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Review

PERIOPERATIVE PREPARATION OF CARDIAC PATIENTS IN REGIONAL ANESTHESIA

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ABSTRACT – Preoperative cardiovascular management is an essential component of overall perioperative cardiovascular care. It involves preoperative detection and management of cardiovascular disease and prediction of both short-term and long-term cardiovascular risk. It affects anesthetic perioperative management and surgical decision making. This requires individualized management. Careful preoperative preparation at least a week before surgery, rational decisions regarding necessary tests and examinations, good cooperation with the cardiologist and surgeon and careful planning of early postoperative treatment are key for better outcome after surgery and reduction of postoperative complications.

Keywords: *perioperative medicine, non-cardiac surgery, ischemic heart disease*

Introduction

Traditionally, the care of patients undergoing major surgery has been tailored to the operation index and disease treated by this procedure. There is evidence that the postoperative complications relate primarily to the interaction between the inflammatory response to the tissue injury of surgery and a patient's physiological reserve, modulated by the type and the quality of surgery.[1] Response to surgery becomes the primary *disease process* and the consequent organ dysfunction the condition on which care should be focused.[2]

The aim of perioperative medicine is to deliver the best possible pre-, intra- and post-operative care to meet the needs of patients undergoing major surgery.[3] Around 250 million major surgical procedures are performed worldwide each year.[1] Cardiovascular complications account for majority of causes of postoperative morbidity and mortality with incidence ranging from 0.5 to 30%[4]. The incidence of perioperative cardiac death has an estimation of 0.5–1.5% and major cardiovascular complications (non-fatal cardiac arrest, non-fatal myocardial infarction, heart failure, clinically relevant arrhythmias and stroke) an estimation of 2–3.5%. The risk is even higher in patients with underlining cardiovascular diseases and with patients older than 70 years of age undergoing major vascular surgery.[5]

The optimal preoperative optimization of patient's condition, carefully planned surgical procedure, anesthetic perioperative management and postoperative rehabilitation are crucial for optimal outcome of surgical treatment.

The immediate aims of preoperative cardiac management are:

1. Identification of patients with potentially life-threatening cardiac disease that requires

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preoperative assessment and treatment by cardiologist.
2. Identification of the most appropriate testing and avoidance of unnecessary testing.
3. Identification and implementation of the most appropriate medical and interventional cardiovascular treatment strategies.[6]

Depending on the type of surgery and patients' characteristics, surgery could be performed under general or regional anesthesia. Nevertheless, regardless of what kind of anesthesia is going to be performed, the preoperative assessment stays the same. Special attention needs to be paid to the medication the patient is taking on regular basis. In numerous studies, regional anesthesia has been shown to decrease the perioperative neuroendocrine stress response and, therefore, reduce the number of thrombotic complications.[7]

Preoperative assessment

Depending on how much time before surgery there is for clinical evaluation, we decide on further changes in perioperative management. The 2014 ACC/AHA Perioperative Guidelines propose a stepwise approach to perioperative cardiac assessment.[8]

Stepwise approach

1. Assessment of surgical urgency.
2. Assessment of the presence or absence of acute coronary event or unstable cardiac condition.
3. Classification of surgical procedures according to the risk of complications from the cardiovascular system.
4. Assessment of patient's functional capacity.
5. Determination of clinical risk factors for postoperative cardiac complications.

The preoperative assessment begins with determination of surgical urgency, followed by an assessment of the presence or absence of a preoperative acute coronary event and concludes with perioperative risk calculation for major adverse cardiac events (MACE).

If the patient is at low risk for MACE, then no further testing is needed and the patient may proceed to surgery without further evaluation.

Different tools and calculators are available to predict perioperative cardiac mortality. Every surgery has a different risk of morbidity and mortality, with the highest being the risk of vascular and emergency surgeries. The Lee Revised Cardiac Risk Index (RCRI) is a simple tool that has been validated to assess the perioperative risk of major cardiac events. The presence of kidney and heart failure, insulin dependent diabetes, ischemic heart disease (IHD), history of transient ischemic attack or cerebrovascular accident and type of surgery are included in RCRI. Intrathoracic, intra-abdominal or suprainguinal vascular surgeries represent the highest risk. The ACS National Surgical Quality Improvement Program (NSQIP) surgical risk calculator uses procedural codes to predict procedure-specific risk with a large number of outcomes. It takes into account whether the procedure is emergent or not together with 21 patient-specific variables. Then, it calculates the risk of MACE along with eight other outcomes.[9] If the patient is at high risk for MACE, then the functional capacity of the patient is determined objectively. The patients' functional capacity is easy to assess by their daily activities. Low exercise tolerance is associated with poor perioperative outcome. The main purpose of perioperative assessment of functional capacity is to predict the individual's ability to increase oxygen delivery in the perioperative period.

Duke Activity Status Index (DASI) and Specific Activity Scale are used to determine patients' functional status. They represent a structural questionnaire that grades exercise ability on the basis of a series of questions related to exercise equivalences ranging from the ability to wash and dress without breathlessness to strenuous activity such as swimming and playing tennis.[10]

Functional status is easier to determine by asking simple questions about their activity and translate the answer into MET. One MET is defined as resting or basal oxygen consumption of a 40-year-old, 70 kg man. Watching TV represents MET 1, stair climbing at slow pace represents MET 4 and jogging or swimming MET 7. Based on MET, functional capacity is classified as poor (<3 METs), moderate (4-6 METs), good (7-10 METs) or excellent (>10 METs). Patients having functional capacity of less than 4 METs are at increased risk of perioperative complications. Patients who have good or excellent functional capacity of greater than 4 METs do not need further testing and should proceed with the surgery. Also, patients scheduled for low-risk procedure do not require any testing at all. Special considerations should be made for patients who have either poor functional capacity or in patients in whom functional capacity is unknown. If further testing would lead to a perioperative change in management and will have an impact on decision

making regarding patient care, pharmacologic stress testing is recommended prior to non-cardiac surgery. Depending on the result of the stress test, patients proceed to coronary revascularization and then proceed for the surgery on optimal therapy.[11]

Surgical risk

Based on expected combined incidence of cardiac death and non-fatal myocardial infarction within 30 days of surgery, surgical procedures can be separated into low, intermediate and high risk with estimated 30-day cardiac event rates of 1%, 1%–5% and >5% (Table 1).

Table 1 Cardiac risk stratification

Low risk < 1%	Intermediate risk 1–5%	High risk > 5%
Breast	Intraperitoneal	Aortic- open
Dental	Intrathoracic	Peripheral
Endocrine	Vascular[3]	vascular[2]
Eye	Head and neck	Duodenum
Gynecology[1]	surgery	Pancreas
Reconstructive	Neurosurgical	Liver
Orthopedic[1]	Orthopedic[2]	resection
Urologic[1]	Lung, kidney, liver	
TEA or KAS	transplantation	
a. carotis	Urologic[2]	

[1]Minor surgery, [2]major surgery, [3]peripheral arterial angioplasty/ carotid, endovascular aneurysm

Patients undergoing vascular surgery carry the highest risk of suffering a perioperative cardiac event. Risk stratification provides a useful tool to identify the need for preoperative cardiac evaluation, drug treatment and assessment of cardiac events risk. Abdominal aortic aneurysm repair or major lower extremity arterial revascularization are classified as high risk procedures. Endovascular procedures, carotid endarterectomy and peripheral angioplasty are classified as intermediate-risk procedures.

Invasive and non-invasive testing before non-cardiac surgery

Resting ECG, echocardiography, myocardial imaging technique and cardiac stress tests have very low (0–33%) positive predictive values for perioperative cardiac events.[12]

A 12-lead ECG gives important prognostic information in patients with IHD related to short-term and long-term morbidity and mortality. It also provides baseline for postoperative comparison in case any change in the clinical status of the patient occurs. Preoperative resting echocardiography is recommended for the evaluation of left ventricular function for patients with severe valvular heart disease and patients undergoing high-risk surgery. Stress tests will primarily detect flow-limiting lesions but not non-flow limiting plaques. However, the latter often consist of vulnerable plaques and are frequently the source of perioperative myocardial infarction.[13]

In patients with poor functional capacity scheduled for elevated risk non-cardiac surgery, it is reasonable to use either dobutamine stress echocardiogram or pharmacologic stress myocardial perfusion imaging, only in cases when it changes further management. Routine screening is not recommended in patients scheduled for low risk non-cardiac surgery. The indications for preoperative coronary angiography are identical to those in non-operative setting. Before performing a preoperative coronary angiography, it should be clear that the patient is a potential candidate for subsequent preoperative coronary revascularization.[6] The recommendation for preoperative coronary angiography is an acute ST-elevation myocardial infarction (STEMI), non-STEMI and unstable angina, and angina unresponsive to medical treatment. The measurement of laboratory markers of myocardial injury (troponin) is recommended in high risk patient if such measurements of injury will lead to an intervention. Evaluation of markers of cardiac injury is recommended in patients at high risk for MACE who may benefit from such an intervention. That routine measurement is not recommended without patient selection.[14]

Preoperative coronary revascularization and antiplatelet therapy

There is no evidence that support the usage of either coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) to decrease intraoperative or postoperative cardiac events as a part of perioperative management for non-cardiac surgery. The indication for CABG and PCI is the same as for nonsurgical patients, that is, patients with acute coronary syndrome. For patients scheduled for time-sen-

sitive non-cardiac surgery, balloon angioplasty or bare-mental stent (BMS) placement is preferred for management.[15] Patients on dual anti-platelet therapy (DAPT) for whom a non-cardiac surgery is planned, the urgency of the surgery and the risk of bleeding along with the risk of ischemic events and stent thrombosis should be considered. Elective non-cardiac surgery, for which DAPT has to be discontinued prior to surgery, should not be performed within 30 days after BMS implantation or within three months after DES. Non-cardiac surgeries should be delayed for 14 days after balloon angioplasty. The highest risk of stent thrombosis is in the first four to six weeks after stent implantation. In case DAPT has to be discontinued for urgent or emergent surgery, such a decision should be individualized, weighting risks and benefits.[11]

Discontinuation of aspirin may be responsible for 15% of all recurrent acute coronary syndromes in patients with documented stable coronary artery disease. Aspirin taken for secondary cardiac prevention should, in general, not be discontinued. Aspirin should be discontinued preoperatively if the expected risk of bleeding and its possible sequelae are similar or even higher than the known cardiovascular risk or acute discontinuation of aspirin.

Perioperative medical therapy

Variety of medication is usually prescribed to patients with cardiac disease. These medications could interfere with our perioperative management. Anesthesiologists should be aware of the medications patients take on regular basis.

β-blockers

The 2014 ACC/AHA Guideline provides recommendation for perioperative β-blockade based on multiple research articles.[16] Patients who are on β-blocker should continue being on them if they are well tolerated. Changes can be made before, during or after surgery, depending on the clinical condition. Modification or even discontinuation may be necessary in patients with hypotension, bradycardia or hemodynamic instability due to bleeding. Initiation of β-blocker therapy in less than one day prior to surgery has minimal effect and can even be harmful. Abrupt withdrawal of β-blocker therapy in perioperative period has shown to be harmful.[17]

The dose of β-blocker should be titrated to the heart rate should be 60–80 beats/min with arterial blood pressure > 100mmHg.

Statin

In addition to their lipid-lowering effect, statins have the pleiotropic effects, which by various mechanism improve endothelial morphology and function and stabilize coronary plaques.[18] A few non-randomized studies, reviews, meta-analyses and a randomized controlled trails have documented perioperative cardioprotection by statins.[6]

There is also evidence that preoperative discontinuation of chronic statin therapy is associated with adverse perioperative outcomes. Perioperative statin therapy for non-cardiac surgery should be continued in patients who were already taking them. If patients who are going for vascular surgery are not on statin therapy, they should start it. If statin therapy is discontinued for whatever reason, it should be restarted as soon as possible.

Calcium channel blockers and α-2 agonist

There are limited data on the efficacy of calcium channel blockers in perioperative therapy for patients undergoing non-cardiac surgery. Most of the shown benefits are attributed to diltiazem. Verapamil and diltiazem can worsen and even precipitate heart failure in patients with decreased left ventricle ejection fraction. If patients are on calcium channel blockers, they should not be discontinued, but their dose should be lowered in case of hypotension. α-2 agonist clonidine does not reduce perioperative cardiac events but rather increases the rate of nonfatal cardiac arrest and clinically significant hypotension.[11]

Angiotensin II inhibitors

Angiotensin converting enzyme (ACE) inhibitor and angiotensin II receptor blockers (ARBs) exert beneficial effects on cardiovascular and other organ functions.[19] If patients are on ACE inhibitor or ARRBs for treatment of left ventricle dysfunction, the medication should not be discontinued, but if they are used to treat hypertension, transient discontinuation should be considered.

Postoperative care

Postoperative complications occur within the first 48 hours after non-cardiac surgery, and it is important that patients are under tight control during that time. Although the postoperative pain management is one of the most important aspects of postoperative management, as pain is one of the factors that can contribute to myocardial infarction, analgetic could even camouflage the chest pain due to myocardial ischemia. It is recommended to use regional techniques for postoperative pain management like epidural analgesia, as it was proven that in patients undergoing abdominal surgery they reduce the incidence of perioperative myocardial infarction.[20] It is also recommended to obtain a 12-lead ECG in patients with symptoms and signs of myocardial ischemia or infarction, or arrhythmia. Measurement of troponin is also recommended in these settings. Postoperative screening with troponin levels or ECG in asymptomatic patients at high perioperative risk of myocardial infarction have no benefits.[21]

Regional anesthesia for cardiac patients

The potential and well-known advantage of regional anesthesia over general anesthesia should be an asset in cardiac patients if surgery can be performed under regional block. Disadvantages of regional anesthesia include hypotension from uncontrolled sympathetic blockade and the need for volume loading that can result in ischemia.[22] The second concern is related to anticoagulation and antiplatelet therapy which is very common in cardiac patients. Regional anesthesia can be performed safely in patients receiving anticoagulant or antiplatelet therapy provided that the patient management is based on appropriate timing of needle placement and catheter removal, relative to the timing of administered anticoagulant drug. Various studies are now available that support the use of regional anesthesia in patients with coronary risk. There are even beneficial effects of thoracic epidural anesthesia in patients with compromised cardiac function.[23] Epidural analgesia is desirable especially in the postoperative period in patients with IHD because tachycardia and hypertension due to pain increase oxygen consumption in the heart muscle and can cause heart ischemia.

Conclusion

Cardiac patients for non-cardiac surgeries still pose a challenge to anesthesiologists. Careful preoperative preparation at least a week before surgery, rational decisions for necessary tests and examinations, good cooperation with the cardiologist and surgeon and careful planning of early postoperative treatment are key to a good outcome after surgery and reduced postoperative complications.

References

1. Pearse RM, Holt PJ, Grocott MP. Managing perioperative risk in patients undergoing elective non-cardiac surgery. BMJ. 2011 Oct 5;343:d5759. doi: 10.1136/bmj.d5759. PMID: 21976704.
2. Grocott MP, Pearse RM. Perioperative medicine: the future of anaesthesia? Br J Anaesth. 2012 May;108(5):723-6. doi: 10.1093/bja/aes124. PMID: 22499744.
3. Kehlet H, Mythen M. Why is the surgical high-risk patient still at risk? Br J Anaesth. 2011 Mar;106(3):289-91. doi: 10.1093/bja/aeq408. PMID: 21317226.
4. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet. 2008 Jul 12;372(9633):139-144. doi: 10.1016/S0140-6736(08)60878-8. Epub 2008 Jun 24. PMID: 18582931.
5. Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery; European Society of Cardiology (ESC), Poldermans D, Bax JJ, Boersma E, De Hert S, Eeckhout E, Fowkes G, et al. Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. Eur Heart J. 2009 Nov;30(22):2769-812. doi: 10.1093/eurheartj/ehp337. Epub 2009 Aug 27. PMID: 19713421.
6. Priebe HJ. Preoperative cardiac management of the patient for non-cardiac surgery: an individualized and evidence-based approach. Br J Anaesth. 2011 Jul;107(1):83-96. doi: 10.1093/bja/aer121. Epub 2011 May 24. PMID: 21610016.
7. Christopherson R, Beattie C, Frank SM, Norris EJ, Meinert CL, Gottlieb SO, et al. Perioperative morbidity in patients randomized to epidural or general anesthesia for lower extremity vascular surgery. Perioperative Ischemia Randomized Anesthesia Trial Study Group. Anesthesiology. 1993 Sep;79(3):422-34. doi: 10.1097/00000542-199309000-00004. PMID: 8363066.
8. Fleisher LA, Fleischmann KE, Auerbach AD, Barnason SA, Beckman JA, Bozkurt B, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014 Dec 9;130(24):2215-45. doi: 10.1161/CIR.0000000000000105. Epub 2014 Aug 1. PMID: 25085962.
9. Cohen ME, Ko CY, Bilimoria KY, Zhou L, Huffman K, Wang X, et al. Optimizing ACS NSQIP modeling for eval-

uation of surgical quality and risk: patient risk adjustment, procedure mix adjustment, shrinkage adjustment, and surgical focus. J Am Coll Surg. 2013 Aug;217(2):336-46.e1. doi: 10.1016/j.jamcollsurg.2013.02.027. Epub 2013 Apr 28. PMID: 23628227.

10. Hlatky MA, Boineau RE, Higginbotham MB, Lee KL, Mark DB, Califf RM, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). Am J Cardiol. 1989 Sep 15;64(10):651-4. doi: 10.1016/0002-9149(89)90496-7. PMID: 2782256.
11. Rafiq A, Sklyar E, Bella JN. Cardiac Evaluation and Monitoring of Patients Undergoing Noncardiac Surgery. Health Serv Insights. 2017 Feb 20;9:1178632916686074. doi: 10.1177/1178632916686074. PMID: 28469459; PMCID: PMC5398290.
12. Fleisher LA, Beckman JA, Brown KA, Calkins H, Chaikof EL, Fleischmann KE, et al. 2009 ACCF/AHA focused update on perioperative beta blockade incorporated into the ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American college of cardiology foundation/American heart association task force on practice guidelines. Circulation. 2009 Nov 24;120(21):e169-276. doi: 10.1161/CIRCULATIONAHA.109.192690. Epub 2009 Nov 2. PMID: 19884473.
13. Priebe HJ. Perioperative myocardial infarction--aetiology and prevention. Br J Anaesth. 2005 Jul;95(1):3-19. doi: 10.1093/bja/aei063. Epub 2005 Jan 21. PMID: 15665072.
14. Ghadimi K, Thompson A. Update on perioperative care of the cardiac patient for noncardiac surgery. CurrOpinAnaesthesiol. 2015 Jun;28(3):342-8. doi: 10.1097/ACO.0000000000000193. PMID: 25915204.
15. Ward HB, Kelly RF, Thottapurathu L, Moritz TE, Larsen GC, Pierpont G, et al. Coronary artery bypass grafting is superior to percutaneous coronary intervention in prevention of perioperative myocardial infarctions during subsequent vascular surgery. Ann Thorac Surg. 2006 Sep;82(3):795-800; discussion 800-1. doi: 10.1016/j.athoracsur.2006.03.074. PMID: 16928485.
16. Wijeysundera DN, Duncan D, Nkonde-Price C, Virani SS, Washam JB, Fleischmann KE, et al. ACC/AHA Task Force Members. Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014 Dec 9;130(24):2246-64. doi: 10.1161/CIR.0000000000000104. Epub 2014 Aug 1. PMID: 25085964.
17. Hoeks SE, Scholte Op Reimer WJ, van Urk H, Jörning PJ, Boersma E, Simoons ML, et al. Increase of 1-year mortality after perioperative beta-blocker withdrawal in endovascular and vascular surgery patients. Eur J VascEndovasc Surg. 2007 Jan;33(1):13-9. doi: 10.1016/j.ejvs.2006.06.019. Epub 2006 Aug 24. PMID: 16935011.
18. Ray KK, Cannon CP. The potential relevance of the multiple lipid-independent (pleiotropic) effects of statins in the management of acute coronary syndromes. J Am Coll Cardiol. 2005 Oct 18;46(8):1425-33. doi: 10.1016/j.jacc.2005.05.086. PMID: 16226165.
19. Sun YP, Zhu BQ, Browne AE, Pulukurthy S, Chou TM, Sudhir K, et al. Comparative effects of ACE inhibitors and an angiotensin receptor blocker on atherosclerosis and vascular function. J Cardiovasc PharmacolTher. 2001 Apr;6(2):175-81. doi: 10.1177/107424840100600209. PMID: 11509924.
20. Park WY, Thompson JS, Lee KK. Effect of epidural anesthesia and analgesia on perioperative outcome: a randomized, controlled Veterans Affairs cooperative study. Ann Surg. 2001 Oct;234(4):560-9; discussion 569-71. doi: 10.1097/00000658-200110000-00015. PMID: 11573049; PMCID: PMC1422079.
21. Garcia S, Marston N, Sandoval Y, Pierpont G, Adabag S, Brenes J, et al. Prognostic value of 12-lead electrocardiogram and peak troponin I level after vascular surgery. J Vasc Surg. 2013 Jan;57(1):166-72. doi: 10.1016/j.jvs.2012.06.084. Epub 2012 Sep 10. PMID: 22975335.
22. Möllhoff T, Theilmeier G, Van Aken H. Regional anaesthesia in patients at coronary risk for noncardiac and cardiac surgery. CurrOpinAnaesthesiol. 2001 Feb;14(1):17-25. doi: 10.1097/00001503-200102000-00004. PMID: 17016379.
23. Meissner A, Rolf N, Van Aken H. Thoracic epidural anesthesia and the patient with heart disease: benefits, risks, and controversies. AnesthAnalg. 1997 Sep;85(3):517-28. PMID: 9296403.

Sažetak

PERIOPERATIVNA PRIPREMA KARDIJALNIK BOLESNIKA ZA REGIONALNU ANESTEZIJU

M. Šoštarič

Preoperativni kardiovaskularni tretman bitna je komponenta cjelokupne perioperativne kardiovaskularne skrbi. Uključuje preoperativno otkrivanje i upravljanje kardiovaskularnim bolestima te predviđanje kratkoročnog i dugoročnog kardiovaskularnog rizika. Utječe na anestetičko perioperativno upravljanje i donošenje kirurških odluka. To zahtijeva individualizirano upravljanje. Pažljiva predoperativna priprema najmanje tjedan dana prije operacije, racionalno odlučivanje o potrebnim pretragama i pregledima, dobra suradnja s kardiologom i kirurgom te pažljivo planiranje ranog postoperativnog liječenja ključni su za dobar ishod nakon operacije i smanjenje postoperativnih komplikacija.

Ključne riječi: *perioperativna medicina, nesrčana kirurgija, ishemijska bolest srca*