – Youthful Yvonne

- Much to the disappointment of Yvonne, you postpone her elective hysterectomy so she can get a stress test.
- The stress test is normal but the surgery is delayed for another 3 months, during which she has severe vaginal bleeding and requires IV iron.
- WAS GETTING THE ECG WORTH IT??

Case #2 – Metabolic Myrtle

- Myrtle is a 65 year old female with:
  - Diabetes – on metformin, Jardiance and Lantus (A1C = 8.5)
  - HTN – controlled on lisinopril and HCTZ
  - Hyperlipidemia – controlled on Lipitor
  - CKD stage 3 – baseline creatinine = 2.1, eGFR = 40
  - Obesity – BMI = 32
- She has no history of MI, heart failure or stroke.

Case #2 – Metabolic Myrtle

- Myrtle presents to your office for preoperative evaluation.
- She is scheduled for right hip replacement in 1 week!!
- She denies any chest pain, dyspnea, palpitations or syncope.
- She does not smoke, drink or use drugs.
- Her exam is normal. BP = 152/90.

Case #2 – Metabolic Myrtle

- Myrtle looks like she is at risk for perioperative complications and she is getting an intermediate risk surgery.
- Her ECG is normal.
- Her labs are at baseline.
- What should we do with Myrtle?
  - “Clear” her?
  - Stress? Echo?
  - What exactly is her risk of major cardiovascular events (MACE)?

Estimating Risk of MACE

- Many guidelines and UTD recommend using a risk assessment tool. (NOT ESC)
  - Revised Cardiac Risk Index (RCRI)
  - National Surgery Quality Improvement Project (NSQIP)
    - *Mayo uses NSQIP MICA (GUPTA) - MD Calc*

Revised cardiac risk index (RCRI)

6 independent predictors of major cardiac complications[1]
High-risk type of surgery (examples include vascular surgery and any open intraperitoneal or intrathoracic procedures)
History of ischemic heart disease (history of myocardial infarction or a positive exercise test, current complaint of chest pain considered to be secondary to myocardial ischemia, use of nitrate therapy, or ECG with pathological Q waves; do not count prior coronary revascularization procedure unless one of the other criteria for ischemic heart disease is present)
History of heart failure
History of cerebrovascular disease
Diabetes mellitus requiring treatment with insulin
Preoperative serum creatinine >2.0 mg/dL (177 micromol/L)
Rate of cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest according to the number of predictors[2]
No risk factors – 0.4% (95% CI 0.1-0.8)
1 risk factor – 1.0% (95% CI 0.5-1.4)
2 risk factors – 2.4% (95% CI 1.3-3.5)
3 or more risk factors – 5.4% (95% CI 2.8-7.9)

Myrtle's risk is 2.4%

Perioperative Myocardial Infarction or Cardiac Arrest Risk Calculator

Age	72	Enter actual age in years	Estimated risk probability for perioperative MICA: 5.89%
ASA Class	4	Enter 1 - 5 for American Society of Anesthesiologists' Class	MI or Cardiac Arrest
Creatinine (preoperative)	1	Enter 2 for missing value 1 for >=1.5 mg/dL 0 for <1.5 mg/dL	
Functional Status (preoperative)	0	Enter 2 for patients with totally dependent funcional status 1 for patients who have partially dependent functional status 0 for those who are totally independent	
Procedure:	4	Enter 1 for Anorectal 2 for Aortic 3 for Bariatric 4 for Brain 5 for Breast 6 for Cardiac 7 for ENT (except thyroid/parathyroid) 8 for Foregut/Hepatopancreatobiliary 9 for Gallbladder, appendix, adrenal and spleen	12 for Neck (Thyoid and Parathyroid) 13 for Obstetric/Gynecologic 14 for Orthopedic and non-vascular Extremity 15 for Other abdominal 16 for Peripheral Vascular 17 for Skin 18 for Spine 19 for non-esophageal Thoracic 20 for Vein

Myrtle's MICA risk = 1.1%

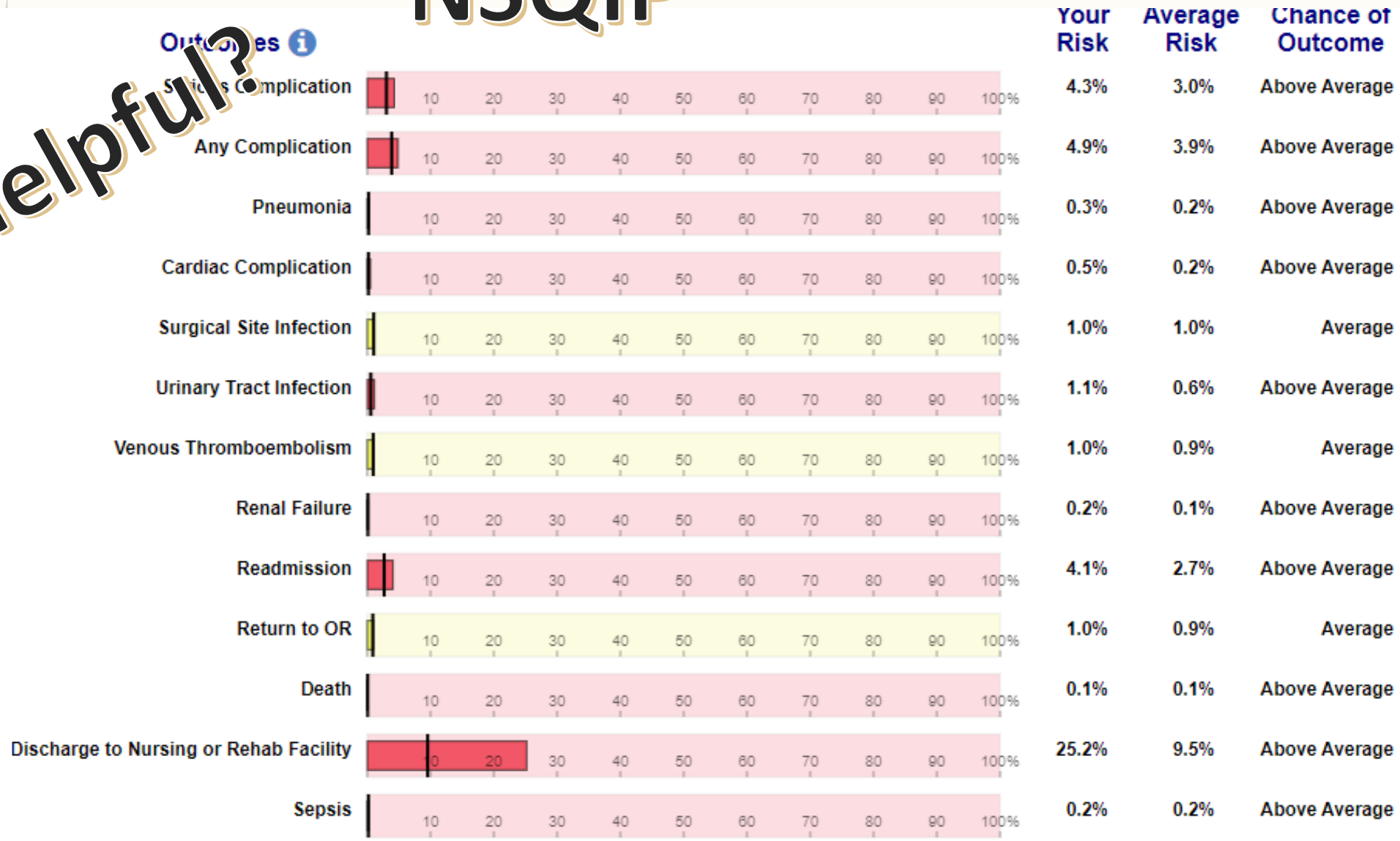
American Society of Anesthesiologists Physical Status (ASA PS) Classification System

ASA PS classification	Definition	Examples, including, but not limited to:
ASA I	A normal healthy patient	Healthy, nonsmoking, no or minimal alcohol use.
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.
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, ESKD undergoing regularly scheduled dialysis, premature infant PCA <60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.

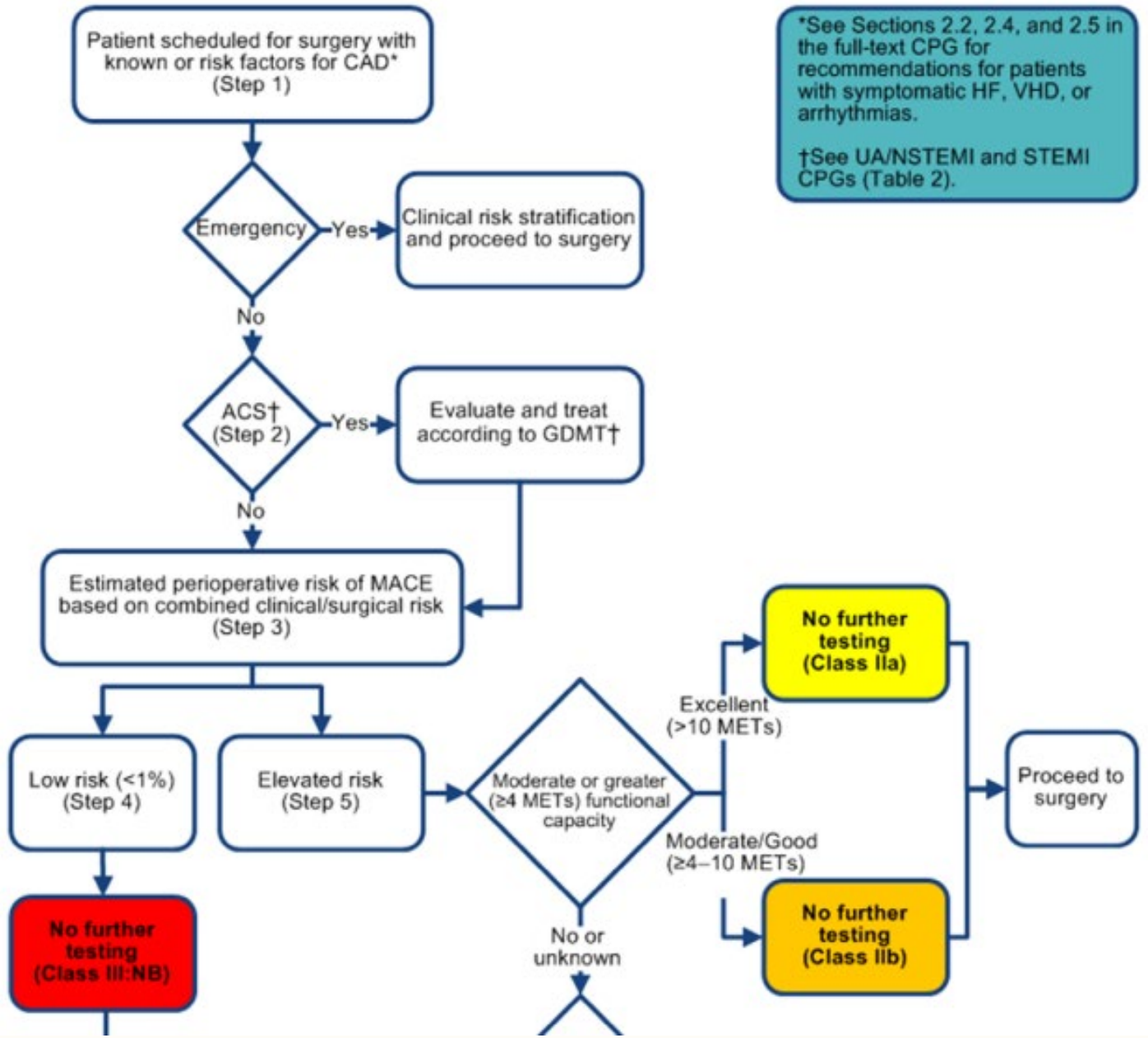
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARDS, or ESKD not undergoing regularly scheduled dialysis.
ASA V	A 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.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

NSQIP

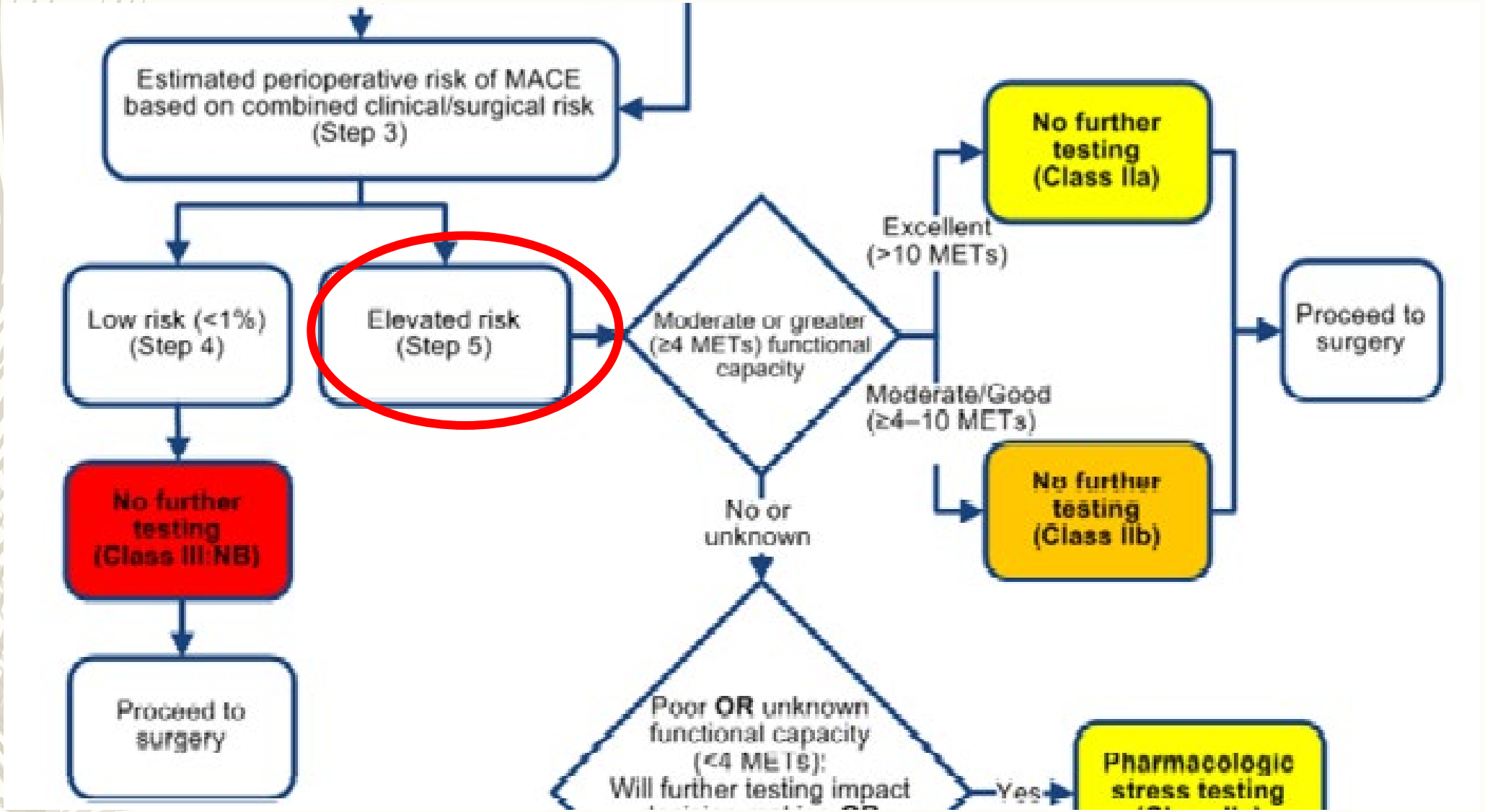
Is this helpful?



Outcomes	Your Risk	Average Risk	Chance of Outcome
Surgical Complication	4.3%	3.0%	Above Average
Any Complication	4.9%	3.9%	Above Average
Pneumonia	0.3%	0.2%	Above Average
Cardiac Complication	0.5%	0.2%	Above Average
Surgical Site Infection	1.0%	1.0%	Average
Urinary Tract Infection	1.1%	0.6%	Above Average
Venous Thromboembolism	1.0%	0.9%	Average
Renal Failure	0.2%	0.1%	Above Average
Readmission	4.1%	2.7%	Above Average
Return to OR	1.0%	0.9%	Average
Death	0.1%	0.1%	Above Average
Discharge to Nursing or Rehab Facility	25.2%	9.5%	Above Average
Sepsis	0.2%	0.2%	Above Average


Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
*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).
Emergency
Yes
Clinical risk stratification and proceed to surgery
No
ACS† (Step 2)
Yes
Evaluate and treat according to GDMT†
No
Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
Low risk (<1%) (Step 4)
Elevated risk (Step 5)
Moderate or greater (≥4 METs) functional capacity
Excellent (>10 METs)
No further testing (Class IIa)
Moderate/Good (≥4–10 METs)
No further testing (Class IIb)
No or unknown
Proceed to surgery
No further testing (Class III:NB)

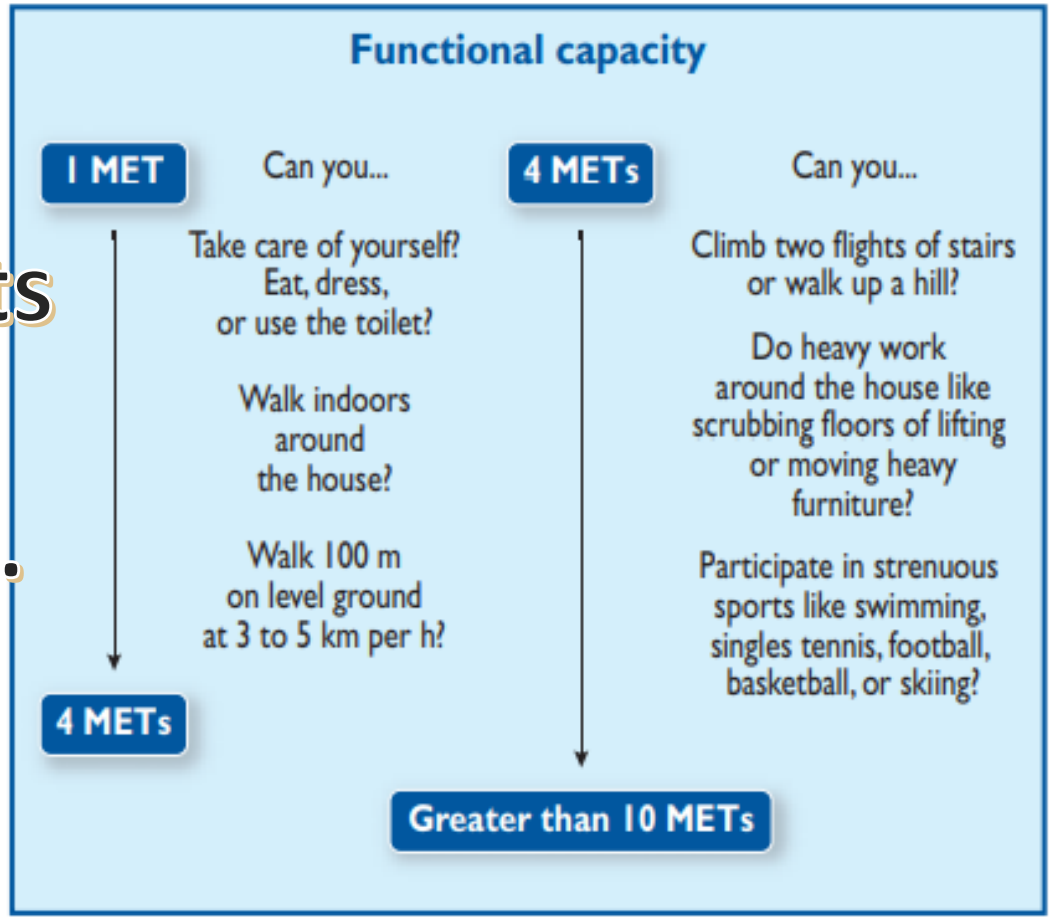
ACC 2014


Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
Low risk (<1%) (Step 4)
Elevated risk (Step 5)
No further testing (Class III:NB)
Proceed to surgery
Moderate or greater (≥4 METs) functional capacity
Excellent (>10 METs)
Moderate/Good (≥4–10 METs)
No or unknown
No further testing (Class IIa)
No further testing (Class IIb)
Proceed to surgery
Poor OR unknown functional capacity (<4 METs): Will further testing impact
Yes
Pharmacologic stress testing

ACC 2014

Determining Functional Capacity

If patient can climb 2 flights of stairs or climb a hill, no further testing needed.



ESC 2014

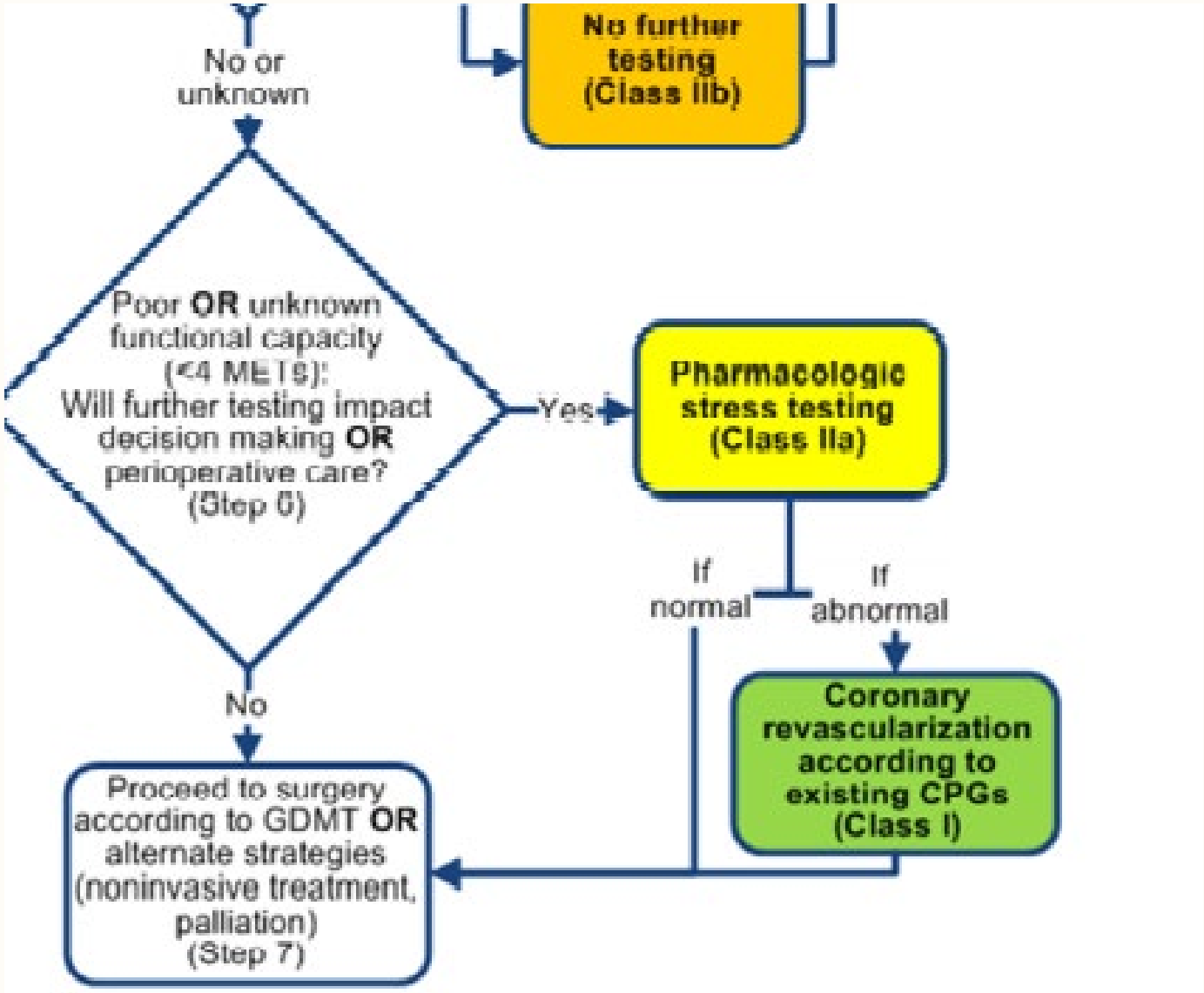
Probably more accurate

TABLE 4 Duke Activity Status Index

Activity	Weight
Can you…	
1. take care of yourself, that is, eating, dressing, bathing, or using the toilet?	2.75
2. walk indoors, such as around your house?	1.75
3. walk a block or 2 on level ground?	2.75
4. climb a flight of stairs or walk up a hill?	5.50
5. run a short distance?	8.00
6. do light work around the house like dusting or washing dishes?	2.70
7. do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries?	3.50
8. do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8.00
9. do yardwork like raking leaves, weeding, or pushing a power mower?	4.50
10. have sexual relations?	5.25
11. participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	6.00
12. participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7.50

DASI = Sum of weights for “yes” replies

$$\text{METs} = \frac{0.43 \times \text{DASI} \times 9.6}{3.5}$$


No or unknown
No further testing (Class IIb)
Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
Yes
Pharmacologic stress testing (Class IIa)
If normal
If abnormal
Coronary revascularization according to existing CPGs (Class I)
No
Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

Case #2 – Metabolic Myrtle

- Myrtle can barely climb one flight of stairs because she gets too short of breath.
- Her MET's are < 4.
- She needs a stress test but her surgery is next week!
- We can either postpone the surgery or try to get the stress test in the next few days.

Cardiac Testing

Is checking a BNP helpful?

ESC 2022

In patients who have known CVD, CV risk factors (including age ≥65 years), or symptoms suggestive of CVD, it should be considered to measure BNP or NT-proBNP before intermediate- and high-risk NCS.[52,104,112–114]	IIa	B

- VERY controversial!
- Canadian GL recommends pre-op BNP on ALL patients over 65 or with increased cardiac risk in order to guide mgt.
- The pre-op BNP probably needs more study before everyone adopts it.
- It CAN be helpful if you have a patient with unexplained edema or dyspnea.

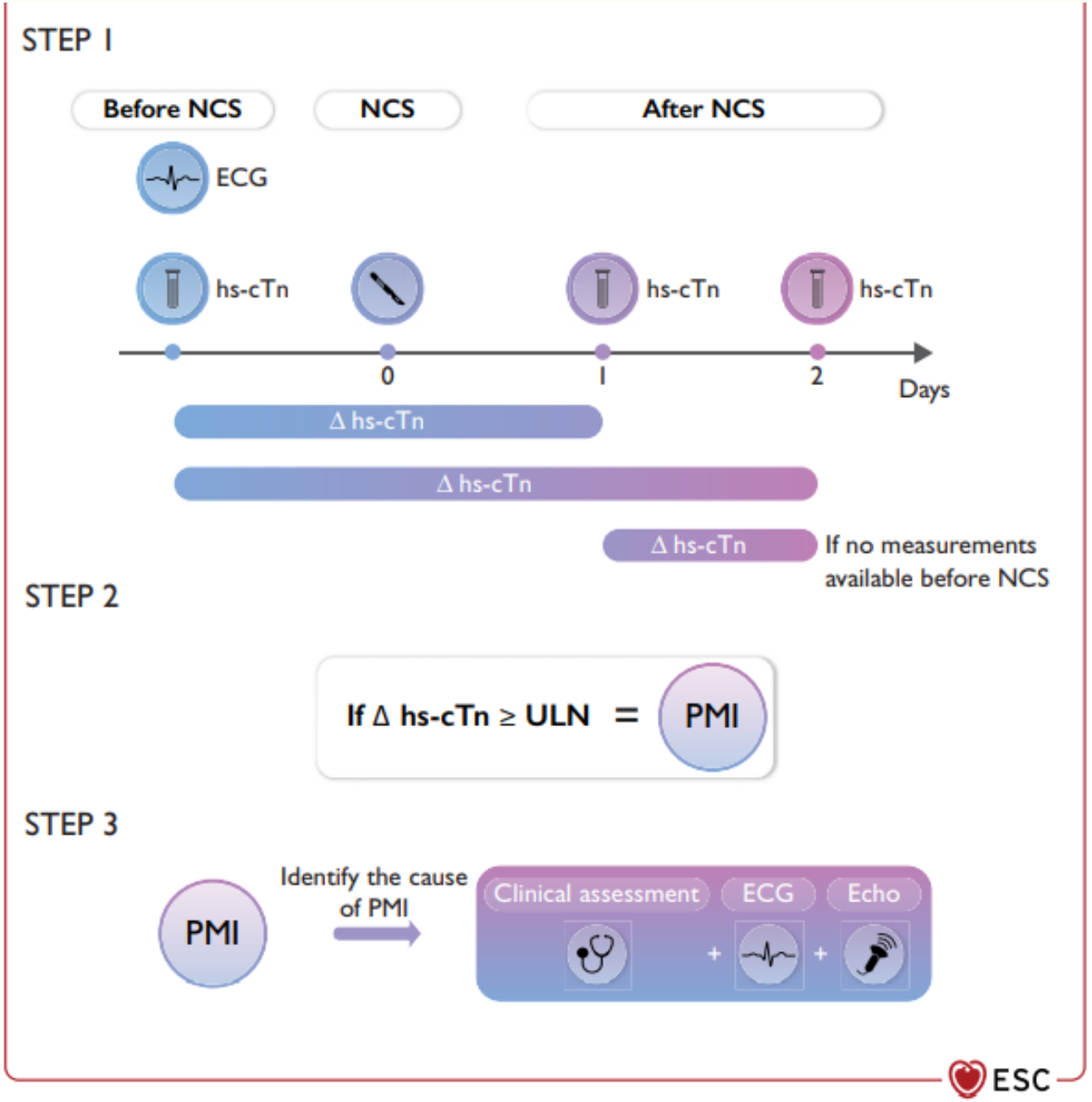
Is checking a troponin helpful?

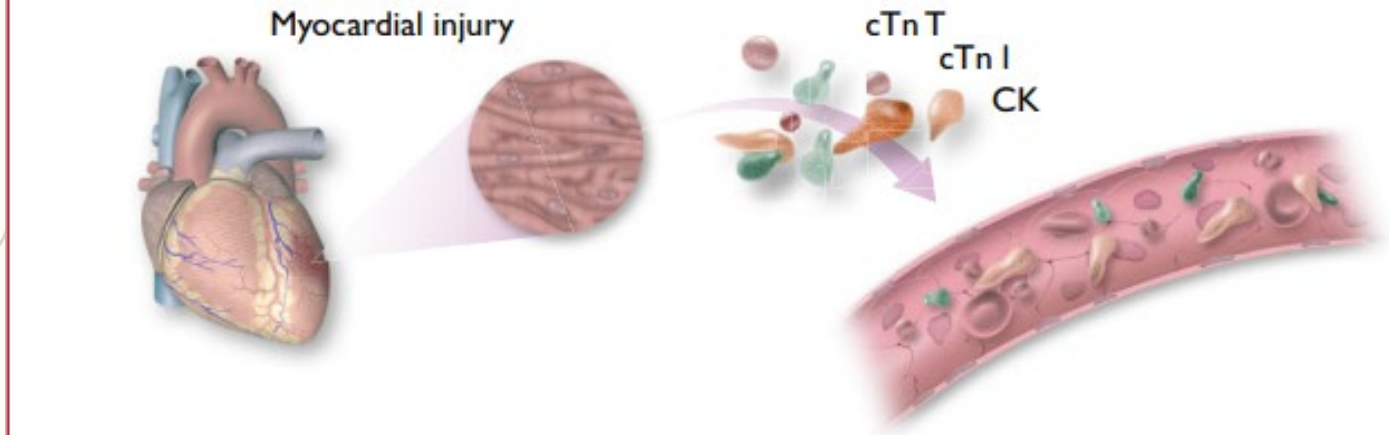
- An evolving concept!
- Canadian and European GL recommend checking a troponin pre-op and POD #1 and POD #2 if at increased risk.

ESC 2022

In patients who have known CVD, CV risk factors (including age ≥65 years), or symptoms suggestive of CVD it is recommended to measure hs-cTn T or hs-cTn I before intermediate- and high-risk NCS, and at 24 h and 48 h afterwards.[53,105–107,109–111,117]	I	B

PMI = Perioperative MI





Day 1 or 2 after the NCS

Cardiac troponin ↑

Chronic cardiac troponin ↑

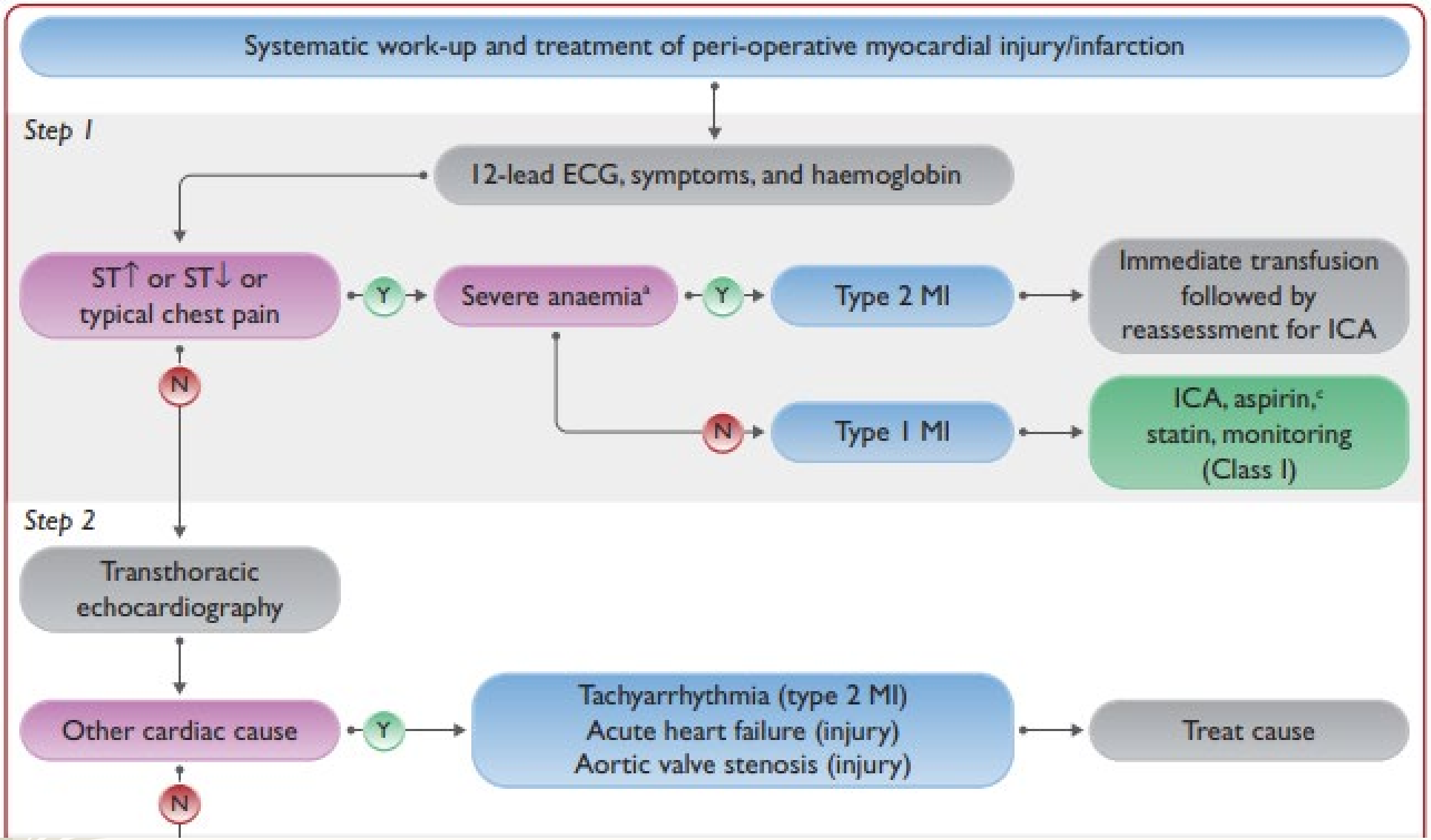
Acute cardiac troponin = PMI ↑

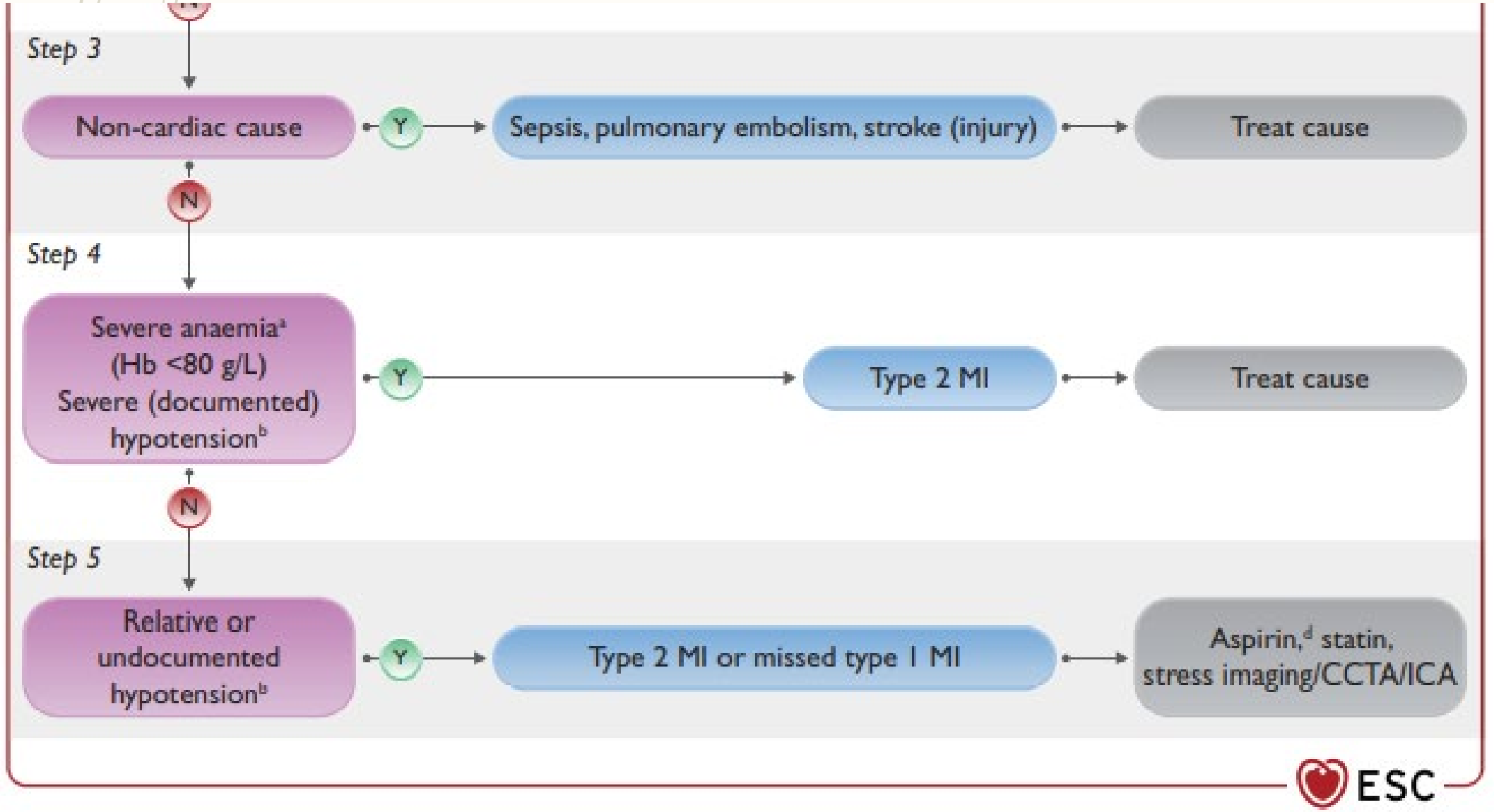
Primarily non-cardiac cause

- Severe sepsis
- Pulmonary embolism
- Stroke

Cardiac cause

Type 1 MI	Type 2 MI	Tachy-arrhythmia	Acute heart failure	Likely type 2 MI
Athero-thrombosis	Supply demand mismatch with obvious type 2 trigger (hypotension, anaemia)	Supply demand mismatch	Multiple mechanisms	•Missed type 1 MI •Undocumented hypotension •Mild hypotension


Systematic work-up and treatment of peri-operative myocardial injury/infarction
Step 1
12-lead ECG, symptoms, and haemoglobin
ST↑ or ST↓ or typical chest pain
Y
Severe anaemia[a]
Y
Type 2 MI
Immediate transfusion followed by reassessment for ICA
N
N
Type 1 MI
ICA, aspirin,[c] statin, monitoring (Class I)
Step 2
Transthoracic echocardiography
Other cardiac cause
Y
Tachyarrhythmia (type 2 MI)
Acute heart failure (injury)
Aortic valve stenosis (injury)
Treat cause
N


Step 3
Non-cardiac cause
Y
Sepsis, pulmonary embolism, stroke (injury)
Treat cause
N
Step 4
Severe anaemia[a] (Hb <80 g/L) Severe (documented) hypotension[b]
Y
Type 2 MI
Treat cause
N
Step 5
Relative or undocumented hypotension[b]
Y
Type 2 MI or missed type 1 MI
Aspirin,[d] statin, stress imaging/CCTA/ICA
ESC

Echocardiogram

- Routine echo is NOT recommended
- Appropriate indications:
  - Elevated BNP
  - Unexplained dyspnea
  - New murmur
  - Suspected NEW cardiovascular disease
  - Abnormal ECG

Stress Imaging

- Do NOT do stress if urgent surgery or if patient clinically unstable.
- Stress imaging is indicated for patients with increased cardiac risk and poor functional capacity who are getting more than a low risk procedure.
- Either stress echo or myocardial perfusion imaging is acceptable.
  - A moderate to large perfusion defect predicts post-op cardiac events.

Coronary CT Angiogram

- CCTA (NOT coronary calcium score) can be used to rule out CAD in patients who have low risk for CAD but have:
  - Inconclusive ECG findings
  - Atypical chest pain

Case #2 – Metabolic Myrtle

- Step 1 - Cardiac Assessment
  - She has lots of cardiac risk factors and poor functional capacity.
  - She should get stress imaging – which type?
  - She has dyspnea when climbing stairs. Should we check a BNP? Would this help us decide on getting an echo?
  - Should she get pre-op and post-op troponins?

Case #2 – Metabolic Myrtle

- Cardiac Plan
  - You opt for a pharmacological stress test with nuclear imaging. She cannot walk that well due to her hip pain.
  - This comes back normal.
  - You opt to not check BNP or troponin because there is too much controversy!
  - It looks like the benefits of getting her hip replaced will outweigh the risks.

Case #2 – Metabolic Myrtle

- BUT WAIT - What about Myrtle's other issues?
- HTN
  - She is on lisinopril 10 mg and HCTZ 12.5 mg.
  - Her BP = 152/90.
  - She does check her BP at home and admits that it is often elevated to 150-170/90-105.
  - Should this delay her surgery?

Hypertension

- Anesthesia is tricky!
  - In normotensive people, BP can initially increase by 20-30 mmHg.
  - People with HTN can have an increase as much as 90 mmHg.
  - After the initial phase of anesthesia, many people will develop HYPOtension.

Hypertension

- Its not clear that better control of BP preop improves outcomes.
- However, a preop diastolic BP of 110 increases the risk of renal failure, neuro complications, myocardial ischemia and dysrhythmias.
- Therefore, surgery should be postponed for DBP > 110. Otherwise they can proceed with surgery.

Hypertension

- People on with HTN on BP meds can also be at risk for severe hypotension during the hypotensive phase of anesthesia.
- Recommendation is to continue all BP meds EXCEPT ACE/ARB which should be held 24 hrs prior to surgery. ACE/ARB have been shown to cause increased hypotension with anesthesia.
- In patients with CKD, diuretic should also be held the day of surgery.

Beta Blockers

- Some studies suggested giving beta blockers to patients with increased risk of CAD would decrease their risk of MI.
- HOWEVER, subsequent studies have shown increased risk of hypotension, stroke, renal failure and death.
- Therefore it is NOT recommended to start a beta blocker on the day of surgery.
- If a patient is already on a beta blocker, it should be continued.

Case #2 – Metabolic Myrtle

- HTN Plan
  - *BP not at goal and lisinopril increased to 20 mg daily*
  - ***Patient will hold her lisinopril and HCTZ on the day of surgery but should restart these post op if BP permits.***

Case #2 – Metabolic Myrtle

- Myrtle also has type 2 DM and is on metformin, Jardiance and insulin (Lantus 20 units qhs).
  - Her A1C = 8.5
  - Should her joint replacement be delayed to improve control of DM?

Diabetes – Pre-Op A1C

- Studies do show increased risk of cardiovascular complications and increased risk of post-op infection.
- NO studies tell us what A1C is “safe” for surgery.
- Some guidelines suggest delaying elective surgery for an A1C of 8.5-9, but this is controversial.

Case #2 – Metabolic Myrtle

- Diabetes
  - What should we recommend for her diabetes meds perioperatively?
  - (Or should we just say “continue diabetes meds” and let the surgeon figure it out?)

Diabetes - Meds

- Oral Meds (per 2023 ADA GL)
  - Hold metformin the day of surgery (usually held throughout hospital stay)
  - Stop SGLT2 inhibitors 3-4 days prior to surgery
    - *To avoid euglycemic DKA*
  - Hold any other oral meds the day of surgery
- GLP-1 agonists are not given in the hospital

Diabetes - Meds

- Insulin
  - TYPE 1 DIABETICS MUST CONTINUE TO GET BOTH BASAL AND BOLUS INSULIN REGARDLESS OF NPO STATUS
  - Long-acting insulin should be reduced by 25% the night prior to surgery and continued in the hospital.
  - Patients should be given both basal and bolus insulin.
  - AVOID GIVING CORRECTION INSULIN (SLIDING SCALE) ONLY!
  - Goal blood glucose in the perioperative period is 100-180.

Case #2 – Metabolic Myrtle

- Diabetes Plan
  - A1C not at goal but adequate control for surgery.
  - **Patient will decrease her dose of Lantus to 15 U the night prior to surgery, and continue in hospital.**
  - **Check prandial or q 6 hour blood sugars post op and give bolus short-acting insulin with goal glucose of 100-180.**
  - **Patient will hold metformin the day of surgery.**
  - **Patient will stop Jardiance 3 days prior to surgery.**

Case #2 – Metabolic Myrtle

- Chronic Kidney Disease
  - Are there any recommendations to make?

Chronic Kidney Disease

- Patients with CKD have increased risk of AKI post-op.
  - Incidence ranges from 18-47% in studies.
- How can we reduce this risk?
  - Liberal fluid is better than restricted fluid (hypotension is BAD!).
  - Avoid nephrotoxic meds – NSAIDs, IV contrast
  - Hold ACE/ARB and diuretics on day of surgery

Chronic Kidney Disease

- Pain Control
  - AVOID
    - *NSAID's*
    - *Morphine*
    - *Codeine*
    - *Hydrocodone*

Chronic Kidney Disease

- Hyperkalemia
  - AVOID kayexalate within one week of surgery due to increased risk of colon necrosis.
  - Can use sodium zirconium cyclosilicate or patiromer instead.
- If there is the potential that patient will need dialysis post-op, discuss with patient and family.

Case #2 – Metabolic Myrtle

- Myrtle is getting a hip replacement.
- What should she get for VTE prophylaxis?

VTE Prophylaxis – Ortho Surgery

Start 12 hrs After surgery

- Canadian GL
  - 3 options for prophylaxis after joint replacement:
    - *Xarelto x 5 days and then ASA 81 mg daily for 14-35 days*
    - *DOAC for 14-35 days*
    - *LMWH for 14-35 days*
  - Consider longer duration for patients at higher risk of VTE
    - *Bilateral joint replacement*
    - *Poor mobility*
    - *Hx VTE*

2021

THROMBOPROPHYLAXIS: ORTHOPEDIC SURGERY

Thrombosis Canada

Thrombose Canada

TABLE: SUGGESTED THROMBOPROPHYLAXIS IN ORTHOPEDIC SURGERY PATIENTS

PATIENT GROUP	THROMBOPROPHYLAXIS OPTIONS*		DURATION
Hip or knee arthroplasty	rivaroxaban	10 mg PO once daily	14-35 days
	apixaban	2.5 mg PO twice daily	
	dabigatran	220 mg PO once daily	
	enoxaparin	30 mg SC twice daily or 40 mg SC once daily	
	dalteparin	5,000 U SC once daily	
	tinzaparin	4,500 U or 75 U/kg SC once daily	
	fondaparinux	2.5 mg SC once daily	
	nadroparin	38 U/kg SC once daily (day 1-3 post-op), followed by 57 U/kg SC once daily (day 4+ post-op)	
	ASA	81 mg PO once daily, beginning after receiving rivaroxaban 10 mg PO once daily for the first 5 post-op days**	
Hip fracture surgery	enoxaparin	30 or 40 mg SC once daily	14-35 days
	dalteparin	2,500 or 5000 U SC once daily	
	tinzaparin	4500 U SC once daily	
	fondaparinux	2.5 mg SC once daily	
	nadroparin	38 U/kg SC once daily (day 1-3 post-op), followed by 57 U/kg SC once daily (day 4+ post-op)	
Major orthopedic trauma	LMWH [enoxaparin 30 mg SC twice daily, dalteparin 5,000 U SC once daily or tinzaparin 4,500 U SC once daily] when hemostasis is evident		Until discharge (including rehabilitation)
	Mechanical method with IPC or ECS if high risk for bleeding with switch to LMWH when bleeding risk decreases. Inferior vena cava (IVC) filters are not recommended for thrombosis prophylaxis.		

	recommended for thrombosis prophylaxis.	
Spine surgery: a) Uncomplicated b) Complicated (cancer, spinal cord injury with leg weakness or paralysis, prior VTE, combined anterior/posterior approach)	a) Mobilization alone b) LMWH once daily starting the day after surgery	Until discharge (including rehabilitation)
Isolated below-knee fracture	No prophylaxis if outpatient or overnight hospital stay LMWH once daily if inpatient	Until discharge (including rehabilitation)
Knee arthroscopy: a) low risk b) higher risk (e.g. major knee reconstruction, prior VTE,	a) None b) LMWH once daily or direct oral anticoagulant	5-30 days

Discussion

- Should we make recommendations about VTE prophylaxis in our preop eval?
- What if we feel a patient is higher risk and should get more than just aspirin?
  - Up-To-Date does NOT use aspirin alone for VTE prophylaxis after joint replacement.

Case #2 – Metabolic Myrtle

- Reviewing Myrtle's history, you notice that she had a DVT many years ago after a stay in the hospital for pneumonia.
- You feel Myrtle is higher risk and decide to make the recommendation of using a DOAC, such as rivaroxaban 10 mg daily for 35 days post-op. This should be started on POD #1 unless there are bleeding concerns.

Case #3 – Fluffy Fred

- Fred is a 62 year old male who presents for pre-op eval.
- He has been diagnosed with renal cell CA and is scheduled for right nephrectomy in 2 weeks.
- He has no cardiac or pulmonary symptoms. He can climb a few steps but gets short of breath. Exam is normal with BP = 120/80.
- PMH
  - HTN – amlodipine
  - Osteoarthritis – naproxen
  - Morbid obesity – BMI = 42

Does he need any cardiac testing?

Surgical Risk by Procedure

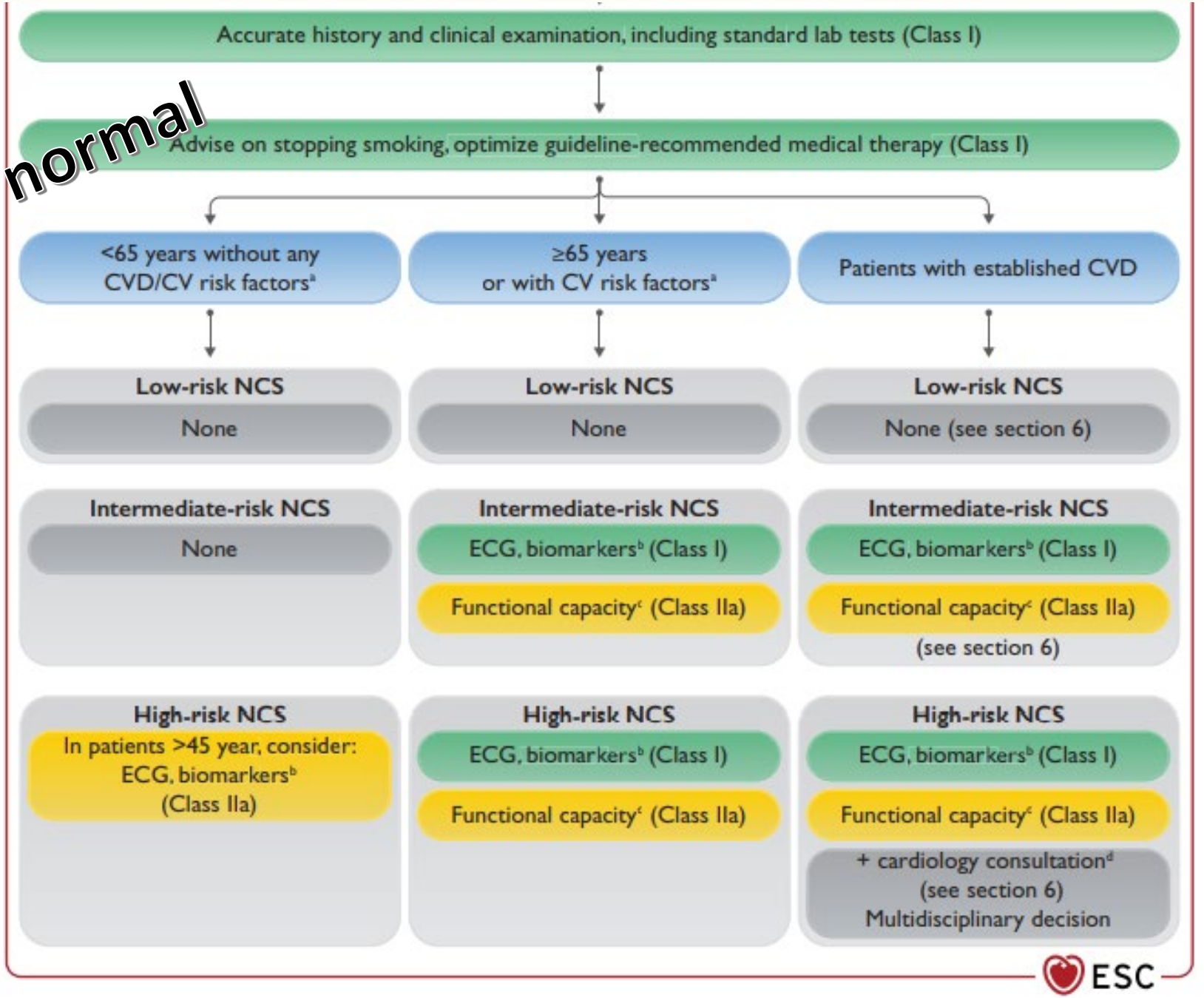
Table 5 **Surgical risk estimate according to type of surgery or intervention**

Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast	• Carotid asymptomatic (CEA or CAS)	• Adrenal resection
• Dental	• Carotid symptomatic (CEA)	• Aortic and major vascular surgery
• Endocrine: thyroid	• Endovascular aortic aneurysm repair	• Carotid symptomatic (CAS)
• Eye	• Head or neck surgery	• Duodenal-pancreatic surgery
• Gynaecological: minor	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy	• Liver resection, bile duct surgery
• Orthopaedic minor (meniscectomy)	• Intrathoracic: non-major	• Oesophagectomy
• Reconstructive	• Neurological or orthopaedic: major (hip and spine surgery)	• Open lower limb revascularization for acute limb ischaemia or amputation
• Superficial surgery	• Peripheral arterial angioplasty	• Pneumonectomy (VATS or open surgery)
• Urological minor: (transurethral resection of the prostate)	• Renal transplants	• Pulmonary or liver transplant
• VATS minor lung resection	• Urological or gynaecological: major	• Repair of perforated bowel
		• Total cystectomy

Based on risk of MI or death

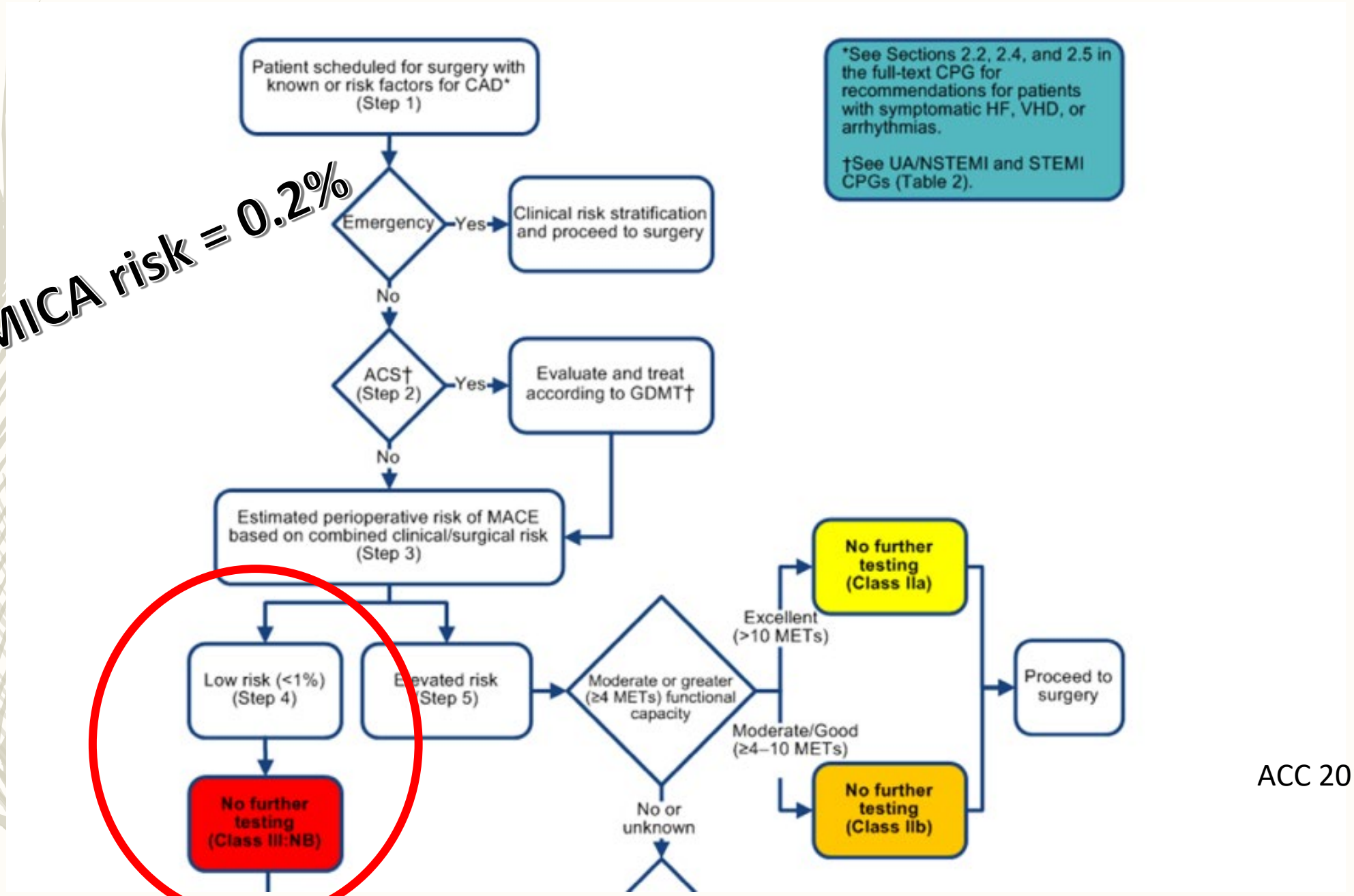
ESC 2022

Fred's ECG is normal



2022

Fred's MICA risk = 0.2%



ACC 2014

Fluffy Fred

- Fred has poor functional capacity but his risk is low (0.2%).
- From a CARDIAC standpoint, he needs no further eval.
- Clearly he needs the surgery!

- ARE WE DONE? Are we ready to “clear” him?

Obesity

- Obesity by itself does not seem to carry a lot of risk, but most obese people will have comorbidities that DO affect risk. However, there is increased risk of VTE with obesity.
- Risk of mortality is actually DECREASED for people who are overweight or have Class 1 obesity (BMI < 35).
  - Underweight people and severely obese people have increased mortality.

Obesity

- For patients with BMI > 35 there is increased risk of:
  - Increased LOS
  - Increased blood loss
  - Longer operative times
  - Surgical site infections
  - Renal failure
  - Prolonged vent
  - Mortality in older patients – more likely to have co-morbidities

Obesity Pre-Op Eval

- OSA – screening questionnaire
- Obesity hypoventilation syndrome – bicarb
- Diabetes – A1C
- HTN – BP
- Cardiovascular disease – ECG
- BMI > 40 – UTD suggests getting a CXR and strongly consider echo and sleep study

Screening for OSA

- Society of Anesthesia and Sleep Medicine
  - Recommends screening ALL patients for OSA pre-op
    - *However, there is NO evidence that this changes outcomes*
  - Definite screening for:
    - *BMI > 35 (BMI > 40 - 50% will have OSA, 10-20% will have OHS)*
    - *Bariatric surgery patients*
    - *Hx difficult intubation*
    - *Co-morbidities – DM, HTN, CHF, severe hypothyroid*

Screening for OSA

- Most validated tool is the STOP-bang questionnaire
- Scores
  - 0-2 - NO OSA
  - 3-4 - Intermediate Risk (GREY zone)
    - *If serum bicarb > 27 - increased risk of OSA*
  - 5 or more - OSA highly likely

STOP-Bang

☐ Yes	☐ No	**Snoring?** Do you **snore loudly** (loud enough to be heard through closed doors, or your bed partner elbows you for snoring at night)?
☐ Yes	☐ No	**Tired?** Do you often feel **tired, fatigued, or sleepy** during the daytime (such as falling asleep during driving)?
☐ Yes	☐ No	**Observed?** Has anyone **observed** you **stop breathing** or **choking/gasping** during your sleep?
☐ Yes	☐ No	**Pressure?** Do you have or are you being treated for **high blood pressure**?
☐ Yes	☐ No	**Body mass index more than 35 kg/m^2?**
☐ Yes	☐ No	**Age older than 50 years old?**
☐ Yes	☐ No	**Neck size large (measured around Adam's apple)?** Is your shirt collar 16 inches or larger?
☐ Yes	☐ No	**Gender (biologic sex) = Male?**

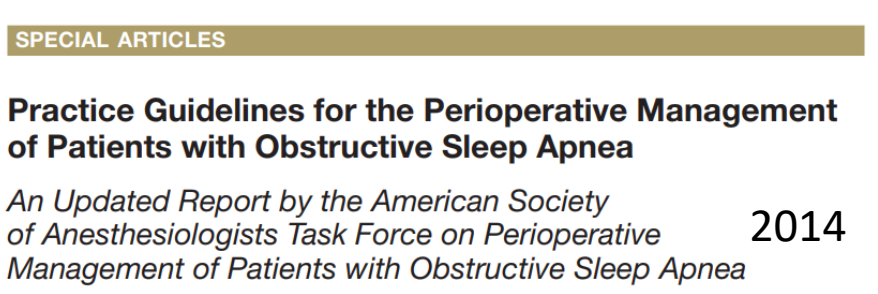
Scoring criteria:
Low risk of OSA: Yes to 0 to 2 questions
Intermediate risk of OSA: Yes to 3 to 4 questions
High risk of OSA: Yes to 5 to 8 questions

Fluffy Fred

- Fred has a STOP-bang score of 6
  - BMI > 35, male, HTN, snores, tired during day, age > 50
- OSA is LIKELY
  - What do we do now??

Perioperative Risk of OSA

- Complications increased 2-4 fold
  - Pulmonary complications
  - CV complications
  - Difficult airway
  - Post-op delirium
- Increasing risk with increasing severity of OSA
- Untreated OSA with increased risk of post-op cardiac arrest, MI or shock compared to treated OSA


SPECIAL ARTICLES

Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea

An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

2014

Do we delay surgery to test for and treat OSA?

Suspected OSA Pre-Op

- Usually surgery is not delayed
- Depends on co-morbidities, urgency of surgery and riskiness of surgery. Consider delay if any of these:
  - Hypoventilation syndrome – daytime hypercarbia
  - Severe pulmonary HTN
  - Unexplained, resting hypoxemia
  - High risk surgery

Do we need to get ABG and/or echo?

Ruling out OHS and Pulmonary HTN

- OHS
  - Almost all patients with OHS will have an elevated bicarb > 27 on BMP.
  - If the bicarb is > 27, need to get ABG or VBG.
- Pulmonary HTN
  - May see changes on ECG but really need echo.

Fluffy Fred

- On review of Fred's labs, his bicarb is 30. O2 sat = 95%.
- You get a VBG which shows pH = 7.39 and pCO2 = 43.
- Echo shows some concentric LVH but is otherwise normal.
- DOES HE NEED ANYTHING ELSE?

Fluffy Fred

- Must have pCO2 > 45 to diagnose OHS.
- Fred does not have OHS or pulmonary HTN.
- Proceed to surgery or get a sleep study?
  - He would need to be treated with PAP for one week preop to see any benefit.

PeriOp Mitigation Strategies for OSA

- Minimize respiratory depressants (eg – opioids)
- Consider regional anesthesia
- Consider PAP post-op
- Give less IV fluids and consider giving LR instead of NS
- Keep patient upright to semi-upright

Fluffy Fred

- What about VTE prophylaxis for this patient?
  - What would you recommend?

References

Thrombosis Canada

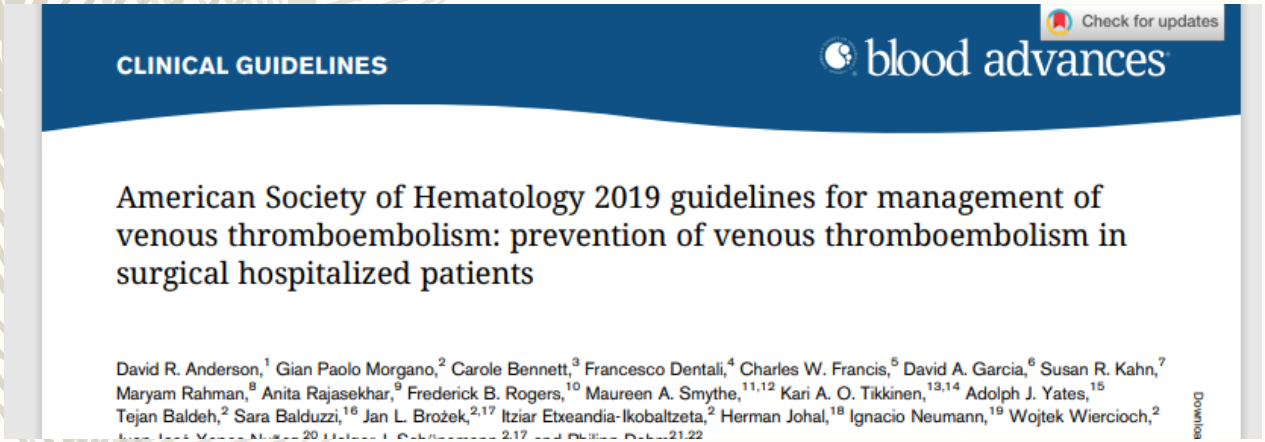
Thrombose Canada

MAYO CLINIC

THEMATIC REVIEW ON PERIOPERATIVE MEDICINE

Perioperative Venous Thromboembolism Prophylaxis 2020

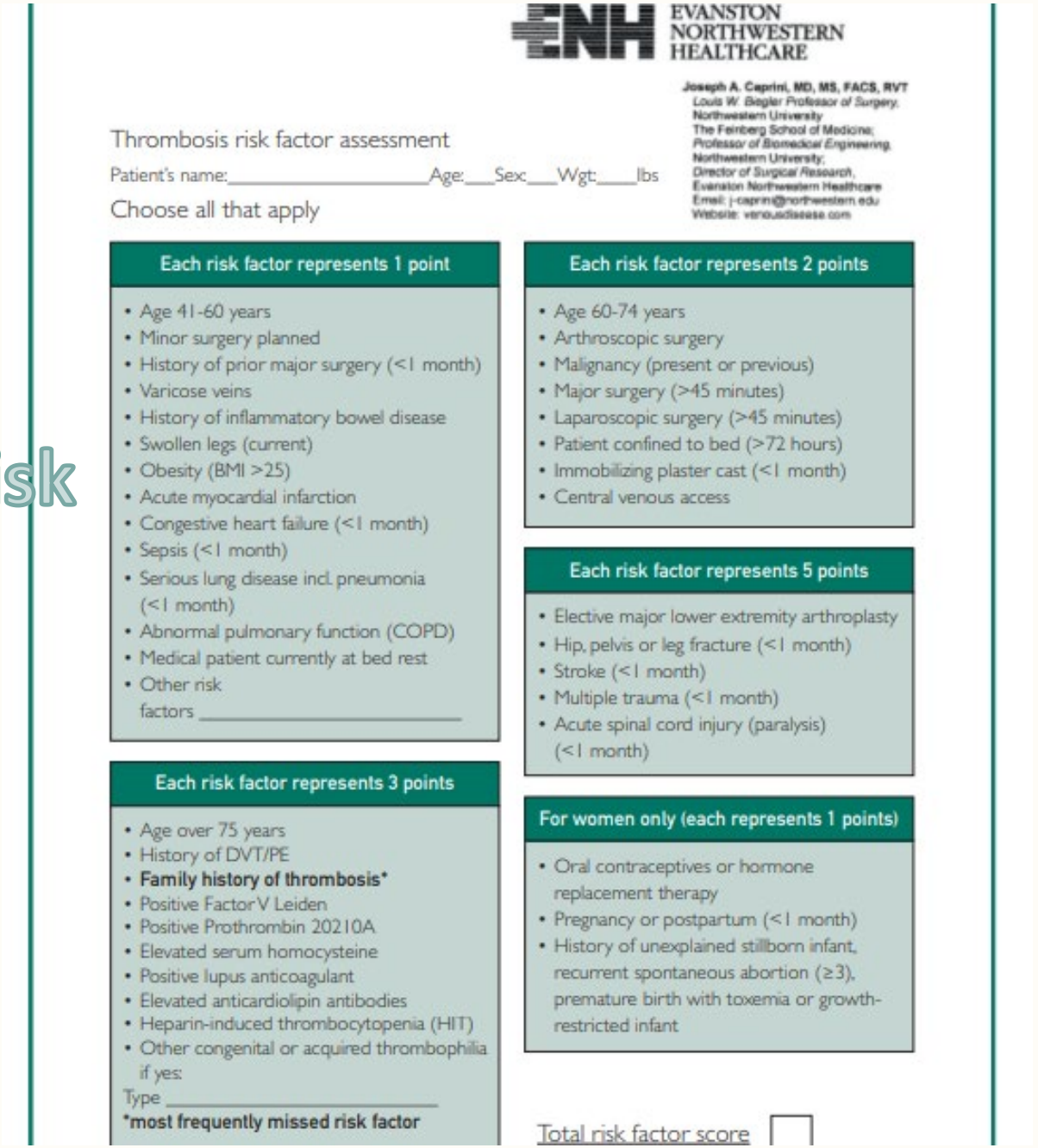
Check for updates



Up To Date

Caprini Score

Score of 7 or more = high risk (score of 5 for gen surg)



EVANSTON NORTHWESTERN HEALTHCARE

Joseph A. Caprini, MD, MS, FACS, RVT
Louis W. Biegler Professor of Surgery, Northwestern University
The Feinberg School of Medicine;
Professor of Biomedical Engineering, Northwestern University;
Director of Surgical Research, Evanston Northwestern Healthcare
Email: j-caprini@northwestern.edu
Website: venousdisease.com

Thrombosis risk factor assessment

Patient's name:_____Age:___Sex:___Wgt:____lbs

Choose all that apply

Each risk factor represents 1 point

- Age 41-60 years
- Minor surgery planned
- History of prior major surgery (<1 month)
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI >25)
- Acute myocardial infarction
- Congestive heart failure (<1 month)
- Sepsis (<1 month)
- Serious lung disease incl. pneumonia (<1 month)
- Abnormal pulmonary function (COPD)
- Medical patient currently at bed rest
- Other risk factors _____

Each risk factor represents 2 points

- Age 60-74 years
- Arthroscopic surgery
- Malignancy (present or previous)
- Major surgery (>45 minutes)
- Laparoscopic surgery (>45 minutes)
- Patient confined to bed (>72 hours)
- Immobilizing plaster cast (<1 month)
- Central venous access

Each risk factor represents 3 points

- Age over 75 years
- History of DVT/PE
- **Family history of thrombosis***
- Positive Factor V Leiden
- Positive Prothrombin 20210A
- Elevated serum homocysteine
- Positive lupus anticoagulant
- Elevated anticardiolipin antibodies
- Heparin-induced thrombocytopenia (HIT)
- Other congenital or acquired thrombophilia if yes:

Type _____

***most frequently missed risk factor**

Each risk factor represents 5 points

- Elective major lower extremity arthroplasty
- Hip, pelvis or leg fracture (<1 month)
- Stroke (<1 month)
- Multiple trauma (<1 month)
- Acute spinal cord injury (paralysis) (<1 month)

For women only (each represents 1 points)

- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (<1 month)
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥3), premature birth with toxemia or growth-restricted infant

Total risk factor score ☐

Each risk factor represents 1 point

- Age 41-60 years
- Minor surgery planned
- History of prior major surgery (<1 month)
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI >25)
- Acute myocardial infarction
- Congestive heart failure (<1 month)
- Sepsis (<1 month)
- Serious lung disease incl. pneumonia (<1 month)
- Abnormal pulmonary function (COPD)
- Medical patient currently at bed rest
- Other risk factors _____

Each risk factor represents 2 points

- Age 60-74 years
- Arthroscopic surgery
- Malignancy (present or previous)
- Major surgery (>45 minutes)
- Laparoscopic surgery (>45 minutes)
- Patient confined to bed (>72 hours)
- Immobilizing plaster cast (<1 month)
- Central venous access

For women only (each represents 1 points)

- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (<1 month)
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥3), premature birth with toxemia or growth-restricted infant

Each risk factor represents 3 points

- Age over 75 years
- History of DVT/PE
- **Family history of thrombosis***
- Positive Factor V Leiden
- Positive Prothrombin 20210A
- Elevated serum homocysteine
- Positive lupus anticoagulant
- Elevated anticardiolipin antibodies
- Heparin-induced thrombocytopenia (HIT)
- Other congenital or acquired thrombophilia if yes:

Type _____

***most frequently missed risk factor**

Each risk factor represents 5 points

- Elective major lower extremity arthroplasty
- Hip, pelvis or leg fracture (<1 month)
- Stroke (<1 month)
- Multiple trauma (<1 month)
- Acute spinal cord injury (paralysis) (<1 month)

Fred's score = 7

TABLE 2. Estimated Risk of Thrombosis Without Prophylaxis by Surgery Type Stratified by Caprini Score*

	Very low	Low	Moderate	High	Highest	
	Caprini 0 (%)	Caprini 1-2 (%)	Caprini 3-4 (%)	Caprini 5-6 (%)	Caprini 7-8 (%)	Caprini ≥9 (%)
General surgery, plastic and reconstructive surgery, ENT surgery, gynecology, lumbar spine surgery, vascular surgery, surgical ICU[35]	NA	NA	0.7	1.8	4.0	10.7
General surgery[13]	0.5	1.5	3.0	6.0		
General surgery, urology, vascular surgery[†33]	<0.7	<0.7	1.0	1.3	2.6	6.5-17.3
Plastic surgery[31]	NA	NA	0.6	1.3	2.7	11.3
Gynecology (oncology)[34]	0.0	0.0	0.0	1.9	4.4	6.5
ENT surgery[30]	0.0	0.5	0.2	0.9	2.4	18.3

*Caprini 2005 version

†Percentages in patients with prophylaxis

ENT = ear, nose, and throat; ICU = intensive care unit

Mayo 2020

Caprini Score – Who gets pharm prophylaxis?

- Patients with a score > 7 are very high risk for VTE and should receive pharmacological prophylaxis.
- Patients with a score > 5 who get general surgery are at very high risk and should receive pharmacological prophylaxis.
- Patients with a score of 1-2 do NOT need pharm prophylaxis, regardless of type of surgery.
- Patients with a score of 3-4 – either mechanical or pharm prophylaxis are appropriate.

Caprini Summary

- The following patients are at HIGH risk and should get prophylaxis:
  - Anyone > age 75 getting major surgery (> 45 mins)
  - Anyone with hx of stroke, major trauma, pelvis/hip/leg fracture or acute spinal cord injury within the past month
  - Anyone getting knee or hip replacement
  - Anyone with personal OR family hx of thrombosis or with a thrombophilia who is getting major surgery
  - Anyone > age 60 with hx of cancer or active cancer who is getting major surgery (especially if active cancer in the past 6 months)
  - ICU patients (prolonged bedrest + multiple comorbidities)
  - COVID patients
- The higher the number of comorbidities, the higher the risk.

Fluffy Fred

- Final A/P
  - Pre-Op eval - Benefits of procedure outweigh risks
    - *His cardiac risk is < 1% and no further testing is needed.*
    - *He may have OSA and mitigation strategies are recommended. Will need a sleep study post-op. OHS and pulmonary HTN ruled out.*
    - *He is at increased risk for VTE with a Caprini score of 7. He should get pharmacologic prophylaxis for VTE post-op.*
  - HTN – BP is controlled on amlodipine 5 mg daily and he should continue this perioperatively.

Case #4 – Peter Puffer

- Peter is a 70 year old male who is scheduled for inguinal hernia repair in one month. He has had a lot of symptoms from the hernia.
- PMH
  - COPD - smokes 1 ppd, Spiriva, albuterol prn - no exacerbations x 1yr
  - Paroxysmal atrial fib - apixaban, metoprolol
  - Severe OA - Tylenol prn
  - TIA - 3 months ago
- Recent labs – normal creatinine, normal hgb

Peter Puffer

- ROS – He gets short of breath when he walks more than a block. He can get up a flight of stairs but gets short of breath. No chest pain, leg edema or palpitations. He is completely independent.
- Exam
  - Vitals normal, O2 sat = 94%, BMI = 22
  - Lungs – decreased breath sounds from COPD
  - Heart – irregular, no murmurs, no edema
- ECG – atrial fib at 80, no acute changes (compared to old ECG)

Does he need further cardiac eval?

Peter Puffer

- His MICA score = 0.2%.
- He is at low risk for cardiac complications and no further eval is needed.

- WHAT ABOUT HIS ATRIAL FIB?
  - Does he need further eval or treatment?
  - Does he need bridging of anticoagulation?

Atrial Fibrillation

- As long as the atrial fib is rate-controlled (HR < 110) and stable, no further eval is needed.
- Rate control medication should be continued perioperatively.
- Usually do not need to bridge anticoagulation.

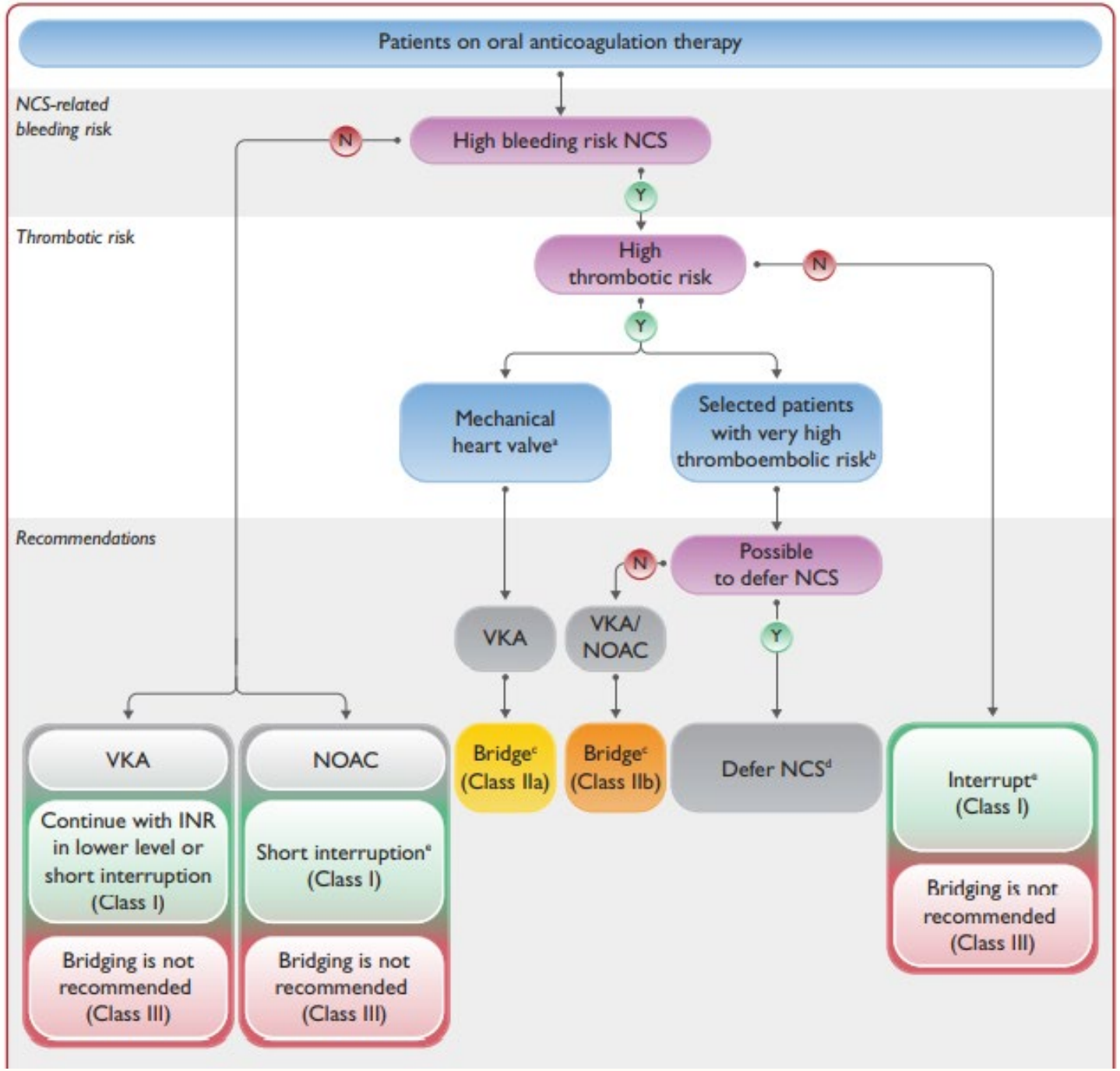

Patients on oral anticoagulation therapy
NCS-related bleeding risk
N
High bleeding risk NCS
Y
Thrombotic risk
High thrombotic risk
N
Y
Mechanical heart valve[a]
Selected patients with very high thromboembolic risk[b]
Recommendations
N
Possible to defer NCS
Y
VKA
VKA/ NOAC
VKA
NOAC
Bridge[c] (Class IIa)
Bridge[c] (Class IIb)
Defer NCS[d]
Interrupt[e] (Class I)
Continue with INR in lower level or short interruption (Class I)
Short interruption[e] (Class I)
Bridging is not recommended (Class III)
Bridging is not recommended (Class III)
Bridging is not recommended (Class III)

Table 9 **Bleeding risk according to type of non-cardiac surgery**

Surgery with minor bleeding risk	Surgery with low bleeding risk (infrequent or with low clinical impact)	Surgery with high bleeding risk (frequent or with significant clinical impact)
• Cataract or glaucoma procedure • Dental procedures: extractions (1–3 teeth), periodontal surgery, implant positioning, endodontic (root canal) procedures, subgingival scaling/cleaning • Endoscopy without biopsy or resection • Superficial surgery (e.g. abscess incision, small skin excisions/ biopsy)	• Abdominal surgery: cholecystectomy, hernia repair, colon resection • Breast surgery • Complex dental procedures (multiple tooth extractions) • Endoscopy with simple biopsy • Gastroscopy or colonoscopy with simple biopsy • Large-bore needles procedures (e.g. bone marrow or lymph node biopsy) • Non-cataract ophthalmic surgery • Small orthopaedic surgery (foot, hand arthroscopy)	• Abdominal surgery with liver biopsy, extracorporeal shockwave lithotripsy • Extensive cancer surgery (e.g. pancreas, liver) • Neuraxial (spinal or epidural) anaesthesia • Neurosurgery (intracranial, spinal) • Major orthopaedic surgery • Procedures with vascular organ biopsy (kidney or prostate) • Reconstructive plastic surgery • Specific interventions (colon polypectomy, lumbar puncture, endovascular aneurysm repair) • Thoracic surgery, lung resection surgery • Urological surgery (prostatectomy, bladder tumour resection) • Vascular surgery (e.g. AAA repair, vascular bypass)

Very High Risk for Thromboembolism

- CVA in the past 3 months
- Mechanical heart valve
- High risk of VTE recurrence (protein S/C, antithrombin 3)
- Atrial fib with a very high risk of stroke (CHADS-Vasc > 6)
- Left ventricular apex thrombus

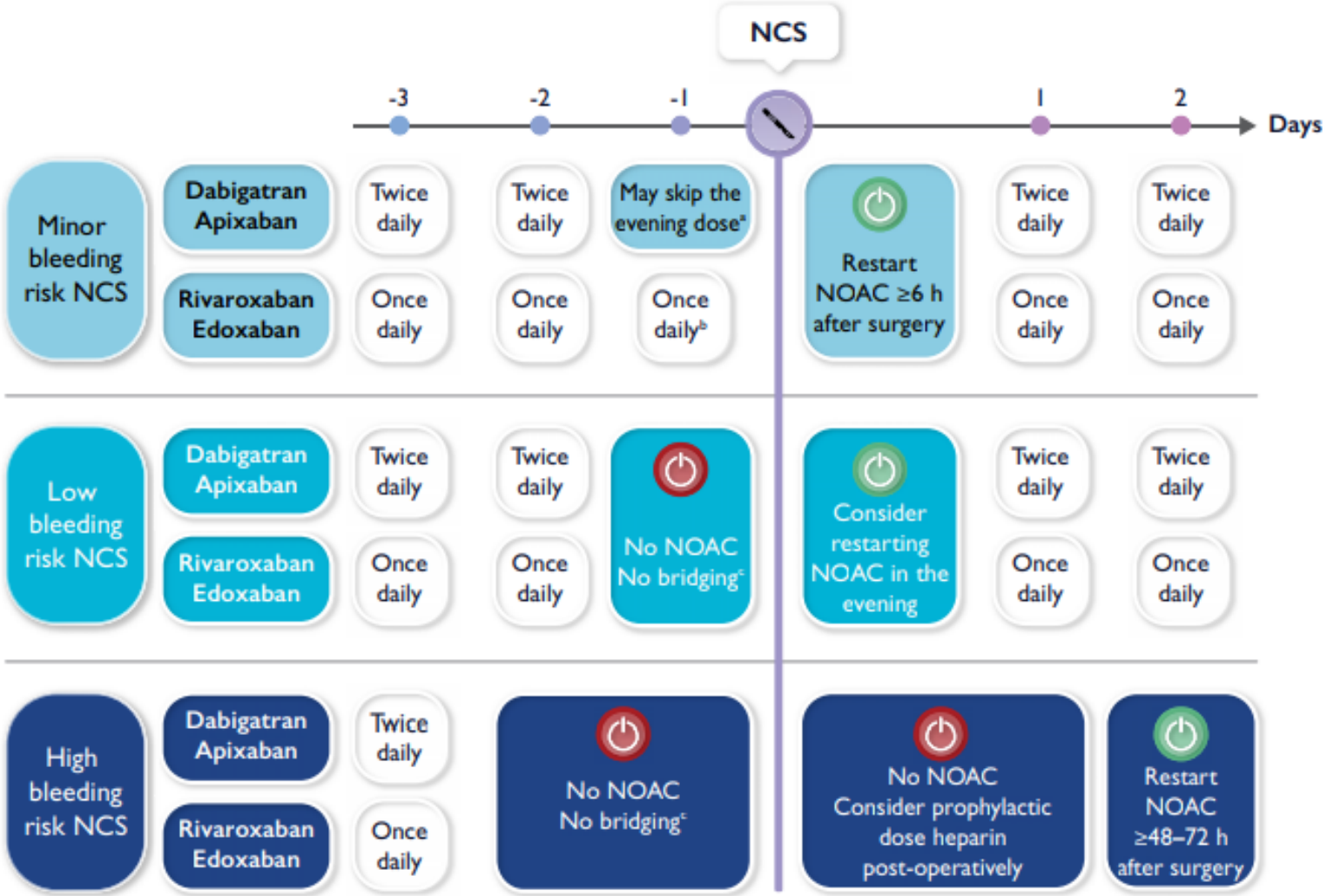
Peter's CHADS-Vasc = 3

Peter Puffer

- You have determined that Peter does not need bridging and we can temporarily interrupt his apixaban.

- When should he stop it and when should he restart it?

Stopping and re-initiation of NOAC therapy in elective NCS according to the periprocedural risk of bleeding in patients with normal renal function



Peter's GFR = 75

Timing of last NOAC dose before elective NCS according to renal function

Minor bleeding risk NCS

Perform intervention at NOAC through level (i.e. 12 h or 24 h after last intake for twice or once daily regimens, respectively). Resume same day or latest next day.

Low and high bleeding risk NCS

Renal function (estimated GFR, mL/min)	Dabigatran		Apixaban, rivaroxaban, edoxaban	
	Low bleeding risk NCS	High bleeding risk NCS	Low bleeding risk NCS	High bleeding risk NCS
≥80	≥24 h	≥48 h	≥24 h	≥48 h
50–79	≥36 h	≥72 h		
30–49	≥48 h	≥96 h		
15–29	Not indicated	Not indicated	≥36 h	
<15	No formal indication for use			

Peter Puffer

- You would like to recommend that Peter stop his apixaban the day prior and try to restart it the evening after surgery.
  - Inguinal hernia repair is low risk for bleeding.
  - Will the surgeon be okay with this??
- At least try to get patient on LMWH 12 hours after surgery.

Peter Puffer

- What about his COPD and smoking?

COPD and Smoking

- Smoking cessation 4-8 weeks prior to surgery can decrease risk of pulmonary complications.
- Continue inhalers perioperatively – make sure optimized
- Pre-Op breathing exercises
- Post-Op lung expansion (incentive spirometry)
- Avoid fluid overload
- Avoid opiates
- Postpone surgery if pulmonary infection or COPD exacerbation

Peter Puffer

- Final A+P
  - Pre-Op eval – Patient is optimized for the planned procedure.
  - Atrial fib
    - *Rate-controlled on metoprolol. Continue perioperatively.*
    - *Does not need bridging but recommend stopping apixaban 24 hrs prior to surgery and restarting apixaban or LMWH the day after surgery.*
  - COPD – He is optimized. Continue inhalers perioperatively.

Questions and Discussion