Severe Angina is Significant Risk Factor in Patients Undergoing the Abdominal Nonvascular Surgery

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KARAPANDZIC ET AL.: ***Severe Angina is Significant Risk Factor in Patients Undergoing the Abdominal Nonvascular Surgery.*** **Background:** *Severe angina is significant risk factor in patients undergoing the abdominal nonvascular surgery.* **Aims:** *The aim of our study was to prove that the incidence of expected perioperative cardiac complications was significantly higher in the group of severe than in the group of mild angina.* **Methods:** *Our prospective observational clinical study included the group of 78 consecutive patients with angiographically verified coronary arterial disease who had angina. Coronary patients underwent open abdominal nonvascular surgery during general anesthesia in University Clinical Center. The patients were classified into stratification subgroups, using the "Canadian Cardiovascular Society" grading of the angina. This subgroups were compared in relation to frequency of perioperative cardiac complications. During operation, and in the following 72 postoperative hours, the patients were monitored by continuous ST-T segment recording. Twelve-lead electrocardiography was performed immediately after the surgery, and on postoperative days 1, 2 and 7 as well as one day before discharge. Cardiac biomarkers were evaluated at 6 hours, 24 hours and 96 hours following the surgery. A non-parametrical Pearson's hi-square test using the contingency tables was used to analyze the data from two subgroups with the level of significance set at 95% (p<0.05).* **Results:** *Significant difference of the the incidence of perioperative cardiac death was found between two evaluated stratification subgroups 15.0% (severe angina) vs 0.0% (mild angina)(p<0.01).* **Conclusions:** *We found high statistical significance of the incidence of perioperative cardiac death between the subgroup of severe angina and the subgroup of mild angina in patients having undergone open abdominal nonvascular surgery during general anesthesia. (J HK Coll Cardiol 2009;17:11-18)*

Angina pectoris, complications, coronary artery disease, risk factors, surgery

摘要

背景：嚴重心絞痛是病人接受腹部非血管手術的重要危險因素。**目的**：此項研究的目的在於證實圍手術期中心臟類併發症的發生率在嚴重心絞痛組顯著高於輕微心絞痛組。**方法**：我們前瞻性臨床觀察研究包括了連續的78位由冠心病造成的心絞痛疾患的病人。在大學臨床醫學中心，冠心病病人在全麻下接受腹部非血管類的開腹外科手術。病人依據「加拿大心血管學會」就心絞痛的分級被分爲不同的亞組。比較這些亞組在圍手術期中相關心臟類併發症的發生率。在手術和術後72小時，病人被持續的監護ST-T段的變化。在手術完成後、以及術後第1、2和7天病人還接受12導聯的心電圖檢查。心臟疾患的生物標誌在手術後的6、24和96小時也同樣被檢測。非參數的Pearson's檢驗用於

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檢測兩個亞組之間概率的差別，並將顯著性設爲95%（p<0.05）。**結果**：兩個亞組在圍手術期中的心因性死亡率有著顯著差別，嚴重心絞痛組爲15%，而輕微心絞痛組爲0%（p<0.01）。**結論**：我們發現在全麻下嚴重心絞痛病人接受腹部非血管手術，較輕微心絞痛病人在圍手術期中的心因性死亡率有著顯著差別。

關鍵詞：心絞痛　併發症　冠心病　危險因素　手術

Introduction

Coronary patients experience significantly more major perioperative cardiac complications, compared with noncardiac population in the similar type of operation and anesthesia.[1] More than 50% perioperative deaths are direct result of cardiovascular event.[2] Patients with verified coronary artery disease accounted for about one third of a total number of cases undergoing non cardiac surgery annually, on what basis the majority of studies have analyzed risk evaluation and perioperative cardiac complications in coronary patients.[1-29]

The objective of our prospective observational clinical study was:

To prove that the incidence of perioperative cardiac death is significantly higher in the subgroup of severe angina than in the subgroup of mild angina in patients undergoing the open abdominal nonvascular surgery during general anesthesia.

Methods

Study Protocol

Our prospective observational clinical study included the group of 78 consecutive patients with angiographically verified coronary arterial disease who had symptomatic angina. Coronary patients underwent the open abdominal nonvascular surgery during general anesthesia at the Department of Digestive Surgery, Institute of Digestive System Diseases, University Clinical Center of Serbia, (tertiary-level teaching hospital), Belgrade, Serbia, between July 2002 and December 2003.

Preoperative cardiac evaluation was carried out in the line with American College of Cardiology/ American Heart Association 2002 guidelines.[3,4]

Within preoperative preparation, all patients were subjected to complete physical and cardiological examination, and in relation to their associated diseases, other necessary specialist and subspecialist examinations. Preoperative twelve-lead electrocardiography (Schiller AT-1, Schiller Corp, Austria), heart and chest X-ray (Shimadzu RS-50 A, Shimadzu Corp, Kyoto, Japan), transthoracic echocardiography (Siemens Sequoia 256, Siemens Corp, Mountain View, CA) and complete laboratory tests (Olympus 400, Olympus, Tokyo, Japan) were carried out in all patients.

Criterion to be enrolled in the study was angiographically verified coronary arterial disease. The group of consecutive patients without coronary angiography performed was excluded from the study, because their coronary disease was diagnosed only by medical history, without any former diagnostic tests.

All patients underwent preoperative and pre-hospital coronary angiography, irrelevant of noncardiac surgery along with decision made by cardiosurgical consultation on further management of coronary artery disease (medicamentous therapy or myocardial revascularization-coronary artery bypass grafting).

Angiographically verified mild stenosis (<75% blood vessel stenosis) of coronary arteries with recommendation for medicamentous therapy (beta blocker, aspirin, statin) had 50 (64.1%) patients with angina. Severe stenosis (>75% blood vessel stenosis) of coronary arteries and indication for myocardial revascularization had 27 (34.6%) patients with angina. The patients were classified into stratification subgroups according to "Canadian Cardiovascular Society" classification of angina pectoris, published by Lucien Campeau as a Letter under the title "Grading of Angina Pectoris", in Circulation 1976[5] (see Table 1).

Perioperative Management – Risk Reduction Strategy

Perioperative monitoring and medicamentous

Table 1. Grading of angina of effort by the "Canadian Cardiovascular Society"

Grading	Angina by effort	Number of patients with stable angina
I	"Ordinary physical activity does not cause...angina," such as walking and climbing stairs. Angina with strenuous or rapid or prolonged exertion at work or recreation.	43 55.1%
II	"Slight limitation of ordinary activity". Walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, or in cold, or in wind, or under emotional stress, or only during the few hours after awakening. Walking more than 2 blocks on the level and climbing more than one flight of ordinary stairs at a normal pace and in normal conditions.	15 19.2%
III	"Marked limitation of ordinary physical activity." Walking one to two blocks on the level and climbing one flight of stairs in normal conditions and at normal pace.	10 12.8%
IV	"Inability to carry on any physical activity without discomfort-anginal syndrome may be present at rest"	2 2.6%

therapy were carried out in the line with American College of Cardiology/American Heart Association guidelines published in 2002.[3,4]

Coronary patients were monitored by continuous electrocardiogram during the surgery as well as in the immediate postoperative 72-hour period in the Intensive Care Unit, which recorded blood pressure and frequency values every hour, all kinds of electrocardiographic changes as well as saturation. All patients had twelve-lead electrocardiography immediately after the surgery, and on postoperative days 1, 2 and 7 as well as a day before discharge from hospital. Cardiac biomarkers (CKMB and troponin-T) were evaluated at 6 hours, 24 hours and 96 hours following the surgery according to American College of Cardiology/American Heart Association 2002 recommendations.[3,4] The patients were monitored on daily basis during their stay in hospital and upon discharge till 30th postoperative day. During hospitalization, all patients were observed by cardiologist every day.

Perioperative medicamentous therapy with beta-blockers was applied in 55/78 (70.5%) patients with angina, and 23/78 (29.5%) patients with angina did not receive beta-blocker therapy because the drugs were contraindicated. The following contraindication for beta-blocker therapy were analyzed: chronic/acute – hypotension, bradycardia, AV block II-III, heart failure and bronchospasm.

All 78 patients with angina were indicated for perioperative beta-blocker application according to type and number of risk factors. One group of patients was covered by long-term chronic beta-blocker therapy in preoperative prehospital period, and the second group of patients had no therapy. In therapy group, beta-blocker was discontinued in one subgroup of patients due to sudden development of contraindications to the respective drug, and other patients continued to take it. In non-therapy group without beta-blocker in preoperative prehospital period, beta-blocker was introduced in one subgroup of patients while others were not administered the drug because of already known contraindications to drug.

Aspirin was terminated 3 days preoperatively, and returned in therapy on the 4th postoperative day. Low molecular weight heparin in profilactic doses was applied twice a day in all patients before and after surgery.

Indicated myocardial revascularization in 27/78 (34.6%) patients prior to open abdominal nonvascular surgery, independent of noncardiac surgery, was

performed only in 6/27 (22.2%) patients with angina, and was not performed in 21/27 (77.8%) patient with angina, because of emergency of surgery and/or poor general health status. In patients who are indicated for coronary revascularization, timing of the procedure depends on the urgency of the noncardiac surgical procedure balanced against stability of the underlying coronary artery disease.

Perioperative Cardiac Complications

The following perioperative cardiac complications were evaluated:

1. Cardiac death until 30th postoperative day;
2. Cardiac arrest;
3. Acute myocardial infarction – according to criteria of European Society of Cardiology/American College of Cardiology 2000);[6]
4. Transient myocardial ischemia with or without anginose pains (transient and/or repeating ST ↑ ≥2 mm in leads V1, V2, V3, and ≥1 mm in other leads, ST ↓ ≥1 mm in at least 2 adjacent leads or symmetric inversion T waves ≥1 mm) – documented by continuous ST-T segment monitoring and/or twelve-lead electrocardiography;[7]
5. Newly developed heart failure and pulmonary edema – according to "Framingham Criteria for Heart Failure";
6. Newly developed arrhythmias and conduction disturbances (sinus tachycardia heart rate >100/min, supraventricular tachyarrhythmias, atrial fibrillation with rapid ventricular response, isolated premature ventricular contractions, non sustained ventricular tachycardia, sustained ventricular tachycardia, ventricular fibrillation, atrioventricular block I, II and III° and new bundle branch block left/right)– documented by continuous ST-T segment monitoring and/or twelve-lead electrocardiography;
7. Hypertension (blood pressure >160/100 mmHg, class II JNC VII) – according to criteria of the Joint National Committee.

Statistical Analysis

Two stratification subgroups were compared: mild angina ("Canadian Cardiovascular Society" class I and II) 58/78 (74.3%), and severe angina ("Canadian Cardiovascular Society" class III, IV, and unstable angina) 20/78 (25.6%), in relation to minor, major and fatal perioperative cardiac complications.

A non-parametrical Pearson's hi-square test using the contingency tables was used to analyze the data from 2 subgroups with the level of significance set at 95% ($p<0.05$).

Results

Comparison of severe angina subgroup – 20/78 (25.6%) and mild angina subgroup – 58/78 (74.3%) revealed statistically significant difference in relation to incidence of all types of the expected perioperative cardiac complications.

Table 2 presents the characteristics of selected patients with angina in relation to significance of coronary artery stenosis, number of stenosed blood vessels and myocardial revascularization.

Table 3 illustrates the characteristics of selected coronary patients in relation to type of angina.

Table 4 shows characteristics of selected patients with angina in relation to medicamentous therapy, echocardiographic parameters, nature of digestive tract diseases and type of surgery.

A total number of patients with angina who experienced perioperative cardiac complications was 52/78 (66.7%), while 26/78 (33.3%) had no cardiac complication. A total number of minor, major and fatal perioperative cardiac complications was 113. The most perioperative cardiac complication was hypertension, and the least frequent was myocardial infarction. Perioperative death of cardiac origin was 3/78 (3.8%) (see Table 5).

The main result of our study was high statistically significant difference in relation to incidence of cardiac death until 30th postoperative day ($p<0.01$).

The study also found high statistically significant difference in relation to incidence of:

- a total number of patients with cardiac complications ($p<0.01$);
- number of patients with major cardiac complications ($p<0.01$);

- total cardiac/noncardiac death 30 days after surgery ($p<0.01$);
- acute myocardial infarction ($p<0.01$);
- transient myocardial ischemia ($p<0.01$);
- newly developed heart failure ($p<0.05$);
- newly developed arrhythmia and conduction disturbances ($p<0.01$);
- and number of patients assisted by mechanical ventilation ($p<0.01$).

There was no significant difference of the incidence of perioperative hypertension, but the percentage of complications was higher in the subgroup of severe angina.

Discussion

Our prospective observational clinical study analyzed the perioperative cardiac complications of 78 consecutive patients with angiographically verified coronary arterial disease who had symptomatic angina, and underwent the open abdominal nonvascular surgery during general anesthesia.

The patients were classified into stratification subgroups according to "Canadian Cardiovascular Society" classification of angina pectoris.[5]

Preoperative cardiac preparation, perioperative monitoring and medicamentous therapy was carried out

Table 2. Angiographic characteristics of selected patients with angina pectoris

Clinical characteristics of selected patients with angina pectoris according to coronary angiography	*CCS AP I+II n=58 (74.4%)	*CCS AP III+IV+Unstable AP n=20 (25.6%)	Total number of patients with AP 78 (100%)
Coronary angiography	58 (100%)	20 (100%)	78 (100%)
Mild stenosis	51 (87.9%)	0 (0.0%)	51 (45.9%)
Severe stenosis	7 (12.1%)	20 (100%)	27 (34.6%)
Non-revascularized myocardium	3 (5.2%)	18 (90.0%)	21 (26.9%)
Single-vessel coronary disease	2	9	11
Two-vessel coronary disease	1	5	6
Two-vessel coronary disease with the left main stem stenosis	0	1	1
Three-vessel coronary disease	0	3	3
Revascularized myocardium	0	6	6 (7.7%)

* CCS AP - "Canadian Cardiovascular Society" grading of angina pectoris

Table 3. Characteristics of selected patients according to type of angina pectoris

	Number of patients
Total number of selected patients with angina pectoris	78 (100%)
Angina pectoris after coronary artery revascularization	6 (7.7%)
Angina pectoris without coronary artery revascularization	72 (92.3%)
Postinfarction angina pectoris	51 (65.4%)
Angina pectoris without previous myocardial infarction	27 (34.6%)
Unstable angina pectoris	8 (10.2%)
Stable angina pectoris	70 (89.7%)

Table 4. Other characteristics of selected patients with angina pectoris

Other clinical characteristics of selected patients with angina pectoris	*CCS AP I+II n=58 (74.4%)	*CCS AP III+IV+Unstable AP n=20 (25.6%)	Total number of patients with AP n=78 (100%)
Medicamentous therapy			
Beta-blockers	45 (77.6%)	10 (50.0%)	55 (70.5%)
Nitrates	58 (100%)	20 (100%)	78 (100%)
Aspirin	27 (46.5%)	15 (75.0%)	42 (53.8%)
Echocardiographic parameters			
End-diastolic diameter of the left ventricle >5.7 cm	26 (44.8%)	16 (80.0%)	42 (53.8%)
Left ventricular ejection fraction <35%	6 (10.3%)	7 (35.0%)	13 (16.7%)
Segmental wall motion abnormalities	33 (56.9%)	15 (75.0%)	48 (61.5%)
Nature of digestive illness			
Malignant disease of digestive system	30 (51.7%)	11 (55.0%)	41 (52.6%)
Benign disease of digestive system	28 (48.3%)	9 (45.0%)	37 (47.4%)
Esophageal surgery	8 (13.8%)	1 (5.0%)	9 (11.5%)
Hepatobiliary surgery	20 (34.5%)	10 (50.0%)	30 (38.5%)
Colorectal surgery	22 (37.9%)	6 (30.0%)	28 (35.9%)
Ventral hernia repair	8 (13.8%)	3 (15.0%)	11 (14.1%)
Type of surgery			
Emergency surgery	9 (15.5%)	11 (55.0%)	20 (25.6%)
Elective surgery	49 (84.5%)	9 (45.0%)	58 (74.3%)

* CCS AP - "Canadian Cardiovascular Society" grading of angina pectoris

Table 5. Comparison of patients according to CCS AP in relation to incidence of minor, major and fatal cardiac complications

Perioperative cardiac complications	*CCS AP I+II n=58 (74.3%)	*CCS AP III+IV+Unstable AP n=20 (25.6%)	Total number of patients with AP n=78 (100%)	P-value
Total number of patients with cardiac complications	33 (56.9%)	19 (95.0%)	52 (66.7%)	p<0.01
Number of patients with major cardiac complications	2 (3.4%)	8 (40.0%)	10 (12.8%)	p<0.01
Total cardiac/noncardiac death 30 days after surgery	1 (1.7%)	4 (20.0%)	5 (6.4%)	p<0.01
Cardiac death until 30th postoperative day	**0 (0.0%)**	**3 (15.0%)**	**3 (3.8%)**	**p<0.01**
Acute myocardial infarction ESC/ACC	0 (0.0%)	5 (25.0%)	5 (6.4%)	p<0.01
Transient myocardial ischemia	7 (12.1%)	18 (90.0%)	25 (32.0%)	p<0.01
Newly developed heart failure	2 (3.4%)	4 (20.0%)	6 (7.7%)	p<0.05
Newly developed arrhythmia and conduction disturbances	19 (32.7%)	12 (60.0%)	31 (39.7%)	p<0.01
Hypertension BP>160/100 mmHg	25 (43.1%)	11 (55.0%)	36 (46.1%)	p>0.05
Mechanical ventilation	1 (1.7%)	7 (35.0%)	8 (10.2%)	p<0.01

* CCS AP - "Canadian Cardiovascular Society" grading of angina pectoris

in the line with American College of Cardiology/ American Heart Association 2002 guidelines.[3,4]

Perioperative cardioprotection – risk reduction strategies with beta-blockers was applied in 55/78 (70.5%) patients and myocardial revascularization – coronary artery bypass grafting was performed in 6/78 (7.7%) patients with angina. In other 21 patients who are indicated for coronary revascularization, timing of the procedure depends on the urgency of the noncardiac surgical procedure balanced against stability of the underlying coronary artery disease.

According to American College of Cardiology/ American Heart Association 2002 guidelines, "Canadian Cardiovascular Society" angina pectoris class I and II are intermediate, and "Canadian Cardiovascular Society" angina pectoris class III, IV and unstable angina are major predictors of the increased perioperative morbidity and mortality.[3,4]

Two stratification subgroups were compared: mild angina ("Canadian Cardiovascular Society" angina pectoris class I and II), and severe angina ("Canadian Cardiovascular Society" angina pectoris class III, IV, and unstable angina), in relation to minor, major and fatal perioperative cardiac complications.

Comparing these two subgroups, our study found high statistical significance of frequency of all types of the expected perioperative cardiac complications, in coronary patients having undergone open abdominal nonvascular surgery during general anesthesia.

Risk factors affecting the major cardiac complications were severe angina (class III, IV and unstable angina pectoris), angiographically verified significant stenosis of coronary arteries (>75% blood vessel stenosis) and dependence of preoperative use of nitrates. Five patients had typical chest pain 7 days before surgery. Elevated troponin-T level over 1,0 micro g/l after surgery had 5 patients with severe angina.

Direct causes of cardiac death until 30th postoperative day in all 3 patients were the acute myocardial infarction, newly developed heart failure and malignant arrhythmias. One patient died on day 2, and other two on postoperative day 3. Cardiac cause of all death was confirmed by postmortem examination. All died patients belonged to the subgroup of patients with severe angina and angiographically verified significant stenosis of coronary arteries with indication for coronary revascularization irrelevant of noncardiac surgery. In this group of patients, myocardial revascularization prior to noncardiac surgery was not performed either because of emergency of surgical intervention or because of poor general medical status of patients.

The incidence of major cardiac complications in our study was 3.4% to 40%. The latest literature data have reported the incidence of major postoperative cardiac events (combined incidence of nonfatal myocardial infarction, unstable angina pectoris, congestive heart failure and cardiac death) to be from 5.5% to 53%.[6]

The obtained results of our study met the American College of Cardiology / American Heart Association 2002 criteria.[3]

We concluded that "Canadian Cardiovascular Society" classification of angina pectoris is adequate for assessing the cardiac risk in open abdominal nonvascular surgery during general anesthesia.

Using the "Canadian Cardiovascular Society" angina pectoris classification during the following 30 years, its value has been proved in clinical practice, independent from surgical intervention, and therefore, it is still widely used nowadays. One study compared four scoring systems for assessing the risk in noncardiac surgery, including "Canadian Cardiovascular Society" angina pectoris classification; this study has established that there is no statistical significance between them, and no index is significantly superior over another.[8]

The results of the study cannot be compared with those of previous studies since no study has been published so far using the "Canadian Cardiovascular Society" angina pectoris classification in patients with angiographically verified coronary arterial disease having undergone open abdominal nonvascular surgery during general anesthesia.

Conclusions

In conclusion, the study established the following:

1. High statistical significance of the incidence of perioperative cardiac death between the subgroup of

severe angina and the subgroup of mild angina in patients having undergone open abdominal nonvascular surgery during general anesthesia;
2. Statistically significant difference of the incidence of all expected perioperative minor, major and fatal cardiac complications between the subgroup of severe angina and the subgroup of mild angina;
3. Patients with angiographically verified significant stenosis of coronary arteries belonged to class of severe angina according to "Canadian Cardiovascular Society" angina pectoris classification;
4. "Canadian Cardiovascular Society" classification of angina pectoris is adequate for assessing the cardiac risk in open abdominal nonvascular surgery during general anesthesia.

References

1. Devereaux PJ, Goldman L, Cook DJ, et al. Perioperative cardiac events undergoing noncardaic surgery: a review of the magnitude of the problem, patophysiology of the events and methods to estimate and communicate risk. CMAJ 2005;173: 627-34.
2. Beattie SW. Evidence based perioperative risk reduction. CJA 2005;52:R5
3. Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA Guideline Update on Perioperative Cardiovascular Evaluation for Noncardiac Surgery 2002. A report of the American Colledge of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery). J Am Coll Cardiol 2002;39**:**542-53.
4. Farid I, Litaker D, Tetzlaff JE. Implementing ACC/AHA guidelines for the preopereative management of patients with coronary artery disease scheduled for noncardiac surgery: effect on perioperative outcome. J Clin Anesth 2005;14:126-8.
5. Campeau L. Letter: Grading of angina pectoris. Circulation 1976;54:522-3.
6. Devereaux PJ, Goldman L, Jusuf S, et al. Surveillance and prevention of major perioperative ischemic cardiac events in patients undergoing noncardiac surgery. CMAJ 2005;173: 779-888.
7. Priebe HJ. Triggers of perioperative myocardial ischaemia and infarction. Br J Anaesth 2004;93:9-20.
8. Gilbert K, Larocque BJ, Patrick LT. Prospective evaluation of cardiac risk indices for patients undergoing noncardiac surgery. Ann Intern Med 2000;133:356-9.
9. Davenport DL, Ferraris VA, Hosokawa P, et al. Multivariable predictors of postoperative cardiac adverse events after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg 2007;204:1199-210.
10. Flood C, Fleisher LA. Preparation of the cardiac patient for noncardiac surgery. Am Fam Physician 2007;75:656-65.
11. Mercado DL, Ling DY, Smetana GW. Perioperative cardiac evaluation interventions and clinical challenges. South Med J 2007;100:486-92;quiz 493, 511.
12. Feringa HH, Bax JJ, Poldermans D. Perioperative medical management of ischemic heart disease in patients undergoing noncardiac surgery. Curr Opin Anaesthesiol 2007;20:254-60.
13. Flood C, Fleisher LA. Preparation of the cardiac patient for noncardiac surgery. Am Fam Physician 2007;75:656-65.
14. Auerbach A, Goldman L. Assessing and reducing the cardiac risk of noncardiac surgery. Circulation 2006;113:1361-76.
15. Kertai MD, Klein J, Bax JJ, Poldermans D. Predicting perioperative cardiac risk. Prog Cardiovasc Dis 2005;47:240-57.
16. Yokoyama H. Preoperative evaluation and management of patients with ischemic heart disease undergoing noncardiac surgery (In Japanese with English abstract). Nippon Geka Gakkai Zasshi 2005;106:323-7.
17. Fleisher LA. Preoperative cardiac evaluation. Anesthesiol Clin North America 2004;22:59-75.
18. Mandolini C, Tornini A, Borgia MC. About cardiovascular risk in non-cardiac surgery. Ann Ital Med Int 2004;19;262-8.
19. Carlino G, Coppola G, Indovina G, et al. The risk of noncardiac surgery in patients with heart disease: a new way for an easy approach to right preoperative assessment. Ital Heart J Suppl 2004;5:653-60.
20. Cohn SL. Risk stratification for noncardiac surgery. Ann Intern Med 2004;140:W2.
21. Older P, Hall A. Clinical review: how to identify high–risk surgical patients. Crit Care 2004;8:369-72.
22. Frost SD, Michota FA. Risk stratification for noncardiac surgery. Ann Intern Med 2004;140:W1.
23. Akhtar S, Silverman DG. Assessment and management of patients with ischemic heart disease. Crit Care Med 2004;32 (4Suppl):S126-36.
24. Cohn SL, Goldman L. Preoperative risk evaluation and perioperative management of patients with coronary artery disease. Med Clin North Am 2003;87:111-36.
25. Chassot PG, Delabays A, Spahn DR. Preoperative evaluacion of patients with, or at risk of, coronary artery disease undergoing non-cardiac surgery. Br J Anaesth 2002;89;747-59.
26. Karnath BM. Preoperative cardiac risk assesment. Am Fam Physician 2002;66:1889-96.
27. Shah KB, Kleinman BS, Rao TL, et al. Angina and other risk factors in patients with cardiac diseases undergoing noncardiac operations. Anesth Analg 2001;70:240-7.
28. Sprung J, Abdelmalak B, Gottlieb A, et al. Analysis of risk factors for myocardial infarction and cardiac mortality after major surgery. Anesthesiology 2000;93:129-40.
29. American College of Physicians. Guidelines for assessing and managing the perioperative risk from coronary artery disease associated with major noncardiac surgery. Ann Intern Med 1997;127:309-28.