

Table 1. ESC 2022 GL on Noncardiac Surgery.

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

CAS, carotid artery stenting; CEA, carotid endarterectomy; CV, cardiovascular; MI, myocardial infarction; VATS, video-assisted thoracic surgery.

Surgical risk estimate is a broad approximation of 30 day risk of CV death, MI, and stroke that takes into account only the specific surgical intervention, without considering the patient's comorbidities.

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)

AAA, abdominal aortic aneurysm.

Table 2. ESC 2022 GL on Noncardiac Surgery.

Recommendations for selection of surgical approach and impact on risk.

Endovascular or video-assisted procedures should be considered for patients with high CV risk IIa
 B
 undergoing vascular or pulmonary surgery.

Recommendations for all patients scheduled for non-cardiac surgery

Accurate history and clinical examination in all patients scheduled for NCS I C

Perform a pre-operative risk assessment, ideally at the same time as the NCS is proposed. I B

If time allows, optimize guideline-recommended treatment of CVD and CV risk factors before NCS. I C

Recommendations for patients aged <65 years without signs, symptoms, or history of cardiovascular disease

In patients with a family history of genetic cardiomyopathy, it is recommended to perform an ECG and TTE before NCS, regardless of age and symptoms.	I	C
In patients aged 45–65 years without signs, symptoms, or history of CVD, ECG and biomarkers should be considered before high-risk NCS.	IIa	C

ECG, electrocardiogram; NCS, non-cardiac surgery; TTE, transthoracic echocardiography.

Recommendations for pre-operative assessment in patients with previously unknown murmur, angina, dyspnoea, or peripheral oedema

Newly detected murmur		
In patients with a newly detected murmur <i>and</i> symptoms or signs of CVD, TTE is recommended before NCS.	I	C
In patients with a newly detected murmur suggesting clinically significant pathology, TTE is recommended before high-risk NCS.	I	C
In patients with a newly detected murmur, but without other signs or symptoms of CVD, TTE should be considered before moderate-risk NCS.	Ila	C
Previously unknown angina		
If a patient scheduled for elective NCS has chest pain or other symptoms suggestive of undetected CAD, further diagnostic work-up before NCS is recommended.	I	C
If a patient in need of acute NCS also has chest pain or other symptoms suggestive of undetected CAD, a multidisciplinary assessment approach is recommended to choose the treatment with lowest total risk for the patient.	I	C
Dyspnoea and/or peripheral oedema		
In patients with dyspnoea and/or peripheral oedema, an ECG and an NT-proBNP/BNP test is indicated before NCS, unless there is a certain non-cardiac explanation.	I	C
In patients with dyspnoea and/or peripheral oedema and elevated NT-proBNP/BNP, TTE is recommended before NCS. ^c	I	C

BNP, B-type natriuretic peptide; CAD, coronary artery disease; CVD, cardiovascular disease; ECG, electrocardiogram; NCS, non-cardiac surgery; NT-proBNP, N-terminal pro-B-type natriuretic peptide; TTE, transthoracic echocardiography.

c If BNP/NT-proBNP testing is unavailable, TTE should be considered.

Recommendations for patient information

It is recommended to give patients individualized instructions for pre-operative and post-operative changes in medication, in verbal and written formats with clear and concise directions.	I	C
It should be considered to set up a structured information list (e.g. a check list to help with common issues) for patients with CVD or at high risk of CV complications scheduled for NCS.	IIa	C

Close follow-up after intervention and subsequent management of heart disease are advised.

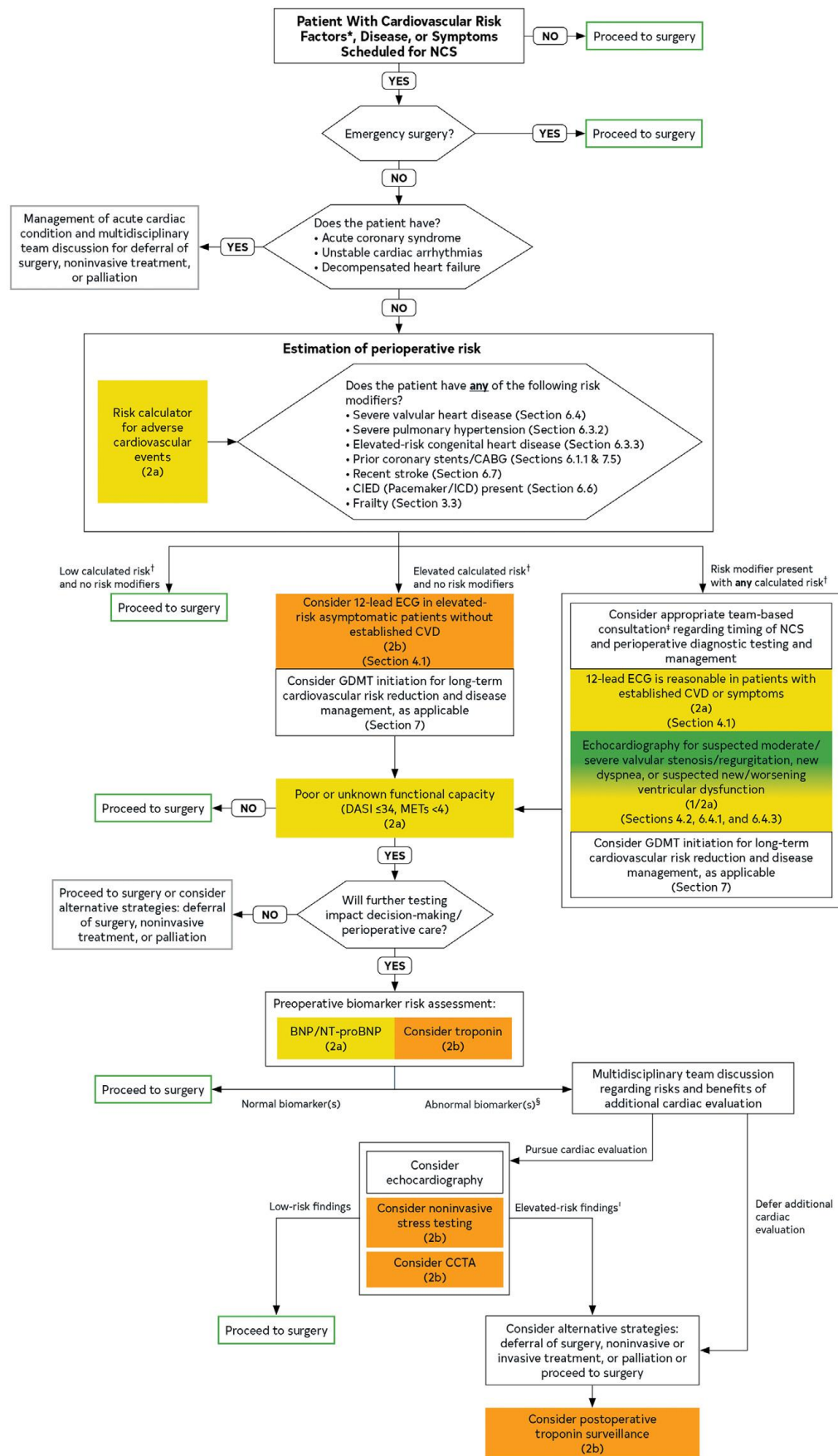


Figure 2. AHA/ACC 2024 GL on Noncardiac Surgery. Stepwise Approach to Perioperative Cardiac Assessment.

*Cardiovascular risk factors: hypertension, smoking, high cholesterol, diabetes, women age >65 y; men age >55 y; obesity; family history of premature CAD.

†Determining elevated calculated risk depends on the calculator used. Traditionally, RCRI >1 or a calculated risk of MACE with any perioperative risk calculator >1% is used as a threshold to identify patients at elevated risk. §Abnormal biomarker thresholds: troponin >99th percentile URL for the assay; BNP >92 ng/L, NTproBNP >300 ng/L.

‡Conditions that pose additional risk for MACE. kNoninvasive stress testing or CCTA suggestive of LM or multivessel CAD.

BNP indicates B-type natriuretic peptide; CABG, coronary artery bypass grafting; CAD, coronary artery disease; CCTA, coronary computed tomography angiography; CIED, cardiovascular implantable electronic device; CVD, cardiovascular disease; DASI, Duke Activity Status Index; ECG, electrocardiogram; GDMT, guideline-directed management and therapy; ICD, implantable cardioverter-defibrillator; LM, left main; MACE, major adverse cardiovascular event; METs, metabolic equivalents; NCS, noncardiac surgery; NT-proBNP, N-terminal pro b-type natriuretic peptide; RCRI, Revised Cardiac Risk Index; and URL, upper reference limit.

Table 3. Duke Activity Status Index (DASI)

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

The DASI score is calculated by adding the points of all performed activities together. The higher the score (range, 0-58.2), the higher the functional status.

Table 4. Recommendations for frailty

ESC 2022 GL on Noncardiac Surgery. Recommendations for pre-operative assessment of frailty and functional capacity.

In patients aged ≥ 70 years and scheduled to undergo intermediate- or high-risk NCS, Frailty screening using a validated screening tool	Ila B
Adjusting risk assessments according to self-reported ability to climb two flights of stairs in patients referred for intermediate- or high-risk NCS	Ila B

AHA/ACC 2024 GL on Noncardiac Surgery. Recommendations for frailty.

In all patients ≥ 65 years of age and in those < 64 years with perceived frailty who are undergoing elevated-risk NCS, preoperative frailty assessment using a validated tool for evaluating perioperative risk and guiding management	2a B-NR
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Table 5. ESC 2022 GL on Noncardiac Surgery.

Recommendations for pre-operative risk assessment—electrocardiography and biomarkers.

In patients who have known CVD or CV risk factors (including age ≥ 65 years), or symptoms or signs suggestive of CVD it is recommended to obtain a pre-operative 12-lead ECG before intermediate- and high-risk NCS. ^{97–99}	I	C
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
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}	Ila	B
In low-risk patients undergoing low- and intermediate-risk NCS, it is not recommended to routinely obtain pre-operative ECG, hs-cTn T/I, or BNP/NT-proBNP concentrations. ^{109,111,117–119}	III	B

Abnormal ECG: pathological Q wave, ST-T wave changes, non-sinus rhythm, left bundle branch block. Abnormal pre-operative hs-cTn T/I: more than ULN. Age, sex, and known cardiac disease should also be considered when interpreting the pre-operative concentration.

Abnormal BNP: ≥ 35 pg/mL; abnormal NT-proBNP: ≥ 125 pg/mL. BNP/NT-proBNP should be interpreted as quantitative markers of heart failure, and also take into account age, sex, obesity, and known cardiac disease. Please note that age, renal dysfunction, and obesity are important confounders in the age group in which

measurement of BNP/NT-proBNP is recommended, while sex has less impact.

BNP, B-type natriuretic peptide; CV, cardiovascular; CVD, cardiovascular disease; ECG, electrocardiogram; hs-cTn I, high-sensitivity cardiac troponin; hs-cTn T, high-sensitivity cardiac troponin T; NCS, non-cardiac surgery; NT-proBNP, N-terminal pro-BNP; ULN, upper limit of normal.

Recommendations for transthoracic echocardiography

TTE is recommended in patients with poor functional capacity ^c and/or high NT-proBNP/BNP, ^d or if murmurs are detected before high-risk NCS, in order to undertake risk-reduction strategies. ^{121,124,127,141–143}	I	B
TTE should be considered in patients with suspected new CVD or unexplained signs or symptoms before high-risk NCS. ^{59,124,125}	IIa	B
TTE may be considered in patients with poor functional capacity, abnormal ECG, high NT-proBNP/BNP, ^d or ≥ 1 clinical risk factor before intermediate-risk NCS. ^{126–128}	IIb	B
To avoid delaying surgery, a FOCUS exam performed by trained specialists may be considered as an alternative to TTE for pre-operative triage. ^{129,130,132,133,144}	IIb	B
Routine pre-operative evaluation of LV function is not recommended. ^{122,145}	III	C

d ≥ 125 pg/mL/35 pg/mL.

Recommendations for stress imaging

Stress imaging is recommended before high-risk elective NCS in patients with poor functional capacity ^c and high likelihood of CAD ^d or high clinical risk. ^{e,146,156–158}	I	B
Stress imaging should be considered before high-risk NCS in asymptomatic patients with poor functional capacity, ^d and previous PCI or CABG. ¹⁴⁷	IIa	C
Stress imaging may be considered before intermediate-risk NCS when ischaemia is of concern in patients with clinical risk factors and poor functional capacity. ^{d,152,157,158}	IIb	B
Stress imaging is not recommended routinely before NCS.	III	C

CABG, coronary artery bypass graft; CAD, coronary artery disease; ECG, electrocardiogram; LV, left ventricular; NCS, non-cardiac surgery; PCI, percutaneous coronary intervention.

c Physical capacity based on Duke Activity Status Index (DASI) or inability to climb two flights of stairs.

d Pre-test probability.15% based on age, sex, and nature of symptoms, or two or more risk factors for CVD (dyslipidaemia, diabetes, hypertension, smoking, family history of

CVD), or resting ECG changes (Q wave or ST-segment/T wave changes), or LV dysfunction suggestive of CAD.^e One or more clinical risk factor according to the Revised Cardiac Risk Index (ischaemic heart disease, cerebrovascular disease, history of congestive heart failure, serum creatinine level ≥ 2 mg/dL, diabetes requiring insulin therapy).

Recommendations for coronary angiography

It is recommended to use the same indications for ICA and revascularization pre-operatively as in the non-surgical setting. ^{98,146}	I	C
CCTA should be considered to rule out CAD in patients with suspected CCS or biomarker-negative NSTEMI-ACS in case of low-to-intermediate clinical likelihood of CAD, or in patients unsuitable for non-invasive functional testing undergoing non-urgent, intermediate-, and high-risk NCS.	IIa	C
Pre-operative ICA may be considered in stable CCS patients undergoing elective surgical CEA. ¹⁷²	IIb	B
Routine pre-operative ICA is not recommended in stable CCS patients undergoing low- or intermediate-risk NCS.	III	C

CAD, coronary artery disease; CCS, chronic coronary syndrome; CCTA, coronary computed tomography angiography; CEA, carotid endarterectomy; ICA, invasive coronary angiography; NCS, non-cardiac surgery; NSTEMI-ACS, non-ST-segment elevation acute coronary syndrome.

Recommendations for lifestyle and cardiovascular risk factors

Smoking cessation >4 weeks before NCS is recommended to reduce post-operative complications and mortality. ^{181,182}	I	B
Control of CV risk factors—including blood pressure, dyslipidaemia, and diabetes—is recommended before NCS. ^{173,176–178,183}	I	B

Table 6. AHA/ACC 2024 GL on Noncardiac Surgery.

Recommendations for Preoperative Biomarkers for Risk Stratification

2a	B-NR	1. In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it is reasonable to measure B-type natriuretic peptide (BNP) or N-terminal pro-B-type natriuretic peptide (NT-proBNP) before surgery to supplement evaluation of perioperative risk. ¹⁻³
2b	B-NR	2. In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it may be reasonable to measure cardiac troponin (cTn) before surgery to supplement evaluation of perioperative risk. ⁴⁻⁶

Recommendations for 12-Lead Electrocardiogram

COR	LOE	RECOMMENDATIONS
2a	B-NR	1. For patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, other significant structural heart disease, or symptoms* of CVD undergoing elevated-risk surgery, a preoperative resting 12-lead electrocardiogram (ECG) is reasonable to establish a preoperative baseline and guide perioperative management. ^{1,2}
2a	B-NR	2. In patients undergoing NCS with a preoperative ECG exhibiting new abnormalities,† further evaluation is reasonable to refine assessment of cardiovascular risk. ³⁻⁸
2b	B-NR	3. For asymptomatic patients undergoing elevated-risk surgeries without known CVD, a preoperative resting 12-lead ECG may be considered to establish a baseline and guide perioperative management. ^{3,9,10}
3: No benefit	B-NR	4. For asymptomatic patients undergoing low-risk surgical procedures, a routine preoperative resting 12-lead ECG is not recommended to improve outcomes. ¹¹

*Active symptoms and signs of CVD include chest pain, dyspnea, undiagnosed palpitations, tachycardia, syncope, or murmurs. †Abnormalities may include ST-segment elevation, ST depression, T-wave inversions, left ventricular (LV) hypertrophy, significant pathologic Q-waves, Mobitz type II or higher atrioventricular block, bundle branch block, QT prolongation, or AF.

Recommendations for Assessment of Left Ventricular Function

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients undergoing NCS with new dyspnea, physical examination findings of HF, or suspected new/worsening ventricular dysfunction, it is recommended to perform preoperative evaluation of LV function to help guide perioperative management. ¹⁻⁸
2a	C-LD	2. In patients with a known diagnosis of HF with worsening dyspnea or other change in clinical status undergoing NCS, preoperative assessment of LV function is reasonable to help guide perioperative management. ^{1,4,7,9-11}
3: No benefit	B-NR	3. In asymptomatic and clinically stable patients undergoing NCS, routine preoperative evaluation of LV function is not recommended due to lack of benefit. ¹²⁻¹⁵

Recommendations for Stress Testing

COR	LOE	RECOMMENDATIONS
2b	B-NR	1. For patients undergoing elevated-risk NCS with poor or unknown functional capacity and elevated risk for perioperative cardiovascular events based on a validated risk tool, stress testing may be considered to evaluate for inducible myocardial ischemia. ¹
3: No benefit	B-R	2. In patients who are at low risk for perioperative cardiovascular events, have adequate* functional capacity with stable symptoms, or who are undergoing low-risk procedures, routine stress testing before NCS is not recommended due to lack of benefit. ¹⁻³

*Poor functional capacity is considered <4 METs or a DASI score of ≤34.

Considerations and Contraindications for Specific Stress Testing Modalities

Modality	Contraindication*
Vasodilator pharmacological stress imaging	Significant arrhythmias (eg, VT, second- or third-degree atrioventricular block), significant hypotension (SBP <90 mm Hg), known or suspected bronchoconstrictive or bronchospastic disease or use of dipyridamole or methylxanthines (eg, aminophylline, caffeine) within 12 h
Exercise stress testing (with or without imaging)	Inability to exercise
Dobutamine stress echocardiography	Critical aortic stenosis, hemodynamically significant LVOT obstruction

*In general, the following contraindications apply to all stress testing modalities: ACS, decompensated HF, severe/symptomatic aortic stenosis, uncontrolled arrhythmia, systemic arterial hypertension (eg, $\geq 200/110$ mm Hg), acute aortic dissections, pericarditis/myocarditis, pulmonary embolism, and severe PH.³⁰

ACS indicates acute coronary syndrome; HF, heart failure; LVOT, left ventricular outflow tract; PH, pulmonary hypertension; SBP, systolic blood pressure; and VT, ventricular tachycardia.

Recommendations for Coronary Computed Tomography Angiography

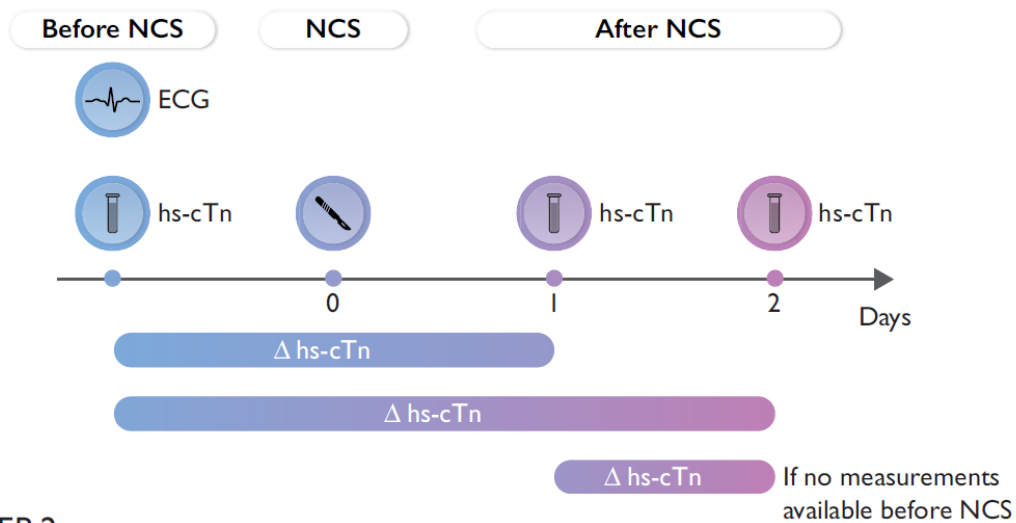
COR	LOE	RECOMMENDATIONS
2b	B-NR	1. For patients undergoing elevated-risk surgery with poor* or unknown functional capacity, and elevated risk for perioperative cardiovascular events based on a validated risk tool, coronary computed tomography angiography (CCTA) for the detection of high-risk coronary anatomy† may be considered. ¹⁻⁴
3: No benefit	B-NR	2. In patients who are at low risk for perioperative cardiovascular events, have adequate* functional capacity with stable symptoms, or who are undergoing low-risk procedures, routine CCTA before NCS is not recommended due to lack of benefit. ^{1,5}

*Poor functional capacity is considered <4 METs or a DASl score of ≤ 34 . †High-risk coronary anatomy is defined as patients with obstructive stenosis who have $\geq 50\%$ left main stenosis or anatomically significant 3-vessel disease ($\geq 70\%$ stenosis).⁶

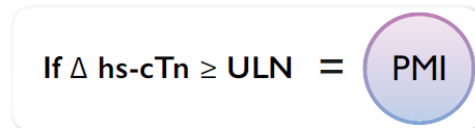
Recommendation for Invasive Coronary Angiography

COR	LOE	RECOMMENDATION
3: No benefit	C-LD	1. In patients undergoing NCS, routine preoperative invasive coronary angiography (ICA) is not recommended to improve perioperative outcomes. ^{1,2}

STEP 1



STEP 2



STEP 3

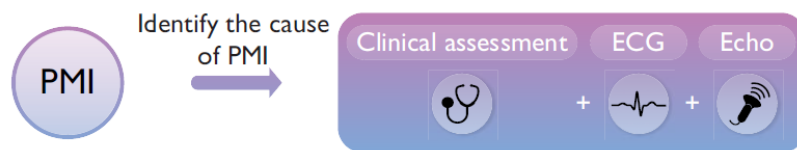


Figure 3. ESC 2022 GL on Noncardiac Surgery. Recommended measurements to assess and detect the risk of post-operative cardiac complications.

An absolute increase in hs-cTn concentration of more than the ULN on days 1 or 2 after surgery compared to the pre-operative level is defined as PMI. In the absence of a pre-operative hs-cTn T/I concentration, a very high hs-cTn T/I concentration on day 1 (e.g. more than five-times the ULN) or a relevant change from day 1 to day 2 (absolute increase or decrease more than the ULN vs. day 1) would also achieve a reliable diagnosis of PMI. Detection of PMI should trigger ECG recording and detailed clinical evaluation for PMI work-up and therapy. The ESC 0/1/2 h algorithm has not been validated for the peri-operative setting and cannot be used here.

ECG, electrocardiogram; hs-cTn, highsensitivity cardiac troponin; PMI, peri-operative myocardial infarction/injury; ULN, upper limit of normal. In patients scheduled to undergo intermediate- or high-risk surgery, pre-operative risk assessment is complemented by ECG, hs-cTn, and BNP/NT proBNP.

Table 7. ESC 2022 GL on Noncardiac Surgery.

Recommendations for pharmacological treatment

Initiation		
In patients with an indication for statins, it should be considered to initiate statins peri-operatively.	IIa	C
Pre-operative initiation of beta-blockers in advance ^c of high-risk NCS may be considered in patients who have two or more clinical risk factors, ^d in order to reduce the incidence of peri-operative myocardial infarction. ^{188,190–192}	IIb	A
Pre-operative initiation of beta-blocker in advance of NCS may be considered in patients who have known CAD or myocardial ischaemia. ^{e,230–232}	IIb	B
Routine initiation of beta-blocker peri-operatively is not recommended. ^{185,187,189,233,234}	III	A
Continuation		
Peri-operative continuation of beta-blockers is recommended in patients currently receiving this medication. ^{190,196–199}	I	B
In patients already on statins, it is recommended to continue statins during the peri-operative period. ²³⁵	I	B
In patients with stable HF, peri-operative continuation of RAAS inhibitors may be considered.	IIb	C
Interruption		
In patients without HF, withholding RAAS inhibitors on the day of NCS should be considered to prevent peri-operative hypotension. ^{215,216}	IIa	B
For patients on diuretics to treat hypertension, transient discontinuation of diuretics on the day of NCS should be considered. ²³⁶	IIa	B
It should be considered to interrupt SGLT-2 inhibitor therapy for at least 3 days before intermediate- and high-risk NCS.	IIa	C

b.p.m., beats per minute; CAD, coronary artery disease; HF, heart failure; NCS, non-cardiac surgery; RAAS, renin–angiotensin–aldosterone system; RCRI, Revised Cardiac Risk Index; SGLT-2, sodium-glucose co-transporter 2.

^c Ideally at least 1 week before surgery, starting with a low dose with dose titration for target heart rate. The target is a resting heart rate 60–70 b.p.m. with a systolic blood pressure <100 mmHg.

^d Ischaemic heart disease, cerebrovascular disease, renal insufficiency, or diabetes mellitus, according to the RCRI score.

^e Treatment should ideally be initiated between 30 and (at least) 2 days before surgery, starting at a low dose, and should be continued post-operatively

Table 8. AHA/ACC 2024 GL on Noncardiac Surgery. Perioperative Medical Therapy

Recommendations for Statins

1	B-NR	1. In patients currently on statins and scheduled for NCS, continuation of statin therapy is recommended to reduce the risk of MACE. ¹⁻³
1	B-R	2. In statin-naïve adult patients who meet criteria for statin use based on ASCVD history or 10-year risk assessment and are scheduled for NCS, perioperative initiation of statin is recommended with intention of long-term use. ^{4,5}

Recommendations for Perioperative Renin-Angiotensin-Aldosterone System Inhibitors

2b	B-R	1. In select* patients on chronic renin-angiotensin-aldosterone system inhibitors (RAASi) for hypertension undergoing elevated-risk NCS, omission 24 hours before surgery may be beneficial to limit intraoperative hypotension. ¹⁻⁶
2a	C-EO	2. In patients on chronic RAASi for HFrEF, perioperative continuation is reasonable. ^{†1,2}

*Patients with controlled BP and undergoing elevated-risk surgical procedures. †Modified from the "2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure."⁷

Recommendation for Perioperative Alpha-2 Receptor Agonists Management

3: No benefit	B-R	1. In patients undergoing NCS, initiation of low-dose clonidine perioperatively is not recommended to reduce cardiovascular risk. ¹
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Recommendations for Perioperative Beta Blockers

1	B-NR	1. In patients on stable doses of beta blockers undergoing NCS, beta blockers should be continued through the perioperative period as appropriate based on the clinical circumstances. ^{1,2}
2b	B-NR	2. In patients scheduled for elective NCS who have a new indication for beta blockade, beta blockers may be initiated far enough before surgery (optimally >7 days) to permit assessments of tolerability and drug titration if needed. ³
3: Harm	B-R	3. In patients undergoing NCS and with no immediate need for beta blockers, beta blockers should not be initiated on the day of surgery due to increased risk for postoperative mortality. ⁴

Recommendations for Perioperative Management of Blood Glucose

2a	B-NR	1. In patients with or at risk for diabetes who are scheduled for elective NCS, preoperative hemoglobin A1c (HbA1C) testing is reasonable if it has not been performed in ≤3 months. ¹⁻⁴
1	C-LD	2. In patients scheduled for NCS, SGLT2i should be discontinued 3 to 4 days* days before surgery to reduce the risk of perioperative metabolic acidosis. ⁵⁻⁷
2a	C-LD	3. In patients with diabetes or impaired glucose tolerance, continuation of metformin during the perioperative period is reasonable to maintain glycemic control. ⁸⁻¹²

*Canagliflozin, dapagliflozin, and empagliflozin should be stopped ≥3 days and ertugliflozin ≥4 days before scheduled surgery.¹³

Table 9. Thromboprophylaxis

AHA/ACC 2024 GL on Noncardiac Surgery. Thromboembolic Risk for Common Oral Anticoagulant Indications

Risk Category	Venous Thromboembolism	Atrial Fibrillation	Mechanical Valve	Other Anticoagulation Indications
Low	VTE >12 mo	CHA ₂ DS ₂ -VASC 1-4 (without prior history of stroke)	Bileaflet mechanical AVR without major risk factors for stroke*	
Moderate	VTE ≤3-12 mo Recurrent VTE	CHA ₂ DS ₂ -VASC 5-6	Bileaflet mechanical AVR with major risk factors for stroke* Mitral valve without major risk factors for stroke*	Nonsevere coagulopathy (heterozygous factor V Leiden or prothrombin gene G20210A mutation) Active cancer
High	Recent VTE (<1 mo or <3 mo)	CHA ₂ DS ₂ -VASC ≥7 (or 5-6 with recent stroke or TIA) AF with rheumatic valvular heart disease	Mechanical mitral valve Caged ball or tilting-disk valve Mechanical heart valve in any position with recent stroke or TIA (<3 mo)	Recent cardioembolic stroke (<3 mo)† Active cancer associated with high VTE risk LV thrombus (within past 3 mo) Severe thrombophilia‡ Antiphospholipid antibodies

Adapted from Douketis et al.¹⁵ Copyright 2022 Elsevier, with permission from Elsevier.

*Major risk factors for stroke include AF, multiple prior strokes/TIAs (≥3 months), prior perioperative stroke, or prior valve thrombosis.

†Deficiency of protein C, protein S, or antithrombin; homozygous factor V Leiden or prothrombin gene G20210A mutation or double heterozygous for each mutation, multiple thrombophilias.

‡AF indicated atrial fibrillation; AVR, aortic valve replacement; CHA₂DS₂-VASC, congestive heart failure, hypertension, age ≥75 (doubled), diabetes mellitus, prior stroke or transient ischemic attack or thromboembolism (doubled), vascular disease, age 65 to 74 years, sex category; LV, left ventricular; OAC, oral anticoagulant; TIA, transient ischemic attack; and VTE, venous thromboembolism.

ESC 2022 GL on Noncardiac Surgery. Recommendations for thromboprophylaxis

It is recommended that decisions about peri-operative thromboprophylaxis in NCS are based on individual and procedure-specific risk factors. ^{328,332}	I	A
If thromboprophylaxis is deemed necessary, it is recommended to choose the type and duration of thromboprophylaxis (LMWH, NOAC, or fondaparinux) according to type of NCS, duration of immobilization, and patient-related factors. ^{328,332}	I	A
In patients with a low bleeding risk, peri-operative thromboprophylaxis should be considered for a duration of up to 14 or 35 days, for total knee or hip arthroplasty, respectively. ^{334–337}	IIa	A
NOACs in thromboprophylaxis dose may be considered as alternative treatments to LMWH after total knee and hip arthroplasty. ³³³	IIb	A

LMWH, low molecular weight heparin; NCS, non-cardiac surgery; NOAC, non-vitamin K oral anticoagulant.

Table 10. Cardiovascular Complications**ESC 2022 Guidelines on Non-cardiac Surgery. Recommendations for peri-operative cardiovascular complications**

It is recommended to have high awareness of peri-operative CV complications, combined with surveillance for PMI in patients undergoing intermediate- or high-risk NCS. ^{41,101,109–111,118,413,636–639}	I	B
Systematic PMI work-up is recommended to identify the underlying pathophysiology and define therapy. ^{41,101,109–111,118,413,636–639}	I	B
It is recommended to treat post-operative STEMI, NSTEMI-ACS, acute HF, and tachyarrhythmias in accordance with guidelines for the non-surgical setting, after interdisciplinary discussion with the surgeon about bleeding risk. ^{98,99,171,651,652}	I	C
In patients with post-operative PE of high or intermediate clinical probability, initiation of anticoagulation is recommended without delay, while diagnostic work-up is in progress, if bleeding risk is low. ^{650,652}	I	C
Post-operative oral anticoagulation for PE is recommended to be administered for a period of at least 3 months. ^{99,650}	I	C
In patients with a post-operative indication for OAC, NOAC is generally recommended over VKA. ⁹⁹	I	A
In patients with post-operative AF after NCS, long-term OAC therapy should be considered in all patients at risk of stroke, considering the anticipated net clinical benefit of OAC therapy, and informed patient preferences. ^{99,682,683,685,686}	IIa	B
In patients with MINS and at low risk of bleeding, treatment with dabigatran 110 mg orally <i>b.i.d.</i> may be considered from ~1 week after NCS. ⁶⁵⁰	IIb	B
Routine use of beta-blocker for the prevention of post-operative AF in patients undergoing NCS is not recommended. ^{185,201}	III	B

AF, atrial fibrillation; *b.i.d.*, twice a day; CV, cardiovascular; HF, heart failure; MI, myocardial infarction; MINS, myocardial injury following non-cardiac surgery; NCS, non-cardiac surgery; NOAC, non-vitamin K antagonist oral anticoagulant; NSTEMI-ACS, non-ST-elevation acute coronary syndrome; OAC, oral anticoagulant; PE, pulmonary embolism; PMI, peri-operative myocardial infarction/injury; STEMI, ST-segment elevation myocardial infarction; VKA, vitamin K antagonist.

AHA/ACC 2024 GL on Noncardiac Surgery.

Recommendations for Myocardial Injury After Noncardiac Surgery Surveillance and Management

MINS Surveillance

2b	B-NR	1. In patients with known CVD, symptoms of CVD, or age ≥ 65 years with cardiovascular risk factors undergoing elevated-risk NCS, it may be reasonable to measure cTn at 24 and 48 hours after surgery to identify myocardial injury. ¹⁻⁴
3: No benefit	B-NR	2. In patients undergoing low-risk NCS, routine postoperative screening with cTn levels is not indicated without signs or symptoms suggestive of myocardial ischemia or MI. ^{5,6}

MINS Management

2a	B-NR	3. In patients who develop MINS, especially in those not previously known to have excess cardiovascular risk, outpatient follow-up is reasonable for optimization of cardiovascular risk factors. ^{4,7-10}
2b	C-LD	4. In patients who develop MINS, antithrombotic therapy may be considered to reduce thromboembolic events. ^{4,11}

Recommendations for Management of Postoperative STEMI/NSTEMI

1	B-NR	1. Patients who develop STEMI after NCS should be considered for GDMT, including consideration of ICA, balancing bleeding and thrombotic risks with the severity of the clinical presentation. ¹⁻³
1	C-EO	2. Patients who develop NSTEMI after NCS should receive medical therapy as recommended for patients with spontaneous MI but after consideration of postoperative bleeding risks and hemodynamic status.
2a	C-LD	3. Patients who develop NSTEMI after NCS can be considered for ICA, balancing bleeding and thrombotic risks with the severity of clinical presentation. ^{2,3}

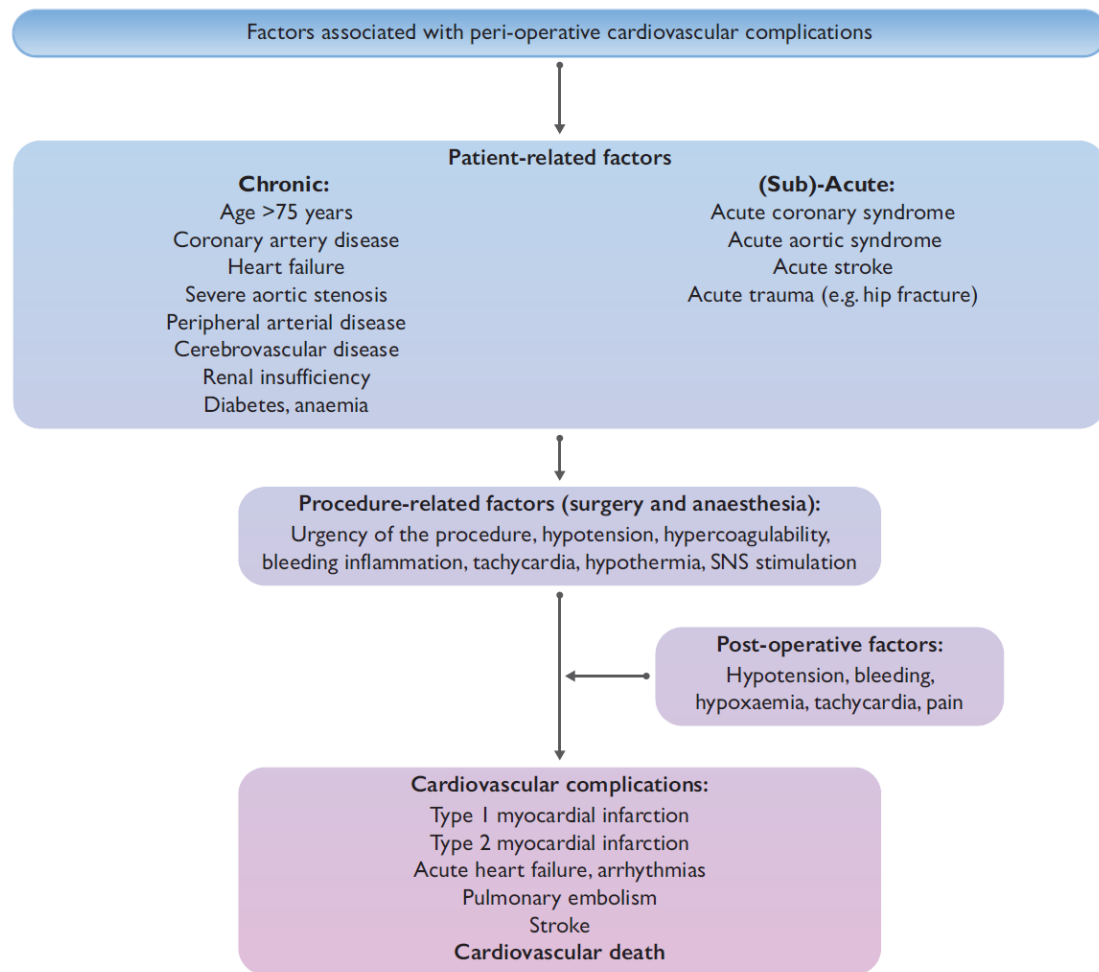


Figure 4. ESC 2022 GL on Noncardiac Surgery. Factors associated with peri-operative cardiovascular complications. SNS, sympathetic nervous system.

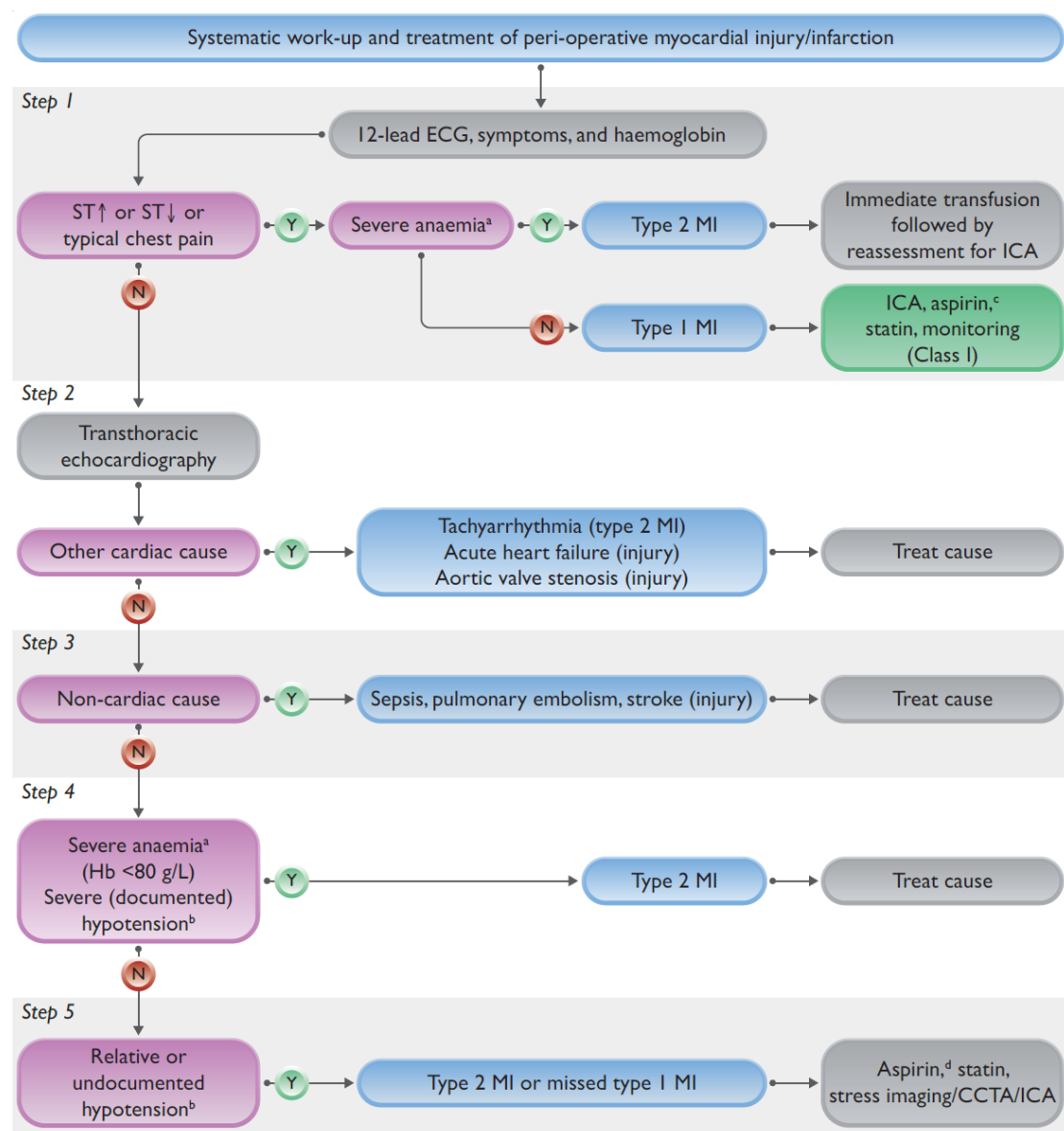


Figure 5. ESC 2022 GL on Noncardiac surgery. Systematic work-up (aetiology) and therapy of peri-operative myocardial infarction/injury.

CCTA, coronary computed tomography angiography; ECG, electrocardiogram; Hb, haemoglobin; ICA, invasive coronary angiography; MI, myocardial infarction; N, no; ST, ST-segment. Y, yes;

Most patients with type-2 MI and silent type-1 MI should be scheduled for stress imaging or CCTA/ICA as outpatients after discharge, depending on symptoms prior to or after surgery and known CAD.

a Or active bleeding.

b Or other type-2 MI trigger such as hypoxaemia, tachycardia, hypertension.

c Dual antiplatelet therapy after coronary stenting.

d Possibly in combination with dabigatran 110 mg b.i.d.

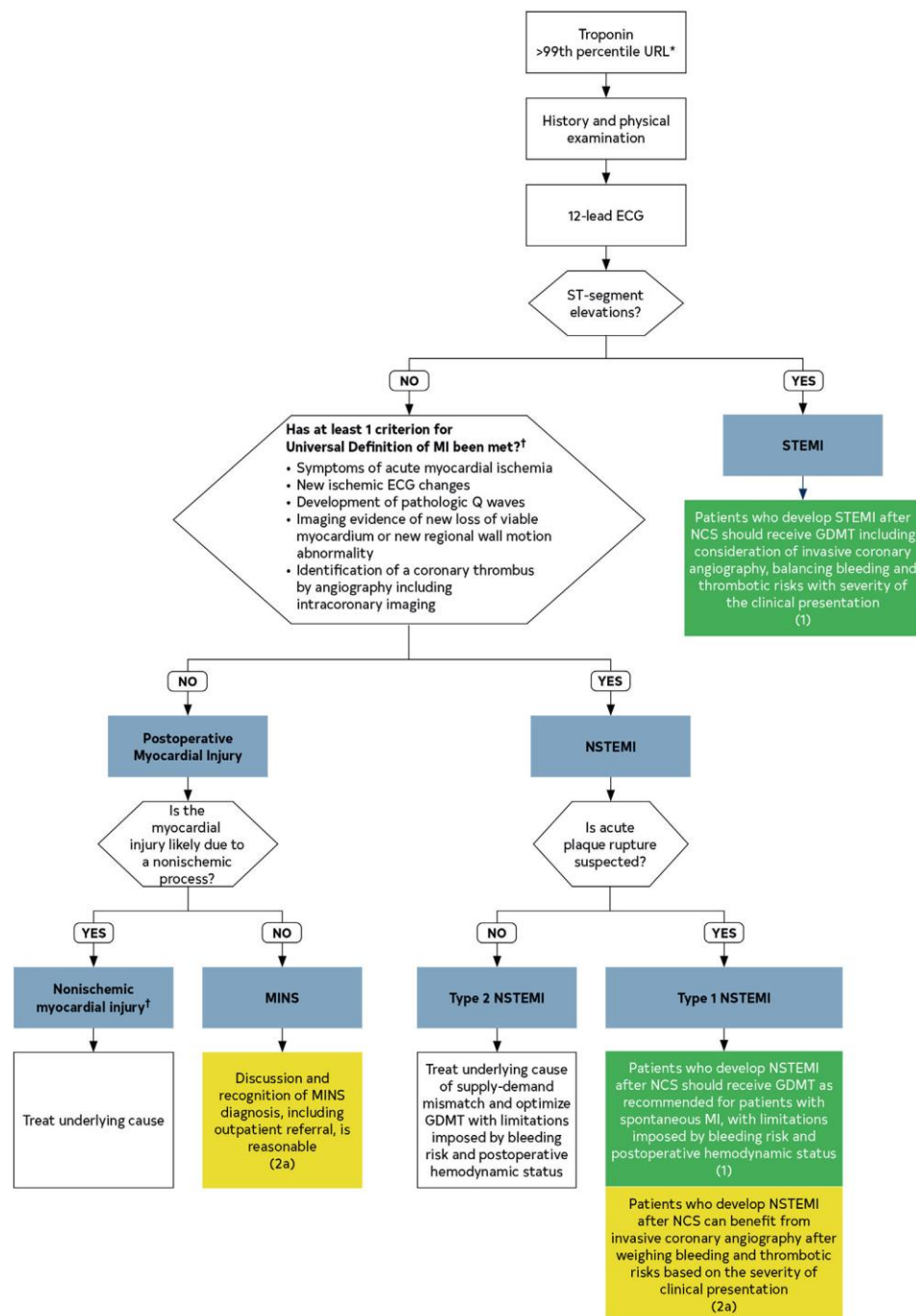


Figure 6. AHA/ACC 2024 GL on Noncardiac Surgery. Evaluation of an Abnormal Troponin Obtained for Postoperative Surveillance

*Presumes a rise and fall of troponin consistent with acute myocardial injury. Troponin may be measured using a conventional fourth-generation or a high-sensitivity assay.

‡Nonischemic myocardial injury encompasses pulmonary embolism, sepsis, acute decompensated heart failure, or acute stroke.

ECG indicates electrocardiogram/electrocardiographic; GDMT, guideline-directed management and therapy; MI, myocardial infarction; MINS, myocardial injury after noncardiac surgery; NCS, noncardiac surgery; NSTEMI, non-ST-segment-elevation myocardial infarction; STEMI, ST-segment-elevation myocardial infarction; and URL, upper reference limit.

Table 11. Anaemia**ESC 2022 Guidelines on Non-cardiac Surgery.****Laboratory parameters for the diagnosis of absolute iron-deficiency anaemia**

Parameter	Normal	Iron deficiency
Mean corpuscular haemoglobin (g/dL)	28–33	<27
Mean cellular volume (fL)	80–96	<80
Transferrin saturation (%)	16–45	<20
Ferritin (ng/mL)	18–360	<30 ^a
Reticulocytes haemoglobin (ng/mL)	18–360	<30

a In cases of chronic kidney disease, chronic heart failure or infections, iron deficiency is diagnosed with ferritin level ,100 ng/mL or transferrin saturation <20%.

Recommendations for intra- and post-operative complications associated with anaemia

It is recommended to measure haemoglobin pre-operatively in patients scheduled for intermediate- to high-risk NCS. ^{350,354}	I	B
It is recommended to treat anaemia in advance of NCS, in order to reduce the need for RBC transfusion during NCS. ^{357,361}	I	A
The use of an algorithm to diagnose and treat anaemic patients before NCS should be considered.	IIa	C

NCS, non-cardiac surgery; RBC, red blood cell.

Recommendations for intra- and post-operative complications associated with blood loss

In patients undergoing surgery with expected blood loss of ≥ 500 mL, use of washed cell salvage is recommended. ^{377,378}	I	A
It is recommended to use point-of-care diagnostics for guidance of blood component therapy, when available. ^{370,379–383}	I	A
In patients undergoing NCS and experiencing major bleeding, administration of tranexamic acid should be immediately considered. ^{375,376,384–386}	IIa	A
Use of closed-loop arterial blood sampling systems should be considered to avoid blood loss. ^{366,378,387,388}	IIa	B
Application of meticulous haemostasis should be considered a routine procedure. ^{350,389}	IIa	B

Recommendations for intra- and post-operative complications associated with allogeneic blood transfusion

A feedback/monitoring programme or clinical decision support system should be considered to be assessed before blood transfusion. ^{392–396}	IIa	B
Before allogeneic blood transfusion, it should be considered to obtain an extensive consent about risks associated with transfusion.	IIa	C

AHA/ACC 2024 GL on Noncardiac Surgery. Recommendations for Perioperative Anemia Management

2a	A	1. In patients having NCS with expected blood loss, tranexamic acid is reasonable to reduce intraoperative blood loss, reduce transfusions, and avoid anemia. ^{1–3}
2a	B-R	2. In patients with iron deficiency anemia having elective NCS, iron therapy (either oral or intravenous) administered preoperatively is reasonable to reduce blood transfusions and to increase hemoglobin. ^{4–18}

Table 12. Intra-operative Management

ESC 2022 GL on Noncardiac Surgery.

Recommendations for peri-operative monitoring and anaesthesia

In order to preserve optimal CV stability, it is recommended to apply goal-directed haemodynamic therapy in patients undergoing high-risk NCS. ^{614–618}	I	A
It is recommended to avoid post-operative acute pain. ⁶¹⁴	I	B
In order to minimize the risk of post-operative organ dysfunction, it is recommended to avoid an intra-operative mean arterial pressure decrease of >20% from baseline values or <60–70 mmHg for ≥10 min. ^{214,600–602,634}	I	B
Non-aspirin NSAIDs are not recommended as first-line analgesics in patients with established or high risk of CVD. ^{633,635}	III	B

CV, cardiovascular; CVD, cardiovascular disease; NCS, non-cardiac surgery; NSAID, non-steroidal anti-inflammatory drug.

AHA/ACC 2024 GL on Noncardiac Surgery.

ANESTHETIC CONSIDERATIONS AND INTRAOPERATIVE MANAGEMENT

Recommendations for Choice of Anesthetic Technique and Agent

2a	A	1. In patients undergoing NCS, use of a volatile-based anesthetic agent or total intravenous anesthesia is reasonable for general anesthesia with no apparent difference in associated cardiovascular events (eg, MI, ischemia). ¹⁻³
2a	B-R	2. In patients undergoing NCS where neuraxial is feasible, either neuraxial or general anesthesia is reasonable with no apparent difference in associated cardiovascular events. ⁴⁻⁶

Recommendations for Perioperative Pain Management

2a	B-R	1. For patients undergoing major abdominal surgery, the use of epidural analgesia for postoperative pain relief is reasonable to decrease the incidence of perioperative cardiac events. ^{1,2}
2b	B-R	2. For patients with a hip fracture waiting for surgical repair, epidural analgesia may be considered to decrease the incidence of preoperative cardiac events. ³

Recommendations for Echocardiography

2a	C-LD	1. In patients with unexplained hemodynamic instability undergoing NCS, the emergency use of perioperative TEE or FoCUS is reasonable to determine the cause if expertise is readily available. ¹⁻⁴
3: No benefit	C-LD	2. In patients undergoing NCS without risk factors or procedural risks for significant hemodynamic compromise, the routine use of intraoperative TEE is not recommended to screen for cardiac abnormalities or to monitor for myocardial ischemia. ⁵⁻⁸

Recommendation for Body Temperature

2a	B-R	1. In patients with CVD undergoing NCS, maintenance of normothermia is reasonable to avoid perioperative complications overall. ¹⁻⁵
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Recommendation for Temporary Mechanical Circulatory Support

2b	C-LD	1. In patients with acute, severe hemodynamic instability and cardiopulmonary dysfunction undergoing urgent or emergency NCS, temporary MCS devices may be used preemptively or as rescue therapy. ¹⁻⁵
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Recommendations for Pulmonary Artery Catheters

2b	C-LD	1. In patients with CVD undergoing NCS, the use of PA catheterization may be considered when underlying medical conditions that significantly affect hemodynamics (eg, decompensated HF, severe valvular disease, combined shock states, PH) cannot be corrected before surgery. ^{1,2}
3: No benefit	A	2. In patients with CVD undergoing NCS, routine use of PA catheterization is not recommended to reduce morbidity or mortality. ³

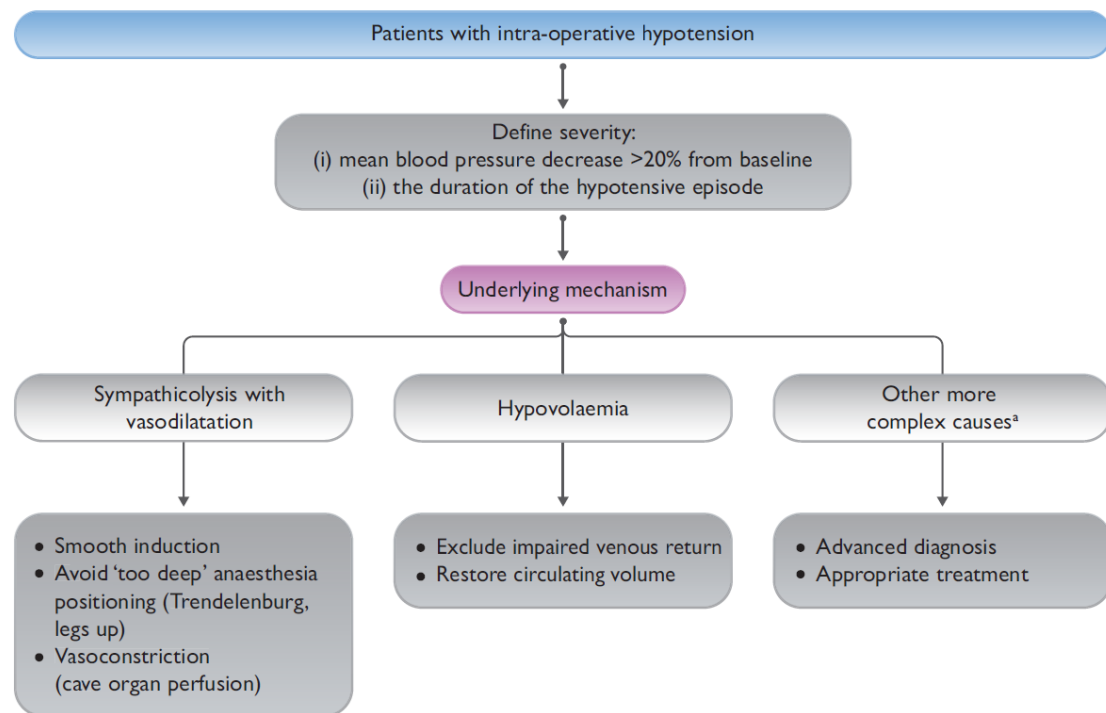


Figure 7. ESC 2022 GL on Noncardiac Surgery. Pathophysiological approach to address intra-operative hypotension.

A E.g. peri-operative myocardial failure.