Myocardial Surgical Revascularization in Patients with Reduced Left Ventricular Ejection Fraction

Nedzad Kadric¹, Enes Osmanovic², Sevleta Avdic², Mizra Jahic³, Stojan Rajkovic³, Edis Salihovic⁴

ABSTRACT
Background: Myocardial surgical revascularization in patients with low left ventricular ejection fraction (LVEF) is accompanied by a high rate of morbidity and mortality. Objective: The aim of this study was to investigate and eliminate the reasons for the most common perioperative and postoperative complications. Methods: A total of 64 were analyzed of patients during 2019 who underwent coronary artery bypass grafting (CABG), average age 61.29±9.12 years. Results: Out of the total number of operated patients, there were 16 women and 48 men. Patients were divided into two groups. The first group consisted of patients who underwent surgery with the use of cardiopulmonary bypass (cCABG-CPB) and the second group those who underwent surgery without the use of cardiopulmonary bypass (OPCAB). In 41 patients, myocardial infarction was previously recorded. Critical stenosis of the main trunk of the left coronary artery was present in 14 patients. The incidence of postoperative complications was higher in the cCABG-CPB 16/10 group (p=0.030). Conclusion: In our study, we confirmed that myocardial revascularization is justified, especially in the case of multivessel coronary disease. In the long term, it significantly improves the systolic function of the left ventricle, and thus and quality and length of life.

Keywords: Myocardial Surgical Revascularization, Reduced Left Ventricular Ejection Fraction.

1. BACKGROUND
Treatment oronary artery disease and reduced left ventricular ejection fraction (LVEF) represents a long-term struggle, often with disappointing results.(1-3). Many patients with reduced LVEF are at high risk of sudden death, ventricular arrhythmias and heart failure (4, 5). However, it has been shown that thanks to surgical treatment, left heart dysfunction is not always an irreversible process. Surgical revascularization of the myocardium can significantly improve and even normalize the function of the left ventricle (LV). Advances in surgical technique, performing the technique without the use of cardiopulmonary bypass (CPB) with the use of arterial grafts, advances in cardiac anesthesia and postoperative intensive care of these patients have resulted by reducing the mortality rate. However, such patients still belong to the high-risk group for the development of postoperative complications such as respiratory failure, atrial fibrillation, bleeding, stroke, wound infections, pneumonia, acute renal failure, gastrointestinal bleeding, endocarditis, and postoperative “pulse volume syndrome”. Preoperative preparation of these patients is of crucial importance, which includes a series of multidisciplinary clinical examinations and procedures, as well as medication and other support.

2. OBJECTIVE
The aim of this study was to investigate and eliminate the reasons for the most common perioperative and postoperative complications.

3. MATERIAL AND METHODS
A total of 64 patients who underwent coronary artery bypass grafting (CABG) were analyzed during 2019. After admission to our Institution, all patients were clinically treated according to the protocol. All patients underwent trans-thoracic echocardiography (TTE) preoperatively, during which
cardiac activity was analyzed in detail and LVEF was determined. Preoperative coronary angiography was performed earlier or upon admission of the patient to the hospital, on the basis of which the operative strategy was determined. These patients are directed to surgical revascularization of the myocardium as the most favorable modality of further treatment, most often, of complex coronary disease. After the operative treatment, all patients were transferred to the intensive care and resuscitation unit for continuous monitoring and follow-up. During the operative procedures, CPB was used with the maintenance of body temperature between 32-34°C. Myocardial protection during ischemic time after "clamping" of the aorta was applied by means of antegrade cold cardioplegia according to Calafiory.

The choice of operative technique depended on the severity of the coronary anatomy and other relevant clinical characteristics of the patient, taking into account comorbidity.

The anticoagulation level was maintained above 450 sec using unfractionated Heparin. For patients operated with cCABG-CPB and 380 sec. for patients operated with the OPCAB technique. Heparin neutralization was achieved with Protamine sulfate in a 1:1 ratio (Heparin management system).

The target value of the MEAN pressure during the operation was 65-70 mmHg. Weaning from mechanical ventilation began with the absence of hemodynamic instability and increased bleeding, and the achievement of normothermia and an adequate level of consciousness. Also, all patients were prescribed antibiotic prophylaxis, which was part of standard therapy. Other therapy included hydration, antacids, diuretics, and inotropic drugs. If necessary, the patients were placed with an intra-aortic balloon pump (IABP) as a mechanical post-operative support for cardiac work.

Statistical analysis
Statistical analysis was performed in the application software "STATA IC version 16.1 (single-user perpetual license serial number: 301606229693)". Continuous variables are presented with arithmetic mean and standard deviation or as real, positional mean: median with interquartile range. Distribution of results of interrupted statistical series is expressed in absolute number and as relative representation (percentages). To determine the association of categorical characteristics, we performed a two-way Chi-square test of independence. To test the statistical significance of the difference between two arithmetic means, we used the Student’s t-test for independent samples, and for non-parametric data Wilcoxon rank sum test (Mann-Whitney U-test).

### 4. RESULTS

Preoperative characteristics of patients presents in Table 1. and Figure 1.

A total of 64 patients were operated on due to coronary disease and reduced ejection fraction. Of that number, there were 16 women and 48 men. The average age at birth was 61.29±9.12. The patients were divided into two groups. The first group consisted of patients who were operated on with the use of cCABG-CPB (34 patients), and the second group of 30 patients who were operated on using the OPCAB technique.

Out of the total number of patients operated on, 41 patients had a previous myocardial infarction (MI), of which 24 belonged to the first group of patients, and 17 to the second group. Critical stenosis of the main trunk

<table>
<thead>
<tr>
<th>Gender</th>
<th>cCABG-CPB</th>
<th>OPCAB</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>7 9</td>
<td></td>
<td>0.405</td>
</tr>
<tr>
<td>Male</td>
<td>27 21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. Baseline (preoperative) characteristics and type of surgical technique.**

![Figure 1. Surgical techniques](image-url)
of the left coronary artery was present in 14 patients (9/5), and 16 patients required emergency coronary angiography. All patients underwent preoperative TTE. The average duration of the operative procedure depended on the applied surgical technique, the use of CPB, the complexity of the coronary disease and the degree of damage to the blood vessels, and was on average 73/66.5 min. The most common problem was presented by patients with diffuse, coronary disease, unsuitable for the PCI procedure, very often ungraftable blood vessels, with T2DM in multiple comorbidities in which T2DM has a special significance. The total number of distal anastomoses in both groups was the same, 3 grafts. Eleven patients required placement of IABP (9/2) in the early postoperative course.

**Postoperative complications**

Common surgical complications present in the Table 2. Pleural effusion and sternal wound infection significantly affected the total length of hospitalization. Pericardial effusion was also recorded in 8 patients, 5 of whom required re-exploration due to threatening tamponade. The reason was high INR and urgently operated patients after coronary angiography. The postoperative stay in the ICU was 2-4 days, while the average length of stay was 7 days for patients without the use of CPB, and 10 days for patients operated on with the use of CPB.

### 5. DISCUSSION

Previous experience in cardiac surgery shows that surgical revascularization of the myocardium provides patients with a better quality of life and longer survival compared to medical treatment (6, 7, 8). It has also been shown that operations on the beating heart significantly contribute to shorter hospitalization and faster recovery (9). A major contribution to the improvement of coronary surgery was also provided by high-quality preoperative preparation, which has improved a lot in recent times thanks primarily to the development of diagnostic procedures and newer generations of drugs. Thanks to this, the negative impact of operative treatment in patients with damaged myocardium and reduced EF of the left ventricle was significantly reduced. It is very important to adopt a proper operative strategy and perform preoperative selection of patients in cooperation with cardiologists.

All our patients underwent TTE preoperatively, on which LVEF was determined, regional disorders of cardiac kinetics and myocardial function were observed. More recent studies report the association of preferred selection and preoperative preparation, and their influence on postoperative outcome in patients with CABG and poor ejection fraction (10-12). Improvement of left ventricular function after myocardial revascularization is also reported in numerous recent studies (13, 14). It has been proven that 43% of patients with EF<35% treated medically have a 5-year survival, while the 5-year survival in patients treated surgically is 63%. A significant reduction in anginal complaints and improvement in quality of life was recorded in patients treated surgically compared to medically treated. Our study showed that most patients with low EF have a high percentage of various associated "comorbidities" (Diabetes mellitus, lung diseases, etc.).

In particular, the correct approach in choosing a surgical strategy (choice of operative technique, preoperative application of IABP, arterial grafts, etc.) as well as preoperative preparation of patients based on a multidisciplinary approach and engagement of the "Heart" team should be highlighted.

Evaluation of myocardial viability was supplemented by scintigraphic findings. Postoperative use of IABP is one of the predictors of negative events after CABG. Poor diastolic function may be the cause of increased

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**Table 2. Postoperative characteristics and type of operative surgical technique.**

<table>
<thead>
<tr>
<th>Operative characteristics</th>
<th>Type of surgery operation</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cCABG-CPB n=34</td>
<td>OPCAB n=30</td>
</tr>
<tr>
<td>Operation duration (min.)</td>
<td>Me (q1-q3) 73 (64-90)</td>
<td>66.5 (55-75)</td>
</tr>
<tr>
<td>N of distal anastomoses</td>
<td>Me (q1-q3) 3 (2-4)</td>
<td>3 (2-3)</td>
</tr>
<tr>
<td>Inotrop support yes (%)</td>
<td>26 (40.6)</td>
<td>14 (21.87)</td>
</tr>
<tr>
<td>IABP support yes (%)</td>
<td>9 (14.0)</td>
<td>2 (3.13)</td>
</tr>
<tr>
<td>Complication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep sternal wound infection yes (%)</td>
<td>6 (9.3)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Pericardial effusion yes (%)</td>
<td>5 (7.8)</td>
<td>3 (4.7)</td>
</tr>
<tr>
<td>Postoperative pleural effusion yes (%)</td>
<td>15 (23.4)</td>
<td>5 (7.81)</td>
</tr>
<tr>
<td>Creatinin Me (q1-q3)</td>
<td>101 (89-120)</td>
<td>98 (88-116)</td>
</tr>
<tr>
<td>Hemoglobin Me (q1-q3)</td>
<td>89.5 (86-97)</td>
<td>110 (96-120)</td>
</tr>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay of ICU M (min-max)</td>
<td>2 (1-3)</td>
<td>4 (3-5)</td>
</tr>
<tr>
<td>Length of stay of hospital M (min-max)</td>
<td>7 (1-24)</td>
<td>10 (1-22)</td>
</tr>
</tbody>
</table>
| Legend: Hb-.hemoglobin, N/A- no/aplicable. IABP- Intra-aortic ballon pump, ICU-intensive care unit.
postoperative mortality. It is an independent risk factor and known predictor of postoperative heart failure, atrial fibrillation and cardiac death. The most common postoperative complications that occurred in our patients were pleural effusion and sternal wound infection, and they occurred in patients burdened with comorbidities (diabetes mellitus, obstructive pulmonary diseases, COVID infections). Diabetes mellitus was a significant predictor of unfavorable outcome after operative treatment, in contrast to patients without this disease.

6. CONCLUSION
In our study, we confirmed that myocardial revascularization is justified, especially in the case of multivessel coronary disease. In the long term, it significantly improves the systolic function of the left ventricle, and thus the quality and length of life. We also proved that the choice of operative technique is very important in the further postoperative course due to the reduced number of complications and shorter hospital stay. A well-organized and efficient multidisciplinary approach in preoperative preparation and adequate evaluation of patients significantly contribute to the reduction of morbidity and mortality.

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- **Conflict of interest:** None declared.
- **Financial support and sponsorship:** Nil.

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