

REVIEW

Revised ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management. Implications for preoperative clinical evaluation

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ABSTRACT

Each year, an increasing number of elderly patients with cardiovascular disease undergoing non-cardiac surgery require careful perioperative management to minimize the perioperative risk. Perioperative cardiovascular complications are the strongest predictors of morbidity and mortality after major non-cardiac surgery. A Joint Task Force of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA) has recently published revised Guidelines on the perioperative cardiovascular management of patients scheduled to undergo non-cardiac surgery, which represent the official position of the ESC and ESA on various aspects of perioperative cardiac care. According to the Guidelines effective perioperative cardiac management includes preoperative risk stratification based on preoperative assessment of functional capacity, type of surgery, cardiac risk factors, and cardiovascular function. The ESC/ESA Guidelines discourage indiscriminate routine preoperative cardiac testing, because it is time- and cost-consuming, resource-limiting, and does not improve perioperative outcome. They rather emphasize the importance of individualized preoperative cardiac evaluation and the cooperation between anesthesiologists and cardiologists. We summarize the relevant changes of the 2014 Guidelines as compared to the previous ones, with particular emphasis on preoperative cardiac testing. (*Minerva Anesthesiol* 2015;81:226-33)

Key words: Cardiovascular surgical procedures - Cardiology - Elderly.

A Joint Task Force of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA) has recently published revised Guidelines on the perioperative cardiovascular management of patients scheduled to undergo non-cardiac surgery.¹ These Guidelines represent the official position of the ESC and ESA on various aspects of perioperative cardiac care. New information and considerable controversy regarding the validity of previous recommendations had required a revision of the 2009 Guidelines.²

Each year an increasing number of elderly patients with cardiovascular disease (CVD) undergo non-cardiac surgery. They require careful perioperative management to minimize the perioperative risk. In fact, perioperative cardiovascu-

lar complications are the strongest predictors of morbidity and mortality after major non-cardiac surgery.³ Effective perioperative cardiac management includes preoperative risk stratification based on preoperative assessment of functional capacity, type of surgery, cardiac risk factors, and cardiovascular function. In the following we summarize the relevant changes of the 2014 Guidelines as compared to the previous ones, with particular emphasis on preoperative cardiac testing.

Novel aspects of the 2014 Guidelines

The updated Guidelines are the result of close co-operation between ESC and ESA. The input of both cardiologists and anaesthesiologists and

their agreement on the perioperative cardiac management (especially with regard to the preoperative assessment) is likely to improve patient care. The revised Guidelines emphasize the importance of preoperative cardiac risk stratification in reducing postoperative cardiac complications. Preoperative cardiac risk stratification should be tailored to the individual patient.

The ESC/ESA Joint Task Force recommends that preoperative cardiac testing be performed independent of type (open *vs.* less-invasive surgery) and urgency of the operation (emergent *vs.* urgent surgery), and only in patients who likely benefit from it. For example, in patients scheduled for low-risk surgery, and even in those scheduled for high-risk surgery a routine preoperative resting echocardiogram is no longer recommended.

Preoperative risk assessment

The previous as well as the revised Guidelines recommend to use clinical risk indices for preoperative cardiac risk stratification (Class I recommendation, level of evidence B) (for definitions of classes of recommendation and levels of evidence see Table I). The revised Guidelines recommend to use, in addition to the traditional Lee cardiac risk index,³ the American College of

Surgeons National Surgical Quality Improvement Program (NSQIP) Myocardial Infarction Cardiac Arrest (MICA) model built on the 2007 data set of the NSQIP database (Class I recommendation, level of evidence B).⁴ Independent predictors of perioperative myocardial infarction or cardiac arrest were found to be type of surgery, functional status, creatinine concentration, American Society of Anesthesiologists' physical status classification, and age. The prognostic information provided by the two models is complementary. However, the predictive ability of the NSQIP MICA model was superior to that of the Revised Lee Cardiac Risk Index, and the risk can easily be calculated at the bedside (<http://www.surgicalriskcalculator.com/miorcardiacarrest>)⁴ (Table II).

Assessment of preoperative functional capacity on the basis of metabolic equivalent tasks (METs) or exercise testing is still considered mandatory in preoperative cardiac risk stratification before non-cardiac surgery.

What's new in preoperative evaluation

The new Guidelines emphasize the importance of selective, individualized preoperative screening of patients scheduled for non-cardiac surgery. Not every patient with CVD requires

TABLE I.—*Classes of recommendation and levels of evidence applied in the 2014 Guidelines.*

Class of recommendation	Definition
Class I	Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective
Class II	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure
Class II a	Weight of evidence/opinion is in favour of usefulness/efficacy
Class II b	Usefulness/efficacy is less well established by evidence/opinion
Class III	Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful
Level of evidence	Definition
Level A	Data derived from multicenter randomized clinical trials or meta-analyses
Level B	Data derived from a single randomized clinical trial or large non-randomized studies
Level C	Consensus of opinion of the experts and/or small studies, retrospective studies, registries

TABLE II.—*Clinical risk factors based on the revalidated cardiac risk index.*

Ischemic heart disease (angina pectoris, myocardial infarction)
Heart failure
Stroke or transient ischemic attack (TIA)
Renal dysfunction (serum creatinine concentration >170 µmol/L or 2 mg/dL, or a creatinine clearance <60 mL/min/1.73 m ²)
Diabetes mellitus requiring insulin therapy

Type of surgery	Functional capacity	Number of clinical risk factors	Resting ECG	Resting echocardiography	Imaging stress testing	BNP, TnT
Low-risk (< 1%)		none	NO	NO	NO	NO
		≥ 1	may be considered	NO	NO	NO
Intermediate (1-5%) or high-risk (> 5%)	Excellent or good		may be considered if age > 65	consider only in high risk	consider only in high risk	consider only in high risk
Intermediate risk (< 1%)	poor	none	may be considered	NO	may be considered	NO
		≥ 1	YES	NO	may be considered	
High-risk (> 5%)	poor	1-2	YES	may be considered	may be considered	may be considered
		≥ 3	YES	may be considered	YES	may be considered

BNP, brain natriuretic peptide; TnT, cardiac troponin T.

Figure 1.—Recommended preoperative testing before elective, non-cardiac surgery in clinically stable patients according to 2014 ESC/ESA Guidelines.

Low-risk: < 1%	Intermediate-risk: 1-5%	High-risk: > 5%
Superficial surgery Breast Dental Endocrine: thyroid Eye Reconstructive Carotid asymptomatic (CEA or CAS) Gynaecology: minor Orthopaedic: minor (meniscectomy) Urological: minor (transurethral resection of the prostate)	Intra-abdominal: splenectomy, hiatal hernia repair, cholecystectomy 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 thromboembolism • Duodeno-pancreatic surgery • Liver resection, biliary duct surgery • Oesophagectomy • Repair of perforated bowel • Adrenalectomy • Total cystectomy • Pneumonectomy • Pulmonary or liver transplant

Figure 2.—Cardiovascular risk and surgery.

detailed preoperative cardiac evaluation (Figure 1). Usually, patients with stable CVD undergoing low- or intermediate-risk surgery do not require additional preoperative cardiac assessment (Figure 2). On the other hand, patients with known or high risk of cardiac disease scheduled for high-risk non-cardiac surgery should un-

dergo cardiac assessment by a multidisciplinary expert team.

Preoperative ECG

Preoperative resting ECG should be performed only in patients with risk factors (Ta-

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TABLE III.—*Recommendations for preoperative resting ECG.*

Patient population	2009 ESC Guidelines	2014 ESC/ESA Guidelines
Patients with risk factor(s) ^a scheduled for intermediate- or high-risk surgery ^b	Recommended (I,B) ^c	Recommended (I,C)
Patients with risk factor(s) scheduled for low-risk surgery	Should be considered (IIa,B)	May be considered (IIb,C)
Patients without risk factors scheduled for intermediate-risk surgery	May be considered (IIb,B)	May be considered (IIb,C)
Patients without risk factors scheduled for low-risk surgery	Not recommended (III,B)	Not recommended (III,B)

^a Risk factors as listed in Table II. ^bTypes of surgery as listed in Figure 2. ^cClass of recommendation (Latin number) and level of evidence (second letter) as listed in Table I.

TABLE IV.—*Recommendations for preoperative resting echocardiography.*

Patient population	2009 ESC Guidelines	2014 ESC/ESA Guidelines
Asymptomatic patients	Not recommended (III,B) ^a	Not recommended (III) ^b
Patients scheduled for high-risk surgery ^c	Should be considered (IIa,C)	May be considered (IIb,C)
Patients scheduled for intermediate or low-risk surgery	–	Not recommended (III,C)
Patients with severe valvular heart disease	Recommended (I,C)	–
Patients with known or suspected valvular heart disease scheduled for intermediate or high-risk surgery	–	Recommended (I,C)

^aClass of recommendation, level of evidence as listed in Table I. ^bLevel of evidence not listed. ^cTypes of surgery as listed in Figure 2.

bles II, III) who are to undergo intermediate- or high-risk surgery. It may be considered in patients without risk factors but older than 65 years scheduled for intermediate- or high-risk surgery. Preoperative resting ECG is not recommended in asymptomatic patients without risk factors undergoing low-risk surgery.

Preoperative echocardiography

Routine preoperative resting echocardiography is only recommended in patients with known or suspected valvular heart disease scheduled for intermediate- or high-risk surgery. It may be considered (rather than recommended as by the previous Guidelines) in patients enrolled for high-risk surgery (Table IV).

Imaging stress testing

In general, the new Guidelines recommend preoperative cardiac stress testing only if the results are likely to modify the perioperative management. It is recommended only in patients with poor functional capacity and more than 2 clinical risk factors before high-risk surgery. It may be considered in patients with 1 or 2 clinical risk factors and poor functional capacity be-

fore intermediate- or high-risk surgery. Imaging stress testing is generally not recommended before low-risk surgery.

Serum biomarkers

Routine preoperative determination of serum biomarkers (brain natriuretic peptide [BNP], NT-proBNP, cardiac troponins) for risk stratification is not recommended in patients undergoing non-cardiac surgery (Class III, level C). It may be considered in high-risk patients. In such patients, determination of cardiac troponins at 48-72 hours after major surgery may be considered.

Coronary angiography

Although many patients undergoing non-cardiac surgery suffer from coronary artery disease, preoperative coronary angiography is rarely indicated. Considering the procedure-associated risk and lack of convincing evidence that preoperative coronary revascularization reliably improves perioperative outcome, the indications for preoperative coronary angiography are restrictive and identical to those in the non-surgical setting.

What's new in preoperative pharmacological management

Beta-blockers

The revised 2014 Guidelines continue to recommend continuation of beta-blocker therapy in the perioperative period in patients currently receiving this medication. However, with regard to preoperative initiation of beta-blocker therapy the current ESC/ESA Guidelines have down-graded their recommendations. Preoperative start of beta-blockers *may* (rather than *should*) be considered in patients: 1) scheduled for high-risk surgery; 2) with ≥ 2 clinical risk factors or ASA physical status ≥ 3 ; and 3) with known ischemic heart disease (IHD) or myocardial ischemia. If the decision for preoperative initiation of oral beta-blocker therapy is made, atenolol or bisoprolol may be considered first choice. Neither the initiation of beta-blockers in patients undergoing low-risk surgery nor the initiation of high-dose beta-blocker therapy without titration is recommended.

Angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin-receptor blockers (ARBs)

The revised Guidelines take into account the proven benefit of ACEI or ARB therapy in medical patients with stable heart failure and left ventricular (LV) dysfunction, the lack of convincing evidence for a benefit of ACEI or ARB therapy on perioperative outcome, and the increased risk of severe hypotension during anesthesia associated with such therapy. In addition, they differentiate between the indication for ACEI or ARB therapy (*i.e.*, hypertension vs. LV dysfunction and heart failure). In patients with stable heart failure and LV dysfunction, continuation of ACEIs or ARBs under close monitoring, and initiation of such therapy at least 1 week before surgery should be

considered. On the other hand, transient discontinuation of ACEIs or ARBs should be considered in patients with arterial hypertension.

Statins

Identical to the 2009 Guidelines, the revised 2014 Guidelines recommend perioperative continuation of chronic statin therapy with preference of statins with a long half-life or extended-release formulation (Class I, level of evidence C). Initiation of statin therapy should be considered (rather than being recommended as by the 2009 Guidelines) before vascular surgery, ideally at least 2 weeks before surgery (Class IIa, level of evidence B).

Anti-platelet agents

ASPIRIN

In general, the decision for or against low-dose aspirin in patients undergoing non-cardiac surgery must be based on individual weighing of the perioperative risk of bleeding against that of thrombotic complications. Continuation of chronic aspirin therapy for secondary cardiovascular prevention may be considered. Its discontinuation should be considered when difficult intraoperative hemostasis is anticipated. Following percutaneous coronary intervention (PCI), aspirin should be continued for 4 weeks after bare-metal stent (BMS) implantation and for 3-12 months after drug-eluting stent (DES) implantation, unless the risk of life-threatening surgical bleeding is considered unacceptably high.

DUAL ANTI-PLATELET THERAPY (DAPT)

The recommendations regarding the perioperative management of DAPT in patients after

TABLE V.—Recommendations for timing of surgery after previous percutaneous coronary intervention (PCI).

Type of PCI	2009 ESC Guidelines	2014 ESC/ESA Guidelines
BMS	6 weeks to 3 months (I,B) ^a	4 weeks to 3 months (I,B)
DES	≥ 12 months (I,B)	≥ 12 months (IIa,B)
New generation DES	—	≥ 6 months (IIa,B)
Balloon angioplasty	≥ 2 weeks (IIa,B)	≥ 2 weeks (IIa,B)

PCI, percutaneous coronary intervention; BMS, bare-metal stent; DES, drug-eluting stent. ^aClass of recommendation, level of evidence as listed in Table 1.

previous PCI, and the timing between PCI and subsequent elective non-cardiac surgery have been revised (Table V). Following BMS and DES implantation, continuation of P2Y₁₂-receptor antagonists for 4 weeks and 3-12 months, respectively, should be considered. The respective recommended time intervals between PCI and subsequent elective non-cardiac surgery are listed in Table V. Whenever possible, aspirin therapy should be continued.

ANTICOAGULANT THERAPY

Before deciding for or against the perioperative administration of oral anticoagulants, the risk of life-threatening perioperative bleeding must be weighed against the potential thromboembolic risk. Discontinuation of therapy is recommended a few days before surgery in patients at low risk of thrombosis. Patients on oral vitamin K antagonists (VKAs) can undergo non-cardiac surgery when the international normalized ratio (INR) is <1.5. Risk factors of thromboembolic events include:

- atrial fibrillation (AF) associated with heart failure, hypertension, age ≥75 years, diabetes, stroke, vascular disease;
- advanced age, female sex;
- mechanical prosthetic heart valves, recently inserted biological prosthetic heart valve;
- mitral valvular repair within past 3 months;
- recent venous thrombo-embolism within past 3 months;
- thrombophilia.

Patients with such risk factors require preoperative bridging therapy with unfractionated heparin (HFU) or low molecular weight heparin (LMWH). The last dose of LMWH should be administered no later than 12 hours before surgery. Depending on the type of VKA, it is recommended to stop therapy 3 - 5 days before surgery.

For patients receiving non-vitamin K antagonist direct oral anticoagulants (NOACs) it is recommended to discontinue NOACs for 2-3 times their respective half-lives before surgery with average risk of bleeding, and for 4-5 times their biological half-lives before surgery with high risk of bleeding. Due to their well-defined “on” and

“off” action, preoperative bridging therapy with UFH or LMWH is usually not required.

What's new in preoperative myocardial angiography and revascularization

Preoperative coronary revascularization

There is no evidence that prophylactic preoperative coronary revascularization improves perioperative outcome in asymptomatic patients or in those with stable coronary artery disease (CAD). In general, the recommendations for perioperative coronary revascularization are identical to those in the medical setting and follow the ESC guidelines for the management of stable CAD. Accordingly, routine prophylactic preoperative coronary revascularization is not recommended in patients with documented CAD scheduled for low- or intermediate-risk surgery. Prophylactic preoperative coronary revascularization may be considered in the presence of a significant stress-induced myocardial perfusion defect.

Clinically stable patients who have undergone surgical myocardial revascularization within the past 6 years do not require additional preoperative cardiac stress testing. This is recommended in patients at high cardiac risk scheduled for surgery within the first year after surgical myocardial revascularization.

Coronary revascularization in patients with non-ST-elevation acute coronary syndrome (NSTEMI-ACS)

In general, patients should perioperatively be treated according to the ESC Guidelines on NSTEMI-ACS. Should the need for emergent surgery and coronary revascularization arise, a team of expert should discuss the management case by case.

Novel insight in specific diseases

Valvular heart diseases

The recommendations of the revised Guidelines with regard to valvular heart disease have remained

unchanged. Antibiotic prophylaxis in patients at high risk of endocarditis remains recommended in accordance with the respective ESC Guidelines.

Arrhythmias

In general, the revised Guidelines reiterate the recommendations of the 2009 Guidelines on the perioperative management of arrhythmias. They are essentially based on American College of Cardiology/American Heart Association/ESC Guidelines for the management of the respective arrhythmia.

Supraventricular arrhythmias and atrial fibrillation (AF)

Ventricular rate control is essential in the management of perioperative atrial fibrillation (AF). Drugs of choice are beta-blockers and calcium channel blockers. The administration of beta-blockers is associated with an increased rate of conversion of AF to sinus rhythm in patients undergoing non-cardiac surgery. In patients with heart failure, amiodarone represents an effective alternative.

Ventricular arrhythmias

Every ventricular tachycardia (VT) needs to be promptly treated with electric cardioversion (hemodynamically unstable VT) or defibrillation (pulseless VT), independent of the underlying etiology. Anti-arrhythmic drugs are recommended in patients with sustained VT (class I recommendation, level of evidence C). Continuation of anti-arrhythmic therapy before non-cardiac surgery is recommended. By contrast, anti-arrhythmic drugs are not recommended in patients with ventricular premature beats.

Bradyarrhythmias

In general, the indications for temporary perioperative temporary pacing are the same as those for permanent pacing. Temporary perioperative pacing in non-cardiac surgery is recommended in patients with complete heart-block and in those with symptomatic asystolic episodes. Tem-

porary perioperative pacing is *not* recommended in asymptomatic patients with bifascicular block, independent of the presence of first-degree atrioventricular block.

Patients with pacemaker/implantable cardioverter defibrillator

Patients with permanent pacemakers require increased perioperative attention because of the possible interference between device and electrocautery. Special precautions should be taken to reduce the risk of the interferences. In patients who are pacemaker-dependent, the device should be set in an asynchronous or non-sensing mode by placing a magnet on the skin over the pacemaker. In patients with an implantable cardioverter defibrillator (ICD) the device should be deactivated before surgery and adequately reactivated after the operation. During the period of deactivation the patient's ECG needs to be continuously monitored and the capability for prompt external cardioversion available. The revised Guidelines recommend that the hospital assigns an individual who is responsible for the coordination of the perioperative management of patients with cardiac rhythm management devices.

Cerebrovascular disease

The revised Guidelines recommend preoperative neurological examination and carotid artery and cerebral imaging in patients with a history of neurological symptoms suggestive of transient ischemic attack (TIA) or stroke during the previous 6 months. Based on the 2011 ESC Guidelines for the management of peripheral artery disease, the revised Guidelines recommend delaying non-cardiac surgery after carotid revascularization in symptomatic patients. Preoperative routine carotid artery imaging may be considered in patients undergoing vascular surgery. Perioperative continuation of anti-platelet and statin therapy should be considered in patients with carotid artery disease.

Renal disease

The revised Guidelines recommend that preoperative risk stratification for acute kidney

