Perioperative Medicine Pearls

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Disclosures

- I have no relevant commercial relationships to disclose.

Learning Objectives

At the conclusion of this session, participants should be able to:

- use a systematic approach to perform a pre-operative evaluation
- choose appropriate testing indicated as part of the evaluation
- institute interventions to lower the risk of peri-operative complications

Postoperative Complications

- Myocardial infarction
- Arrhythmia
- Pneumonia
- Respiratory failure
- Delirium
- Death

Preoperative evaluation

- How urgent is the surgery?
  - Emergency surgery is a threat to life or limb without intervention within six hours
- What is the surgery-specific risk?
- What is the patient-specific risk?

- Are there interventions we can institute that would lower this patient's risk of having a complication?

The steps

- Cardiac evaluation
- Pulmonary evaluation
- Evaluation of delirium risk
- Venous thromboembolism prophylaxis
- Disease specific evaluation
- Medications

Cardiac Evaluation

- Complications include
  - Myocardial infarction
  - Arrhythmia

Our Case

- A 68 year-old man is seen for a preoperative evaluation for a total knee arthroplasty.
- no exercise and minimal walking due to knee pain
- no other symptoms
- medical history:
  - hypertension, for which he takes losartan
- physical exam:
  - blood pressure is 130/74 mm Hg
  - cardiovascular exam is normal
  - left knee shows changes compatible with severe osteoarthritis
- laboratory studies show a normal serum creatinine level

The Question

- Which of the following should be performed preoperatively?
  - A. noninvasive pharmacologic cardiac stress testing
  - B. resting echocardiography
  - C. serum troponin measurement
  - D. no further diagnostic testing

Preoperative evaluation

- How urgent is the surgery?
- What is the surgery-specific risk?
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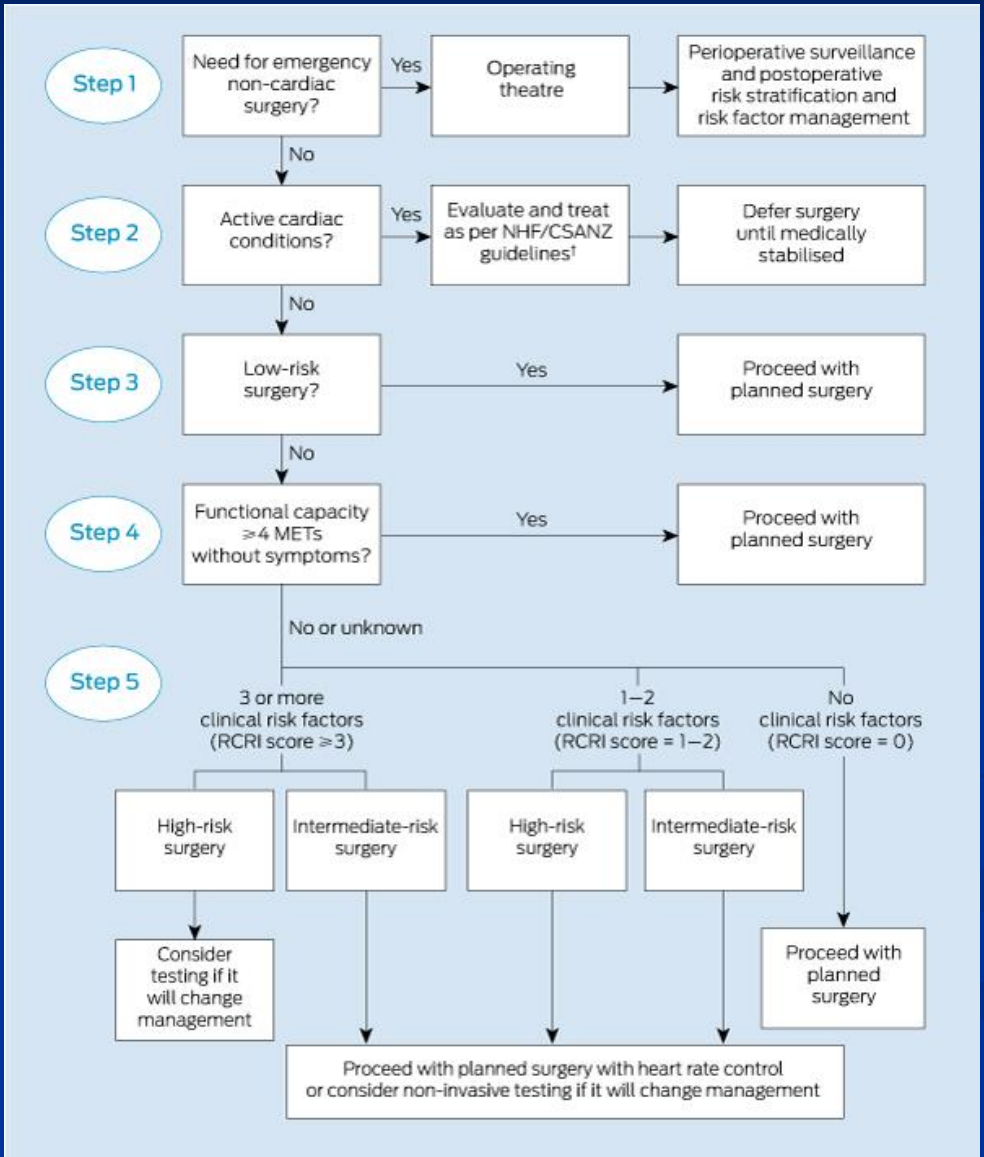
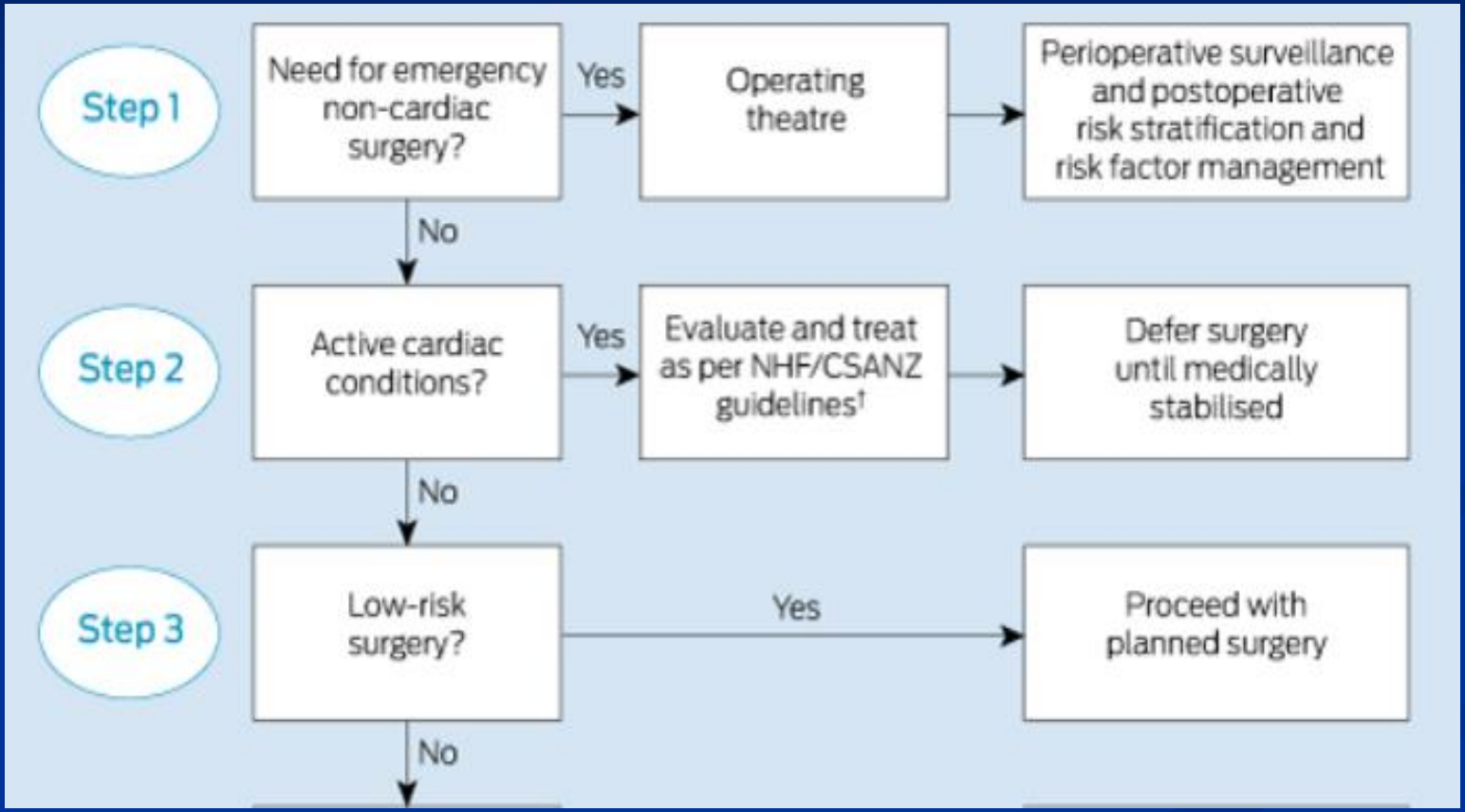
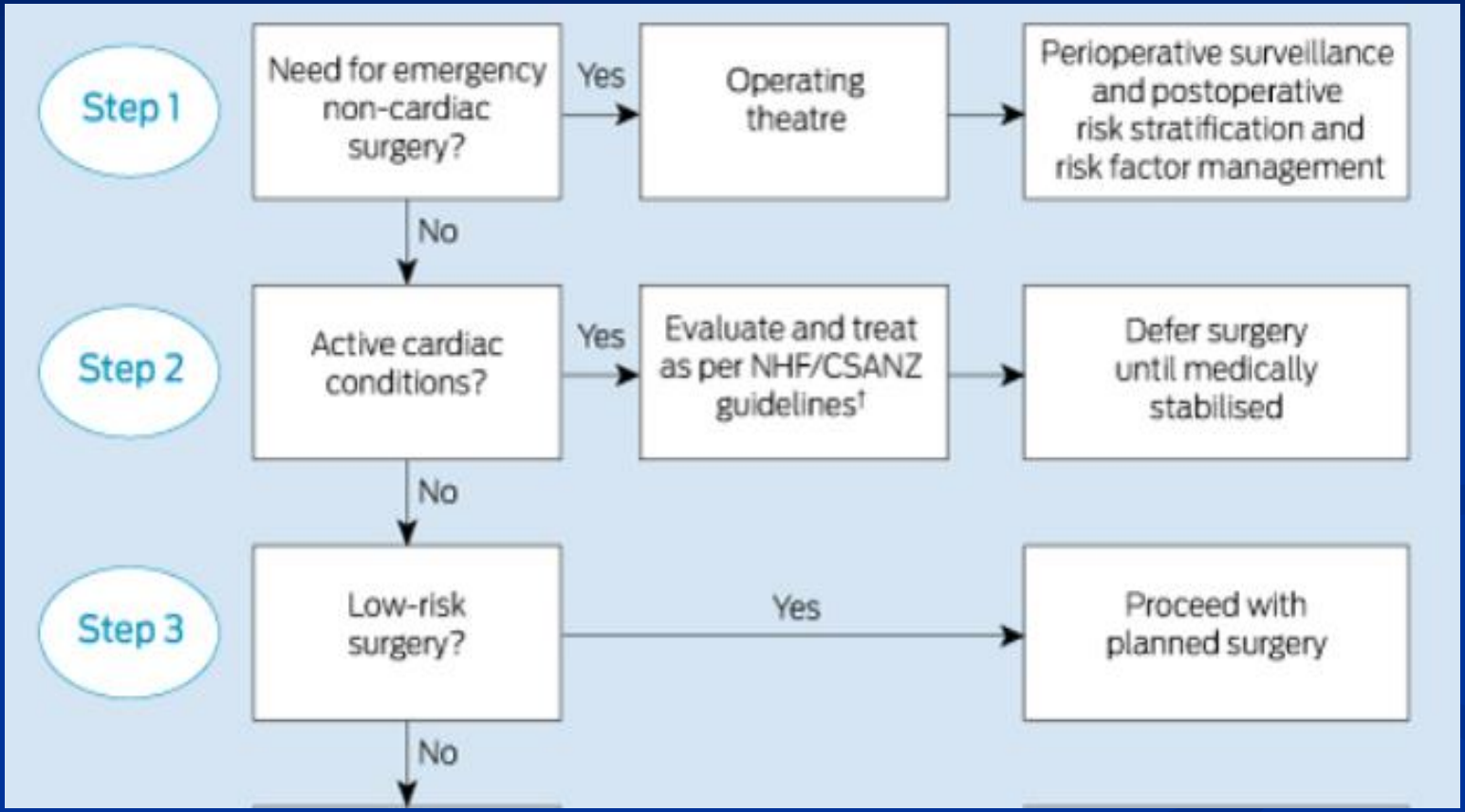
Preoperative cardiac testing[1]




Step 1
Need for emergency non-cardiac surgery?
Yes
Operating theatre
Perioperative surveillance and postoperative risk stratification and risk factor management
No
Step 2
Active cardiac conditions?
Yes
Evaluate and treat as per NHF/CSANZ guidelines†
Defer surgery until medically stabilised
No
Step 3
Low-risk surgery?
Yes
Proceed with planned surgery
No

Types of surgery

- Low Risk Surgery (<1%)
  - cataract extraction
  - carpal tunnel release
  - breast biopsy
  - inguinal hernia
- High Risk Surgery
  - intrathoracic
  - intraperitoneal
  - suprainguinal vascular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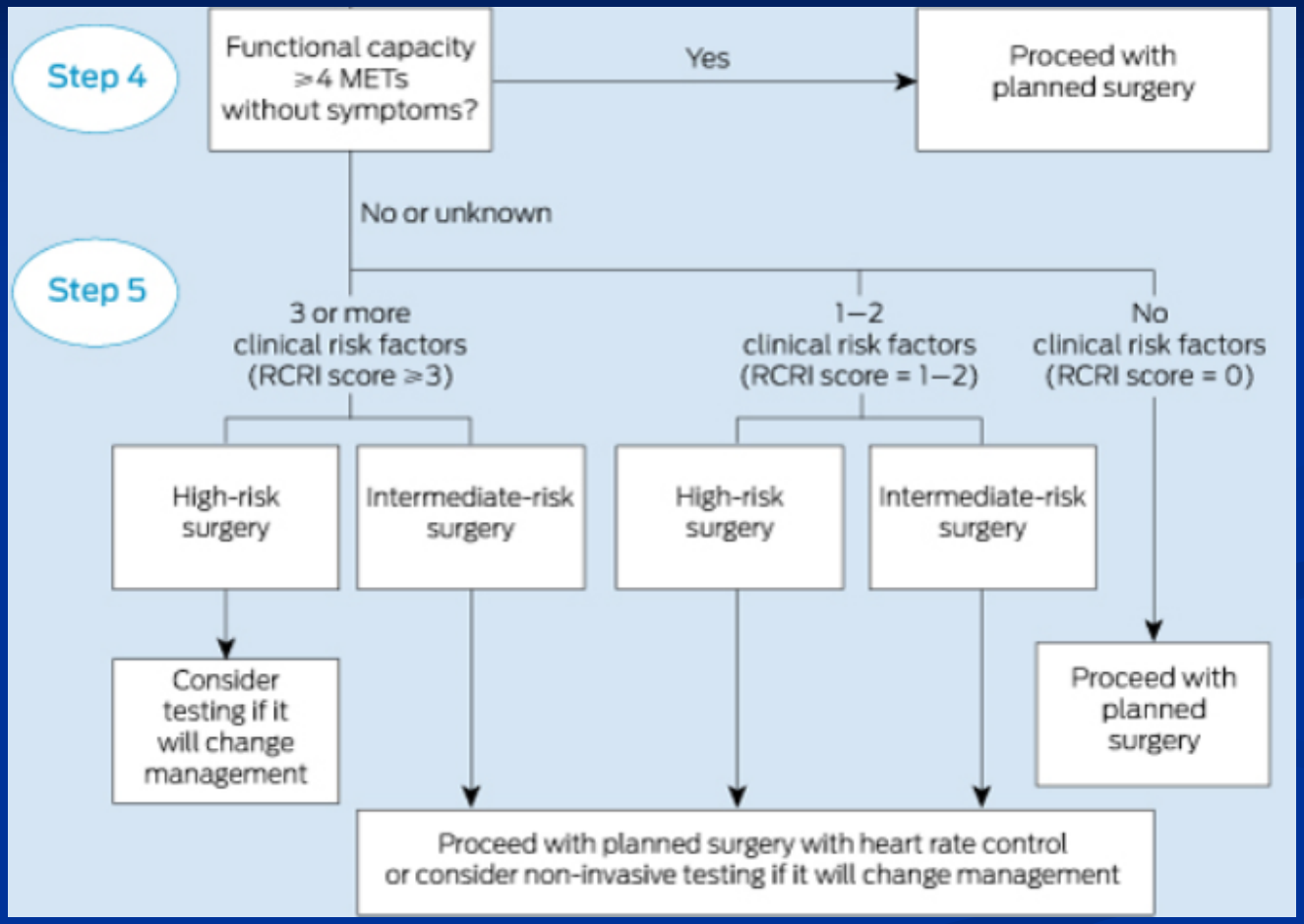
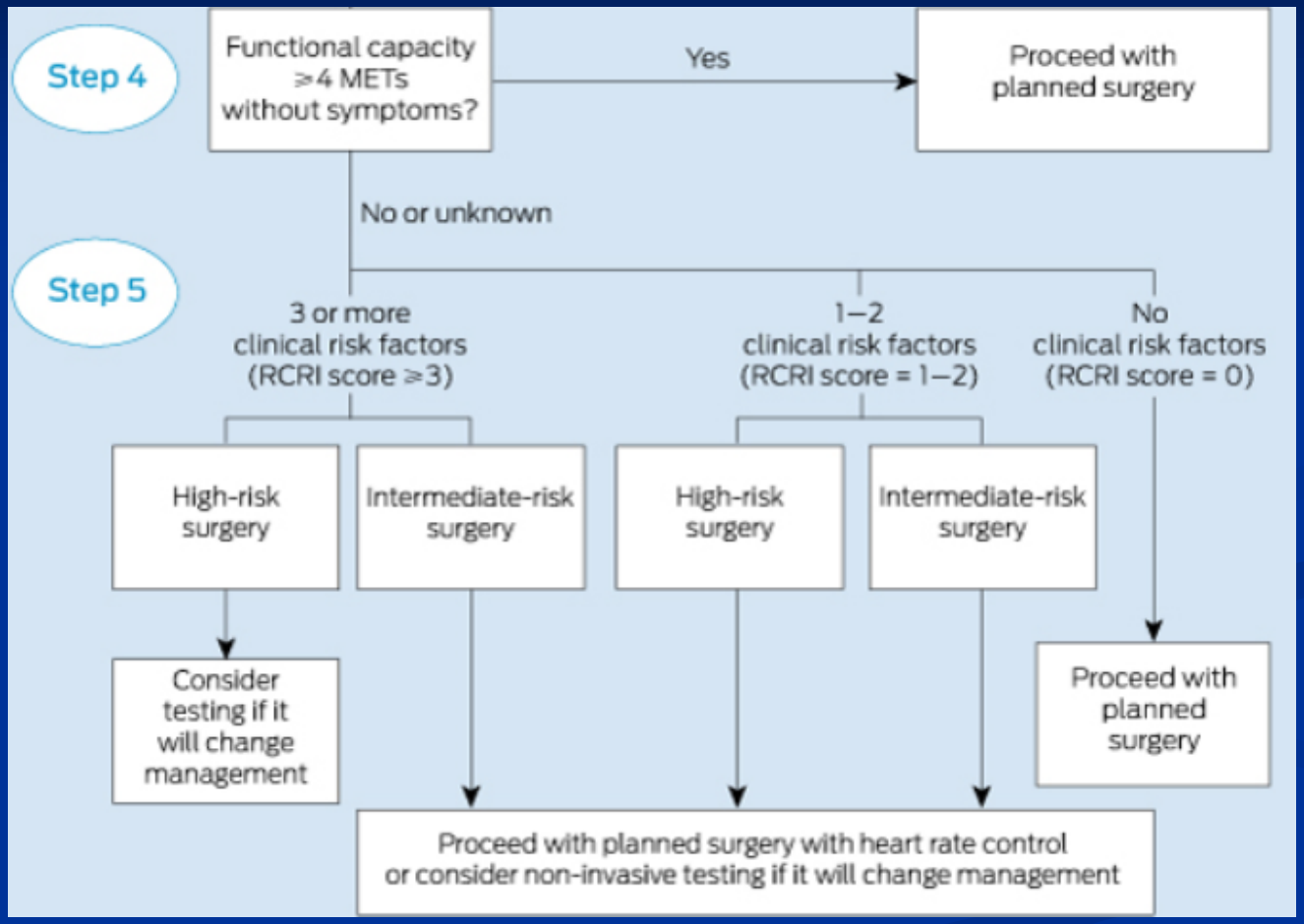

Step 4
Functional capacity ≥4 METs without symptoms?
Yes
Proceed with planned surgery
No or unknown
Step 5
3 or more clinical risk factors (RCRI score ≥3)
1–2 clinical risk factors (RCRI score = 1–2)
No clinical risk factors (RCRI score = 0)
High-risk surgery
Intermediate-risk surgery
High-risk surgery
Intermediate-risk surgery
Consider testing if it will change management
Proceed with planned surgery
Proceed with planned surgery with heart rate control or consider non-invasive testing if it will change management

4 METS

- Climb a flight of stairs
- Walk on level ground at 3 to 4 mph
- Scrubbing floors
- Vacuuming
- Bowling
- Golfing without riding a cart
- Swimming at 0.25 mph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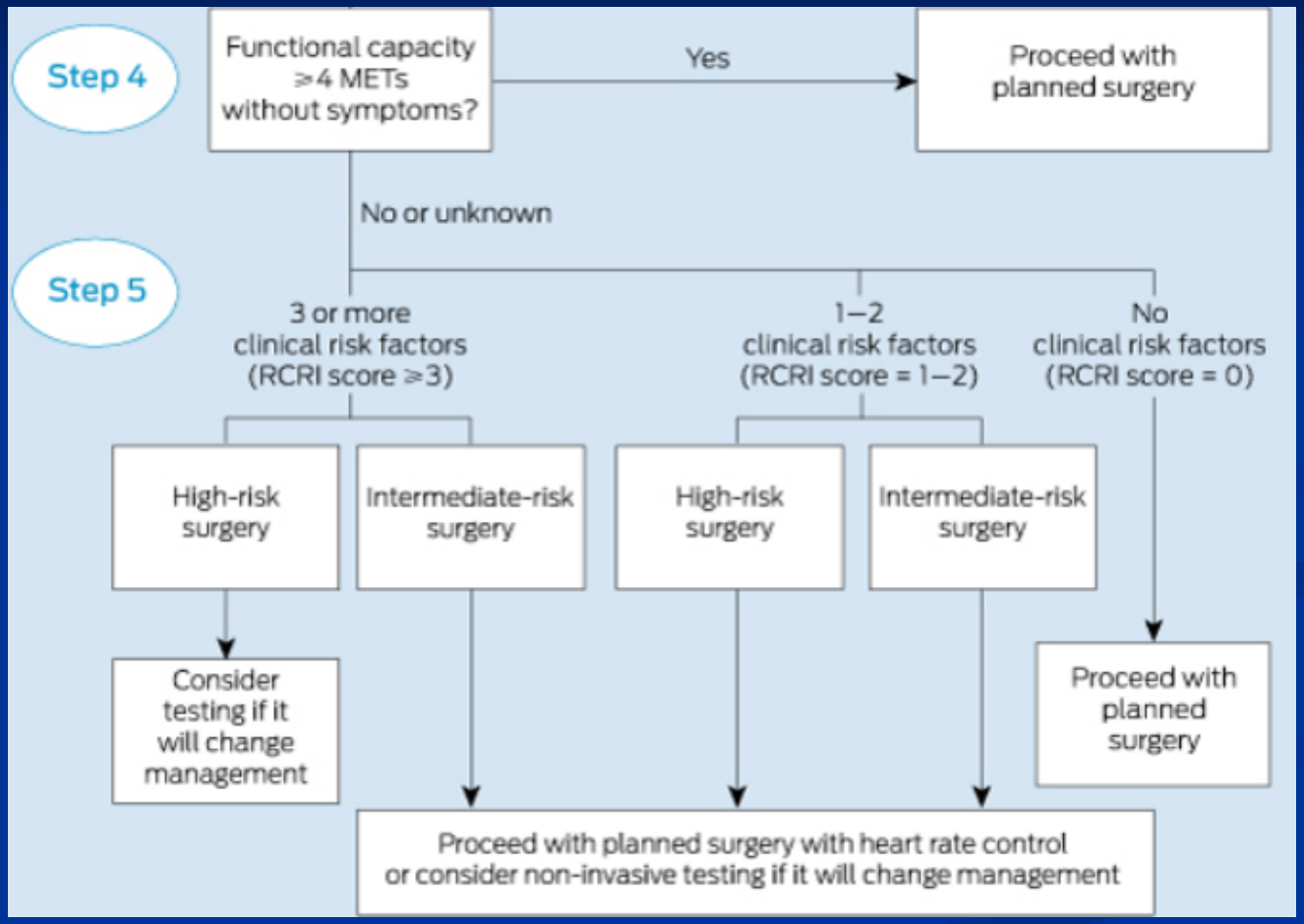
Revised Cardiac Risk Index[2]

- elective major noncardiac surgery
- six independent predictors of complications
  - high-risk type of surgery
  - history of ischemic heart disease
  - history of congestive heart failure
  - history of cerebrovascular disease
  - preoperative treatment with insulin
  - preoperative serum creatinine > 2.0 mg/dL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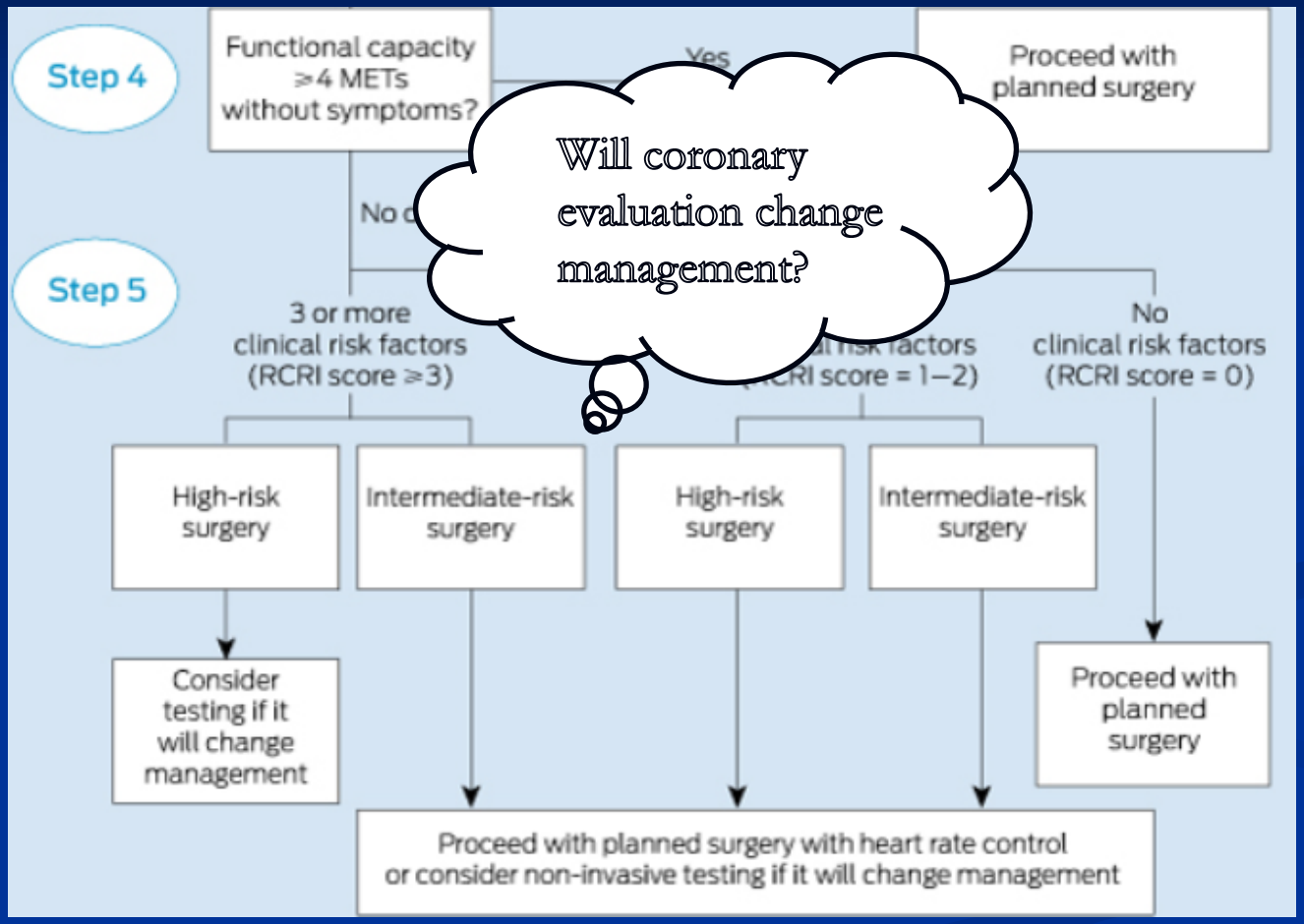

For an asymptomatic patient undergoing noncardiac surgery, in most cases, preoperative coronary evaluation will not influence management.

Who needs an echocardiogram

- Symptoms suggestive of undiagnosed heart failure
- Change in symptoms of diagnosed heart failure
- Diagnosed heart failure but no evaluation of function in over a year
- Known moderate to severe valvular disease if there has been a change in symptoms or exam, or if there has been no evaluation in over a year

Our Case

- A 68 year-old man is seen for a preoperative evaluation for a total knee arthroplasty.
- no exercise and minimal walking due to knee pain
- no other symptoms
- medical history:
  - hypertension, for which he takes losartan
- physical exam:
  - blood pressure is 130/74 mm Hg
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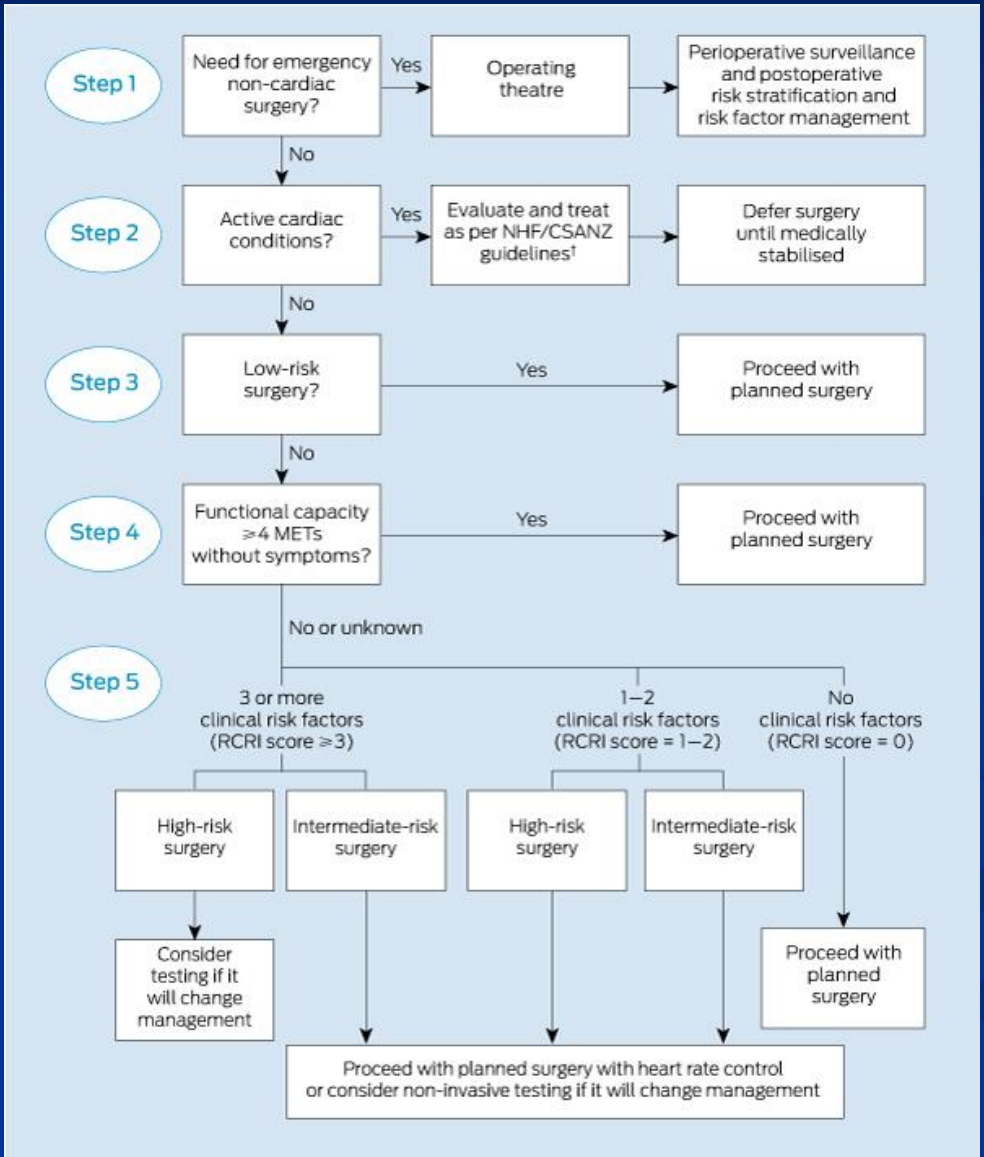
Preoperative cardiac testing



The Answer

- Which of the following should be performed preoperatively?
  - A. noninvasive pharmacologic cardiac stress testing
  - B. resting echocardiography
  - C. serum troponin measurement
  - D. no further diagnostic testing

Preoperative evaluation

- How urgent is the surgery?
- What is the surgery-specific risk?
- What is the patient-specific risk?

- Are there interventions we can institute that would lower this patient's risk of having a complication?

Interventions

Placebo controlled trial of perioperative β-blockade[3]

	Placebo	Beta blocker
Mortality (%)	17	3.4
Nonfatal MI (%)	17	0

POISE[4]

- Randomly assigned 8351 patients from 190 centers in 23 countries
- Received extended-release metoprolol or placebo beginning 2-4 hours before surgery and continuing for 30 days after surgery
- Primary endpoint was a composite of cardiovascular death, non-fatal MI and non-fatal cardiac arrest

POISE[4]

- Fewer patients in the metoprolol group had MI (4.2% vs 5.7%, hazard ratio 0.73)
- Fewer patients in the metoprolol group reached the primary endpoint (5.8% vs 6.9%, hazard ration 0.84)
- More patients in the metoprolol group had a stroke (1.0% vs 0.5%, hazard ratio 2.17)
- More patients in the metoprolol group died (3.1% vs 2.3%, hazard ratio 1.33)

The Catch

- Patients received 100 mg of extended-release metoprolol 2-4 hours before surgery and 100 mg of extended-release metoprolol within the first 6 hours after surgery
- Patients then received 200 mg of extended-release metoprolol daily for 30 days

Perioperative Risk Management

- A beta blocker should be continued uninterrupted in those already taking one before the surgery
- Starting a beta blocker is reasonable for patients at moderate to high risk of having coronary artery disease

Perioperative Medication Management

- Statins should be continued uninterrupted as well
- 2013 ACC guidelines suggest in individuals who otherwise meet indications for statins, the medication should be started perioperatively

Pulmonary Evaluation

- Pulmonary complications include
  - Pneumonia
  - Respiratory failure
- Post-operative pulmonary complications are just as problematic as cardiac complications
  - Costly
  - Increase length of stay

Next Case

- 66 year-old man admitted after undergoing urgent sigmoid colectomy for a perforated diverticulum is evaluated for co-management of his medical problems.
- tolerated general anesthesia well and had no immediate perioperative complications
- history provided by his wife indicates he snores loudly when sleeping and occasionally seems to gag and stop breathing
- no daytime somnolence
- medical history:
  - hypertension – takes lisinopril
  - hyperlipidemia – takes simvastatin, and as needed oxycodone

Next Case

- Physical Exam:
  - fully awake, alert, and breathing comfortably with adequate control of post-op pain
  - morbidly obese
  - blood pressure 156/94 mm Hg
  - respiration rate 18/min
  - oxygen saturation 97%
  - cardiovascular exam is normal
  - lungs are clear
  - LLQ surgical incision is intact with minimal tenderness to palpation; bowel sounds are present, and the abdomen is not distended.

Next Case

- Laboratory studies:
  - hemoglobin of 14.6 g/dL
  - leukocyte count of 18,000 with 95% neutrophils
  - bmp normal

Question

- In addition to continuous pulse oximetry, which of the following is the most appropriate respiratory management of this patient?
  - A. insert an NG tube
  - B. keep the head of the bed elevated at 30 degrees
  - C. start nebulized albuterol
  - D. start nocturnal continuous positive airway pressure ventilation

Pulmonary Evaluation

Do we have tools to assess risk?

- ARISCAT[5]
- ACS NSQIP[6]
- Gupta Respiratory Failure[7] or Postoperative Pneumonia[8]

- STOP-BANG[9]

Pulmonary Evaluation ARISCAT[5]

Age	
51-80 yrs old	3 pts
Over 80 yrs old	16 pts
Preoperative SpO2	
91-95%	8 pts
≤90%	24 pts
Recent respiratory infection	
Yes	17 pts
Preoperative Anemia	
Hgb≤10 g/dL	11 pts
Surgical incision site	
Upper abdomen	15 pts
Intrathoracic	24 pts
Duration of surgery	
2-3 hrs	16 pts
>3hrs	23 pts
Emergency procedure	
Yes	8 pts

Pulmonary Evaluation ARISCAT[5]

Risk Category	Risk of post-operative pulmonary complication
Low risk < 26 pts	1.6 %
Intermediate risk 26 to 44 pts	13.3%
High risk ≥ 45 pts	42.1%

STOP-Bang Questionnaire

STOP-Bang Sleep Apnea Screening Tool[9]

Answer each of the following yes or no:

1. Do you **SNORE** loudly (louder than talking or loud enough to be heard through closed doors)?
2. Do you often feel **TIRED**, fatigued, or sleepy during daytime?
3. Has anyone **OBSERVED** you stop breathing during your sleep?
4. Do you have or are you being treated for high blood **PRESSURE**?
5. **BMI** more than 35?
6. **AGE** over 50 years old?
7. **NECK** circumference > 15.75 inches?
8. Male **GENDER**?

≥5 yes answers: High-risk for OSA

Second Case

- 66 year-old man admitted after undergoing urgent sigmoid colectomy for a perforated diverticulum is evaluated for co-management of his medical problems.
- tolerated general anesthesia well and had no immediate perioperative complications
- history provided by his wife indicates he snores loudly when sleeping and occasionally seems to gag and stop breathing
- no daytime somnolence
- medical history:
  - hypertension – takes lisinopril
  - hyperlipidemia – takes simvastatin, and as needed oxycodone

Second Case

- Emergency surgery 8 pts
- Abdominal surgery 16 pts
- Length of surgery 15 pts
- Age 3 pts

- Total 42 pts

- Snores
- Observed apnea
- Hypertension
- BMI
- Age
- Male

- Total 6 pts

Question and Answer

- In addition to continuous pulse oximetry, which of the following is the most appropriate respiratory management of this patient?
  - A. insert an NG tube
  - B. keep the head of the bed elevated at 30 degrees
  - C. start nebulized albuterol
  - D. start nocturnal continuous positive airway pressure ventilation

Pulmonary Evaluation

- Treat acute symptoms of pulmonary diagnosis
- Consider cpap in those with high STOP-BANG score
- The mainstay – lung expansion maneuvers
- Encourage smoking cessation if time permits

Evaluation for Delirium Risk

- Delirium is common in elderly surgical patients
- Dementia
- Decreased ability to perform ADLs
- Malnutrition
- Sensory impairment
- Severity of illness
- Infection
- Medications

- Mini-Cog score ≤ 2 more likely to develop postoperative delirium[12]

Minimizing Delirium

- Avoid medications associated with delirium
  - Benzodiazepines
  - Anti-cholinergic medications
  - Narcotics
- Reinforce the day-night cycle by keeping the room bright during the day and dim but not dark at night
- Maintain adequate hydration
- Avoid/address constipation
- Address sensory deficits
- Ambulate

Treating delirium

- Evaluate for underlying causes of delirium
  - Electrolyte abnormality
  - Dehydration
  - Medication
  - Infection such as urinary tract infection
- If a patient becomes a danger to himself because of agitation associated with delirium, consider using medication to reduce the risk of injury
  - Avoid benzodiazepines
  - Atypical anti-psychotics

Venous Thromboembolism Prophylaxis

- Caprini Risk Assessment[10]
  - Total joint replacement
  - Hip fracture
  - Spine surgery
  - Nonorthopedic surgery
- ACCP[11]

Caprini Risk Assessment

Each risk factor=1 point

- Age 40–59 years
- Minor surgery planned
- BMI ≥30 kg/m^2
- History of prior major surgery (<1 month)
- Swollen legs (current)
- Varicose veins
- Sepsis (<1 month)
- Abnormal pulmonary function (COPD)
- Acute myocardial infarction (<1 month)
- Congestive heart failure (<1 month)
- History of IBD
- Medical patient currently at bed rest

For women only (1 point each)

- Pregnant of post-partum
- History of unexplained or recurrent spontaneous abortion
- Oral contraceptives or hormone replacement therapy

Each risk factor=2 points

- Age 60–74 years
- Arthroscopic surgery
- Major open surgery (>45 minutes)
- Laparoscopic surgery (>45 minutes)
- Prior cancer (except non-melanoma skin cancer)
- Present cancer (except breast and thyroid)
- Confined to bed (>72 hours)
- Immobilizing plaster cast
- Central venous access

Caprini risk category based on total risk score

Total score	Category
0–4	Low
5–8	Moderate
≥9	High

Each risk factor=3 points

- Age ≥75 years
- History of VTE
- Family history of VTE
- Present chemotherapy
- Positive Factor V Leiden
- Positive Prothrombin 20210A
- Positive Lupus anticoagulant
- Elevated anticardiolipin antibodies
- Elevated serum homocysteine
- HIT
- Other congenital or acquired thrombophilias

Each risk factor=5 points

- Major surgery lasting >6 hours
- Stroke (<1 month)
- Elective major lower extremity arthroplasty
- Hip, pelvis, leg fracture (<1 month)
- Acute spinal cord fracture or paralysis (<1 month)
- Multiple traumas (<1 month)

Disease Specific Recommendations – Glucose Management

- Fish LH, Weaver TW, Moore AL, Steel LG. Value of postoperative blood glucose in predicting complications and length of stay after coronary artery bypass grafting. Am J Cardiol. 2003;92(1):74–76.
- Gandhi GY, Nuttall GA, Abel MD, Mullany CJ, Schaff HV, Williams BA, Schrader LM, Rizza RA, McMahon MM. Intraoperative hyperglycemia and perioperative outcomes in cardiac surgery patients. Mayo Clin Proc. 2005;80(7):862–866.
- Dronge AS, Perkal MF, Kancir S, Concato J, Aslan M, Rosenthal RA. Long-term glycemic control and postoperative infectious complications. Arch Surg. 2006;141(4):375–380.
- Desai SP, Henry LL, Holmes SD, Hunt SL, mArtin CT, Hebsur S, Ad N. Strict versus liberal target range for perioperative glucose in patients undergoing coronary artery bypass grafting: a prospective randomized controlled trial. J Thorac Cardiovasc Surg. 2012;143(2):318–325.
- Han HS, Kang SB. Relations between long-term glycemic control and postoperative wound and infectious complications after total knee arthroplasty in type 2 diabetics. Clin Orthop Surg. 2013;5(2):118–123.
- Abdelmalak BB, Knittel J, Abdelmalak JB, Dalton JE, Christiansen E, Foss J, Argalious M, Zimmerman R, Van den Berghe G. Preoperative blood glucose concentrations and postoperative outcomes after elective non-cardiac surgery: an observational study. Br J Anaesth. 2014;112(1):79–88.

Perioperative Glucose Control

Randomized Controlled Trial of Intensive Versus Conservative Glucose Control in Patients Undergoing Coronary Artery Bypass Graft Surgery: GLUCO-CABG Trial

Guillermo Umpierrez,[1] Saumeth Cardona,[1] Francisco Pasquel,[1] Sol Jacobs,[1] Limin Peng,[2] Michael Unigwe,[1] Christopher A. Newton,[1] Dawn Smiley-Byrd,[1] Priyathama Vellanki,[1] Michael Halkos,[3] John D. Puskas,[3] Robert A. Guyton,[3] and Vinod H. Thourani[3]

Diabetes Care 2015;38:1665–1672 | DOI: 10.2337/dc15-0303

- 352 patients (152 diabetic, 150 non-diabetic) with hyperglycemia after coronary artery bypass surgery
- Randomized to intensive glucose control (100 to 140 mg/dL) or conservative glucose control (141 to 180 mg/dL)
- After the intensive care unit, patients received a single treatment regimen in hospital and for 90 days post-discharge
- Primary outcome was differences in a composite of complications, including mortality, wound infection, pneumonia, bacteremia, respiratory failure, acute kidney injury, and major cardiovascular events

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- Mean glucose measurement in the intensive group was 132 +/- 14 mg/dL
- Mean glucose measurement in the conservative group was 154 +/- 17 mg/dL
- No significant difference in the composite score of complications

Perioperative glucose control[13]

Society Guidelines Recommendations for Treatment of Perioperative Hyperglycemia and Diabetes			
	Ambulatory Surgery	**ICU**	**Non-ICU**
SAMBA	SC rapid-acting insulin analogs are preferred over IV or SC regular insulin ***Treatment goal:*** Intraoperative blood glucose levels <180 mg/dL (10 mmol/L)		
ADA/AACE		Initiate insulin therapy for glucose >180 mg/dL (10 mmol/L). ***Treatment goal:*** For most patients, target a glucose level between 140–180 mg/dL (7.7-10 mmol/L). Glucose target between 110–140 mg/dL (6.1-7.7mmol/L) may be appropriate for select patients, if achievable without significant risk for hypoglycemia.	***Treatment goal:*** If treated with insulin, pre-meal glucose targets should generally be <140 mg/dL (<7.7 mmol/L), with random glucose levels <180 mg/dL (10 mmol/L).
ACP		Recommends against intensive insulin therapy in patients with or without diabetes in surgical/medical ICUs. ***Treatment goal:*** Target glucose is between 140-200 mg/dL (7.7-11.1mmol/L) in patients with or without diabetes.	
Critical Care Society		BG >150 mg/dL (8.3 mmol/L) should trigger insulin therapy. ***Treatment goal:*** Maintain glucose <150 mg/dL (8.3 mmol/L) for most patients in ICU.	
Endocrine Society			***Treatment goal:*** Target premeal blood glucose <140 mg/dL (7.7 mmol/L) and random glucose <180 mg/dL (10 mmol/L). Higher target glucose <200 mg/dL (11.1 mmol/l) is acceptable in patients with terminal illness and/or with limited life expectancy or at high risk for hypoglycemia.
Society of Thoracic Surgeons		Continuous insulin infusion preferred over SC or intermittent IV boluses. ***Treatment goal:*** Recommend glucose <180 mg/dL (10 mmol/L) during surgery, ≤110 mg/dL (6.1 mmol/L) in fasting and pre-meal states.	
Joint British Diabetes Societies			Initiate insulin therapy for glucose >10 mmol/L (180 mg/dL).

SAMBA: Society for Ambulatory Anesthesia; AACE/ADA: American Association of Endocrinologists and American Diabetes Association joint guidelines; ACP: American College of Physicians; ADA: American Diabetes Association; ICU: intensive care unit; IV: intravenous; SC: subcutaneous.

Preoperative Glucose Control

- Some data to suggest that pre-operative glucose control affects outcome of surgery
- No prospective, randomized data to clearly define our goal
- With that, current recommendations include:
  - Hold oral agents
  - Continue long-acting insulin unchanged or at two-thirds usual dose depending on risk factors for hypoglycemia
  - Do not give scheduled short-acting insulin the morning of surgery
  - Insulin regimens should include both basal and prandial coverage
  - Prandial coverage can be supplemented with additional insulin (correction doses)

Discharge regimens

- If patients on oral agents had good glucose control prior to hospitalization, they can resume oral agents after discharge.
- If, however, they had poor glucose control prior to hospitalization, they should be transitioned to insulin therapy upon discharge.

Next Case

- A 35 year-old woman is scheduled for right carpal tunnel release to be performed with local anesthesia and mild sedation. Anticipated duration of surgery is less than 1 hour. She is physically active and otherwise feels well with no lightheadedness, weight changes, fatigue or shortness of breath.
- Medical history:
  - PCKD s/p kidney transplant 5 years ago
  - hypertension.
- Medications:
  - amlodipine
  - Tacrolimus
  - Mycophenolate
  - prednisone 5 mg/d

Next Case

- physical exam:
  - afebrile
  - blood pressure is 128/80 mm Hg
  - pulse rate is 68/min
  - paresthesia in the right hand following the distribution of the median nerve
  - otherwise unremarkable.
- laboratory studies:
  - bmp normal

Question

- Which of the following is the most appropriate preoperative management of this patient's glucocorticoid therapy on the day of surgery?
  - A. continue current prednisone dose
  - B. double the current prednisone dose
  - C. substitute intravenous hydrocortisone, 50 mg, for daily prednisone
  - D. hold prednisone

Disease Specific Recommendations - Adrenal insufficiency

Surgical factors

Mild surgical stress	**- short (<1 hour) duration of surgery** **- procedures under local anesthesia**
Severe stress	- lengthy surgeries - surgery requiring general or regional anesthesia - intra-thoracic or intra-abdominal surgeries

Disease Specific Recommendations - Adrenal insufficiency

Patient factors

Low risk	**- patients continuously taking <10 mg prednisone or equivalent daily** **- patients taking alternating day therapy** **- patients who have taken steroids for <3 weeks**
High risk	- primary adrenal insufficiency - patients taking ≥10 mg prednisone daily ≥3 weeks in the past year

Disease Specific Recommendations - Adrenal insufficiency

	Mild Surgical Stress	Severe Surgical Stress
Low Patient Risk	No change in dose	No change in dose
High Patient Risk	No change in dose	Hydrocortisone 50-100 mg IV given before surgery, then 25-50 mg IV q8h for 24-48 hours after surgery

Question and Answer

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Disease Specific Recommendations - Hepatic Evaluation

- Tools to estimate risk:
  - MELD[14, 16]
  - Childs-Turcotte-Pugh[15, 16]
- Mayo End-Stage Liver Disease (MELD) score can estimate mortality at 30 days[14]
- Generally, an elective surgery is safe in a patient with a MELD score less than 8[14]
- Thirty-day mortality over 50% in patients with a MELD score of ≥20[14]

Disease Specific Recommendations - Renal Evaluation

- Preoperatively
  - Recent basic metabolic panel
  - Optimization of blood pressure control
  - Optimization of fluid status
- No evidence that specific interventions preserve kidney function perioperatively
  - Maintain adequate hydration
  - Minimize perioperative hypotension
  - Avoid nephrotoxic agents
  - Renally dose medications that are given
  - Monitor kidney function, electrolytes, blood pressure and volume status closely

Medications

- Anti-hypertensive medications
  - Beta blockers
  - Calcium channel blockers
  - ACE inhibitors and angiotensin receptor blockers
  - Diuretics
- Lipid Lowering medications
  - Statins
  - Fibrates
- Thyroid medications
  - Thyroid replacement therapy
  - Propylthiouracil
  - Methimazole

Medications

- Estrogen
- Immunomodulators
  - Transplant patients
    - Sirolimus
  - Non-transplant patients
    - Hydroxychloroquine
    - Methotrexate
    - Sulfasalazine
    - Leflunomide
    - Biologic agents (etanercept, adalimumab, etc.)

Next case

- A 61 year-old man is seen for preoperative evaluation before left total hip arthroplasty in 2 weeks.
- hospitalized 4 months ago for an ST-elevation myocardial infarction related to a completely occluded proximal left circumflex artery
- underwent percutaneous coronary intervention and stenting with an everolimus-eluting coronary stent
- echocardiogram one month ago showed preserved left ventricular function and no structural heart disease

Next Case

- medical history:
  - hypertension
  - hyperlipidemia
- Medications:
  - aspirin
  - clopidogrel
  - carvedilol
  - atorvastatin
  - lisinopril

Next Case

- physical exam
  - blood pressure is 126/76 mm Hg
  - pulse rate is 64/min
  - central venous pressure is normal
  - cardiac and pulmonary exams are normal
  - no peripheral edema
- laboratory studies
  - cbc normal
  - basic metabolic panel normal
  - electrocardiogram shows normal sinus rhythm

Question and Answer

- Which of the following is the optimal preoperative management?
  - A. continue clopidogrel and aspirin throughout surgery
  - B. delay surgery for at least 8 months
  - C. stop aspirin and clopidogrel 5 to 7 days before surgery
  - D. stop clopidogrel 5 to 7 days before surgery; continue aspirin

Take Home Points

- Preoperatively, use a systematic approach considering surgical urgency, surgical factors and patient factors to evaluate cardiac, pulmonary, venous thromboembolism and delirium risk.
- Choose your tools and use them consistently.
- Make disease-specific recommendations, giving detailed instructions regarding suggested medication changes.
- Be ready to assist in managing co-morbidities until discharge.

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Questions?

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