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Сравнительные результаты стандартного коронарного шунтирования, этапной гибридной реваскуляризации миокарда и сугубо эндоваскулярной коронарной коррекции у пациентов с ИБС в отдаленные сроки после операции

Ю. Л. Шевченко, Г. Г. Борщев, Д. Ю. Ермаков, М. А. Масленников, А. Ю. Вахрамеева, Д. С. Ульбашев✉

Клиника грудной и сердечно-сосудистой хирургии имени Святого Георгия Национального медико-хирургического Центра имени Н. И. Пирогова, Москва, Российская Федерация

АННОТАЦИЯ

Введение. Ишемическая болезнь сердца (ИБС) в настоящее время остается ведущей причиной заболеваемости и смертности в России и во всем мире. В 2022 г. общая заболеваемость ИБС среди взрослого населения России составила 6517,9 на 100 тыс. Основными хирургическими методами лечения ИБС являются коронарное шунтирование (КШ) и стентирование венечных артерий. В некоторых случаях выполнение одномоментной полной реваскуляризации невозможно — гибридный подход является одним из решений.

Цель. Сравнить 5-летние результаты КШ, этапной гибридной реваскуляризации миокарда и изолированного эндоваскулярного вмешательства у пациентов с ИБС и многососудистым поражением коронарного русла.

Материалы и методы. В ретроспективное исследование включено 330 пациентов с ИБС и многососудистым атеросклеротическим поражением венечных артерий, которым в 2010–2018 гг. была проведена плановая реваскуляризация миокарда. В 1 группу было включено 110 пациентов, которым выполнено КШ, во 2 группу — 110 больных, перенесших этапную гибридную реваскуляризацию миокарда, в 3 группу — 110 пациентов после чрескожного коронарного вмешательства. В послеоперационном периоде в течение 5 лет оценивались клинические и инструментальные данные, учитывались осложнения, летальные исходы и повторные вмешательства.

Результаты. В ближайшие сроки после оперативного вмешательства во всех группах частота сердечно-сосудистых осложнений и резидуальной ишемии миокарда была ожидаемо низкой ($p > 0,05$). Через 1 год наблюдения сердечно-сосудистые осложнения реже наблюдались во 2 группе (17,3%) по сравнению с 1 группой (29,1%, $p = 0,038$), при этом у больных 3 группы неблагоприятные события также отмечались в 27,3%, однако отличия не были значимы ($p = 0,075$). Через 5 лет частота сердечно-сосудистых осложнений превалировала у больных 1 группы (80,0%) по сравнению со 2 группой (57,3%) и 3 группой (67,3%, $p = 0,001–0,032$). В конце периода наблюдения частота повторной реваскуляризации была значимо больше в 1 группе (41,8%) по сравнению со 2 группой (29,1%, $p = 0,049$). Число таких случаев в 3 группе (33,6%) было меньше, чем в первой, однако различия не были статистически значимы ($p = 0,125$).

Заключение. Изолированное КШ демонстрирует большую частоту повторных эндоваскулярных вмешательств через 5 лет после операции по сравнению с гибридной реваскуляризацией, которая к тому же обеспечивает лучшие результаты в отношении профилактики сердечно-сосудистых осложнений.

Ключевые слова: *ИБС; коронарное шунтирование; чрескожное коронарное вмешательство; гибридная реваскуляризация миокарда*

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Comparative Results of Standard Coronary Artery Bypass Grafting, Staged Hybrid Myocardial Revascularization and Purely Endovascular Correction in Patients with Coronary Artery Disease in Long-Term Period after Surgery

Yuriy L. Shevchenko, Gleb G. Borshchev, Dmitriy Yu. Ermakov, Mikhail A. Maslennikov, Anastasiya Yu. Vakhrameyeva, Daniil S. Ul'bashev✉

St. George Thoracic and Cardiovascular Surgery Clinic of the National Medical and Surgical Center named after N. I. Pirogov, Moscow, Russian Federation

ABSTRACT

INTRODUCTION: Coronary artery disease (CAD) currently remains the leading cause of morbidity and mortality in Russia and in the world. In 2022, the overall morbidity with CAD among the adult population of Russia was 6517.9 per 100 thousand populations. The main surgical methods of treatment for CAD are coronary artery bypass grafting (CABG) and stenting of the coronary arteries. In some cases, a single-step complete revascularization is not possible, and one of solutions is a hybrid approach.

AIM: To compare 5-year results of CABG, staged hybrid myocardial revascularization and isolated endovascular intervention in patients with CAD and multi-vessel lesion of the coronary arteries.

MATERIALS AND METHODS: The prospective study included 330 patients with CAD and multi-vessel atherosclerotic lesion of the coronary arteries, who underwent planned myocardial revascularization in 2010–2018. Group 1 included 110 patients who underwent CABG, group 2 — 110 patients who underwent staged hybrid myocardial revascularization, group 3 included 110 patients after percutaneous coronary intervention. In 5-year follow-up period, clinical and instrumental data were evaluated, complications, lethal outcomes and re-interventions were considered.

RESULTS: In the immediate period after the surgical intervention, frequency of cardiovascular complications and residual myocardial ischemia was expectedly low in all the groups ($p > 0.05$). At 1 year of follow-up, cardiovascular complications were less common in group 2 (17.3%) compared to group 1 (29.1%, $p = 0.038$), while in group 3, adverse events were also noted in 27.3% of cases, however, the differences were not significant ($p = 0.075$). At 5 years, the frequency of cardiovascular complications prevailed in patients of group 1 (80.0%) compared to group 2 (57.3%) and group 3 (67.3%, $p = 0.001$–0.032). At the end of follow-up, the frequency of repeat revascularization was significantly higher in group 1 (41.8%) compared to group 2 (29.1%, $p = 0.049$). The number of such cases in group 3 (33.6%) was less than in group 1, however, the differences were not statistically significant ($p = 0.125$).

CONCLUSION: Isolated CABG demonstrates a higher frequency of repeat endovascular interventions at 5 years after surgery compared to hybrid revascularization that also provides better results in terms of preventing cardiovascular complications.

Keywords: *CAD; coronary artery bypass grafting; percutaneous coronary intervention; hybrid myocardial revascularization*

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ECO•VECTOR

LIST OF ABBREVIATIONS

ACVA — acute cerebrovascular accident
CA — coronary artery
CABG — coronary artery bypass grafting
CAD — coronary artery disease
CS — coronary system
DES — drug-eluting stent
EA — exertion angina
EF — ejection fraction
FC — functional class
HMR — hybrid myocardial revascularization
LV — left ventricle
MACE — Major Adverse Cardiovascular Events
MI — myocardial infarction
OMT — optimal medical therapy
PCI — percutaneous coronary intervention
RMI — residual myocardial ischemia

INTRODUCTION

Coronary artery disease (CAD) remains the most important cause of morbidity, disability and mortality of the population in Russia and in the world [1]. Today, endovascular and surgical methods for correcting coronary bed (CB) lesions are widely used in the treatment of patients with CAD [2]. Coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) more effectively reduce the functional class (FC) of exertion angina (EA) and improve the quality of life compared with the isolated use of optimal medical therapy (OMT) [2, 3].

CABG permits a single-step complete myocardial revascularization and is the optimal treatment method for patients with anatomically complex atherosclerotic coronary bed lesion [4]. Application of CABG in patients with reduced left ventricular ejection fraction (LVEF) less than 35% improves the long-term survival compared to OMT and PCI [2–4].

Despite the evident advantages of CABG, its application in some patients is limited by a number of factors. Diffuse atherosclerotic coronary bed lesion, intramyocardial course and a small diameter of the target coronary artery (CA) on revision, limit the possibility of anastomosis formation and reduce the scope of planned revascularization [5, 6].

PCI, in its turn, permits to avoid anesthesia, transthoracic surgical access, extracorporeal circulation, long stay of the patient in intensive care unit and long postoperative rehabilitation [7, 8]. Upon this, endovascular revascularization of CA also has significant limitations: PCI in patients with a high Syntax score (> 33 points) leads to a higher frequency of Major Adverse Cardiovascular Events (MACEs) compared to CABG [9]. The absence of hemodynamic support may be critical in development of acute intraoperative complications during PCI, and is also a significant factor in patients with a low and very low LVEF. Technical difficulties of the intervention in case of prominent calcification of the coronary arteries, their tortuosity, chronic occlusions, bifurcation lesions also limit complete revascularization in PCI [9–12].

Hybrid myocardial revascularization (HMR) is a less invasive strategy possessing the advantages of CABG and PCI. Favorable results of PCI using the second and third generation drug-eluting stents (DES) compared to venous conduits, long functioning period of mammary-coronary shunt, as well as development and introduction of minimally invasive surgical myocardial revascularization methods served as the basis for combining the advantages of the two methods in patients with a multi-vessel coronary artery disease [13–15].

The **aim** of this study to comparison of the effectiveness and safety of standard coronary artery bypass grafting, staged hybrid myocardial revascularization and percutaneous coronary intervention in the long-term postoperative period.

MATERIALS AND METHODS

The retrospective study included 330 patients with CAD who underwent planned myocardial revascularization in St. George Thoracic and Cardiovascular Surgery Clinic of the National Medical and Surgical Center named after N. I. Pirogov in 2010–2018.

Inclusion criteria: II–IV FC EA; myocardial ischemia proven in loading tests; two- and three-vessel atherosclerotic lesion of CA.

Non-inclusion criteria: patients with CAD with hemodynamically significant multivalvular heart disease, LV aneurysm requiring reconstruction, evident insufficiency of renal and liver function, oncological pathology.

Group 1 included 110 patients who underwent CABG, group 2 included 110 patients who underwent staged HMR, and group 3 included 110 patients after PCI for multi-vessel atherosclerotic lesion. No additional interventions were performed (ethical committee approval was not required), and patients signed informed consent as part of the standard

procedures of the medical institution. Patients of both groups had no statistical differences in clinical and angiographic characteristics (Tables 1, 2).

Table 1. Comparative Clinical Characteristics of Patients of Study Groups

Parameter		Group 1 (CABG)	Group 2 (staged HMR)	Group 3 (PCI)	p
n		110	110	110	–
Age, Me [Q_1; Q_3], years		67.7 [62.8; 70.1]	65.9 [63.1; 68.5]	66.1 [62.1; 69.3]	*> 0.05*
Male gender, n (%)		76 (69.1)	78 (70.9)	80 (72.7)	*> 0.05*
Smoking, n (%)		81 (73.6)	72 (65.5)	79 (71.8)	*> 0.05*
Diabetes mellitus, n (%)		68 (61.8)	71 (64.5)	70 (63.6)	*> 0.05*
Chronic kidney disease, n (%)		35 (31.8)	38 (34.5)	37 (33.6)	*> 0.05*
Left ventricular ejection fraction, Me [Q_1; Q_3], %		54.1 [51.7; 57.8]	55.2 [50.5; 57.2]	53.9 [49.9; 57.4]	*> 0.05*
Arterial hypertension, n (%)		39 (35.5)	40 (36.4)	40 (36.4)	*> 0.05*
History of myocardial infarction, n (%)		27 (24.5)	29 (26.4)	28 (25.5)	*> 0.05*
Asymptomatic myocardial ischemia, n (%)		8 (7.3)	9 (8.2)	7 (6.4)	*> 0.05*
Functional class of exertion angina, n (%)	I	0 (0)	0 (0)	*> 0.05*	*> 0.05*
	II	43 (38.2)	40 (36.4)	*> 0.05*	*> 0.05*
	III	50 (45.5)	53 (48.1)	*> 0.05*	*> 0.05*
	IV	9 (8.2)	8 (7.3)	*> 0.05*	*> 0.05*

Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention

Table 2. Comparative Angiographic Characteristics of Patients of Study Groups

Parameter	Group 1 (CABG)	Group 2 (staged HMR)	Group 3 (PCI)	p
n	110	110	110	–
Total coronary artery lesions, n	315	325	308	*> 0.05*
Number of affected coronary arteries				
Two, n (%)	29 (26.4)	21 (19.1)	32 (29.1)	*> 0.05*
Three, n (%)	70 (63.6)	77 (70.0)	68 (61.8)	*> 0.05*
More than three, n (%)	11 (10.0)	12 (10.9)	10 (9.1)	*> 0.05*
Location of coronary bed defect				
Left main coronary artery, n (%)	12 (3.8)	11 (3.4)	5 (1.6)	*> 0.05*
Anterior descending artery, n (%)	107 (34.0)	102 (31.4)	109 (35.4)	*> 0.05*
Circumflex artery, n (%)	90 (28.6)	99 (30.5)	95 (30.8)	*> 0.05*
Right coronary artery, n (%)	106 (33.6)	113 (34.8)	99 (32.1)	*> 0.05*
RCA dominance, n (%)	82 (74.5)	80 (72.7)	83 (75.5)	*> 0.05*
SYNTAX score				
Results, Me [Q_1; Q_3], points	21.3 [18.1; 25.2]	22.0 [18.3; 25.9]	21.1 [17.5; 24.8]	*> 0.05*

Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention

At the preoperative stage, selective multi-view coronary angiography was performed on a Toshiba Infinix angiographic unit (Japan) according to a standard protocol with the results assessed by two independent specialists. To diagnose myocardial ischemia, 265 (80.3%) patients underwent loading tests. Single-photon emission tomography of the myocardium, synchronized with ECG with ^{99m}Tc-technetril (synchro-SPECT), was performed in 210 (63.6%) patients according to a standard protocol: load-rest alternation. Stress echocardiography with physical activity was conducted in 55 (16.7%) patients.

CABG was performed through the median sternotomy with standardized anesthesia and perfusion, mainly off-pump. A standard plan of the surgery included autoarterial bypass of the anterior descending artery using the left internal mammary artery, autovenous bypass of the circumflex and right coronary artery using the great saphenous vein.

PCI was performed according to a standard method, mainly through transradial access. Before stent implantation, the zone of stenosis was predilated with a standard balloon catheter. During PCI, the patients were implanted second generation DESs (cobalt (cobalt alloy) stent systems with zotarolimus, cobalt-chromium stent systems with sirolimus and zotarolimus) and third-generation DESs (platinum-chromium stent systems with everolimus, cobalt-chromium stent systems with sirolimus, rapamycin with biodegradable drug coating).

Statistical calculations were carried out in Statistica 10.0 program (Stat Soft Inc., USA). The compliance of the data with normal distribution was assessed using Shapiro–Wilk test. Descriptive statistics included the number of observations (n), mean (M), standard deviation (SD), median (Me), lower and upper quartiles [Q_1; Q_3]. With the distribution close to normal, one-way analysis of variance was used. In cases where the distribution differed from normal, the analysis was performed using nonparametric tests: Friedman for related samples, Kruskal–Wallis U test for independent ones. Survival curves were constructed using Kaplan–Meier method and compared using the log-rank test. Differences were considered statistically significant at $p < 0.05$.

RESULTS

In total, 269 (group 1) and 160 (group 2) coronary anastomoses were formed (Table 3), of which 103 (group 1) and 107 (group 2) were performed using the left internal thoracic artery, 166 (group 1) and 53 (group 2) using autovenous grafts. Revascularization index medians made 3.1 [2.8; 3.5] and 1.5 [1.3; 1.6] in groups 1 and 2, respectively. The median of time interval between CABG and PCI in group 2 made 12.5 [8.6; 15.6] days. At the stage on endovascular intervention, 131 (group 2) and 276 (group 3) CA stenoses were eliminated, 197 (group 2) and 461 stents (group 3) were placed.

Table 3. Comparative Perioperative Characteristics of Patients of Study Groups

Parameter	Group 1 (CABG)	Group 2 (staged HMR)	Group 3 (PCI)
n	110	110	110
Number of formed anastomoses, n	269	160	–
Arterial shunts, n	103	107	–
Venous shunts, n	166	53	–
Number of corrected lesions of coronary arteries in percutaneous coronary intervention, n	–	131	276
Number of placed stents, n	–	197	461

Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention

In group 1, one (0.9%) death was recorded after a large-focal myocardial infarction (MI) that developed in the intensive care unit. At 30 days of the surgical intervention, residual myocardial ischemia (RMI) was recorded in 7 (6.4%, group 1), 5 (4.5%, group 2) and 6 (5.5%, group 3) patients ($p = 0.318$, Figure 1).

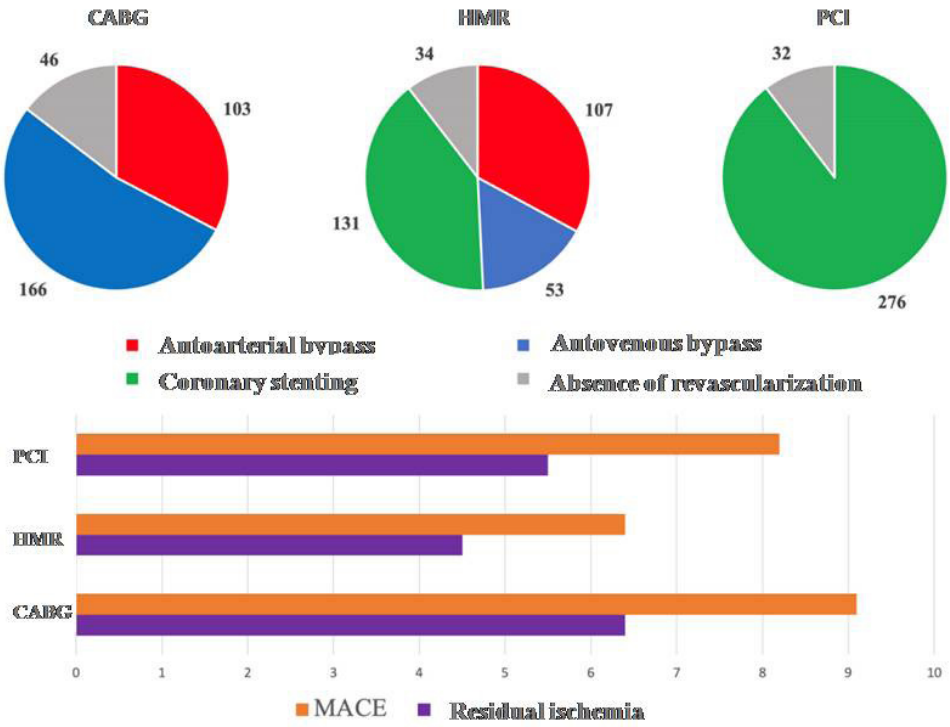

Fig. 1. Structure of revascularization, MACE and residual ischemia in the study groups at 30 days after the intervention.
Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention, MACE — Major Adverse Cardiovascular Events.

Patients of groups 2 and 3 suffered 2 (1.8%) and 3 (2.7%) MIs, respectively (p = 0.653). Also, in two (1.8%) patients of group 1 and one (0.9%) patient of group 2, acute cerebrovascular accident (ACVA) of ischemic type was recorded (p = 0.157). MACE frequency at 1 months did not statistically differ among the groups: 10 (9.1%) in group 1, 7 (6.4%) in group 2 and 9 (8.2%) in group 3 (p = 0.451, Table 4).

At 12 months after surgery, acute MI was recorded in 8 (7.3%) patients in group 1, in 5 (4.5%) in group 2 and 7 (6.4%) in group 3 (p = 0.393). There was also no statistical difference in the incidence of ACVA: 2 (1.8%), 2 (1.8%) and 3 (2.7%) cases in patients after CABG, HMR and PCI (p = 0.653). The number of deaths in the structure of complications also did not differ statistically and was 5 (4.5%) in group 1, 4 (3.6%) in group 2, and 4 (3.6%) in group 3 (p = 0.735). In group 2, the need for repeat revascularization at 12 months was lower compared to the CABG and PCI groups — 7.3% versus 15.5% and 11.8%, respectively, but the differences were not significant (p = 0.056). A combined MACE end point within 1 year of follow-up was less often achieved in patients after HMR — 17.3% versus 29.1% (group 1), 27.3% (group 3) (p = 0.038; Figure 1, Table 4).

At 5 years after surgery, the total ACVA incidence was 7 (6.4%) in group 1, 8 (7.3%) in group 2 and 10 (9.1%) cases in group 3 (p = 0.451). No statistically significant differences in the frequency of registration of acute MI were not detected either, however, in group 2 this complication was detected somewhat less frequently 16.4% versus 11.8% (group 1) and 13.6% (group 2, p = 0.335). The total number of deaths was slightly higher in patients after CABG 17 (15.5%) cases versus 10 (9.1%) patients in group 2 and 14 (12.7%) in group 3 (p = 0.152). The clinical need for repeated revascularization more often arose in patients of group 1 — 46 (41.8%) compared with group 2 — 32 (29.1%) observations (p = 0.049); the differences between groups 1 and 3 in this criterion were not significant (p = 0.125, Figure 2, Table 4).

The frequency of adverse cardiovascular events was higher in patients of group 1: 88 (80.0%) cases compared to groups 2 and 3: 63 (57.3%) and 74 (67.3%), respectively (p= 0.001-0.032). The number of MACEs in the HMR group by the end of follow-up was lower compared to the CABG group (p = 0.001) and lower than in the PCI group (p = 0.127, Table 4).

Table 4. Frequency of Reaching End Points (Kaplan–Meier Method) in Study Groups

Parameter	Group 1 (CABG)	Group 2 (staged HMR)	Group 3 (PCI)	p
n	110	110	110	–
MACE				
30 days, n (%)	10 (9.1)	7 (6.4)	9 (8.2)	*0.451*
1 year, n (%)	32 (29.1)*	19 (17.3)*	30 (27.3)	*0.038**
5 years, n (%)	88 (80.0)*	63 (57.3)*	74 (67.3)*	*0.001–0.032**
All-cause mortality				
30 days, n (%)	1 (0.9)	0 (0)	0 (0)	*0.318*
1 year, n (%)	5 (4.5)	4 (3.6)	4 (3.6)	*0.735*
5 years, n (%)	17 (15.5)	10 (9.1)	14 (12.7)	*0.152*
Myocardial infarction				
30 days, n (%)	2 (1.8)	2 (1.8)	3 (2.7)	*0.653*
1 year, n (%)	8 (7.3)	5 (4.5)	7 (6.4)	*0.393*
5 years, n (%)	18 (16.4)	13 (11.8)	15 (13.6)	*0.335*
Acute cerebrovascular accident				
30 days, n (%)	2 (1.8)	1 (0.9)	0 (0)	*0.157*
1 year, n (%)	2 (1.8)	2 (1.8)	3 (2.7)	*0.653*
5 years, n (%)	7 (6.4)	8 (7.3)	10 (9.1)	*0.451*
Repeat revascularization				
30 days, n (%)	5 (4.5)	4 (3.6)	6 (5.5)	*0.520*
1 year, n (%)	17 (15.5)	8 (7.3)	13 (11.8)	*0.056*
5 years, n (%)	46 (41.8)*	32 (29.1)*	35 (33.6)	*0.049**

Notes: *— p < 0.05; KCABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention, MACE — Major Adverse Cardiovascular Events.

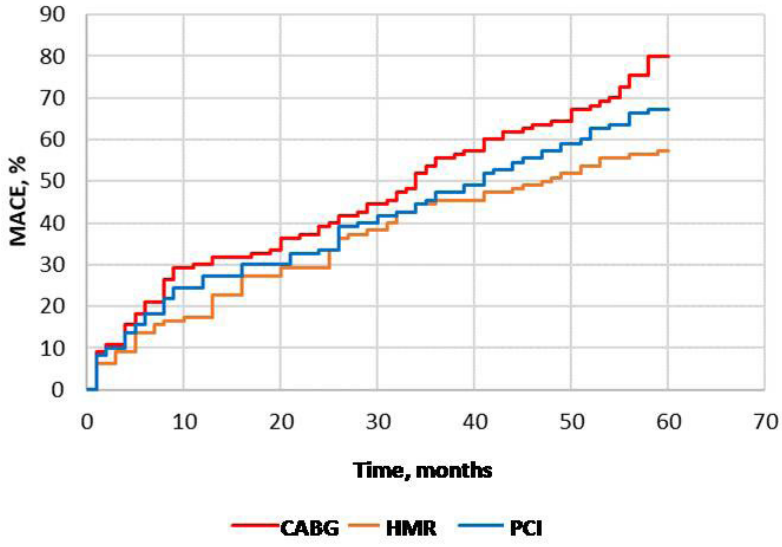

Fig. 2. Adverse cardiovascular events within 5 years after surgical intervention (Kaplan–Meier curves).
Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention, MACE — Major Adverse Cardiovascular Events.

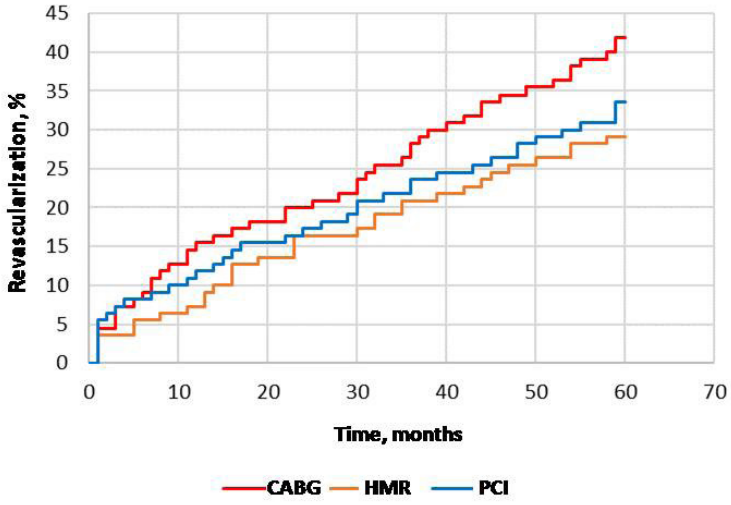

Fig. 3. Repeat revascularization within 5 years after surgical intervention (Kaplan–Meier curves).
Notes: CABG — coronary artery bypass grafting, HMR — hybrid myocardial revascularization, PCI — percutaneous coronary intervention.

DISCUSSION

Our retrospective study demonstrated a comparison of 5-year effectiveness and safety of standard CABG, HMR and PCI in multi-vessel lesion of CA. The groups of patients were completely comparable in clinical and angiographic characteristics. All the patients in the study sample had lesion of the anterior descending artery or the left main coronary artery. The patients of the three groups did not differ in severity of CA lesion and impairment of systolic function of the left ventricle (all patients had preserved or moderately reduced LVEF). When using endovascular treatment methods, patients with the intermediate and moderate risk of development of cardiovascular complications predominated.

Thus, taking into account modern clinical recommendations [13], the vast majority of patients in the study groups could be initially considered as candidates for both surgical treatment and for PCI. Moderate degree of atherosclerotic lesion of CA and absence of evident systolic dysfunction of LV were determined by the limiting factors of the study it did not include a significant number of patients with > 33 Syntax score and LVEF < 35%.

The total volume of performed revascularizations did not differ significantly in groups. In patients in the CABG group, 269 (85.4%) lesions of the coronary artery were corrected, in HMR group 291 (89.5%), in PCI group 276 (89.6%). Anatomically complete revascularization in some situations was limited by objective factors distal or diffuse lesion of the target coronary artery, its intramyocardial course, severe calcification of the coronary artery and aorta, chronic occlusion of the coronary artery with weak contrast of the distal bed, etc. Patients who did not receive anatomically complete revascularization due to objective reasons, were not excluded from our study in order to objectify the results obtained.

In the immediate period after surgery, in all the groups, the incidence of cardiovascular complications and RMI were expectedly low and did not differ between the groups. During 1- and 5-year follow-up, there were no significant differences in the incidence of death from all causes, MI and stroke in patients of all groups.

The data we obtained correlated with the results of domestic and foreign studies [16, 17]. However, statistical differences were reported in achieving the combined MACE end point at 12 and 60 months after surgery. After 1 year of follow-up, cardiovascular complications were less frequent in the HMR group compared to CABG 17.3% versus 29.1% ($p = 0.038$), as well as compared to the PCI group 27.3%, but the differences were not significant ($p = 0.075$).

The data obtained disagreed with the results of the HREVS work by V I Ganyukov, et al. (2023), where MACE rate at a follow-up of 12 months was, on the whole, lower and did not differ in patients with CABG, HMR and PCI (12.0%, 13.4% and 13.2%, respectively, $p = 0.831$). To note, HREVS study was randomized,

included a smaller number of patients (50 in a group), and the surgical access in HMR patients was mini-thoracotomy [16]. S Hu, et al. (2011) in their work noted a lower MACE frequency in the HMR group compared to standard CABG at 18 months of follow-up 90.4% versus 99.0% (p = 0.03) [17], which correlated with the data obtained in our study.

At 5 years, MACE frequency was higher in patients after CABG compared with patients after HMP and PCI 80.0% versus 57.3% (p = 0.001) and 67.3% (p = 0.032). Upon that, the number of MACE cases in the HMR group was lower compared to PCI group (p = 0.127). In contrast, in HREVS study, at 5 years, adverse cardiovascular and cerebral events were more often recorded in the PCI group compared to CABG and HMR 69.4% versus 51.1% and 51.1% (p = 0.033) [16]. In the study by A Hage, et al. (2019), a higher frequency of adverse events after the median follow-up period of 81 [48; 113] months for the CABG group and 96 [53; 115] months for the HMR group was found in patients after CABG, the main contribution was made by survival index 85% versus 96% (p = 0.054) [18].

It should be noted that the main contribution to the combined end point was made by clinically determined repeat revascularization. Thus, by the end of the first year of follow-up, the differences in this parameter between the groups were not significant, however, patients after HMR demonstrated a lower frequency of target lesion failure compared to CABG and PCI subjects, while the maximum differences were achieved with the CABG group 15.5% versus 7.3% (p = 0.056). At the end of the follow-up period, the rate of repeat revascularization was significantly higher in the CABG group compared with HMR 41.8% versus 29.1% (p = 0.049). The number of such observations in the PCI group was also less than in the CABG group, but the differences were not statistically significant: 41.8% versus 33.6% (p = 0.125). In a study by V Giambruno, et al. (2018), patients after HMR demonstrated a lower rate of repeat revascularization compared to the CABG group — 93% versus 91% (p = 0.27), as well as greater freedom from recurrence of exertion angina – 70% versus 91% (p = 0.001) [19], which generally correlated with our results. E L Hannan, et al. (2021) noted that patients after HMR demonstrated greater freedom from repeated revascularization in the system of the anterior descending artery compared with patients after PCI 91.13% versus 83.59%, adjusted odds ratio 0.51, 95% confidence interval 0.34–0.77 [20].

CONCLUSION

Isolated coronary artery bypass grafting demonstrates a higher frequency of repeat endovascular interventions at 5 years after surgery compared to hybrid revascularization, the latter providing statistically significantly better results in terms of cardiovascular complications. It seems promising to develop a unified method of hybrid myocardial revascularization, which includes optimization of surgical access, of phasing, tactics and the amount of surgical and endovascular revascularization.

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ОБ АВТОРАХ

Шевченко Юрий Леонидович, д.м.н., профессор, академик РАН;
ORCID: https://orcid.org/0000-0001-7473-7572;
eLibrary SPIN: 8705-9810; e-mail: yur.leon@mail.ru

AUTHORS' INFO

Yuriy L. Shevchenko, MD, Dr. Sci. (Med.), Professor;
ORCID: https://orcid.org/0000-0001-7473-7572;
eLibrary SPIN: 8705-9810; e-mail: yur.leon@mail.ru

Борщев Глеб Геннадьевич, д.м.н., доцент;
ORCID: https://orcid.org/0000-0002-8332-7521;
eLibrary SPIN: 3536-7949; e-mail: glebcenter@mail.ru

Ермаков Дмитрий Юрьевич, к.м.н.;
ORCID: https://orcid.org/0000-0002-8479-8405;
eLibrary SPIN: 6512-5603; e-mail: ermakov.hs@gmail.com

Масленников Михаил Андреевич, к.м.н.;
ORCID: https://orcid.org/0009-0003-3302-5167;
eLibrary SPIN: 5944-4676; e-mail: cardiologyru@gmail.com

Вахрамеева Анастасия Юрьевна, к.м.н.;
ORCID: https://orcid.org/0000-0003-2429-3015;
eLibrary SPIN: 5772-9062; e-mail: vakhrameeva_n@mail.ru

***Ульбашев Даниил Сергеевич**, к.м.н.;
ORCID: https://orcid.org/0000-0003-3288-8414;
eLibrary SPIN: 5294-3315; e-mail: dan103@mail.ru

Gleb G. Borshchev, MD, Dr. Sci. (Med.), Associate Professor;
ORCID: https://orcid.org/0000-0002-8332-7521;
eLibrary SPIN: 3536-7949; e-mail: glebcenter@mail.ru

Dmitriy Y. Ermakov, MD, Cand. Sci. (Med.);
ORCID: https://orcid.org/0000-0002-8479-8405;
eLibrary SPIN: 6512-5603; e-mail: ermakov.hs@gmail.com

Mikhail A. Maslennikov, MD, Cand. Sci. (Med.);
ORCID: https://orcid.org/0009-0003-3302-5167;
eLibrary SPIN: 5944-4676; e-mail: cardiologyru@gmail.com

Anastasiya Y. Vakhrameyeva, MD, Cand. Sci. (Med.);
ORCID: https://orcid.org/0000-0003-2429-3015;
eLibrary SPIN: 5772-9062; e-mail: vakhrameeva_n@mail.ru

***Daniil S. Ul'bashev**, MD, Cand. Sci. (Med.);
ORCID: https://orcid.org/0000-0003-3288-8414;
eLibrary SPIN: 5294-3315; e-mail: dan103@mail.ru

* Автор, ответственный за переписку / Corresponding author