Invasive & Non-invasive Tools for Preoperative Assessment of Cardiac Patients Undergoing Non-cardiac Surgery

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Scope of Problem

- Worldwide >200,000,000 major non-cardiac surgical procedures are done annually.
- 1:20 suffer myocardial injury/infarction or cardiac arrest/death within 30 days
- Perioperative cardiac complications account for 1/3 of perioperative deaths.
- For EU countries at least 167,000 cardiac complications occur due to non-cardiac surgeries, of which 19,000 are life threatening.

Definitions of Urgency

- An **emergency procedure** is one in which life or limb is threatened if not in the operating room, where there is time for no or very limited or minimal clinical evaluation, typically within <6 hours.
- An **urgent procedure** is one in which there may be time for a limited clinical evaluation, usually when life or limb is threatened if not in the operating room, typically between 6 and 24 hours.
- A **time-sensitive procedure** is one in which a delay of >1 to 6 weeks to allow for an evaluation and significant changes in management will negatively affect outcome
- An **elective procedure** is one in which the procedure could be delayed for up to 1 year.

Risk of surgical produre: 30-day CV death and MI

Low-risk: < 1%	Intermediate-risk: 1-5%	High-risk: > 5%
• Superficial surgery • Breast • Dental • Endocrine: thyroid • Eye • Reconstructive • Carotid asymptomatic (CEA or CAS) • Gynecology: minor • Orthopaedic: minor (meniscectomy) • Urological: minor (transurethral resection of the prostate)	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecy-stectomy • Carotid symptomatic (CEA or CAS) • Peripheral arterial angioplasty • Endovascular aneurysm repair • Head and neck surgery • Neurological or orthopaedic: major (hip and spine surgery) • Urological or gynaecological: major • Renal transplant • Intra-thoracic: non-major	• Aortic and major vascular surgery • Open lower limb revascularization or amputation or thrombo-embolectomy • Duodeno-pancreatic surgery • Liver resection, bile duct surgery • Oesophagectomy • Repair of perforated bowel • Adrenal resection • Total cystectomy • Pneumonectomy • Pulmonary or liver transplant

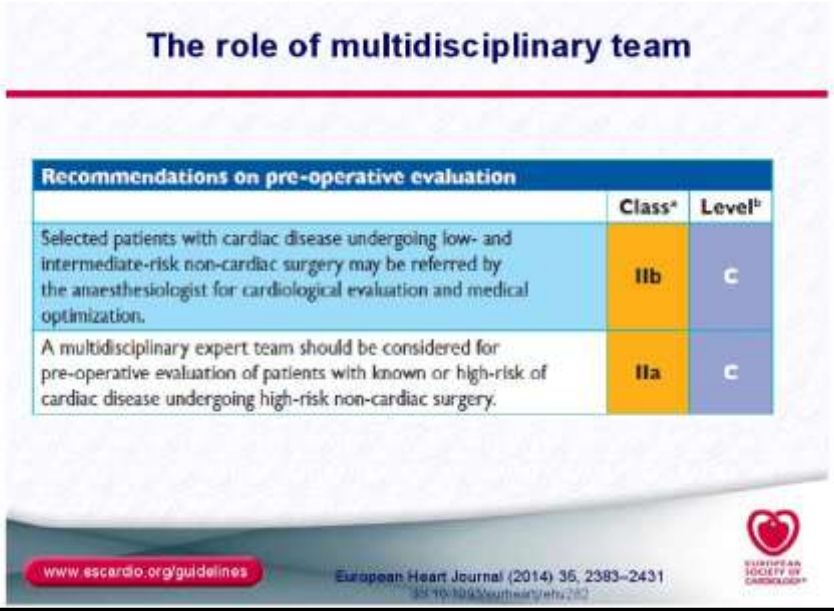
www.escardio.org/guidelines

European Heart Journal (2014) 35, 2383–2431

Definition of Risk

- A **low-risk procedure** is one in which the combined surgical and patient characteristics predict a risk of a major adverse cardiac event (MACE) of death or myocardial infarction (MI) of <1%.
- Procedures with a risk of MACE of ≥1% are considered **elevated risk**.

Scope of Guidelines



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Scope of Guidelines

- Four themes:
  1. Preoperative cardiac risk assessment
  2. Perioperative cardiac risk modification
  3. Monitoring for perioperative cardiac events
  4. Management of perioperative cardiac complications

- Significant change from previous guidelines…
  - Shift of emphasis from preoperative noninvasive cardiac testing to increased use of biomarkers and postoperative monitoring of patients at risk and management of cardiac complication

Speaker: Joel Parlow

Canadian Cardiovascular Society

Good Practice Statement

We recommend communicating to patients their perioperative cardiac risk

Speaker: PJ Devereaux

Canadian Cardiovascular Society

Good Practice Statement

For patients requiring **emergency** surgery,

we recommend against delaying surgery for preoperative cardiac risk assessment

Speaker: PJ Devereaux

Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Calculation of Risk to Predict Perioperative Cardiac Morbidity

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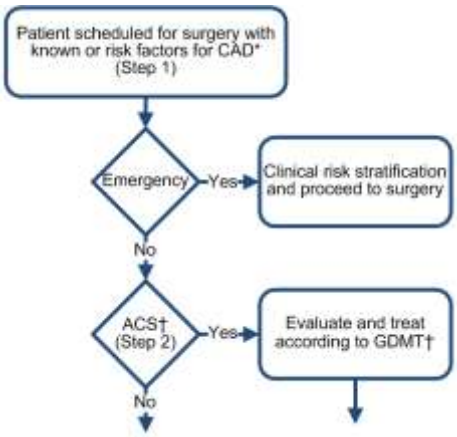
Calculation of Risk to Predict Perioperative Cardiac Morbidity

Multivariate Risk Indices

Recommendations	COR	LOE
A validated risk-prediction tool can be useful in predicting the risk of perioperative MACE in patients undergoing noncardiac surgery.	IIa	B
For patients with a low risk of perioperative MACE, further testing is not recommended before the planned operation.	III: No Benefit	B

Stepwise Approach to Perioperative Cardiac Assessment for CAD



Colors correspond to the Classes of Recommendations in Table 1.

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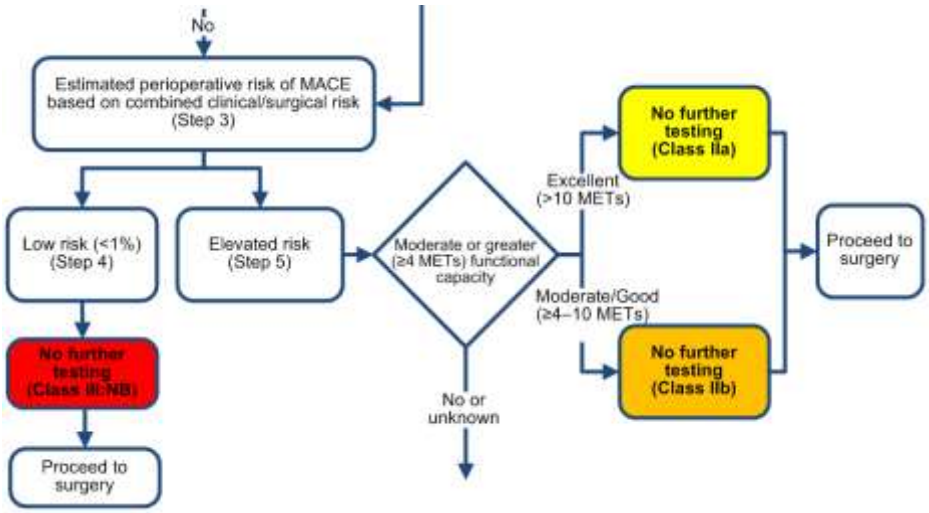
Stepwise Approach to Perioperative Cardiac Assessment for CAD (cont'd)



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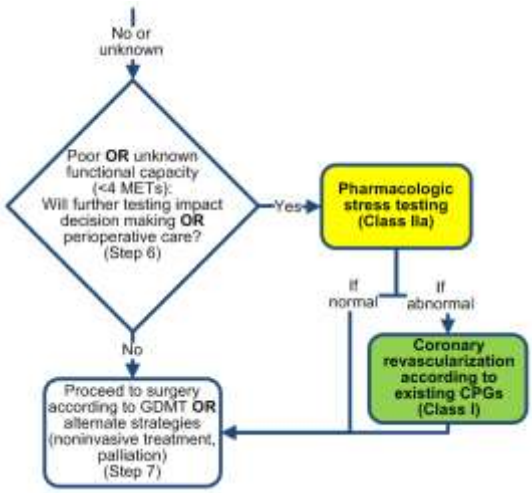
Stepwise Approach to Perioperative Cardiac Assessment for CAD (cont'd)



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Colors correspond to the Classes of Recommendations in Table 1.

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What do the guidelines say?

Preoperative Assessment of Cardiac Patients Undergoing Non-cardiac Surgery

Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

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Supplemental Preoperative Evaluation

The 12-Lead ECG

Recommendations	COR	LOE
Preoperative resting 12-lead ECG is reasonable for patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease, except for those undergoing low-risk.	IIa	B
Preoperative resting 12-lead ECG may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery.	IIb	B
Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures.	III: No Benefit	B

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Supplemental Preoperative Evaluation

Assessment of LV Function

Recommendations	COR	LOE
It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function.	IIa	C
It is reasonable for patients with HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function.	IIa	C
Reassessment of LV function in clinically stable patients with previously documented LV dysfunction may be considered if there has been no assessment within a year.	IIb	C
Routine preoperative evaluation of LV function is not recommended.	III: No Benefit	B

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Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardial Ischemia and Functional Capacity

Recommendations	COR	LOE
For patients with elevated risk and excellent (>10 METs) functional capacity, it is reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIa	B
For patients with elevated risk and unknown functional capacity, it may be reasonable to perform exercise testing to assess for functional capacity if it will change management.	IIb	B
For patients with elevated risk and moderate to good (≥4 METs to 10 METs) functional capacity, it may be reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIb	B

Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardia Ischemia and Functional Capacity (cont'd)

Recommendations	COR	LOE
For patients with elevated risk and poor (<4 METs) or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia if it will change management.	IIb	C
Routine screening with noninvasive stress testing is not useful for patients at low risk for noncardiac surgery.	III: No Benefit	B

Supplemental Preoperative Evaluation

Assessment of LV Function

Recommendations	COR	LOE
It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function.	IIa	C
It is reasonable for patients with HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function.	IIa	C
Reassessment of LV function in clinically stable patients with previously documented LV dysfunction may be considered if there has been no assessment within a year.	IIb	C
Routine preoperative evaluation of LV function is not recommended.	III: No Benefit	B

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Recommendation

We recommend against performing preoperative resting echocardiography to enhance perioperative cardiac risk estimation

Strong recommendation

low-quality evidence

Speaker: Kim Styles

Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardial Ischemia and Functional Capacity

Recommendations	COR	LOE
For patients with elevated risk and excellent (>10 METs) functional capacity, it is reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIa	B
For patients with elevated risk and unknown functional capacity, it may be reasonable to perform exercise testing to assess for functional capacity if it will change management.	IIb	B
For patients with elevated risk and moderate to good (≥4 METs to 10 METs) functional capacity, it may be reasonable to forgo further exercise testing with cardiac imaging and proceed to surgery.	IIb	B

Supplemental Preoperative Evaluation

Exercise Stress Testing for Myocardia Ischemia and Functional Capacity (cont'd)

Recommendations	COR	LOE
For patients with elevated risk and poor (<4 METs) or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia if it will change management.	IIb	C
Routine screening with noninvasive stress testing is not useful for patients at low risk for noncardiac surgery.	III: No Benefit	B

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Coronary CT Angiography

Coronary CTA VISION (Sheth 2015)

- Prospective cohort - 955 patients
- Results blinded unless left main disease identified
- Preop CCTA predicted CV death and nonfatal MI beyond RCRI
  - extensive disease: aHR 3.76 (95% CI, 1.12-12.62)
  - CCTA overestimated risk amongst patients who did not suffer primary outcome
- compared to RCRI, preop CCTA results in inappropriate risk classification in **81** patients in **1000** patient sample
  - based on risk categories of <5%, 5-15%, >15%

Speaker: PJ Devereaux

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Recommendation

We recommend against performing preoperative coronary CT angiography to enhance perioperative cardiac risk estimation

Strong recommendation,

moderate-quality evidence

Speaker: PJ Devereaux

Supplemental Preoperative Evaluation

Cardiopulmonary Exercise Testing

Recommendation	COR	LOE
Cardiopulmonary exercise testing may be considered for patients undergoing elevated risk procedures in whom functional capacity is unknown.	IIb	B

Supplemental Preoperative Evaluation

Noninvasive Pharmacological Stress Testing Before Noncardiac Surgery

Recommendations	COR	LOE
It is reasonable for patients who are at an elevated risk for noncardiac surgery and have poor functional capacity (<4 METs) to undergo noninvasive pharmacological stress testing (either DSE or pharmacological stress MPI) if it will change management.	IIa	B
Routine screening with noninvasive stress testing is not useful for patients undergoing low-risk noncardiac surgery.	III: No Benefit	B

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NT-proBNP/BNP

Individual patient data meta-analysis (Rodseth 2014)

- 2179 patients – 18 studies
- Preop NT-proBNP/BNP independently associated with death or nonfatal MI at 30 days
  - aOR 3.40 (95% CI, 2.57-4.47) p<0.001
- Threshold value associated with lowest p value for death and MI
  - NTproBNP ≥300 ng/l
  - BNP ≥92 mg/l

Speaker: Emmanuelle Duceppe

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NT-proBNP/BNP

Risk of death or MI at 30 days after noncardiac surgery, based on patient's preoperative NT-proBNP or BNP

Test result	Risk estimate	95% CI
NT-proBNP <300 ng/L or BNP <92 mg/L	4.9%	3.9% - 6.1%
NT-proBNP value ≥300 ng/L or BNP ≥92 mg/L	21.8%	19.0% - 24.8%

- compared to RCRI, preop NT-proBNP/BNP results improved risk classification in **155** patients in **1000** patient sample
- based on risk categories <5%, 5-10%, >10-15%, >15%

Speaker: Emmanuelle Duceppe

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Recommendation

We recommend measuring NT-proBNP or BNP before noncardiac surgery to enhance perioperative cardiac risk estimation in patients

≥65 years of age, 45 to 64 years of age with significant cardiovascular disease, or

who have RCRI score ≥1

Strong recommendation,

moderate-quality evidence

Speaker: Emmanuelle Ducenne

Supplemental Preoperative Evaluation

Preoperative Coronary Angiography

Recommendation	COR	LOE
Routine preoperative coronary angiography is not recommended.	III: No Benefit	C

Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Perioperative Therapy

Perioperative Therapy

Coronary Revascularization Prior to Noncardiac Surgery

Recommendations	COR	LOE
Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing CPGs.	I	C
It is not recommended that routine coronary revascularization be performed before noncardiac surgery exclusively to reduce perioperative cardiac events.	III: No Benefit	B

Perioperative Therapy

Timing of Elective Noncardiac Surgery in Patients With Previous PCI

Recommendations	COR	LOE
Elective noncardiac surgery should be delayed 14 days after balloon angioplasty…	I	C
…and 30 days after BMS implantation	I	B
Elective noncardiac surgery should optimally be delayed 365 days after DES implantation.	I	B
In patients in whom noncardiac surgery is required, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy can be useful.	IIa	C

Perioperative Therapy

Timing of Elective Noncardiac Surgery in Patients With Previous PCI (cont'd)

Recommendations	COR	LOE
Elective noncardiac surgery after DES implantation may be considered after 180 days if the risk of further delay is greater than the expected risks of ischemia and stent thrombosis.	IIb*	B
Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 12 months after DES implantation in patients in whom DAPT will need to be discontinued perioperatively.	III: Harm	B
Elective noncardiac surgery should not be performed within 14 days of balloon angioplasty in patients in whom aspirin will need to be discontinued perioperatively.	III: Harm	C

*Because of new evidence, this is a new recommendation since the publication of the 2011 PCI CPG

Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Anesthetic Consideration and Intraoperative Management

Anesthetic Consideration and Intraoperative Management

Intraoperative Monitoring Techniques

Recommendations	COR	LOE
The emergency use of perioperative TEE is reasonable in patients with hemodynamic instability undergoing noncardiac surgery to determine the cause of hemodynamic instability when it persists despite attempted corrective therapy, if expertise is readily available.	IIa	C
The routine use of intraoperative TEE during noncardiac surgery to screen for cardiac abnormalities or to monitor for myocardial ischemia is not recommended in patients without risk factors or procedural risks for significant hemodynamic, pulmonary, or neurologic compromise.	III: No Benefit	C

Anesthetic Consideration and Intraoperative Management

Perioperative Use of Pulmonary Artery Catheters

Recommendations	COR	LOE
The use of pulmonary artery catheterization may be considered when underlying medical conditions that significantly affect hemodynamics (i.e., HF, severe valvular disease, combined shock states) cannot be corrected before surgery.	IIb	C
Routine use of pulmonary artery catheterization in patients, even those with elevated risk, is not recommended.	III: No Benefit	A

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Perioperative Surveillance

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Troponin Monitoring

POISE Trial (8351 patients)

- 65% of patients suffering a perioperative MI do not experience ischemic symptoms
  - **2/3 of perioperative MIs would go unrecognized without periop troponin monitoring**
- Presence or absence of signs/symptoms does not change risk 30-day mortality
  - symptomatic MI: aOR 4.76 (95% CI, 2.68-8.43)
  - asymptomatic MI: aOR 4.00 (95% CI, 2.65-6.06)

Speaker: Emmanuelle Duceppe

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VISION Study (Botto 2014)

- Asymptomatic perioperative TnT elevations adjudicated as myocardial injuries due to ischemia – that did not fulfill Universal Definition of MI – were also associated with increased risk of 30-day mortality
  - aHR, 3.30; 95% CI, 2.26–4.81

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Troponin Monitoring

Meta-analysis of postop troponin (Levy 2011)

- 14 studies – 3,318 patients
- Postop troponin elevation associated with all-cause mortality at 12 months
  - aOR 6.7 (95% CI, 4.1-10.9)

Speaker: Emmanuelle Ducepne

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Recommendation

We recommend obtaining daily troponin measurements for 48 to 72 hours after noncardiac surgery in patients with baseline risk >5%* for cardiovascular death or nonfatal MI at 30 days after surgery

Strong recommendation, moderate-quality evidence

* Patients with an elevated NT-proBNP/BNP measurement before surgery or, if there is no NT-proBNP/BNP measurement before surgery, in those who have an RCRI score ≥1, age 45 to 64 years with significant cardiovascular disease, or age ≥65 years

Speaker: Emmanuelle Ducepne

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Postoperative ECG

Prospective cohort study (Rinfret 2004)

- 3564 patients, age ≥50 years old, major noncardiac surgery
- ECG done in recovery room and on day 1, 3 and 5 postop
- New ischemic findings independent predictor of subsequent major cardiac events
  - aOR 2.19 (95% CI, 1.22–3.93) p=0.009

Speaker: Kim Styles

Canadian Cardiovascular Society

Recommendation

We suggest performing postoperative ECG in post-anesthetic care unit in patients with baseline risk >5%* for CV death or nonfatal MI

Conditional recommendation,

low-quality evidence

Perioperative Surveillance

Surveillance and Management for Perioperative MI

Recommendations	COR	LOE
Measurement of troponin levels is recommended in the setting of signs or symptoms suggestive of myocardial ischemia or MI.	I	A
Obtaining an ECG is recommended in the setting of signs or symptoms suggestive of myocardial ischemia, MI, or arrhythmia.	I	B
The usefulness of postoperative screening with troponin levels in patients at high risk for perioperative MI, but without signs or symptoms suggestive of myocardial ischemia or MI, is uncertain in the absence of established risks and benefits of a defined management strategy.	IIb	B

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Perioperative Surveillance

Surveillance and Management for Perioperative MI (cont'd)

Recommendations	COR	LOE
The usefulness of postoperative screening with ECGs in patients at high risk for perioperative MI, but without signs or symptoms suggestive of myocardial ischemia, MI, or arrhythmia, is uncertain in the absence of established risks and benefits of a defined management strategy.	IIb	B
Routine postoperative screening with troponin levels in unselected patients without signs or symptoms suggestive of myocardial ischemia or MI is not useful for guiding perioperative management.	III: No Benefit	B

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Clinical Risk Factors

Valvular Heart Disease

Recommendations	COR	LOE
It is recommended that patients with clinically suspected moderate or greater degrees of valvular stenosis or regurgitation undergo preoperative echocardiography if there has been either 1) no prior echocardiography within 1 year or 2) a significant change in clinical status or physical examination since last evaluation.	I	C
For adults who meet standard indications for valvular intervention (replacement and repair) on the basis of symptoms and severity of stenosis or regurgitation, valvular intervention before elective noncardiac surgery is effective in reducing perioperative risk.	I	C

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Clinical Risk Factors

Aortic Stenosis

Recommendation	COR	LOE
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe AS.	IIa	B

Mitral Stenosis

Recommendation	COR	LOE
Elevated-risk elective noncardiac surgery using appropriate intraoperative and postoperative hemodynamic monitoring may be reasonable in asymptomatic patients with severe mitral stenosis if valve morphology is not favorable for percutaneous mitral balloon commissurotomy.	IIb	C

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Clinical Risk Factors

Aortic and Mitral Regurgitation

Recommendations	COR	LOE
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe MR.	IIa	C
Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe AR and a normal LVEF.	IIa	C

Case Presentation

CASE SUMMARY

2017

A 87 years old female patient

Hypertensive

Dyslipidemic

Not Diabetic

Sedentary life

CASE SUMMARY

2017

- Pre-operative assessment for Surgical resection for Cancer Bladder.
- ECG: Infero-lateral ST-T wave changes.
- Echocardiography: EF 46% RWMA Mild MR, Sclerotic AV

How would you proceed?

Diagnostic Coronary Angio

CASE SUMMARY

2017

- Coronary angiography revealed severe 3-vessel CAD.

What options do we have…

- Surgery high risk?
- Coronary revascularization first
- Medical treatment.

Post-procedural hospital course…

- Mild elevation of Troponin.
- No ECG changes

- Patient was discharged home in a stable condition.

CONCLUSIONS

THANK YOU