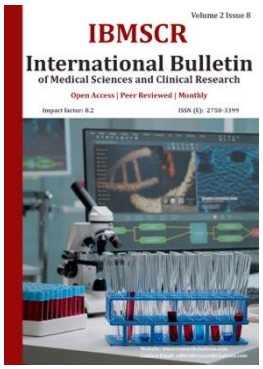

FACTORS INDICATING THE RISK OF CARDIOVASCULAR EVENTS IN PATIENTS WITH CHRONIC ISCHEMIC HEART DISEASE POST CORONARY ARTERY BYPASS GRAFTING

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Summary. The researchers analyzed a cohort of 137 individuals with coronary artery disease who underwent coronary artery bypass graft surgery with cardiopulmonary bypass. During a follow-up period of 2-5 years, instances of cardiac-related mortality were documented, encompassing sudden death occurrences, along with the emergence of non-fatal cardiovascular complications such as myocardial infarction and stroke

Relevance. The most common cause of mortality for adults in the working age group is ischemic heart disease (CHD). Coronary bypass grafting (CS) is a crucial component of the current treatment for coronary artery disease. Notwithstanding the advancements in surgical techniques, CABG may still present long-term and early postoperative problems. It will be possible to identify a group of patients who have a higher risk of developing cardiovascular complications by predicting the development of unfavorable outcomes in patients with coronary artery disease following surgical myocardial revascularization. This will increase the efficacy of preventive measures.

Purpose of the study: in the course of prospective observation to identify independent predictors of the development of fatal and non-fatal cardiovascular complications in patients with chronic coronary artery disease who underwent surgical myocardial revascularization.

Material and methods. Examined were 120 IHD patients. Based on the recommendations of cardiac surgery departments at surgery centers in Tashkent, Samarkand, and other nations, including the Russian Federation, India, and Turkey, all patients had bypass surgery. The Republican Specialized Scientific and Practical Center for Cardiology's Bukhara regional branch implemented patient surveillance following bypass surgery.

120 individuals with coronary artery disease who had CABG between October 2017 and December 2020 were included in the study. As per the study protocol, prior to surgery, every patient was subjected to a series of laboratory and instrumental research methods, which included a clinical minimum, transthoracic and, if required, transesophageal echocardiography (ECHOCG), abdominal cavity ultrasound examination, Doppler examination of the brachiocephalic, renal arteries, lower extremity vessels, and selective coronary angiography (CAG), based on the ventriculography indications.

Criteria for inclusion in the study: exertional angina of various classes according to the classification of the Canadian Society of Cardiology against the background of optimal drug therapy, angiographic indications for CABG.

Criteria for exclusion from the study: concomitant valvular heart disease, decompensated heart failure, emergency CABG, CABG on a beating heart.

All patients underwent surgical myocardial revascularization under cardiopulmonary bypass. In dynamics, we monitored laboratory parameters, electrocardiography,

echocardiography, and chest X-ray, analyzed intra- and postoperative data, and assessed the frequency of cardiac fatal outcomes and various non-fatal complications. Prospective follow-up lasted from 2 to 5 years.

In order to study the relationship of various anamnestic, clinical, laboratory, intraoperative parameters and the incidence of fatal and non-fatal cardiovascular complications after CABG, the studied patients were divided into 4 groups: the 1st group consisted of patients with fatal cardiac outcomes, the 2nd group - patients without fatal cardiac outcomes, the 3rd group consisted of patients with cardiovascular complications (both fatal and non-fatal), the 4th group - patients without cardiovascular complications. During follow-up, the first "endpoint" was death due to cardiac causes, including cases of sudden cardiac death. All cases of fatal and non-fatal cardiovascular complications (sudden death,

Results and discussions. The follow-up period lasted 36 +/- 3 months on average. Eighteen patients passed away throughout the observation period: nine died of myocardial infarction, five passed away unexpectedly, and three of pneumonia. Among the non-fatal consequences, three cases had an acute cerebrovascular accident and five cases had myocardial infarction.

According to stepwise regression analysis, the following indicators were independent predictors of fatal cardiac complications:

1) ejection fraction less than 40% (relative risk - 5.7 with deviations within the 95% confidence interval 1.2–10.7);

2) age of patients 70 years and older (4.9; 1.4–8.4);

3) diabetes mellitus (2.3; 1.1–3.7);

4) left ventricular aneurysm (2.1; 1.04–3.8);

5) the duration of artificial lung ventilation for more than 24 hours (2.0; 1.2–2.9);

6) chronic obstructive pulmonary disease (1.9; 1.1-3.1).

Independent predictors of all cases of cardiovascular complications (both fatal and non-fatal) were:

1) age of patients 70 years and older (4.1; 1.2–8.1);

2) ejection fraction less than 40% (3.7; 1.1–6.5);

3) endarterectomy during coronary bypass surgery (2.9; 1.1–5.4);

4) duration of cardiopulmonary bypass over 100 minutes (2.2; 1.2–3.9); damage to the arteries of the brachiocephalic zone (2.1; 1.1–6.4); previous stroke (1.8; 1.1–3.8).

Males made up 63.3% (76 persons) of the study sample, while females made up 36.7% (44). The average age of the patients was 55. Patients between the ages of 51 and 60 made up 65% of the population, whilst patients beyond 70 made up 4.2%. Every patient in the study had a lengthy family history of cardiovascular illnesses. The majority of patients—105 (87.5%)—had arterial hypertension, 104 (86.7%) had postinfarction cardiosclerosis, 14 (11.7%) had a history of diabetes mellitus, 13 (10.8%) had chronic obstructive pulmonary disease (COPD) as a coexisting pathology, 9 (7.5%) had obliterating atherosclerosis of the lower extremity vessels, 2 (1.6%) had previously experienced cerebrovascular accidents, and 1 (0,8%) had chronic renal failure.

Patients were classified according to their functional classifications (FC) of heart failure: class I comprised 18.6%, class II accounted for 59.4%, and class III for 22.6%. Based on EchoCG data, dilatation of the left atrial cavity was observed in 17 (14.2%) patients, and

dilatation of the left ventricular (LV) cavity was observed in 27 (22.5%) patients. The EF of the LV ranged from 27 to 71%, with an average of 52±8.2%. Of these, 17 (14.2%) patients had an EF of less than 40%. Of them, 11 (9.2%) had signs of a postinfarction LV aneurysm. CAG data were evaluated to confirm the characteristics of a coronary lesion: 104 patients (86.7%) in the study group had the correct kind of coronary circulation, which was the majority of the patients.

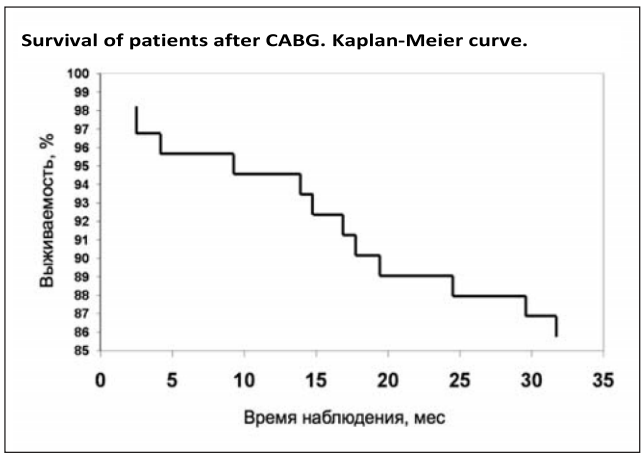
Morphologically, there were severe lesions of the coronary bed.

Twelve patients (10%) had hemodynamically significant lesions of the left coronary artery (LCA) trunk. One patient (0.8%) had the largest number of damaged vessels (7). The four arteries with the highest frequency of damage were found to have changed vessels in 51 (42.5%) of the patients. When the revealed changes were distributed according to their localization, it was discovered that lesions occurred in 106 (88.3%) cases in the right descending artery (RDA), in 104 (86.7%) cases in the right coronary artery (RCA), including the posterolateral and posterior diaphragmatic branches, in 99 (82.5%) cases, in the circumflex artery system, in 23 (19.2%) patients, and in 16 (13.3%) cases in the diagonal artery, in the intermediate - in 8 (6.7%).

Pharmaco-cold cardioplegia was used to protect the myocardium during cardiopulmonary bypass surgery for all patients undergoing CABG. Five cases (4.2%) involved the use of the left internal mammary artery for isolated mammary-coronary bypass grafting. Eighteen patients (15%) underwent isolated coronary artery bypass grafting using radial arteries and autoveins; the majority of patients (84/70%), however, underwent a combination of these two revascularization techniques. Five patients (4.2%) underwent CABG in addition to LV endoventricular plasty. Endarterectomy from these regions was added to CABG in 6 (6.6%) cases due to diffuse alterations in the distal bed of the coronary arteries.

The average number of bypasses performed per patient was 2.7, and the extent of the coronary lesion determined the volume of surgical intervention. According to the study of intraoperative data, the average length of the surgery was 236±20 minutes, and the average length of cardiopulmonary bypass was 82±3 minutes. Of the patients, 9 (7.5%) had a cardiopulmonary bypass duration more than 100 minutes. The average duration of artificial ventilation (ALV) during the postoperative period was 12±3 hours, and 4 (3.3%) patients had ALV for longer than 24 hours. The average time of aortic occlusion was 51±17 minutes.

An average of 17±8 hours were spent in the intensive care unit, and 162±39 ml of blood were lost on average. One (0.8%) patient died during the first three days following surgery due to an intraoperative transmural myocardial infarction (MI). This patient was unusual. Among the early postoperative complications, perioperative MI was also observed in 8 (6.7%) cases. This was supported by a unique clinical picture, characteristic ECG changes, and increases in the level of cardiospecific enzymes (MB-CK or troponin T) by more than five times. Of the patients, atrial fibrillation was observed in 18 (15%) and sternal diastasis in 5 (4.1%). Of the rather rare postoperative complications, there were phenomena of psychosis, pneumonia, mediastinitis, pneumothorax and gastrointestinal bleeding.



Between 2005 and 2009, 109 patients completed the trial and achieved the end point, with an average follow-up duration of 36±5 months. Of those who dropped out, communication was lost. Pneumonia was the cause of mortality for one of the twelve patients who passed away over the two to five year monitoring period. Out of the 109 patients, 11 (10.1%) passed away due to cardiovascular events. In 8 (7.3%) cases, MI was the cause of death; in 3 (2.8%) cases, sudden death was the cause of death. Of the non-fatal sequelae, two patients (1.8%) had acute cerebrovascular accidents, and seven patients (6.4%) had MI. The survival rate of patients following surgical myocardial revascularization at various points during prospective follow-up is depicted in the figure; the highest number of deaths happened between one and two years following surgery. The information below shows how surgical revascularization of the myocardium might be beneficial: Prior to surgery, individuals with FC I did not strain themselves; in the majority of cases (87/72.5%), FC III was the outcome; in 20.8% of cases, FC II angina developed; and in 8 (6.7%) of cases, angina IV FC happened. During the dynamic observation procedure, the majority of patients (83.5% of the total) did not have angina pectoris or FC I registered, while 12.8% of patients had angina FC II reported. Patients with angina FC IV were not registered. The patients under investigation were split into two groups according on whether or not they had fatal cardiovascular complications in order to examine the association between several perioperative parameters and the incidence of unfavorable cardiac outcomes following CABG. The lifestyle data from the preoperative and postoperative phases, the anamnesis of concomitant diseases and cardiovascular conditions, the anthropometric, hemodynamic, and laboratory parameters of the patients, the dynamics of the EchoCG and CAG data, the course of the early and late postoperative periods, and the analysis of the frequency of fatal cardiac events during prospective follow-up (2–5 years) were all analyzed when comparing the groups.

Eighty parameters in total were examined. A single as well as an analysis of the dynamics of the EchoCG and CAG data, the course of the early and late postoperative periods, the protocols of operations, and an analysis of the frequency of fatal cardiac events during prospective follow-up (2–5 years) are all necessary for the further investigation of correlation dependencies and the establishment of significant relationships. Eighty parameters in total were examined. A single as well as an analysis of the dynamics of the EchoCG and CAG data, the course of the early and late postoperative periods, the protocols of operations, and an analysis of the frequency of fatal cardiac events during prospective follow-up (2–5 years) are all necessary for the further investigation of correlation dependencies and

the establishment of significant relationships. Eighty parameters in total were examined. A single toric regression analysis can be used to construct meaningful correlations and investigate correlation dependencies in more detail. LV EF <40%, patient age 70 years and above, diabetes mellitus, LV aneurysm, ventilator time greater than 24 hours, LCA lesion, and COPD were hence the seven factors that were chosen. It should be mentioned that although no meaningful association was discovered, a positive link was identified with postoperative lethal complications and damage to the LCA trunk. Then, using binary logistic regression analysis and stepwise feature selection, independent predictors of the development of fatal cardiac events were found. These features are shown in order of significance based on the relative risk level (Table 1).\

- LV EF <40%, which increases the risk of postoperative fatal outcomes by 5.7 times.
- The age of patients is 70 years and older, which increases the relative risk of cardiac events by 4.9 times. • Diabetes mellitus, which increases the relative risk of fatal cardiovascular complications by 2.3 times.
- LV aneurysm, which increases the risk of fatal cardiovascular events by 2.1 times.
- The duration of mechanical ventilation for more than 24 hours increases the relative risk of death from cardiovascular causes by 2 times.
- COPD, which increases the risk of long-term fatal complications by 1.9 times.

Table 1.

Independent Predictors of Fatal Cardiac Outcomes

predictor	**Relative risk (95% confidence interval)**	***p***
LV EF <40%	5.7 (1.2–10.7)	0.001
Age 70 and over	4.9 (1.4–8.4)	0.03
Diabetes	2.3 (1.1–3.7)	0.003
LV aneurysm	2.1 (1.04–3.8)	0.047
Ventilation time>24 h	2.0 (1.2–2.9)	0.009
COPD	1.9 (1.1–3.1)	0.008

Sensitivity and specificity values were established for every prognostic parameter in order to evaluate the predictive value of the found predictors. Research has demonstrated that patients aged 70 years and above have the highest specificity and that prognostic factors such as LVEF <40% have the highest sensitivity.

Finding risk factors for the emergence of all cardiovascular issues during the lengthy period following surgical myocardial revascularization was the second phase of the research. In addition to analyzing intraoperative and postoperative data, 80 anamnestic, anthropometric, hemodynamic, biochemical, and instrumental characteristics of the patients were examined. During prospective follow-up (2–5 years), cases of cardiovascular problems were found and documented. There were independent predictors of the emergence of cardiovascular problems following CABG, according to a subsequent analysis using binary logistic regression with stepwise inclusion of relevant features in the model (Table 2).

Table 2.

Independent predictors of cardiovascular events

predictor	**Relative risk (95% CI)**	***p***
Age over 70	4.1 (1.2–8.1)	0.02
LV EF<40%	3.7 (1.1–6.5)	0.004
Endarterectomy during CABG	2.9 (1.1–5.4)	0.001
Cardiopulmonary bypass time >100 min	2.2 (1.2–3.9)	0.036
Damage to the brachiocephalic arteries	2.1 (1.1–6.4)	0.001
Having a history of stroke	1.8 (1.1–3.8)	0.032

• The age of patients older than 70 years increases the relative risk of developing cardiovascular complications in the long-term period of surgical myocardial revascularization by 4.1 times.

• LV EF <40%, which increases the relative risk of developing cardiovascular complications by 3.7 times.

• Performing endarterectomy during CABG, which increases the relative risk of postoperative complications by 2.9 times.

• The duration of cardiopulmonary bypass over 100 minutes - 2.2 times.

• The initial lesion of the brachiocephalic arteries, this prognostic parameter increases the relative risk of cardiovascular complications by 2.1 times.

• A history of stroke increases the relative risk of complications by 1.8 times.

Sensitivity and specificity values were also established in order to evaluate the predictive value of the selected predictors for every prognostic parameter. It has been determined that the age of patients over 70 years old is the most sensitive prognostic indicator, and the endarterectomy performed during CABG has the highest specificity.

Conclusions:

Following surgical myocardial revascularization, the all-cause death rates in patients with coronary artery disease were 0.8% at the hospital follow-up and 11% during the next two to five years (average three years). In addition, 91% of the recorded deaths were due to cardiovascular problems.

44.9% was the total incidence of complications following CABG. In the early postoperative phase following CABG, the proportion of non-fatal complications resulting from cardiovascular causes was 6.7%.

In the final stages of surgical myocardial revascularization, the following factors were found to be independent predictors of fatal cardiac outcomes: LV EF <40% (relative risk 5.7 with deviations within the 95% confidence interval 1.2–10.7), patient age (4.9; 1.4–8.4), history of diabetes mellitus (2.3; 1.1–3.7), and LV aneurysm (2.1; 1.04–3.8), duration of mechanical ventilation in the postoperative period for more than 24 hours (2.1; 1.2–2.9), as well as COPD (1.9; 1.1–3.1).

Thus, predictors of cardiovascular complications after CABG are the age of patients older than 70 years (4.1; 1.2–8.1), LV EF<40% (3.7; 1.1–6.5), endarterectomy in process of revascularization (2.9; 1.1–5.4), duration of cardiopulmonary bypass over 24 h (2.2; 1.2–3.9),

initial lesion of brachiocephalic arteries (2.1; 1.1–6 .4), as well as a history of stroke (1.8; 1.1–3.8).

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