

Screening Models for Cardiac Risk Evaluation in Emergency Abdominal Surgery. II. Evaluation of the Postoperative Period Risk based on Data from the Pre- and Intraoperative Period

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Abstract: A classification of intraoperative (IO) and postoperative (PO) cardio-vascular complications (CVC) was performed, based on data from 466 patients subjected to emergency surgery, due to severe abdominal surgical diseases or traumas, in accordance with the severe criteria of ACC/AHA in CVC for non-cardiac surgery. There were 370 intra- and 405 postoperative (IO; PO) CVC registered, distributed as follows: groups with low risk (IO: 148; PO: 87), moderate risk (IO: 200; PO: 225), and high risk (IO: 22; PO: 93). Patient groups were formed, according to the CVC risk level, during the intra- and postoperative periods, for which the determinant factor for the group distribution of patients was the complication with the highest risk. Individual data was collected for each patient, based on 65 indices: age, physical status, diseases, surgical interventions, anaesthesiological information, intra and postoperative cardio-vascular complications, disease outcome, causes of death, cardio-vascular disease anamnesis, anamnesis of all other nonsurgical diseases present, laboratory results, results from all imaging and instrumental examinations, etc. The trend toward increase or decrease of the CVC risk was studied during the transition from intra- to the postoperative period. On the basis of these indices, a new distribution of the patients was implemented, into groups with different levels of risk of CVC during intra- and postoperative. This result is a solid argument, substantiating the proposal to introduce these adjustments to the ACC/AHA criteria for determining the severity of CVC in the specific conditions of emergency abdominal surgery.

Keywords: Cardiac risk, Methods of perioperative risk assessment, Emergency abdominal surgery.

Introduction

In part I of the study [13] we indicated that the emergency abdominal surgery is an area in which the possibilities for a number of cardiologic tests and methods for perioperative cardiac risk evaluation are limited [7, 8, 9, 15]. Our former studies [10, 11, 12, 14] show the low reliability of the known indices for cardiac risk evaluation: of Goldman [2, 3, 4], of Larsen [6] and of Detsky [1] in patients subject to emergency abdominal operations with and without perioperative cardiovascular accidents.

The evaluation of cardiac risk as part of the total operative risk defines the probability for onset of cardiac complications during the operation and in the postoperative period, enables prediction of complication severity (based on the standards adopted by ACC/AHA [5]) and the period of their onset. Thus such evaluation is a prerequisite for recommendations about the therapeutic and surgical tactics.

The aim of this research is to be determined the constellations of factors, which are risky for the occurrence of perioperative heart complications at patients, who will be subjected to emergency abdominal surgery and through them, we shall create screening models for prediction of intraoperative and postoperative cardio-vascular complications with specific risk level. In this second part from the research, the results are related to the prediction of the occurrence of cardio-vascular complications in the postoperative period by data from the pre- and intra-operative period.

Method and materials

The first part of the research [13] contains general data about the researched group of patients. For this reason, we shall present here only additional data, used for defining the screening models for prediction of cardiac risk in the postoperative period.

The registered postoperative cardio-vascular complications for the researched nosological groups of surgical diseases are 405, registered at 242 patients. The distribution of the classified postoperative cardio-vascular complications in accordance with the standards of the ACC/AHA is given in Table 1.

Table 1. Postoperative cardio-vascular complications

Type of risk	Type of complication	Number of complications	Number of patients
Low	Hypotonia	20	
	Supraventricular extrasystoles	30	4
	Ventricular extrasystoles	37	
	Total:	87	
Moderate	Hypertension	55	
	Supraventricular arrhythmia (atrial fibrillation, supraventricular tachycardia)	41	
	Fit of stenocardia	19	
	Raised heart rate (>120 heart beats per minute)	54	168
	Sinus bradycardia	3	
	Ventricular extrasystoles (class 3)	3	
	Manifested ischemia (on ECG)	50	
Total:	225		
High	Heart failure	57	
	Acute cardiogenic pulmonary edema	20	
	Acute myocardial infarction	12	70
	Cardiac arrest	4	
	Total:	93	

We have made a comparative analysis of the indicators using their values from the preoperative and intra operative period for the groups of patients, having postoperative cardio-vascular complications by degree of severity: cardiogenic death, highly risky and moderately risky complications, as well as of the control group. We did not incorporate the

group of patients, having low risk postoperative cardio-vascular complications due to their small number – only 4.

Results

Table 2 contains the values of the calculated t-criterion for differentiation of indicators by couples of groups in accordance with the severity of pre- and intraoperative cardio-vascular complications: cardio-vascular complications with cardiogenic death with regard to the control group and with respect to the groups of cardio-vascular complications of highly risky and moderately risky nature; cardio-vascular complications of highly risky nature with regard to the control group and there are also cardio-vascular complications of moderate risk; cardio-vascular complications of moderate risk with regard to the control group. The calculated t-values, exceeding the limit at $p < 0.05$ (for the relative degrees of freedom) have been marked with * (Table 3 [13] for the used abbreviations).

The data presented in Table 2 enable differentiation of specific constellations of indicators (risk profiles) which are sensitive to the emergence of intraoperative CVC with different degree of the cardiac risk.

Table 2. T-criteria for differentiation between the indicators

Period	Indicator	Moderate risk - control group	High risk - control group	Cardiogenic death - control group	High risk - moderate risk	Cardiogenic death - high risk
<i>Preoperative</i>	Age	*4.5740	*5.0597	*7.2532	1.7875	*2.2316
	AH	*3.8972	1.3018	1.5429	1.5355	0.6785
	IHD	*2.9303	1.5992	1.0091	0.4427	0.1934
	MI	0.9125	1.5089	*3.5485	1.0304	*2.7446
	RD	*2.0421	*2.6976	*2.4477	1.5757	0.9720
	HF	*4.8908	*4.8157	*6.7064	*2.1575	*2.3603
	CNPD	*4.3585	*3.2283	*2.4033	0.9448	0.5134
	DM	0.1719	0.3156	*2.0320	0.2106	1.0655
	L-Res	*3.9528	*3.1280	*2.5976	1.4103	0.4237
	L-Aus	*3.3808	*3.5438	*2.1348	1.9683	0.4984
	SAP	*1.9864	*1.9843	0.0330	0.6213	1.1896
	DAP	1.4425	0.6028	0.7167	0.4556	0.2197
	CVP	1.0000	*2.8284	1.4510	*2.0404	0.5750
	HR	*4.4511	*2.6806	*3.3402	0.5159	1.1547
	CR	1.1479	*2.5802	*2.9389	*2.0479	1.4395
	HAusc	1.7956	0.9283	1.5239	0.2160	1.1166
	Hb	1.7079	*2.3548	*2.4845	1.5011	1.0719
	Glu	*3.0387	0.9898	*3.4053	1.2860	*2.2791
	Urea	0.2051	1.5304	1.6789	1.7253	0.6855
	Crea	1.0000	1.5082	1.8763	1.1572	0.1292
	Potassium	0.5192	1.0047	1.0000	0.7567	1.4292
	SGOT	1.1238	1.1713	1.7503	0.5076	1.2649
	SGPT	0.4611	0.4982	1.5218	0.1975	1.7693
	Rö L	1.0151	*2.9744	1.4668	*2.0648	0.8382
LVH	1.9131	0.9197	1.2188	*2.6872	*2.0109	
Isch-ECG	*9.7573	*5.0497	*4.6904	0.2068	1.3489	

Table 2. Continuation

Period	Indicator	Moderate risk - control group	High risk - control group	Cardiogenic death - control group	High risk - moderate risk	Cardiogenic death - high risk
Intraoperative	COpT	0.2142	0.9593	0.5693	1.1885	0.1081
	EOpInt	*2.4311	*6.2859	*4.4211	*4.5237	0.0000
	DAnest	*3.7846	*4.9935	*4.4538	*2.1616	0.5239
	TIP	*2.5293	*5.2711	*2.7817	*3.5193	1.0578
	SuOpE	1.1933	0.9505	*3.2402	0.1480	*2.2597
	CVC-LR-Op	1.4206	*3.5082	1.8257	*2.2632	0.6279
	CVC-MR-Op	*30.2001	*7.6752	*3.8729	*3.8183	0.9283
	CVC-HR-Op	1.0182	*2.8284	*3.5082	*2.2952	*1.9881
	SAP-Op	1.3623	0.2905	0.6205	0.7495	0.4108
	DAP-Op	0.4810	0.0149	0.2656	0.3550	0.2311
	CVP-Op	1.2844	*3.5799	*2.0216	*1.9987	0.4126
	HR-Op	*4.1219	*3.3541	*3.3784	0.6180	0.9283
	Hb-Op	1.5292	*2.4446	1.5324	1.6416	0.1292
	Glu-Op	*3.5217	*4.7038	*5.1355	*2.1164	1.0217
Ish-ECG-Op	1.0745	1.0000	1.8257	1.2358	1.5143	

I. Constellations of indicators, which are sensitive to the appearance of postoperative moderately risky cardio-vascular complications.

I.1. Comparison between the indicators of the patients from the group having postoperative moderately risky cardio-vascular complications and the control group of patients:

- from the preoperative period: 1. average age (53 and 60 years old); 2. arterial hypertension (42.2% and 20.6%); 3. ischemic heart disease (13.1% and 4.1%); 4. rhythm disorders (15.6% and 5.2%); 5. heart failure (45.2% and 22.7%) with emphasized difference for individual classes; 6. chronic nonspecific pulmonary diseases (23.2% and 7.2%); 7. the pathology of lung respiration (14.9% and 2.1%); 8. lung-auscultatory (17.3% and 4.1%); 9. systolic arterial pressure (50.6% and 40.2%); 10. raised heart rate (61.3% and 34%); 11. increased serum glucose (65.5% and 46.4%); 12. manifested ischemia on electrocardiogram (36.3% and 0%);

- from the intraoperative period: 1. extent of the operative intervention: we notice obvious differences in the relative share of patients by volume of operation; 2. duration of the anesthesia (170 minutes and 150 minutes); 3. total intubation period (3 hours and 2.6 hours); 4. intra operative cardio-vascular complications of moderate risk (84.5% and 0%); 5. raised heart rate (40% and 17.5%); 6. increased serum glucose (60% and 38%).

II. Constellations of indicators, which are sensitive to the appearance of postoperative highly risky cardio-vascular complications.

II.1. A comparison between the indicators by values of the patients from the group having postoperative highly risky cardio-vascular complications and the control group of patients:

- from the preoperative period: 1. average age (70 and 53 years old); 2. rhythm disorders (26.5% and 5.2%); 3. heart failure (57.1% and 22.7%); 4. chronic nonspecific pulmonary diseases (28.6% and 7.2%); 5. the pathology of lung respiration (24.5% and

2.1%); 6. **lung-auscultatory** (34.7% and 4.1%); 7. **systolic arterial pressure** (hypotension 18.4% and 9.3% and increased systolic arterial pressure – 515 and 40.2%); 8. **central venous pressure**; 9. **raised heart rate** (57% and 34%); 10. **disturbances of heart (auscultatory)** (16.3% and 2.1%); 11. **hemoglobin**; 12. **pathological R_ö findings of the lung** (24.4% and 6.2%); 13. **manifested ischemia on electrocardiogram** (34.7% and 0%);

- **from the intraoperative period:** 1. **extent of the operative intervention:** in this case there are no substantial differences; 2. **duration of the anesthesia** (190 minutes and 150 minutes); 3. **total intubation period** (4 hours and 2.6 hours); 4. **intraoperative cardio-vascular complications of low risk** (20.4% and 0%); 5. **intraoperative cardio-vascular complications of moderate risk** (55.1% and 0%); 6. **intraoperative cardio-vascular complications of high risk** (14.3% and 0%); 7. **central venous pressure over 90 mm H₂O** (28.6% and 1%); 8. **raised heart rate** (45% and 17.5%); 9. **decreased level of hemoglobin** (20% and 5%); 10. **increased serum glucose** (respectively 75.5% and 38.1%).

Because of the probability some of the outlined in the constellations indicators (risk profiles) outlined as important to the cardio-vascular complications of high risk, to have the same importance to the group of moderate risk, it is expedient to form a constellation of indicators, which will really differentiate the above-mentioned two groups.

II.2. A comparison between the indicators of the patients from the groups, having postoperative cardio-vascular complications of high and moderate risk:

- **from the preoperative period:** 1. **heart failure** (57.1% and 45.2%); 2. **central venous pressure** (14.3% and 4%); 3. **heart (auscultatory)** (16.3% and 4.2%); 4. **R_ö-lung** (24.4% and 10.7%); 5. **left ventricular hypertrophy on the electrocardiogram** (10% and 25%);

- **from the intraoperative period:** 1. **extent of the operative intervention;** 2. **duration of the anesthesia** (190 minutes and 170 minutes); 3. **total intubation period** (4 hours and 3 hours); 4. **intraoperative cardio-vascular complications of low risk** (20.4% and 6.5%); 5. **intraoperative cardio-vascular complications of moderate risk** (55.1% and 84.5%); 6. **intraoperative cardio-vascular complications of high risk** (14.3% and 2.4%); 7. **central venous pressure over 90 mm H₂O** (28.6% and 15.5%); 8. **increased serum glucose** (75.5% and 48.8%).

III. Constellations of indicators, which are sensitive to the appearance of the most highly risky postoperative cardio-vascular complications - cardiogenic death.

III.1. A comparison between the indicators by values of patients from the group meeting cardiogenic death postoperatively and the control group of patients:

- **from the preoperative period:** 1. **average age** (75 and 53 years old); 2. **myocardial infarction** (42.9% and 3%); 3. **rhythm disorders** (33.3% and 5.2%); 4. **heart failure** (90.5% and 22.7%); 5. **chronic nonspecific pulmonary diseases** (33.3% and 7.2%); 6. **diabetes** (57.1% and 24.7%); 7. **lung respiration** (28.6% and 2.1%); 8. **lung auscultatory** (33.3% and 4.1%); 9. **raised heart rate** (71.4% and 34%); 10. **heart (auscultatory)** (33.3% and 2.1%); 11. **decreased hemoglobin** (28.6% and 3.1%); 12. **increased serum glucose** (81% and 48.4%); 13. **manifested ischemia on electrocardiogram** (52.4% and 0%);

- **from the intraoperative period:** 1. **extent of the operative intervention;** 2. **duration of the anesthesia** (200 minutes and 150 minutes); 3. **total intubation period** (3.7 hours and 2.6 hours); 4. **surgical intraoperative complications** – there are present substantial and authentic differences; 5. **intraoperative cardio-vascular complications of moderate risk** (43% and 0%); 6. **intraoperative cardio-vascular complications of high**

risk (38% and 0%); 7. **central venous pressure** over 90 mm H₂O (24% and 4%); 8. **raised heart rate** (57.1% and 17.5%); 9. **increased serum glucose** (respectively 85.7% and 38.1%).

Most probably except for cardiac death, these indicators contain a component which is also typical of the remaining groups by risk level – high and moderate. By the selection of indicators, which authentically differentiate the group of cardiogenic death from the group, having highly risky cardio-vascular complications, it is possible to form a series of indicators, which are **typical** of lethal outcome.

III.2. A comparison between the indicators by values of the patients from the group, meeting cardiogenic death postoperatively and the group of patients, having postoperative highly risky cardio-vascular complications:

- **from the preoperative period:** 1. **average age** (75 and 70 years old); 2. **myocardial infarction** (42.9% and 10.2%); 3. **heart failure** (90.5% and 57.1%); 4. **increased serum glucose** (81% and 55.1%); 5. **left ventricular hypertrophy on the preoperative electrocardiogram** (28.6% and 10.2%);

- **from the intraoperative period:** 1. **surgical intra operative complications;** 2. **cardio-vascular complications of high risk** (38% and 14.3%).

The comparative quantity data, systematized in the sections I, II and III, combined with the different severity of the surgical disease (see Table 1 in [13]), give an opportunity for outlining the specific profiles (screening models) of the basic groups of patients by the type of cardio-vascular complications (Table 3).

Table 3. Distribution of surgical diseases by groups of postoperative cardio-vascular complications

Group	Control group	Control group %	Moderate risk	Moderate risk%	High risk	High risk%	Cardiogenic death	Cardiogenic death %
A	22	22.7	21	12.5	1	2.0	0	0.0
B	18	18.5	36	21.4	6	12.3	1	4.8
C	28	28.9	34	20.2	7	14.4	4	19.0
D	14	14.5	38	22.6	14	28.6	6	28.6
E	11	11.3	26	15.5	14	28.6	10	47.6
F	1	1.0	5	3.0	1	2.0	0	0.0
G	2	2.1	7	4.2	2	4.1	0	0.0
H	1	1.0	1	0.6	1	2.0	0	0.0
Total for groups: %		A, B, C 70.1		B, C, D 64.6		C, D, E 71.6		C, D, E 95.2

There is a group of patients (97 medical cases) without preoperative cardio-vascular complications, although having previous cardio-vascular diseases or abnormal values of some indicators, related to the cardio-vascular system (control group). The typical features of this group are comparatively low average age, relatively frequent arterial hypertension, heart failure from I class, raised heart rate, systolic arterial pressure and high share of increased serum glucose. It is quite rare to notice rhythm disorders, ischemic heart disease and previous myocardial infarction. The lighter surgical diseases are prevalent. The operative interventions are mainly of average extent.

There was a group of patients (168 cases) with postoperative moderately risky cardio-vascular complications. The present, in the previous group, indicators of cardio-vascular diseases and deviations from the norm were also noticed in the specific for this group constellation of indicators but at considerably higher levels. New distinguishing indicators are

the chronic nonspecific pulmonary diseases, disturbances of breathing mechanics and the lung-auscultatory findings. The prevalent surgical diseases are from low and moderate severe (from the groups B, C and D). The operative interventions are mainly of mean extent. The duration of anesthesia and of the total intubation period are extended. We easily notice the big frequency of intraoperative moderately risky cardio-vascular complications.

There was a group of patients (49 cases) with postoperative highly risky cardio-vascular complications. The average age is increased to 70 years. We distinguish specifically with regard to the values of control group indicators: heart failure, rhythm disorders, breathing mechanics, auscultatory pulmonary pathology, chronic nonspecific pulmonary diseases, systolic arterial pressure, increased serum glucose and central venous pressure over 90 mm H₂O. The new indicators are R_ö-lung pathology and diastolic arterial pressure. The surgical diseases continue the trend to aggravation (mainly in the groups C, D and E), the average duration of the anesthesia and the total intubation period get extended. The other discriminatory intraoperative indicators are: abnormal raised heart rate, serum glucose and central venous pressure, intraoperative cardio-vascular complications of low, moderate and high risk.

A group of patients (21 cases) with cardiogenic death in the postoperative period

Average age is 75 years old. The newly appeared discriminatory indices at that, at very high frequency are: myocardial infarction, diabetes and S-T changes on the preoperative electrocardiogram, together with the already recorded rhythm disorders, heart failure and heart rate above 100 beats per minute, chronic nonspecific pulmonary diseases, auscultatory lung pathology, disturbances in breathing mechanics and increased level of serum glucose. The surgical diseases are more severe, moreover those from group E are dominant. The indices from the intraoperative period, which are easily distinguishable, are: extent of operative intervention, average duration of anesthesia, total intubation period, raised heart rate, increased level of serum glucose and central venous pressure. Quite typical of this group are surgical complications, established or which occurred during the time of operation, as well as the increase in the frequency of highly risky intraoperative complications.

Summary of results and conclusions

From the presented systematized profiles, we can determine the main rules for the preliminary assessment of the probability of the occurrence of cardiovascular complications at concrete risk level in the postoperative period. In practice, this assessment is a two-stage algorithm: initially by preoperative data and surgical disease diagnosis; subsequently, there is a correction depending on the peculiarities of the operative intervention, reflected through specific for the intraoperative period indicators.

This is a preliminary prognosis for the occurrence of cardio-vascular complications at specific risk level in the postoperative period by preoperative data and a surgical disease diagnosis:

Arterial hypertension and the stable and unstable forms of **stenocardia** are risk factors for the cardio-vascular complications of moderate risk, **preoperative increased systolic arterial pressure** – for cardio-vascular complications of moderate and high risk. As specific risk factors for the cardio-vascular complications of moderate and high risk we may point out **the previous myocardial infarction, rhythm disorders – established physically on the electrocardiogram, the presence of left ventricular hypertrophy** on the preoperative electrocardiogram and decreased hemoglobin and only for cardio-vascular complications of high risk – **R_ö-lung pathology**. Diabetes and the increased serum glucose

seriously distinguish the group with cardiogenic death. The predictors of the postoperative cardio-vascular complications for the three age groups are: **rhythm disorders – through anamnesis, myocardial ischemia on the electrocardiogram, heart failure, chronic nonspecific pulmonary diseases, pathological changes in breathing mechanics and lung auscultation and raised heart rate.** The severity of surgical diseases is a factor not only for higher frequency, but also for a greater degree of the risk from cardiovascular complications.

This is a corrected prognosis by data about the intraoperative period about the occurrence of cardio-vascular complications with specific risk level in the postoperative period:

The indicators: **extent of operative intervention, duration of anesthesia and total intubation period** are risk factors for all groups having postoperative cardio-vascular complications and **the surgical intraoperative complications** relate especially to the most severe postoperative cardio-vascular complication – cardiogenic death. **The intra operative cardio-vascular complications of low risk** lead to a forecast for postoperative cardio-vascular complications of moderate and high risk. We distinguish with greater authenticity the **cardio-vascular complications of moderate risk** during the time of operation as a risk factor mainly for the appearance of postoperative cardio-vascular complications of moderate risk and of **cardio-vascular complications of high risk intraoperatively** leading to severe postoperative cardio-vascular complications (of high risk or cardiogenic death). The intra operative indicators – **raised heart rate, increased central venous pressure and the increased level of serum glucose** are predictors of all groups of postoperative cardio-vascular complications.

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References

1. Detsky A. L., H. B. Abrams, J. R. Mc Laughlin et al. (1986). Predicting Cardiac Complications in Patients undergoing Noncardiac Surgery, *J Gen Intern Med*, 1, 211-219.
2. Goldman L. (1987). Multifactorial Index of Cardiac Risk in Noncardiac Surgery. Ten-year Status Report (review article), *J Cardiothoracs Anesthesiol*, 1, 237-244.
3. Goldman L. (1995). Cardiac Risk in Noncardiac Surgery: An Update, *Anesth. Anal*, 80, 810-820.
4. Goldman L., D. Caldera, S. Hussbaum et al. (1977). Multifactorial Index of Cardiac Risk in Noncardiac Surgical Procedures, *N Engl J Med*, 297, 845-850.
5. Guidelines for Perioperative Cardiovascular Evaluation for Noncardiac Surgery (1996). Report of ACC/AHA Task Force. *Circulation*, 93, 6, 1286-1317.
6. Larsen S. F., K. H. Olesen, E. Jacobsen et al. (1987). Prediction of Cardiac Risk in Noncardiac Surgery, *Eur Heart J*, 8, 179-185.
7. Mangano D. T. (1995). Perioperative Assessment of the Patient with Cardiac Disease, *Curr Opin Cardiol*, 10(5), 530-542.
8. Mangano D. T., W. S. Browner, M. Hollenberg et al. (1992). Long-term Cardiac Prognosis following Noncardiac Surgery, *J Am Med Assoc*, 268, 233-239.
9. Massie B. M., D. T. Mangano (1993). Risk Stratification for Noncardiac Surgery. How (and Why)? *Circulation*, 87, 1752 -1755.
10. Milanova M., M. Matveev (1998). Cardiac Risk Evaluation in Noncardiac Surgical Procedures, *J Emerg Med*, 6(2), 27-32.
11. Milanova M., M. Matveev (1999). Heart Risk Assessment Indicators in Emergency Noncardiac Surgery. I. Practicability in Patients Presenting Perioperative Cardiovascular Accidents, *J Emerg Med*, 7(2), 45-52.

12. Milanova M., M. Matveev (2001). Heart Risk Assessment Indicators in Emergency Noncardiac Surgery. II. Practicability in Patients Free of Perioperative Cardiovascular Accidents, *J Emerg Med*, 9, 60-63.
13. Milanova M., M. Matveev (2008). Screening Models for Cardiac Risk Evaluation in Emergency Abdominal Surgery. I. Evaluation of the Intraoperative Period Risk Based on Data from the Preoperative Period, *Bioautomation*, 9, 40-49.
14. Milanova M., M. Matveev, Sh. Tadjer et al. (2002). Heart Risk in Urgent Abdominal Surgery – What's New? Proceedings of the 12th World Congress of International Association of Surgeons & Gastroenterologists, Istanbul, Oct. 30 - Nov. 2, OP166, 1-3.
15. Wender N. (1990). A 50-year-old Useful Report on Coronary Risk for Noncardiac Surgery, *Am J Cardiol*, 66, 1375-1376.

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