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RCRI VS. GSCRI IN SIX-MONTHS PREDICTION OF MYOCARDIAL INFARCTION AND CARDIAC ARREST OCCURRENCE

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The aim of the study was to compare prognostic abilities of Revised Cardiac Risk Index (RCRI) and Geriatric Sensitive Cardiac Risk Index (GSCRI) for myocardial infarction (MI) and cardiac arrest (CA) occurrence during 180 days in patients older than 65 years scheduled for major elective vascular surgery. MICA occurrence was noted in 16 (11.1%) patients. Both myocardial infarction and cardiac arrest were of equal frequency, each in 8 patients (24.2%). MICA occurrence was associated both with higher RCRI ($p < 0.001$) and GSCRI scores ($p < 0.001$). Multivariate analysis of binary logistic and Cox regression models determined better predictor ability of GSCRI score. Each unit of GSCRI score was associated with 1.2 times ($p < 0.05$) greater risk of MICA.

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Key words: *RCRI, GSCRI, myocardial infarction, cardiac arrest, vascular surgery*

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Introduction

Preoperative risk stratification is a strategy of clinical doctors with the goal of preventing cardiac events (1). Myocardial infarction (MI) and cardiac arrest (CA) are major adverse cardiac events that carry highest mortality (2). By 2050, the population over the age of 65 will reach almost 90 million in the United States (3). Elective vascular procedures belong to the subset of high risk surgeries based frequency of occurrence of the MI and CA, which is greater than 5% after 30 days (4). Given that elderly patients are more susceptible to cardiac adverse events (5), their prediction is crucial in perioperative management. Aim of the study was to compare prognostic abilities of Revised Cardiac Risk Index (RCRI) and Geriatric Sensitive Cardiac Risk Index (GSCRI) for MICA occurrence during 180 days in patients older than 65 years scheduled for major elective vascular surgery.

Materials and methods

During the three-year period (2017-2019), the study included 144 patients (men:women = 2:1) with average age of 70 years. Essential inclusion criteria were major elective vascular surgery and age above 65 years. Patients were followed for 180 days after the procedure. All participants underwent balanced endotracheal anesthesia and detailed preoperative examination which included an extensive clinical and medical history evaluation. Outcomes of interests were myocardial infarction and cardiac arrest. We have implemented the following definitions:

1) MI - indicative electrocardiogram changes and new onset cardiac troponin I elevation greater than three times the upper reference limit and

2) CA - absence of heart mechanical response as effect of ventricular fibrillation, pulseless ventricular tachycardia and pulseless electric activity. The study was approved by Ethics Committee of the Faculty of Medicine, University of Niš and directed at the Clinic of Cardiovascular Surgery, University Clinical Center Niš, in consonance with the principles of the Declaration of Helsinki. All participants signed an informed consent before inclusion.

Statistical analysis

Statistical Package for Social Sciences (SPSS 21.0; Chicago, IL, USA) was used for data analysis. Quantitative variables were presented as means with SDs or medians with interquartile ranges. Student's t-test and Mann-Whitney U-test were implemented. Prediction of myocardial injury and cardiac arrest were identified by univariate and multivariate binary logistic and Cox-regression analysis. A p-value less than 0.05 was considered to be a measure of statistical significance.

Results

During the 180 days after surgical procedure, MICA was noted in 16 (11.1%) patients. Ten of these patients (62.5%) had MICA in the first month. Eleven patients (68.8%) had only one event, in two patients two events were observed, and three events in three patients. Three patients (2.1%) died during the follow-up. Both myocardial infarction and cardiac arrest were of equal frequency, each in 8 patients (24.2%).

MICA occurrence was associated both with higher RCRI ($p < 0.001$) and GSCRI scores ($p < 0.001$) (Table 1).

ROC curve analysis has shown statistically significant power of RCRI and GSCRI in discriminating patients with and without MICA. Discriminatory ability of both scores was with AUC > 0.7 (Table 2).

Multivariate analysis of binary logistic and Cox regression model were determined better predictor ability of GSCRI score. Each unit of GSCRI score was associated with 1.2 times ($p < 0.05$) greater risk of MICA (Tables 3, 4).

Table 1. Correlation of RCRI and GSCRI with occurrence of MICA six months after the procedure

Risk score	With MICA	Without MICA	P value
RCRI	2.44 ± 1.21	1.25 ± 1.16	3.852 (0.000)*
RCRI (%)	11.29 ± 3.43	7.52 ± 3.85	3.741 (0.000)*
GSCRI	7.7 (2.8-12.1)	1.9 (0.3-7.2)	3.497 (0.000)†

*- t-test, †- Z-test
MICA-myocardial infarction and cardiac arrest; RCRI-Revised Cardiac Risk Index;
GSCRI-Geriatric Sensitive Cardiac Risk Index

Table 2. Discriminative ability of risk scores

Variable	Area (95% CI)	P value	Cut-off	Sensitivity (%)	Specificity (%)
RCRI	0.769 (0.655-0.882)	0.000	2.0	87.5	66.4
RCRI (%)	0.762 (0.650-0.874)	0.001	10.1	87.5	66.4
GSCRI	0.767 (0.666-0.868)	0.001	1.7	100.0	44.5

CI-confidence interval; RCRI-Revised Cardiac Risk Index; GSCRI-Geriatric Sensitive Cardiac Risk Index

Table 3. Binary logistic regression model of six-months MICA occurrence

Variable	Univariate analysis - OR (95% CI)	P value	Multivariate analysis- OR (95% CI)	P value
RCRI (%)	1.249 (1.095-1.424)	0.001		
RCRI (≥ 2 or ≥ 10.1%)	13.837 (3.007-63.668)	0.001		
GSCRI	1.157 (1.054-1.270)	0.002	1.367 (1.068-1.750)	0.013

OR-odds ratio; CI-confidence interval; RCRI-Revised Cardiac Risk Index; GSCRI-Geriatric Sensitive Cardiac Risk Index

Table 4. Cox regression model of six-months MICA occurrence

Variable	Univariate analysis - OR (95% CI)	P value	Multivariate analysis- OR (95% CI)	P value
RCRI	1.801 (1.285-2.525)	0.001	2.340 (0.733-7.469)	0.151
RCRI (%)	1.212 (1.078-1.363)	0.001		
RCRI (≥ 2 or ≥ 10.1%)	11.829 (2.687-52.075)	0.001		
GSCRI	1.130 (1.046-1.220)	0.002	1.251 (1.048-1.493)	0.013

OR-odds ratio; CI-confidence interval; RCRI-Revised Cardiac Risk Index; GSCRI-Geriatric Sensitive Cardiac Risk Index

Discussion

RCRI is a simple and most commonly tested method for risk assessment of all surgical patients proposed by ESC/ESA (4). This score system is not reliable in prediction of major adverse cardiac events in vascular surgery patients (6). There are several obstacles in analysis of the clinical applicability of RCRI. In the original study, four major cardiovascular complications were selected as outcomes of interests: ventricular fibrillation or primary cardiac arrest, myocardial infarction, pulmonary edema and complete heart block. The definitions of these complications of that time differ from today's. For example: The diagnosis of pulmonary edema was made on the basis of radiograms, and myocardial infarction on the basis of detection of MB fraction of creatine kinase (7). In this study, we used high sensitivity TnI assay which is more specific and sensitive for diagnosis of MI (8).

ROC curve analysis showed AUC for RCRI of 0.762 (0.650 - 0.874) which represented a slightly smaller area compared to the original study (0.774 ± 0.032). Unexpectedly high values of AUC we explain by monitoring only two outcomes of interest as well as the lower prevalence of abdominal aortic aneurysm reparations (24%), since in the original study, RCRI showed unsatisfactory predictive characteristics in these patients (7).

GSCRI is a newly created risk score index for the geriatric population. Multivariate analysis of both binary logistic and cox regression models detected predictive significance of GSCRI over RCRI score. In our study conducted in geriatric vascular patients, we obtained almost identical values of AUC (0.767 vs. 0.76) as in the original study which included general geriatric cohort (9). We consider this to be a high value, since it is very difficult to achieve a value over 0.8 with a single score, especially in a group of high-risk patients such as geriatric vascular patients. The reasons for better predictive abilities of GSCRI in relation to RCRI can be found in:

1) a dichotomy was avoided in most variables in the formation of GSCRI;

2) lower cut-off values of creatinine were set in GSCRI (132 μmol/L vs. 176.8 μmol/L);

3) ASA score was implemented (10).

Davenport et al. reported that ASA score is one of the most important independent predictors for cardiac morbidity in general and vascular surgery. In the same group of predictors, there are also variables of age and type of surgery that were implemented in the GSCRI.

Conclusion

MICA occurrence was associated both with high RCRI and GSCRI scores. GSCRI has better ability to predict MICA occurrence during six-months period.

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RCRI VS. GSCRI U ŠESTOMESEČNOM PREDVIĐANJU POJAVE INFARKTA MIOKARDA I SRČANOG ZASTOJA

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Cilj studije je uporediti prognostičke sposobnosti revidiranog indeksa srčanog rizika (*RCRI*) i gerijatrijski osetljivog indeksa srčanog rizika (*GSCRI*) za infarkt miokarda (*MI*) i srčani zastoj (*CA*) tokom 180 dana, kod bolesnika starijih od 65 godina, pripremljenih za veliku elektivnu vaskularnu hirurgiju. Pojave *MICA* evidentirana je kod 16 (11,1%) bolesnika. I infarkt miokarda i srčani zastoj su bili jednake učestalosti, kod 8 bolesnika pojedinačno (24,2%). Pojava *MICA* povezana je sa visokim vrednostima *RCRI* ($p < 0,001$) i *GSCRI* skora ($p < 0,001$). Multivarijantna analiza binarnog logističkog i Koks-regresionog modela označila je veću prediktorsku sposobnost *GSCRI* skora. Svaka jedinica *GSCRI* skora povezana je sa 1,2 puta većim rizikom za *MICA*.

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Ključne reči: *RCRI, GSCRI, miokardni infarkt, srčani zastoj, vaskularna hirurgija*